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Ripidinelia daiboyui sp. nov. from mid-Cretaceous Kachin amber (Coleoptera: Ripiphoridae)

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Abstract

The second species of the ripidiine genus *Ripidinelia* Batelka & Prokop, *R. daiboyui* Li & Cai **sp. nov.**, is reported from mid-Cretaceous Kachin amber of northern Myanmar. *Ripidinelia daiboyui* is distinguishable from *R. burmiticola* Batelka & Prokop by having 5-5-4 tarsi. The apically dentate pretarsal claws found in *R. daiboyui* are rarely present in Ripidiinae. Together with previous studies, our discovery emphasizes the palaeodiversity of Ripiphoridae during the late Mesozoic.

Keywords: Ripidiinae, Burmese amber, Cretaceous, fossil, taxonomy

Introduction

The ripiphorid subfamily Ripidiinae is morphologically distinctive in having larviform females and strongly reduced mouthparts (Besuchet, 1956; Selander, 1957; Viana, 1971; Falin, 2003). Several ripidiines have been reported from mid-Cretaceous Kachin amber of Myanmar, including *Eodrias* Batelka & Prokop of Eorhipidiini (Batelka & Prokop, 2023), and *Protoripidius* Cai *et al*., *Ripidinelia* Batelka & Prokop, *Cretaceoripidius* Falin & Engel, *Paleoripiphorus* Perrichot *et al*. and *Amberocula* Batelka *et al*. of Ripidiini (Falin & Engel, 2010; Batelka *et al*., 2018; Cai *et al*., 2018; Batelka & Prokop, 2019). These fossils have revealed several morphological features that are unknown or rarely present in their extant relatives. Among them, *Ripidinelia* was characterized by the 11-segmented uniflabellate antennae, 3-segmented maxillary palpi, all tibiae with a single spur, and 4-4-4 tarsi (Batelka & Prokop, 2019). In this study, we report a new species of *Ripidinelia* from Kachin amber, which provides new information and clarifies some misunderstandings about the morphology of the genus.

Material and methods

The Kachin (Burmese) amber specimens studied herein (Figs 1–6) originated from amber mines near Noije Bum (26°20’ N, 96°36’ E), Hukawng Valley, Kachin State, northern Myanmar. The amber specimens are deposited in the Nanjing Institute of Geology and Palaeontology (NIGP), Chinese Academy of Sciences, Nanjing, China. The amber piece NIGP203880 was trimmed with a small table saw, ground with emery paper of different grit sizes, and finally polished with powder.

Photographs under incident light were taken with a Zeiss Discovery V20 stereo microscope. Widefield fluorescence images were captured with a Zeiss Axio Imager 2 light microscope combined with a fluorescence imaging system. Confocal images were obtained with a Zeiss LSM710 confocal laser scanning microscope, using the 488 nm (Argon) or 561 nm (DPSS 561-10) laser excitation line (Fu *et al*., 2021). The original confocal data are available in the Zenodo repository (https://doi.org/10.5281/zenodo.10864014). Images were stacked with Helicon Focus 7.0.2, Zerene Stacker 1.04 and Adobe Photoshop CC, and were further processed in Adobe Photoshop CC to adjust brightness and contrast.

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Systematic palaeontology

Order Coleoptera Linnaeus, 1758
Superfamily Tenebrionoidea Latreille, 1802
Family Ripiphoridae Gemminger, 1870
Subfamily Ripidiinae Gerstaecker, 1855
Tribe Ripidiini Gerstaecker, 1855
Genus *Ripidinelia* Batelka & Prokop, 2019

***Ripidinelia daiboyui* Li & Cai sp. nov.**
(Figs 1–6)

Material. Holotype, NIGP203880 (male). Paratypes, NIGP203881-1 (male) and NIGP203881-2 (male).

Etymology. The specific name is dedicated to Mr. Boyu Dai, aiming to inspire his interest in fossil insects and nature in general.

Diagnosis. *Ripidinelia daiboyui* **sp. nov.** differs from *Ripidinelia burmiticola* Batelka & Prokop primarily in the 5-5-4 tarsi (Figs 2B, 3D, 5) (tarsi 4-4-4 in *R. burmiticola*). The interfacetal setae on the compound eyes also appear to be shorter in *R. daiboyui* (Fig. 3A, B).

Locality and horizon. Amber mine located near Noije Bum Village, Tanai Township, Myitkyina District, Kachin State, Myanmar; unnamed horizon, mid-Cretaceous, Upper Albian to Lower Cenomanian.

Description. Body elongate, apparently weakly sclerotized; surface with dense fine short hairs.

Head with mouthparts strongly reduced. Compound eyes large, dorsally contiguous anteriad, ventrally entirely contiguous, with moderately long interfacetal setae. Antennae 11-segmented, uniflabellate; antennomere 1 robust, elongate, slightly widening apically; antennomeres 2 and 3 submoniliform, moderately wide; antennomeres 4–10 each with a long ramus; body of antennomeres 4–10 short (weakly elongate in antennomere 10), narrower than antennomeres 2 and 3, narrowing progressively; antennomere 11 long, expanded, similar in shape to rami of previous antennomeres. Maxillary palpi 3-segmented, basally unfused.

Pronotum campaniform. Procoxae contiguous, projecting. Mesonotum with differentiation of disc and scutellum; scutellum relatively long, trapezoidal, narrowing posteriorly. Elytra separated, each with apex rounded, reaching only abdominal segment II. Mesocoxae projecting. Metanepisternum long and narrow. Metacoxae contiguous.

Legs moderately long and slender. Trochanterofemoral joints strongly oblique, though with femora well separated from coxae. Tibiae with one unequivocal apical spur (at least as seen in meso- and metatibiae). Tarsi 5-5-4; tarsomeres simple. Pretarsal claws pectinate near apex.

FIGURE 1. General habitus of *Ripidinelia daiboyui* Li & Cai **sp. nov.**, holotype, NIGP203880, under incident light. **A**, Dorsal view. **B**, Ventral view. Scale bars = 1 mm.

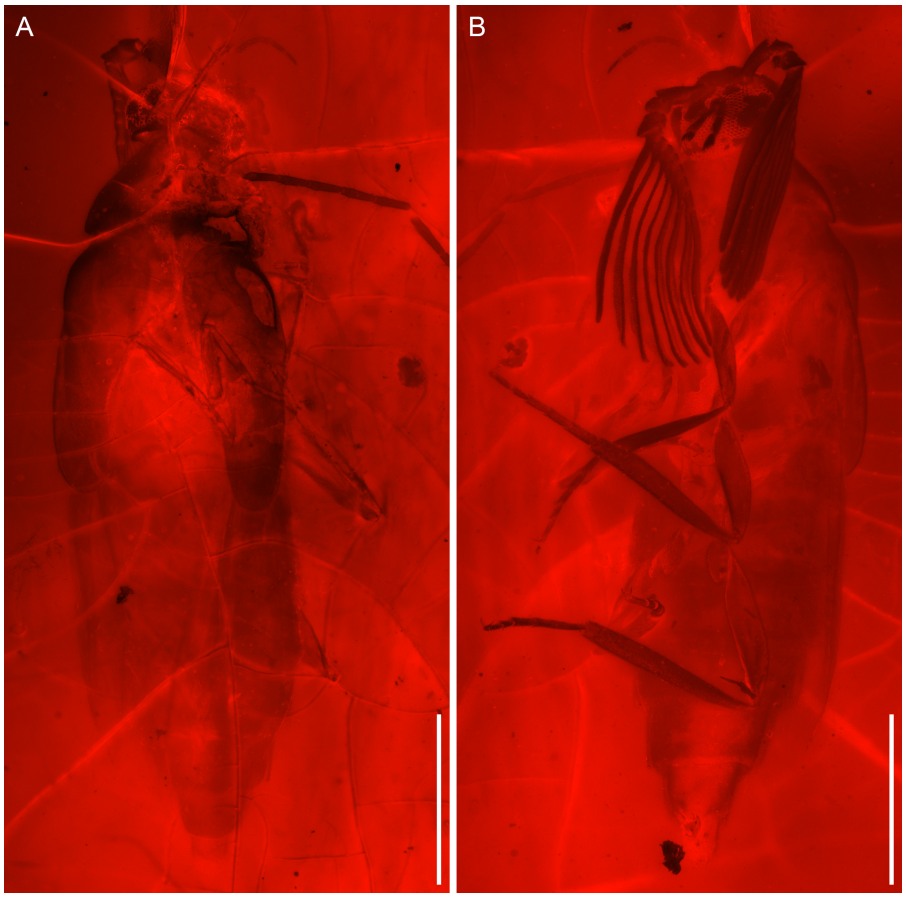

FIGURE 2. General habitus of *Ripidinelia daiboyui* Li & Cai **sp. nov.**, holotype, NIGP203880, under widefield fluorescence. **A**, Dorsal view. **B**, Ventral view. Scale bars = 1 mm.

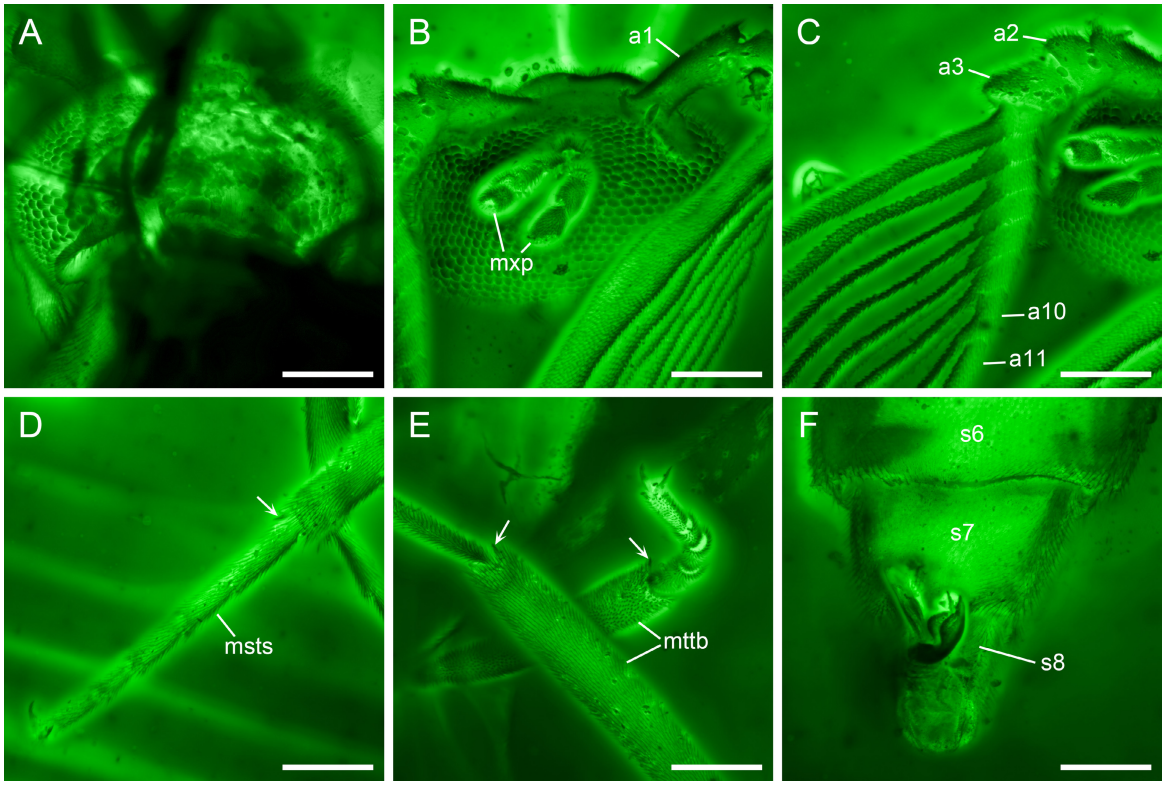

FIGURE 3. Details of *Ripidinelia daiboyui* Li & Cai **sp. nov.**, holotype, NIGP203880, under confocal microscopy. **A**, Head, dorsal view. **B**, Head, ventral view. **C**, Antenna. **D**, Mid leg, with arrow showing the tibial spur. **E**, Hind legs, with arrows showing the tibial spurs. **F**, Abdominal apex, ventral view. Abbreviations: a1–11, antennomeres 1–11; msts, mesotarsus; mttb, metatibia; mxp, maxillary palp; s6–8, abdominal sternites VI–VIII. Scale bars = 200 μm.

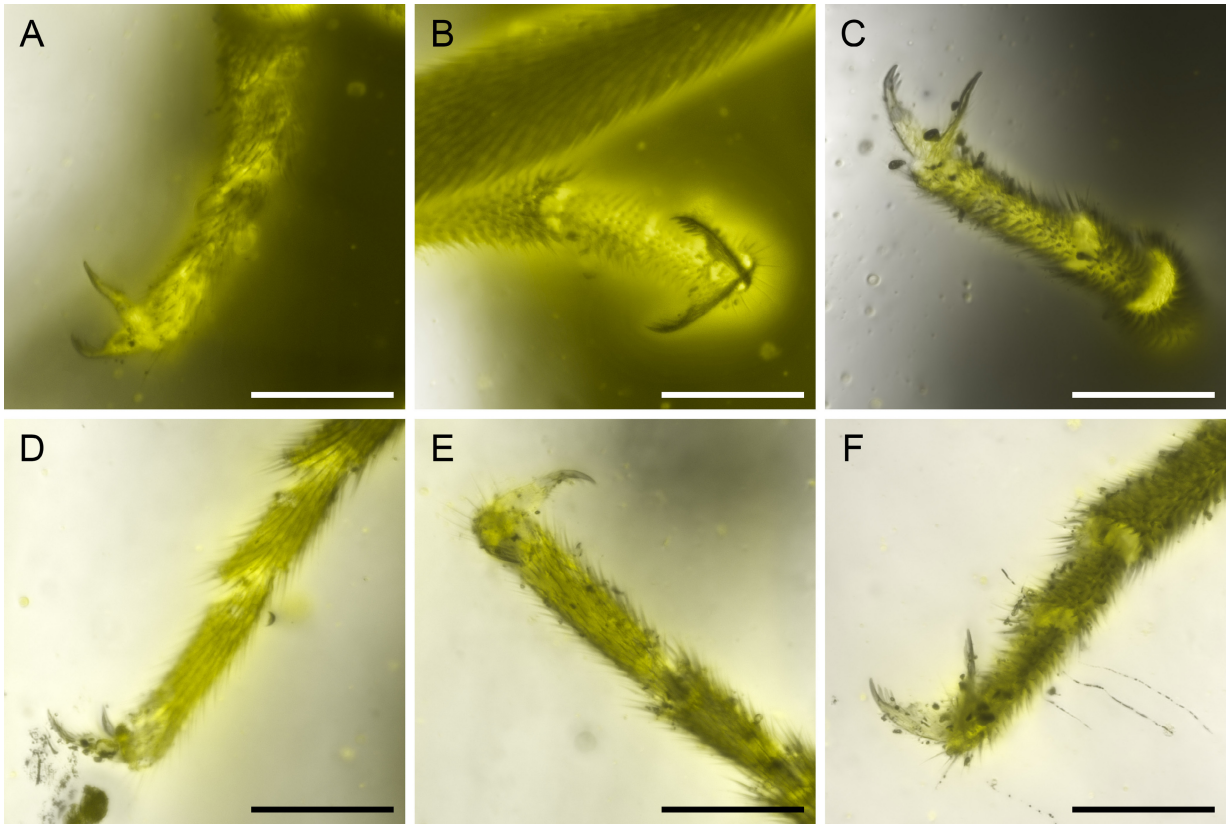

FIGURE 4. Pretarsal claws of *Ripidinelia daiboyui* Li & Cai **sp. nov.**, holotype, NIGP203880, under confocal microscopy. **A**, **D**, Fore legs. **B**, **E**, Mid legs. **C**, **F**, Hind legs. Scale bars = 100 μm.

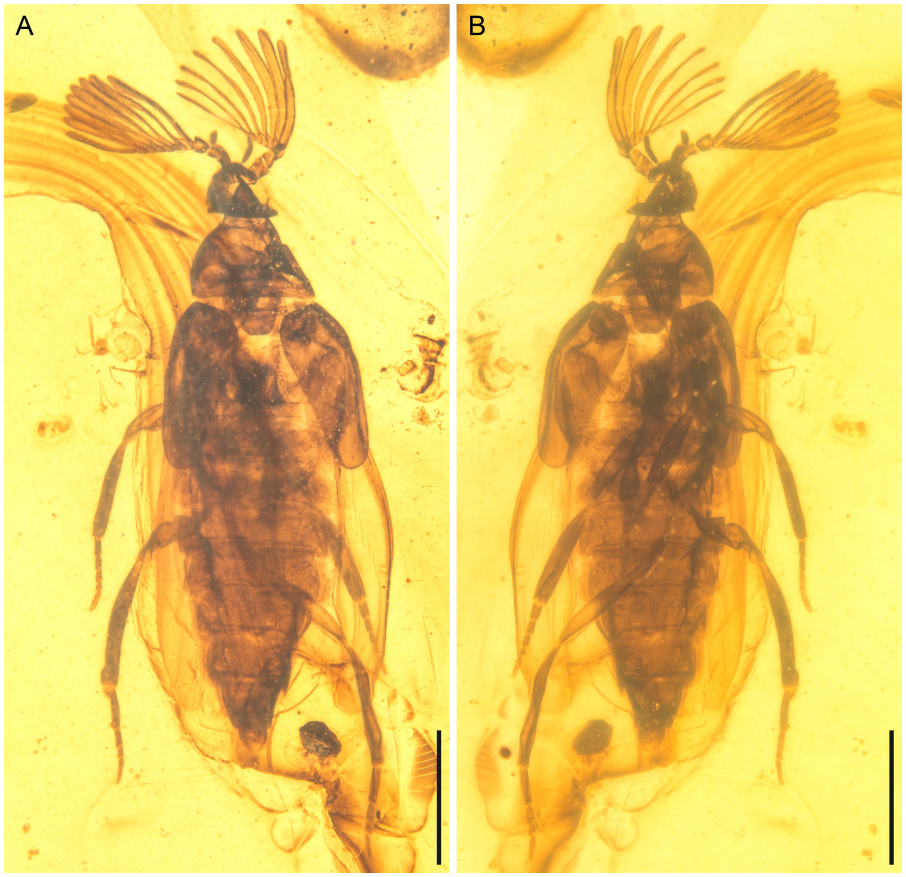

FIGURE 5. General habitus of *Ripidinelia daiboyui* Li & Cai **sp. nov.**, paratype, NIGP203881-1, under incident light. **A**, Dorsal view. **B**, Ventral view. Scale bars = 1 mm.

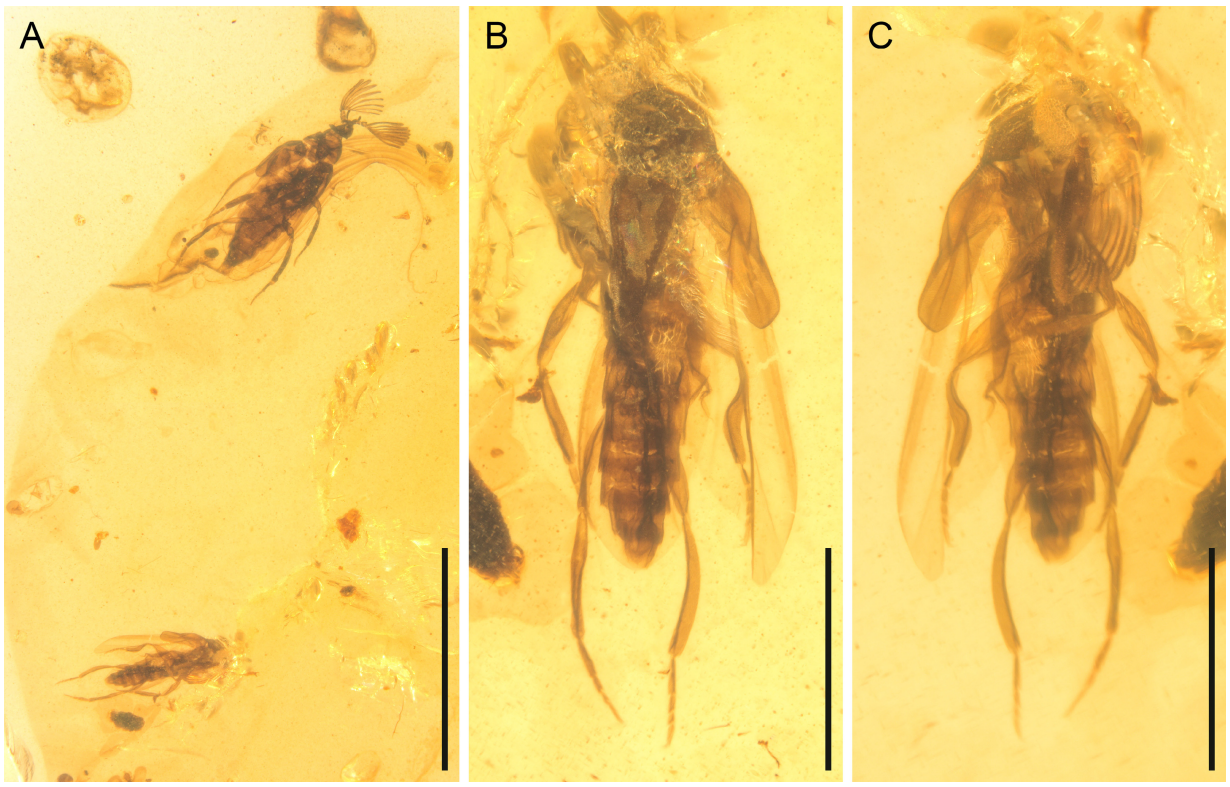

FIGURE 6. *Ripidinelia daiboyui* Li & Cai **sp. nov. A**, NIGP203881, two individuals of *Ripidinelia daiboyui* preserved together. **B**–**C**, *Ripidinelia daiboyui*, paratype, NIGP203881-2, dorsal (**B**) and ventral (**C**) views. Scale bars = 5 mm in **A**, 1 mm in **B**, **C**.

Abdomen with seven free ventrites (sternites II–VIII).

Measurements. NIGP203880: body length about 4.7 mm, body width about 1.3 mm. NIGP203881-1: body length about 4.3 mm, body width about 1.3 mm.

Remarks. The description and labelling of abdominal segments by Batelka & Prokop (2019) are erroneous. As they used Roman numerals for the labels in their fig. 4F, and due to the presence of IX, we suppose these labels represent the number of abdominal segments, rather than ventrites. The last segment before the genital segment was labelled as VII. In the description they also wrote "abdomen with seven visible tergites and six ventrites". However, as shown in their fig. 4D, eight segments are clearly present before the genital segment.

Our specimens confirm that *Ripidinelia* indeed has eight abdominal segments before the genital segment. The basalmost abdominal segments is visible only dorsally as the tergite I (Fig. 5A). The segments II–VIII are normally exposed both dorsally (tergites II–VIII) and ventrally (sternites II–VIII, or ventrites 1–7) (Figs 1, 3F, 5).

Discussion

In Ripidiini, the antennae and maxillary palpi may be variably reduced (*e.g.*, Besuchet, 1957; Falin & Engel, 2014a, 2014b; Vega-Badillo *et al*., 2022). Among the genera of Ripidiini known as males, only *Neonephrites* Riek and *Ripidinelia* have 11-segmented uniflabellate antennae and 3-segmented maxillary palpi as seen in the new species (Riek, 1955; Batelka & Prokop, 2019).

Neonephrites shares with the new species the 5-5-4 tarsi, while the single previously described species of *Ripidinelia* has 4-4-4 tarsi. However, the new species shares with *Ripidinelia burmiticola* the presence of tibial spur (Fig. 3D, E), which is unknown in any other Ripidiini (Falin, 2003; Batelka & Prokop, 2019). In Ripidiini, compared with the presence or absence of tibial spur, the number of tarsomeres appears to have higher plasticity in both evolutionary and developmental aspects: the ground plan of tarsi in Ripidiini should be 5-5-4, but besides *Ripidinelia* the 4-4-4 tarsi are also known in (the males of) *Neopauroripidius* Falin & Engel, *Falsorhipidius* Pic, *Amberocula* and *Cretaceoripidius* (Falin & Engel, 2010, 2014b; Batelka *et al*., 2018), which seems to involve multiple evolutionary events of character-state change; in *Rhipidioides* Riek the males have 5-5-4 tarsi, but the females have 4-4-4 tarsi (Riek, 1955). Thus, the new species is assigned to the genus *Ripidinelia*, rather than *Neonephrites*. In fact, the new species is extremely similar to *R. burmiticola* except for the different tarsal formula.

Unlike other Ripiphoridae where the mesonotum is usually differentiated into a disc and a scutellum, the mesonotum of most genera in Ripidiini is less or not differentiated at all (Falin, 2003; Batelka *et al*., 2011). The mesonotum of *Ripidinelia* was not described in Batelka & Prokop (2019) due to the poor state of preservation. Our specimen NIGP203881-1 shows that it has a relatively large and clearly differentiated mesonotal scutellum (Fig. 5). In *Zaragozapirhidius* Vega-Badillo *et al*., which also has a well-developed mesonotal scutellum, the scutellum is subtriangular and widest posteriorly (Vega-Badillo *et al*., 2022: fig. 2a, b), while in *Ripidinelia* the scutellum is subtrapezoidal and widest anteriorly (Fig. 5).

The pretarsal claws are clearly pectinate near the apex in *Ripidinelia daiboyui* **sp. nov.** (Fig. 4). *Ripidinelia burmiticola* was originally described as having simple pretarsal claws (Batelka & Prokop, 2019). However, their figures tell another possibility that *R. burmiticola* might also have similarly pectinate claws (Batelka & Prokop, 2019: fig. 3A, D), although the image resolution does not allow us to make a more conclusive judgment. Members of Ripidiinae are generally known as having simple pretarsal claws (Falin, 2003; Lawrence *et al*., 2010). The extant *Riekella* Selander was originally described as having serrate claws (under the name *Nephrites*; see Selander, 1957) (Riek, 1955), but in the character matrix by Falin (2003) it was coded as having simple claws. Although we are unable to check which state is correct for *Riekella*, the modified pretarsal claws as seen in *Ripidinelia* would be otherwise at least extremely rare in Ripidiinae. This character, together with the previously reported tibial spur found in *Ripidinelia*, extends our knowledge on the morphological variability of the subfamily Ripidiinae.

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