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The second species of the enigmatic genus *Microblattellus* Ferrer, 2006 (Coleoptera, Tenebrionidae) from Cambodia: A possibility of termitophily in the genus

MUNETOSHI MARUYAMA[1*], WEI-REN LIANG[1,4], HENG SOKH[2] & KIYOSHI ANDO[3]

[1]*The Kyushu University Museum, Hakozaki 6-10-1, Higashi-ku, Fukuoka, 812-8581 Japan.*
[2]*Forest-Wildlife Research and Development Institute, Forestry Administration, 40 Preah Norodom Boulevard, Phnom Penh, Cambodia.*
sokhhengpiny@yahoo.com; https://orcid.org/0009-0009-0852-3678
[3]*Entomological Laboratory, Faculty of Agriculture, Ehime University, Tarumi 3–5–7, Matsuyama, 790–8566 Japan.*
cnodalonini@kbe.biglobe.ne.jp; https:/orcid.org/0000-0003-1794-2718
[4] *leif2051@gmail.com; https://orcid.org/0000-0003-0529-6907*
**Corresponding author. dendrolasius@gmail.com; https://orcid.org/0000-0003-4531-1008*

Abstract

The second species of the enigmatic tenebrionid genus *Microblattellus* Ferrer, 2006, *Microblattellus kakizoei* **sp. nov.**, is described from Cambodia. The type specimen was collected from a nest of the fungus-growing termite *Macrotermes gilvus* (Hagen, 1858). Although the genus is currently placed in the tribe Falsocossyphini, its assignment is highly doubtful, and its true systematic position remains uncertain.

Key words: Falsocossyphini, fungus garden, *Macrotermes*, systematic position, termite

Introduction

The enigmatic tenebrionid genus *Microblattellus*, established by Ferrer in 2006, has been comprised of only a morphologically strange single species, *M. lecongmani* Ferrer, 2006, described simultaneously from Vietnam (Ferrer 2006, Bremer & Lillig 2014). This genus is characterized by a highly distinct pronotum shape, where the head is completely hidden under the anterior margin, and the absence of eyes. Alongside the description of this genus, in the same publication, Ferrer (2006) also established the tribe Falsocossyphini, which encompasses the genera *Falsocossyphus* Pic, 1916, its close relative *Blatticephalus* Heller, 1918, and *Microblattellus*, all sharing a similar pronotal structure (Ferrer 2006). The original description suggested that the type species might inhabit underground or have an association with ants, based on the condition and morphology of the specimens (Ferrer 2006).

In 2015, Dr. Showtaro Kakizoe collected a small but extraordinary species of Tenebrionidae from a termite nest in Siem Reap, Cambodia. Subsequently, it was identified as a member of *Microblattellus*. It was somewhat similar to *M. lecongmani*, the only known species of the genus at that time, but the identification was pending until the photos of the type series were available. Recently, Dr. Harold Labrique of Muséum de Lyon, France, kindly photographed the type series of *M. lecongmani* in detail. Then, we found that the type series and the Cambodian specimen are completely different species from each other. In this paper, we describe the Cambodian species as a new species with information on collecting circumstances and discuss the systematic position of the genus.

Material and methods

Photography. Only a single specimen of the new species was available. We applied non-destructive methods for the specimen. The color images of the specimen were generated using the focus stacking technique through Zerene

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Stacker software. Original photographs were captured with a Canon 7D Mark II camera equipped with an MP-E65 lens. To faithfully represent the specimens' luster and three-dimensionality, a diffuser made of thin tracing paper was used, and the specimens were photographed with two strobes. The specimens were observed under a Nikon SMZ1500 microscope.

Micro-CT scan and measurements. In preparation for micro-CT scans, the beetle was mounted in pipette tip following the method of Metscher (2009). Micro-CT observations were conducted using a Bruker SkyScan 1272 microtomograph (Bruker microCT, Kontich, Belgium) at Kyushu University. The setting parameters were as follows: voltage = 40 kV; current = 100 μA; voxel size = 0.640094 μm (*Microblattellus*) and 1.800624μm (*Blatticephalus*); image rotation step = 0.2°; and 180° of rotation scan. The NRecon (Bruker microCT's Skyscan software) was used for reconstructions. Volume rendered images and measurements of the body parts were obtained with 3D Slicer software (Fedorov *et al.*, 2012). Measurements in micrometers (μm).

Genus *Microblattellus* Ferrer, 2006

Microblattellus Ferrer, 2006: 78 (original description); Bremer 2014: 180 (systematic note); Bremer & Lillig, 2014: 150 (catalogued); Bouchard *et al.* 2021: 545 (catalogued).
"Microblattelus": Bremer, 2014: 181 (key, misspelling); Bouchard *et al.* 2021: 58 (note of misspelling).

Redescription. Body elongate, constricted at middle. Legs dorsally visible.

Head rounded, completely embedded below pronotum, anophthalmous; dorsum gently convex above; upper area of antennal insertion roundly projected; antennae 11-segmented, thickened apically, having club comprised by apical three segments, which bear a row of long setae on apical margin; antennal segment X truncate at apex; segment XI subquadrate; venter slightly convex, but deeply concave around bases of maxillae.

Pronotum oblong or oblong-oval, but almost truncate on posterior margin; anterior margin of dorsum strongly, roundly projected to cover whole head, then large, circular hole appears on apical 2/5 of venter, from which venter of head visible; prosternal process reaching pronotal posterior margin.

Elytra oblong or elongate, gently convex above; humerus more or less angled.

Mesoventrite narrowed anteriorly, slightly convex, with sparse punctures; posterior area between coxae without ridge, smoothly produced posteriad, slightly expanded around apex. Metaventrite large, well convex, slightly widened posteriorly.

Legs rather short; femora and tibiae widened apically; tarsi thick, short, with segments I–III as wide as long; segment IV oblong oval, as long as I–III combined.

Abdomen with ventrite III laterally expanded; ventrite V semicircular, flattened.

Microblattellus kakizoei sp. nov.

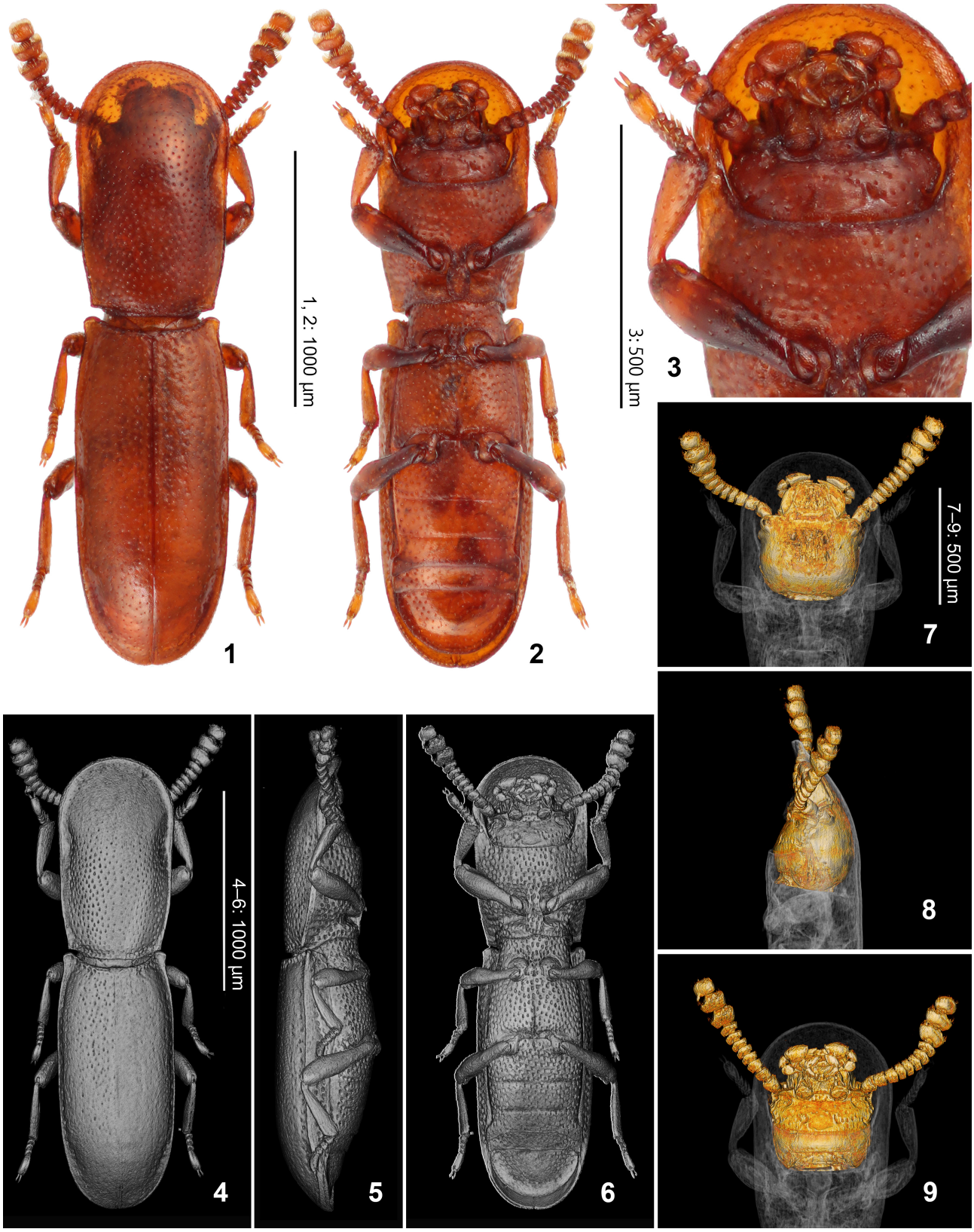
(Figs. 1–11)

Type series. Holotype, male, near the exit gate of Angkor Watt, Siem Reap, Cambodia, 15 X 2015, S. Kakizoe. Deposited in M. Maruyama's collection at the Kyushu University Museum, Fukuoka.

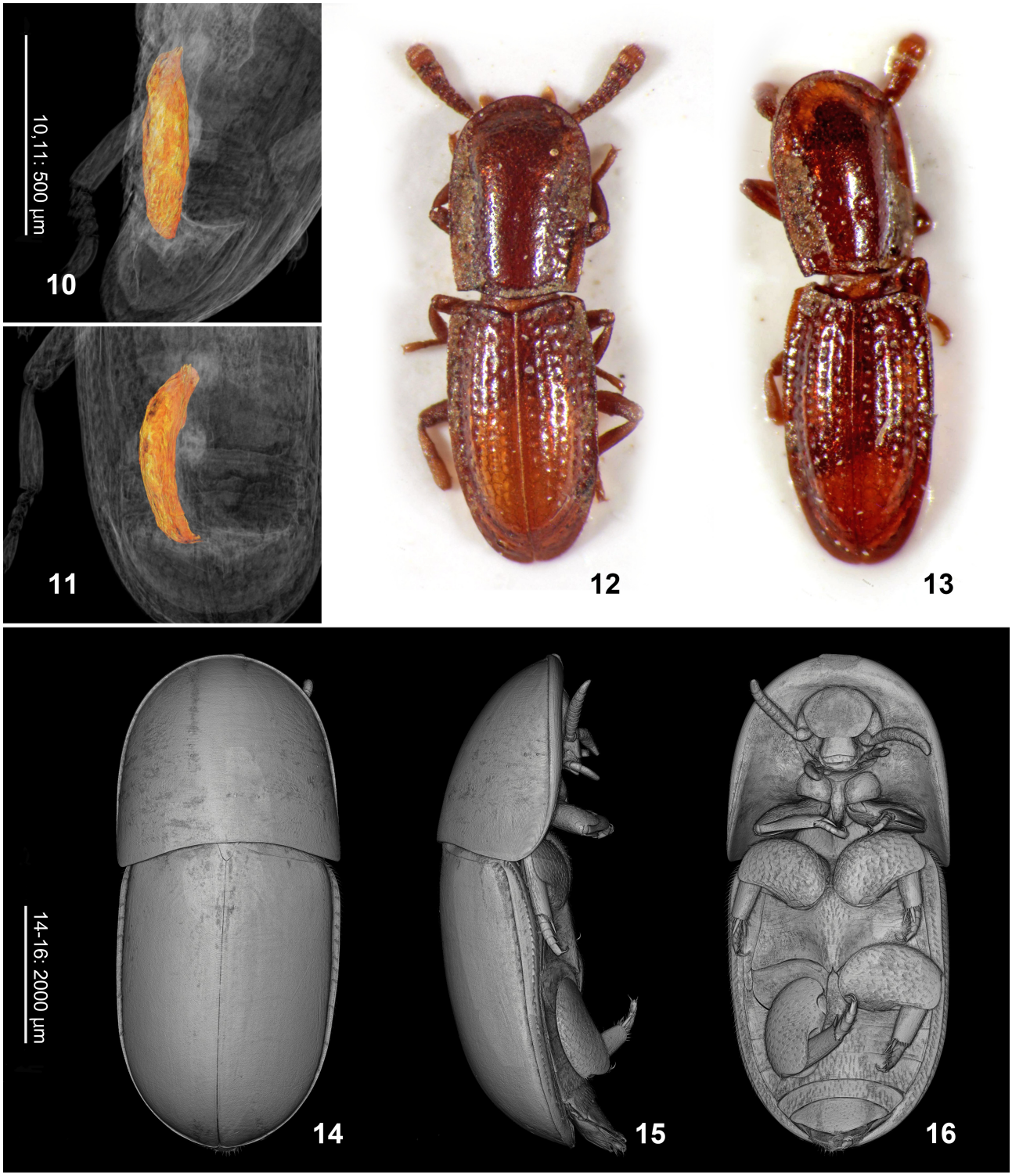
Diagnosis. *Microblattellus kakizoei* **sp. nov.** is easily distinguished from *M. lecongmani* (Figs. 12, 13) by the more elongate and less robust body, more loosely articulate antennal segments, clear and transverse scutellum instead of reduced and invisible one in the latter, obviously produced humeral corners of elytra, finely and irregularly arranged strial punctures on elytra, and less punctate body surface. (See, also key to species.)

Description. Male. Body length: ca. 2.1 mm. Body (Figs. 1, 2, 4–6) subparallel-sided, reddish brown overall. Head (Figs. 3, 7–9) slightly longer than wide; traces of eyes slightly convex laterally; dorsum almost glabrous; venter with coarse and piligerous punctures; antennae long, somewhat loosely articulate and all antennal segments wider than long except for scape; distal three antennal segments distinctly dilated and forming a club; antennal segments III to XI visible in dorsal view; segment I long, large; segment II almost as long as III, slightly wider than long; segments IV to VIII short and transverse; segment IX widest; segment X slightly shorter and narrower than IX; segment XI 2/5 as wide as X; labrum semicircular; mandibles thick, slightly asymmetric, apically pointed; mentum obtrapezoidal, deeply emarginate on anterior margin; labial palpus with segment I minute, as long as wide; segment

II widened apically; III large, oval; maxillary palpus with segment I large, spherical; segment II short, triangular in ventral view; segment III large, oval, slightly truncate at apex.



FIGURES 1–9. *Microblattellus kakizoei* **sp. nov.**, holotype. 1, Habitus, dorsal view; 2, ditto, ventral view; 3, head and pronotum, ventral view; 4, habitus, micro-CT scan, dorsal view; 5, ditto, lateral view; 6, ditto, ventral view; 7, head, micro-CT scan, dorsal view; 8, ditto, lateral view; 9, ditto, ventral view.



FIGURES 10–16. 10, Aedeagus of *Microblattellus kakizoei* **sp. nov.**, holotype, dorsal view; 11, ditto, lateral view; 12. *Microblattellus lecongmani* Ferrer, 2006, holotype male; 13, ditto, paratype female; 14, *Blatticephalus adelotopus* Heller, 1917, habitus, dorsal view; 15, ditto, lateral view; 16, ditto, ventral view.

Pronotum (Figs. 1, 3, 4) elongate, very feebly bisinuate at sides in basal two-thirds, almost twice as long as wide, widest around anterior 2/5; surface moderately, uniformly punctate, the punctures shallower on apical 1/5, each bearing a seta; basal margin almost straight though faintly produced posteriad; scutellum short and transverse, impunctate, with fine microsculpture; prosternal process oblong-oval, rounded at apex.

Elytra (Figs. 1, 4) elongate, more than twice as long as wide, widest around middle; humeral corners distinctly projected antero-laterally, and their apices rounded; surface moderately convex, finely, irregularly punctate; each puncture bearing a short seta; lateral margins feebly serrated, and each serration with a short seta; hindwing reduced, brachypterous.

Legs (Figs. 2, 6) short and robust; femora and tibiae sparsely covered with minute setae, posterior margins of meso- and metafemora ancipital for receiving corresponding tibia; tibiae scarcely incurved, dilated apicad.

Male genitalia as in Figs. 10 and 11; basale more than four times as long as apicale, strongly curved ventrad; apicale short and robust.

Female. Unknown.

Measurements. Head length (from base to labral apex), 486.80; head width, 417.05; antennal length, 582.31; pronotal length, 987.59; pronotal width, 570.43; elytral length, 1242.71; elytral width, 573.08; hind tibial length, 316.02; hind tibial width, 81.03. In micrometers.

Remarks. Holotype was collected from a fungus garden of *Macrotermes gilvus* (Hagen, 1858). The morphology of the mouthparts is probably mostly common to that of *M. lecongmani* due to the close resemblance of the other character states*;* thus, it could be the character states delimiting the genus. The absence of the hindwings was confirmed by micro-CT data of *M. kakizoei*.

Key to the species of the genus *Microblattellus* Ferrer

- Ultimate antennal segment nearly as long as antepenultimate one. Pronotum almost twice as long as wide, finely punctate. Elytra subparallel-sided, less rounded, finely and irregularly punctate, without rows of punctures, space between punctures almost flat; humeral corners distinctly projected antero-laterally; lateral margins with week serrations. Prosternal process rounded at apex. Abdominal ventrite V shorter than the length of ventrites II, III and IV combined. . . . . *Microblattellus kakizoei* **sp. nov.**
- Ultimate antennal segment the shortest in the distal three clubbed segments. Pronotum 1.5 times as long as wide, with finer punctures. Elytra more rounded posteriorly, with rows of large and coarse punctures, space between rows distinctly convex; humeral corners scarcely projected; lateral margins carinate, without any serrations. Prosternal process pointed at apex. Abdominal ventrite V almost equi-length of ventrites II, III and IV combined. . . . . .*Microblattellus lecongmani* Ferrer

Discussion

In conclusion, the phylogenetic placement of *Microblattellus* remains uncertain. Its diminutive size and specialized morphology have resulted in the loss of important characteristics necessary for determining its phylogenetic position within the family Tenebrionidae, and the scarcity of specimens has hindered detailed dissection. Ferrer (2006) assigned it to the tribe Falsocossyphini based on its distinct pronotal morphology, in which the anterior margin of the dorsum is strongly and roundly projected to cover the entire head. However, this classification likely reflects convergent evolution. A key distinguishing character state of *Falsocossyphus* and its close relative *Blatticephalus* is the posterior orientation (hypognathous) of their mouthparts, a highly unusual trait within Tenebrionidae. In other morphological aspects, such as body shape, antennae, and legs, *Falsocossyphus* and *Blatticephalus* also differ considerably from *Microblattellus*. *Falsocossyphus* and *Blatticephalus* exhibit elliptical bodies, thick and apically narrowed antennae, strongly large and flattened femora, and apically narrowed tibiae and tarsi (Figs. 14–16). *Microblattellus*, by contrast, is more generalized in character states other than the head and pronotum, compared with *Falsocossyphus* and *Blatticephalus*. Consequently, *Falsocossyphus* and *Blatticephalus* do not resemble *Microblattellus*, leading us to question whether *Microblattellus* truly belongs to Falsocossyphini.

The holotype of *Microblattellus kakizoei* was collected from a fungus garden within a *Macrotermes gilvus* termite nest. While no additional specimens were discovered from other nests of this termite species, this finding appears to be more than mere coincidence, given the deep interior location within the nest (Kakizoe, pers. comm.), and the distinctive morphology of this species. Specifically, the morphology includes the head being entirely concealed beneath the anterior margin of the pronotum, the robust antennae, and the antennal club covered with a row of elongated setae along the apical margin of each segment, as well as the tightly interlocking structures between body segments, with no discernible gaps, and the ancipital posterior margins of the meso- and metafemora, designed to receive the corresponding tibia. Such protective or sensory adaptations are commonly observed in termitophilous insects.

Notably, the pronotal covering of the head is a feature frequently found in termitophilous rove beetles (subfamily Aleocharinae), serving as a defense mechanism against termite attacks (Kistner 1969, 1979, 1982). Anophthalmia, or the absence of eyes, is also a characteristic observed in termitophilous scarabs (some of the members of the genus *Termitotrox* Reichensperger, 1915), suggesting an evolutionary relationship with termitophily. *Termitotrox* species also display an extremely small and compact body plan, which might be adaptations to their termitophilous lifestyle. The robust antenna is a specialized characteristic found in termitophilous tenebrionid beetles (genus *Ziaelas* Fairmaire, 1892). One species, *Ziaelas formosanus* Hozawa, 1914, has been found inside the fungus garden of *Odontotermes formosanus* (Shiraki, 1909) (Hozawa 1914). The elongate setae on the antennae have been found in the tenebrionid genus *Rhyzodina* Chevrolat, 1873, which has specialized antennae morphology and has been considered an adaptation to termitophily (Schawaller 2013).

Although it is challenging to definitively ascertain the termitophily of this species based on the discovery of a single individual, various circumstantial pieces of evidence suggest its likelihood. *Microblattellus lecongmani*, another member of the same genus, was discovered in the soil and may possibly have been associated with a termite nest because all fungus-growing termites nest in soil. If these species were simply soil-dwellers, more individuals would have been found. Further investigations are warranted to elucidate the ecology of this genus.

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