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Article

A new sexually dimorphic species of *Machadobelba* (Acari, Oribatida, Machadobelbidae) from Malaysia

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ABSTRACT
Machadobelba (Oribatida, Machadobelbidae) currently comprises 18 species collectively distributed in the Afrotropical, Neotropical, and Oriental regions. We describe a new species—*M. bimorpha* **sp. nov.**—based on adults collected from forest litter in Malaysia. The new species is characterized by the morphology of the rostral (short, phylliform, shortly ciliated distally in males versus medium-sized, setiform, sparsely barbed in females), bothridial (bifurcate), and notogastral (dilated mediodistally) setae, the presence of two anoadanal porose areas in males (versus absent in females), two long, longitudinal ridges in anterior part of the prodorsum, and the length of the costula (shorter than half of prodorsum).

KEYWORDS: Machadobelbid oribatid mites, morphology, Oriental region, Southeast Asia, taxonomy.

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INTRODUCTION

The oribatid mite genus *Machadobelba* (Acari, Oribatida, Machadobelbidae) was proposed by Balogh (1958), with *Machadobelba symmetrica* Balogh, 1958 as type species. The genus comprises 18 species, collectively distributed in the Tropics (Subías 2022): five species are Afrotropical, two species are Neotropical, and 11 species are Oriental. The generic diagnosis and an identification key to the known species of *Machadobelba* were presented by Ermilov (2020).

This study is part of an ongoing investigation of the oribatid mite fauna of Malaysia (e.g. Ermilov and Kalúz 2020; Ermilov and Jäger 2024). Sampled materials included representatives of a new sexually dimorphic species of *Machadobelba*. Our goal is to describe this new species under the name *Machadobelba bimorpha* **sp. nov.**

Prior to this study, three species of *Machadobelba*—*M. descombesi* Mahunka, 1988, *M. similis*

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Mahunka, 1988, and *M. spathulifer* Mahunka, 1987—have been registered in the Malaysian fauna (Corpuz-Raros and Ermilov 2019).

METHODS

Observation and documentation – For measurement and illustration, specimens were mounted in lactic acid on temporary cavity slides. All measurements are in micrometers (μm); body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the notogaster; notogastral width refers to the maximum width in dorsal aspect; setal lengths were measured in lateral aspect. Formulas for leg setation are given in parentheses according to the sequence trochanter-femur-genu-tibia-tarsus (famulus included); formulas for leg solenidia are given in square brackets, according to the sequence genu-tibia-tarsus. Drawings were made with a camera lucida using a Leica DM 2500 transmission light microscope.

Terminology – Morphological terminology is mostly that of Grandjean (references in Travé and Vachon 1975); fundamentals of leg setation were reviewed by Norton (1977).

Abbreviations – The following morphological abbreviations are used: *Prodorsum*: *rr* = rostral ridge; *cos* = costula; *mpt* = medial prodorsal tubercle; *pbt* = postbothridial tubercle; *ro*, *le*, *in*, *bs*, *ex* = rostral, lamellar, interlamellar, bothridial, and exobothridial setae, respectively. *Notogaster*: *mnt*, *lnt* = medial and lateral notogastral tubercles, respectively; *cr* = crista; *c*, *la*, *lm*, *lp*, *h*, *p* = setae; *ia*, *im*, *ip*, *ih*, *ips* = lyrifissures; *gla* = opisthonotal gland opening. *Gnathosoma*: *a*, *m*, *h* = subcapitular setae; *or* = adoral seta; *d*, *l*, *sup*, *inf*, *cm*, *acm*, *ul*, *su*, *vt*, *lt* = palp setae; ω = palp solenidion; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ. *Epimeral and lateral podosomal regions*: *1a*, *1b*, *1c*, *2a*, *3a*, *3b*, *3c*, *4a*, *4b*, *4c* = epimeral setae; *et* = epimeral tubercle; *PdI* = pedotectum I; *alt*, *plt* = anterior and posterior lateral tubercles, respectively; *dis* = discidium. *Anogenital region*: *g*, *ag*, *an*, *ad* = genital, aggenital, anal, and adanal setae, respectively; *pa* = porose area; *iad* = adanal lyrifissure; *po* = preanal organ. *Legs*: *Tr*, *Fe*, *Ge*, *Ti*, *Ta* = trochanter, femur, genu, tibia, and tarsus, respectively; ω, φ, σ = solenidia; *d*, *l*, *v*, *bv*, *ev*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv*, *pl* = setae; *pa* = porose area.

TAXONOMY

Family Machadobelbidae
Genus *Machadobelba* Balogh, 1958

Type species: *Machadobelba symmetrica* Balogh, 1958

Machadobelba bimorpha sp. nov. (Figs. 1–12)

http://zoobank.org/urn:lsid:zoobank.org:act:C6A9675F-91BE-463C-8C34-3585182A4C21

Type material

Holotype (male) and three paratypes (one male and two females): Malaysia, Perak District, 33 km NE to Gerik, 05° 34′ 42″ N, 101° 22′ 44.0″ E, 350 m a.s.l., forest complex Belum–Temenggor, litter, 2–13.iv.2015 (E. Jendek and O. Šauša).

Type deposition

The holotype is deposited in the collection of the Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovakia; two paratypes (one male and one female) are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia; one paratype (one female) is in the personal collection of the first author. All specimens are preserved in 70% solution of ethanol with a drop of glycerol.

Diagnosis

Body length: 420–435. Rostrum protruding, narrowly rounded. Rostral region with two longitudinal ridges. Costula shorter than half of prodorsum. Sexual dimorphism in morphology of rostral seta (short, dilated mediodistally, with short cilia distally in males versus medium-sized, setiform, sparsely barbed in females); lamellar and interlamellar setae medium-sized, dilated and shortly ciliated mediodistally; bothridial seta bifurcate, with sparsely barbed branches. Medial prodorsal, postbothridial, medial notogastral, and lateral notogastral tubercles well developed. All notogastral setae dilated and shortly ciliated mediodistally; *c* and p_3 short versus other setae medium-sized. Epimeral, aggenital, anal, and adanal setae short, setiform, sparsely barbed; all genital setae short, setiform, roughened. One pair of epimeral tubercles slightly developed. Discidium elongate triangular. Males with one pair of anoadanal porose areas versus females without anoadanal porose areas.

Description

Measurements – Body length: 435 (holotype), 420–435 (paratypes); body width: 225 (holotype), 195–225 (paratypes). No differences between males and females in body size.

Integument (Figs. 4, 5) – Body color brown. Body surface densely microfoveolate (visible under high magnification); pedotectum I partially with ridges and tubercles (diameter up to 4); lateral part of body partially with microgranulate cerotegument.

Prodorsum (Figs. 1–3, 5) – Rostrum protruding, narrowly rounded. Rostral region with two thin, longitudinal ridges. Costula well-developed, shorter than half of prodorsum. Sexual dimorphism in morphology of rostral seta: in male, seta comparatively short (19–22), dilated mediodistally, with short cilia distally (Figs. 1, 2, 4, 5); in female, seta medium-sized (28–30), setiform, sparsely barbed (Fig. 3); *ro* inserted on rostral ridge end. Lamellar and interlamellar setae (34–41) dilated and shortly ciliated mediodistally; exobothridial seta (19–22) setiform, roughened; bothridial seta bifurcate, with short, smooth stalk and long, sparsely barbed branches. Medial prodorsal and postbothridial tubercles rounded distally.

Notogaster (Figs. 1, 4, 5) – Medial notogastral tubercle rounded distally; lateral notogastral tubercle smaller, nearly triangular. Ten pairs of notogastral setae (*c*, p_3: 19–26; p_2: 30–34; others: 34–41) dilated and shortly ciliated mediodistally. Opisthonotal gland opening and all lyrifissures well visible.

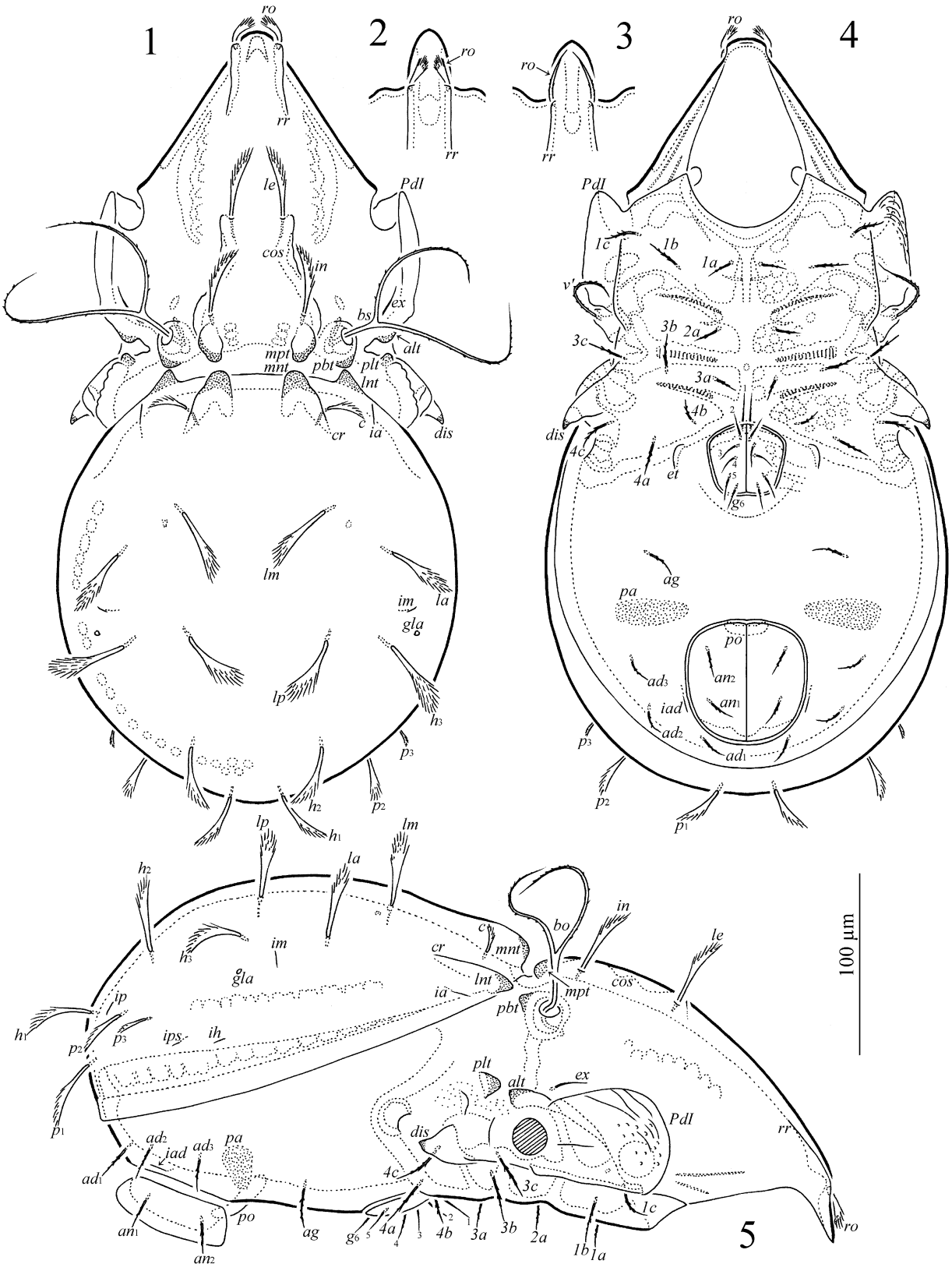
Gnathosoma (Figs. 6–8) – Subcapitulum size: 94–102 × 67–71; subcapitular setae *a* (19–22) and *h* (22–26) setiform, barbed; *m* (9–11) setiform, roughened; *h* thickest, *m* thinnest; both adoral setae (9–11) setiform, roughened. Palp length: 64–67; setation: 0-2-1-3-9(+ω); postpalpal seta (49) dilated and shortly ciliated mediodistally. Chelicera length: 92–102; seta *cha* (30) setiform, barbed; *chb* (19) setiform, slightly barbed.

Epimeral and lateral podosomal regions (Figs. 4, 5) – Epimeral formula: 3-1-3-3; all setae (*1a*, *2a*, *3a*, *4b*: 19–22; others: 28–30) setiform, sparsely barbed. One pair of epimeral tubercles (close to epimeral border IV) slightly developed. Anterior and posterior lateral tubercles rounded distally. Discidium elongate triangular.

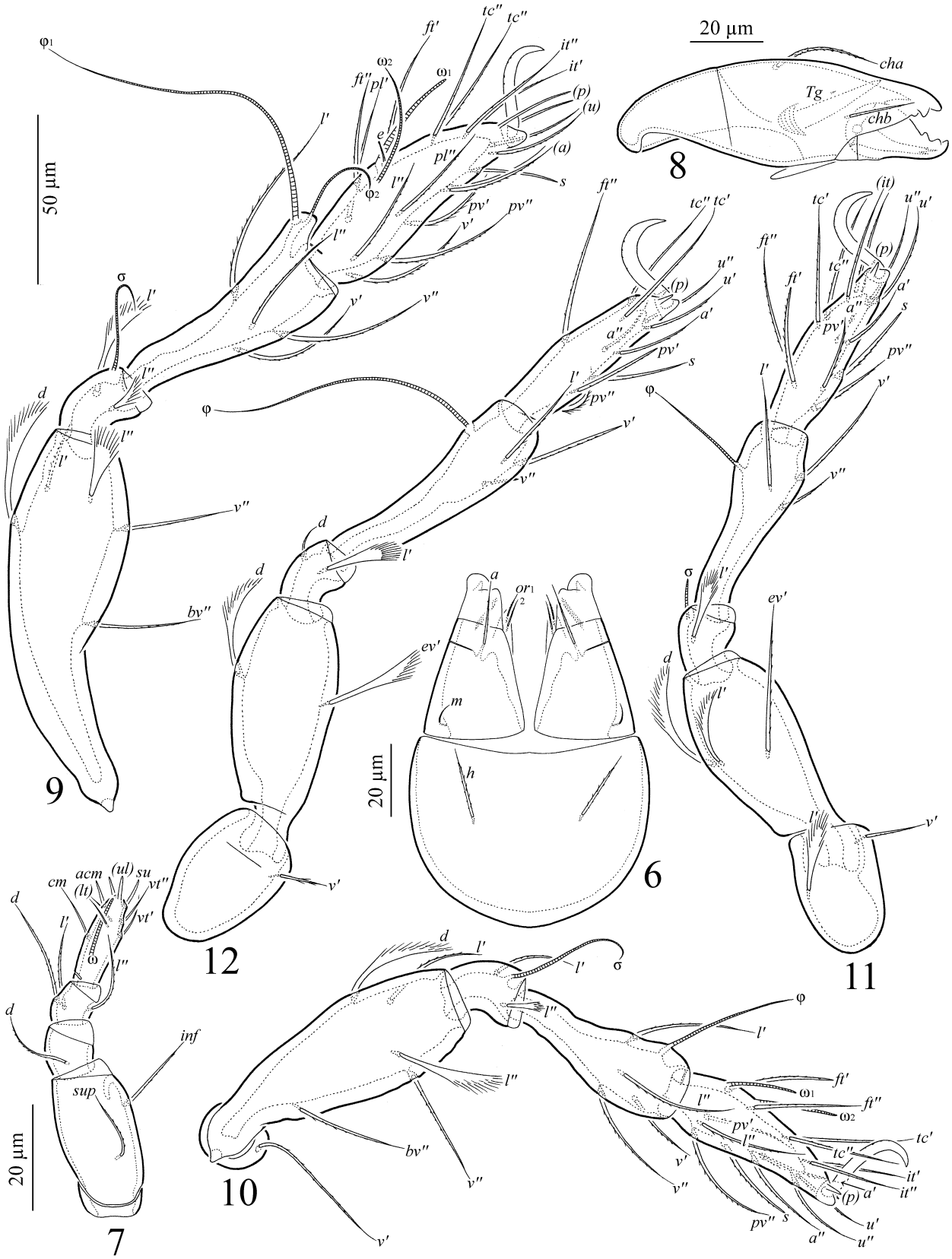
Anogenital region (Figs. 4, 5) – Anogenital formula: 6-1-2-3; all genital setae (g_1: 24–30; others: 17–19) setiform, roughened; aggenital, anal, and adanal setae (19–22) setiform, sparsely barbed. Adanal lyrifissure close and parallel to posterior half of anal plate. Males with one pair of nearly triangular or elongate oval anoadanal porose areas; females without anoadanal porose areas.

Legs (Figs. 9–12) – Claw of each leg strong, slightly barbed dorsal side, without tubercle ventrobasally. Porose area on all segments not observed. Formulas 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; seta *p* of tarsus I eupathidial; *p* of tarsi II–IV thorn-like; *s* of tarsus I eupathidial, located between paired setae *(u)* and *(a)*; genua I–IV, femora I–IV, and trochanter III with one or several setae dilated and shortly ciliated mediodistally; solenidion ω_1 of

tarsus I, ω_1 and ω_2 of tarsus II, and σ of genu III thickened, rounded distally; φ_1 subflagellate; other solenidia setiform.



Figures 1–5. *Machadobelba bimorpha* **sp. nov.** (adult, gnathosoma and legs omitted) – 1. Male, dorsal view; 2. Male, rostral region, anterior view; 3. Female, rostral region, anterior view; 4. Male, ventral view. 5. Male, right lateral view.



Figures 6–12. *Machadobelba bimorpha* **sp. nov.** (adult) – 6. Subcapitulum, ventral view; 7. Palp, right, antiaxial view; 8. Chelicera, right, antiaxial view; 9. Leg I (trochanter omitted), right, antiaxial view; 10. Leg II, right, antiaxial view; 11. Leg III, left, antiaxial view; 12. Leg IV, left, antiaxial view.

Table 1. Leg setation and solenidia of adult *Machadobelba bimorpha* **sp. nov.**

Leg	*Tr*	*Fe*	*Ge*	*Ti*	*Ta*
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'', e*, 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)*

Note: *Tr*, *Fe*, *Ge*, *Ti*, *Ta* = trochanter, femur, genu, tibia, and tarsus, respectively. Roman letters refer to normal setae; Greek letters to solenidia; single prime (′) marks setae on the anterior and double prime (″) setae on the posterior side of a given leg segment; parentheses refer to a pair of setae.

Comparison

Machadobelba bimorpha **sp. nov.** belongs to the complex of *Machadobelba*-species with notogastral setae well dilated mediodistally: *M. baloghi* Mondal & Kundu, 1999 (India), *M. foliata* Hammer, 1982 (Bali), *M. similis* Mahunka, 1988 (Borneo), and *M. spathulifer* Mahunka, 1987 (Borneo). The new species differs from all species listed above in the presence (versus absence) of the sexual dimorphism in morphology of the rostral seta, as well as two long, longitudinal ridges in anterior part of the prodorsum. Additionally, *M. foliata*, *M. similis* and *M. spathulifer* with setiform bothridial seta (versus bifurcate in *M. bimorpha*) and some setiform setae in posterior part of the notogaster (versus all notogastral setae dilated mediodistally); moreover, *M. baloghi* and *M. foliata* with costula reaching rostrum (versus costula shorter than half prodorsum).

Etymology

The species name *bimorpha* alludes to the two morphological forms of the new species.

GENERAL REMARKS

The data on sexual dimorphism of the known brachypyline oribatid mites was summarized by Behan-Pelletier and Eamer (2010) and Behan-Pelletier (2015). The number of species with identified sexual dimorphism is constantly increasing (e.g., Bayartogtokh *et al*. 2017; Shimano and Aoki 2019; Ermilov *et al*. 2022, 2023; Pfingstl *et al*. 2022; Ermilov and Salavatulin 2024).

Sexual dimorphism is poorly investigated in *Machadobelba*. Because many species were described without mentioning the gender of the specimens or the description was based on one gender only. In the genus, sexual dimorphism was stated for one morphological character (presence/absence of two anoadanal porose areas: present in males versus absent in females) in one species, *M. spathulifer* (see Mahunka 1987). The new species (*M. bimorpha*) has similar case of the sexual dimorphism.

Moreover, *M. bimorpha* is characterized by the sexual dimorphism in morphology of the rostral seta (short, phylliform, shortly ciliated distally in males versus medium-sized, setiform, sparsely barbed in females), which is the first recorded case in *Machadobelba*. Gender-specific morphology of the rostral setae is known for some oribatid taxa. For example, in many species of *Symbioribates* Aoki, 1966 (Oripodoidea, Symbioribatidae), the rostral seta is thick in males versus setiform in females (Ermilov *et al*. 2023).

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گونه‌ای جدید با دوشکلی جنسی *Machadobelba* (Acari, Oribatida, Machadobelbidae) از مالزی

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چکیده

جنس *Machadobelba* (Oribatida, Machadobelbidae) در حال حاضر ۱۸ گونه دارد که در مجموع در مناطق آفروتروپیکال، نئوتروپیکال و اورینتال پراکنده‌اند. گونه‌ای جدید – ***M. bimorpha* sp. nov.** – بر اساس نمونه‌های بالغ جمع‌آوری شده از خابرگ‌های جنگلی در مالزی توصیف می‌شود. گونه جدید با ریخت‌شناسی موهای خرطوم (کوتاه، برگی‌شکل، کمی مژه‌دار در انتها در نرها در مقابل اندازه خرطوم متوسط، مویی‌شکل، مژه‌دار پراکنده در ماده‌ها)، موهای درشت‌حفره‌ای (دو شاخه) و نوتوگاستری (بزرگ شده در نیمهٔ انتهایی)، وجود دو ناحیهٔ روزنه‌دار مخرجی و کنار مخرجی در نرها (عدم وجود در ماده‌ها) دو برجستگی بلند طولی در قسمت جلویی گرده و طول تیغه‌واره (کوتاه‌تر از نیمی از گرده) مشخص می‌شود.

واژگان کلیدی: هرناهای اوریباتید ماکادوبلبید، ریخت‌شناسی، ناحیهٔ اورینتال، آسیای جنوب شرقی، آرایه‌شناسی.

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