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Two new species of oribatid mites of *Lasiobelba* (Acari, Oribatida, Oppiidae) from Nepal, including a key to all species of the genus

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Abstract

Two new species of oribatid mites of the genus *Lasiobelba* (Oribatida, Oppiidae), *Lasiobelba* (*Lasiobelba*) *daamsae* **sp. n.** and *Lasiobelba* (*Antennoppia*) *nepalica* **sp. n.**, are described from eastern Nepal. *Lasiobelba* (*L.*) *daamsae* **sp. n.** is most similar to *L.* (*L.*) *remota* Aoki, 1959 and *L.* (*L.*) *gibbosa* (Mahunka, 1985), however, it differs from both by the anterior part of pedotecta I specifically curved, rostrum pointed and exobothridial setae not shorter than bothridial setae. *Lasiobelba* (*Antennoppia*) *nepalica* **sp. n.** is most similar to *L.* (*A.*) *granulata* (Mahunka, 1986), however, it differs from the latter by the larger body size, exobothridial setae longer than rostral setae and bothridial setae not longer than interlamellar setae. An identification key to known species of *Lasiobelba* is given.

Keywords

Oribatid mites, new species, *Lasiobelba*, key, Nepal

Introduction

Lasiobelba is a genus of oribatid mites (Oribatida, Oppiidae, Oppiinae) that was proposed by Aoki (1959) with *Lasiobelba remota* Aoki, 1959 as type species. The main generic characters (summarized by Aoki 1959; Subías and Balogh 1989; Ohkubo 2001; including our additions) are: costulae and transcostula absent; prodorsal setae well developed, setiform (exception: interlamellar setae represented by alveoli); bothridial setae spindle-form or setiform; notogaster with nine to 10 pairs of notogastral setae (setae *c* reduced, minute or represented by alveoli); dorsal notogastral setae inserted in four subparallel rows, rarely in two parallel rows; genital plates with five pairs of genital setae; adanal lyrifissures located near to anal aperture.

Currently, *Lasiobelba* comprises two subgenera (*Lasiobelba* (*Lasiobelba*) Aoki, 1959, *Lasiobelba* (*Antennoppia*) Mahunka, 1983 – see Mahunka 1983a) and 32 species, which have a cosmopolitan distribution (Subías 2004, updated 2014). The subgenus *Lasiobelba* (*Lasiobelba*) differs from *Lasiobelba* (*Antennoppia*) by the morphology of bothridial setae (spindle-form versus setiform).

In the course of taxonomic identification of oribatid mites from Nepal[1] (Ermilov et al. 2013, 2014; Ermilov and Martens 2014), we found two new species of the genus *Lasiobelba*; one belonging to *Lasiobelba* (*Lasiobelba*), other to *Lasiobelba* (*Antennoppia*). The first goal of our paper is to describe these species. The second goal of our paper is to present an identification key to all known species of *Lasiobelba*.

Materials and methods

Five specimens (holotype: male; four paratypes: all males) of *Lasiobelba* (*Lasiobelba*) *daamsae* sp. n. are from: eastern Nepal, 27°19'N, 87°78'E, Panchthar District, upper course of Mai Majuwa river, pasture Dhorpar Kharka, soil in mixed broadleaved forest, 2770 m a.s.l., 27–28.VIII.1983, collected by J. Martens and B. Daams. Four specimens (holotype: male; three paratypes: two males and one female) of *Lasiobelba* (*Antennoppia*) *nepalica* sp. n. are from: eastern Nepal, 26°99'N, 86°67'E, Ilam District, soil in remnants of broadleaved forest with plantations of *Cryptomeria japonica*, 2100 m a.s.l., 31.III.–01.IV.1980, collected by J. Martens and A. Ausobsky.

Holotypes and paratypes were mounted in lactic acid on temporary cavity slides for measurement and illustration. The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate. The notogastral width refers to the maximum width in dorsal aspect. Lengths of body setae were measured in lateral aspect. All body measurements are presented in micrometers. Formula for leg setation is given in parentheses according to the sequence trochanter–femur–genu–tibia–tarsus (famulus included). Formula for leg solenidia is given in square brackets according to the sequence genu–tibia–tarsus. General terminology used in this paper follows that of Norton and Behan-Pelletier (2009).

[1] Results of the Himalaya Expeditions (1980, 1983) of Dr. Jochen Martens.

Taxonomy

Description of *Lasiobelba* (*Lasiobelba*) *daamsae* sp. n.
http://zoobank.org/EE1BC06A-8B49-4004-B3EA-D1FF46336897
Figs 1–9

Diagnosis. Body size: 1278–1310 × 747–863. Rostrum pointed. Prodorsal setae long, barbed; *in* ≈ *le* > *ss* ≈ *ex* > *ro*. Bothridial setae spindle-form, with long, thin apex, barbed. Nine pairs of notogastral setae long, barbed (p_1–p_3 shorter than others). Antero-medial part of rutelli with tooth. Anterior part of pedotecta I specifically curved. Anogenital setae barbed. Dorsal side of leg claws with small teeth.

Description. *Measurements*. Body length: 1294 (holotype, male), 1278–1310 (four paratypes: males); notogaster width: 796 (holotype), 747–863 (four paratypes).

Integument (Figs 1, 3). Body color light brownish. Body surface smooth, but lateral parts of prodorsum with microgranulate cerotegument (diameter granules less than 1).

Prodorsum (Figs 1–3). Rostrum with conical tooth (*tr*, 12–16). A row, comprising several muscle sigillae, is located in front of the bothridia (usually very poorly visible). Muscle sigilla in interbothridial region absent, but one pair of longitudinal, dark brown structures are present. Rostral (*ro*, 199–232), lamellar (*le*, 365–381), interlamellar (*in*, 365–381) and exobothridial (*ex*, 265–298) setae well developed, setiform, barbed. Bothridial setae (*ss*, 265–298) spindle-form, barbed, with weakly developed elongate head and long, thin apex. A pair of triangular tubercles (*tb*) located posteriorly to bothridia.

Notogaster (Figs 1–3). Anterior border convex. Notogastral setae *c* represented by alveolus. Nine other pairs of notogastral setae long, barbed; p_1–p_3 (215–249) shorter than others (431–481). Lyrifissures *ia* poorly visible, *im*, *ip*, *ih*, *ips* and opisthonotal gland openings present, but visible under high magnification in dissected specimens.

Gnathosoma (Figs 2, 4, 5). Subcapitulum longer than wide (298–315 × 199–215). Antero-medial part of rutelli with tooth (*ts*, 8). Subcapitular setae setiform, barbed; *a* (66–83) shorter than *m* and *h* (both 116–132). Two pairs of adoral setae (or_1, or_2, 33–49) setiform, hook-like distally, smooth. Palps (199) with setation 0–2–1–3–8(+ω). Solenidion thickened, blunt-ended, pressed to the palptarsus surface in basal part and distal seta in distal part. Chelicerae (298–315) with two barbed setae; *cha* (99) longer than *chb* (66). One short tooth (4–6) located posteriorly to seta *cha*. Trägårdh's organ distinct.

Epimeral and lateral podosomal regions (Figs 1–3). Apodemes (1, 2, sejugal, 4) weakly developed. Epimeral setae setiform, barbed; setae *1a*, *2a*, *3a* (83–99) shorter than *1b*, *1c*, *3b*, *4a*, *4b* (149–166) and *3c*, *4c* (199–232). Anterior part of pedotecta I (Pd I) elongate and specifically curved, forming a tooth (*tpd*). Discidia (*dis*) triangular, pointed.

Anogenital region (Figs 2, 3). Five pairs of genital (g_1–g_3, 74–83; g_4, g_5, 108–116), one pair of aggenital (*ag*, 166–199), three pairs of adanal (ad_1–ad_3, 166–199) and two pairs of anal (an_1, an_2, 149–166) setae setiform, barbed. Distance between setae ad_3–ad_3 longer than ad_2–ad_2 and ad_1–ad_1. Adanal lyrifissures *iad* located diagonally, but very close to anal aperture.

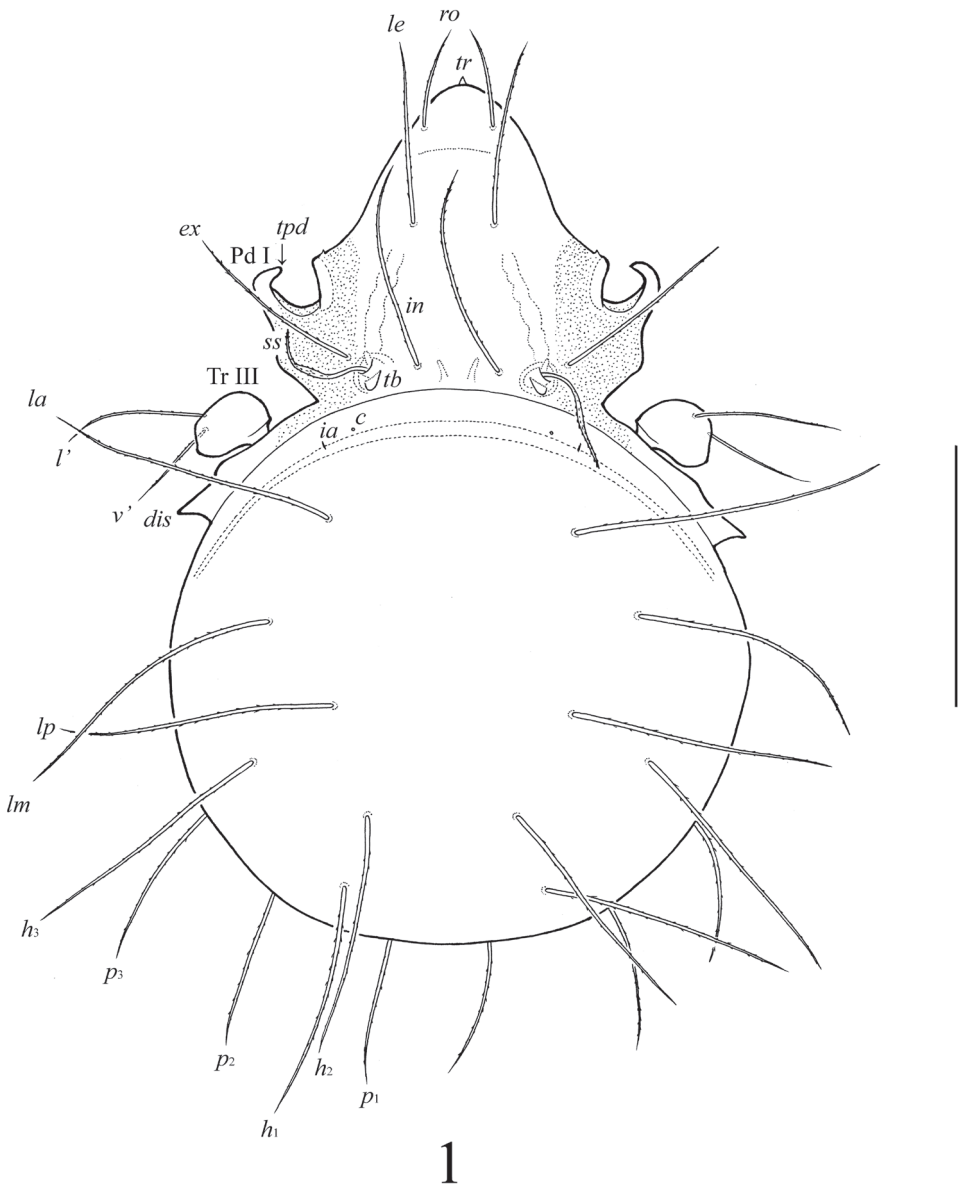

Figure 1. *Lasiobelba* (*Lasiobelba*) *daamsae* sp. n.: dorsal view (legs except trochanters III not illustrated). Scale bar 400 μm.

Legs (Figs 1, 6–9). Generally, morphology typical for species of *Lasiobelba* (Bernini 1973; Ohkubo 2001; Ermilov and Kalúz 2012). Dorsal side of each claw in all tarsi with two rows of small teeth (*tl*). Formulae of leg setation and solenidia: I (1–5–2–4–20) [1–2–2], II (1–5–2–4–16) [1–1–2], III (2–3–1–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]; homology of setae and solenidia indicated in Table 1. Setae *p* setiform on

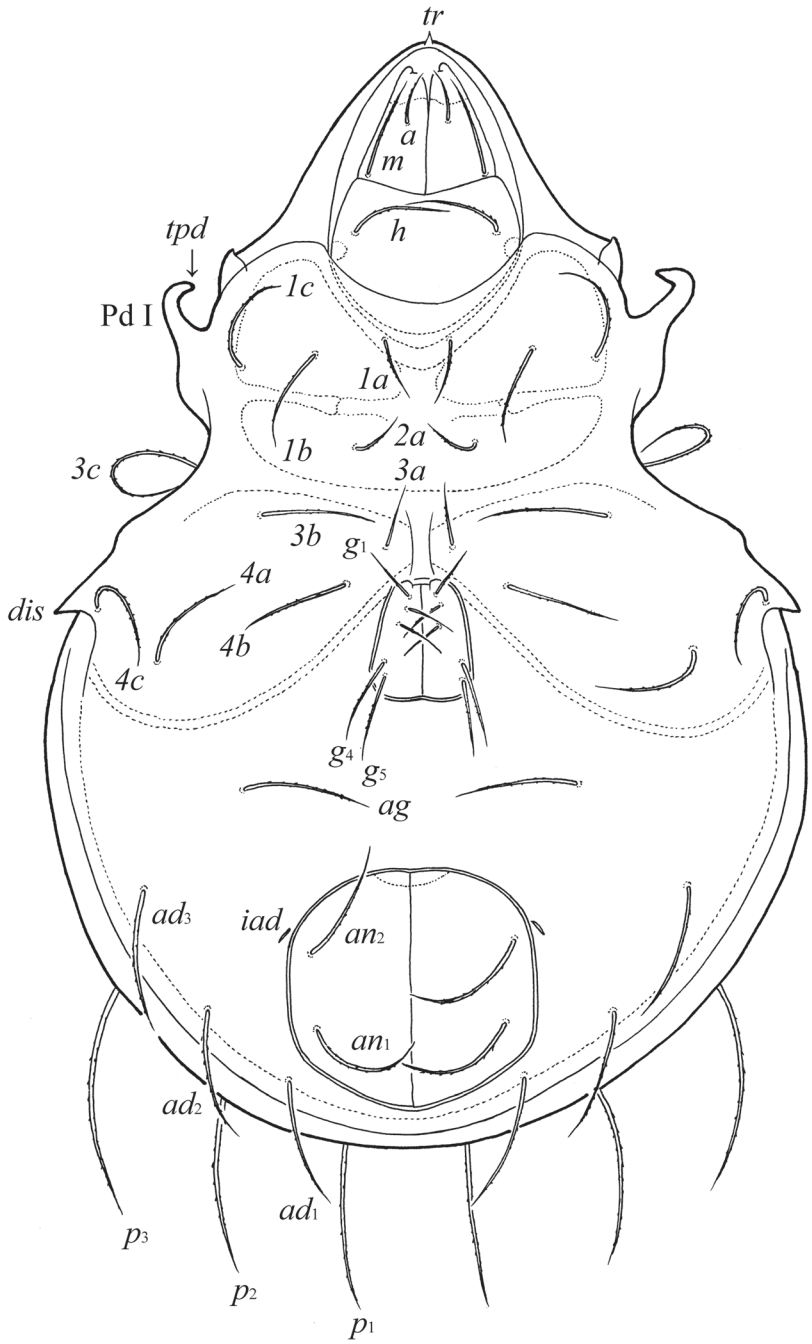

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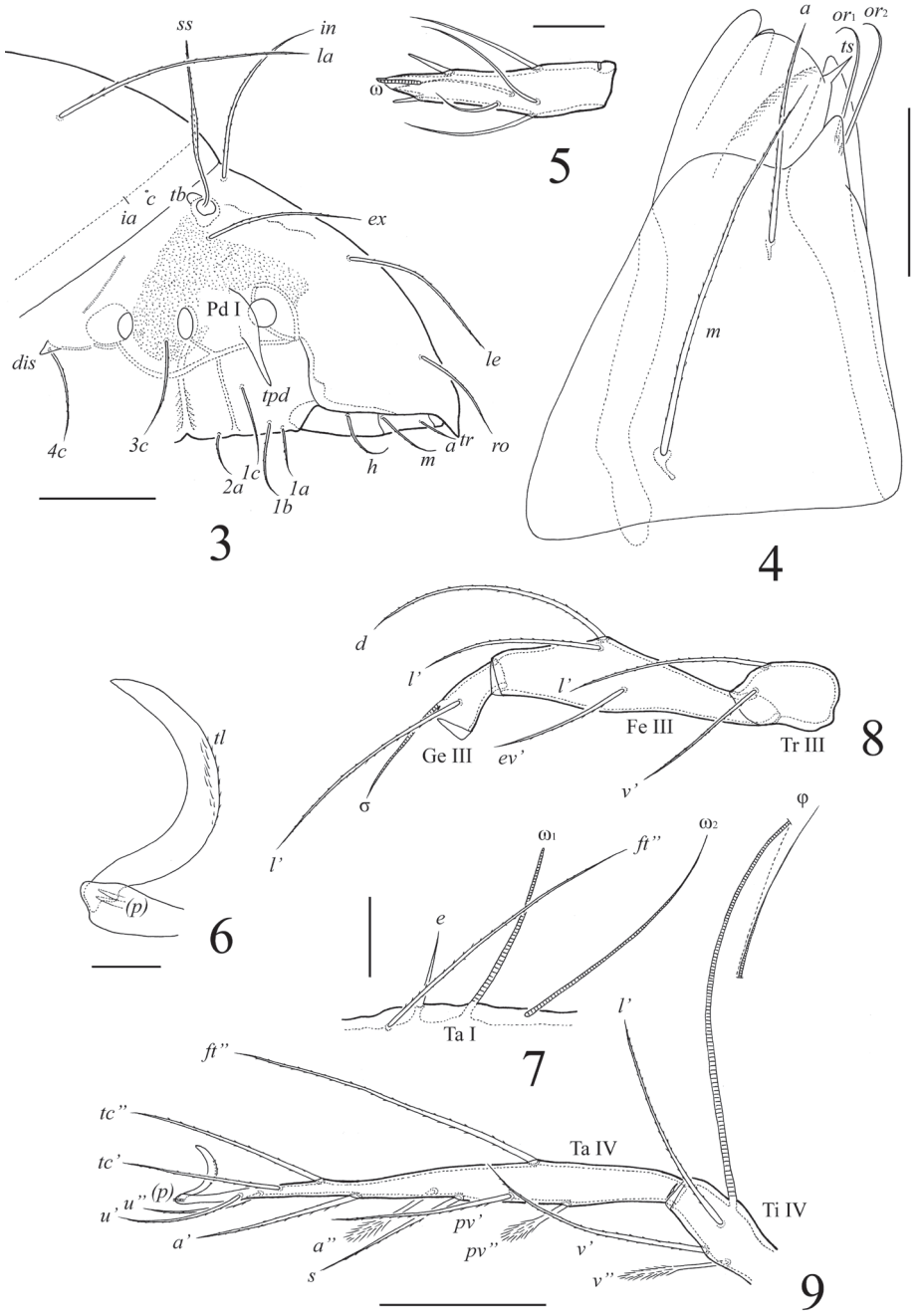
Figure 2. *Lasiobelba* (*Lasiobelba*) *daamsae* sp. n.: ventral view (legs not illustrated). Scale bar 400 μm.



Figures 3–9. *Lasiobelba* (*Lasiobelba*) *daamsae* sp. n.: **3** lateral view of prodorsum (legs not illustrated) and anterior part of notogaster **4** right rutellum and gena of subcapitulum, ventral view **5** palptarsus **6** leg claw II and setae *p* **7** localization of solenidia, famulus and seta *ft"* on tarsus I, right, antiaxial view **8** trochanter, femur and genu of leg III, right, antiaxial view **9** tarsus and anterior part of tibia of leg IV, right, antiaxial view. Scale bars 200 μm (**3, 8, 9**), 50 μm (**4, 7**), 20 μm (**5, 6**).

Table 1. Leg setation and solenidia of *Lasiobelba* (*Lasiobelba*) *daamsae* sp. n. (same data for *Lasiobelba* (*Antennoppia*) *nepalica* sp. n.).

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	*v'*	*d*, *(l)*, *bv''*, *v''*	*(l)*, σ	*(l)*, *(v)*, φ_1, φ_2	*(ft)*, *(tc)*, *(it)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*, *v'*, *(pl)*, *l''*, *ε*, ω_1, ω_2
II	*v'*	*d*, *(l)*, *bv''*, *v''*	*(l)*, σ	*(l)*, *(v)*, φ	*(ft)*, *(tc)*, *(it)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*, *l''*, ω_1, ω_2
III	*l'*, *v'*	*d*, *l'*, *ev'*	*l'*, σ	*l'*, *(v)*, φ	*(ft)*, *(tc)*, *(it)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*
IV	*v'*	*d*, *ev'*	*d*, *l'*	*l'*, *(v)*, φ	*ft''*, *(tc)*, *(p)*, *(u)*, *(a)*, *s*, *(pv)*

Roman letters refer to normal setae (*ε* to famulus), Greek letters to solenidia. Single prime (') marks setae on anterior and double prime ('') setae on posterior side of the given leg segment. Parentheses refer to a pair of setae.

tarsi I, very short, conical on tarsi II–IV. Famulus (*ε*) setiform, straight, pointed, inserted posteriorly to solenidion ω_1.

Type deposition. The holotype and one paratype are deposited in the collection of the Senckenberg Institution Frankfurt, Germany; three paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

Etymology. The specific name is dedicated to Mrs. Beate Daams for her assistance in Nepalese scientific researches.

Remarks. In having the long notogastral setae, large body size and spindle-form bothridial setae, *Lasiobelba* (*Lasiobelba*) *daamsae* sp. n. is most similar to *L.* (*L.*) *remota* Aoki, 1959 from the Oriental and Palaearctic regions and *Lasiobelba* (*Lasiobelba*) *gibbosa* (Mahunka, 1985) from the Ethiopian region. However, it differs from both by the anterior part of pedotecta I specifically curved (versus straight in *L.* (*L.*) *remota* and *L.* (*L.*) *gibbosa*), rostrum pointed (versus rounded in *L.* (*L.*) *remota* and nasiform in *L.* (*L.*) *gibbosa*) and exobothridial setae not shorter than bothridial setae (versus shorter in *L.* (*L.*) *remota* and *L.* (*L.*) *gibbosa*).

Description of *Lasiobelba* (*Antennoppia*) *nepalica* sp. n.

http://zoobank.org/F023D27B-A28D-4A1F-B987-3834F4DF4E97
Figs 10–15

Diagnosis. Body size: 996–1278 × 697–830. Prodorsal setae long, barbed; *ss* ≈ *in* > *le* > *ex* > *ro*. Nine pairs of notogastral setae long, barbed (p_1–p_3 shorter than others). Antero-medial part of rutelli with tooth. Anogenital setae barbed. Dorsal side of leg claws with small teeth.

Description. *Measurements*. Body length: 1195 (holotype, male), 996–1278 (three paratypes: two males and one female); notogaster width: 730 (holotype), 697–830 (three paratypes).

Integument (Figs 10, 12). Body color light brownish. Body surface smooth, but lateral parts of prodorsum with microgranulate cerotegument (diameter granules up to 1).

Prodorsum (Figs 10, 12). Rostrum widely or narrowly rounded. A row, comprising several muscle sigillae, is located in front of the bothridia. One pair of muscle sigilla in

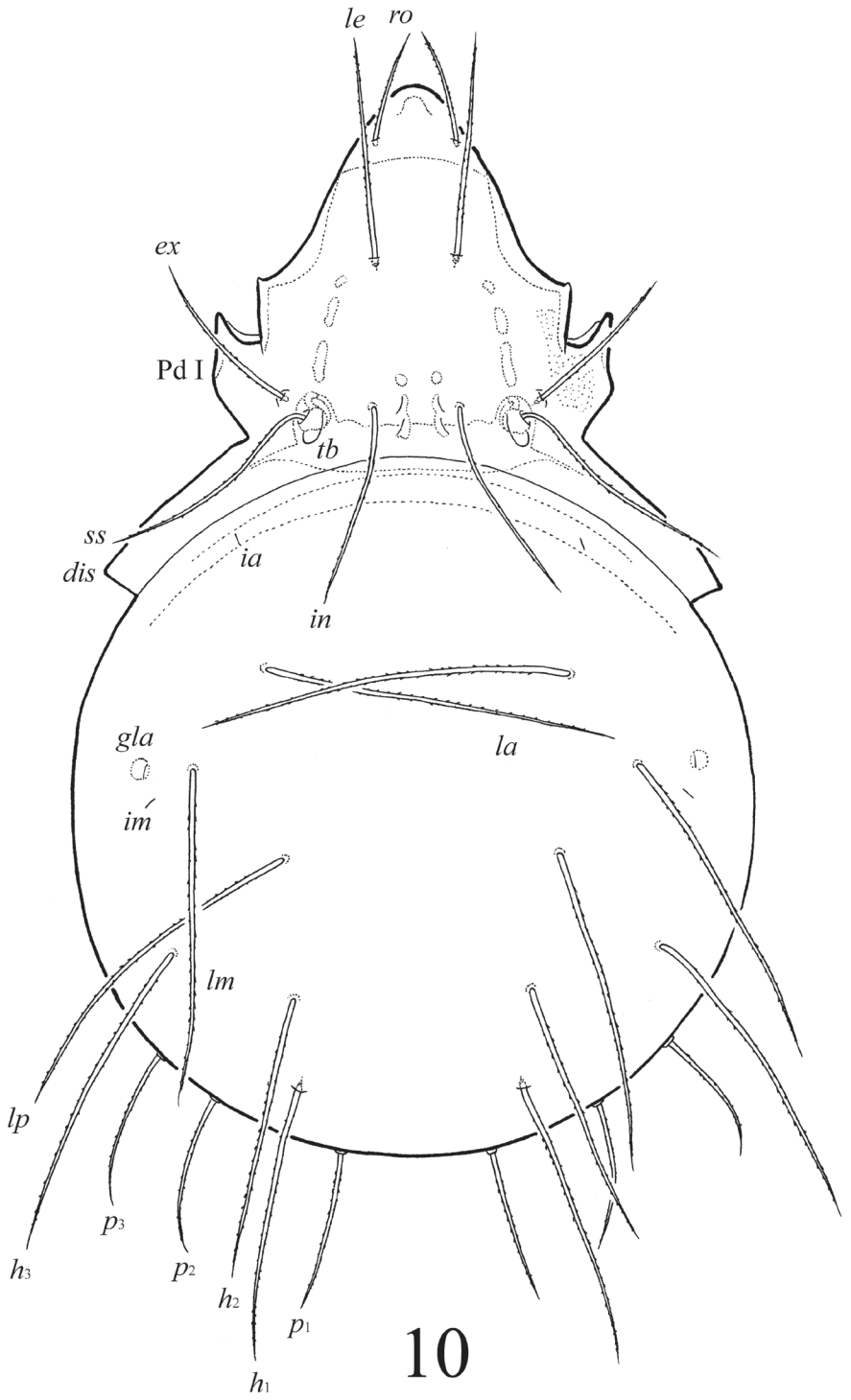


Figure 10. *Lasiobelba* (*Antennoppia*) *nepalica* sp. n.: dorsal view (legs not illustrated). Scale bar 400 μm.

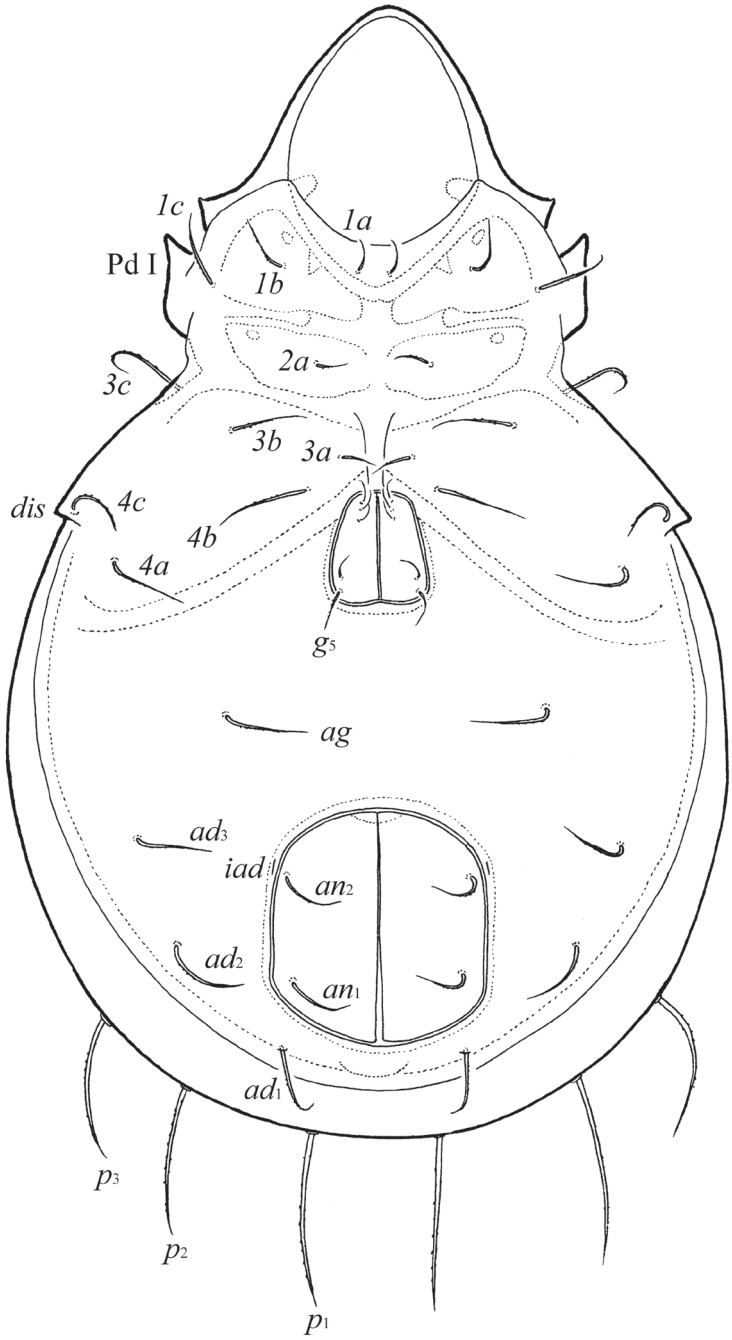


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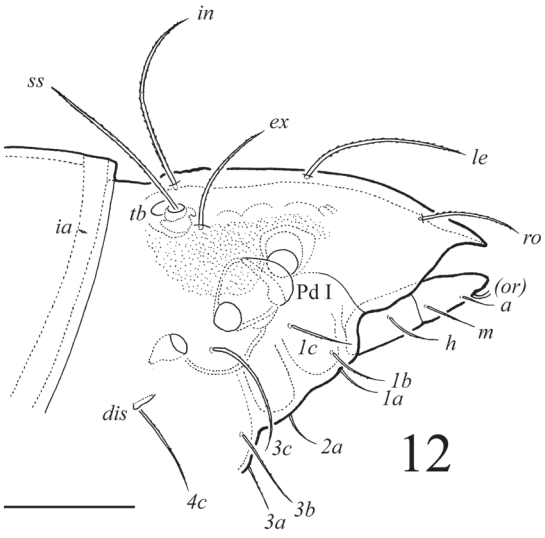
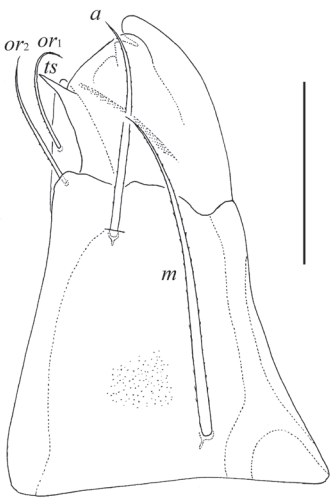
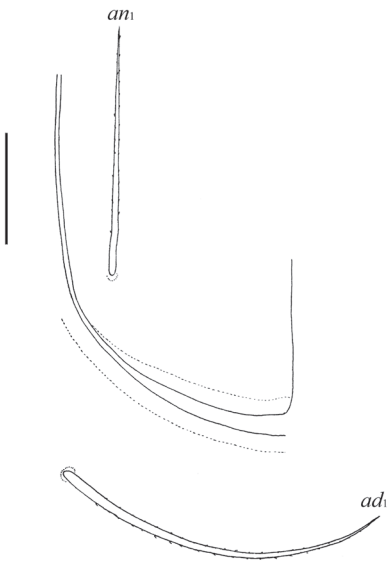
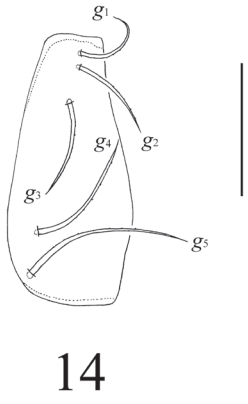
Figure 11. *Lasiobelba* (*Antennoppia*) *nepalica* sp. n.: ventral view (gnathosoma and legs not illustrated). Scale bar 400 μm.









Figures 12–15. *Lasiobelba* (*Antennoppia*) *nepalica* sp. n.: **12** lateral view of prodorsum (legs not illustrated) and anterior part of notogaster **13** left rutellum and gena of subcapitulum, ventral view **14** genital plate, right **15** posterior part of anal plate with seta an_1 and adanal seta ad_1. Scale bar 50 μm.

interbothridial region poorly visible. Rostral (143–164), lamellar (254–287), interlamellar (307–348), exobothridial (205–258) and bothridial (307–348) setae well developed, setiform, barbed. A pair of triangular tubercles located posteriorly to bothridia.

Notogaster (Figs 10–12). Anterior border convex. Notogastral setae *c* and their alveoli reduced. Nine pairs of notogastral setae long, barbed; p_1–p_3 (184–192) shorter than h_1, h_2 (265–332) and others (398–464). Lyrifissures *ia*, *im* and opisthonotal gland openings (*gla*) poorly visible; lyrifissures *ip*, *ih*, *ips* present, but visible under high magnification in dissected specimens.

Gnathosoma (Figs 12, 13). Subcapitulum longer than wide (266 × 199–209). Antero-medial part of rutelli with tooth (8–10). Subcapitular setae setiform, barbed; *a* (61–65) shorter than *m* and *h* (both 98–102). Two pairs of adoral setae (41–45) setiform, indistinctly smooth. Palps (196) with setation 0–2–1–3–8(+ω). Solenidion thickened, blunt-ended, pressed to the palptarsus surface in basal part and distal seta in distal part. Chelicerae (266) with two barbed setae; *cha* (86) longer than *chb* (53). One short tooth (4–6) located posteriorly to seta *cha*. Trägårdh's organ distinct.

Epimeral and lateral podosomal regions (Figs 10–12). Apodemes (1, 2, sejugal, 4) weakly developed. Epimeral setae setiform, barbed; setae *1a*, *2a*, *3a* (69–86) shorter than *1b*, *1c*, *3b*, *4a*, *4b* (114–127), *3c* (205–209) and *4c* (155–164). Pedotecta I normally developed, scale-like. Discidia triangular, pointed.

Anogenital region (Figs 11, 14, 15). Five pairs of genital setae (g_1–g_3, 41–53; g_4, 61–69, g_5, 73–82) setiform, indistinctly barbed. One pair of aggenital (123–135), three pairs of adanal (159–172) and two pairs of anal (114–123) setae setiform, barbed. Distance between setae ad_3–ad_3 longer than ad_2–ad_2 and ad_1–ad_1. Adanal lyrifissures *iad* located longitudinally.

Legs. Generally, similar to *Lasiobelba* (*Lasiobelba*) *daamsae* sp. n. (see also Table 1).

Type deposition. The holotype and one paratype are deposited in the collection of the Senckenberg Institution Frankfurt, Germany; two paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

Etymology. The specific name "*nepalica*" refers to the country origin, Nepal.

Remarks. In having the long prodorsal and notogastral setae and large body size, *Lasiobelba* (*Antennoppia*) *nepalica* sp. n. is most similar to *L.* (*A.*) *granulata* (Mahunka, 1986) from Tanzania. However, it clearly differs from the latter by the larger body size (996–1278 × 697–830 versus 820–861 × 541–574 in *L.* (*A.*) *granulata*), exobothridial setae longer than rostral setae (versus rostral longer in *L.* (*A.*) *granulata*) and bothridial setae not longer than interlamellar setae (versus clearly longer in *L.* (*A.*) *granulata*).

Key to known species of *Lasiobelba*[2]

1 Bothridial setae spindle-form ..... **2, subgenus *Lasiobelba* (*Lasiobelba*)**
– Bothridial setae setiform ..... **18, subgenus *Lasiobelba* (*Antennoppia*)**
2 Dorsal notogastral setae long, *lm* reaching the insertions of *lp*..... **3**
– Dorsal notogastral setae of medium size or short, *lm* not reaching the insertions of *lp*..... **13**

[2] *Lasiobelba* (*Antennoppia*) *rigida* was very poorly described by Ewing (1909), therefore we did not include this species in the key.

3 Notogastral setae *la*, *lm*, *lp* longer than bothridial setae **4**
– Notogastral setae *la*, *lm*, *lp* shorter than bothridial setae **10**
4 Rostrum pointed **5**
– Rostrum widely or narrowly rounded, or truncated **6**
5 Anterior part of pedotecta I specifically curved; notogastral setae p_1–p_3 longer than adanal setae; body size: 1278–1310 × 747–863 ..... ***Lasiobelba* (*Lasiobelba*) *daamsae* sp. n.** Distribution: Nepal
– Pedotecta I normally developed; notogastral setae p_1–p_3 shorter than adanal setae; body size: 772–891 × 410–456..... ***Lasiobelba* (*Lasiobelba*) *gibbosa* (Mahunka, 1985)**. Distribution: Ethiopian region
6 Interlamellar setae similar in length (little longer or shorter) to bothridial setae **7**
– Interlamellar setae clearly shorter than bothridial setae **9**
7 Rostrum truncated; body size: 794–834 × 492–564 ....***Lasiobelba* (*Lasiobelba*) *insulata* Ohkubo, 2001**. Distribution: Japan
– Rostrum widely or narrowly rounded **8**
8 Rostrum widely rounded; notogastral setae p_1–p_3 inserted close to each other; body size: 560 × 330 ....***Lasiobelba* (*Lasiobelba*) *subuligera* (Berlese, 1916)** (see also Mahunka and Mahunka-Papp 1995). Distribution: Argentina
– Rostrum with protruding ledge; notogastral setae p_1–p_3 clearly distanced from each other; body size: 940–1030 × 620–650 .....***Lasiobelba* (*Lasiobelba*) *remota* Aoki, 1959**. Distribution: Palaearctic and Oriental regions
9 Bothridial setae with head without long apex; interbothridial region with two pairs of muscle sigilla; body size: 950 × 630 ....***Lasiobelba* (*Lasiobelba*) *suchetae* Sanyal, 1992**. Distribution: India
– Bothridial setae with long, thin apex; interbothridial region without muscle sigilla; body size: 625–684 × 388–437***Lasiobelba* (*Lasiobelba*) *vietnamica* Balogh, 1983** (see Balogh and Mahunka 1967). Distribution: Vietnam
10 Notogastral setae *c* short, present **11**
– Notogastral setae *c* represented by alveoli **12**
11 Anterior part of notogaster smooth; epimeral setae *1a*, *2a*, *3a* thin, almost smooth; body size: 478–522 × 277–315 ....***Lasiobelba* (*Lasiobelba*) *lemurica* Mahunka, 1997**. Distribution: Madagascar
– Anterior part of notogaster microfoveolate; epimeral setae *1a*, *2a*, *3a* heavily barbed; body size: 566 × 307 ..... .***Lasiobelba* (*Lasiobelba*) *pontica*** Vasiliu & Ivan, 2011. Distribution: Romania
12 Body surface of notogaster with longitudinal ridges; interbothridial region with one pair of tubercles; body size: 693 × 455 ....***Lasiobelba* (*Lasiobelba*) *sculptra* Wang, 1993**. Distribution: southern China
– Body surface of notogaster granulate; interbothridial region without tubercles; body size: 610–644 × 386–402 ....***Lasiobelba* (*Lasiobelba*) *yunanensis* Wen, 1999**. Distribution: southern China

13 Notogastral setae *c* represented by alveoli **14**
– Notogastral setae *c* short, present **15**
14 Notogastral setae smooth; body length: 468 ..... ***Lasiobelba* (*Lasiobelba*) *hespiridiana* (Pérez-Íñigo, 1986)**. Distribution: Mediterranean
– Notogastral setae barbed; body size: 787–825 × 495–539..... ***Lasiobelba* (*Lasiobelba*) *rubida* (Wallwork, 1977)**. Distribution: Santa Helena Islands
15 Interlamellar setae shorter than lamellar setae; body size: 413–600 × 228–336..... ***Lasiobelba* (*Lasiobelba*) *pori* (Vasiliu & Ivan, 1995)** (=*Lasiobelba arabica* Mahunka, 2000, =*Lasiobelba* (*Lasiobelba*) *neonominata* Subías, 2004 (see Kok 1967)[3]. Distribution: Ethiopian and Palaearctic regions, Hawai
– Interlamellar setae longer or similar in length to lamellar setae..... **16**
16 Rostrum tripartite; interbothridial region with three pairs of muscle sigilla; body size: 500–540 × 253 ..... ***Lasiobelba* (*Lasiobelba*) *decui* (Vasiliu et Ivan, 1995)**. Distribution: Israel
– Rostrum rounded; interbothridial region with two pairs of muscle sigilla . 17
17 Bothridial setae with numerous barbs; notogastral setae p_3 longer than p_1 and p_2; body size: 400–530 × 215–280. ***Lasiobelba* (*Lasiobelba*) *arcidiaconoae* (Bernini, 1973)**. Distribution: Mediterranean, India
– Bothridial setae with several short barbs; notogastral setae p_3 similar in length to p_1 and p_2; body size: 313 × 233..... ***Lasiobelba* (*Lasiobelba*) *kuehnelti* (Csiszár, 1961)**. Distribution: Oriental, Australian and Ethiopian regions
18 Heterotrichy of dorsal notogastral setae well developed, *la* and *lm* considerably longer than *lp* **19**
– Heterotrichy of dorsal notogastral setae absent or weakly expressed, *la* and *lm* not longer than *lp* **20**
19 Notogastral setae *la* long, reaching the insertions of *lp*; lamellar setae longer than rostral setae; body size: 456 × 216..... ***Lasiobelba* (*Antennoppia*) *quadrisetosa* Subías, 1989** – see Subías and Balogh 1989 (see also Mahunka 2001). Distribution: Greece
– Notogastral setae *la* of medium size, not reaching the insertions of *lp*; lamellar setae shorter than rostral setae; body size: 498–547 × 298–332... ***Lasiobelba* (*Antennoppia*) *chistyakovi* Ermilov & Kalúz, 2012**. Distribution: Ecuador
20 Dorsal notogastral setae long, *lm* reaching the insertions of *lp*..... **21**
– Dorsal notogastral setae of medium size or short, *lm* not reaching the insertions of *lp* **29**
21 Notogastral setae *la*, *lm*, *lp* longer or similar in length to bothridial setae..... **22**
– Notogastral setae *la*, *lm*, *lp* shorter than bothridial setae..... **25**
22 Apodemes IV absent; adanal lyrifissures located diagonally to anal aperture; body size: 745 × 510..... ...***Lasiobelba* (*Antennoppia*) *insignis* Balogh, 1970**. Distribution: New Guinea

[3] *Lasiobelba* (*Lasiobelba*) *pori*, *L.* (*L.*) *arabica* and *L.* (*L.*) *neonominata* Subías, 2004 (=*Oppia yodai africana* Kok, 1967 "nom. praeoc." by Evans, 1953) morphologically are very similar among themselves. We have found any significant morphological differences. Hence, we suggest that *L.* (*L.*) *arabica* and *L.* (*L.*) *neonominata* Subías, 2004 are junior subjective synonyms of *L.* (*L.*) *pori*.

– Apodemes IV present; adanal lyrifissures located longitudinally to anal aperture **23**

23 Bothridial setae smooth; body size: 590 × 330 .... ***Lasiobelba*** **(*Antennoppia*)** ***subnitida*** **(Sellnick, 1924)**. Distribution: Brazil

– Bothridial setae barbed **24**

24 Exobothridial setae longer than rostral setae; bothridial setae similar in length to interlamellar setae; body size: 996–1278 × 697–830 .... ***Lasiobelba*** **(*Antennoppia*)** ***nepalica*** **sp. n.** Distribution: Nepal

– Exobothridial setae shorter than rostral setae; bothridial setae longer than interlamellar setae; body size: 820–861 × 541–574 ..... ***Lasiobelba*** **(*Antennoppia*)** ***granulata*** **(Mahunka, 1986)**. Distribution: Tanzania

25 Rostrum pointed; body size: 715–800 × 448–486 ....***Lasiobelba*** **(*Antennoppia*)** ***major*** **(Mahunka, 1983)**, see Mahunka 1983a. Distribution: Tanzania

– Rostrum rounded **26**

26 Interlamellar setae represented by alveoli; body size: 590–623 × 232–250 ....***Lasiobelba*** **(*Antennoppia*)** ***trichoseta*** **(Mahunka, 1983)**, see Mahunka 1983b. Distribution: Tanzania

– Interlamellar setae well developed **27**

27 Dorsal notogastral setae inserted in four subparallel rows; interbothridial region with one pair of triangular ridges; body size: 810–1180 × 510–526..... .. ***Lasiobelba*** **(*Antennoppia*)** ***yoshii*** **(Mahunka, 1987)**. Distribution: Borneo

– Dorsal notogastral setae inserted in two parallel rows; interbothridial region without triangular ridges..... **28**

28 Interlamellar setae longer than lamellar setae; interbothridial region with three pairs of muscle sigilla; body size: 740 × 450 ..... . ***Lasiobelba*** **(*Antennoppia*)** ***capilligera*** **(Berlese, 1916)** (see also Mahunka 1991). Distribution: Ethiopian region

– Interlamellar setae slightly shorter than lamellar setae; interbothridial region without muscle sigilla; body size: 555–652 × 314–367 ....***Lasiobelba*** **(*Antennoppia*)** ***minor*** **(Mahunka, 1983)**, see Mahunka 1983a. Distribution: Tanzania

29 Notogastral setae *c* represented by alveoli; rostrum with protruding ledge; body size: 565–605 × 315–335..... ***Lasiobelba*** **(*Antennoppia*)** ***ultraciliata*** **(Jacot, 1934)**. Distribution: Australian region

– Notogastral setae *c* short, present; rostrum rounded, without protruding ledge **30**

30 Interlamellar setae similar in length to lamellar setae; exobothridial setae similar in length to rostral setae, respectively; body size: 347 × 185 ... ***Lasiobelba*** **(*Antennoppia*)** ***heterosa*** **(Wallwork, 1964)**. Distribution: Ethiopian and Palaearctic regions

– Interlamellar setae longer than lamellar setae; exobothridial setae shorter than rostral setae; body size: 525–637 × 288–337 .....***Lasiobelba*** **(*Antennoppia*)** ***izquierdoae*** **Arillo, Gil-Martin & Subías, 1994**. Distribution: Canary Islands

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RESEARCH ARTICLE

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Systematic and biogeographical study of Protura (Hexapoda) in Russian Far East: new data on high endemism of the group

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Abstract

Proturan collections from Magadan Oblast, Khabarovsk Krai, Primorsky Krai, and Sakhalin Oblast are reported here. Twenty-five species are found of which 13 species are new records for Russian Far East which enrich the knowledge of Protura known for this area. Three new species *Baculentulus krabbensis* **sp. n.**, *Fjellbergella lazovskiensis* **sp. n.** and *Yichunentulus alpatovi* **sp. n.** are illustrated and described. The new materials of *Imadateiella sharovi* (Martynova, 1977) are studied and described in details. Two new combinations, *Yichunentulus borealis* (Nakamura, 2004), **comb. n.** and *Fjellbergella jilinensis* (Wu & Yin, 2007), **comb. n.** are proposed as a result of morphological examination. Keys to species of the genera *Fjellbergella* and *Yichunentulus* are given. An annotated list of all species of Protura from Russian Far East is provided and discussed. Widely distributed species were not recorded in this area. This may be because of the high sensitivity of Protura to anthropogenic impact and low dispersal ability of the group.

Keywords

Key, checklist, *Baculentulus*, *Fjellbergella*, *Yichunentulus*, biogeography

Introduction

The Protura are minute soil-dwelling arthropods with more than 800 species known so far in the world (Bu et al. 2012, Szeptycki 2007, Shrubovych 2014). They have been a group of focus in the study of the evolutionary history of Hexapoda and Arthropoda because of their basal phylogenetic position (Chen et al. 2011, Luan et al. 2005, Mallatt et al. 2010, Meusemann et al. 2010).

The Russian Far East (abbreviated as RFE throughout the present paper) occupies an area of 3,016 thousand sq. km. and extends from Wrangel Island southwards to Khasan Lake (Fig. 1). Forests occupy 39% of the territory and predominate in Primorsky Krai, Amur Oblast, Sakhalin Oblast, and Khabarovsk Lrai. The insect fauna is associated with mixed broadleaved-coniferous forests in the south of RFE. About 31,500 species of insects have been recorded in the RFE so far where Eastern-Asiatic and local species make the most part of the fauna (Storozhenko et al. 2002). Eighteen species of Protura have been recorded in the RFE. Compared to the neighbouring regions, 34 species of Protura have been recorded in Northeast China (Bu et al. 2013), 20 species were found in Korea (Lee and Rim 1988) and 88 species are recorded in Japan (Kaneko et al. 2012). The only seven publications on Protura of the RFE are: Martynova who described *Imadateiella sharovi* (Martynova, 1977) from Magadan; Nakamura (2004) who reported eight species from Khabarovsk Krai; Shrubovych (2009, 2010, 2014) and Shrubovych and Bernard (2012, 2013) who studied the Protura materials from different collections of Primorsky Krai and Sakhalin Island and nine species have been added to the proturan fauna of RFE.

Much of the material was collected by us during a joint Chinese-Russian expedition in autumn of 2011 which was a part of study of the biodiversity of basal Hexapoda of Pacific coast of Asia (2011–2012). Several localities in southern RFE were searched: three locations of Primorsky Krai (Shkotovsky, Khasansky, and Lazovsky districts) and one of Khabarovsk Krai (Vaninsky district). Other materials collected by M. Potapov et al. (2009–2010) were also used. Around a thousand individuals are included in our study. Based on this material in all 25 species were identified, including 3 new species and 10 species newly recorded for the RFE. For another 12 species we give the new data on their distribution. The genera *Fjellbergella* and *Yichunentulus* are revised and rediagnosed, and the keys to species of the two genera are given.

Materials and methods

The specimens were collected by Tullgren funnels using fast extraction with strong heating of samples during several hours. All specimens were mounted on slides in Hoyer's medium and dried at 60 °C. Specimens were identified and drawn with the aid of a NIKON E600 phase contrast microscope. The photos were taken by digital camera Nikon DXM1200. Type specimens are deposited in the Shanghai Entomological Museum (SEM), Institute of Plant Physiology & Ecology, Shanghai Institutes

Figure 1. The sampling sites in RFE.

for Biological Sciences, Chinese Academy of Sciences, and Moscow State Pedagogical University (MSPU).

Eight localities of RFE were sampled so far (Fig. 1) if including our collecting (denoted as 2–5 and 7); localities 1, 6 and 8 were studied in previous publications:

1: Magadan Oblast, Snezhnaja dolina, 59°32.92'N, 150°48.16'E.
2: Khabarovsk Krai, Vaninsky area, Valley of Mulinka, 49°49.42'N, 140°0.50'E.
3: Khabarovsk Krai, Khabarovsk district, Korfovsky, Khekhtsyr Range, 48°30.95'N, 135°6.06'E.
4: Primorsky Krai, Shkotovsky area, Anisimovka, Khualaza Mt. 43°10.33'N, 132°47.16'E.
5: Primorsky Krai, Khasansky area, 42°37.40'N, 130°52.35'E.
6: Primorsky Krai, Partizansky area, Chondolaz Range, 42°45.97'N, 133°3.75'E.
7: Primorsky Krai, Lazovsky area, nearby Preobrazheniye, 42°54.16'N, 133°53.33'E.
8: Sakhalin Oblast, Sakhalin Island, Yuzhno-Sakhalinsk, Susunaysky Range, Chenov Mt. 47°1.50'N, 142°52.35'E.

Abbreviations used in the text follow the paper of Bu and Yin (2007). Head setae and pores are marked according to Rusek et al. (2012). Arrangements of the taxa follow the system proposed by Yin (1999).

Results

Systematics

Descriptions of new species

***Baculentulus krabbensis* sp. n.**
http://zoobank.org/2AD017F3-F73F-4AF5-A0FE-C317387B9A77
Figs 2, 3; Table 1

Material examined. Holotype, female (No. FE-2011022-2) (SEM), Russia, Far East, Primorsky Krai, Khasansky area, eastern part of Krabbe Peninsula, from mixed samples of soil and moss under a broad-leaved forest on a hill beside the coast, 42°37.40'N, 130°52.35'E, 16-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov. Paratypes, 2 females (Nos. FE-2011022-1, FE-2011023) (SEM; MSPU), 1 maturus junior (No. FE-2011022-3) (SEM), same data as holotype.

Description. Adult body length 1000–1100 μm (n=3), pale yellow in color (Fig. 3A).

Head (Fig. 2A). Ovate, length 90–110 μm, width 70 μm. Setae *d6* present, *sd4* and *sd5* short sensilliform. Setae *d6* 11 μm, *d7* 10 μm and *sd7* 19 μm in length. Clypeal pore *cp* and frontal pore *fp* present. Pseudoculus round, length 7–8 μm, with short posterior extension, PR=15 (Fig. 2B). Calyx of maxillary gland smooth, without any appendix, blind end split into two leaves, posterior filament 15 μm, CF=7 (Fig. 2C).

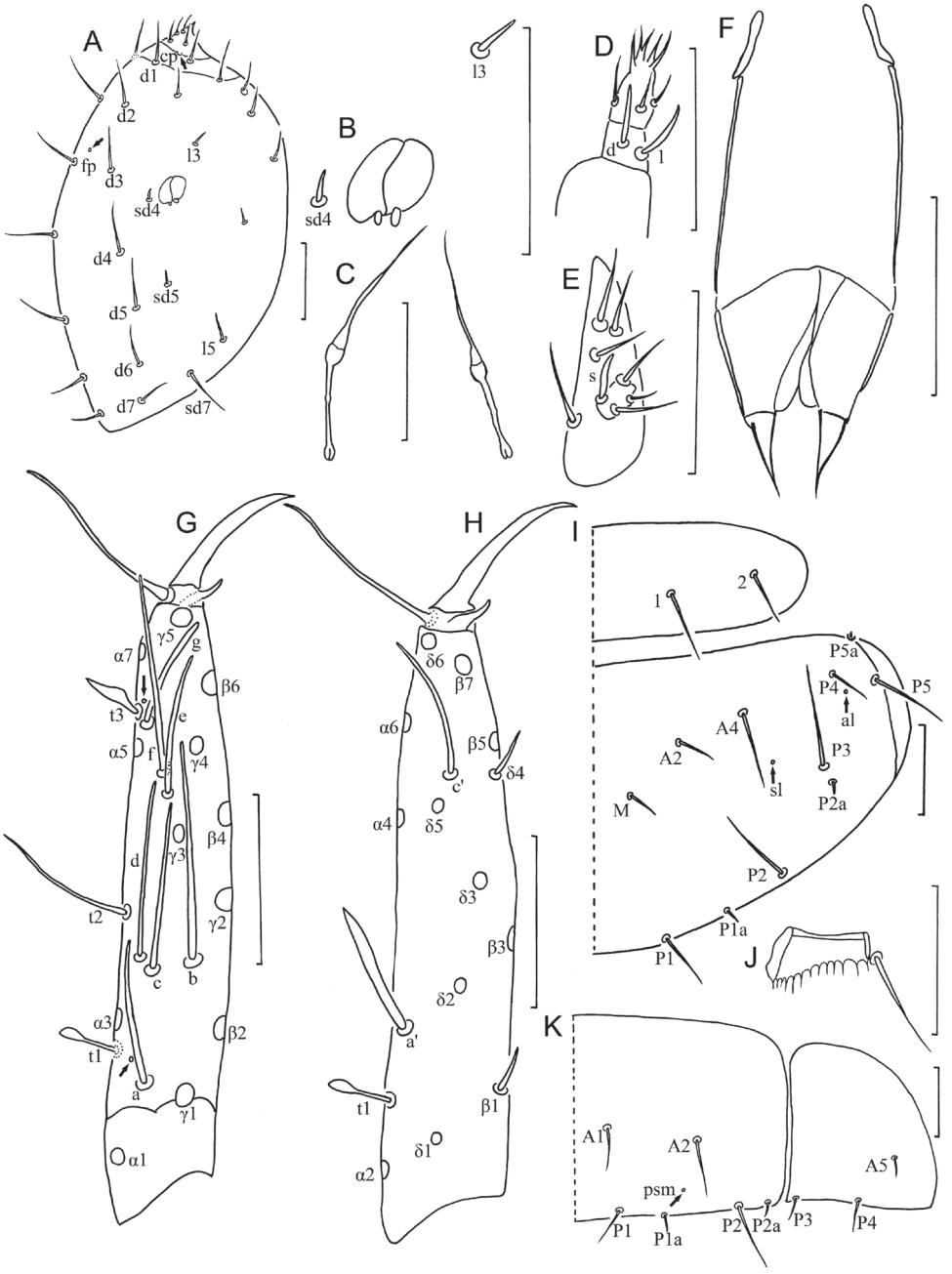

Figure 2. *Baculentulus krabbensis* sp. n. holotype. **A** Head, dorsal view (*cp* = clypeal pore, *fp* = frontal pore) **B** pseudoculus **C** canal of maxillary gland **D** maxillary palpus **E** labial palpus **F** female quama genitalis **G** foretarsus, exterior view **H** foretarsus, interior view **I** pronotum and mesonotum, right side (*al* = anterolateral pore, *sl* = sublateral pore) **J** comb **K** tergite I, right side. Arrows indicate pores. Scale bar: 20 μm.

Maxillary palpus with two tapering sensilla, subequal in length (Fig. 2D). Labial palpus reduced, with three setae and one lanceolate basal sensillum (Fig. 2E).

Foretarsus (Fig. 2G, H). Length 80 μm, claw length 20 μm, without inner flap, TR=4; empodium length 3 μm, EU=0.15. Dorsal sensilla *t-1* baculiform, *t-2* slender and long (17 μm), BS=0.33, *t-3* broad-leaf shape. All other exterior sensilla slender, except broadened sensillum *g*, *a* surpassing base of *b* and *c*, *b* broad at base and extremely long (29 μm), reaching base of *γ4*, *c* nearly reaching base of *e* and slightly lower than *b* and *d*, *d* located at same level to *b*, *e* short, *f* long, *g* broad and short. Interior sensilla *a'* lanceolate and broad, *b'* absent, *c'* reaching base of claw. Relative length of sensilla: *t1* = *t3* < *a'* < (*g* = *t2* = *c'*) < *a* < (*c* = *e*) < *d* < *f* < *b*. Setae *β1* and *δ4* sensillum, 6 μm and 7 μm respectively. Pores close to base of sensilla *a* and *t3* present. Length of middle tarsus 35 μm, claw length 15 μm. Length of hind tarsus 38 μm, claw length 18 μm.

Thorax. Thoracic chaetotaxy given in Table 1. Setae *1* and *2* on pronotum 16 μm and 12 μm length respectively, mesonotum and metanotum with eight pairs of *P*-setae, accessory setae short sensilliform; setae *P1*, *P1a* and *P2* on mesonotum 15 μm, 3 μm and 20 μm respectively (Fig. 2I). Prosternum with two pairs of anterior seta, and setae *A2* and *M2* sensilliform (Fig. 3B). Mesosternum and metasternum each with 7 *A*-setae, and setae *A2* sensilliform (Fig. 3C, D). Pronotum and prosternum without pores (Figs 2I, 3B). Mesonotum with pores *sl* and *al*, metanotum with pores *sl* only (Fig. 2I). Mesosternum and metasternum without pores (Fig. 3C, D). Single membranal pore present on membrane between each coxa and the body.

Abdomen. Abdominal chaetotaxy given in Table 1. Tergite I with three pairs of anterior setae (*A1*, *A2*, A5) and six pairs of posterior setae (Fig. 2K). Tergites II–VI with eight pairs of posterior setae. Tergite VI and VII with four pairs of anterior setae (*A1*, *A2*, *A4*, *A5*). Tergites VII with nine pairs of posterior setae, *P3a* present. All accessory setae on tergites I–VII sensilliform, 5–6 μm on tergites I–VI and 7 μm on VII. Tergite VIII with paired setae *M1* (Fig. 3G). Sternite IV–VII each with eight posterior setae, *Pc* absent (Fig. 3H, I, J). Sternite VIII with 4 setae.

Tergites I and VIII with pores *psm* only (Figs 2K, 3G), II–V with pores *psm* and *al* (Fig. 3E), VI–VII with pores *psm*, *al* and *psl* (Fig. 3F), IX–XI without pores, XII with single medial pore. Sternites I–III without pores, IV with 1+1 anteromembranal pores, V and VI each with 1+1 posterior pores anterior to seta *P1* and 1+1 anteromembranal pores (Fig. 3H, I), VII with single posterior pore asymmetrical located left or right and 1+1 anteromembranal pores (Fig. 3J), VIII–XI without pores, XII with 1+1 pores *al*.

Abdominal appendages I, II, III with 2, 1, 1 segments and 4, 2, 2 setae respectively. On appendages II and III, subapical seta 15–17 μm, apical seta 11–12 μm in length. Striate band on abdominal segment VIII reduced, anterior margin regular wave shaped (Fig. 3G). Comb on abdomen VIII rectangular, with 12–13 teeth (Fig. 2J). Female squama genitalis with very short basal apodeme, extremely long and pointed acrostyli (Fig. 2F). Male unknown.

Etymology. The species is named after Krabbe Peninsula where the type specimens were collected.

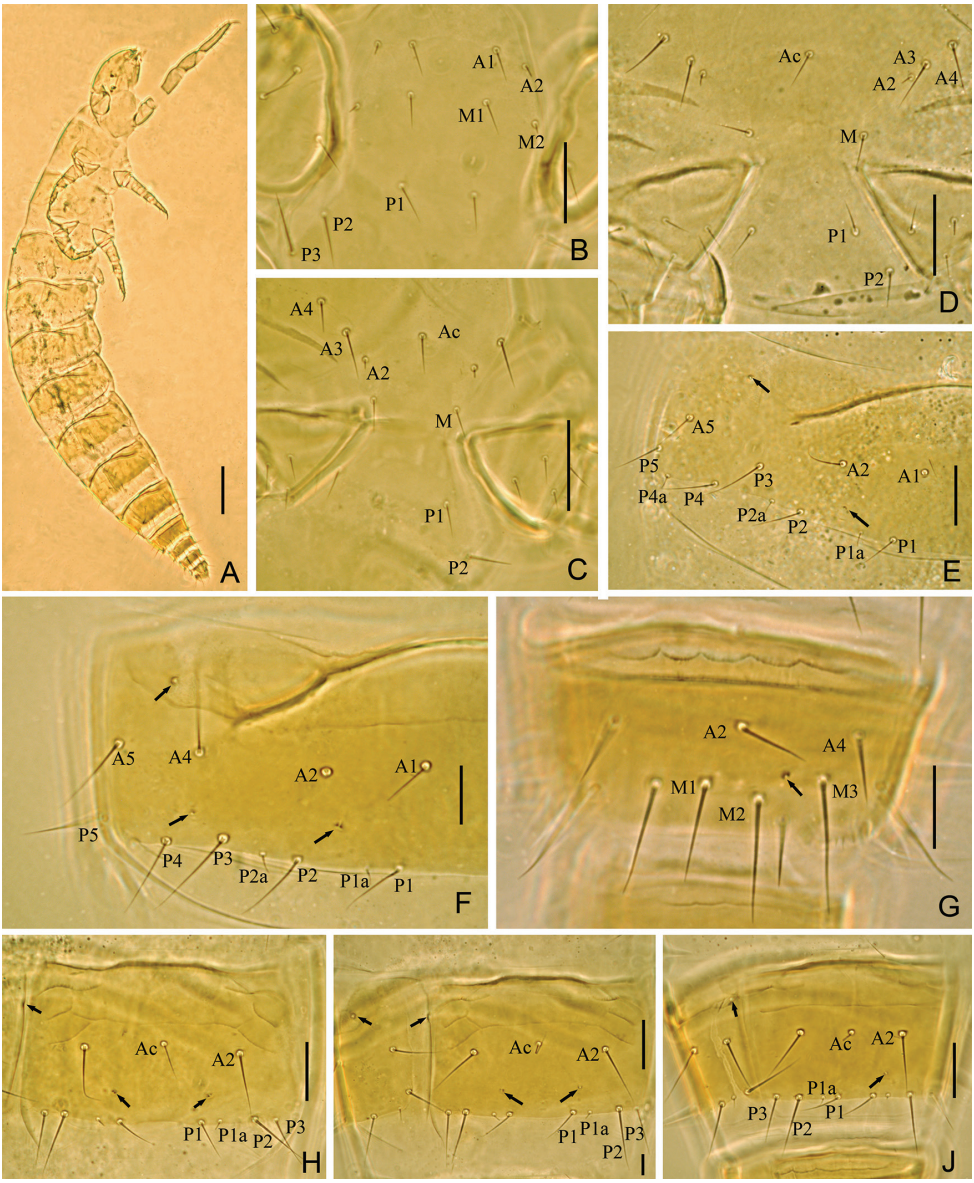

Figure 3. *Baculentulus krabbensis* sp. n. holotype. **A** Habitus **B** prosternum **C** mesosternum **D** metasternum **E** tergite III, left side **F** tergite VI, left side **G** tergite VIII **H**–**J** sternites V–VII. Arrows indicate pores. Scale bar: 100 μm in **A**, others, 20 μm.

Distribution. Known only from type locality.

Diagnosis. *Baculentulus krabbensis* sp. n. is characterized by extremely long sensillum *b* on foretarsus, sensillum *a'* located distal to *t1*, sensillum *b'* absent, eight *A*-setae on tergite VI and VII, presence of *P3a* on tergite VII, and special female genitalia with short basal apodeme.

Table 1. Adult chaetotaxy of *Baculentulus krabbensis* sp. n.

Segment		Dorsal		Ventral	
		Formula	Setae	Formula	Setae
Th.	I	4	1, 2	(4+4)/6	A1, 2, M1, 2 P1, 2, 3
	II–III	6/16	A2, 4, M P1, 1a, 2, 2a, 3, 4, 5, 5a	(7+2)/4	Ac, 2, 3, 4, M Pc, 1, 2
Abd.	I	6/12	A1, 2, 5 P1, 1a, 2, 2a, 3, 4	3/4	Ac, 2 P1, 2
	II–III	6/16	A1, 2, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/5	Ac, 2 Pc, 1a, 2
	IV–V	6/16	A1, 2, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/8	Ac, 2 P1, 1a, 2, 3
	VI	8/16	A1, 2, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/8	Ac, 2 P1, 1a, 2, 3
	VII	8/18	A1, 2, 4, 5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	3/8	Ac, 2 P1, 1a, 2, 3
	VIII	6/16	A2, 4, 5 M1, 2, 3, 4, P2, 3, 4, 5	4	A1, 2
	IX	14	1, 1a, 2, 2a, 3, 3a, 4	4	1, 2
	X	12	1, 1a, 2, 2a, 3, 4	4	1, 2
	XI	6	1, 3, 4	6	1, 1a, 2
	XII	9		6	

Remarks. We placed the present new species in the genus *Baculentulus* because the baculiform sensillum *t1* on foretarsus, reduced labial palpus with three setae and one sensillum, smooth calyx of maxillary gland, reduced striate band, two pairs of anterior setae on mesonotum and metanotum, abdominal appendages II and III each with two setae of different length, and only 4 setae on sternite VIII. It is similar to *B. samchonri* (Imadaté & Szeptycki, 1976) from North Korea in having eight *A*-setae on both tergites VI and VII, absence of sensillum *b'* and extremely long sensillum *b* on foretarsus. They can be distinguished by the posterior setae on tergite VII (9 pairs of *P*-setae with *P3a* present in *B. krabbensis* sp. n. vs. 8 pairs of *P*-setae with *P3a* absent in *B. samchonri*), the anterior setae on tergite I (6 A-setae in *B. krabbensis* sp. n. vs. 4 in *B. samchonri*), the length of sensillum *f* (extremely long and surpassing the base of claw in *B. krabbensis* sp. n. vs. short and not reaching base of claw in *B. samchonri*), and the shape of female squama genitalis (basal apodeme very short in *B. krabbensis* sp. n. vs. basal apodeme in moderate length in *B. samchonri*).

Fjellbergella lazovskiensis sp. n.

http://zoobank.org/152D05AF-CE80-4BDA-B821-833163392DC1
Figs 4, 5; Table 2

Material examined. Holotype, female (No. FE-2011051-2) (SEM), Russia, Far East, Primorsky Krai, Lazovsky area, nearby Preobrazheniye, from the mixed samples of humus (full of white mycelium) and a little soil under a broad-leaved forest close to

the seashore, 42°54.16'N, 133°53.33'E, 22-IX-2011. coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov. Paratypes, 5 females (Nos. FE-2011046-2, FE-2011052-4, FE-2011052-5, FE-2011052-6, FE-2011073-1) (SEM), 5 males (Nos. FE-2011071-1, FE-2011072-1, FE-2011074-1, FE-2011075-1, FE-211075-3) (SEM; MSPU), same data as holotype. Other materials, 3 male preimagos (Nos. FE-2011048-2, FE-2011048-3, FE-2011049-3) (SEM), same date as holotype.

Description. Adult body length 1100–1300 μm (n=10), pale yellow in color (Fig. 5A).

Head (Fig. 4A). Ovate, length 120–125 μm, width 85 μm. Setae *d6* present, *sd4* and *sd5* short sensilliform. Setae *d6* and *d7* subequal in length. Seta *sd7* 18 μm in length. Clypeal pore *cp* and frontal pore *fp* present. Pseudoculus round, length 9–10 μm, with short posterior extension, some irregular lines visible under light microscope, PR=12–13 (Fig. 4B). Calyx of maxillary gland smooth, with one helmet-like dorsal appendix, blind end split into two leaves, and posterior filament 15 μm, CF=8 (Fig. 4C). Maxillary palpus with two tapering sensilla, dorsal one (8–10 μm) slightly longer than lateral one (7–9 μm) (Fig. 4D). Labial palpus reduced, with two-branched terminal tuft of setae, with one leaf-shape basal sensillum (Figs 4E, 5B).

Foretarsus (Fig. 4H, I). Length 90–95 μm, claw length 20–21 μm, without inner flap, TR=4.3–4.7; empodium length 4 μm, EU=0.2. Dorsal sensilla *t-1* claviform, *t-2* slender and long (25–26 μm), BS=0.38–0.42, *t-3* short and lanceolate. All other exterior sensilla slender, with except *a* slightly broad, surpassing base of *c*, *b* shorter than *c* and located in subequal level, *d* lower than *c*, *e* slender, *f* long, *g* short. Interior sensilla *a'* short and broad, *b'* slender and surpassing base of *δ5*, *c'* reaching base of claw. Relative length of sensilla: $t3 < t1 < a' < b < (a = g = d = b' = c') < (c = e = f = t2)$. Setae *β1* and *δ4* sensillum, 7 μm and 5 μm respectively. Pores close to base of sensilla *a* and *t3* present. Length of middle tarsus 40–45 μm, claw length 18–20 μm. Length of hind tarsus 45–50 μm, claw length 20–23 μm.

Thorax. Thoracic chaetotaxy given in Table 2. Setae *1* and *2* on pronotum 20 μm and 15 μm length respectively, mesonotum and metanotum with eight pairs of *P*-setae, accessory setae short sensilliform, 2.5 μm; setae *P1*, *P1a* and *P2* on mesonotum 18–20 μm, 2.5 μm and 22–25 μm respectively (Fig. 4J). Prosternum with two pairs of anterior seta, and setae *A2* and *M2* sensilliform (Fig. 5C). Mesosternum and metasternum each with 7 *A*-setae, and setae *A2* and *A4* sensilliform (Fig. 5D, E). Pronotum and prosternum without pores (Figs 4J, 5C). Mesonotum with pores *sl* and *al*, metanotum with pores *sl* only (Fig. 4J). Mesosternum and metasternum each with single median pore, situated anterioral to level of setae *M* (Fig. 5D, E).

Abdomen. Abdominal chaetotaxy given in Table 2. Tergite I with three pairs of anterior setae (*A1*, *A2*, A5) and six pairs of posterior setae. Tergites II–VI with eight pairs of posterior setae. Tergite VI and VII with four pairs of anterior setae (*A1*, *A2*, *A4*, *A5*). Tergite VII with nine pairs of posterior setae, *P3a* present. All accessory setae on tergites I–VII short sensilliform, 3 μm on tergites I–VI and 6 μm on VII. Tergite VIII with paired setae *M1* (Fig. 5F). Sternites IV–VII each with eight posterior setae, *Pc* absent (Fig. 5K, L, M). Sternite VIII with two rows of setae (4/2) (Fig. 5G).

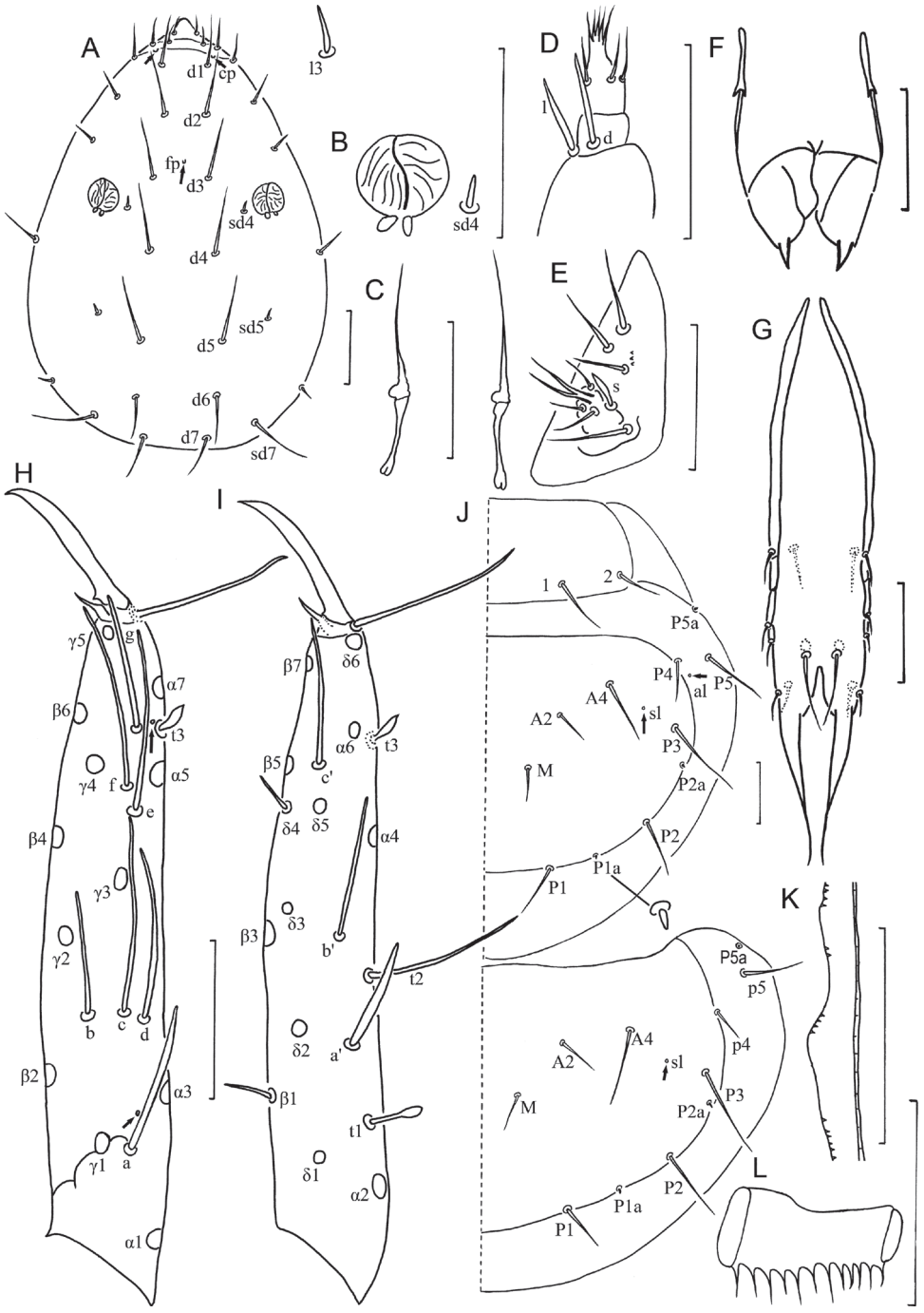

Figure 4. *Fjellbergella lazovskiensis* sp. n. holotype. **A** Head, dorsal view **B** pseudoculus **C** canal of maxillary gland **D** maxillary palpus **E** labial palpus **F** female squama genitalis **G** male squama genitalis **H** foretarsus, exterior view **I** foretarsus, interior view **J** nota, right side **K** part of striate band **L** comb. Arrows indicate pores. Scale bar: 20 μm.

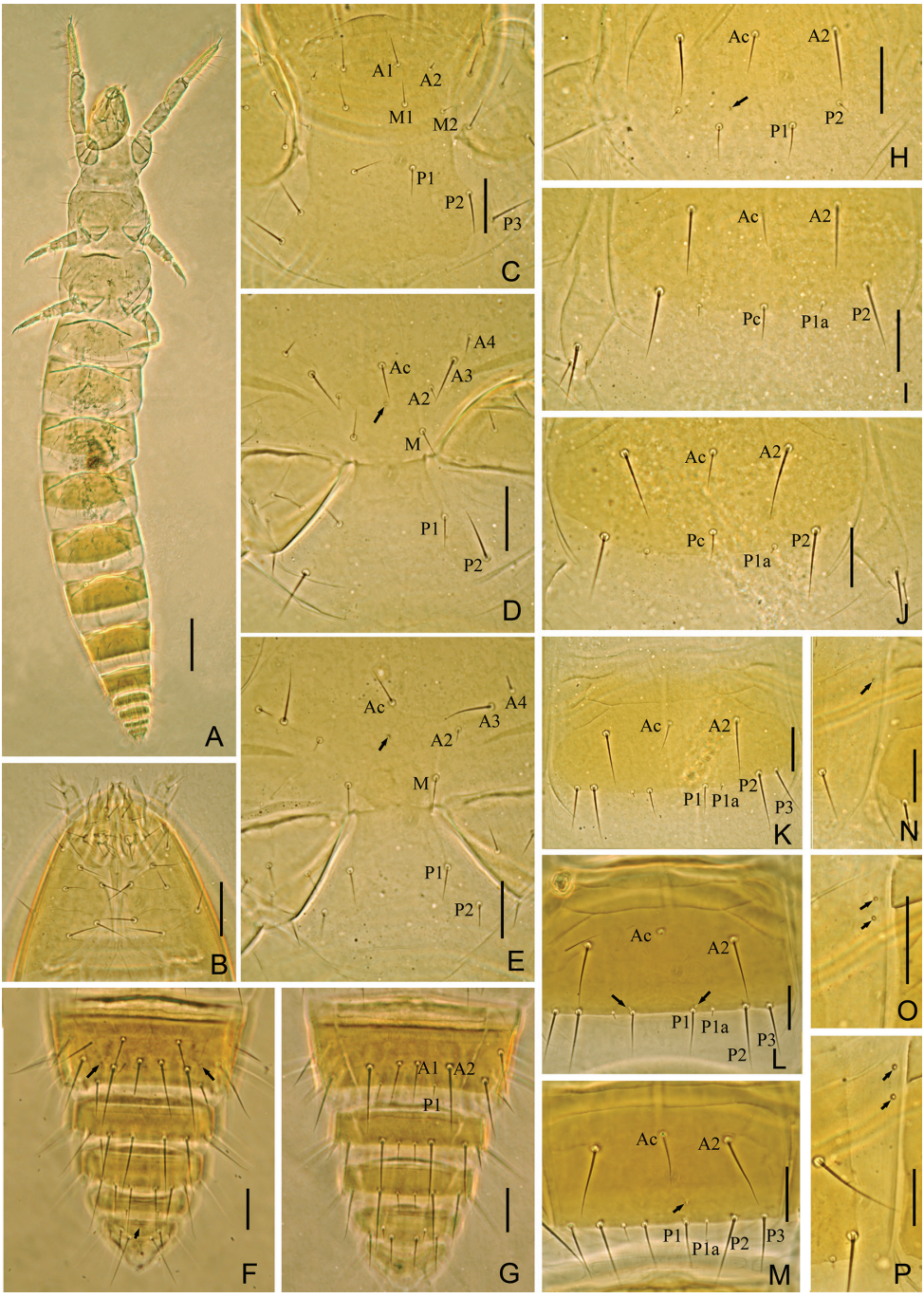

Figure 5. *Fjellbergella lazovskiensis* sp. n. holotype. **A** Habitus **B** ventral side of head **C** prosternum **D** mesosternum **E** metasternum **F** tergites VIII–XII **G** sternites VIII–XII **H–J** sternites I–III **K** sternite IV **L** sternite VI **M** sternite VII **N–P** laterotergites of abdominal segments IV, V and VI. Arrows indicate pores. Scale bar: 100 μm in **A**, others, 20 μm.

Table 2. Adult chaetotaxy of *Fjellbergella lazovskiensis* sp. n.

Segment		Dorsal		Ventral	
		Formula	Setae	Formula	Setae
Th.	I	4	1, 2	(4+4)/6	A1, 2, M1, 2 P1, 2, 3
	II–III	6/16	A2, 4, M P1, 1a, 2, 2a, 3, 4, 5, 5a	(7+2)/4	Ac, 2, 3, 4, M Pc, 1, 2
Abd.	I	6/12	A1, 2, 5 P1, 1a, 2, 2a, 3, 4	3/4	Ac, 2 P1, 2
	II–III	6/16	A1, 2, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/5	Ac, 2 Pc, 1a, 2
	IV–V	6/16	A1, 2, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/8	Ac, 2 P1, 1a, 2, 3
	VI	8/16	A1, 2, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/8	Ac, 2 P1, 1a, 2, 3
	VII	8/18	A1, 2, 4, 5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	3/8	Ac, 2 P1, 1a, 2, 3
	VIII	6/16	A2, 4, 5 M1, 2, 3, 4, P2, 3, 4, 5	4/2	A1, 2 P1
	IX	14	1, 1a, 2, 2a, 3, 3a, 4	4	1, 2
	X	12	1, 1a, 2, 2a, 3, 4	4	1, 2
	XI	6	1, 3, 4	6	1, 1a, 2
	XII	9		6	

Tergites I and VIII with pores *psm* only, II–VII with pores *psm* and *al*, IX–XI without pores, XII with single medial pore (Fig. 5F). Sternites I–III without pores (Fig. 5H–J), IV with 1+1 anteromembranal pores (Fig. 5K, N), V and VI each with 1+1 posterior pores close to seta *P1* and 2+2 anteromembranal pores (Fig. 5L, O, P), VII with single posterior pore asymmetrical located left or right (Fig. 5M), VIII–XI without pores, XII with 1+1 pores *al*.

Abdominal appendages I, II, III with 2, 1, 1 segments and 4, 3, 3 setae respectively. On appendages II and III, subapical seta 19–21 μm, two apical setae 11–12 μm, and 5–7 μm in length (Fig. 5I–J). Striate band on abdominal segment VIII reduced, anterior margin with sparse irregular teeth (Figs 4K, 5F, G). Comb on abdomen VIII rectangular, with 12 teeth (Fig. 4L). Female squama genitalis with short subuliform acrostyli (Fig. 4F). Male squama genitalis with 5+5 setae on dorsal side and 3+3 setae on ventral side (Fig. 4G).

Chaetal variability. Chaetal variations were observed in 4 specimens: on tergite VI, asymmetrical absence of *A4* of right side (No. FE-2011071-1); on tergite VII, asymmetrical absence of *P1* of right side (No. FE-2011052-4); on sternite VII, absence of *Ac* (No. FE-2011075-1), and asymmetrical absence of *A2* of left side (No. FE-2011052-6).

Etymology. The species is named after Lazovsky Nature Reserve where the type specimens were collected.

Distribution. Known only from type locality.

Diagnosis. *Fjellbergella lazovskiensis* sp. n. is characterized by three pairs of anterior setae on tergites II-V which is different to any other members of the genus, four pair of anterior setae, nine pairs of posterior setae on tergite VII, foretarsal sensilla *b*, *c* and *d* located in subequal level, *b* shorter than *c*, and tergite IX and X with 14, 12 setae respectively.

Remarks. The present species is located in the genus *Fjellbergella* because three setae on abdominal legs, labial palpus with two-branched terminal tuft of setae, claviform sensillum *t1* on foretarsus, reduced striate band, two pairs of anterior setae on mesonotum and metanotum, and 4/2 setae on sternite VIII. *Fjellbergella lazovskiensis* sp. n. is similar to *F. tuxeni* Nosek, 1980 from Alaska in having 8 *A*-setae on tergite VII and presence of *P1a* on tergite I–VII. They can be distinguished by the chaetotaxy of tergite IX and X (14 and 12 setae in *F. lazovskiensis* sp. n. respectively vs. 12 and 8 setae in *F. tuxeni*), length and location of foretarsal sensilla *b* and *c* (*b* shorter than *c* and they located at the same level in *F. lazovskiensis* sp. n. vs. *b* and *c* subequal in length and *c* located lower than *b* distinctly in *F. tuxeni*), shape and length of sensillum *a'* (broad and reaching base of sensillum *b'* in *F. lazovskiensis* sp. n. vs. slender and far surpassing base of sensillum *b'* in *F. tuxeni*), and shape of claw of foreleg (absence of inner flap in *F. lazovskiensis* sp. n. vs. presence in *F. tuxeni*). In addition, the new species has only 6 anterior setae on tergites II-V contrary to two other members of this genus, which have 8 anterior setae.

***Yichunentulus alpatovi* sp. n.**

http://zoobank.org/513B6344-D78B-4777-90A9-AEB3BAEAB83E

Fig 6; Table 3

Material examined. Holotype, female (No. FE-2011035-1) (SEM), Russia, Far East, Primorsky Krai, Lazovsky area, nearby Preobrazheniye, from the mixed samples of soil and humus from mountains, 42°54. 48'N, 133°53. 96'E, 21- IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov. Paratypes, 1 female (No. FE-2011035-6), 3 males (Nos. FE-2011035-4, FE-2011037-1, FE-2011045-3) (SEM; MSPU), 2 male preimagos (Nos. FE-2011038-1, FE-2011038-2) (SEM), same data as holotype.

Description. Adult body length 1200–1350 μm (n=5).

Head (Fig. 6A). Ovate, length 120–130 μm, width 70–80 μm. Setae *d6* present, *sd4* and *sd5* short sensilliform. Setae *d6* 11 μm, *d7* 10 μm and *sd7* 18 μm in length. Clypeal pore *cp* and frontal pore *fp* present. Pseudoculus round, length 7–8 μm, with short posterior extension, PR=16 (Fig. 6B). Calyx of maxillary gland smooth, without any appendix, blind end split into two leaves, posterior filament 16–17 μm, CF=7–8 (Fig. 6C). Maxillary palpus with two tapering sensilla, dorsal snsillum is evidently longer than lateral one (Fig. 6D). Labial palpus completed, with one-branched terminal tuft of setae, with three setae and one lanceolate basal sensillum (Fig. 6E).

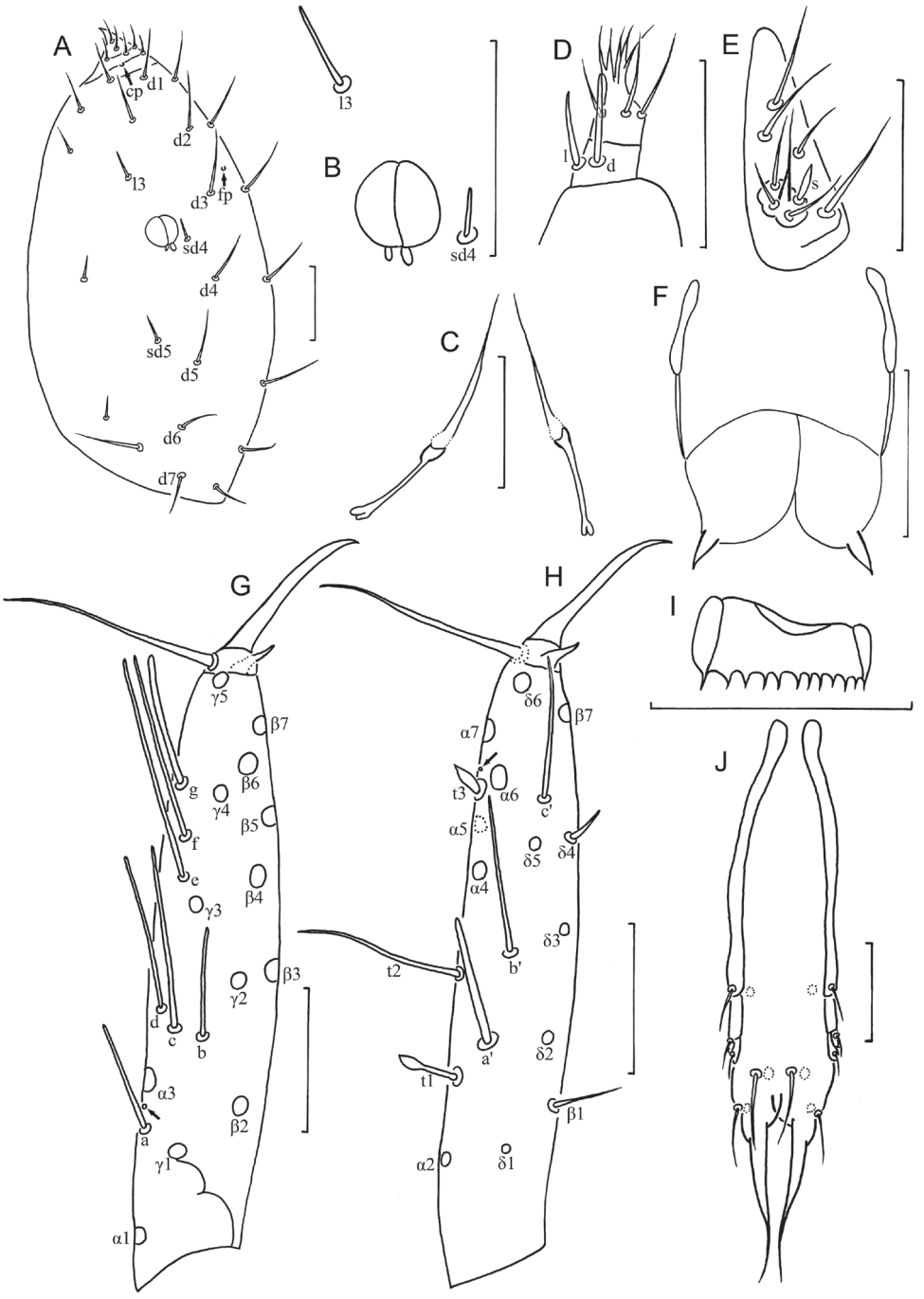

Figure 6. *Yichunentulus alpatovi* sp. n. holotype. **A** Head, dorsal view **B** pseudoculus **C** canal of maxillary gland **D** maxillary palpus **E** labial palpus **F** female squama genitalis **G** foretarsus, exterior view **H** foretarsus, interior view **I** comb **J** male squama genitalis. Arrows indicate pores. Scale bar: 20 μm.

Table 3. Adult chaetotaxy of *Yichunentulus alpatovi* sp. n.

Segment		Dorsal		Ventral	
		Formula	Setae	Formula	Setae
Th.	I	4	1, 2	(4+4)/6	A1, 2, M1, 2 P1, 2, 3
	II–III	6/16	A2, 4, M P1, 1a, 2, 2a, 3, 4, 5, 5a	(7+2)/4	Ac, 2, 3, 4, M Pc, 1, 2
Abd.	I	6/12	A1, 2, 5 P1, 1a, 2, 2a, 3, 4	3/4	Ac, 2 P1, 2
	II–III	6/16	A1, 2, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/5	Ac, 2 Pc, 1a, 2
	IV–V	6/16	A1, 2, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/8	Ac, 2 P1, 1a, 2, 3
	VI	8/16	A1, 2, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/8	Ac, 2 P1, 1a, 2, 3
	VII	8/16	A1, 2, 4, 5 P1, 1a, 2, 2a, 3, 3a, 4, 4a, 5	3/8	Ac, 2 P1, 1a, 2, 3
	VIII	6/16	A2, 4, 5 M1, 2, 3, 4, P2, 3, 4, 5	4/2	A1, 2 P1
	IX	14	1, 1a, 2, 2a, 3, 3a, 4	4	1, 2
	X	12	1, 1a, 2, 2a, 3, 4	4	1, 2
	XI	6	1, 3, 4	6	1, 2
	XII	9		6	

Foretarsus (Fig. 6G, H). Length 86–93 μm, claw length 20–23 μm, without inner flap, TR=4; empodium length 4 μm, EU=0.18. Dorsal sensilla *t-1* baculiform, *t-2* slender and long (23 μm), BS=0.5, *t-3* lanceolate. Exterior sensilla *a* surpassing base of *b* and *c*, *b* slender and short (16 μm), not reaching base of *γ3*, *c* reaching base of *f* and in subequal level to *b*, *d* located higher than *b* and *c*, *e* long and reaching base of claw (30 μm), *f* slender, *g* broad and short (18 μm). Interior sensilla *a'* broad, *b'* slender and reaching base of α6, *c'* nearly reaching base of claw. Relative length of sensilla: *t3* < *t1* < *b* < (*a* = *a'*) < *g*< (*b'* = *c'*) < *d* < *t2* < *c* < *e* < *f*. Setae *β1* setiform and *δ4* sensilliform. Pores close to sensilla *a* and *t3* present. Length of middle tarsus 40 μm, claw length 17 μm. Length of hind tarsus 45 μm, claw length 20 μm.

Thorax. Thoracic chaetotaxy given in Table 3. Setae *1* and *2* on pronotum 20 μm and 12–14 μm length respectively. Mesonotum and metanotum with eight pairs of *P*-setae, accessory setae short sensilliform, 2 μm in length; setae *P1*, *P1a* and *P2* on mesonotum 17–20 μm, 3 μm and 20–24 μm respectively. Prosternum with two pairs of anterior seta, and setae *A2* and *M2* sensilliform. Mesosternum and metasternum each with 7 *A*-setae, and setae *A2* sensilliform. Pronotum and prosternum without pores. Mesonotum with pores *sl* and *al*, metanotum with pores *sl* only. Mesosternum and metasternum each with single median pore, situated anterioral to level of setae *M*.

Abdomen. Abdominal chaetotaxy given in Table 3. Tergite I with three pairs of anterior setae (*A1*, *A2*, *A5*). Tergites II–VI with eight pairs of posterior setae. Tergites VI and VII with four pairs of anterior setae (*A1*, *A2*, *A4*, *A5*). Tergite VII with nine pairs of posterior setae, *P3a* present. All accessory setae on tergites I–VII short sensilliform, 3 μm on tergites I–V, 4 μm on tergite VI, and 5 μm on VII. Tergite VIII with paired setae *M1*. Sternite IV–VII each with eight posterior setae, *Pc* absent. Sternite VIII with two rows of setae (4/2).

Tergites I and VIII with pores *psm* only, II–V with pores *psm* and *al*, VI–VII with pores *psm*, *al* and *psl*, IX–XI without pores, XII with single medial pore. Sternites I–IV without pores, V and VI each with 1+1 posterior pores anterior to seta *P1* and 1+1 anteromembranal pores, VII with single posterior pore asymmetrical located left or right and 1+1 anteromembranal pores, VIII–XI without pores, XII with 1+1 pores *al*.

Abdominal appendages I, II, III with 2, 1, 1 segments and 4, 2, 2 setae respectively. On appendages II and III, subapical setae 16–17 μm, apical setae 13–14 μm in length. Striate band on abdominal segment VIII reduced, anterior margin regular wave shaped. Comb on abdomen VIII rectangular, with 12–13 teeth (Fig. 6I). Female squama genitalis robust, with moderate basal apodeme and pointed acrostyli (Fig. 6F). Male squama genitalis with 5+5 setae on dorsal side and 3+3 setae on ventral side (Fig. 6J).

Etymology. The species is named after Dr. V. Alpatov who accompanied us during our scientific trips.

Distribution. Known only from type locality.

Diagnosis. *Yichunentulus alpatovi* sp. n. is characterized by the presence of sensillum *b'* on foretarus and short sensilum *b* on foretarsus, 6 anterior seate on tergites IV–V, swelled sensillum *a'*, presence of pores *psl* only on tergites VI and VII, and female squama genitalis with moderate basal apodeme and pointed acrostyli.

Remarks. The present species is located in the genus *Yichunentulus* because the labial palpus with one-branched terminal tuft of setae, with three setae and one lanceolate basal sensillum, the baculiform sensillum *t1* on foretarus, reduced striate band, two pairs of anterior setae on mesonotum and metanotum, 4/2 setae on sternite VIII, and abdominal appendages II and III each with two setae of different length. *Yichunentulus alpatovi* sp. n. is close to the type species *Yichunentulus yichunensis* Yin, 1980 in having short sensillum *b* and identical body chaetotaxy. However, it can be easily distinguished from *Y. yichunensis* and *Y. borealis* (Nakamura, 2004), comb. n. by the presence of sensillum *b'* on foretarsus. It also differs from *Y. yichunensis* in the length of sensillum *e* (extremely long in *Y. alpatovi* sp. n. vs. short in *Y. yichunensis*) and sensilla *c'* (long and surpassing base of *δ6* in *Y. alpatovi* sp. n. vs. short and only reaching base of *β7* in *Y. yichunensis*). It differs from *Y. borealis* in the chaetotaxy of tergites IV–V (each with 6 *A*-setae in *Y. alpatovi* sp. n. vs. 8 in *Y. borealis*), shape of sensillum *a'* (slightly broad and as long as sensillum *a* in *Y. alpatovi* sp. n. vs. distinctly swell and shorter than sensillum *a* in *Y. borealis*), and the body porotaxy (pore *psl* present on tergites VI and VII only and sternites I–IV without pores in *Y. alpatovi* sp. n. vs. *psl* present on tergites III–VII and sternites II and IV each with 1+1 anteromembranal pores in *Y. borealis*).

New records of genera, keys and new taxonomic combinations

Genus *Acerentulus* Berlese, 1908, new to RFE

***Acerentulus* Berlese, 1908: 122.**

Type species. *Acerentomon confine* Berlese, 1908.

Diagnosis. Abdominal appendages II and III each with 3 setae, mesonotum and metanotum each with two pairs of anterior setae, foretarsal sensillum *t1* claviform, sensillum *b'* present, *t3* willow-leaf shaped, sensillum *b'* present, labial palpus with terminal tuft of setae, striate band on abdominal segment VIII well developed, and sternite VIII with 4/2 setae or with 4 setae only.

Remarks. The genus *Acerentulus* has 47 species described in the world and most from Europe (Szeptycki 2007; Shrubovych et al. 2012), and only five species (*A. kisonis* Imdadaté, 1961, *A. keikoae keikoae* Imdadaté, 1988, *A. keikoae capillatus* Imdadaté, 1988, *A. omoi* Imdadaté, 1988 and *A. sinensis* Wu & Yin, 2007) were recorded in East Asia so far. *Acerentulus kisonis* Imdadaté, 1961 is new to RFE and very rare in the samples like in Japan (Imdadaté 1988), which has single individual present in hundreds of specimens.

Genus *Fjellbergella* Nosek, 1978 neto RFE

***Fjellbergella* Nosek, 1978: 57.**

Type species. *Fjellbergella tuxeni* Nosek, 1980.

Diagnosis. Mesonotum and metanotum each with two pairs of anterior setae, labial palpus with two-branched terminal tuft of setae, sensillum *d* located near *t2* insertion, abdominal appendages II and III each with three setae, foretarsal sensillum *t1* claviform, sensillum *b'* present, striate band on abdominal segment VIII reduced and sternite VIII with 4/2 setae.

Remarks. The genus *Fjellbergella* containes only two species so far: *Fjellbergella tuxeni* Nosek, 1980 from Alaska and *F. uteorum* Shrubovych & Bernard, 2013 from Colorado (Nosek 1980; Shrubovych and Bernard 2013). Except that, one species of the similar form *Brasilidia jilinensis* Wu & Yin, 2007 was also found from Northeast China. However, the species of genus *Brasilidia* has reduced labial palpus without tuft, and all of them occurred in tropical area (South America and India). After recheck the type specimens, we confirmed that *Brasilidia jilinensis* has reduced striate band, the labial palpus with reduced tuft (two-brunched), and three setae on abdominal appendages II and III which indicate it is a member of *Fjellbergella*. Thus we transfer *B. jilinensis* to the genus *Fjellbergella* as a new combination *Fjellbergella jilinensis* (Wu & Yin, 2007), comb. n. Plus the new species described in present paper, the genus *Fjellbergella* contains 4 species. They can be distinguished by the following key.

Key to the species of the genus *Fjellbergella* Nosek, 1978

1 Tergite VII with 4 pairs of anterior setae, seta *Pc* absent **2**
– Tergite VII with 5 pairs of anterior setae, seta *Pc* present .... ***F. uteorum* Shrubovych & Bernard, 2013**; USA (Colorado)
2 Tergites I–VI without seta *P1a* .... ***F. jilinensis* (Wu & Yin, 2007), comb. n.**; China (Jilin)
– Tergites I–VI with seta *P1a* **3**
3 Tergites IX and X with 14 and 12 setae respectively, sensillum *b* shorter than *c* and they located at the same level, claw of foreleg without inner flap..... ..... ***F. lazovskiensis* sp. n.; Russia** (Far East)
– Tergites IX and X with 12 and 8 setae respectively, sensillum *b* and *c* subequal in length and *c* located lower than *b* distinctly, claw of foreleg with one inner flap ..... ***F. tuxeni* Nosek, 1980**; USA (Alaska)

***Fjellbergella jilinensis* (Wu & Yin, 2007), comb. n.**

Brasilidia jilinensis Wu & Yin, 2007: 53–61, figs 19–36. **Syn.**

Material examined. Holotype, female, Paratype, 1 female, China, Jilin Province, Dehui city, 15-IX-2006, coll. D. H. Wu.

Distribution. China (Jilin).

Genus *Yichunentulus* Yin, 1980, new to RFE

Yichunentulus Yin, 1980: 146-147, 155.

Type species. *Yichunentulus yichunensis* Yin, 1980.

Diagnosis. Mesonotum and metanotum each with two pairs of anterior setae, abdominal appendages II and III each with two setae, labial palpus with one-branched terminal tuft of setae, with 3 setae and 1 sensillum, foretarsal sensillum *t1* baculiform, sensillum *b'* absent or present, sensillum *a'* located distal to *t1*, maxillary gland simple and without appendages, sternite VIII with 4/2 setae, striate band on abdominal segment VIII reduced, and sternites II–VI each has 1+1 membranal pores.

Remarks. The genus *Yichunentulus* Yin, 1980 has only one species described from Heilongjiang, Northeast China (Yin 1980). After compare *Baculentulus borealis* Nakamura, 2004 with congeners, we find two important characters of this species: presence of one-branched terminal tuft of setae and 3 seate on labial palpus and 4/2 setae on sternite VIII are different to any other species of the genus *Baculentulus*. On the contrary, those two characters match well with genus *Yichunentulus*. Two specimens of

B. borealis newly collected from type locality are also studied. We proposed to transfer *Baculentulus borealis* to the genus *Yichunentulus* as a new combination *Yichunentulus borealis* (Nakamura, 2004), comb. n. The three species of the genus *Yichunentulus* can be distinguished by the following key.

Key to the species of the genus *Yichunentulus* Yin, 1980

1 Tergites IV and V each with 4 pairs of anterior setae ..... ***Y. borealis* (Nakamura, 2004), comb. n.**
– Tergites IV and V each with 3 pairs of anterior setae **2**
2 Foretarsal sensillum *b'* absent ..... ***Y. yichunensis* Yin, 1980**
– Foretarsal sensillum *b'* present ..... ***Y. alpatovi* sp. n.**

***Yichunentulus borealis* (Nakamura, 2004), comb. n.**

Baculentulus borealis Nakamura, 2004: 17–20, figs 1–15. **Syn.**

Material examined. 1 female, 1 male, Locality 3, 25-IV-2010, coll. E. Sokolova & M. Potapov.

Distribution. Russia (Far East, Khabarovsk Krai).

Notes. Body length 1300–1380 μm, foretarsus length 110 μm. We studied the new materials of *Y. borealis* collected from type locality and redescribe the head chaetotaxy and body porotaxy. Head with *d6* seta present, *sd4* and *sd5* sensilliform. Pronotum and prosternum without pores. Mesonotum with pores *sl* and *al*, metanotum with pores *sl* only. Mesosternum and metasternum each with single medial pore. Tergites I and VIII with pores *psm* only, II with pores *psm* and *al*, III–VII with pores *psm*, *al* and *psl*, IX–XI without pores, XII with single medial pore. Sternites I with single medial pore, II–IV without 1+1 anteromembranal pores, V and VI each with 1+1 posterior pores anterior to seta *P1* and 1+1 anteromembranal pores, VII with single posterior pore asymmetrical located left or right, VIII–XI without pores, XII with 1+1 pores *al*.

Description of known species

***Imadateiella sharovi* (Martynova, 1977)**
Figs 7, 8; Table 4

Acerella sharovi Martynova, 1977: 164–166, Figs 1, 2. **Syn.**
Imadateiella sharovi (Martynova, 1977), Imadaté 1981: 144.

Material examined. 7 females (Nos. FE-2011062-1, FE-2011062-4, FE-2011062-5, FE-2011085-1, FE-2011085-2, FE-2011087-1, FE-2011089-1) (SEM; MSPU), 5 males (Nos. FE-2011062-2, FE-2011062-3, FE-2011086-1, FE-2011086-2, FE-2011087-2) (SEM; MSPU), 1 male preimago (No. FE-2011090-2), Russia, Far East, Khabarovsk Krai, Vaninsky area, nearby Vysokogorny, Valley of Mulinka, from *Picea* and *Abies* forest on Northeast slope, sample No. 27, 750 m alt., 30-IX-2011, 1 male preimago (No. FE-2011059-2), 1 maturus junior (No. FE-2011059-1), Russia, Far East, Khabarovsk Krai, Vaninsky area, nearby Datta, from coastal larch-wood on East slope (green moss), sample No. 24, 28-IX-2011. 1 female (No. FE-2011060-1), Russia, Far East, Khabarovsk Krai, Vaninsky area, nearby Vysokogorny, Valley of Mulinka, from spruce forest at pass, sample No. 26, 900 m alt., 29-IX-2011. 2 females (FE-2011067-2, FE-2011088-1), 1male (No. FE-2011088-2), Russia, Far East, Khabarovsk Krai, Vaninsky area, nearby Vysokogorny, Valley of Mulinka, from mixed sample of spruce-forest and rotten wood, sample No. 30, 600 m alt., 29-ix-2011. 1 female (No. FE-2011069-1), Russia, Far East, Khabarovsk Krai, Vaninsky area, nearly Vysokogorny (5 km South), Valley of Dopolnitel'ny Stream, from mixed sample of litter under old poplar-trees in floodplain, sample No. 32, 400 m alt., 30-IX-2011. All specimens are collected by M. Potapov & V. Alpatov.

Description of new materials. Adult body length 1000–1200 μm (n=16), yellow in color (Fig. 8A).

Head (Fig. 7A). Ovate, length 130–135 μm, width 80–85 μm. Setae *d6* present, *sd4* and *sd5* short. Setae *d6* 14–15 μm, *d7* 16–17 μm and *sd7* 18–19 μm in length. Clypeal pore *cp* and frontal pore *fp* present. Pseudoculus round, length 7–8 μm, with short posterior extension, PR=16–17 (Fig. 7B). Maxillary gland large, calyx with lateral racemose appendices and one helmet-like dorsal appendix, and bilobed posterior dilation, posterior filament length 20–22 μm, CF=6–7 (Fig. 7C). Labial palpus reduced, with one-branched terminal tuft of setae, three setae and one leaf-shaped basal sensillum (Figs 7D, 8B), but well developed in five specimens (Figs 7E, 8C). Maxillary palpus with two tapering sensilla, subequal in length (Fig. 7F).

Foretarsus (Fig. 7H, I). Length 85–92 μm, claw length 23–29 μm, with one inner flap, TR=3.5–3.7; empodium length 4 μm, EU=0.15–0.18. Dorsal sensilla *t-1* filiform, *t-2* slender and long (17 μm), BS=0.33, *t-3* lanceolate and short. All exterior sensilla slender, *a* far surpassing base of *b* and *c*, *b* slightly longer than *c*, *c* short and lower than *b*, *d* and *e* short, *f* long, *g* broad and short. Interior sensilla *a'* broad and long, surpassing base of *δ5*, *b'* absent, *c'* slender and surpassing base of claw. Relative length of sensilla: $t3 < g < t1 < (c = d = e) < b < a' < a < t2 < c' < f$. Setae *β1* and *δ4* sensilliform, 12–13 μm in length. Pores close to sensilla *c* and *t3* present. Length of middle tarsus 40 μm, claw length 15–20 μm. Length of hind tarsus 45 μm, claw length 18–20 μm.

Thorax. Thoracic chaetotaxy given in Table 4. Setae *1* and *2* on pronotum 26–35 μm and 16–17 μm length respectively, mesonotum and metanotum with eight pairs of *P*-setae, accessory setae sensilliform; setae *P1*, *P1a* and *P2* on mesonotum 30 μm, 10 μm and 43 μm respectively (Fig. 7J). Prosternum with two pairs of anterior seta, and setae *A2* and *M2* sensilliform (Fig. 8E). Mesosternum with 5 *A*-setae, and metasternum each with 7 *A*-setae, and setae *A2* sensilliform (Fig. 8F, G). Pronotum and prosternum

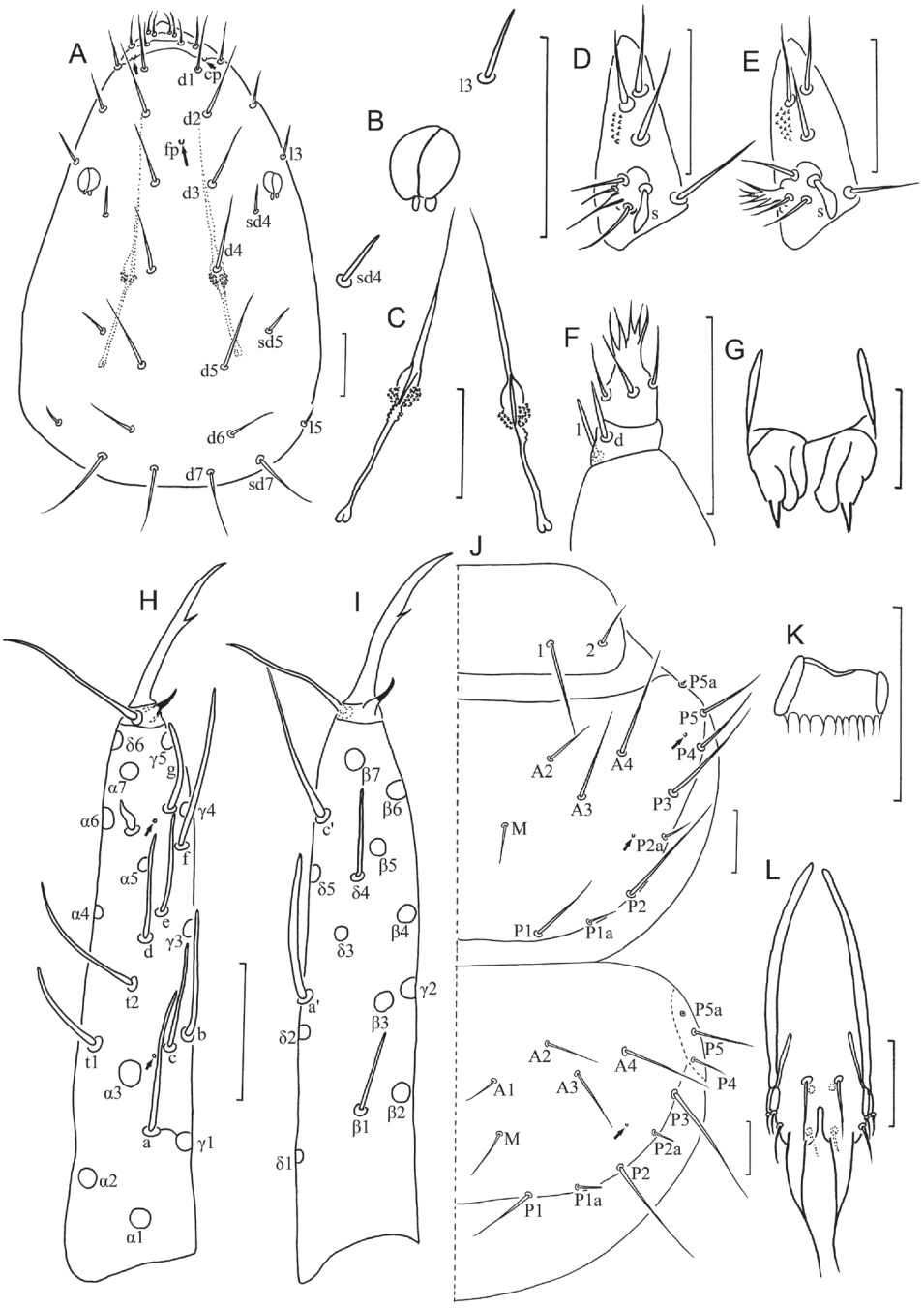

Figure 7. *Imadateiella sharovi* (Martynova, 1977) **A** Head, dorsal view **B** pseudoculus **C** canal of maxillary gland **D** labial palpus (specimens from samples 24 and 27) **E** labial palpus (specimens from samples 26, 30 and 32) **F** maxillary palpus **G** female squama genitalis **H** foretarsus, exterior view **I** foretarsus, interior view **J** nota, right side **K** comb **L** male squama genitalis. **A–D** and **F–L** specimen No. FE-2011062-4; **E** specimen No. FE-2011060-1. Arrows indicate pores. Scale bar: 20 μm.

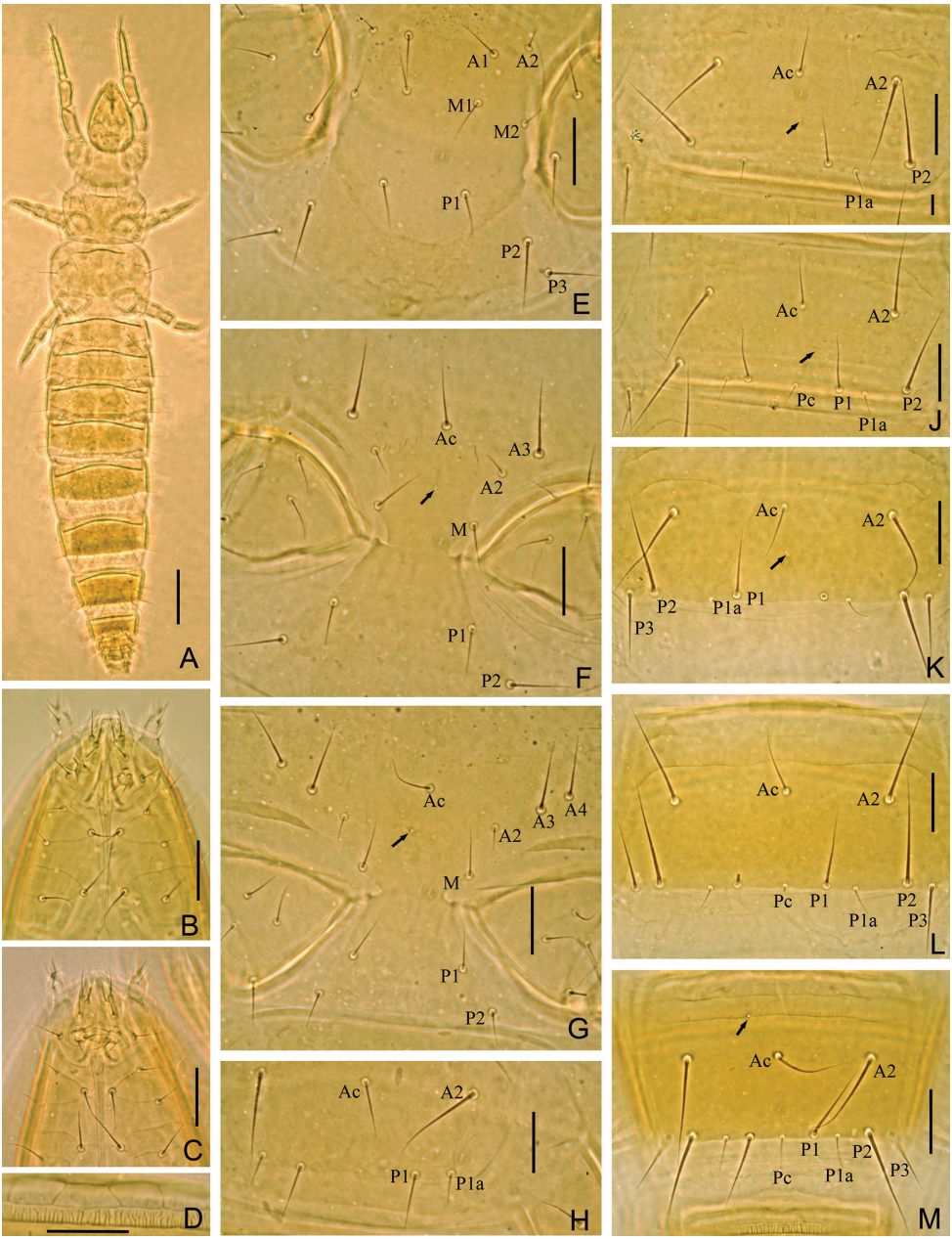

Figure 8. *Imadateiella sharovi* (Martynova, 1977) **A** Habitus **B** ventral side of head, shows reduced labial palpus **C** ventral side of head, shows well developed labial palpus **D** part of striate band **E** prosternum **F** mesosternum **G** metasternum **H–M** sternites I–III, IV, VI and VII. **A–B** and **D–M** specimen No. FE-2011062-4; **C** specimen No. FE-2011060-1. Arrows indicate pores. Scale bar: 100 μm in (**A**), others, 20 μm.

without pores (Figs 7J, 8E). Mesonotum with pores *sl* and *al*, metanotum with pores *sl* only (Fig. 7J). Mesosternum and metasternum each with single medial pore (Fig. 8F, G). Single membranal pore present on membrane between each coxa and the body.

Table 4. Adult chaetotaxy of *Imadateiella sharovi* (Martynova, 1977).

Segment		Dorsal		Ventral	
		Formula	Setae	Formula	Setae
Th.	I	4	1, 2	(4+4)/6	A1, 2, M1, 2 P1, 2, 3
	II	8/16	A2, 3, 4, M P1, 1a, 2, 2a, 3, 3a, 4, 5	(5+2)/4	Ac, 2, 3, M P1, 2
	III	10/16	A1, 2, 3, 4, M P1, 1a, 2, 2a, 3, 3a, 4, 5	(7+2)/4	Ac, 1, 2, 3, M P1, 2
Abd.	I	6/12	A1, 2, 5 P1, 1a, 2, 2a, 3, 4	3/4	Ac, 2 P1, 1a
	II	10/16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/5	Ac, 2 Pc, 1a, 2
	III	10/16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/6	Ac, 2 P1, 1a, 2
	IV–V	10/16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/8	Ac, 2 P1, 1a, 2, 3
	VI	10/16	A1, 2, 3, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/9	Ac, 2 Pc, 1, 1a, 2, 3
	VII	8/16	A2, 3, 4, 5 P1, 1a, 2, 2a, 3, 4, 4a, 5	3/9	Ac, 2 Pc, 1, 1a, 2, 3
	VIII	6/15	A1, 3, 5 Mc, 2, 3, 4, P2, 3, 4, 5	4/2	1, 2 1a
	IX	12	1, 1a, 2, 2a, 3, 4	4	1, 2
	X	10	1, 2, 2a, 3, 4	4	1, 2
	XI	6	1, 3, 4	6	1, 2, 3
	XII	9		6	

Abdomen. Abdominal chaetotaxy given in Table 4. Tergite I with three pairs of anterior setae (*A1*, *A2*, A5) and six pairs of posterior setae. Tergites II–VII with eight pairs of posterior setae, *P3a* present. Tergite VII with four pairs of anterior setae (*A2*, *A3*, *A4*, *A5*). Tergite VII with nine pairs of posterior setae. All accessory setae on tergites I–VII sensilliform, 14–15 μm on tergites I–VI and 17 μm on VII. Tergite VIII with setae *Mc*). Sternite IV–V each with three anterior setae and eight posterior setae (Fig. 8K), VI–VII each with three anterior setae and nine posterior setae, *Pc* present (Fig. 8L, M). Sternite VIII with 4/2 setae. Hind margin of tergite IX smooth. Hind margin of tergites X–XI with very short fine ciliation. Hind margin of sternites IX–XI smooth. Posterior margin of tergite XII smooth, sternite with delicate serration in central part.

Tergites I and VIII with pores *psm* only, II–VII with pores *psm* and *al*, IX–XI without pores, XII with single medial pore. Sternites I and VI without pores (Fig. 8H, L), II–V each with single medial pore (Fig. 8I, J), VII with single anterior pore asymmetrical located left or right on the line (Fig. 8M), VIII–XI without pores, XII with 1+1 pores *al*.

Abdominal appendages I, II, III with 2, 1, 1 segments and 4, 2, 2 setae respectively. On appendages II and III, subapical seta 16–18 μm, apical seta 12–15 μm

in length. Striate band on abdominal segment VIII well developed, anterior margin regular wave shaped (Fig. 8D). Comb on abdomen VIII rectangular, with 10–12 teeth (Fig. 7K). Female squama genitalis with short basal apodeme and pointed acrostyli (Fig. 7G). Male squama genitalis with 4+4 setae on dorsal side and 2+2 setae on ventral side (Fig. 7L).

Chaetal variability. Chaetal variations were observed in 7 specimens : on tergite II, absence of *P4a* (No. FE-2011067-2); on tergite IV, asymmetrical absence of *A1* of right side (No. FE-2011060-1); on sternite II, absence of *Pc* and present of P1 on right side (No. FE-2011060-1, Fig. 70); on sternite III, present of *Pc* (No. FE-2011060-1, Fig. 71); on sternite VI, absence of *Pc* (Nos. FE-2011067-2, FE-2011088-2, FE-2011089-1); on sternite VIII, asymmetrical absence of *P1* of left side (Nos. FE-2011062-3, FE-2011062-5, FE-2011069-1), or both side (No. FE-2011060-1).

Distribution. Russia (Far East, Magadan Oblast; Khabarovsk Krai).

Diagnosis. *Imadateiella sharovi* (Martynova, 1977) is characterized by the presence of setae *Pc* on sternite VI and 4/2 setae on sternite VIII.

Remarks. *Imadateiella sharovi* (Martynova, 1977) is the first species of Protura described in RFE. We give the redescription of *Imadateiella sharovi* basing on our vast material since it shows minor differences from the redescription of Shrubovych (2014) (labial palpus , length of sensilla *b*, *e* and *t2* on fortarsus and pores on sternite I). The male squama genitalis is also described for the first time. The variation on labial palpus is also uncommon – 15 specimens from samples 27 and 24 have labial palpus with reduced terminal tuft of setae (Figs 7D, 8B) while other 5 specimens from samples 26, 30 and 32 have it well developed (Figs 7E, 8C). According to the redescription of Shrubovych (2014), the type specimens have well developed labial palpus. We treat all our populations as belonging to one variable species.

List of species of Russian Far East

Family Berberentulidae Yin, 1983

Baculentulus krabbensis sp. n.

The description is given above.

Baculentulus loxoglenus Yin, 1980

Material examined. 3 females, locality 4, 10-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Northeast China; Russia (Far East: Khabarovsk Krai; Primorsky Krai). For Russia, it was already recorded from Khabarovsk Krai by Nakamura (2004) and we found it from Primorsky Krai.

***Baculentulus morikawai* (Imadaté & Yosii, 1956)**

Material examined. 2 females, 2 males, locality 3, 25-IV-2010, E. Sokolova & M. Potapov collected; 2 females, 5 males, locality 5, 16-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov; 36 females, 39 males, 5 male preimagos, locality 7, 22-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Widely distributed in eastern areas of Asia: China (Anhui, Taiwan, Xianggang, Yunnan, Zhejiang); Japan; Korea; Russia (Far East: Khabarovsk Krai: Khekhtsyr Range; Primorsky Krai: Shkotovsky area). New for Russia.

***Baculentulus samchonri* Imdadaté & Szeptycki, 1976**

Material examined. 1 female, 1 male, locality 5, 16-IX-2011, 12 females, 7 males, locality 7, 22-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Korea; Russia (Far East: Primorsky Krai). New for Russia.

***Baculentulus potapovi* Shrubovych, 2010**

Material examined. 3 females, 4 males, 2 maturi juniors, 1 prelarva, locality 4, 10-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Russia (Far East: Primorsky Krai). It was described from Partizansky, Shkotovsky and Khasansky areas by Shrubovych (2010) and we found it from the same areas.

Family Acerentomidae Silvestri, 1907

***Acerentulus kisonis* Imdadaté, 1961**

Material examined. 1 female, locality 7, 21-IX-2011. coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Japan; Russia (Far East: Primorsky Krai). New for Russia.

Notes. Body large and robust, 1700 μm in length. Foretarsus length 115 μm, setae *β1* and *δ4* sensilliform, 5 μm in length. Setae *d6* present on head, 16 μm. Clypeal pore *cp* and frontal pore *fp* present. Pronotum and prosternum without pores, mesonotum with pores *sl* and *al*, metanotum with pores *sl*. Mesosternum and metasternum each with 1 medial pore. Tergites I and VIII with pores *psm* only, II–V with pores *psm* and *al*, VI–VII with pores *psm*, *al*, and *psl*. X–XI without pores, XII with single medial pore. Pores on sternites I–IV and VII not observed. Sternite V with 1 posterior pore. Sternite VI with 4 posterior pores composed by two groups, each group contains two close adjacent pores. VIII–XI without pores, XII with 1+1 pores *al*.

***Filientomon gentaroanum* Nakamura, 2001**

Material examined. 1 female, 2 maturi juniors, locality 5, 16-IX-2011. coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Japan; Russia (Far East: Primorsky Krai). New for Russia.

***Filientomon takanawanum* (Imdadaté, 1956)**

Material examined. 1 female, 2 maturi juniors, locality 4, 9-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov; 5 females, 2 males, 3 maturi juniors, 2 Larvae II, locality 2, 30-ix-2011, coll. M. Potapov & V. Alpatov.

Distribution. Widely distributed in Asia: China (Anhui, Hebei, Jilin, Shanxi, Zhejiang); Japan; Korea; Russia (Far East: Primorsky Krai; Khabarovsk Krai). New for Russia.

***Fjellbergella lazovskiensis* sp. n.**

The description is given above.

***Tuxenentulus ohbai* Imdadaté, 1974**

Material examined. 1 female, 1 male, locality 2, sample No. 29, 30-IX-2011, coll. M. Potapov & V. Alpatov.

Distribution. Northeast China; Japan; Russia (Far East: Khabarovsk Krai). New for Russia.

***Yamatentomon yamato* Imadaté & Yosii, 1956**

Material examined. 4 females, 2 males, 2 maturi juniors, 1 Larva LII, locality 3, 20-IX-2009. coll. O. Smirnova; 2 females, 1 larva I, 1 larva II, locality 3, 24-IV-2010, coll. E. Sokolova & M. Potapov; 2 females, 3 males, 2 larvae II, locality 4, 10-IX-2011; 3 females, 1 males, 1 maturus junior, locality 5, 16-IX-2011; 5 females, 4 males, 3 maturi juniors, 3 larvae II, 1 males preimago, locality 7, 22-IX-2011. coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Northeast China; Japan; Korea; Russia (Far East: Primorsky Krai; Khabarovsk Krai). It was reported from Shkotovsky and Khasansky areas by Shrubovych (2014) and we found it from the same areas.

***Yichunentulus alpatovi* sp. n.**

The description is given above.

***Yichunentulus borealis* (Nakamura, 2004), comb. n.**

The description is given above.

Family Nipponentomidae Yin, 1996

***Callientomon chinensis* Yin, 1980**

Material examined. 5 females, locality 7, 22-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Northeast China; Russia (Far East: Primorsky Krai, Lazovsky area). It was reported from Shkotovsky and Khasansky areas by Shrubovych (2014) and we also found it from Lazovsky area.

***Verrucoentomon louisanne* Shrubovych, 2012**

Material examined. 4 females, locality 4, 10-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Russia (Far East, Primorsky Krai). It was recorded from Ussuriysky, Khasansky and Shkotovsky areas by Shrubovych and Bernard (2012) and we found it from Shkotovsky area again.

***Verrucoentomon shirampa* Imadaté, 1964**

Material examined. 10 females, 9 males, locality 3, 20-IX-2009. coll. O. Smirnova; 2 females, 1 male, locality 3, 24-IV-2010, E. Sokolova & M. Potapov collected; 1 female, locality 4, 10-IX-2011, Y. Bu, C. W. Huang, M. Potapov & V. Alpatov collected.

Distribution. Japan; Korea; Russia (Far East: Khabarovsk Krai; Prmorsky Krai). It was already recorded from Ussuriysky and Shkotovsky areas by Shrubovych and Bernard (2012) and we found it also occurred in Khabarovsk Krai.

***Imadateiella sharovi* (Martynova, 1977)**

The description of the new material from Russian Far East is given above.

Nipponentomon cf. *bidentatum* Nakamura, 2004

Material examined. 2 males, locality 3, 20-IX-2009, coll. O. Smirnova; 3 females, 2 males, locality 2, 30-IX-2011, coll. M. Potapov & V. Alpatov.

Distribution. Russia (Far East, Khabarovsk Krai). New for Russia.

Notes. The present species is nearly identical to *N. bidentatum* Nakamura, 2004 found from Korfovsky area of Khabarovsk Krai, they have the same shape of sensilla on foretarsus and the body chaetotaxy (seta *P3a* absent on tergites II–VII and *A3* present on tergite I), our form only differs in the presence of seta *d6* on head and 1 inner flap on the claw. Final decision on the status of our population calls for the additional study.

Nipponentomon cf. *heterothrixi* Yin & Xie, 1993

Material examined. 2 males, locality 5, 16-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Russia (Far East, Primorsky Krai). New for Russia.

Notes. The present species has nearly the same body chaetotaxy (with *P2a'* on mesonotum and metanotum) and the shape of sensilla on foretarsus as in *N. heterothrixi* described from Northeast China, but differs by presence of setae *P3a* on tergites II–V which are absent in *N. heterothrixi*. Insufficient material does not allow describing a new species.

Nipponentomon khabarovskense Nakamura, 2004

Material examined. 2 females, 2 males, locality 7, 21-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov. 1 female, 1 male, locality 2, 30-IX-2011, coll. M. Potapov & V. Alpatov.

Distribution. Russia (Far East, Khabarovsk Krai; Primorsky Krai). New for Russia.

Notes. The present species was described from Korfovsky area of Khabarovsk Krai by Nakamura (2004) and we found it also occurred in Primorsky Krai.

Nipponentomon jaceki Shrubovych, 2009

Material examined. 3 females, locality 4, 10-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Russia (Far East, Primorsky Krai). It was recorded from Shkotovsky area by Shrubovych (2009) and we found it from the same area again.

Nipponentomon nippon (Yoshii, 1938)

Material examined. 1 female, locality 5, 16-IX-2011; 2 females, locality 7, 21-IX-2011. coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Russia (Far East, Primorsky Krai). It was already recorded from Partizansky and Khasansky areas by Shrubovych (2009). We found it also occurred in Lazovsky area.

Family Eosentomidae Berlese, 1909

Eosentomon asahi Imadaté, 1961

Material examined. 1 male, locality 3, 2-X-2009, coll. O. Smirnova; 5 females, 1 male, 1 larva I, and 1 larva II, locality 4, 10-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Russia (Far East: Khabarovsk Krai; Primorsky Krai). It is already recorded from Khabarovsk Krai by Nakamura (2004), and we also found it in Primorsky Krai.

Eosentomon brevicorpusculum Yin, 1965

Material examined. 1 female, locality 4, 10-IX-2011; 1 female, 1 male, 1 larva I, locality 7, 21-IX-2011, 1 female, 1 male, locality 7, 22-IX-2011; coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Widely distributed in China. Russia (Far East, Primorsky Krai). New for Russia.

Eosentomon orientale Yin, 1965, new to RFE

Material examined. 4 females, 1 male, locality 7, 22-IX-2011, coll. Y. Bu, C. W. Huang, M. Potapov & V. Alpatov.

Distribution. Widely distributed in China; Russia (Far East, Primorsky Krai). New for Russia.

Discussion

The 31 species of Protura recorded from RFE so far are listed in Table 5. They belong to 12 genera and 4 families Berberentulidae, Acerentomidae, Nipponentomidae and Eosentomidae, half the species are known only from the RFE. The most species are representatives of Acerentomidae and Nipponentomidae, each with 11 species (70%). The family Eosentomidae is rare and consists of only 3 species. Palearctic genera *Yamatentomon*, *Imadateiella*, *Yichunentulus*, *Callientomon* and Holarctic genera *Filientomon*, *Fjellbergella*, *Nipponentomon*, *Tuxenentulus*, *Verrucoentomon* are the dominant taxa composing 66% of all species.

Compared with neighbouring regions, the Protura fauna of RFE is closely related to the fauna of Northeast China, Korea, and Japan, sharing 11, 7, and 11 species with each respectively (Bu et al. 2013, Imadaté 1974, Lee and Rim 1988, Szeptycki 2007, Yin 1999) (Table 5).

Based on the distributional data available so far, the species of Protura recorded in RFE can be classified into three groups:

1) Species widespread in the Eastern Asia including both its temperate and tropical parts (Fig. 9): *B. morikawai* (Imdadaté & Yosii, 1956), *F. takanawanum* (Imdadaté, 1956), *E. brevicorpusculum* Yin, 1965 and *E. orientale* Yin, 1965.
2) Temperate East Palearctic species: *B. loxoglenus* Yin, 1980, *B. samchonri* Imdadaté & Szeptycki, 1976, *A. kisonis* Imdadaté, 1961, *F. gentaroanum* Nakamura, 2001, *T. ohbai* Imdadaté, 1974, *Y. yamato* Imadaté & Yosii, 1956, *Y. kunnepchupi* Imadaté, 1964, *C. chinensis* Yin, 1980, *N. bidentatum* Nakamura, 2004, *N. nippon* (Yoshii, 1938), *V. kawakatsui* Imadaté, 1964, *V. shirampa* Imadaté, 1964, and *E. asahi* Imadaté, 1961. The species are recorded in RFE, Northeast China, Korea and temperate part of Japan (Fig. 10).
3) Local species: *B. krabbensis* sp. n., *B. pomorskii* Shrubovych, 2010, *B. potapovi* Shrubovych, 2010, *F. duodecimsetosum* Nakamura, 2004, *F. lazovskiensis* sp. n., *T. solncevae* Shrubovych & Bernard, 2013, *Y. alpatovi* sp. n., *Y. borealis* (Nakamura, 2004), comb. n., *I. sharovi* (Martynova, 1977), *N.* cf. *bidentatum* Nakamura, 2004, *N.* cf. *heterothrixi* Yin & Xie, 1993, *N. khabarovskense* Nakamura, 2004, *N. jaceki* Shrubovych, 2009, *V. louisanne* Shrubovych & Bernard 2012 and *Eosentomon* sp. Nakamura, 2004. So far they have been recorded only in the south of RFE apart from *I. sharovi* distributed wider penetrating to the northern part of RFE (Fig. 11).

The biogeographical composition of Russian Far East, including Primorsky Krai and Khabarovsk Krai, has been described for many arthropods (Belyaev 2011, Kupyanskaya 2011, Loktionov 2011, Mutin 2011, Nemkov 2011, Proshchalykin 2011, Ryabinin 2009, Storozhenko 2011, Teslenko 2007, Wang et al. 2009). Strict detailed comparison of different taxa is not possible since the authors usually used different although similar chorological nomenclatures. Generalizing the published data mentioned above, the Primorsky Krai, the region in which the Protura was mostly studied by us, shows a high portion of species

Table 5. List of Protura from RFE and their distributions.

Classification	Species	RFE	China	Korea	Japan
Acerentomata Yin, 1996					
Berberentulidae Yin, 1983					
Baculentulus Tuxen,1977	*B. krabbensis* sp. n.*	5**			
	B. loxoglenus Yin, 1980	3, 4	+		
	B. morikawai (Imdadaté & Yosii, 1956)	3, 5, 7	+	+	+
	B. pomorskii Shrubovych, 2010*	4, 5, 6			
	B. potapovi Shrubovych, 2010*	4, 5, 6			
	B. samchonri Imdadaté & Szeptycki, 1976	5, 7		+	
Acerentomidae Silvestri, 1907					
Acerentulus Berlese, 1908	*A. kisonis* Imdadaté, 1961	7			+
Filientomon Rusek, 1974	*F. duodecimsetosum* Nakamura, 2004*	3			
	F. gentaroanum Nakamura, 2001	5			+
	F. takanawanum (Imdadaté, 1956)	2, 4	+	+	+
Fjellbergella Nosek, 1978	*F. lazovskiensis* sp. n.*	7			
Tuxenentulus Imdadaté, 1974	*T. ohbai* Imdadaté, 1974	2	+		+
	T. solncevae Shrubovych & Bernard, 2013*	8			
Yamatentomon Imdadaté, 1964	*Y. kunnepchupi* Imadaté, 1964	3			+
	Y. yamato Imadaté & Yosii, 1956	3, 4, 5, 7	+	+	+
Yichunentulus Yin, 1980	*Y. alpatovi* sp. n.*	7			
	Y. borealis (Nakamura, 2004), comb. n.*	3			
Nipponentomidae Yin, 1996					
Callientomon Yin, 1980	*C. chinensis* Yin, 1980	4, 5, 7	+		
Imadateiella Rusek, 1974	*I. sharovi* (Martynova, 1977)*	1, 2			
Nipponentomon Imdadaté & Yosii, 1959	*N. bidentatum* Nakamura, 2004	3	+		
	N. cf. *bidentatum* Nakamura, 2004*	2, 3			
	N. cf. *heterothrixi* Yin & Xie, 1993*	5			
	N. khabarovskense Nakamura, 2004*	2, 3, 7			
	N. jaceki Shrubovych, 2009*	4			
	N. nippon (Yoshii, 1938)	5, 6,7	+	+	+
Verrucoentomon Rusek, 1974	*V. kawakatsui* Imadaté, 1964	3			+
	V. louisanne Shrubovych, 2012*	4			
	V. shirampa Imadaté, 1964	3, 4		+	+
Eosentomata Yin, 1996					
Eosentomidae Berlese, 1909					
Eosentomon Berlese, 1909	*E. asahi* Imadaté, 1961	3, 4	+	+	+
	E. brevicorpusculum Yin, 1965	3, 7	+		
	E. orientale Yin, 1965	7	+		

* Known only from RFE so far. ** Numbers indicate the localities given in the materials and methods.

distributed only in eastern parts of Asia. These species are usually called as "far-eastern" (several subgroups can be involved to this group), manchurian etc. In fact, all species of Protura recorded in RFE belong to this "far-eastern" group in wide understanding although an

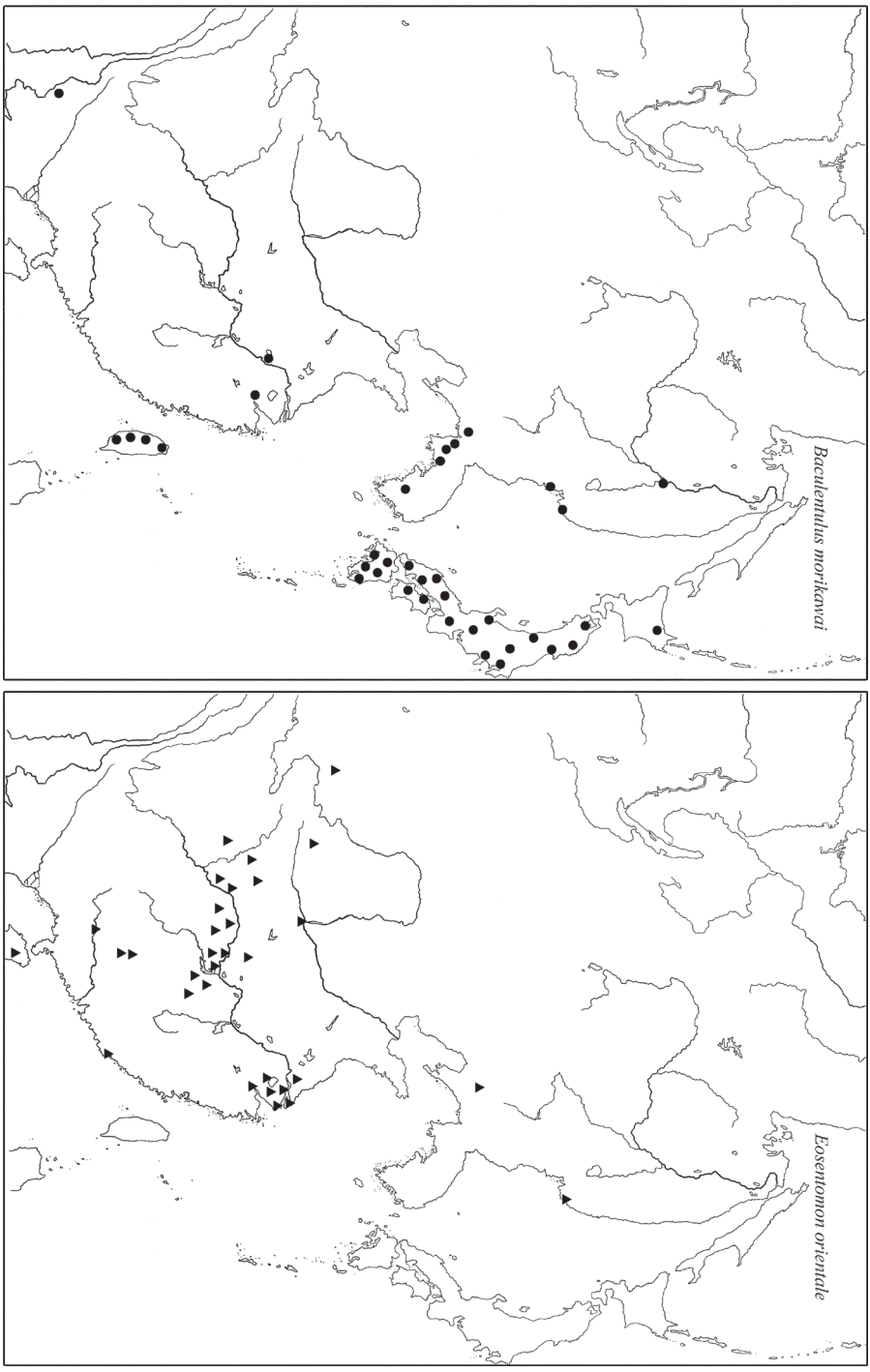

Figure 9. Distribution of two widely distributed East-Asiatic species of RFE. In addition to locations listed in the text, other records are used after Imadaté (1974), Lee and Rim (1988), Szeptycki (2007) and Yin (1999).

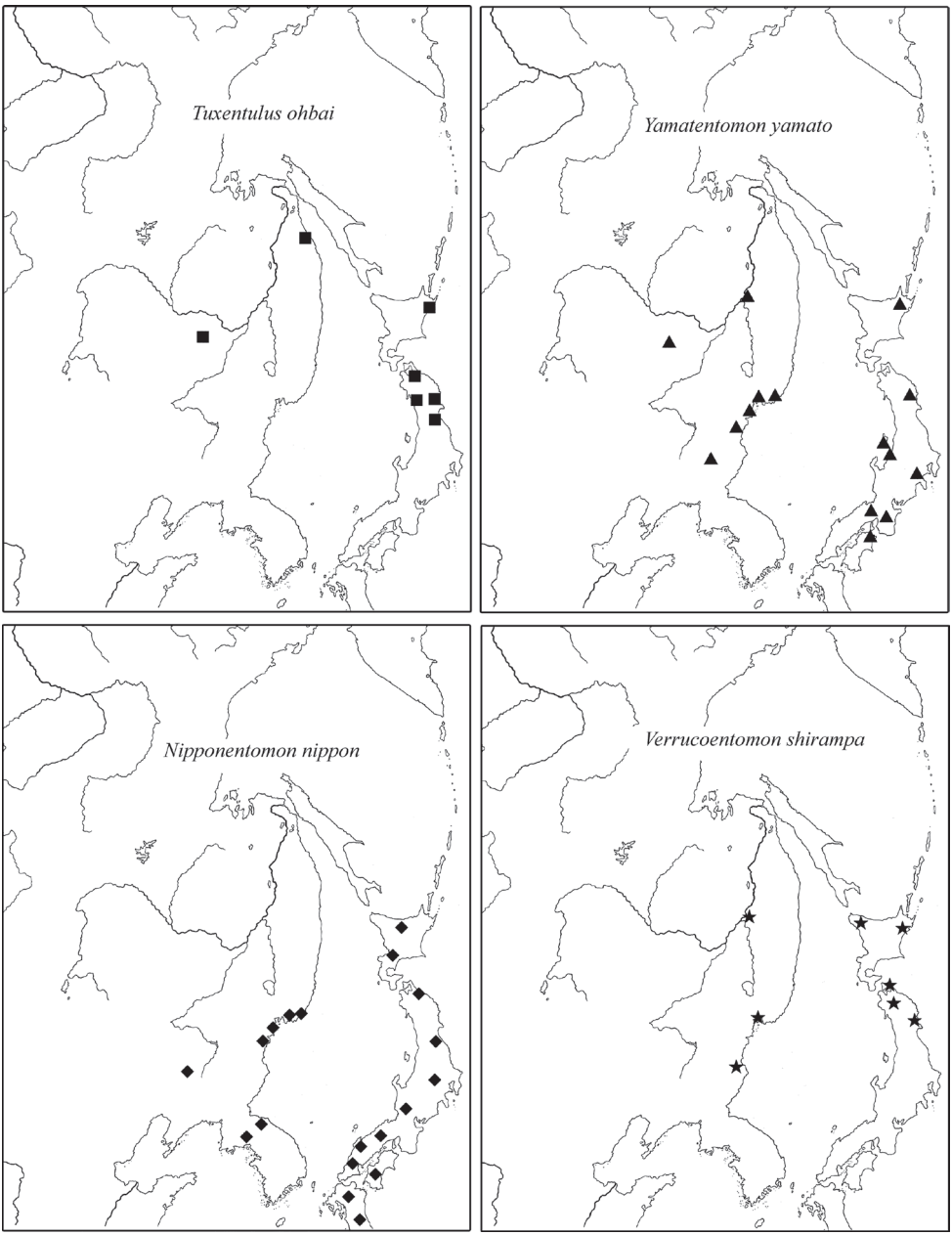

Figure 10. Distribution of typical East-Palearctic species of RFE. In addition to locations listed in the text, other records are used after Imadaté (1974), Lee and Rim (1988), Szeptycki (2007) and Yin (1999).

exact biogeographical state of them can not be understood for now, especially in group of "local" species (see above). At a species level, the unexpected thing is that neither Holarctic nor Palearctic species of Protura is found by us. In invertebrates the Holarctic and trans-Palearctic groups of species take the considerable portion, from 10 to 55% (Table 6).

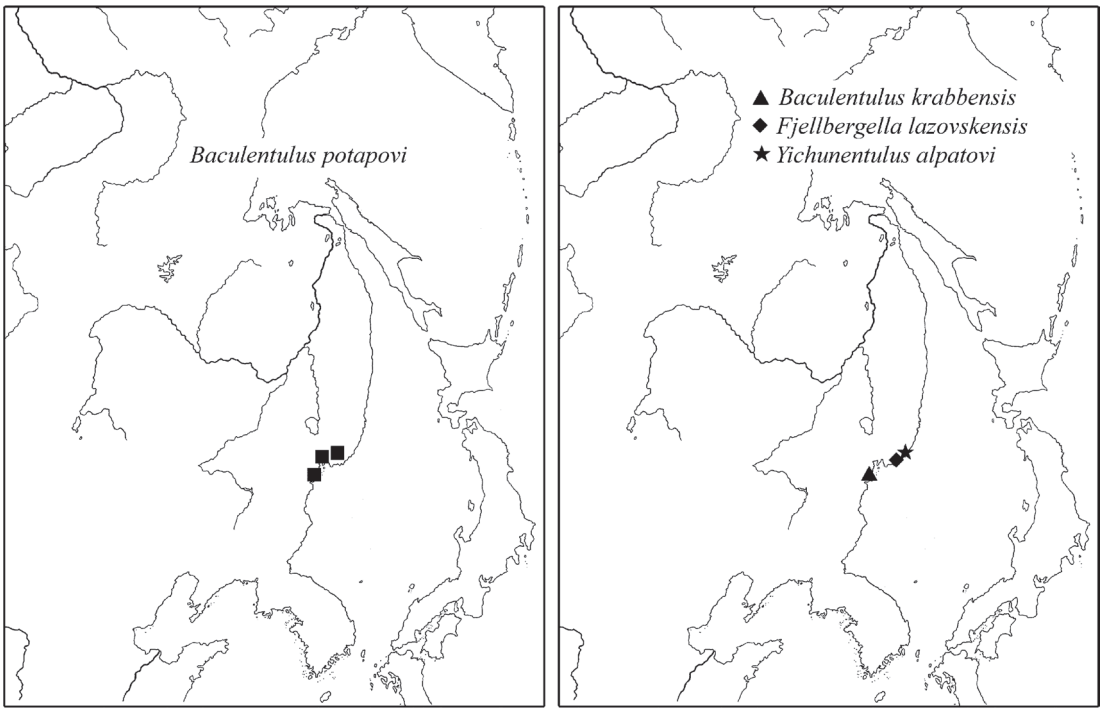

Figure 11. Distribution of some local species of RFE.

Only three widely distributed species of Protura are known so far: *Acerentulus confinis* (Berlese, 1908), *Berberentulus capensis* (Womersley, 1931), and *Gracilentulus gracilis* (Berlese, 1908). These species are cosmopolitans in the broad sense, but their distribution is not fully understood (Szeptycki 2007). Two of them (*A. confinis* and *G. gracilis*) are recorded from many European countries and, more rarely, from few other regions (Africa, North America, Australia, and New Zealand). *Berberentulus capensis* is scarcely recorded in warmer regions of the whole world. The reliable records of these species are unknown in Eastern Asia and, particularly, in RFE, but their presence is possible.

Several reasons can be proposed to explain the absence of the Holarctic and Palearctic species of Protura:

- High sensitivity of Protura to anthropogenic impact (Andrés 1999, Hågvar and Abrahamsen 1990, Niijima 1976, Parisi et al. 2005, Rusek 2007). The species preferring the disturbed sites are unknown in this group of animals. As a rule, in disturbed sites the portion of wider distributed and generalist species is greater while the endemic species decline, thus we can expect higher portion of endemic species in fauna of Protura. Strong negative effect of human practices on endemic species was shown, for instance, for the Collembola, the group of arthropods closely related to Protura (Cassagne et al. 2006, Deharveng 1996).

Table 6. The portion of Holarctic and trans-Palearctic species in fauna of arthropods of Primorsky Krai.

Taxa	Holarctic and trans-Palearctic species	References
Geometridae (Insecta: Lepidoptera)	~28%	Belyaev 2011
Formicidae (Insecta: Hymenoptera)	~14%	Kupyanskaya 2011
Pompilidae (Insecta: Hymenoptera)	~30%	Loktionov 2011
Syrphidae (Insecta: Diptera)	~37%	Mutin 2011
Spheciformes (Insecta: Hymenoptera)	~45%	Nemkov 2011
Apiformes (Insecta: Hymenoptera)	~43%	Proshchalykin 2011
Orthoptera (Insecta)	~14%	Storozhenko 2011
Plecoptera (Insecta)	~10%	Teslenko 2007
Oribatei (Arachnida)	~55%	Ryabinin 2009
Protura (Hexapoda)	0%	this study

- In the Northern hemisphere, this group sharply declines at higher latitudes. In many groups of animals the portion of endemic species increases southwards in Eurasia (Chernov 1975) therefore we can assume higher endemism in Protura. The sharp decline from south to north along global transect of RFE is, however, shown for the most taxa of animals – for example, according to generalized analysis of Chernov et al. (2011) number of species of all insects in Chukotka (the most northern region) is about 20 times less than in Primorsky Krai (the most southern region).

- Low dispersal ability of Protura. This reason is possible but could not be substantiated since widely distributed species are known in other groups with low active movement but with high possibility of passive carriage (Coulson et al. 2002, Thibaud 2007). The passive carriage is unknown in Protura but only supposed by Yin et al. (1994).

In conclusion, the Protura appear to be a group with a low level of biogeographical "noise" (ruderal species), with high endemism and are candidate organisms for more detailed biogeographical analysis when more information is available for other regions.

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Addition to the study of the genus *Dusona* (Hymenoptera, Ichneumonidae, Campopleginae) in Korea with description of a new species and key to the Korean species

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Abstract

Korean species of the genus *Dusona* Cameron (Hymenoptera: Ichneumonidae: Campopleginae) are reviewed. Twenty seven species of *Dusona* are reported from South Korea, including 12 previously unrecorded species, *D. bellipes* (Holmgren, 1872), *D. bicoloripes* (Ashmead, 1906), *D. chabarowski* Hinz & Horstmann, 2004, *D. cultrator* (Gravenhorst, 1829), *D. japonica* (Cameron, 1906), *D. mactatoides* Hinz, 1994, *D. scalprata* Horstmann, 2004, *D. sasayamae* Hinz & Horstmann, 2004, *D. oblitera* (Holmgren, 1872), *D. obtutor* Hinz, 1994, *D. auriculator* Aubert, 1964, *D. longicauda* (Uchida, 1928), and a new species, *D. koreana* **sp. n.** An illustrated key to Korean species of *Dusona* provided.

Keywords

Dusona koreana sp. n., taxonomy

Introduction

The subfamily Campopleginae includes more than 2,000 valid species worldwide. Yu et al. (2012) listed 33 species of 11 genera in Korea, 431 species in the Eastern Palaearctic region, and 2,102 species of 66 genera worldwide. Among them, *Dusona* is the largest

genus of Campopleginae, cosmopolitan with 440 described species (Yu et al. 2012). Taxonomic study of Korean Campopleginae was initiated by Matsumura (1926). Since the first record of Korean campoplegine species by Matsumura, there have been only a few reports on Campopleginae by Kim (1955). Since then intensive study of Korean Campopleginae has only been performed in our recent study. Some species of *Dusona* have been reported by Hinz and Horstmann (2004) and Choi and Lee (2008).

In this study a new species, *Dusona koreana* sp. n., is described. We also report 12 species new for the Korean fauna: *Dusona bellipes* (Holmgren, 1872), *D. bicoloripes* (Ashmead, 1906), *D. chabarowski* Hinz & Horstmann, 2004, *D. cultrator* (Gravenhorst, 1829), *D. japonica* (Cameron, 1906), *D. mactatoides* Hinz, 1994, *D. scalprata* Horstmann, 2004, *D. sasayamae* Hinz & Horstmann, 2004, *D. obliterata* (Holmgren, 1872), *D. obtutor* Hinz, 1994, *D. auriculator* Aubert, 1964 and *D. longicauda* (Uchida, 1928).

We also provide a description with photographs of the new species, comparative illustrations of all Korean species of *Dusona*, including habitus photographs, and an identification key to all Korean species.

Materials and methods

Specimens used in this study were collected by sweeping and Malaise trapping, and are deposited in the animal systematic laboratory of Yeungnam University (YNU, Gyeongsan, Korea). Specimens were photographed using an AxioCam MRc5 camera attached to a stereo microscope (Zeiss SteREO Discovery. V20; Carl Zeiss, Göttingen, Germany), processed using AxioVision SE64 software (Carl Zeiss), and optimized with a Delta imaging system (i-solution, IMT i-Solution Inc. Vancouver, Canada). Some specimens examined in this study were loaned by the ZSM (Zoologisches Staatsammlung, München, Germany). The morphological terminology is mostly that of Gupta and Maheshwary (1977). Distribution data and host records are taken from Yu et al. (2012) and Horstmann (2011).

Abbreviations are as follows. TD, type depository; TS, type species; **CNC**, Canadian National Collections, Centre for Land and Biological Resources Research, Agriculture Canada, Ottawa, Ontario, K1A 0C6, Canada; **DEI**, Deutsches Entomologisches Institut, Schicklerstrasse 5, D-16225; **GUPTA**, Entomology & Nematology Department, University of Florida, Gainesville, Florida, 32611, U.S.A.; **HU**, Hokkaido University, Faculty of Agriculture, Entomological Institute, Sapporo, Japan; **MCZ**, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, 02138, U.S.A.; **MLSU**, Zoological Museum, Moscow Lomonosov State University, Moscow, Russia; **MRSN**, Museo Regionale di Scienze Naturali, Via Giolitti 36, I-10123 Torino, Italy; **MZ**, Musée Zoologique, Place Riponne, CH-1000 Lausanne, Switzerland; **NHM**, The Natural History Museum, Department of Entomology, Cromwell Road, London, England, SW7 5BD, United Kingdom; **NM**, Naturwissenschaftliche Sammlungen der Stadt Krefeld, Brempter Hof, D-47829 Krefeld-Uerdingen, Germany; **NR**, Naturhistoriska Riksmuseet, Sektionen för Entomologi, S-104

05 Stockholm, Sweden; **SAWON**, Department of Forest Protection and Ecology, Warsaw Agricultural University, ul. Rakowiecka 26/30, 02-528 Warszawa, Poland; **TMA**, Termeszettudomanyi Muzeum Allattara, Barossa-Utea 13, Budapest H-1088, Hungary; **USNM**, National Museum of Natural History, Smithsonian Institute, Washington, D.C., 20560, U.S.A.; **UZM**, Universitets Zoologiske Museum, Universitetsparken 15, Copenhagen, Denmark; **YU**, Yale University, Peabody Museum, New Haven, Connecticut, 06511, U.S.A.; **ZI**, Zoological Institute, Academy of Sciences, St. Petersburg 199034, Russia; **YNU**, Animal systematic laboratory of Yeungnam University, Gyeongsan, Korea; **ZSM**, Zoologisches Staatsammlung, D 81247, München, Germany; GW, Gangwon-do; GG, Gyeonggi-do; GB, Gyeongsangbuk-do; GN, Gyeongsangnam-do; JB, Jeollabuk-do; JN, Jeollanam-do; JJ, Jeju-do.

Results

Family Ichneumonidae Latreille, 1802
Subfamily Campopleginae Förster, 1869

Genus *Dusona* Cameron, 1901

Dusona Cameron, 1901: 107. TS: *Dusona stramineipes* Cameron
Delopia Cameron, 1903: 304. TS: *Delopia cariniscutis* Cameron = *Dusona cariniscutis* (Cameron, 1903)
Campoplegidea Viereck, 1912: 633. TS: *Campoplex oxyacanthae* (Boie, 1855) = *Dusona mercator* (Fabricius, 1793)
Pseudocasinaria Viereck, 1912: 644. TS: *Casinaria americana* Ashmead = *Dusona americana* (Ashmead, 1890) = *Dusona annexa* (Förster, 1868)
Thymarimorpha Viereck, 1913: 384. TS: *Thymarimorpha platygastra* Viereck = *Dusona gnara* (Cresson, 1874)
Viereckiana Strand, 1914: 163-164.
Zachrestinus Enderlein, 1921: 38. TS: *Zachrestinus fractocristatus* Enderlein = *Dusona fractocristata* (Enderlein, 1921)
Idiosomidea Viereck, 1925: 271. TS: *Campoplex photomorphus* (Viereck, 1905) = *Dusona bellula* (Dalla Torre, 1901)
Neodelopia Benoit, 1957: 314. TS: *Neodelopia pauliani* Benoit = *Dusona pauliani* (Benoit, 1957)
Kartika Gupta & Gupta, 1976: 460. TS: *Kartika aspera* Gupta & Gupta = *Dusona aspera* (Gupta & Gupta, 1976)

Diagnosis. Inner margin of eye with emargination opposite antenna socket; clypeus weakly convex, truncate or blunt; areola and petiolar areas of propodeum not separated by carina; propodeum with elongate spiracle; fore wing with large, usually rhombic areolet, pointed or stalked; discoidella reaching nervellus or detached; glymma of peti-

ole present, vestigial or absent; epipleurum of 3rd tergum not separated by crease or sometimes partly separated; metasomal segments usually reddish brown and partly black or sometimes mostly black.

Distribution. Worldwide.

Key to the species of genus *Dusona* from Korea

1 Epipleurum separated from the 3rd tergum, the crease with black line (Fig. 7D) **2**
– Epipleurum not separated from the 3rd tergum, with lateral black line above the anterior ventrolateral edge or without lateral black line (Figs 7J, 7K) ... **13**
2 Ovipositor upcurved and longer than hind tibia (Fig. 3L) ..... ***D. longicauda***
– Ovipositor straight and shorter than hind tibia (Fig. 1A) **3**
3 Antennal flagellum with less than 40 segments. 2nd recurrent vein of fore wing distad of the middle of areolet (Fig. 5D) ..... ***D. maruyamator***
– Antennal flagellum with more than 40 segments. 2nd recurrent vein of fore wing basad or opposite the middle of areolet (Figs 5B, 5C) **4**
4 Areolet of fore wing pentagonal shape, without stalk (Fig. 5M) ... ***D. bellipes***
– Areolet of fore wing quadrate, with or without stalk (Fig. 5R) **5**
5 Antennal carina very highly raised, with wrinkles (Fig. 8A). Central part of face with weak protuberance (Fig. 4R) ..... ***D. mactatoides***
– Antennal carina not raised or low and narrow (Fig. 8B). Face convex generally (Fig. 4F) **6**
6 Mandible brown to dark brown except basal part black (Fig. 4O) 7
– Mandible completely or partly yellow (Fig. 4K) **8**
7 Mandible dark brown (Fig. 4O). Tegula black. Nervellus vertical..... ..... ***D. chabarowski***
– Mandible brown (Fig. 4F). Tegula yellow. Nervellus inclivous ..... ***D. rugosa***
8 Petiole in front of glymma smooth (Fig. 1F) **9**
– Petiole in front of glymma at least with fine sculpture or striate (Fig. 8C) ... **11**
9 Antennal flagellum with less than 55 segments. Clypeus with rounded apical margin ..... ***D. stragifex***
– Antennal flagellum with more than 55 segments. Clypeus with truncate apical margin..... **10**
10 Antennal carina distinctly raised, its rim bent upwards (Fig. 8A). Nervellus vertical, intercepted in lower 0.4. 4th tergum at least reddish brown anteriorly (Fig. 2B) ..... ***D. celator***
– Antennal carina low and narrow (Fig. 1C). Nervellus reclivous, intercepted in lower 0.25. Metasoma completely black posteriorly from 4th tergum black completely (Fig. 1A) ..... ***D. koreana*** **Choi & Lee, sp. n.**
11 Body length longer than 17 mm. Hind femur reddish brown, sometimes marked brown or black basally (Fig. 3D). Petiole with striate in front of glymma..... ***D. cultrator***

– Body length shorter than 16 mm. Hind femur black (Fig. 3B). Petiole with fine sculpture in front of glymma (Fig. 8C) **12**

12 Clypeus with truncate apical edge (Fig. 4N). 5th tergum reddish brown completely (Fig. 3B) ..... ***D. bicoloripes***

– Clypeus with concave apical edge (Fig. 4T). 5th tergum reddish brown narrowly marked with black dorsally (Fig. 3H) ..... ***D. sasayamae***

13 Epipleurum not separated from the 3rd tergum, without anterior ventrolateral black stripe (Fig. 7K) **14**

– Epipleurum not separated from the 3rd tergum, however with distinct or weak black stripe anterior ventrolateral edge (Fig. 7J) **19**

14 Antennal carina raised and the rim bent upward or widened (Fig. 8A) **15**

– Antennal carina low and narrow (Fig. 8B) **17**

15 Clypeus with convex apical edge. Petiole without glymma (Fig. 8D). Nervellus reclivous and not intercepted ..... ***D. auriculator***

– Clypeus with truncate or weak concave apical edge. Petiole with distinct or large deep glymma (Fig. 8C). Nervellus inclivous and intercepted **16**

16 Antennal flagellum with more than 65 segments. Frons with a median longitudinal carina. Mandible dark brown ..... ***D. matsumurae***

– Antennal flagellum with fewer than 65 segments. Frons without a median longitudinal carina. Mandible yellow ..... ***D. crassiventris***

17 Clypeus with convex apical edge. Areolet of fore wing small, 2nd recurrent vein distad of its middle. Petiole without glymma (Fig. 5I). Body length shorter than 10 mm ..... ***D. schikotani***

– Clypeus with truncate apical edge. Areolet of fore wing large, 2nd recurrent vein basad of its middle. Petiole with glymma (Fig. 5G). Body length longer than 15 mm **18**

18 Antennal flagellum with more than 65 segments. Frons without median longitudinal carina ..... ***D. falcator***

– Antennal flagellum with fewer than 60 segments. Frons with strong or weak a median longitudinal carina ..... ***D. obliterata***

19 Petiole with distinct or weak glymma (Fig. 8C) **20**

– Petiole without glymma (Fig. 8D **21**

20 Antennal carina low, the rim weakly bent upward. Frons with incomplete median longitudinal carina. Mandible yellow. Nervellus inclivous ..... ***D. glauca***

– Antennal carina weakly raised, the rim bent upward. Frons with very high raised median longitudinal carina. Mandible brown to black. Nervellus reclivous ..... ***D. ucrainica***

21 3rd tergum and 4th tergum black dorsally and widely reddish brown laterally **22**

– 3rd tergum reddish brown, 4th tergum reddish brown or black with reddish brown anteriorly **23**

22 2nd recurrent vein of fore wing connected to middle of areolet (Fig. 5J). Nervellus vertical. Tegula yellow ..... ***D. signator***

– 2nd recurrent vein of fore wing basad middle of areolet (Fig. 5S). Nervellus inclivous. Tegula blackish brown ..... ***D. scalprata***

23 Antennal carina weakly raised, the rim weak bent upward. Hind femur reddish brown (Fig. 2A). Body length shorter than 10 mm..... ***D. annexa***

– Antennal carina low and narrow or very strongly raised. Hind femur black. Body length longer than 10 mm (except body length of *D. petiolator* 8–10 mm) **24**

24 Antennal flagellum with more than 56 segments. Antennal carina strongly raised. Clypeus with convex apical edge ..... ***D. okadai***

– Antennal flagellum with less than 52 segments. Antennal carina low and narrow. Clypeus with truncate apical edge **25**

25 Frons with a median longitudinal carina. Nervellus reclivous. Petiole with longitudinal striae in front of glymma..... ***D. obtutor***

– Frons without median longitudinal carina. Nervellus inclivous. Petiole smooth in front of glymma or with weak sculpture..... **26**

26 Mandible black. Areolet large with short stalk. 2nd recurrent vein of fore wing basad middle of areolet (Fig. 5Q). 4th tergum reddish brown (Fig. 3E) .... ***D. japonica***

– Mandible yellow. Areolet large without stalk. 2nd recurrent vein of fore wing distad middle of areolet. 4th tergum black or reddish brown anteriorly (Fig. 2E) .... ***D. petiolator***

***Dusona koreana* Choi & Lee, sp. n.**
http://zoobank.org/D4E50E9B-BB60-4C79-ABD4-7C3A85BE953D
Fig. 1

Holotype. Female. Body length 16.5 mm. Fore wing 13.0 mm.

***Color*:** Face and mesosoma black (Fig. 1B, E). Mandible yellow except black basally (Fig. 1B). Tegula blackish brown. All coxae black except fore coxa yellowish brown apically; fore trochanter to tarsus yellowish brown; mid trochanter and trochantellus black, mid femur to tarsus yellowish brown; hind trochanter to femur black, hind tibia yellowish brown marked dark brown apically. 2nd tergum on apical 0.25, 3rd tergum reddish brown broadly. Ovipositor reddish brown, ovipositor sheath black with brown apically.

***Head*:** Frons slightly depressed, with median longitudinal carina, with transverse wrinkles (Fig. 1C). Antennal flagellum with 61 segments. Antennal carina low and narrow, above with radial wrinkles. Face convex, densely punctate. Clypeus separated from face by weak groove, with truncated apical margin. Mandible tapered to apex, lower tooth as long as upper tooth. Malar space 0.5 times as long as width of mandible. Occipital carina complete. Temple weakly convex.

***Mesosoma*:** Pronotum with distinct epomia. Mesoscutum without notaulus. Speculum depressed and flat, mesopleuron in front of speculum with short longitudinal striae (Fig. 1E). Scutellum and postscutellum convex, scutellum without lateral carina.

Figure 1. *Dusona koreana* Choi & Lee, sp. n. (female). **A** habitus in lateral view **B** head in frontal view **C** Frons **D** propodeum **E** mesosoma in lateral view **F** petiole in lateral view **G** wings **H** Ovipositor sheath. (Scale bar 2.0 mm for **A, G**; 0.5 mm for **B, D–F**; 0.2 mm for **C, H**).

Propodeal spiracle elongate, distinctly connected to pleural carina. Propodeum depressed, with rugose wrinkles; anterior transverse carina of propodeum present medially, costula absent (Fig. 1D). First radius of fore wing originating before middle of pterostigma. Areolet large, with short stalk (Fig. 1G), 2nd recurrent vein originating before middle of areolet. Nervellus reclivous, intercepted in lower 0.25, discoidella faint (Fig. 1G). Hind wing with 9 distal hamuli. Tibiae and tarsi with short strong spines; tarsal claws pectinate.

***Metasoma*:** Petiole with very strong glymma, dorsolateral carina very strong (Fig. 1F). Epipleurum separated from 3rd tergum, crease with distinct black line. 1st tergum 4.3 times as long as wide, 2nd tergum 1.6 times as long as wide. Ovipositor straight, shorter than hind tibia and longer than hind basitarsus. Ovipositor sheath wide and aciculate basally in lateral view (Fig. 1H).

Male. unknown.

Intraspecific variation based on the paratypes. (only differences from holotype described) Antennal flagellum with 56–62 segments.

Material examined. Holotype: [Korea] TD: YNU. 1 female, GW, Wonju-si, Panbu-myeon, Seogok-ri, Yongsugol, 19 May 2001, J.W. Lee & D.C. Kim. **Paratype: [Korea]** TD: YNU. 1 female, Seoul, Gangnam-gu, Wonji-dong, 1 June 1985, K.H. Shin; 1 female, GG, Cheonmasan, 7 June 1986, P.C. Yun; 1 female, GG, Seongnam-si, Namhansan, 23 May 1999, E.J. Kim. **Non-Type: [Korea]** TD: YNU. 1 female, 24 May 1986, S.Y. Park.

Distribution. Korea.

Region. Eastern Palaearctic.

Host. Unknown.

Etymology. The specific name is derived from Korea, the country of the type specimens.

Remarks. The species is similar to *Dusona cultrator* (Gravenhorst, 1829) but differs by in the following characters: lower valve of ovipositor straight (Fig. 8E) (lower valve sinuous in *D. cultrator*) (Fig. 8F), hind tibia yellowish brown marked dark brown apically (hind tibia yellowish brown, sometimes narrowly marked with brown basally in *D. cultrator*); petiole with very large glymma (Fig. 1F), which is bordered by very distinct longitudinal carina dorsally; 1st tergum longer than 4 times as long as wide (1st tergum 3.4 times as long as wide in *D. cultrator*). Also, the metasomal segments of *Dusona* are usually reddish brown and partly black but the metasoma of *Dusona koreana* is mostly black with only the 2nd tergum reddish brown apically and 3rd tergum widely reddish brown laterally (Fig. 1A).

Dusona bellipes (Holmgren, 1872)

Figs 3A, 4M, 5M, 7A

Campoplex bellipes Holmgren, 1872: 1–89. Type: male; TD: unknown.
Dusona vernalis Hinz, 1957: 86–90. Holotype: female; TD: ZSM.

Material examined. [Korea]: 1 female, Seoul, Cheonggyesan, 28 May 1989, G.G. Lee.

Redescription based on Korean specimen. Female. Body length 16.0 mm.

***Color*:** Face and mesosoma black. Mandible yellow except basal part black. Tegula blackish brown. All coxae black; fore and mid legs yellowish brown except trochanter to femur dark brown ventrally; hind femur black, hind tibia to tarsus dark brown. 2nd tergum on 0.25 apically to 5th tergum reddish brown broadly. Ovipositor reddish brown and ovipositor sheath black except brown apically.

***Head*:** Frons slightly depressed, with fine punctures and with a median longitudinal carina. Antennal flagellum with 57 segments. Antennal carina low and narrow; frons above antennal carina polished. Face moderately convex, densely punctated (Fig. 4M). Clypeus not separated from face, with truncate apical edge. Mandible tapered to apex, lower tooth as long as upper tooth. Malar space much shorter than half of basal width of mandible.

***Mesosoma*:** First radius of fore wing originated before middle of pterostigma. Areolet large (Fig. 5M), 2nd recurrent vein connected before middle of areolet. Nervellus inclivous, intercepted in lower 0.3, discoidella faint. Hind wing with 8 distal hamuli. Propodeum without areola but basal transverse carina distinct, costula absent.

***Metasoma*:** Epipleurum separated from the 3rd tergum, the crease marked with black line (Fig. 7A). 1st tergum 5.1 times as long as wide, 2nd tergum 2.4 times as long as wide. Ovipositor straight and shorter than hind tibia.

Distribution. Korea (new record), Austria, Belarus, France, Germany, Italy, Japan, Latvia, Netherlands, Poland, Romania, Russia (Saratov), Sweden, Switzerland and United Kingdom.

Region. Eastern Palaearctic, Western Palaearctic.

Host. Unknown.

***Dusona bicoloripes* (Ashmead, 1906)**

Figs 3B, 4N, 5N, 7B

Campoplex bicoloripes Ashmead, 1906: 169-201. Type: male. TD: USNM.
Campoplex foersteri Roman 1942: 1-20. Lectotype: female; TD: ZSM.

Material examined. [Korea]: 1 female, Seoul, Seocho-gu, Cheonggyesan, 21 May 2002, H.J. Lim.

Redescription based on Korean specimen. Female. Body length 15.5 mm.

***Color*:** Face and mesosoma black. Mandible yellow except basal part black. Tegula black. All coxae black; fore and mid legs brown to dark brown; hind femur black, tibia to tarsus dark brown. 2nd tergum on 0.25 apically to 5th tergum reddish brown, except upper part of half of 5th tergum broadly black. Ovipositor reddish brown and ovipositor sheath black except brown apically.

***Head*:** Frons slightly depressed, with fine punctures and with weak median longitudinal carina. Antennal flagellum with 55 segments. Antennal carina low and narrow, without wrinkles. Face moderately convex, densely punctated (Fig. 4N). Clypeus not

separated from face, with truncate apical edge. Mandible tapered to apex, lower tooth as long as upper tooth. Malar space shorter than half of basal width of mandible.

***Mesosoma*:** First radius of fore wing originated from middle of pterostigma. Areolet with long stalk, 2nd recurrent vein connected before middle of areolet (Fig. 5N). Nervellus vertical or reclivous, intercepted in lower 0.3, discoidella faint. Hind wing with 8 distal hamuli. Propodeum without areola but basal transverse carina distinct, costula absent.

***Metasoma*:** Epipleurum separated from the 3rd tergum, the crease marked with black line (Fig. 7B). 1st tergum 3.6 times as long as wide, 2nd tergum 1.8 times as long as wide. Ovipositor straight and shorter than hind tibia.

Distribution. Korea (new record), Algeria, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bulgaria, Croatia, Czech Republic, late Czechoslovakia, Finland, France, Georgia, Germany, Greece, Ireland, Italy, Japan, Kazakhstan, Kyrgyzstan, Moldova, Netherlands, Norway, Poland, Romania, Russia (Kabarovsk, Krasnodar, Primor'ye, Sakhalin, Sankt Petersburg, Yevreyskaya), Slovakia, Slovenia, Spain, Switzerland, Turkey, Ukraine and United Kingdom.

Region. Eastern Palaearctic, Western Palaearctic.

Host. Unknown.

Dusona chabarowski Hinz & Horstmann, 2004

Figs 3C, 4O, 5O, 7C

Dusona chabarowski Hinz & Horstmann, 2004: 59. Holotype: female; TD: ZI.

Material examined. [Korea]: 1 female, Seoul, Nowon-gu, Suraksan, 15 May 1997, J.Y. Kim; 1 female, Seoul, Hwagyesan, 6 May 1989, J.H. Hwang; 1 female, GG Anyang-si, Anyang Arboretum, 13 May 1995, T.H. Gu; 1 female, GW Chuncheon-si, Bongraesan, 13 June 1981, S.H. Kim; 1 female, GW Sockcho-si, Seolaksan National Park, 18 May 2002, M.H. Kim.

Redescription based on Korean specimens. Female. Body length 10.0-13.0 mm.

***Color*:** Face and mesosoma black. Mandible dark brown except ventrobasal part black. Tegula blackish brown. All coxae black; fore leg dark reddish brown; mid leg dark brown except tibia brown; hind leg black. 2nd tergum on 0.3 apically to 4th tergum reddish brown. Ovipositor reddish brown and ovipositor sheath black and brown apically.

***Head*:** Frons slightly depressed, with median longitudinal carina. Antennal flagellum with 47-53 segments. Antennal carina low and narrow. Face moderately convex, densely punctated. Clypeus not separated from face, with truncate apical edge (Fig. 4O). Mandible tapered to apex, lower tooth as long as upper tooth. Malar space as long as half of basal width of mandible.

***Mesosoma*:** First radius of fore wing originated before middle of pterostigma. Areolet with long stalk (Fig. 5O), 2nd recurrent vein begin before middle of areolet. Nervellus almost vertical or inclivous, intercepted in lower 0.5, discoidella absent. Hind wing with 8 distal hamuli. Propodeum without areola, costula absent.

***Metasoma*:** Epipleurum separated from the 3rd tergum, the crease with black line (Fig. 7C). 1st tergum 3.1 times as long as wide, 2nd tergum 1.7 times as long as wide. Ovipositor straight and shorter than hind basitarsus.

Distribution. Korea (new record) and Russia (Khabarovsk, Primo'ye).

Region. Eastern Palaearctic.

Host. Unknown.

***Dusona cultrator* (Gravenhorst, 1829)**
Figs 3D, 4P, 5P, 7D

Campoplex cultrator Gravenhorst, 1829: 1-1097. Type: female; TD: MRSN.
Campoplex nigriventris Ulbricht, 1916: 1-21. Type: male; TD: NM.
Campoplex phalerae Uchida, 1929: 169-187. Lectotype: female; TD: HU.

Material examined. [Korea]: 1 female, Seoul, Dobong-gu, Bukhansan National Park, 24 April 1999, T.H. Kim.

Redescription based on Korean specimen. Female. Body length 17.5 mm.

***Color*:** Face and mesosoma black. Mandible yellow. Tegula blackish brown. All coxae black; fore leg yellowish brown; mid trochanter and trochantellus black, mid femur brown; hind leg black except tibia brown. 2nd tergum on 0.3 apically to 3rd tergum reddish brown completely. Ovipositor reddish brown.

***Head*:** Frons slightly depressed, with median longitudinal carina. Antennal flagellum all missing. Antennal carina low and narrow; antennal carina above with radial wrinkles. Face moderately convex, densely punctated. Clypeus not separated from face, with truncate apical margin (Fig. 4P). Mandible tapered to apex, lower tooth as long as upper tooth. Malar space shorter than half of basal width of mandible.

***Mesosoma*:** First radius of fore wing originated before middle of pterostigma. Areolet large (Fig. 5P), with short stalk, 2nd recurrent vein begin before middle of areolet. Nervellus vertical, intercepted in lower 0.3, discoidella faint. Hind wing with 10 distal hamuli. Propodeum without areola, costula incomplete.

***Metasoma*:** Epipleurum separated from the 3rd tergum, the crease with black line (Fig. 7D). 1st tergum 3.4 times as long as wide, 2nd tergum 1.2 times as long as wide. Lower valve of ovipositor winding, ovipositor shorter than hind tibia.

Distribution. Korea (new record), Algeria, Austria, Belarus, Belgium, Bulgaria, Czech Republic, late Czechoslovakia, Finland, France, Germany, Greece, Hungary, Italy, Japan, Kazakhstan, Kyrgyzstan, Latvia, Moldova, Morocco, Netherlands, Poland, Romania, Russia (Chita, Irkutsk, Khabarovsk, Primor'ye, Samarskaya, Sankt Petersburg, Tomsk, Yaroslavl), Slovakia, Spain, Sweden, Switzerland, Tunisia, Turkey, Ukraine and United Kingdom.

Region. Eastern Palaearctic, Western Palaearctic.

Host. Lepidoptera. Noctuidae: *Orthosia stabilis* (Denis & Schiffermüller, 1775).

***Dusona japonica* (Cameron, 1906)**
Figs 3E, 4Q, 5Q, 7E

Campoplex japonica Cameron, 1906: 98-99. Holotype: female; TD: NHM.
Dusona interima Gupta & Gupta, 1977: 1-226. Type: female; TD: GUPTA.

Material examined. [Korea]: 1 female, Seoul, Nowon-gu , Hagye1-dong, 25 April 1998, H.J. Yun; 2 females, GB Gyeongsan-si, Dae-dong, Yeungnam univ., 22-29 April 2008, J.W. Lee; 1 female, JN Yeongkwang-gun, Yeomsan-myeon, Bongnam-ri, 23 April 2009, J.K. Choi & D.H. Lee.

Redescription based on Korean specimens. Female. Body length 11.0-12.0 mm.

***Color*:** Face and mesosoma black. Mandible dark brown to black. Tegula black. All legs black; fore femur and tibia with yellow spots on anterior part. 3rd tergum and 4th tergum reddish brown, basal part of 5th tergum reddish brown. Ovipositor reddish brown to dark brown and ovipositor sheath black.

***Head*:** Frons not depressed, without median longitudinal carina. Antennal flagellum with 48-52 segments. Antennal carina low and narrow. Face moderately convex, densely punctated. Clypeus a little separated from face by weak groove, with truncate apical margin (Fig. 4Q). Mandible tapered to apex, lower tooth as long as upper tooth. Malar space longer than half of basal width of mandible.

***Mesosoma*:** First radius of fore wing originated from middle of pterostigma. Areolet with short stalk, 2nd recurrent vein begin before middle of areolet (Fig. 5Q). Nervellus inclivous, intercepted in lower 0.1, discoidella absent. Hind wing with 6 distal hamuli. Propodeum without areola, costula absent.

***Metasoma*:** Epipleurum not separated from the 3rd tergum, with lateral black line above the ventrolateral edge (Fig. 7E). 1st tergum 4.6 times as long as wide, 2nd tergum 1.9 times as long as wide. Ovipositor shorter than hind basitarsus.

Distribution. Korea (new record), China, India, Japan, Kazakhstan, Kyrgyzstan, Russia (Irkutsk, Sakhalin) and Uzbekistan.

Region. Eastern Palaearctic, Oriental.

Host. Unknown.

***Dusona mactatoides* Hinz, 1994**
Figs 3F, 4R, 5R, 7F

Dusona mactatoides Hinz, 1994: 29-46. Type: female; TD: ZI.

Material examined. [Korea]: 1 female, GG Hanam-si, Namhansanseong, 31 July 1993, J.S. Lee.

Redescription based on Korean specimen. Female. Body length 17.5 mm.

***Color*:** Face and mesosoma black. Mandible brown except ventrobasal part dark brown. Tegula blackish brown. All coxae black; fore leg yellowish brown; mid femur

borwn to blackish brown, mid tibia yellowish brown, mid tarsi dark brown; hind leg black except tibia brown and black apically. 2nd tergum on ventro-apical part reddish brown; 3rd tergum to 7th tergum dark reddish brown. Ovipositor sheath black.

***Head*:** Frons and surface between the antennal sockets deeply depressed, with median longitudinal carina. Antennal flagellum with 64 segments. Antennal carina strongly raised, the rim bend upwards and with transverse striae; antennal carina above with long radial wrinkles. Face moderately convex, densely punctated. Central part of face with weak protuberance (Fig. 4R). Clypeus weakly convex and a little separated from face by a weak groove, with truncate apical margin. Mandible tapered to apex, lower tooth as long as upper tooth. Malar space shorter than half basal width of mandible.

***Mesosoma*:** First radius of fore wing originated from middle of pterostigma. Areolet with stalk, 2nd recurrent vein begin before middle of areolet (Fig. 5R). Nervellus reclivous, intercepted in lower 0.3, discoidella faint. Hind wing with 8 distal hamuli. Propodeum without areola, costula incomplete.

***Metasoma*:** Epipleurum separated from the 3rd tergum, but the crease without black line, but with lateral black line above the anterior ventrolateral edge (Fig. 7F). 1st tergum 4.3 times as long as wide, 2nd tergum 2.2 times as long as wide. Ovipositor shorter than hind basitarsus.

Distribution. Korea (new record) and Russia (Sakhalin).

Region. Eastern Palaearctic.

Host. Unknown.

***Dusona scalprata* Horstmann, 2004**
Figs 3G, 4S, 5S, 7G

Dusona scalprata Horstmann, 2004: 149. Holotype: male; TD: MLSU.

Material examined. [Korea]: 1 male, Seoul, Gangnam-gu, Suseo-dong, Guryongsan, 27 May 1998, J.E. Kim.

Redescription based on Korean specimen. Male. Body length 15.5 mm.

***Color*:** Face and mesosoma black. Mandible yellow except basal part black. Tegula blackish brown. Fore and mid legs yellowish brown except coxae black; hind coxa to femur black except apical part of femur yellowish brown, hind tibia and tarsus yellowish brown. 2nd tergum on ventro-apical to 7th tergum reddish brown; 2nd tergum broadly black dorsally, 3rd to 7th terga with narrow black line dorsally. Clasper of male reddish brown.

***Head*:** Frons slightly depressed, with fine punctures and with median longitudinal carina. Antennal flagellum with 53+ segments, apical flagellomeres missing. Antennal carina low and narrow. Face moderately convex, densely punctated, with white hairs (Fig. 4S). Clypeus a little separated from face by weak groove, with truncate apical margin. Mandible tapered to apex, lower tooth a little shorter than upper tooth. Malar space as long as half of basal width of mandible.

***Mesosoma*:** First radius of fore wing originated from middle of pterostigma. Areolet without stalk, 2nd recurrent vein begin before middle of areolet (Fig. 5S). Nervellus inclivous, intercepted in lower 0.25, discoidella absent. Hind wing with 8 distal hamuli. Propodeum without areola but basal transverse carina distinct.

***Metasoma*:** Epipleurum not separated from the 3rd tergum, with indistinct lateral black line above the anterior ventrolateral edge (Fig. 7G). 1st tergum 4.4 times as long as wide, 2nd tergum 4.6 times as long as wide.

Distribution. Korea (new record) and Russia (Primor'ye).

Region. Eastern Palaearctic.

Host. Unknown.

Dusona sasayamae Hinz & Horstmann, 2004

Figs 3H, 4T, 5T, 7H

Dusona sasayamae Hinz & Horstmann, 2004: 148. Holotype: female; TD: HU.

Material examined. [Korea]: 2 females, Daejeon-si, Dong-gu, Daejeon univ., 16 May–5 June 2006, J.W. Lee.

Redescription based on Korean specimens. Female. Body length 12.0–16.0 mm.

***Color*:** Face and mesosoma black. Mandible yellow. Tegula blackish brown. All coxae black; fore leg yellowish brown except outer areas of trochanter and inner areas of trochantellus blackish brown; mid leg blackish brown except part of femur and tibia brown; hind leg black except tibia brown. 2nd tergum to 4th tergum reddish brown, 5th tergum reddish brown except black dorsally, 6th tergum black except reddish brown ventrally. Ovipositor reddish brown and ovipositor sheath black and reddish brown apically.

***Head*:** Frons slightly depressed, with fine punctures and with median longitudinal carina. Antennal flagellum with 55 segments. Antennal carina low and narrow. Face moderately convex, densely punctated. Clypeus not separated from face, with concaved apical edge (Fig. 4T). Mandible tapered to apex, lower tooth shorter than upper tooth. Malar space shorter than half basal width of mandible.

***Mesosoma*:** First radius of fore wing originated from middle of pterostigma. Areolet with stalk (Fig. 5T), 2nd recurrent vein begin a little before middle of areolet. Nervellus almost vertical, intercepted in lower 0.25, discoidella faint. Hind wing with 8 distal hamuli. Propodeum without areola, costula absent.

***Metasoma*:** Epipleurum separated from the 3rd tergum, the crease marked with black line (Fig. 7H). 1st tergum 3.5 times as long as wide, 2nd tergum 1.8 times as long as wide. Ovipositor straight and shorter than hind basitarsus.

Distribution. Korea (new record) and Japan.

Region. Eastern Palaearctic.

Host. Unknown.

***Dusona obliterata* (Holmgren, 1872)**
Figs 3I, 4U, 5U, 7I

Campoplex oblitera Holmgren, 1872: 1-89. Lectotype: female; TD: NR.
Campoplex limiventris Kriechbaumer, 1883: 97-115. Holotype: male; TD: ZSM.

Material examined. [Korea]: 1 female, GG Paju-si, Jeokseong-myeon, Seolma-ri, 18 August 1984, M.I. Lee.

Redescription based on Korean specimen. Female. Body length 16.0 mm.

***Color*:** Face and mesosoma black. Mandible yellow. Tegula blackish brown. All coxae black; fore and mid legs yellowish brown; hind leg blackish brown except tibia yellowish brown. 2nd tergum on ventro-apical edge to basal of 5th tergum reddish brown.

***Head*:** Frons slightly depressed, with fine punctures and with partly obliterated median longitudinal carina. Antennal flagellum with 58 segments. Antennal carina low, the rim weak bent upwards and with radial wrinkles. Face moderately convex, densely punctated. Central part of face with weak protuberance (Fig. 4U). Clypeus not separated from face, with truncate apical edge. Mandible tapered to apex, lower tooth as long as upper tooth. Malar space shorter than half basal width of mandible.

***Mesosoma*:** First radius of fore wing originated from middle of pterostigma. Areolet large without stalk, 2nd recurrent vein begin a little before middle of areolet (Fig. 5U). Nervellus vertical, intercepted in lower 0.3, discoidella faint. Hind wing with 9 distal hamuli. Propodeum without areola but basal transverse carina distinct.

***Metasoma*:** Epipleurum not separated from the 3rd tergum, without black line (Fig. 7I). 1st tergum 4.6 times as long as wide, 2nd tergum 2.0 times as long as wide. Ovipositor straight and shorter than hind basitarsus.

Distribution. Korea (new record), Austria, Belarus, Belgium, Bulgaria, Croatia, Czech Republic, late Czechoslovakia, Finland, France, Germany, Hungary, Italy, Latvia, Moldova, Netherlands, Poland, Romania, Russia (Irkutsk, Moscow, Primor'ye, Sankt Petersburg, Smolensk), Spain, Sweden, Switzerland, Turkey and United Kingdom.

Region. Eastern Palaearctic, Western Palaearctic.

Host. Lepidoptera. Noctuidae: *Acronicta leporina* (Linnaeus, 1758); Notodontidae: *Euchila palpina* (Clerck, 1759); Thyatridae: *Achlya flavicornis* (Linnaeus, 1758).

***Dusona obtutor* Hinz, 1994**
Figs 3J, 4V, 5V, 7J

Dusona obtutor Hinz, 1994: 29-46. Holotype: female; TD: HU.

Material examined. [Korea]: 1 female, JB Jeongeup-si, Naejang-dong, Naejangsan National Park, Ansambatsil, 18 May 2004, J.G. Han.

Redescription based on Korean specimen. Female. Body length 11.0 mm.

***Color*:** Face and mesosoma black. Mandible yellow except basal part black. Tegula blackish brown. All coxae to trochentellus black; fore femur yellowish brown to dark brown, from fore tibia yellow; middle leg blackish brown except tibia brown; hind leg black. 2nd tergum on ventroapical edge to 3rd tergum reddish brown. Ovipositor reddish brown and ovipositor sheath black.

***Head*:** Frons slightly depressed, with fine punctures and with median longitudinal carina. Antennal flagellum with 43 segments. Antennal carina low and narrow. Face moderately convex, densely punctated (Fig. 4V). Clypeus not separated from face, with truncate apical edge. Mandible tapered to apex, lower tooth shorter than upper tooth. Malar space longer than half basal width of mandible.

***Mesosoma*:** First radius of fore wing originated from middle of pterostigma. Areolet small with long stalk (Fig. 5V), 2nd recurrent vein begin after middle of areolet. Nervellus reclivous, intercepted in lower 0.25, discoidella absent. Hind wing with 7 distal hamuli. Propodeum without areola, basal transverse carina incomplete.

***Metasoma*:** Epipleurum not separated from the 3rd tergum, with distinct lateral black line above the anterior ventrolateral edge (Fig. 7J). 1st tergum 4.4 times as long as wide, 2nd tergum 2.1 times as long as wide. Ovipositor straight, shorter than hind basitarsus.

Distribution. Korea (new record) and Japan.

Region. Eastern Palaearctic.

Host. Unknown.

Dusona auriculator Aubert, 1964

Figs 3K, 4W, 5W, 7K

Dusona auriculator Aubert, 1964: 35–40. Holotype: female; TD: MZ.

Material examined. [Korea]: 1 male, GW Wongju-si, Socho-myeon, Hakgong-ri, Chiaksan National Park, 28 August-16 September 2013, J.W. Lee.

Redescription based on Korean specimen. Male. Body length 8.5 mm.

***Color*:** Face and mesosoma black. Mandible and tegula yellow. Fore leg yellow except fore coxa black basally; middle leg yellow except coxa black dorsally; hind coxa black; hind trochanter to tibia brown, femur and tibia black apically; hind tarsus darker than hind femur. 2nd tergum reddish brown on ventroapical edge; 3rd tergum to 7th tergum reddish brown, with narrow black line dorsally. Clasper of male yellowish brown.

***Head*:** Frons slightly depressed, with fine punctures and with median longitudinal carina. Antennal flagellum with 46 segments. Antennal carina strongly raised, the rim widened to a smooth bulge. Face moderately convex, densely punctated. Clypeus not separated from face, with round apical edge (Fig. 4W). Mandible tapered to apex, lower tooth as long as upper tooth. Malar space as long as half basal width of mandible.

***Mesosoma*:** Pronotum and speculum of mesosoma polished. First radius of fore wing originated weakly before middle of pterostigma. Areolet small with long stalk,

2nd recurrent vein distad of middle of areolet (Fig. 5W). Nervellus reclivous, not intercepted or weak, discoidella absent. Hind wing with 5 distal hamuli. Propodeum without areola but basal transverse carina distinct.

***Metasoma*:** Epipleurum not separated from the 3rd tergum, without lateral black line (Fig. 7K). 1st tergum 4.8 times as long as wide, 2nd tergum 2.9 times as long as wide.

Distribution. Korea (new record), Austria, Bulgaria, France, Greece, Italy, Japan, Romania and Russia (Khabarovsk, Primor'ye).

Region. Eastern Palaearctic, Western Palaearctic.

Host. Unknown.

***Dusona longicauda* (Uchida, 1928)**
Figs 3L, 4X, 5X, 7L

Campoplex longicauda Uchida, 1928: 177–297. Holotype: female; TD: HU.

Material examined. [Korea]: 1 female, Seoul, Gangnam-gu, Cheonggyesan, 6 September 1986, Y.H. Lee; 2 females, GG Su-dong, Chukryeongsan, 28 September 1980, H.K. Park; 1 female, GW Sokcho-si, Seorak-dong, 11 June 1992, J.W. Lee; 1 female, GB Gyeongsan-si, Dae-dong, Yeungnam univ., 17 May 1989, Y.K. Lee; 1 female, ditto, 30 May 1989, J.W. Lee; 1 female, ditto, 21-27 May 2008, J.W. Lee; 9 females, GB Eulseong-gun Ansa-myeon, Ansamyeonsamuso, 1 April-1 May 2013, S.J. Park; 1 female, GB Cheongdo-gun, Gakbuk-myeon, Namsan 3-ri, 2-15 June 2008, J.W. Lee; 2 females, GN Jinju-si, Gajwa-dong, 18-24 May 1990, J.W. Lee; 1 female, ditto, 27 May 1991, J.W. Lee; 1 female, ditto, 29 May 1991, J.W. Lee; 1 female, ditto, 1-9 June 1990, J.W. Lee; 1 female, GN Haman-gun, Daesan-myeon, 22 April 1991, J.W. Lee; 1 female, JN Wando-gun Soan-myeon, Soan-do, 15 May-11 June 2011, J.W. Lee; 1 female, JJ Jeju-si, Aewol-eup, Gwangnyeong-ri, Sumeunmulbaengdwi, weltland of 1,100Goji, 24 August 2010, H.S. Lee; 1 female, JJ Seogeypo-si, Cheongsonyeonyayeongjang, 21 May 2003, J.W. Lee.

Redescription based on Korean specimens. Female. Body length 10.0–13.0 mm.

***Color*:** Face and mesosoma black. Mandible yellow except basal part black. Tegula blackish brown. All coxae to trochentellus black; fore leg yellowish brown except femur ventrally dark brown; middle leg blackish brown except tibia yellowish brown; hind leg blackish brown. 2nd tergum on 0.25 apically to 4th tergum reddish brown. Ovipositor reddish brown and ovipositor sheath black.

***Head*:** Frons slightly depressed, with fine punctures and with median longitudinal carina. Antennal flagellum with 41-45 segments. Antennal carina low and narrow. Face moderately convex, densely punctated (Fig. 4X). Clypeus not separated from face, with round apical edge. Mandible tapered to apex, lower tooth as long as upper tooth. Malar space as long as half basal width of mandible.

***Mesosoma*:** First radius of fore wing originated weakly before middle of pterostigma. Areolet large, without stalk (Fig. 5X), 2nd recurrent vein begin a little before middle

of areolet. Nervellus inclivous, intercepted in lower 0.5, discoidella faint. Hind wing with 6-7 distal hamuli. Propodeum without areola but basal transverse carina distinct.

***Metasoma*:** Epipleurum separated from the 3rd tergum, the crease marked with black line (Fig. 7L). 1st tergum 5.2 times as long as wide, 2nd tergum 2.4 times as long as wide. Ovipositor upcurved, longer than hind tibia.

Distribution. Korea (new record), China, Japan and Russia (Khabarovsk, Krasnoyarsk, Primor'ye, Sakhalin).

Region. Eastern Palaearctic, Oriental.

Host. Unknown.

Dusona annexa (Förster, 1868)

Figs 2A, 4A, 5A, 6A

Campoplex annexa Förster, 1868: 761–876. Type: female; TD: ZSM.
Casinaria americana Ashmead, 1890: 1–47. Type: female; TD: USNM.
Campoplegidea erythromera Viereck, 1926: 173–186. Type: female; TD: CNC.
Campoplex neoluteipes Uchida, 1942: 107–146. Type: female; TD: HU.
Dusona oyamadai Hinz, 1994: 29–46. Type: female; TD: lost.

Material examined. [Korea]: No specimens; [Germany]: 1 female, 17 July 1956, Zwiesel B.W.

Distribution. Korea, Austria, Belarus, Belgium, Bulgaria, Canada, China, Czech Republic, late Czechoslovakia, Finland, France, Georgia, Germany, Hungary, Ireland, Italy, Japan, Kazakhstan, Moldova, Mongolia, Netherlands, Norway, Poland, Romania, Russia (Amur, Buryatskaya Respublika, Chita, Kamchatka, Khabarovsk, Murmansk, Primor'ye, Sakhalin, Sankt Petersburg, Yevreyskaya), Slovakia, Sweden, Switzerland, Turkey, U.S.A., Ukraine and United Kingdom.

Region. Eastern Palaearctic, Western Palaearctic, Nearctic.

Host. Unknown.

Remarks. No Korean specimens were available for this study. However we have seen a voucher specimen from ZSM.

Dusona celator Hinz, 1985

Figs 2B, 4B, 5B, 6B

Dusona celator Hinz, 1985: 297–317. Type: female; TD: ZI.

Material examined. [Korea]: No specimens; [TD: ZSM]: 1 female.

Distribution. Korea and Russia (Chita, Primor'ye).

Region. Eastern Palaearctic.

Figure 2. General habitus in lateral view. **A** *Dusona annexa* (=*D. americana*) **B** *D. celator* **C** *D. glauca* **D** *D. maruyamator* **E** *D. petiolator* **F** *D. rugosa* **G** *D. falcator* **H** *D. matsumurae* **I** *D. schikotani* **J** *D. signator* **K** *D. stragifex* **L** *D. ucrainica*.

Host. Unknown.

Remarks. No Korean specimens were available for this study. However we have seen a Russian voucher specimen from ZSM. The tip of the fore coxa of male is yellowish red, whereas in other characters it is similar to the female.

Dusona crassiventris Horstmann, 2004

Dusona crassiventris Horstmann, 2004: 67. Holotype: female; TD: SAWON.

Material examined. [Korea]: No specimens.

Distribution. Korea.

Region. Eastern Palaearctic.

Figure 3. General habitus in lateral view. **A** *Dusona bellipes* **B** *D. bicoloripes* **C** *D. chabarowski* **D** *D. cultrator* **E** *D. japonica* **F** *D. mactatoides* **G** *D. scalprata* **H** *D. sasayamae* **I** *D. obliterata* **J** *D. obtutor* **K** *D. auriculator* **L** *D. longicauda*.

Host. Unknown.

Remarks. This species was recorded from Korea as an endemic species by Horstmann (2004). However no Korean specimens were available for this study.

Dusona falcator (Fabricius, 1775)

Figs 2G, 4G, 5G, 6G

Ichneumon falcator Fabricius, 1775: 832. Holotype: female; TD: UZM.

Material examined. [Korea]: 1 male, GW Donghae-si, Samhwa-dong, Muryeong valley, 16–28 June 2005, J.W. Lee; 1 female, JN Jeongeup-si Ibam-myeon, Deungcheon-ri, 23 July 2004, J.G. Han.

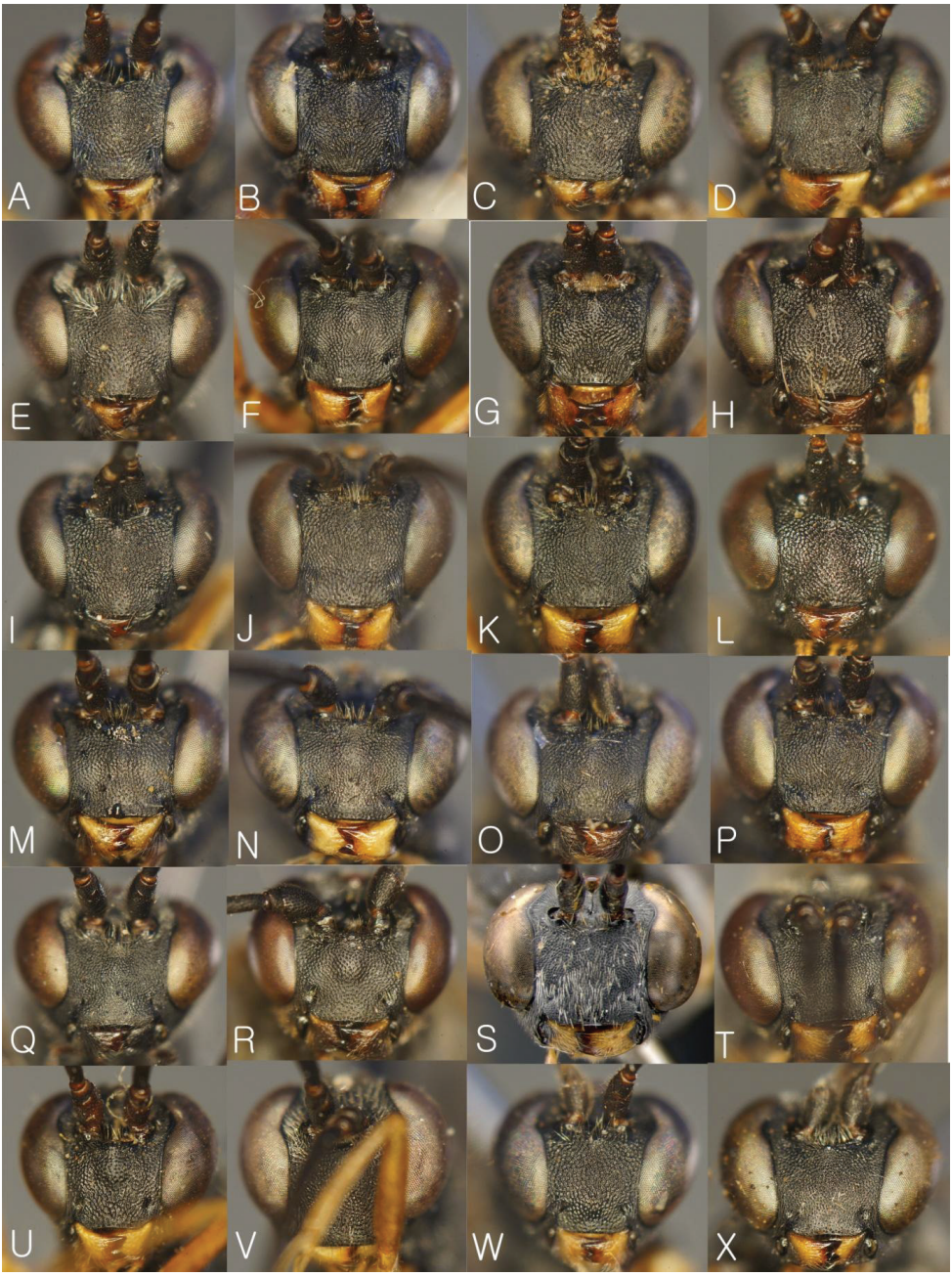

Figure 4. Head in frontal view. **A** *Dusona annexa* (=*D. americana*) **B** *D. celator* **C** *D. glauca* **D** *D. maruyamator* **E** *D. petiolator* **F** *D. rugosa* **G** *D. falcator* **H** *D. matsumurae* **I** *D. schikotani* **J** *D. signator* **K** *D. stragifex* **L** *D. ucrainica* **M** *D. bellipes* **N** *D. bicoloripes* **O** *D. chabarowski* **P** *D. cultrator* **Q** *D. japonica* **R** *D. mactatoides* **S** *D. scalprata* **T** *D. sasayamae* **U** *D. obliterata* **V** *D. obtutor* **W** *D. auriculator* **X** *D. longicauda*.

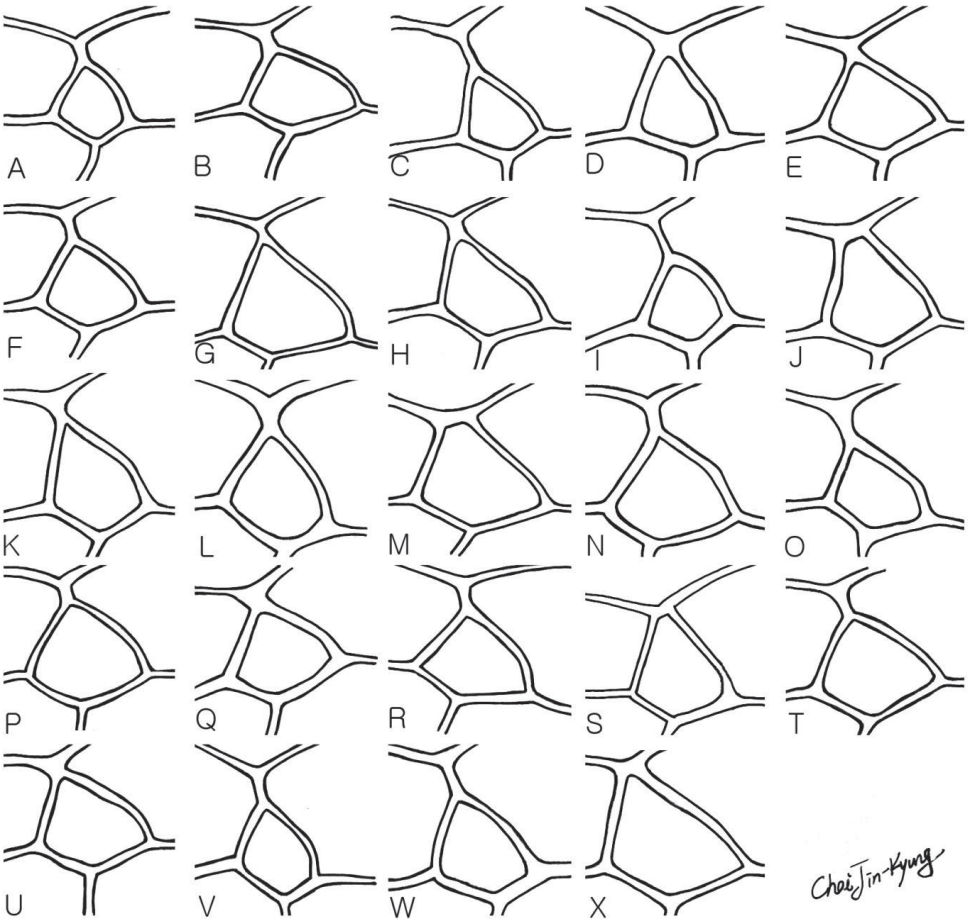

Figure 5. Areolet of fore wing. **A** *Dusona annexa* (=*D. americana*) **B** *D. celator* **C** *D. glauca* **D** *D. maruyamator* **E** *D. petiolator* **F** *D. rugosa* **G** *D. falcator* **H** *D. matsumurae* **I** *D. schikotani* **J** *D. signator* **K** *D. stragifex* **L** *D. ucrainica* **M** *D. bellipes* **N** *D. bicoloripes* **O** *D. chabarowski* **P** *D. cultrator* **Q** *D. japonica* **R** *D. mactatoides* **S** *D. scalprata* **T** *D. sasayamae* **U** *D. obliterata* **V** *D. obtutor* **W** *D. auriculator* **X** *D. longicauda*.

Distribution. Korea, Austria, Azerbaijan, Belgium, Bulgaria, Czech Republic, late Czechoslovakia, Finland, France, Germany, Hungary, Ireland, Israel, Italy, Kazakhstan, Netherlands, Norway, Poland, Romania, Russia (Altayskiy, Kirov, Primor'ye, Samarskaya, Sankt Petersburg), Sweden, Switzerland, Turkey, Ukraine and United Kingdom.

Region. Eastern Palaearctic, Western Palaearctic.

Host. Unknown.

***Dusona glauca* (Norton, 1863)**
Figs 2C, 4C, 5C, 6C

Campoplex glauca Norton, 1863: 357–368. Type: female; TD: YU.
Campoplex dissitus Norton, 1863: 357–368. Type: female; TD: MCZ.
Campoplegidea rossi Viereck, 1925: 259–273. Type: male; TD: CNC.

Material examined. [Korea]: No specimens; [TD: ZSM]: 1 male.

Distribution. Korea, Canada, Japan, Russia (Chita, Irkutsk, Khabarovsk, Magadanskaya, Primor'ye, Sakhalin) and U.S.A.

Region. Eastern Palaearctic, Nearctic.

Host. Unknown.

Remarks. No Korean specimens were available for this study. However we have seen a Japanese voucher specimen from ZSM.

***Dusona maruyamator* Hinz, 1979**
Figs 2D, 4D, 5D, 6D

Dusona maruyamator Hinz, 1979: 215. Type: female; TD: HU.

Material examined. [Korea]: 4 females, Daejeon-si, Daejeon univ., 1-17 May 2006, J.K Choi; 1 female, GB Gyeongsan-si, Dae-dong, Yeungnam univ., 22 April-1 May 2006, J.W. Lee; 1 female, JB Jeongeup-si, Naejang-dong, Wonjeogam, 28 April-28 May 2006, J.K Choi.

Distribution. Korea, Japan and Russia (Khabarovsk, Primor'ye, Sakhalin).

Region. Eastern Palaearctic.

Host. Unknown.

***Dusona matsumurae* (Uchida, 1928)**
Figs 2H, 4H, 5H, 6H

Campoplex matsumurae Uchida, 1928: 277.
Mesochorus japonicus Matsumura 1912: 117. Lectotype: female; TD: HU.

Material examined. [Korea]: 1 female, GG Gapyeung-gun, Seorak-myeon, 14 June 1992, J.W. Lee; 1 female, 1 male, GN Gayasan, 5 August 1960, C.H. Kim.

Distribution. Korea, Japan and Russia (Amur, Primor'ye).

Region. Eastern Palaearctic.

Host. Unknown.

***Dusona okadai* (Uchida, 1942)**

Campoplex okadai Uchida, 1942: 136. Type: female; TD: HU.

Material examined. [Korea]: No specimens; Holotype: 1 female.

Distribution. Korea, China and Russia (Primor'ye, Yevreyskaya).

Region. Eastern Palaearctic.

Host. Unknown.

Remarks. No Korean specimens were available for this study. However we have seen a voucher specimen from ZSM and have loaned holotype from HU.

***Dusona petiolator* (Fabricius, 1804)**
Figs 2E, 4E, 5E, 6E

Ophion petiolator Fabricius, 1804: 140. Holotype: female; TD: UZM.
Campoplex lapponicus (Holmgren, 1860): 37. Type: female; TD: NR.
Campoplex callizonus Förster, 1868: 761-876. Type: female; TD: ZSM.
Campoplex greeni (Cameron, 1905): 127. Type: female; TD: NHM.
Campoplex sachalinensis Uchida, 1928: 276. Lectotype: female; TD: HU.

Material examined. [Korea]: 1 female, 1male, Daejeon-si, Daejeon univ., 16 May–5 June 2006, J.W. Lee; 1 male, ditto, 1-17 May 2006, J.W. Lee.

Distribution. Korea, Austria, Belarus, Belgium, Canada, Czech Republic, late Czechoslovakia, Denmark, Finland, France, Germany, India, Ireland, Italy, Japan, Kyrgyzstan, Latvia, Netherlands, Norway, Pakistan, Poland, Romania, Russia (Altayskiy, Amur, Chita, Irkutsk, Kamchatka, Khabarovsk, Murmansk, Novosibirsk, Orenburg, Sakhalin, Sankt Petersburg, Vologda, Yaroslavl), Sri Lanka, Sweden, Turkey, U.S.A. and United Kingdom.

Region. Eastern Palaearctic, Western Palaearctic, Nearctic, Oriental.

Host. Lepidoptera. Geometridae: *Philereme transversata* (Hufnagel, 1767), *Philereme vetulata* (Denis & Schiffermüller, 1775), *Rheumaptera cervinalis* (Scopoli, 1763), *Rheumaptera hastata* (Linnaeus, 1758), *Rheumaptera undulata* (Linnaeus, 1758).

***Dusona rugosa* Horstmann, 2004**
Figs 2F, 4F, 5F, 6F

Dusona rugosa Horstmann, 2004: 146. Holotype: female; TD: HU.

Material examined. [Korea]: No specimens; Holotype: 1 female.

Distribution. Korea and Japan.

Region. Eastern Palaearctic.

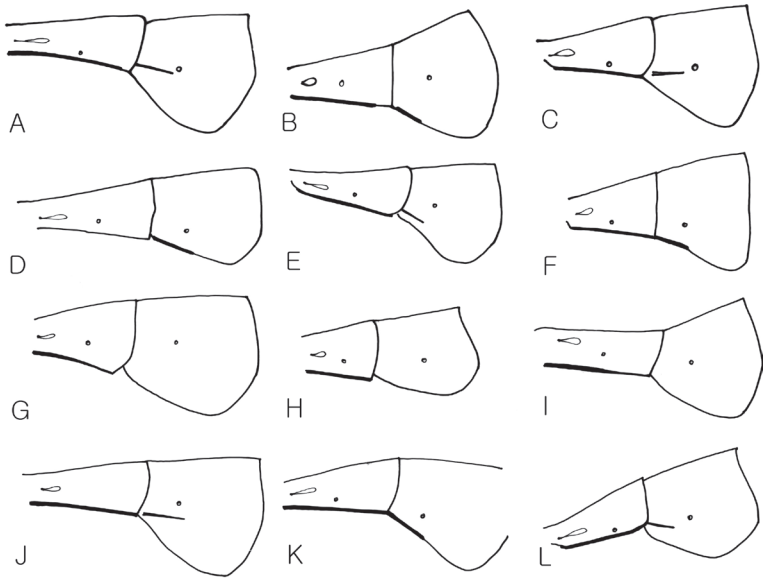

Figure 6. 2nd and 3rd terga in lateral view. **A** *Dusona annexa* (=*D. americana*) **B** *D. celator* **C** *D. glauca* **D** *D. maruyamator* **E** *D. petiolator* **F** *D. rugosa* **G** *D. falcator* **H** *D. matsumurae* **I** *D. schikotani* **J** *D. signator* **K** *D. stragifex* **L** *D. ucrainica*.

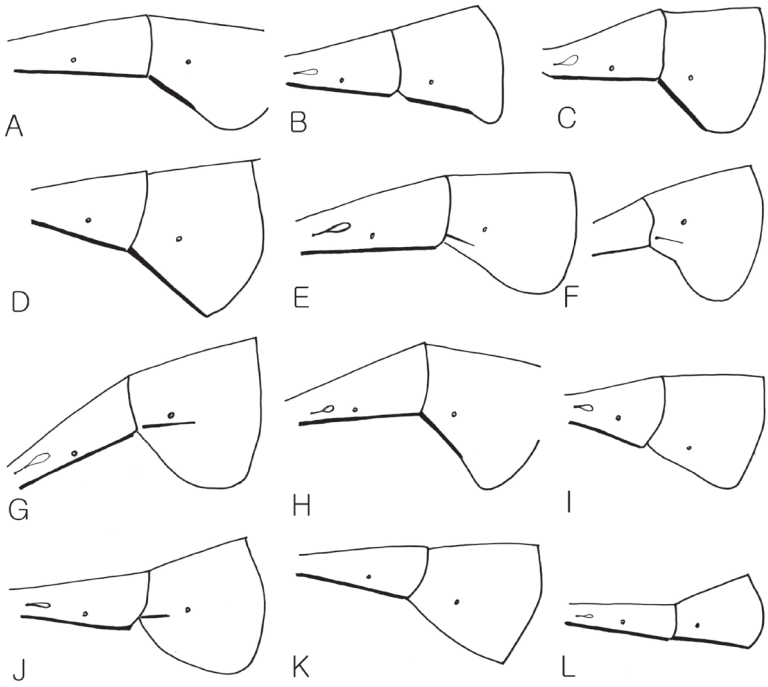

Figure 7. 2nd and 3rd terga in lateral view. **A** *D. bellipes* **B** *D. bicoloripes* **C** *D. chabarowski* **D** *D. cultrator* **E** *D. japonica* **F** *D. mactatoides* **G** *D. scalprata* **H** *D. sasayamae* **I** *D. obliterata* **J** *D. obtutor* **K** *D. auriculator* **L** *D. longicauda*.

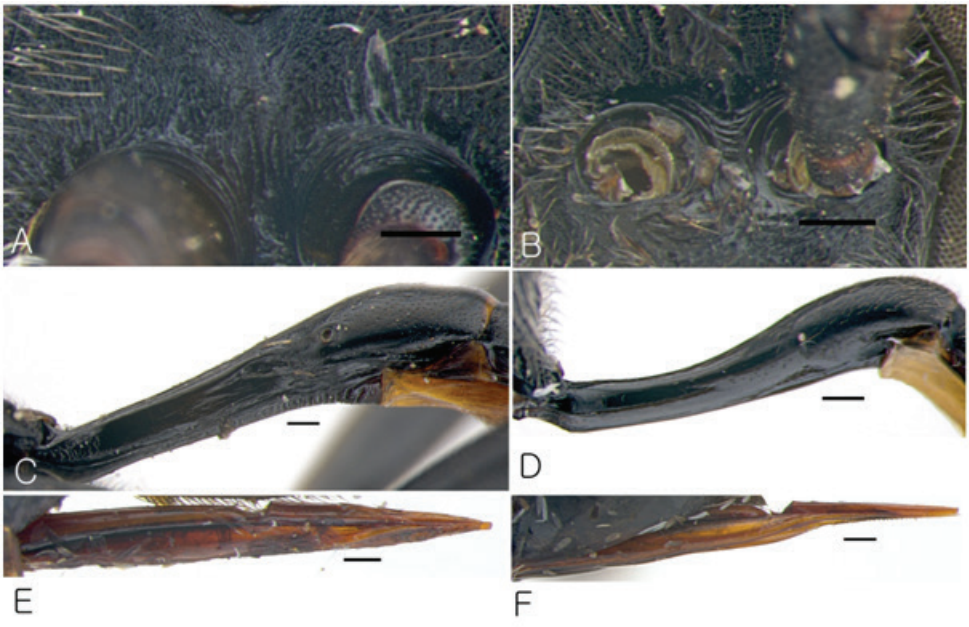

Figure 8. Characters of Korean *Dusona*. **A** Antennal carina highly raised, rim bent upwards and with striae (*D. mactatoides*) **B** Antennal carina low and narrow, without striae (*D. chabarowski*) **C** Petiole with fine sculpture in front of strong glymma (*D. bicoloripes*) **D** Petiole without glymma (*D. auriculator*) **E** Lower valve of ovipositor straight (*D. koreana*) **F** Lower valve of ovipositor sinuous (*D. cultrator*). (Scale bar 0.2 mm).

Host. Unknown.

Remarks. No Korean specimens were available for this study. However we have seen a voucher specimen from ZSM and have loaned holotype from HU.

Dusona schikotani Hinz, 1994

Figs 2I, 4I, 5I, 6I

Dusona schikotani Hinz, 1994: 29–46. Holotype: female; TD: ZI.

Material examined. [Korea]: No specimens.

Distribution. Korea and Russia (Primor'ye, Sakhalin).

Region. Eastern Palaearctic.

Host. Unknown.

Remarks. No Korean specimens were available for this study. However we have seen a voucher specimen in ZSM.

***Dusona signator* (Brauns, 1895)**
Figs 2J, 4J, 5J, 6J

Campoplex signator Brauns, 1895: 42–49. Type: female; TD: TMA.
Campoplex jozanus Uchida 1928: 275. Type: female; TD: HU.
Campoplex subrubrus Uchida 1928: 275. Lectoype: female; TD: HU.
Campoplex ohshimensis Uchida 1930: 78–88. Type: female; TD: HU.
Campoplex kaigensis Uchida 1942: 135. Type: female; TD: HU.

Material examined. [Korea]: 17 males, Daejeon-si, Dong-gu, Daejeon univ., 1–17 May 2006, J.W. Lee; 1 male, GB Gyeongsan-si, Dae-dong, Yeungnam univ., 16 May 1989, J.H. Park. .

Distribution. Korea, Austria, Bulgaria, China, Czech Republic, late Czechoslovakia, France, Georgia, Germany, Hungary, Italy, Japan, Moldova, Poland, Romania, Russia (Primor'ye, Sakhalin, Yevreyskaya), Slovakia and Slovenia.

Region. Eastern Palaearctic, Western Palaearctic.

Host. Unknown.

***Dusona stragifex* (Förster, 1868)**
Figs 2K, 4K, 5K, 6K

Campoplex stragifex Förster, 1868: 811. Type: female; TD: ZSM.
Campoplex adjunctus Förster 1868: 761–876. Type: female; TD: ZSM.
Campoplex areolatus Brauns 1895: 42–49. Type: male; TD: TMA.
Campoplex daisetsuzanus Uchida 1928: 277. Lectotype: female; TD: HU.

Material examined. [Korea]: No specimens.

Distribution. Korea, Armenia, Austria, Belarus, Belgium, Bulgaria, Czech Republic, late Czechoslovakia, Finland, France, Georgia, Germany, Greece, Hungary, Ireland, Italy, Japan, Latvia, Moldova, Morocco, Netherlands, Norway, Poland, Romania, Russia (Altayskiy, Astrakhanskaya, Buryatskaya, Khabarovsk, Murmansk, Primor'ye, Sakhalin, Sverdlovsk, Tambov, Tomsk), Slovakia, Spain, Sweden, Switzerland, Turkey, Ukraine and United Kingdom.

Region. Eastern Palaearctic, Western Palaearctic.

Host. Lepidoptera. Geometridae: *Lycia isabellae* (Harrison, 1914), *Odontopera bidentata* (Clerck, 1759); Noctuidae: *Lithophane ornitopus* (Hufnagel, 1766), *Orthosia opima* (Hübner, 1809), *Polymixis flavicincta* (Denis & Schiffermüller, 1775).

Remarks. No Korean specimens were available for this study. However we have seen a voucher specimen in ZSM. This species is very similar to *D. bicoloripes* and *D. chabrowski*, but the impression of *D. stragifex* in front of the speculum is distinctly striate, the propodeum is distinctly depressed, and the longitudinal carinae are present medially and posteriorly.

***Dusona ucrainica* Hinz, 1972**

Figs 2L, 4L, 5L, 6L

Dusona ucrainica Hinz, 1972: 45–54. Type: female; TD: DEI.

Material examined. [Korea]: No specimens.

Distribution. Korea, Armenia, Austria, Azerbaijan, Bulgaria, Croatia, late Czechoslovakia, Japan, Moldova, Mongolia, Romania, Russia (Amur, Chita, Omsk, Primor'ye, Volgograd, Yevreyskaya), Slovakia, Turkey and Ukraine.

Region. Eastern Palaearctic, Western Palaearctic.

Host. Lepidoptera. Geometridae: *Tephrina murinaria* (Denis & Schiffermüller, 1775); Noctuidae: *Discestra trifolii* (Hufnagel, 1766), *Heliothis viriplaca* (Hufnagel, 1766), *Mamestra brassicae* (Linnaeus, 1758).

Remarks. No Korean specimens were available for this study. However we have seen a voucher specimen in ZSM.

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RESEARCH ARTICLE

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Descriptions of three new species of the Termitophilous tribe Termitopaediini in China (Coleoptera, Staphylinidae, Aleocharinae)

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Abstract

Three new species belonging to two genera of the aleocharine tribe Termitopaediini Seevers, *viz.*, *Dioxeuta rara* Song & Li, **sp. n.**, *D. yunnanensis* Song & Li, **sp. n.**, and *Termitopulex sinensis* Song & Li, **sp. n.** from Baihualing Natural Reserve (Southwest China: Yunnan) are described and illustrated. This is the first record of *Termitopulex* Fauvel, 1899 from China.

Keywords

Termitopaediini, *Dioxeuta*, *Termitopulex*, termitophily, taxonomy, new species, China, Oriental region

Introduction

The termitophilous tribe Termitopaediini Seevers was established by Seevers (1957) and subsequently revised by Kistner (1968, 2001). Up to date, 19 valid genera of the tribe have been known from the Oriental and Afrotropical regions (Kistner 2001). Pace (1999) described the first and only Chinese termitopaediine species, *Dioxeuta rougemonti* Pace, 1999 from Hong Kong. Recently, the senior author and

his colleagues surveyed the termitophilous and myrmecophilous staphylinid fauna in the Baihualing Natural Reserve (Southwest China: Yunnan), and collected a series of unidentified aleocharine beetles from the fungus garden in a nest of termite *Macrotermes* Holmgren (Fig. 5A). A closer examination of this material revealed two new species of the genus *Dioxeuta* Sharp and one of the genus *Termitopulex* Fauvel, which are described herein.

Material and methods

Holotypes and most of the paratypes are deposited in the Insect Collection of the Shanghai Normal University, Shanghai, China (SNUC), and some of paratypes are deposited in the Kyushu University Museum, Fukuoka, Japan (KUM).

Specimens were killed with ethyl acetate and preserved in 75% ethanol before dissection; photos of habitus were taken by a Canon EOS 7D with an MP-E 65mm macro photo lens; photos of characteristic pattern were taken by a Canon G9 Camera mounted on an Olympus CX31 microscope.

The following abbreviations are applied in the text: **BL** – body length, from the anterior margin of the head to the posterior margin of the abdominal tergite VIII; **FBL** – forebody length, from the clypeal anterior margin to the posterior margin of elytra; **HL** – head length, from the clypeal anterior margin to the occipital constriction; **PL** – length of the pronotum along the midline; **HW** – width of the head across the eyes; **PW** – maximum width of the pronotum.

Taxonomy

Dioxeuta Sharp

Dioxeuta Sharp, 1899: 205 (original description, type species: *Dioxeuta microps* Sharp, 1899); Blackwelder 1952: 128 (discussion of type species); Seevers 1957: 217 (redescription, placed in tribe Termitopaediini); Kistner 1968: 169 (redescription, key to species); Kistner 2001: 17 (redescription; key to species).

Jacobsonella Silvestri, 1911: 59 (original description, type species: *Jacobsonella termitobia* Silvestri, 1911); Blackwelder 1952: 206 (discussion of type species); Seevers 1957: 217 (synonymized with *Dioxeuta*).

Remarks. The genus is similar to *Neodioxeuta* Seevers and *Termitopulex* Fauvel by the shape of head and thorax. It can be easily separated from *Neodioxeuta* by the abdomen only slightly physogastric and the abdominal segment II represented by a reduced tergite only. It can be distinguished from *Termitopulex* by the outer paratergites about twice the width of the inner paratergites (Kistner 1968, 2001).

***Dioxeuta rara* sp. n.**
http://zoobank.org/FDB7E398-A593-4706-A236-2E551EC7E211
Fig. 1

Type material. Holotype: China: ♂ (on slide), labeled 'CHINA: Yunnan, Baoshan City, Mangkuan Town (芒宽乡), Baihualing N. R. (百花岭), 25°17'47"N, 98°48'22"E, alt. 1400 m, 23-IV-2013, Xiao-Bin Song leg. / HOLOTYPE [red], *Dioxeuta rara* sp. n., Song & Li det. 2014, SNUC'. **Paratype: China:** 1 ♀, same data as holotype, bearing the following label: 'PARATYPE [yellow], *Dioxeuta rara* sp. n., Song & Li det. 2014, SNUC'.

Comparative notes. *Dioxeuta rara* is most similar to *D. rougemonti* and *D. yunnanensis* described below through its yellowish-brown color and the presence of macrochaetae on abdominal tergite VII. The new species can be readily separated from *D. rougemonti* by the deferent abdominal macrochaetotaxy as well as the shape of aedeagal median lobe. It differs from *D. yunnanensis* by the presence of short macrosetae on abdominal tergites VII; tergite VIII with 5 pairs of macrosetae; sternite VIII almost truncate at apex and the deferent shapes of aedeagal median lobe and spermatheca.

Description. Body (Fig. 1A) shining, smooth. Coloration: fore body and legs yellowish-brown; antennae yellowish-brown to brown; abdomen yellowish-brown, with mesal area of tergites brown.

Head (Fig. 1A) subquadrate, slightly longer than wide, about 0.89 times as wide as long; sparsely covered with long setae. Pronotum (Fig. 1A) slightly wider than long, about 1.05 times as wide as long; with 7 pairs of macrosetae, with a row of 4 macrosetae along the anterior margin, 6 on disc and 2 each along the lateral margins. Elytra (Fig. 1A) wider than long; disc sparsely covered with macrosetae; hypomera with several long yellow setae along lateral margin. Abdomen slightly physogastric, widest at segments III–V; abdominal tergite VII shaped as in Figs. 1B–C, sparsely covered with long yellow setae, posterior margin with a row of 8 very short setae; tergite VIII (Figs. 1D–E) with 5 pairs of macrosetae. Macrochaetotaxy of abdominal tergites II–VIII: 4, 6, 6, 6, 6, 1–2 (short), 10; inner paratergites without macrosetae but sparsely covered with yellow setae; macrochaetotaxy of outer paratergites III–VII variable: 6–7, 5–7, 4–5, 2–3, 1.

Male. Sternite VIII almost truncate at apex, shaped as in Fig. 1F; with 5 pairs of macrosetae. Median lobe of aedeagus (Fig. 2A) with apical lobe distinctly curved; paramere shaped as in Fig. 2B.

Female. Sternite VIII slightly emarginate at apex, shaped as in Fig.1G; with 5 pairs of macrosetae. Spermatheca shaped as in Fig. 2C.

Measurements. Male: BL: 2.63; FBL: 1.06; HL: 0.38; HW: 0.35; PL: 0.41; PW: 0.45; HW/HL: 0.92; PW/PL: 1.05; HW/PW: 0.78. **Female:** BL: 2.65; FBL: 1.10; HL: 0.40; HW: 0.35; PL: 0.40; PW: 0.43; HW/HL: 0.88; PW/PL: 1.05; HW/PW: 0.81.

Distribution. Southwest China: Yunnan.

Symbiotic host. *Macrotermes* sp.

Etymology. The Latin adjective *rāra* means 'rare'.

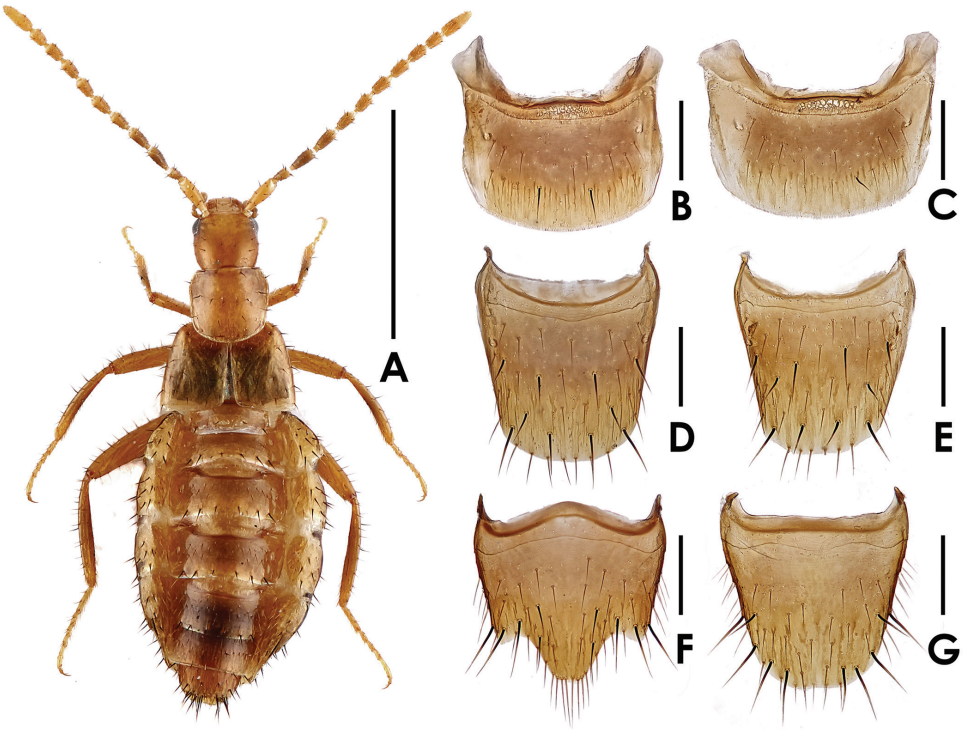

Figure 1. *Dioxeuta rara* sp. n. **A** holotype, female habitus **B** male tergite VII **C** female tergite VII **D** male tergite VIII **E** female tergite VIII **F** male sternite VIII **G** female sternite VIII. Scales (mm): **A** = 1; **B–G** = 0.2.

***Dioxeuta yunnanensis* sp. n.**
http://zoobank.org/E47D43BF-D6B2-4A5F-A736-C172C63EB8C2
Fig. 3

Type material. Holotype: China: ♂, labelled 'CHINA: Yunnan, Baoshan City, Mangkuan Town (芒宽乡), Baihualing N. R. (百花岭), 25°17'47"N, 98°48'22"E, alt. 1400 m, 23-IV-2013, Xiao-Bin Song leg. / HOLOTYPE [red], *Dioxeuta yunnanensis* sp. n., Song & Li det. 2014, SNUC'. **Paratypes: China:** 1 ♂, 9♀♀, same data as holotype, bearing the following label: 'PARATYPE [yellow], *Dioxeuta yunnanensis* sp. n., Song & Li det. 2014, SNUC'. (SNUC, KUM).

Comparative notes. *Dioxeuta yunnanensis* is most similar to *D. rara* described above, but can be readily separated from it by the different abdominal macrochaetotaxy as well as the shape of aedeagal median lobe and spermatheca.

Description. Body (Figs 3A, 5B) shining, smooth. Coloration: fore body and legs yellowish-brown; antennae yellowish-brown to brown; abdomen yellowish-brown, with mesal area of tergites brown.

Head (Fig. 3A) subquadrate in form; slightly longer than wide, about 0.86 times as wide as long; sparsely covered with long setae. Pronotum (Fig. 3A) slightly wider

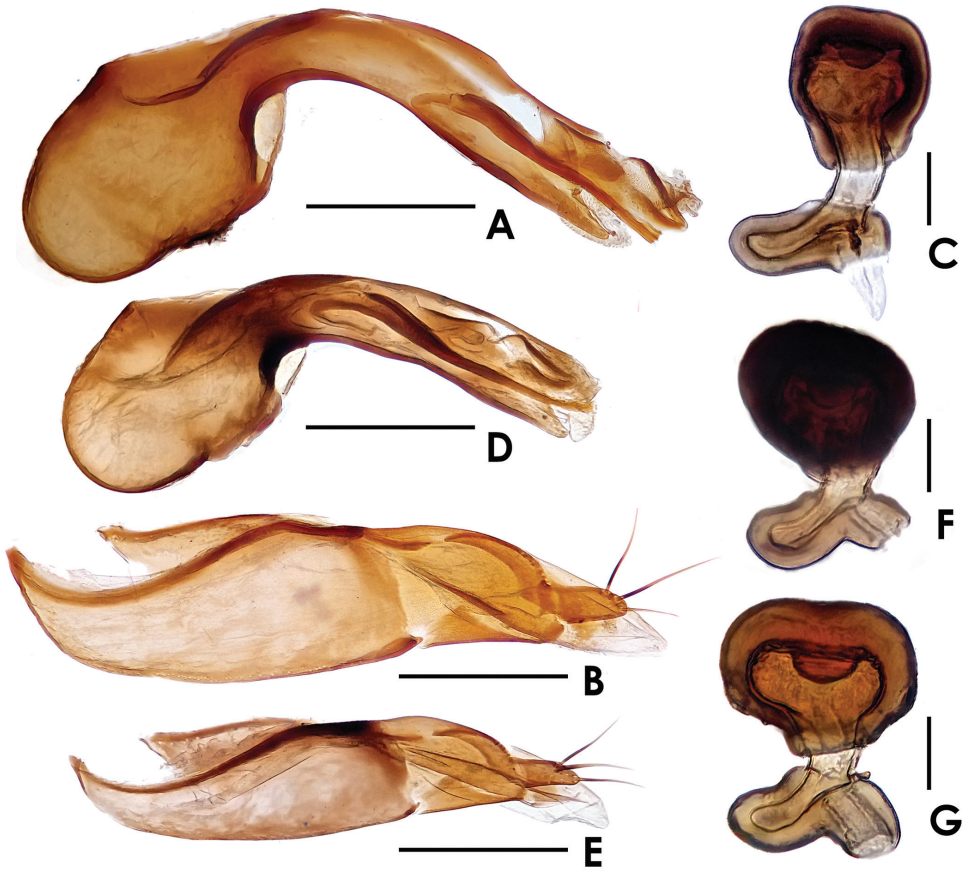

Figure 2. *Dioxeuta rara* sp. n. **A** median lobe of aedeagus, in lateral view **B** paramere **C** spermatheca *D. yunnanensis* sp. n. **D** median lobe of aedeagus, in lateral view **E** paramere **F** spermatheca **G** ditto. Scales (mm): **A, B, D, E** = 0.2; **C, F, G** = 0.03.

than long, about 1.02 times as wide as long; with 7 pairs of macrosetae, with a row of 4 macrosetae along the anterior margin, 6 on disc and 2 each along the lateral margins. Elytra (Fig. 3A) wider than long; disc sparsely covered with macrosetae; hypomera with several short yellow setae along lateral margin. Abdomen slightly physogastric, widest at segments III–V; abdominal tergite VII shaped as in Figs. 3B; tergite VIII (Figs. 3C, E) with 4–5 macrosetae, posterior margin with a row of 6–8 long yellow setae. Macrochaetotaxy of abdominal tergites II–VIII: 2, 6, 6, 6, 4–6, 0, 4–5; inner paratergites without macrosetae but sparsely covered with yellow setae; macrochaetotaxy of outer paratergites III–VII is variable: 5–8, 4–6, 3–4, 0, 0.

Male. Sternite VIII rounded at apex, shaped as in Fig. 3D; with 4 pairs of macrosetae. Median lobe of aedeagus (Fig. 2D) with apical lobe curved; paramere shaped as in Fig. 2E.

Female. Posterior margin of sternite VIII (Fig. 3 F–G) nearly rounded; with 7–8 macrosetae. Spermatheca shaped as in Fig. 2F–G.

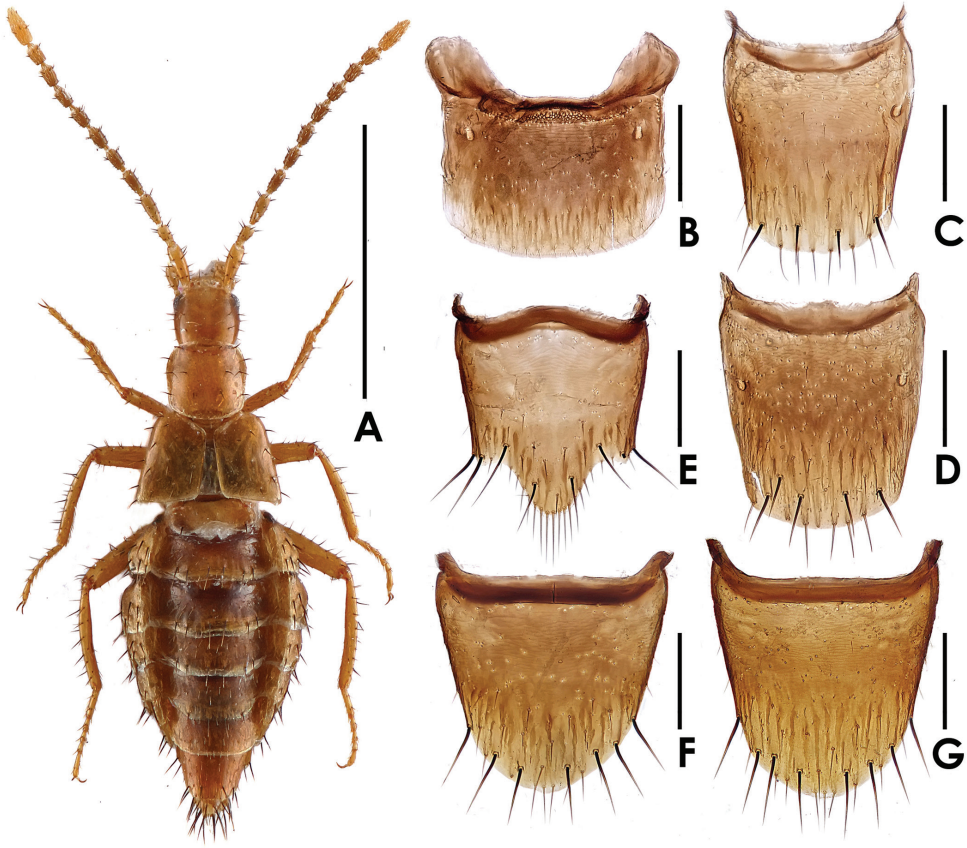

Figure 3. *Dioxeuta yunnanensis* sp. n. **A** male habitus **B** tergite VII **C** tergite VIII **D** ditto **E** male sternite VIII **F** female sternite VIII **G** ditto. Scales (mm): **A** = 1; **B–G** = 0.2.

Measurements. Male: BL: 2.34–2.46; FBL: 0.95–1.06; HL: 0.35; HW: 0.30; PL: 0.38; PW: 0.38; HW/HL: 0.87; PW/PL: 1.00; HW/PW: 0.79. **Female:** BL: 2.61–2.72; FBL: 1.02–1.06; HL: 0.35–0.38; HW: 0.32; PL: 0.37–0.40; PW: 0.39–0.41; HW/HL: 0.84–0.87; PW/PL: 1.03–1.04; HW/PW: 0.78–0.82.

Distribution. Southwest China: Yunnan.

Symbiotic host. *Macrotermes* sp.

Etymology. Named after its type locality of Yunnan Latinized.

Termitopulex Fauvel

Termitopulex Fauvel, 1899: 37 (original description, type species: *Termitopulex grandicornis* Fauvel, 1899); Blackwelder 1952: 379 (discussion of genotype); Seevers 1957: 222; (placed in tribe Termitopaediini); Kistner 1968: 153 (redescription; key to species).

Silvestrinus Bernhauer, 1932: 14 (original description, type species: *Silvestrinus erythraeanus* Bernhauer, 1932); Blackwelder 1952: 352 (discussion of the type species); Seevers 1957: 222 (synonymized with *Termitopulex*).

Remarks. The genus is similar to *Polyteinia* Bernhauer and *Paratermitopulex* Kistner through the overall shape. It can be easily separated from *Polyteinia* by the absence of easily visible exit pores from abdominal segment VII and the different shape of paramere. It can be distinguished from *Paratermitopulex* by the rounded lateral edges of the pronotum. *Termitopulex* is also related to *Dioxeuta* from which it can be distinguished the less physogastric abdomen and the paratergites approximately equal in width (Kistner 2001).

***Termitopulex sinensis* sp. n.**
http://zoobank.org/3759E492-F1D6-4421-99DA-FCA7C212794D
Fig. 4

Type material. Holotype: China: ♂, labelled 'CHINA: Yunnan, Baoshan City, Mangkuan Town (芒宽乡), Baihualing N. R. (百花岭), 25°17'47"N, 98°48'22"E, alt. 1400 m, 23-IV-2013, Xiao-Bin Song leg. / HOLOTYPE [red], *Termitopulex sinensis* sp. n., Song & Li det. 2014, SNUC'. **Paratypes: China:** 3 ♂♂, 8♀♀, same data as holotype, bearing the following label: 'PARATYPE [yellow], *Termitopulex sinensis* sp. n., Song & Li det. 2014, SNUC'. (SNUC, KUM).

Comparative notes. *Termitopulex sinensis* can be readily separated from the only Asian congener *T. omaniensis* Kistner by the posterior margin of abdominal tergite VIII being broadly concave and the different abdominal macrochaetotaxy. The new species differs from other species of the genus by the different macrochaetotaxy of abdomen as well as the shape of aedeagus and spermatheca.

Description. Body (Figs 4A, 5C) shining, smooth. Coloration: fore body and legs yellowish-brown; abdomen yellowish-brown, with tergites VI–VIII darker.

Head (Fig. 4A) subquadrate in form; slightly longer than wider, about 0.92 times as wide as long; with 4 macrosetae on disc and 1 each along the lateral margins. Mandibles with apical teeth elongate. Pronotum (Fig. 4A) slightly wider than long, about 1.06 times as wide as long; with 6 pairs of macrosetae, with a row of 4 macrosetae along the anterior margin, 4 on disc and 2 each along the lateral margins. Elytra (Fig. 4A) wider than long; disc sparsely covered with macrosetae. Abdomen widest at segments III–V; posterior margin of tergite VIII (Fig. 4B) broadly concave. Macrochaetotaxy of abdominal tergites II–VIII: 2, 4, 4, 4, 4, 2 (very short), 6; inner paratergites without macrosetae but covered with brown setae; macrochaetotaxy of outer paratergites III–VII as follow: 2, 1–2, 1–2, 0, 0.

Male. Sternite VIII rounded at apex; shaped as in Fig. 4D; with 6 pairs of macrosetae. Median lobe of aedeagus and paramere shaped as in Fig. 4E–F.

Female. Posterior margin of sternite VIII (Fig. 4C) nearly rounded; with 4 pairs of macrosetae. Spermatheca shaped as in Fig. 4G.

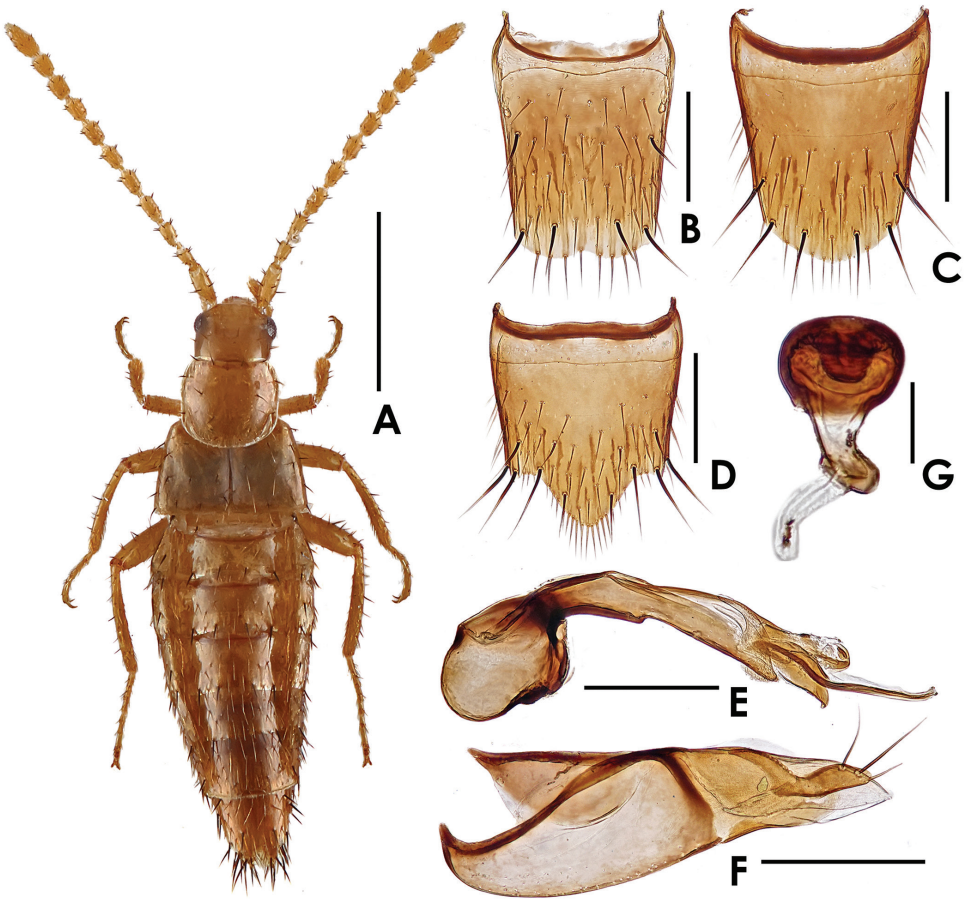

Figure 4. *Termitopulex sinensis* sp. n. **A** male habitus **B** tergite VIII **C** female sternite VIII **D** male sternite VIII **E** median lobe of aedeagus, in lateral view **F** paramere **G** spermatheca. Scales (mm): **A** = 1; **B–F** = 0.2; **G** = 0.03.

Measurements. Male: BL: 2.08–2.31; FBL: 0.88–0.92; HL: 0.32; HW: 0.29; PL: 0.32–0.33; PW: 0.34–0.35; HW/HL: 0.92; PW/PL: 1.06–1.08; HW/PW: 0.85–0.88. **Female:** BL: 2.38–2.76; HL: 0.32–0.35; HW: 0.31–0.32; PL: 0.32–0.37; PW: 0.34–0.38; HW/HL: 0.89–0.96; PW/PL: 1.03–1.08; HW/PW: 0.82–0.84.

Distribution. Southwest China: Yunnan.

Symbiotic host. *Macrotermes* sp.

Etymology. Named after the type locality.

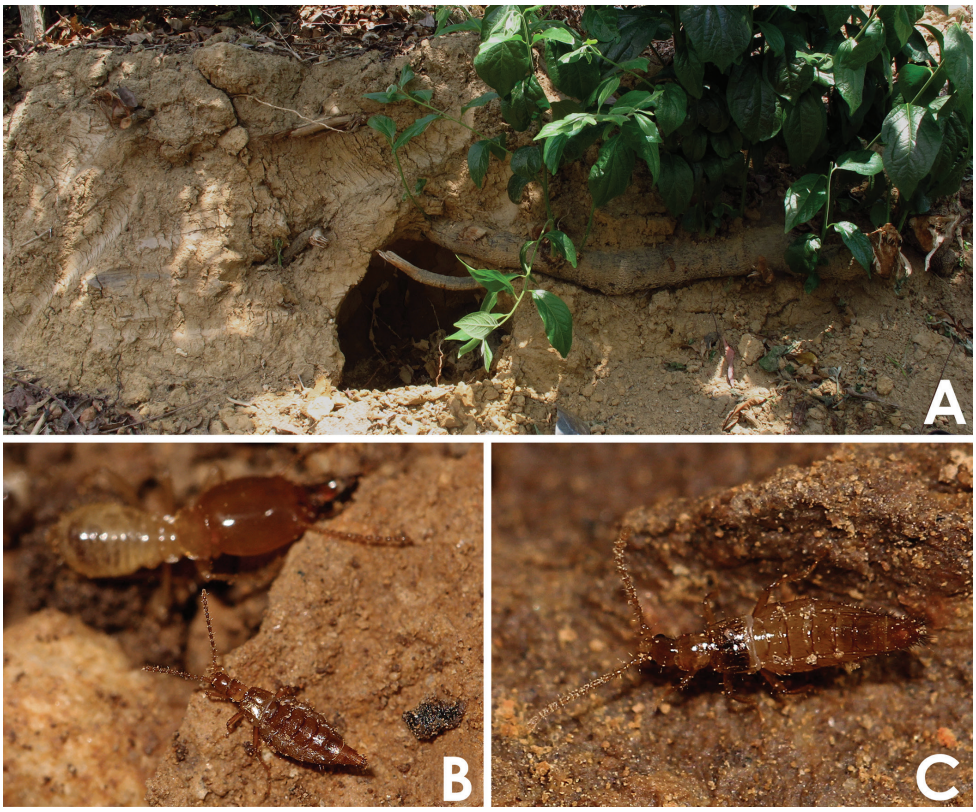

Figure 5. A over view of the symbiotic host's nest **B** Living *Dioxeuta yunnanensis* **C** Living *Termitopulex sinensis*.

Acknowledgements

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Serendipity at the Smithsonian: The 107-year journey of *Rhipidocyrtus muiri* Falin & Engel, new genus and species (Ripidiinae, Ripidiini), from jungle beast to valid taxon

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Abstract

The long and tortuous history of an enigmatic and rare new genus and species of ripidiine wedge beetle (Ripiphoridae: Ripidiinae: Ripidiini) from Borneo is discussed and the taxon described and figured as *Rhipidocyrtus muiri* Falin & Engel, **gen. n.** and **sp. n.** The holotype male, and only known specimen, was collected 107 years ago in Borneo but subsequent to this it was transferred among early researchers in the early 1900s. The specimen was dissected and many portions slide mounted, but these were disassociated from the pinned body for more than a generation. A happenstance encounter led to the rediscovery and reassociation of the body and slide-mounted abdomen and other sclerites in 2011, and to its eventual description herein. Ripidiine diversity is briefly discussed and comparisons made between *Rhipidocyrtus* and other members of the subfamily.

Keywords

Coleoptera, Ripiphoridae, Smithsonian Institution, taxonomy, morphology, Southeast Asia

Introduction

Taxa within the ripiphorid tribe Ripidiini are both evolutionarily fascinating and woefully under-described. All members whose biology is known are internal parasitoids of roaches as larvae (Lawrence et al. 2010), a lifestyle likely established at least 90 million years ago resulting in highly derived yet incredibly stable morphologies (Falin and Engel 2010). While the higher level systematics of this lineage have been discussed recently, only a handful of extant species have been named in the last half century (see Falin and Engel in press, and references therein), leaving the true evolutionary breadth and depth of the clade poorly understood. This paper is another small step in the effort to make these rather rare and curious beetles known to science.

Herein we describe a single new genus and species from West Kalimantan, Borneo, Indonesia, based on a partially disarticulated specimen housed in the Department of Entomology of the National Museum of Natural History (USNM) in Washington, DC (Fig. 1). In this case, despite its striking size, the morphological distinctiveness and phylogenetic importance of the new taxon is debatable. However, the historical aspect of the type specimen itself and how it came to be described is indeed rather remarkable and deserves mention, if only to highlight the role of serendipity (and proper specimen curation) in systematics. The crux of the story takes place in the Casey Room of the USNM in January, 2011, though it begins with Frederick Muir's travels in Borneo in the summer of 1907.

Although dimly recognized by coleopterists for his collaboration with Dr. David Sharp (1840–1922) on their monographic work on the male genitalia of beetles (Sharp and Muir 1912), Dr. Fredrick A.G. Muir (1872–1931) is perhaps more widely and intimately known for the combination of his pioneer research on biological control agents while employed by the Hawaiian Sugar Planters' Association (1905–1928) and for his numerous contributions to fulgoroid (Auchenorrhyncha: Fulgoroidea) systematics (Imms 1931, Swezey and Williams 1932). Muir, a quintessential field entomologist, traveled extensively in the Pacific region in the first quarter of the 20th Century; reading accounts of his travels (e.g., Muir 1908) invokes an intense sense of wonder, adventure and nostalgia in all but the most jaded naturalists. One of his epic adventures (in the literal sense) was a 38-month expedition (July, 1906 – Sept., 1909) in search of sugarcane borer biological control agents. This outing led him back and forth from China to Macau, Hong Kong, Singapore and the current nations of Malaysia, Indonesia, and Papua New Guinea, the expedition finally ending in Australia to recover from typhoid fever. No less epic (in the colloquial sense) was Muir's penchant for taking visitors surfing at Waikiki Beach while visiting the Experimental Station in Hawaii (Paine 1994).

Indeed, it was in the midst of his 1906–1909 expedition, during a six week visit to the island of Borneo (July to September 1907), that Muir collected the specimen that is the subject of this paper. Muir apparently deduced the creature's parasitic nature and had it sent to William D. Pierce (1881–1967) at the USDA office in Washington, DC. Pierce was obviously familiar with strepsipterans and at least certain ripiphorid

clades (Pierce 1904), though his familiarity with the Ripidiini is unclear and he apparently did nothing with the specimen. A terse handwritten note associated with the specimen provides the barest of insights as to its early history while simultaneously revealing Muir's great interest in it: "This was left with Pierce and after his [Pierce's] leaving [~1918] Muir visited USNM [~1918] and got [E.A.] Schwarz to find it. Then in 1928 Muir again visited us and called attention of H.S.B. [Herbert S. Barber] [to the specimen] but [Muir] declined to take it back".

Unlike Pierce, Barber (1882–1950) clearly took interest in the specimen, going so far as to dissect and slide mount portions of the specimen, to create type labels bearing the name proposed here, and providing it with a USNM type number. However, for an unknown reason the nomenclatorial act was never consummated. The slides and pinned specimen became separated (likely after Barber's death in 1950), the slides curated with the strepsipterans, the pinned specimen with the ripiphorids and the proposed taxon all but forgotten for another 50 years.

The first author (ZHF) visited the USNM in January of 1996, as so many young systematists do, to gather material for what was to become his Ph.D. dissertation. While there, he noticed the majority of the pinned ripidiines, a taxonomically diverse and phylogenetically puzzling lineage within the ripiphorids, had been loaned to John K. Bouseman (1936–2006) of the Illinois Natural History Survey sometime around 1980. Noting the importance of this material to the author's project and the lack of research done on them in the intervening 16 years, the specimens were eventually transferred to the Snow Entomological Collection at the University of Kansas (SEMC) late in 1997. Like Muir, Barber, and Bouseman, ZHF was struck by the Bornean specimen, though was at the time baffled to find no mention of it in the taxonomic literature.

As it did in Illinois, the specimen remained in Kansas for another 14 years relatively untouched, neither useful for research nor describable as a taxon given what appeared to be its poor state of preservation. However, ZHF visited the USNM again in 2011, coincidentally meeting J. Kathirithamby, a leading expert on Strepsiptera, while there. The two were going about their business in the Casey Room, her looking through slide-mounted strepsipterans, him working on pinned Ripiphoridae when at one point she noted aloud that the three slides in her hand were not strepsipterans at all, but rather ripiphorids and would ZHF care to have a look. He instantly recognized these exquisitely prepared slides as the missing pieces from Muir's specimen; after well over half a century curated in different parts of the same institution the specimen was once again complete.

Granted, the Casey Room at the USNM is a privileged point of reference; it is not by random chance that entomologists unexpectedly meet there. However, the odds of one of the few leading experts on one obscure taxon recognizing the misidentification of a second obscure taxon and then casually handing slides over the table to one of the few experts on *that* obscure taxon who knows *exactly* what those slides represent is nothing short of statistically incredible. It has taken yet another three years to come to fruition, but Muir's taxon, so deserving of a name, will finally receive one here, three institutions, at least five systematists, and approximately 107 years after its collection in the mountains of Borneo.

Material and methods

All observations were made on the single type specimen borrowed from the USNM. This specimen consists of a partially disarticulated adult male (Fig. 1) mounted to an insect pin with a modified minuten, a second insect pin containing ancillary labels, and three microscope slides, all of which are described in detail under the Holotype heading in the species description below.

Measurements were made using an ocular reticle calibrated with a hand-held micrometer observed through and Olympus SZH10 stereomicroscope. Photomicrographs were prepared with a Canon Eos 7D digital camera attached to an Infinity K-2 long-distance microscope lens.

Notal morphological descriptors follow Falin and Engel (in press) and hind wing venation descriptors follow Falin (2003). Other morphological terms used herein (e.g., post-ocular ommatidia) represent a consensus of use by recent authors.

A barcode label bearing the four letter coden for the Snow Entomological Collection (e.g., SEMC1270146) has been added to the pin containing the partially disarticulated specimen. This is explicitly not meant to convey ownership or deposition location of the specimen, it merely allows the taxonomic and collection data of the holotype to be incorporated and served by the University of Kansas's Division of Entomology's specimen-level database.

Systematics

Family Ripiphoridae Gemminger & Harold, 1870 (1855)
Subfamily Ripidiinae Gerstaecker, 1855
Tribe Ripidiini Gerstaecker, 1855

***Rhipidocyrtus* Falin & Engel, gen. n.**
http://zoobank.org/1B99831B-55CA-4192-A744-B2D1F5A32F62

Type species. *Rhipidocyrtus muiri* Falin & Engel, sp. n.

Diagnosis. Closely agreeing with the generalized form of Ripidiini though larger and appearing more hump-backed than typical. *Rhipidocyrtus* possesses the following combination of historically diagnostic characters: unfused, two-segmented maxillary palpi; postocular ommatidia present (Fig. 4); 11 antennomeres, antennomere I simple (Figs 2, 3), antennomere II toroidal, antennomere III more robust, produced medially (Fig. 2), antennomeres IV–XI strongly uniflabellate (Figs 2, 9); mesoscutellum present but weakly developed (Fig. 2), posterior margin very weakly bisinuate with a small medial point (Fig. 5); tarsal formula 5-5-4 (Figs 10–12). *Rhipidocyrtus* differs from all known ripidiines in the form of the metanotum (Figs 5, 6), possessing what appears to be a reduced "metascutellar box" visible at the anterior margin of the metanotum to

either side of the midline. This structure is typically either robust (most New World taxa) or absent (most Old World taxa). Likewise, *Rhipidocyrtus* appears unique in that the metascutellum narrows evenly to an anterior point, terminating at the anterior margin of the metanotum as a single medial sulcus (Fig. 5) (but see the following comparative comments).

Etymology. The new genus-group name is one of several spelling variants first composed and applied to the holotype specimen and slide labels by H.S. Barber. It is a combination of the Greek words *rhipido*, meaning, "fanlike", and *cyrtus*, meaning, "curved". Our interpretation is that it is meant to describe the unusually convex or "hump-backed" appearance of the type species. The name is masculine.

Comments. *Rhipidocyrtus* is superficially distinctive within the Ripidiini for its particularly hump-backed facies, its relative size (it is the largest ripidiine known), and possessing a pronotum that is strongly dorso-ventrally compressed laterally, resulting in an unusually abrupt lateral margin. However, despite this novel first impression it is in most regards morphologically unremarkable. It shares with most other Old World taxa a well-developed and medially-produced antennomere III as well as the presence of a mesoscutellum (albeit weakly produced), suggesting a strong relationship with that putative lineage [see Batelka et al. (2011) and Falin and Engel (in press) for discussions of supra-generic character patterns within the Ripidiini].

That said, *Rhipidocyrtus* exhibits what is here tentatively described as a rudimentary "metascutellar box" *sensu* Falin and Engel (in press). Apart from the Old World genus described in that paper, this structure is exclusive to New World ripidiines; finding an otherwise typical Old World taxon with a rudimentary "box" may prove phylogenetically significant. However, the homologous nature of this "box" remains poorly understood and, in the case of *Rhipidocyrtus*, this structure may simply be an artefact of the relatively more developed flight musculature necessary for such a large individual.

While likely less phylogenetically significant than the "metascutellar box", the form of the metascutellum is considerably more obvious and also serves to differentiate this taxon from its close relatives. Typically, the metascutellum narrows anteriorly, its margins becoming more or less parallel as they terminate at either the anterior margin of the metanotum or at the metascutellar box, depending on the lineage. In the case of *Rhipidocyrtus*, the lateral margins converge to form a single median sulcus well before the anterior metanotal margin. A similar arrangement is illustrated for the fossil genus *Paurorhipidius* Kaupp and Nagel, though the authors state the metanotal structures are obscured in the type specimens (Kaupp et al. 2001) and the exact configuration is indeed uncertain. Likewise, species of the genus *Blattivorus* Chobaut tend to have anteriorly-narrowed, parallel-sided metascutella, in some cases terminating just before the anterior metanotal margin. However, *Blattivorus* appears to be a well-defined monophyletic lineage not closely related to *Rhipidocyrtus*; it is unlikely the superficially similar forms of the metascutellur apex are truly homologous.

Rhipidocyrtus muiri **Falin & Engel, sp. n.**
http://zoobank.org/FCE0859D-3AF2-42DC-BCBC-1D915779FD9D
Figs 1–15

Holotype. ♂, USNM Type No. 41869, Department of Entomology, US National Museum of Natural History, Smithsonian Institution, Washington DC, USA; partially disarticulated, specimen preparation and labels distributed on two pins and three microscope slides as follows: first pin has only the original specimen labels; second pin contains the complete head, thorax, and poorly preserved portions of abdominal segments I–III mounted on a modified minuten (Fig. 1), the right elytron is glued to the minuten; first slide has the right antenna and left middle and hind legs; second slide has the left elytron, hind wing, and foreleg; third slide has the splayed abdomen and genitalia. Specimen labels read as follows [each preparation starts as a distinct paragraph, different lines of those labels separated by a slash (/) and separate labels by double slashes (//)]:

Pin 1: No specimen parts: "Borneo / 383" // "Rhipideus [sic]" // "This was left with Pierce / and after his leaving / Muir visited USNM / and got Schwarz to find / it. Then in 1928 Muir again / contacted us & called attention / of H.S.B. but declined to take it back." [underside of last label reads] "Found by / F. Muir / on flowers / P.T.O." // "HOLOTYPE / Rhipidocyrtus / muiri / Z.H. Falin & M.S. Engel".

Pin 2: Head, thorax, + basal abdominal segments, right elytron glued to minuten: "F. Muir #383 / on flowers / Aug 1907 / Mowong / Borneo" // "Ripidius / muiri Bar. / U.S.N.M. / Type no. / 41869" // "SEMC1158329 / KUNHM-ENT" // "HOLOTYPE / Rhipidocyrtus / muiri / Z.H. Falin & M.S. Engel".

Slide 1: "muiri / Barber / antenna, middle & hind leg / F. Muir #383 on flowers / Aug 1907 / Mowong Borneo. / Holotype No. 41869 U.S.N.M.".

Slide 2: "Rhipidocyrtus / muiri / Barber / left wing elytron / & front leg / F. Muir #383 on flowers / Aug 1907 Mwong Borneo / Type No. 41869 U.S.N.M.".

Slide 3: "Rhipidocyrtus / muiri / Barber / ♂ genitalia / & abd. seg. / spiracles nos. 3 (front) / 4, 5, & 6. – Mwong Borneo / F. Muir / Type No. 41869 U.S.N.M.".

Diagnosis. As per the generic diagnosis above.

Description. Male. Large, though difficult to measure given the longitudinally arched facies and the partial disarticulation; approximately 2.8 mm long in dorsal view from anterior margin of pronotum to posterior margin of metascutellum, approximately 2.2 mm wide at base of pronotum (although a gross approximation given the disarticulation involved, total length in life might approximate 6 mm); elytron length 2.4 mm; hind wing length 6.5 mm. Body nearly unicolorous brown (Figs 1–6); antennomere I similar in color to body, antennomeres II–XI lighter brown (Figs 1, 2) as are various subregions of the notum (e.g., posterolateral mesonotal angles). Elytra coriaceous, more or less translucent brown, darker along margins and with short, suberect setae (Fig. 7). Hind wing typical, very lightly pigmented at most (Fig. 8), but covered with microsetae giving an infuscate appearance and a reflective sheen.

Figures 1–2. Photographs of holotype male of *Rhipidocyrtus muiri* Falin & Engel, gen. et sp. n. from Borneo. **1** Lateral habitus as preserved **2** Dorsal detail of head and thorax as preserved.

Head subspherical (Figs 2, 4), slightly compressed dorso-ventrally (Fig. 3). Vertex weakly convex (Fig. 4), sloping uniformly to occiput, integument shining with indistinct punctation and weak, irregular, sculpturing. Dorsal and ventral aspects of head with suberect to erect setae. Compound eyes large (Figs 3, 4), coarsely faceted,

with erect setae dorsally; weakly convergent dorsally, strongly convergent ventrally, occupying nearly the entire ventral surface of the head (Fig. 3); two large post-ocular ommatidia present at posterolateral margins of compound eyes (Fig. 4). Frons obsolete between antennal bases and maxillary palpi, these structures dorsoventrally contiguous (Fig. 3). Maxillary palpi two-segmented, basal segments free, obliquely toroidal, apical segments approximately 3.5 to 4 × length of basal segments (Figs 3, 4), fusiform, broadest near base, with subapical, obliquely-depressed sensory pits.

Antennae consisting of 11 antennomeres; antennomere I stout (Fig. 3), asymmetrically cup-like, apical opening produced laterally; antennomere II irregularly toroidal, longest at midline, subequal to III; antennomere III similar in shape to II except strongly produced mesally (Fig. 2); antennomeres IV–X with mesally facing rami (Figs 2, 9), bases of IV–VI longitudinally compressed, subequal, base of antennomere VII approximately 2 × length of antennomere VI; antennomere XI expanded, similar in shape to rami of previous segments (Fig. 9); antennae constructed such that rami VIII and IX nearly equal in apparent length, rami decreasing subequally in apparent length to either side, rami V shortest in apparent length; antennomeres I and II with moderately dense suberect setae similar to those of head, similar setae present on bases of antennomeres III–X but diminish in length apically; rami of antennomeres with specialized sensory trichia beginning with mesal projection of antennomere III.

Pronotum with suberect to erect setae, integument shining, weakly, irregularly punctate; pronotum broadly bell-shaped in dorsal view (Fig. 2); anterior margin broadly excavate; anterolateral angles rounded, nearly obsolete, strongly deflected ventrally; posterior margin gently arcuate with a small medial projection, deflected dorsally (Fig. 1); posterolateral angles broadly rounded, projecting, slightly concave on surface and deflected dorsally; lateral margins evenly arcuate, converging anteriorly, strongly dorso-ventrally compressed, proplurae reduced, hidden in dorsal view. Pronotal disc with a raised medial tubercle at anterior margin and a weakly rounded medial carina extending posteriorly approximately ¼ length of pronotum, gradually becoming obsolete, otherwise disc gently but irregularly convex laterally with two large but weak convexities near lateral margins, apparently demarcating internal articulation points of procoxae.

Mesonotum with suberect, posteriorly-facing setae, integument shining, very weakly punctate, appearing nearly glabrous; posterior margin weakly bisinuate with medial projection (Fig. 5), forming a broad but narrow mesoscutellum; posterolateral angles obtusely rounded, deflected dorsally; lateral and anterior margins obscured. Mesonotal disc gently but irregularly convex laterally (Fig. 2), with a large convexity on either side of midline near anterior margin.

Metanotum with scattered recumbent to suberect setae (many appear abraded on holotype specimen), integument shining, punctation variably weak and scattered to nearly obsolete with exception of metapostscutellum described below. Metascutum apparently divided into three regions – anteromedial box, anterolateral lobes, and posterolateral lobes (Figs 5, 6). Anteromedial box partially obscured medially by mesocutellum but appears to form a contiguous, narrow band separated posteriorly from posterolateral lobes by an arcuate impressed sulcus and laterally from anterolateral lobes by indistinctly impressed

Figures 3–4. Photographs of holotype male of *Rhipidocyrtus muiri* Falin & Engel, gen. et sp. n. from Borneo. **3** Facial view **4** Right lateral view of head and prothorax.

longitudinal constrictions. Anterolateral lobes obliquely convex and themselves separated from obliquely convex posterolateral lobes by wide, deep and relatively setose impressions (Fig. 5). Metascutellum clearly delineated by a pair of oblique, deeply impressed sulci curved basally (Figs 5, 6), nearly linear anteriorly, converging to a single impressed medial sulcus terminating at apparent anterior metanotal margin (Fig. 5). Posterior margin of metascutellum straight in dorsal view (Fig. 5), gently convex dorsoventrally; metascutellar disc gently convex (Fig. 6) with a weak, rounded carina originating at apex, continuing approximately 1/3 length of metascutellum (Fig. 5), gradually becoming obsolete. Metapostscutellum a relatively narrow band positioned more or less dorso-ventrally, ventral and slightly anterior to posterior margin of metascutellum (Fig. 6), posterior margin of metapostscutellum strongly deflected dorsally (Figs 1, 6). Surface of metapostscutellum glabrous, impunctate except posterior-facing aspect of posterior marginal flange appearing setose due to superimposed abdominal tergite I.

Figures 5–6. Photographs of holotype male of *Rhipidocyrtus muiri* Falin & Engel, gen. et sp. n. from Borneo. **5** Dorsal detail of metathorax. **6** Posterior view of thorax as preserved.

Lateral and ventral aspects of pterothorax typical of tribe, if slightly exaggerated in form; vestiture and texture similar to notum, setae more or less uniform, suberect; punctation variable, generally scattered and weak to nearly obsolete except as noted.

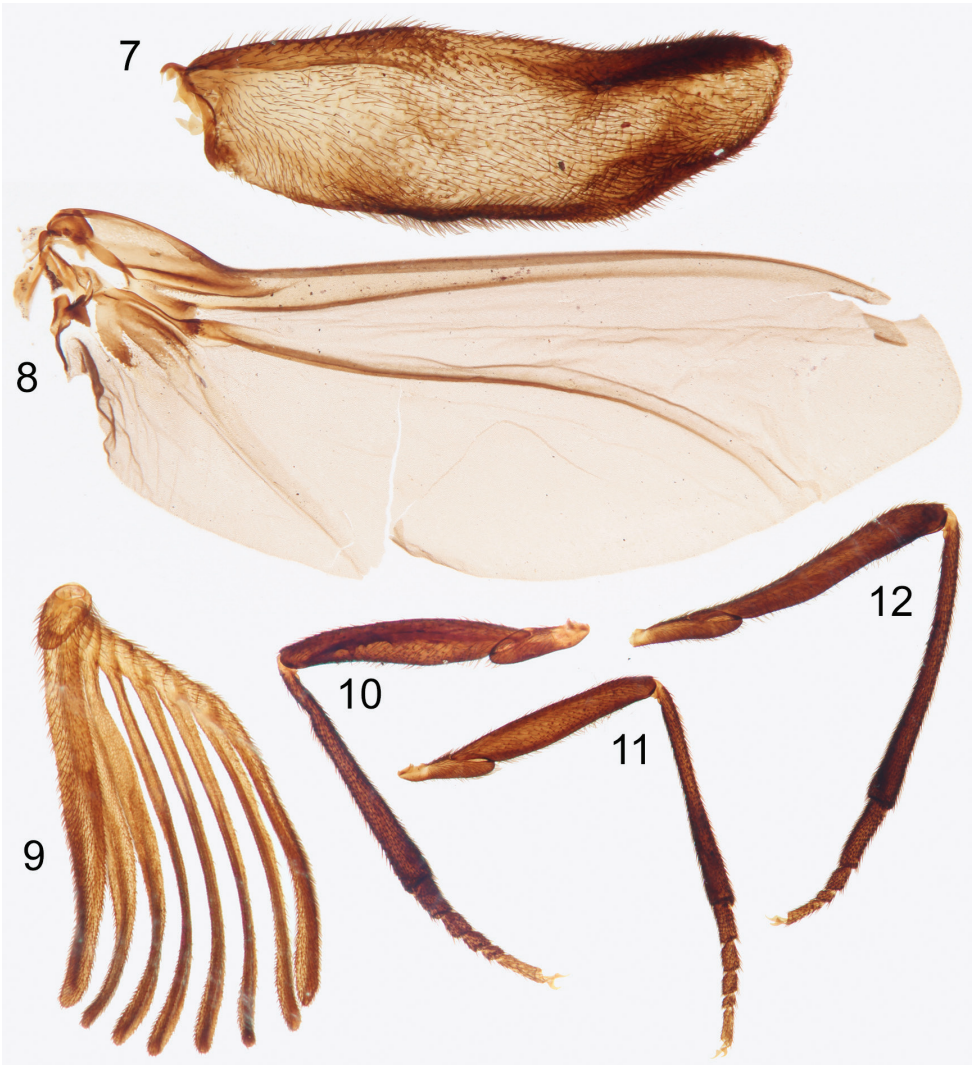
Mesepisternum fused with mesosternum; mesepimeron a prominent, rounded flange separated from mesepisternum by a strong invagination. Metepisternum typical, dorsoanterior lobe present, nearly glabrous and impunctate (Fig. 1). Metepimeron separated from metepisternum by a strongly invaginated sulcus (Fig. 1), strongly dorsally arcuate in lateral view, widest near middle, tapering evenly to a point anteriorly, tapering posteriorly as well but then slightly thickening and recurving posteriorly.

Legs typical; coxae, trochanters, and femora smooth, shining with suberect setae and scattered punctation. Tibiae clothed in more stout, spine-like setae, punctation much closer, integument appearing nearly granular; tibiae more or less straight (Figs 10–12), cylindrical, broadening slightly apically; apical spurs absent. Tarsi 5-5-4 (Figs 10–12), setation and texture similar to tibiae; all tarsomeres more or less cylindrical, progressively subequal in diameter, and obliquely truncate apically; apical tarsomeres obliquely tapered basally; protarsomere I approximately 1.5 × length of protarsomere II, protarsomeres II and III subequal, protarsomere IV approximately 0.5 × length of protarsomere III, protarsomere V approximately equal to protarsomeres II and III combined; length of mesotarsi greater than that of protarsi, but relative ratios similar. Metatarsomere I approximately as long as metatarsomeres II–IV combined, metatarsomere II 2 × length of metatarsomere III, metatarsomere IV approximately equal to metatarsomeres II and III combined. Pretarsal claws small, simple, sickle-shaped.

Elytra as described above; widely separated, short, both disarticulated in holotype but approximately extending just past posterior margin of metanotum when closed. Deformed in preservation, lateral margin somewhat thickened (Fig. 7), both margins widening slightly in basal 1/3, roughly parallel in medial 1/3, then medial margin tapering unevenly laterally in apical 1/3, forming a blunt, rounded apex nearest lateral margin. Hind wing also as above, with vein R parallel to and more or less fused with C+Sc, terminating prior to wing apex (Fig. 8); vein Cu well defined, $2^{nd}A_3$+$3^{rd}A_1$ less so, each reaching wing margin (Fig. 8).

Abdomen partially disarticulated in holotype specimen making *in situ* characterization difficult. Abdomen likely bluntly sub-conical, possibly dorso-ventrally compressed in life; with eight (I–VIII) visible tergites and seven (II–VIII) visible ventrites; well-sclerotized spiracles present in poorly-defined pleural region of segments I–VI (Fig. 13); tergites and ventrites fairly uniformly setose (Fig. 13), pleural regions slightly more densely. Tergites I–V and ventrites II–V weakly sclerotized; remaining visible abdominal segments (VI–VIII) comparatively more so (Fig. 13), color similar to that of body, integument virtually impunctate. Abdominal segment IX with dorso-posterior margin evenly emarginate though sclerotization gives it a bilobed appearance (Fig. 13); dorso-ventrally convex, lobes fusing ventrally, forming a spine projecting anteriorly and asymmetrically to left in dorsal view (Fig. 13).

Tegmen appearing typical for tribe (Fig. 14); an approximately bilaterally symmetrical tube sclerotized dorsally, open ventrally, truncate but slightly flared basally, deeply emarginate apically. Gonoforceps similarly sclerotized, membranously articulated to apex of tegmen dorsally, lateral articulation difficult to discern, also more or



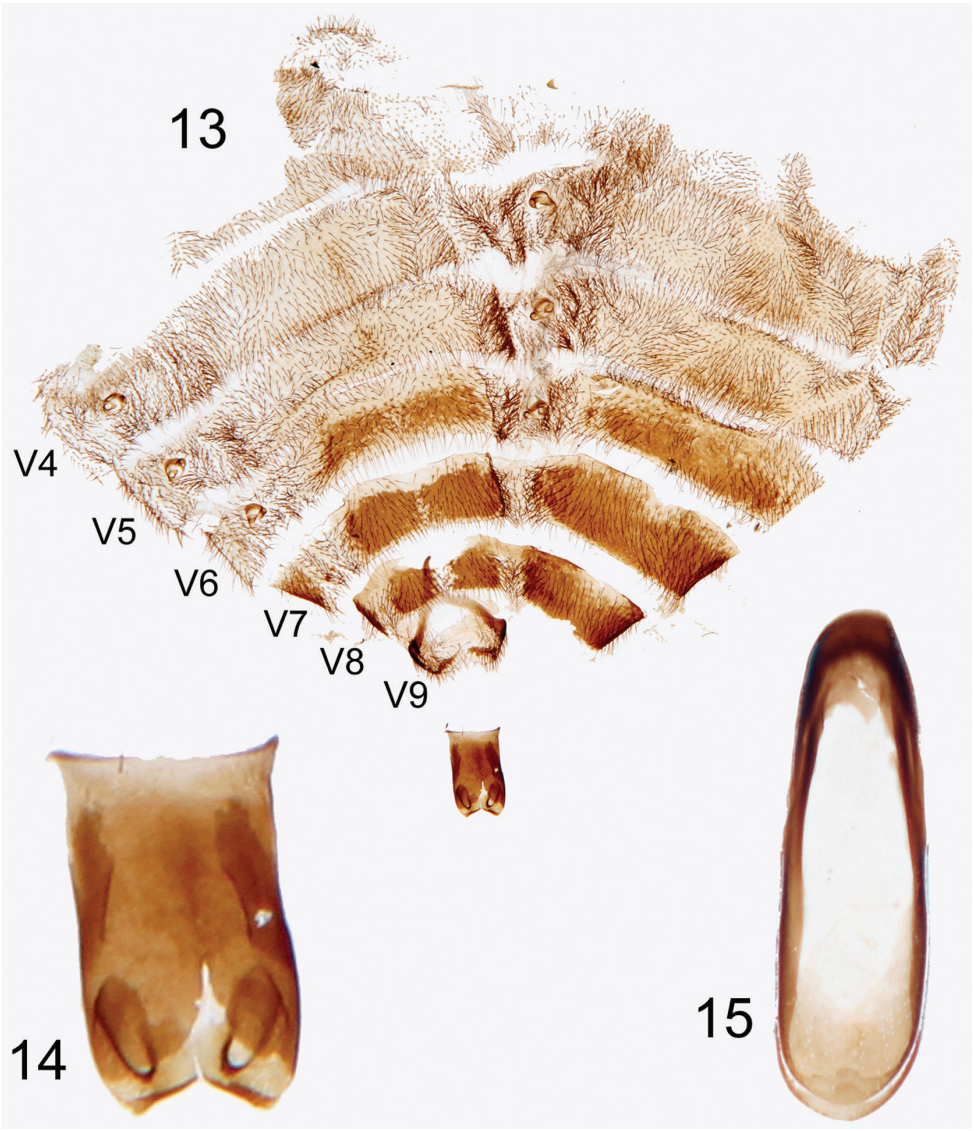
Figures 7–12. Photographs of slide mounted structures from holotype male of *Rhipidocyrtus muiri* Falin & Engel, gen. et sp. n. **7** Elytron **8** Hind wing **9** Right antenna **10** Foreleg **11** Mid-leg **12** Hind leg.

less bilaterally symmetrical and consisting of paired, medio-obliquely truncate lobes dorsally and medio-obliquely oriented digitiform projections ventrally. Median lobe extremely simple, essentially appearing as a strongly beveled ovoid ring, the basal end with a dorsally sclerotized shelf and the apical end with a ventrally sclerotized shelf (Fig. 15).

Female. Unknown.

Immature stages. Unknown.

Etymology. The specific epithet is as proposed by H.S. Barber and meant to commemorate Dr. Frederick Muir, a remarkable and inspiring entomologist.



Figures 13–15. Photographs of slide mounted abdominal structures from holotype male of *Rhipidocyrtus muiri* Falin & Engel, gen. et sp. n. **13** Splayed abdomen as preserved on slide, numbered ventrites to the left, unnumbered tergites to the right **14** Enlarged detail, ventral view of tegmen **15** Enlarged detail of median lobe.

Comments. Most ripidiine species, this one included, are described on the basis of very few, if not unique specimens, naturally making estimations of intra-specific variation in size and appearance difficult. In the few cases in which we have examined long series of a single species, such variability appears to be quite low. We expect, then, that additional specimens of *Rh. muiri* will hew quite closely to the above description.

Discussion

As currently understood, Southeast Asia is home to two precinctive ripidiine genera (e.g., *Falsorhipidius* Pic and *Pseudorhipidius* Chobaut) containing three species in total. Four additional nominal species in the widespread Old World genus *Ripidius* Thunberg have been described from Southeast Asia, though their taxonomic placement and status is uncertain. At least five new species spanning two established genera (e.g., *Pseudorhipidius* and the Australian genus *Rhipidioides* Riek) and two new genera, one precinctive to Southeast Asia, one not, await description (Falin and Engel in press, unpublished data). Undoubtedly additional specimens representing additional new taxa reside in the world's collections; the total number of ripidiine taxa that may yet be documented from this under-collected yet critically threatened region is sobering indeed.

While Southeast Asia stands out as an area of high diversity and endemism for the tribe, only one other species, *Ripidius angusticollis* Pic, 1943, has been described from Borneo (in Pic's infamously succinct and uninformative style). Notes taken during a cursory examination of the putative type by ZHF during a 1996 visit to the Muséum National d'Histoire Naturelle, Paris, provide no evidence to contradict its placement within *Ripidius* and certainly foreshadow no close relationship with *Rhipidocyrtus*.

Uncertainty remains as to the exact type locality for *R. muiri*, the house and lands associated with a mining concession owned by an Englishman named Mr. Girdlestone. It is variously transliterated as "Mwong", "Mowong", and in Muir's own accounts "Moewong" (Muir 1908), though does not appear to correspond to any similarly named extant locality today. Muir spent "two weeks" there, from 10 August to approximately 24 August 1907 and "would willingly have spent two years" (Muir 1908: 56). While this has been cited as the type locality for numerous new taxa (e.g., Muir 1913, 1923; Carvalho 1983), it does not appear to have been definitively pinpointed in the literature. A close reading of Muir's travel notes suggests Moewong may be the elevated point at 0.7621°N, 109.4298°E, approximately 2 km SSW of the settlement currently called Tirta Kencana, Bengkayang District, Bengkayang Regency, West Kalimantan, Indonesia. A more thorough investigation of Muir's collecting localities would be both fascinating and scientifically profitable.

Apart from the notal characters tentatively described above, little about the morphology of *Rhipidocyrtus* lends itself to strong phylogenetic inference. It remains to be seen whether the genus falls neatly within the standard Old World ripidiine lineage as current evidence suggests or perhaps just outside the clade, in some way intermediate between the Old and New World morphological archetypes.

Likewise, the relative lack of complexity of the male genitalia despite the size of the specimen and the exquisite preparation is somewhat disappointing, indicating that male genitalia may be generally uninformative at the species level and perhaps even among closely related genera within the tribe. Little comparative work has been done on ripiphorid genitalia (see Rivnay 1929, Selander 1957; genitalic comparisons were not attempted by Falin 2003); our knowledge of the subject remains distressingly fractured and incomplete, particularly in regards to the Ripidiinae. Besuchet's (1956) morpho-

logical examination of *Ripidius quadriceps* Abeille, 1872, stands as both the best and only detailed study within the subfamily. Although a detailed comparison of male ripidiine genitalia falls outside the scope of this paper, it is interesting to note that while similar in overall structure, differences in the postero-dorsal margins of abdominal segment IX and the tegmen, the appearance and relative sclerotization of the parameres and, while simple, the form of the median lobe appears to differ between *R. quadriceps* and *Rh. muiri*; these and other genitalic characters may prove useful in future comparisons.

Lastly, it is worth considering again the circuitous and serendipitous path this specimen took to description. While lapses in personal scientific productivity are common, indeed inevitable, they can eventually be overcome with good personal and institutional specimen curation. We will never know why Barber failed to follow through with the original description despite his obvious interest and efforts. However, we do know that the specimen and its component slides were separated, either by Barber himself or, more likely, by some harried staff member preparing his office for its next occupant. It took well over half a century for an incredibly unlikely meeting of systematists to occur to transcend that particular curatorial oversight. Thankfully, the specimen will return to Washington, DC, "whole" and validly named.

Acknowledgements

We extend our gratitude to the various actors in this torrid tale of entomological intrigue, specifically the late Frederick A.G. Muir, William D. Pierce, Hebert S. Barber, John K. Bouseman, as well as the more recent Jeyaraney Kathirithamby and David Furth. The manuscript received considerable improvements from two anonymous reviewers. This is a contribution of the Division of Entomology, University of Kansas Natural History Museum and was partially supported by the G.W. Byers Entomology Opportunity Fund (to Z.H.F. for travel to the USNM) and US National Science Foundation grants DEB-0741475 and DEB-1144162 (to M.S.E.).

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RESEARCH ARTICLE

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Review of the genus *Chrysotimus* Loew from Tibet (Diptera, Dolichopodidae)

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Abstract

A review of the species of the genus *Chrysotimus* from Tibet is provided. The following four species are described as new to science: *C. motuoensis* **sp. n.**, *C. tibetensis* **sp. n.**, *C. xuankuni* **sp. n.**, *C. zhui* **sp. n.** A key to the eight Tibetan species is presented.

Keywords

Diptera, Dolichopodidae, *Chrysotimus*, review, new species, Tibet, Taxonomy

Introduction

The genus *Chrysotimus* Loew, 1857 belongs to the subfamily Peloropeodinae with following characters: often yellow or yellowish hairs and bristles, small first flagellomere, posterior mesonotum distinctly flattened, wing length usually distinctly longer than body length, femora II and III each with strong anterior preapical bristles, most males with hind tarsomere 1 bearing several short black ventral bristles at base, and males

with mid tarsomere 1 at least as long as the total of corresponding tarsomeres 2-4, hypopygium with 1-2 epandrial bristles (not processes) for most Chinese species. The genus is distributed worldwide except for the Afrotropical region with 70 known species, of which 14 species are known from the Palaearctic (Negrobov 1978, 1991), and 27 species from the Oriental (Dyte 1975; Yang et al. 2011, Wang et al. 2012). Thirty-seven species are known from China including those newly described herein. *Guzeriplia* Negrobov, 1968, embodies the characters of *Chrysotimus* Loew in the head and thorax with the yellow hairs and bristles and biseriate acr, though it has large hypopygium and a long surstylus and long cercus. For these reasons, it was synonymized with *Chrysotimus* by Yang et al. (2006).

Tibet, together with the Qinghai-Xizang Plateau, Hengduan Mountains, the Himalayas and the Yarlung Zangbo River, is considered to be the one of the most active geological regions and the most sensitive and richest regions in biological diversity in Southeast Asia. Furthermore, southeastern Tibet, bordered by tropical and monsoon rainforest, provides diverse habitats for numerous Oriental insect species, a large number of which are endemic to this area. So, it is likely that more Dolichopodidae and other dipterans will be discovered in the future in this area.

All the specimens in this study were collected from the Oriental part of southeastern Tibet. Four new species are described and a key to the species of *Chrysotimus* from Tibet is presented.

Materials and Methods

Specimens were studied and illustrated with a ZEISS Stemi 2000–c stereo microscope. Genitalic preparations were made by macerating the apical portion of the abdomen in warm 10% NaOH for 17–20 min. After examination and drawing the hypopygium, it was transferred to 75% alcohol and stored in a microvial pinned below the specimen. All specimens are deposited in the Entomological Museum of China Agricultural University (EMCAU), Beijing, China.

Abbreviations are as follows

acr	acrostichal bristles
ad	anterodorsal bristles
av	anteroventral bristles
d	dorsal bristles
dc	dorsocentral bristles
LI	fore leg
LII	mid leg
LIII	hind leg

oc ocellar bristles
pd posterodorsal bristles
pv posteroventral bristles
v ventral bristles
CuAx ratio length of m-cu / length of distal portion of CuA

Taxonomy

Genus *Chrysotimus* Loew, 1857

Chrysotimus Loew, 1857: 48. Type species: *Chrysotimus pusio* Loew, 1861, des. Coquillett (1910: 524).
Guzeriplia Negrobov, 1968: 470. Type species: *Guzeriplia chlorina* Negrobov, 1968 (original designation).

Key to species (males) of *Chrysotimus* from Tibet

1 Hypopygium large (about as long as half of abdomen in length)..... ***C. grandis* Wang & Yang**
– Hypopygium small (normal).....**2**
2 Tarsomere III1 without black ventral bristles at base ....***C. motuoensis* sp. n.**
– Tarsomere III1 with black ventral bristles at base.....**3**
3 First flagellomere as long as wide (Fig. 5).....**4**
– First flagellomere shorter than 2/3 width (Figs 2, 7, 11, 14).....**5**
4 Nine to ten irregularly paired acr; tarsomere III1 with 2 black ventral bristles at base; cercus long with basal part wide (Fig. 16)..... ***C. zhui* sp. n.**
– Three to four irregularly paired acr; tarsomere III1 with 10-11 black ventral bristles on basal 1/6; cercus short and round in lateral view (Fig. 6)..... .....***C. lii* Wang & Yang**
5 Acr 3-4 paired; cercus round in lateral view (Figs 8, 15).....**6**
– Acr more than 5 pairs; cercus not round in lateral view (Figs 3, 12) **7**
6 Tarsomere III1 with more than 10 black ventral bristles on basal 1/6; epandrium with wide lateral process (Fig. 8) ..... ***C. linzhiensis* Wang & Yang**
– Tarsomere III1 with 5–6 black ventral bristles at base; epandrium without distinct lateral process (Fig. 15).....***C. xuankuni* sp. n.**
7 Tarsomere II1 longer than total length of tarsomere II2-5; Tarsomere III1 with 4-6 black ventral bristles at base; cercus long and thick with long bristles (Fig. 12)..... ***C. tibetensis* sp. n.**
– Tarsomere II1 shorter than total length of tarsomere II2-5; Tarsomere III1 with 10–12 black ventral bristles on basal 1/5; cercus short and bifurcated (Fig. 3).....***C. bifurcatus* Wang & Yang**

Chrysotimus bifurcatus Wang & Yang, 2006

Figs 1–3

Chrysotimus bifurcatus Wang & Yang, 2006. Ent. Fenn. 16: 100. Type locality: China: Tibet, Bomi.

Diagnosis. All coxae yellow. 6-7 irregularly paired acr short and hair-like. Tarsomere III1 with group of 10–12 short black ventral bristles on basal 1/5, and row of 8-9 pv. Cercus bifurcated. For a full description of this species, see Wang and Yang (2006).

Specimens examined. Type holotype, ♂, Tibet: Bomi, alt. 3050m, 1978.VII.16, leg. Fasheng Li. This specimen was collected from the subtropical rainforest with a sweep net and is deposited in EMCAU.

Distribution. Tibet (Bomi).

Chrysotimus grandis Wang & Yang, 2006

Fig. 4

Chrysotimus grandis Wang & Yang, 2006. Ent. Fenn. 16: 101. Type locality: China: Tibet, Bomi.

Diagnosis. Palpus blackish. 6 strong dc, 6-7 irregularly paired acr short and hair-like. Tarsomere II1 longer than the total length of tarsomeres II2-5. Surstylus with large swollen apex. For a full description of this species, see Wang and Yang (2006).

Specimens examined. Type holotype, ♂, Tibet : Bomi, alt. 3700m, 1978.VIII.12, leg. Fasheng Li. This specimen was collected from the subtropical rainforest with a sweep net and is deposited in EMCAU.

Distribution. Tibet (Bomi).

Chrysotimus lii Wang & Yang, 2006

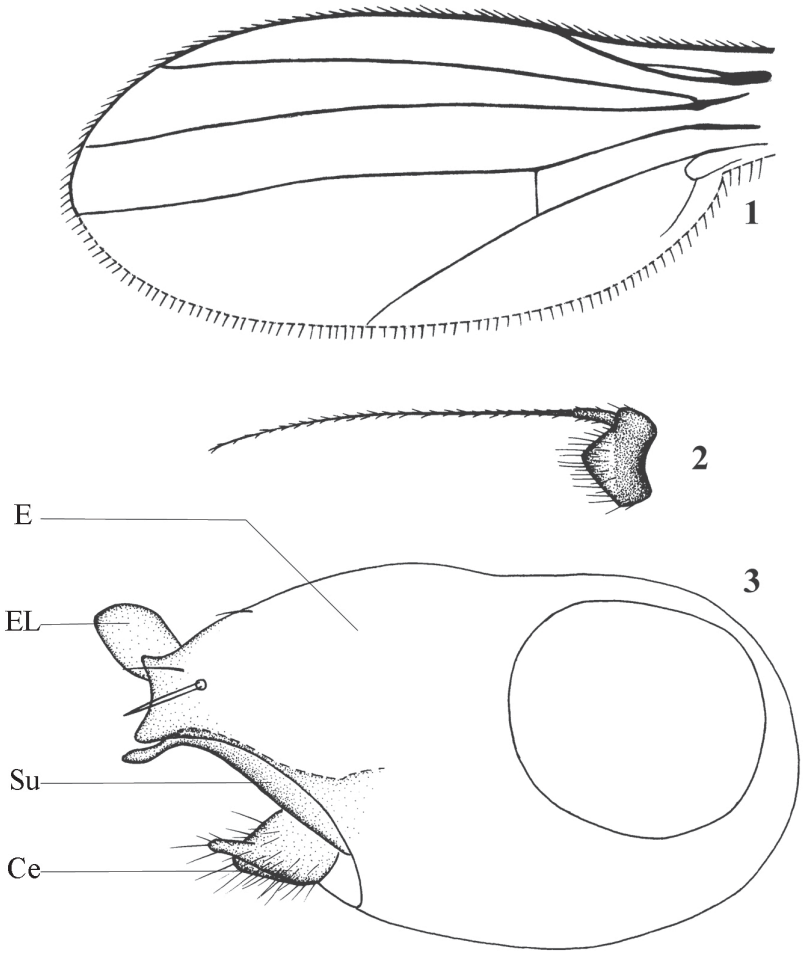
Figs 5–6

Chrysotimus lii Wang & Yang, 2006. Ent. Fenn. 16: 102. Type locality: China: Tibet, Bomi.

Diagnosis. First flagellomere subtriangular, as long as wide. Tarsomere III1 with group of 10–11 short black ventral bristles on basal 1/6. For a full description of this species, see Wang and Yang (2006).

Specimens examined. Type holotype, ♂, Tibet: Bomi, alt. 3050m, 1978.VII.16, leg. Fasheng Li. Paratypes, 2 ♂♂, Tibet: Linzhi, 1978. VI.1-3, leg. Fasheng Li. These specimens were collected from the subtropical rainforest with a sweep net and are deposited in EMCAU.

Distribution. Tibet (Bomi, Linzhi).



Figures 1–3. *Chrysotimus bifurcatus* Wang & Yang, 2006, male. **1** wing **2** first flagellomere, lateral view **3** hypopygium, lateral view. **C** cercus; **E** epandrium; **EL** epandrial lobe; **Su** surstylus.

Chrysotimus linzhiensis Wang & Yang, 2006

Figs 7–8

Chrysotimus linzhiensis Wang & Yang, 2006. Ent. Fenn. 16: 103. Type locality: China: Tibet, Linzhi.

Diagnosis. Palpus pale yellow. First flagellomere short, about 1.5 times wider than long. Tarsomere III1 with group of about 13 short black ventral bristles on basal 1/6. For a full description of this species, see Wang and Yang (2006).

Specimens examined. Type holotype, ♂, Tibet : Linzhi, alt. 3050m, 1978.VI.1-3, leg. Fasheng Li. This specimen was collected from the monsoon rainforest with a sweep net and is deposited in EMCAU.

Distribution. Tibet (Linzhi).

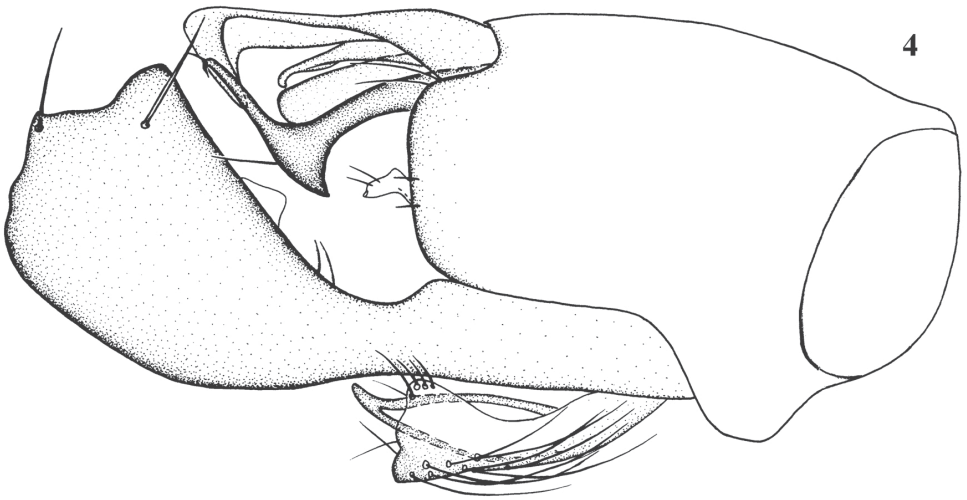
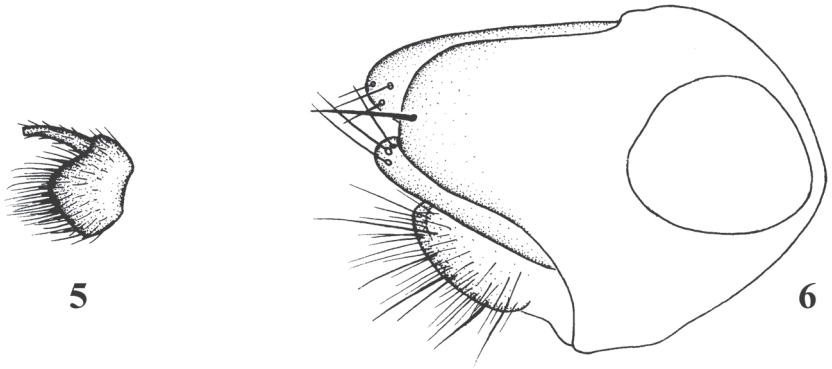


Figure 4. *Chrysotimus grandis* Wang & Yang, 2006, male, hypopygium, lateral view.



Figures 5–6. *Chrysotimus lii* Wang & Yang, 2006, male. **5** first flagellomere (arista broken); lateral view **6** hypopygium, lateral view.

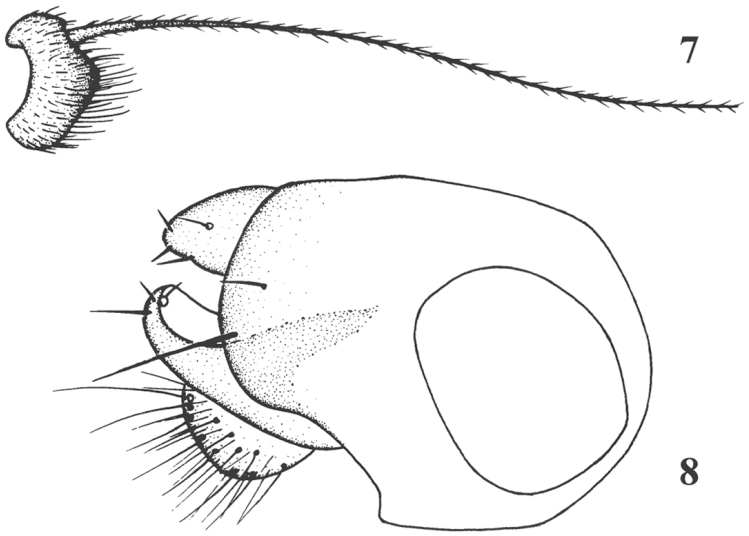
Chrysotimus motuoensis sp. n.

http://zoobank.org/0786482E-B699-45E4-9BC0-065F4A687EAC
Figs 9–10

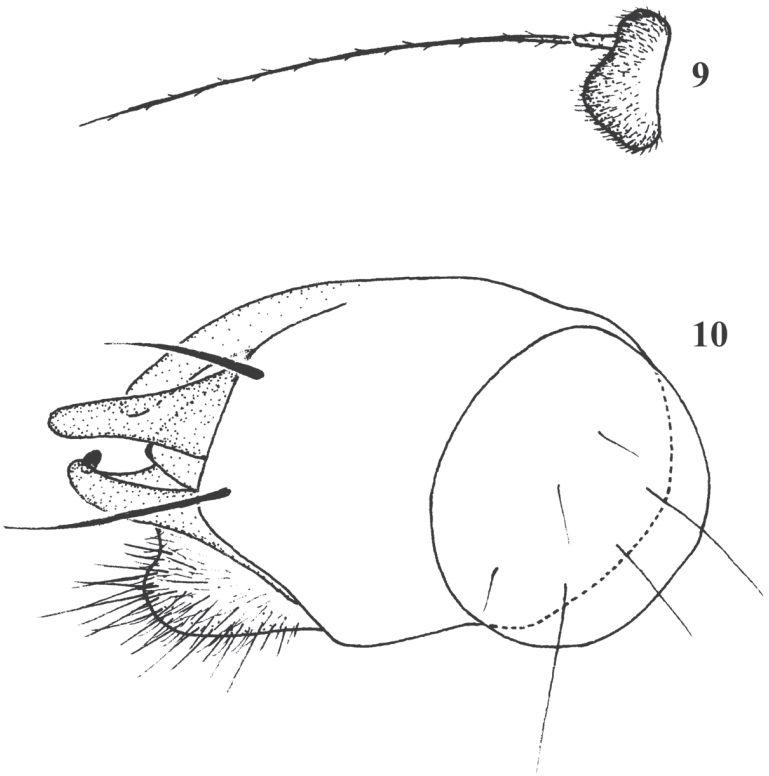
Diagnosis. Antenna yellow, with both pedicel and 1st flagellomere both with brown dorsal surface; acr absent; abdomen with tergites brilliantly metallic green dorsally and yellow laterally, and with yellow sternites; tarsomere III1 without black ventral spine-like bristles at base.

Dexcription. Male. Body length 1.9 mm, wing length 1.9 mm.

Head metallic green with gray pollen; frons and face brilliant; eyes separated distinctly; face wide and slightly narrower towards clypeus. Hairs and bristles yellow. Ocellar tubercle weak, with 2 very long oc and 2 very short posterior hairs. Lower



Figures 7–8. *Chrysotimus linzhiensis* Wang & Yang, 2006, male. **7** first flagellomere, lateral view **8** hypopygium, lateral view.



Figures 9–10. *Chrysotimus motuoensis* sp. n., male. **9** first flagellomere, lateral view **10** hypopygium, lateral view.

postocular bristles (including ventral hairs) pale. Antenna yellow, with both pedicel and 1st flagellomere with brown dorsal surface; first flagellomere (Fig. 9) rather short, about 0.6 times as long as wide; arista apical, with basal segment very short. Proboscis brown, with pale hairs; palpus pale yellow, with pale hairs and 2 brown apical bristles.

Thorax metallic green with pale gray pollen, with pleura yellow. Hairs and bristles yellow; 6 dc, acr absent; scutellum with 2 pairs of bristles. Propleuron with 1 pale bristle on lower part. Legs including coxae yellow with 5th tarsomeres brown. Hairs and bristles on legs pale yellow; coxa I with 3-4 anterior and apical bristles, coxa II with 2 anterior and apical bristles, coxa III with 1 brown outer bristle near middle. Femora II and III each with 1 apical av. Tibia II with 2 ad and 2 pd, apically with 3 bristles; tibia III with 1 ad and 2 pd, apically with 3 bristles. All tarsomere 1 each with row of v. Tarsomere III 1 without black ventral spine-like bristles at base. Relative lengths of tibia and 5 tarsomeres of legs. LI 3.4: 2.2: 1.0: 0.8: 0.6: 0.4; LII 4.0: 2.4: 1.1: 0.9: 0.5: 0.4; LIII 4.7: 1.0: 1.4: 0.9: 0.6: 0.4.

Wing hyaline; veins brownish, R_{4+5} and M parallel apically; CuAx ratio 0.3. Squama brown with brown hairs. Halter pale yellow.

Abdomen metallic green with pale gray pollen, tergites brilliant, sternites and lateral portion yellow. Hairs and bristles on tergites dark brown, and pale yellow on sternites.

Hypopygium (Fig. 10): Epandrium with truncate apex bearing 2 epandrial bristles, apically with wide lateral epandrial process; long surstylus with inner spine-like process; cercus somewhat round, with moderately long hairs; hypandrium with round apex.

Female. Body length 1.8 mm, wing length 1.7 mm. Similar to male, but antenna entirely yellow.

Specimens examined. Holotype ♂, Tibet: Motuo county, alt. 1100m, 2012. VIII.26, leg. Xuankun Li. Paratype, 1 ♀ same data as holotype. These specimens were collected from the subtropical rainforest with a sweep net and are deposited in EMCAU.

Distribution. Known only from the type locality in Tibet.

Remarks. This new species is similar to *Chrysotimus guangxiensis* Yang & Saigusa, but may be separated from the latter by brown proboscis, pale yellow palpus, and the tergites metallic green, sternites and lateral portion yellow. In *guangxiensis*, it has yellow proboscis, brown palpus, and whole abdomen metallic green (Yang and Saigusa 2001).

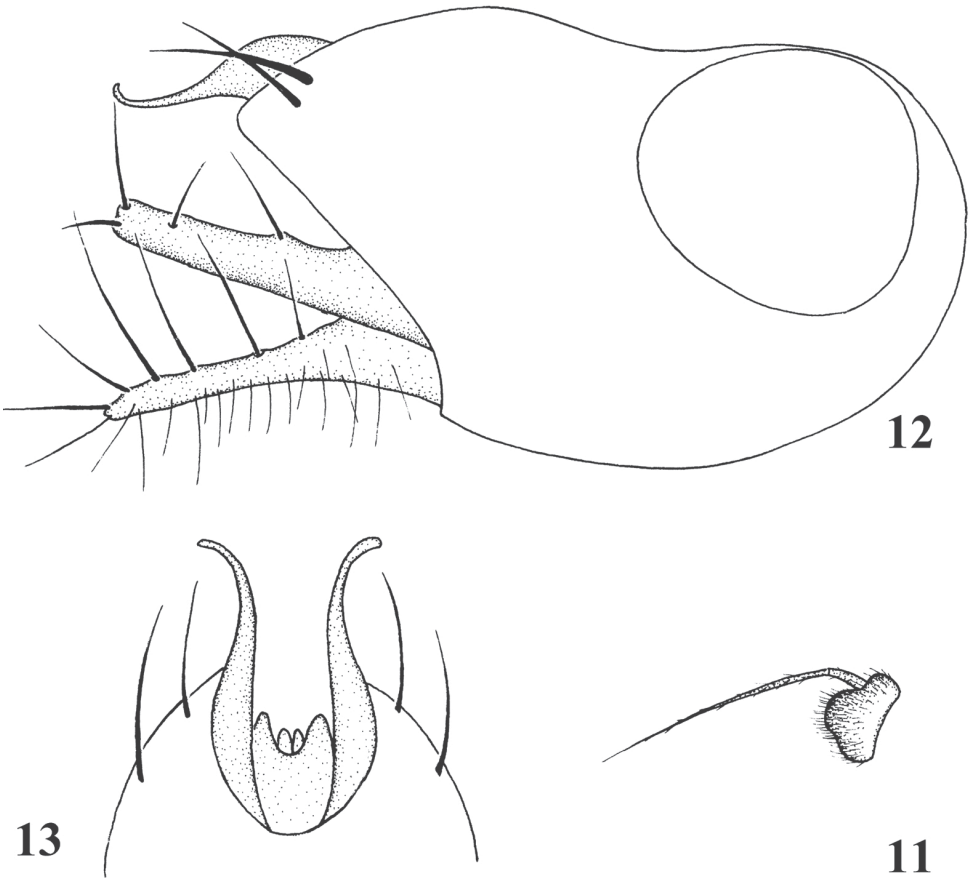
Etymology. The specific epithet derives from the type locality Motuo (Tibet).

Chrysotimus tibetensis sp. n.

http://zoobank.org/17995E26-9DAB-4CD9-AE81-1DC2068681FD
Figs 11–13

Diagnosis. Antenna whole brown; acr 5–6 irregular pairs; abdomen whole brilliant metallic green; tarsomere III1 with 4–6 short black ventral bristles at base; cercus long and thick, with sparse hairs and long bristles.

Description. Male. Body length 1.7–1.8 mm, wing length 2.2–2.5 mm.



Figures 11–13. *Chrysotimus tibetensis* sp. n., male. **11** first flagellomere, lateral view **12** genitalia, lateral view **13** tip of hypopygium, ventral view.

Head metallic green with gray pollen; frons and face brilliant; eyes separated distinctly. Hairs and bristles on head yellow. Ocellar tubercle weak, with 2 very long oc and 2 very short posterior hairs. Lower postocular bristles (including ventral hairs) pale. Antenna (Fig. 11) brown; first flagellomere with round apex, rather short, about 0.6 times as long as wide; arista dorsal, with basal segment very short. Proboscis brown, with pale hairs; palpus pale yellow, with pale hairs and 2 brown apical bristles.

Thorax metallic green with pale gray pollen, mesonotum and scutellum brilliant. Hairs and bristles on thorax yellow; 6 dc, 5–6 irregular paired acr; scutellum with 2 pairs of bristles. Propleuron with 1 pale bristle on lower portion. Legs including coxae yellow with 5th tarsomeres brown (some specimens with black legs, except for yellow femoral base and tip). Hairs and bristles on legs pale yellow; coxa I with 2-4 anterior and apical bristles, coxa II with 3-4 anterior and apical bristles, coxa III with 1 brown outer bristle near middle. Femur II with 1 av and 1 pv apically, femur III with 1 av apically. Tibia II with 2 ad and 1 pd, apically with 3 bristles; tibia III with 2 ad, 2 pd, and row of pv, api-

cally with 3 bristles. All tarsomere 1 each with row of v. Tarsomere III1 with 4-6 short black ventral bristles at base. Relative lengths of tibia and 5 tarsomeres of legs. LI 4.2: 2.4: 1.2: 1.0: 0.6: 0.4; LII 5.6: 3.2: 1.2: 0.8: 0.5: 0.4; LIII 6.4: 2.8: 1.6: 1.2: 0.8: 0.6.

Wing hyaline; veins brownish, R_{4+5} and M parallel apically; CuAx ratio 0.27. Squama yellow with pale hairs. Halter pale yellow.

Abdomen metallic green with pale gray pollen, tergites and sternites brilliant. Hairs and bristles on tergites dark brown.

Hypopygium (Figs 12–13): Epandrium with acute apex, apically with 2 epandrial bristles and wide lateral epandrial process, bearing thin and curved apex; long and thick surstylus with long bristles; cercus long and thick, with sparse hairs and long bristles; hypandrium shorter than epandrium.

Female. Body length 1.5–1.7 mm, wing length 1.9–2.0 mm. Similar to male, with whole abdomen metallic green.

Specimens examined. Holotype ♂, Tibet: Linzhi, 2012. IX.2–12 (M). Paratypes, 32♂♂ 14♀♀, same data as holotype. Other specimens: 1♂4♀♀, Tibet: Linzhi, 2012.VIII (M); 3♂32♀♀, Tibet: Linzhi, 2012. IX.22–X.1 (M); 12♂♂7♀♀, Tibet: Linzhi Sejila Mountain, alt. 3810m, 2012.VIII.25–IX.2 (M); 4♂♂11♀♀, Tibet: Linzhi Sejila Mountain, alt. 3260m, 2012.VIII.12–18 (M); 3♂♂2♀♀, Tibet: Linzhi Sejila Mountain Lulangdong, alt. 3349m, 2012.VIII.25–IX. 2 (M); 7♂♂15♀♀, Tibet: Linzhi Sejila Mountain Lulangdong, alt. 3312m, 2012.VIII.18–25 (M); 8♂♂, Tibet: Linzhi Sejila Mountain Kouxi, alt. 3780m, 2012.VIII.15–18 (M); 18♂♂13♀♀, same site, 2012.VIII.19–25 (M); 5♂♂11♀♀, Tibet: Linzhi Nongmuxueyuan Dianzhan, alt. 3573m, 2012.VII.7–15 (M), all leg. Chaodong Zhu. These specimens were collected from the monsoon rainforest with Malaise traps and are deposited in EMCAU.

Distribution. Known only from the type locality in Tibet.

Remarks. This new species is similar to *Chrysotimus ningxianus* Wang, Yang & Grootaert, but may be separated from the latter by rounded first flagellomere, and the epandrium with 1 lateral epandrial process. In *ningxianus*, it has triangular first flagellomere, and the epandrium has 2 lateral epandrial processes (Wang et al. 2005).

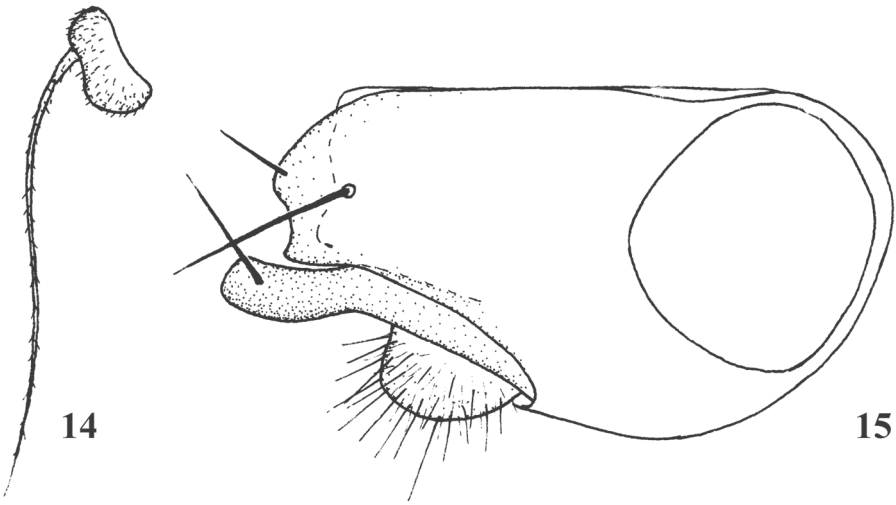
Etymology. The specific epithet derives from the type locality in Tibet.

Chrysotimus xuankuni sp. n.

http://zoobank.org/53EFFF74-0CF8-46D2-B9DE-5BC83BB27D7D
Figs 14–15

Diagnosis. Antenna blackish; first flagellomere rather short, about 0.4 times as long as wide; ac 3–4 irregular pairs; tibia I with row of 8–9 d; abdomen whole brilliant metallic green; tarsomere III1 with 5–6 short black ventral bristles at base; epandrium without distinct lateral process; cercus round, with moderate hairs.

Description. Male. Body length 1.5 mm, Wing length 1.6 mm.



Figures 14–15. *Chrysotimus xuankuni* sp. n., male. **14** first flagellomere, lateral view **15** genitalia, lateral view.

Head metallic green with gray pollen; frons and face brilliant; eyes separated distinctly. Hairs and bristles on head yellow. Ocellar tubercle weak, with 2 very long oc and 2 very short posterior hairs. Lower postocular bristles (including ventral hairs) pale. Antenna blackish; first flagellomere (Fig. 14) rather short, about 0.4 times as long as wide; arista dorsal, with basal segment very short. Proboscis blackish, with brown hairs; palpus brown, with brown hairs and 2 brown apical bristles.

Thorax metallic green with pale gray pollen, mesonotum and scutellum brilliant. Hairs and bristles on thorax yellow; 6 dc, 3-4 irregular paired acr; scutellum with 2 pairs of bristles. Propleuron with 1 pale bristle on lower portion. Legs including coxae yellow with 5th tarsomeres brown. Hairs and bristles on legs pale yellow; coxa I with 3–4 anterior and apical bristles, coxa II with 3–4 anterior and apical bristles, coxa III with 1 brown outer bristle near middle. Femora II and III each with 1 av apically. Tibia I with row of 8–9 d; tibia II with 2 ad and 2 pd, apically with 3 bristles; tibia III with 1 ad, 2 pd, apically with 3 bristles. All tarsomere 1 each with row of v. Tarsomere III1 with 5–6 short black ventral bristles at base. Relative lengths of tibia and 5 tarsomeres of legs. LI 4.2: 2.0: 1.0: 0.8: 0.6: 0.6; LII 5.2: 2.4: 1.6: 1.2: 0.6: 0.6; LIII 5.2: 1.4: 1.4: 0.8: 0.6: 0.6.

Wing hyaline; veins brownish, R_{4+5} and M parallel apically; CuAx ratio 0.28. Squama yellow with pale hairs. Halter brownish.

Abdomen metallic green with pale gray pollen, tergites and sternites brilliant. Hairs and bristles on abdomen dorsal dark brown.

Hypopygium (Fig. 15): Epandrium with wide apex, apically with invision, bearing 2 epandrial bristles, but no distinct lateral epandrial process; long and thick surstylus with curved apex; cercus round, with moderate hairs; hypandrium shorter than epandrium.

Female. Body length 1.5–1.6 mm, Wing length 1.5–1.6 mm. Similar to male, with whole abdomen metallic green.

Specimens examined. Holotype ♂, Tibet: Motuo county, alt. 1100m, 2012. VII. 26, leg. Xuankun Li. Paratype, 2♀♀, same data as holotype. These specimens were collected from the subtropical rainforest with a sweep net and are deposited in EMCAU.

Distribution. Known only from the type locality in Tibet.

Remarks. This new species is similar to *Chrysotimus guangdongensis* Wang, Yang & Grootaert, but may be separated from the latter by the rowed d on tibia I, and the epandrium bearing no distinct lateral process. In *guangdongensis,* it lacks distinct rowed d on tibia I, and features a lateral process of the epandrium (Wang et al. 2005).

Etymology. The specific epithet derives from the collector of type species Xuankun Li.

***Chrysotimus zhui* sp. n.**

http://zoobank.org/0F6879D6-3630-4423-B4B0-D77A4D7ED7DD

Fig. 16

Diagnosis. Antenna brown; first flagellomere subtriangular, about as long as wide; acr 9–10 irregular pairs; tarsomere III1 with 2 short black ventral bristles on long kidney-shaped black spot; abdominal dorsum brilliant metallic green; epandrium with long and curved surstylus; cercus long with wide basal part, with long hairs and bristles.

Description. Male. Body length 1.9–2.0 mm, Wing length 2.2–2.4 mm.

Head metallic green with gray pollen; frons and face brilliant; eyes separated distinctly. Hairs and bristles on head yellow. Ocellar tubercle weak, with 2 very long oc and 2 very short posterior hairs. Lower postocular bristles (including ventral hairs) pale. Antenna brown; first flagellomere subtriangular, about as long as wide; arista dorsal, with basal segment very short. Proboscis blackish, with brown hairs; palpus yellow, with yellow hairs and 2 brownish apical bristles.

Thorax metallic green with pale gray pollen, mesonotum and scutellum brilliant. Hairs and bristles on thorax yellow; 6 dc, 9–10 irregular paired acr; scutellum with 2 pairs of bristles. Propleuron with 1 pale bristle on lower portion. Legs including coxae yellow with 5th tarsomeres brown. Hairs and bristles on legs pale yellow; coxa I with 3–4 anterior and apical bristles, coxa II with 4–6 anterior and apical bristles, coxa III with 1 brown outer bristle near middle. Femur II with 1 av and 1 pv apically, femur III with 1 av apically. Tibia II with 2 ad and 2 pd, apically with 3 bristles; tibia III with 2 ad, 2 pd, and row of pv, apically with 3 bristles. All tarsomere 1 each with row of v. Tarsomere III1 with long kidney-shaped black spot at base, with 2 short black ventral bristles at black spot. Relative lengths of tibia and 5 tarsomeres of legs. LI 4.4: 2.8: 1.0: 0.8: 0.5: 0.5; LII 6.0: 3.6: 1.4: 1.0: 0.6: 0.6; LIII 6.4: 2.0: 1.4: 1.0: 0.7: 0.6.

Wing hyaline; veins brownish, R_{4+5} and M parallel apically; CuAx ratio 0.25. Squama yellow with pale hairs. Halter pale yellow.

Abdomen metallic green with pale gray pollen, tergites brilliant. Hairs and bristles on abdomen dorsal dark brown.

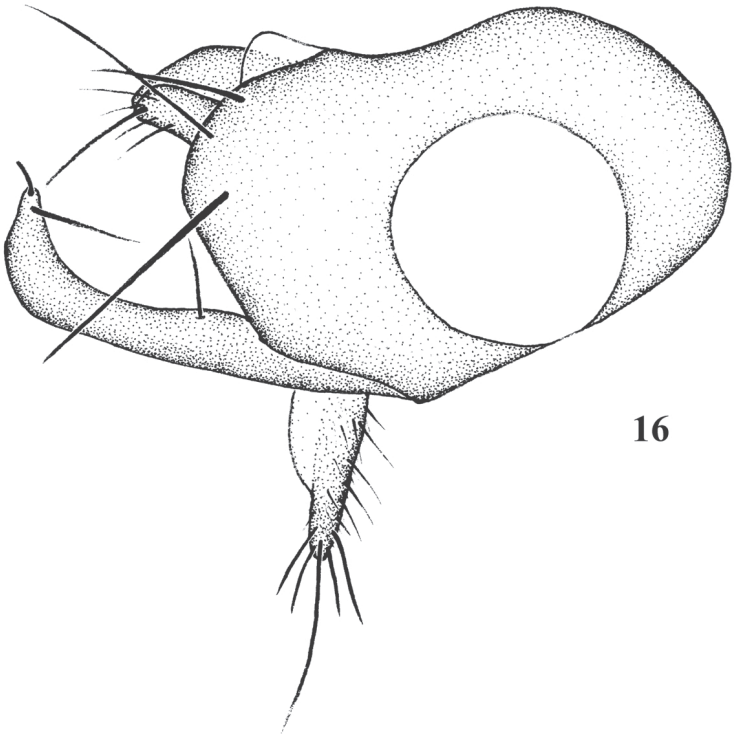


Figure 16. *Chrysotimus zhui* sp. n., male. hypopygium, lateral view.

Hypopygium (Fig. 16) metallic green (except pale hypandrium): Epandrium distinctly longer than wide, apically with 3 epandrial bristles and round short finger-like lateral epandrial process; long and curved surstylus with long bristles; cercus long with wide basal part, with long hairs and bristles; hypandrium short, pale.

Female. Body length 2.0 mm, Wing length 2.8 mm. Similar to male, with whole abdomen metallic green.

Specimens examined. Holotype ♂, Tibet: Linzhi Sejila Mountain Kouxi, alt. 3780m, 2012. VIII. 15–18 (M), leg. Chaodong Zhu; Paratype, 1♂ 1♀, same data as holotype. These specimens were collected from the monsoon rainforest with a Malaise trap and are deposited in EMCAU.

Distribution. Known only from the type locality in Tibet.

Remarks. This new species is similar to *Chrysotimus ningxianus* Wang, Yang & Grootaert, but may be separated from the latter by the black spot at tarsomere III1 base, and the epandrium with 1 single finger-like lateral epandrial process. In *ningxianus*, it has no black spot at tarsomere III1 base, and the epandrium has 2 lateral epandrial processes (Wang et al. 2005).

Etymology. The specific epithet derives from the collector of types Dr. Chaodong Zhu (Beijing).

Acknowledgements

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