

Two new species of the genus *Paralycus* Womersley, 1944 (Oribatida, Pediculochelidae) from Japan

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Abstract Two new oribatid mite species of the genus *Paralycus* Womersley, 1944, *Paralycus aokii* Oshima & Shimano, sp. nov. and *Paralycus shibai* Oshima & Shimano, sp. nov., are described based on private collection of Professor Minoru Shiba, which he had collected himself. This genus has previously been recorded (no species record) as a taxon under Prostigmata in Japan, but the genus is firstly recorded in Japan by these new species described here. An updated key to the species of the genus *Paralycus* is provided.

Key words: morphology, new species, oribatid mites, Pediculochelidae, taxonomy

Introduction

The mite genus *Paralycus* Womersley, 1944 was erected by Womersley (1944), and this genus composes the monogeneric family Pediculochelidae Lavoipierre, 1946. Because pediculochelid adults retain paedomorphic and juvenile traits a lot, the systematic classification of this family had been controversial (see Kolesnikov *et al.*, 2023). Based on a cladistic analysis, Norton *et al.* (1983) proposed that Pediculochelidae represents a sister-group of Haplochthoniidae, and placed this family in the oribatid superfamily Protoplophoroidea under Enarthronota. This systematic account was confirmed by recent molecular phylogenetic analyses (Pepato and Klimov, 2015; Klimov *et al.*, 2017).

All mites of *Paralycus* were identified as female individuals, and therefore, they are deemed asexual organisms (Norton *et al.*, 1983). To date, 11 species of *Paralycus* have been described/recorded from all continents except for Antarctica, and their species richness is more significant in tropical and temperate regions (Kolesnikov *et al.*, 2023). They are found in various habitats (e.g., soil, on bees, bird nests, pine trees), but due to the small specimens' number, it is difficult to deter-

mine that these mites originally inhabit those environments, or migrated from other environments (Kolesnikov *et al.*, 2023). Additionally, our knowledge about the exact species richness and distribution of *Paralycus* has been hampered by its small body size and weak coloration (Kolesnikov *et al.*, 2023).

The diversity of *Paralycus* in East Asia has not been thoroughly investigated. Four species have been described from mainland China (*P. chongqingensis* Fan, Li & Xuan, 1996; *P. longior* Fan, Li & Xuan, 1996; *P. parasi* Zhang & Li, 2001; *P. nortoni* Xu, Zhu, Wu & Zhang, 2020), but in other regions, including the Japanese Archipelago, species of this genus have never been identified and recorded as Oribatida because oribatologists in Japan looked over the taxonomic account of Norton *et al.* (1983) as below.

In Japan, this genus has previously been recorded (with no species record) as a taxon under Prostigmata (Shiba, 1991, 1999). Therefore, Emeritus Professor Minoru Shiba, who has been studying mainly free-living prostigmatid mites for a long time in Japan, also collected specimens of Japanese *Paralycus*; after his following the systematic account of *Paralycus* clarified by Norton *et al.* (1983), his private collection (hereinafter Shiba Collection), which he had collected himself, was do-

nated to the first and last authors, who are studying oribatid mites. During the morphological examination of specimens in Shiba collection, we recognize at least two unidentified species of this genus. In this study, we describe two new species. An updated key to the species of the genus *Paralycus* is also provided.

Materials and Methods

Mites were collected from tree barks by Prof. Shiba. These materials were brought to the Matsuyama Shinonome Junior College, then immediately put in a Tullgren apparatus and irradiated with 60-W electric bulb to extract mites into 80% ethanol. The extracted mites were mounted on slides with Hoyer's medium by Prof. Shiba. Specimens were provided to the authors for microscopic observation under 400–1000 × magnifications. Drawings were made with an Olympus BX53 Microscope equipped with a drawing attachment and then modified in Photoshop CC 2014 (Adobe Inc.). Morphological terminology used in this paper follows that of Grandjean (1953), Schubart (1975), Norton and Behan-Pelletier (2009), Behan-Pelletier and Lindo (2023) and Kolesnikov *et al.* (2023).

Body length was measured from its tip to the posterior edge of the notogaster. Notogastral width refers to its maximum widths in dorsal aspect. For leg solenidion and bothridial seta, measurements are given as length × width of the widest part. The length of the chelicera means the distance from the base of trochanter to the tip of the fixed digit. All numbers measured on holotype in the text are in micrometers (μm).

Taxonomic Accounts

Family Pediculochelidae Lavoipierre, 1946
[Japanese name: Hokorichibi-dani-ka]

Genus *Paralycus* Womersley, 1944
[Japanese name: Oboro-dani-zoku]

Type species: *Alicus pyrrigerus* Berlese, 1905

Paralycus aokii Oshima & Shimano sp. nov.

[Japanese name: Aoki-oboro-dani]

(Figures 1–6)

Type material

Holotype: adult female, Japan, Takigawa, Kikai-jima Island, Kagoshima-ken, 25-III-1999, coll. M. Shiba from the bark of fallen tree in secondary deciduous broad-leaved forest (Shiba Collection).

Non type

One deutonymph; same data as for holotype.

Type deposition

Holotype was deposited in the Collection of Arachnida, Department of Zoology, National Museum of Nature and Science, Tokyo (NSMT) [collection number: NSMT-Ac 14749].

Diagnosis. Female

Rostral seta long, exceeding tip of chelicera. Bases of lamellar setae separated to each other. Cheliceral seta *cha* shorter than half length of chelicera. Gastronotal setae *c*₁, *d*₁, *e*₁, not reaching bases of next row of setae; *f*₁ and *h*₁ reaching bases of next row of setae. Epimeral seta *2a* short, not exceeding base of *1a*. Epimeral seta *4a* present. Four pairs of genital setae present; distance $g_3-g_4 > g_2-g_3 > g_1-g_2$. Leg trochanteral formula 0-0-1-0. Genu I with four setae (*d*, *l* and *v'*), genu II with three setae (*d*, *l*). Solenidion ω of tarsus I not expanding in middle; solenidion φ of tibia III short.

Description. Female

Measurements. Idiosomal length 266, width 105.

Integument. Colorless in living, elongate and weakly sclerotized. Prodorsal shield (except its posterior part), legs and coxae smooth. Dorsal side (except segment P), ventral side, chelicerae (basal part), and ovipositor finely striated.

Gnathosoma. Subcapitulum (40 × 42) with three pairs of filiform, smooth setae (*a* 16; *m* 15; *h* 33) and two pairs of filiform and smooth adoral setae (5, 7). Palp (32) simple, with four free segments; femur and genu separated by incomplete suture. Palpal setae formula: 0-1-0-1-9+ ω, including four eupathidia (*sul*, *acm*, *ul*; *sul*, *acm*, *ul'* with expanded tips); *inf* absent. Postpalpal seta (*ep* 2) blunt. Chelicera large (36), with two filiform and smooth setae (*cha* 16; *chb* 15); *cha* shorter than half of cheliceral length. Pharyngeal cupola long, reaching level of *bs*.

Prodorsum. Mid-dorsal region covered with shield-shaped plate, bearing two pairs of filiform and smooth setae (*ro* 43; *le* 40); *ro* exceeding length of chelicera. Bases of setae *le* separated to each other. In dorsolateral region, three pairs of

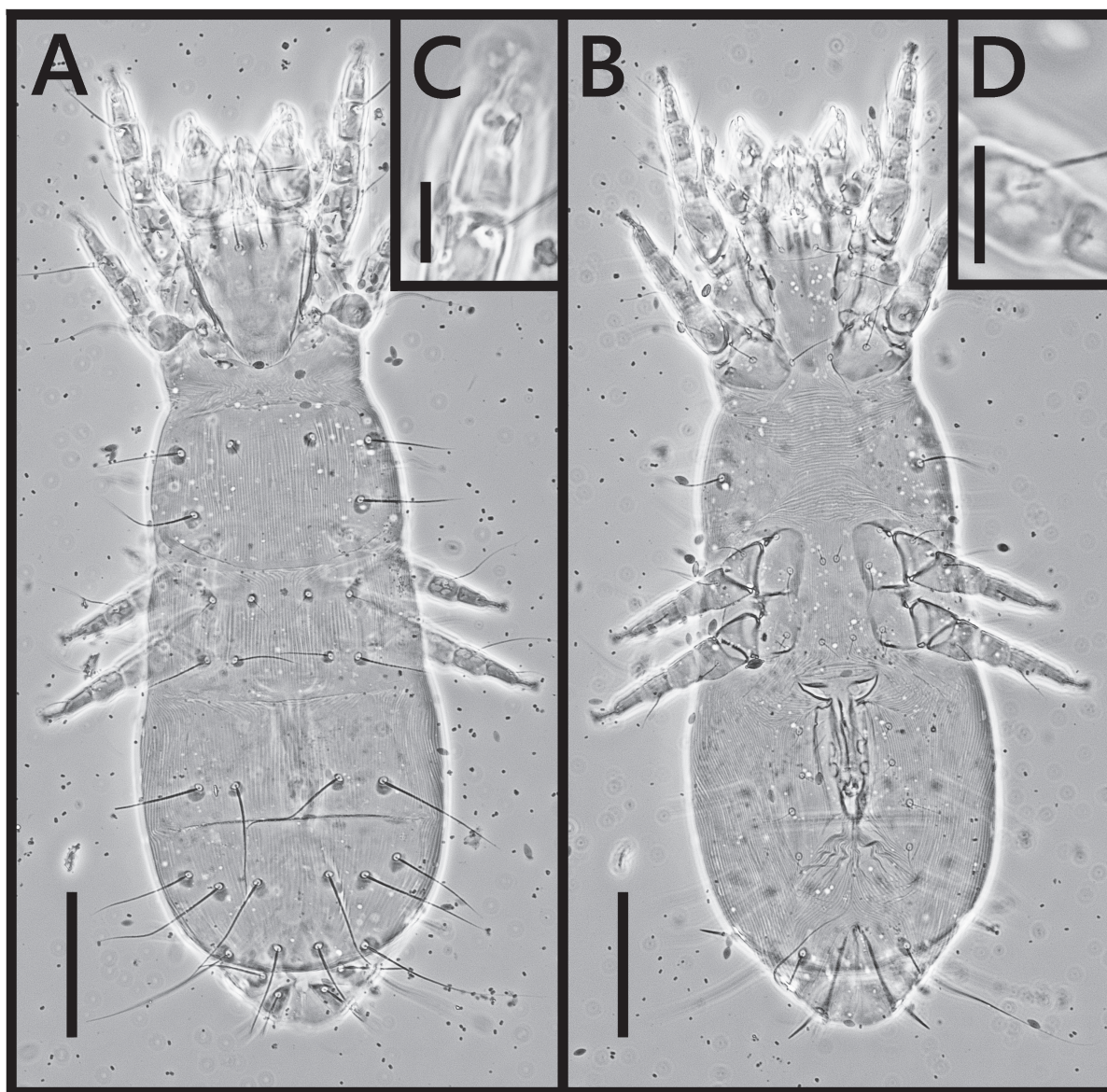


Fig. 1. *Paralycus aokii* sp. nov., female, light microscope images: A, dorsal view; B, ventral view; C, solenidion ω I; D, solenidion ϕ III. Scale bar, 50 μ m (A, B), 10 μ m (C, D).

filiform setae (*in*, *exa*, *exp*) and one pair of clavate bothridial setae (*bs*) present; *in* (56), *exa* (18), *exp* (11) and *bs* (18 $\times$ 13) smooth.

Notogaster. Notogaster divided into four regions by three transverse scissures. Sixteen pairs of notogastral setae present. Four pairs of setae in region of segment C: *c*₁ (10), *c*₂ (31), *c*₃ (31) and *c*_p (39). Four pairs of setae in region of segment DE: *d*₁ (12), *d*₂ (12), *e*₁ (24) and *e*₂ (27). Two pairs of setae in region of segment F: *f*₁ (40) and *f*₂ (48). Segments H and P fused with six pairs of setae: *h*₁ (40), *h*₂ (49), *h*₃ (36), *p*₁ (34), *p*₂ (55) and *p*₃ (13). All gastral setae filiform and smooth, not expanded at their bases. Seta *c*₁ not reaching base of *c*_p; *d*₁ not

reaching base of *e*₁; *e*₁ not reaching base of *f*₁; *f*₁ reaching base of *h*₁; *h*₁ reaching base of *p*₁. Seta *p*₂ longer than *p*₁. Notogastral cupules absent.

Epimeral and podosomal regions. Epimeral setation 3-2-3-3; *1a* (11), *1b* (31), *1c* (9), *2a* (18), *2b* (31), *3a* (5), *3b* (22), *3c* (9), *4a* (13), *4b* (5) and *4c* (14) filiform and smooth. Seta *2a* not reaching base of *1a*. Bases of *3a* close to each other. One pair of triangular supracoxal setae (*el* 3) with rounded tips.

Anogenital region. Four pairs of genital setae: *g*₁ (9), *g*₂ (10), *g*₃ (19) and *g*₄ (18). Distance *g*₃–*g*₄ > *g*₂–*g*₃ > *g*₁–*g*₂. Two pairs of minutes eugenital setae (2) and two pairs of genital

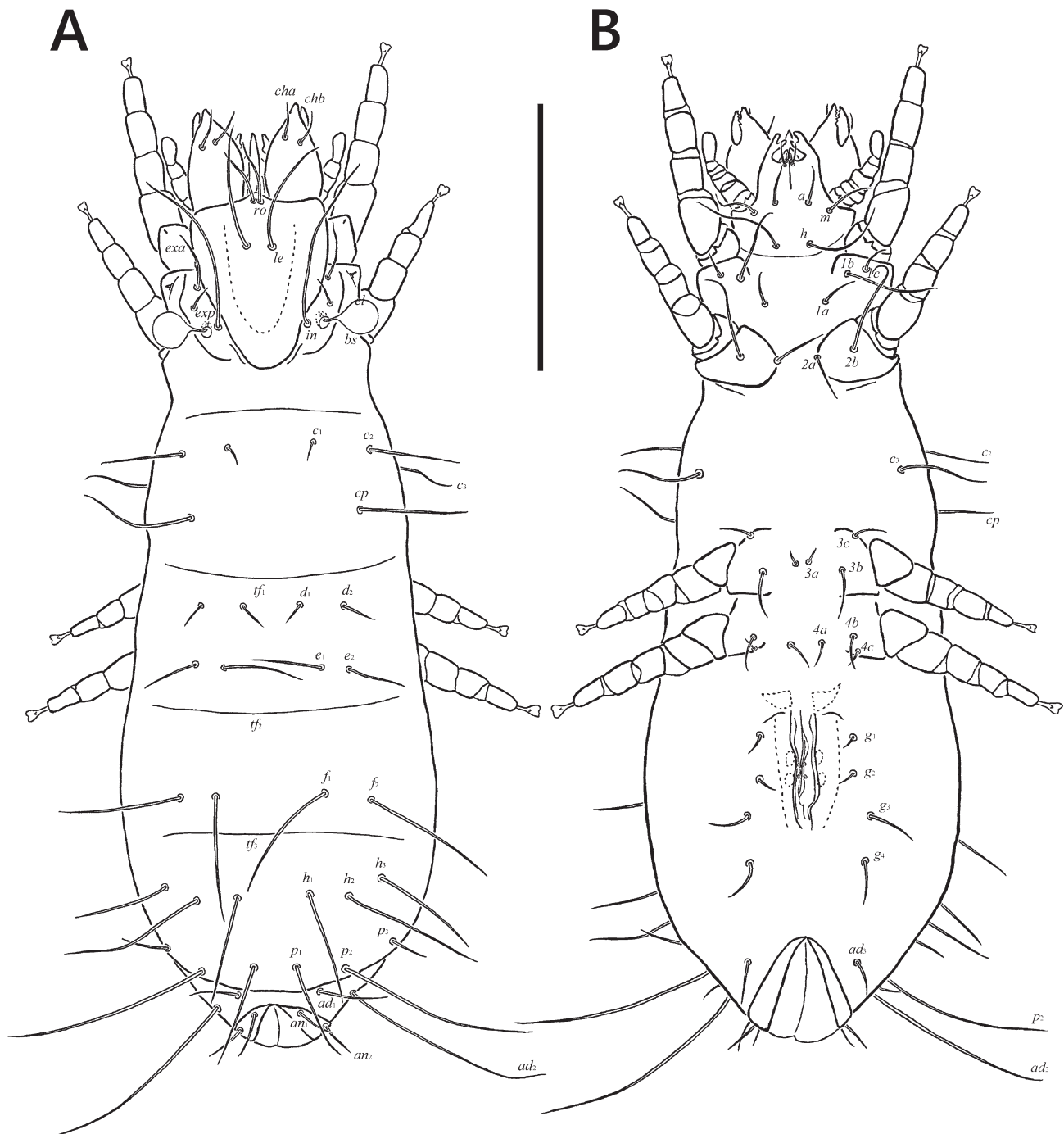


Fig. 2. *Paralycus aokii* sp. nov., female: A, dorsal view; B, ventral view. Scale bar, 100 μ m.

papillae within genital orifice. Three pairs of adanal setae: ad_1 (23), ad_2 (67), ad_3 (15) and two pairs of anal setae: an_1 (15), an_2 (13). All anogenital setae filiform and smooth. Aggenital setae absent. Genital, anal and adanal plates absent. Genital tracheae reduced and represented by short cavities.

Legs. Relatively short. Measurements (total length from trochanter to tarsus, pretarsus excluded): I 67, II 55, III 49,

and IV 56. Leg structure simple with highly visible five segments. Famulus ϵ of tarsus I bacilliform, thin and expanded at end; other setae filiform and smooth. Solenidium ω of tarsus I 5×1 not expanding in middle; ω of tarsus II 3×1 small and not expanding in middle. Solenidium ϕ of tibia I elongated and attenuate; ϕ of tibia III short (2) and bacilliform. Formula of leg setation (from trochanter to tarsus, solenidia in brackets): I

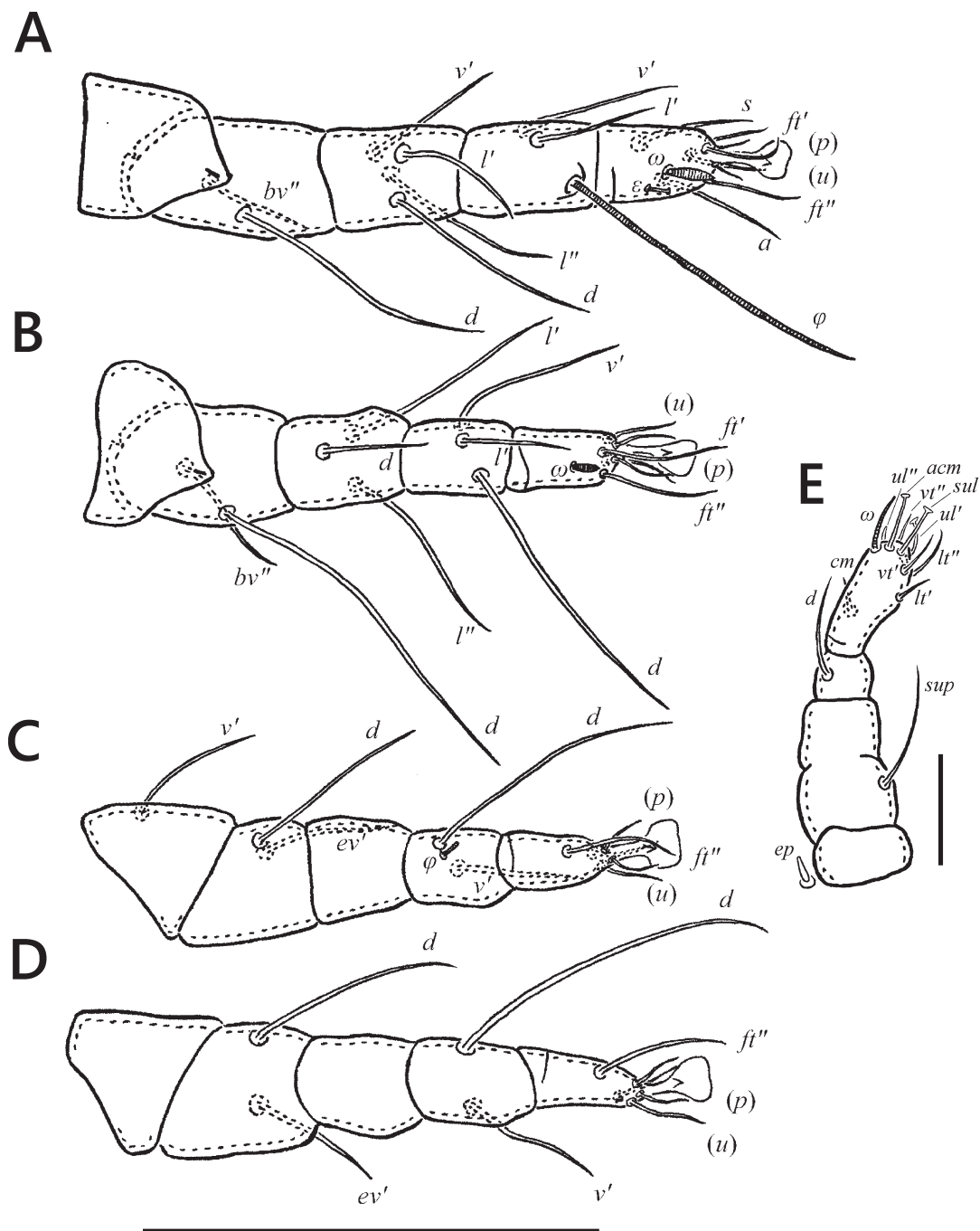


Fig. 3. *Paralycus aokii* sp. nov., female: A, leg I, right, dorsal view; B, leg II, right, dorsal view; C, leg III, right, dorsal view; D, leg IV, right, dorsal view; E, palp, left, dorsal view. Scale bars, 50 µm (A–D), 10 µm (E).

0-2-4-2(1)-9(1); II 0-2-3-3-6(1); III 1-2-0-2(1)-5; IV 0-2-0-2-5. Claws absent on all tarsi, each tarsus with minute empodial remnant and caruncle-like membrane.

Male

Unknown.

Deutonymph

Measurements. Idiosomal length 231, width 88.

Integument. Similar to adult female.

Gnathosoma. Subcapitulum (31 × 36) with three pairs of filiform, smooth setae (*a* 13; *m* 16; *h* 15) and two pairs of filiform and smooth adoral setae (3, 4). Palp (25) simple, with four free segments; femur and genu separated by incomplete

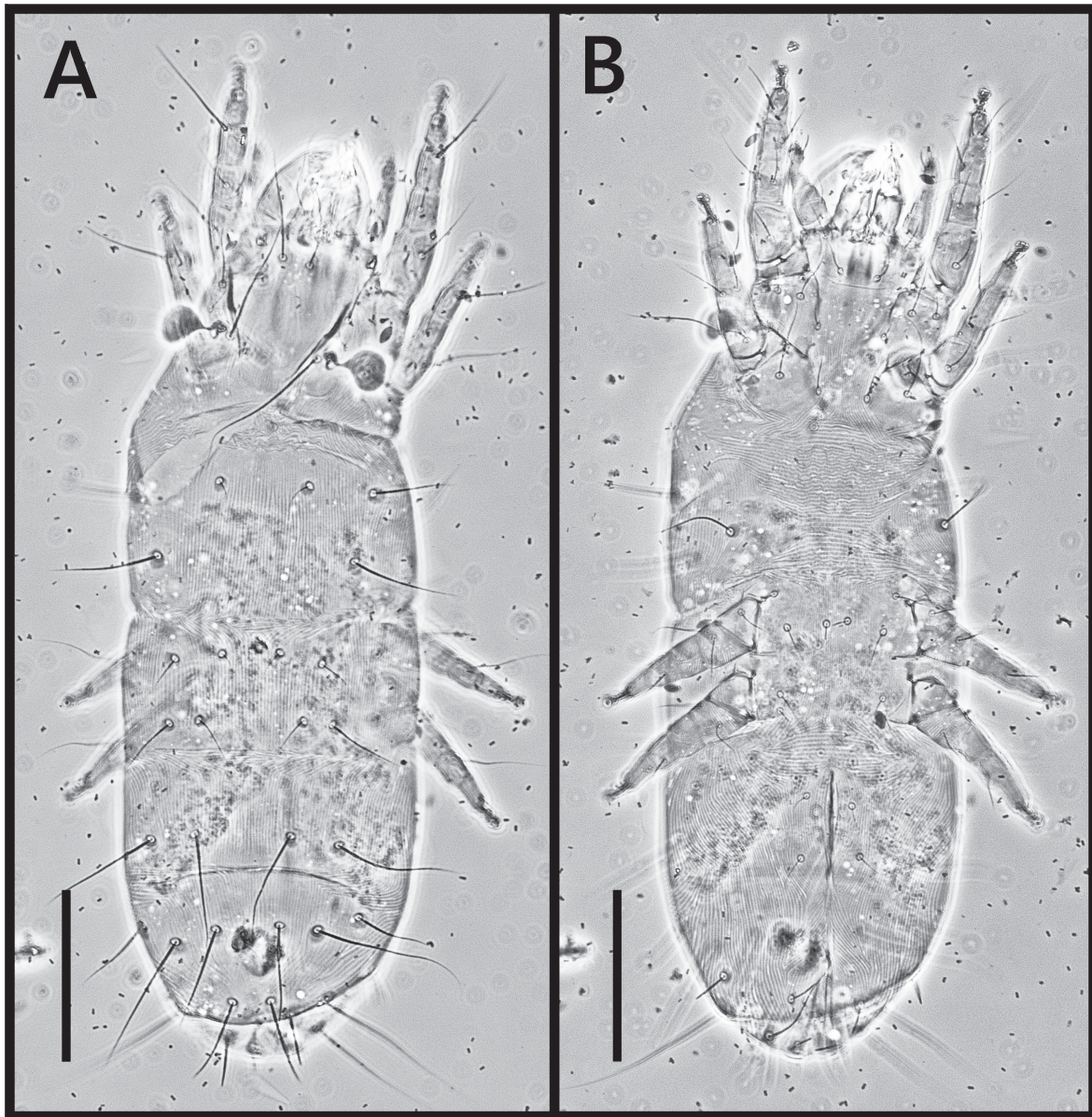


Fig. 4. *Paralycus aokii* sp. nov., deutonymph, light microscope images: A, dorsal view; B, ventral view. Scale bar, 50 μ m.

suture. Palpal setae formula: 0-1-0-1-9+ ω , including four eupathidia (*sul*, *acm*, *ul*; *sul*, *acm*, *ul'* with expanded tips); *inf* absent. Chelicera large (25), with two filiform and smooth setae (*cha* 9; *chb* 8).

Prodorsum. Mid-dorsal region covered with shield-shaped plate, bearing two pairs of filiform and smooth setae (*ro* 31; *le* 32); *ro* reaching half length of chelicera. Bases of setae *le* separated to each other. In dorsolateral region, three pairs of filiform setae (*in*, *exa*, *exp*) and one pair of clavate bothridial setae (*bs*) present; *in* (54), *exa* (17), *exp* (9) and *bs* (16 $\times$ 12) smooth.

Gastronotum. Notogaster divided into four regions by

three transverse scissures. Sixteen pairs of notogastral setae present. Four pairs of setae in region of segment C: *c*₁ (9), *c*₂ (21), *c*₃ (25) and *c*_p (33). Four pairs of setae in region of segment DE: *d*₁ (10), *d*₂ (11), *e*₁ (15) and *e*₂ (20). Two pairs of setae in region of segment F: *f*₁ (39) and *f*₂ (40). Segments H and P fused with six pairs of setae: *h*₁ (31), *h*₂ (55), *h*₃ (24), *p*₁ (34), *p*₂ (55) and *p*₃ (9). All gastronotal setae filiform and smooth, not expanded at their bases. Notogastral cupules absent.

Epimeral and podosomal regions. Epimeral setation 3-2-3-2; *1a* (8), *1b* (19), *1c* (8), *2a* (14), *2b* (28), *3a* (5), *3b* (18), *3c* (11), *4b* (5) and *4c* (10) filiform and smooth. One pair of triangular supracoxal setae (*el* 3) with rounded tips. Epimeral

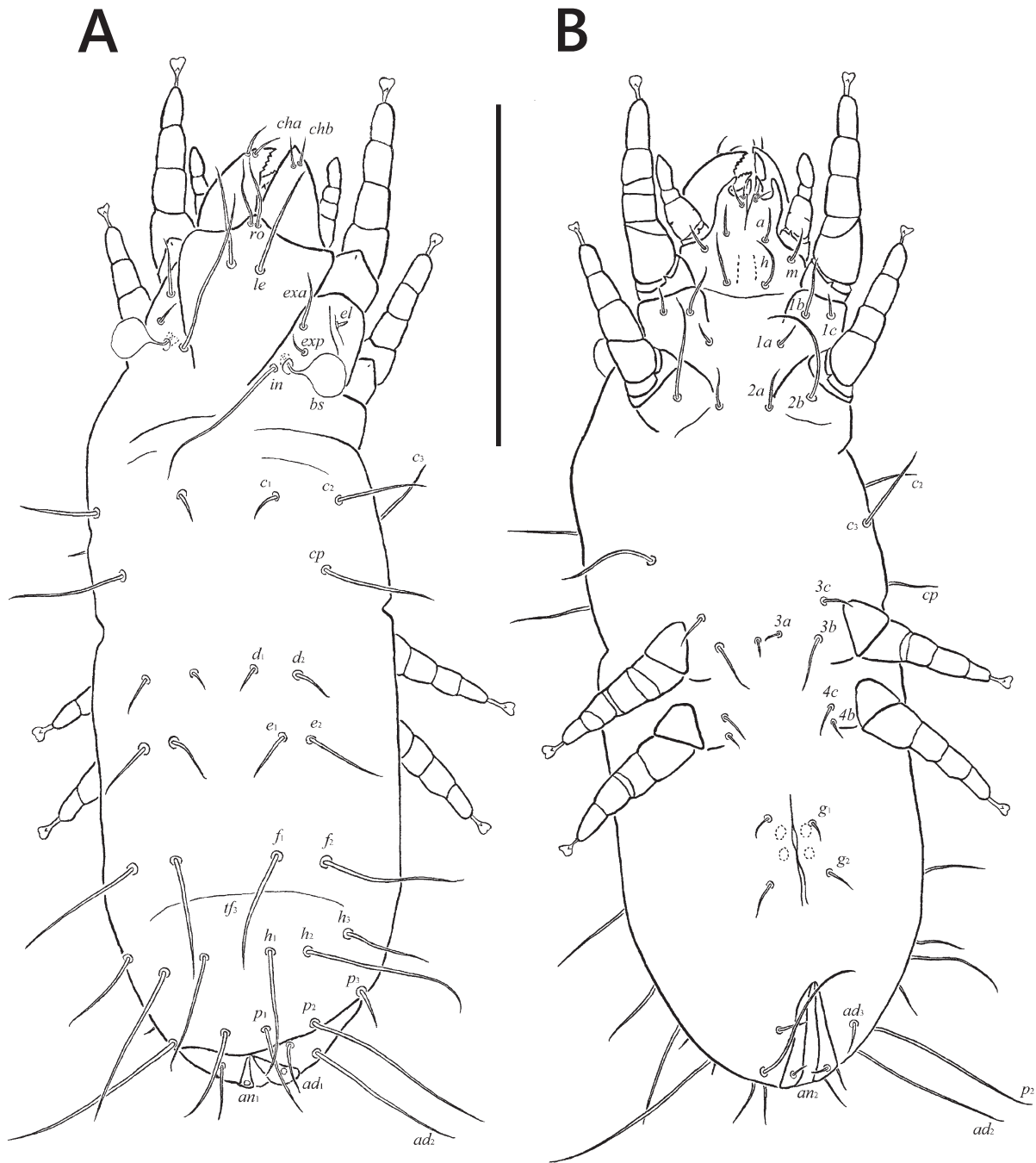


Fig. 5. *Paralycus aokii* sp. nov., deutonymph: A, dorsal view; B, ventral view. Scale bar, 100 μ m.

seta 4a absent.

Anogenital region. Two pairs of genital setae: g_1 (8), g_2 (10) and two pairs of genital papillae. Three pairs of adanal setae: ad_1 (15), ad_2 (47), ad_3 (10) and two pairs of anal setae: an_2 (8), an_1 represented by alveoli. All anogenital setae (except an_1) filiform and smooth. Aggenital setae absent. Genital, anal and adanal plates absent. Eugenital setae and other genital structures absent.

Legs. Similar to adult female. Measurements (total length from trochanter to tarsus, pretarsus excluded): I 58, II 46, III 42, and IV 45. Formula of leg setation (from trochanter to tarsus, solenidia in brackets): I 0-2-4-2(1)-9(1); II 0-2-3-3-6(1); III 1-2-0-2(1)-5; IV 0-2-0-2-5.

Etymology

This species is named in honor of our esteemed colleague

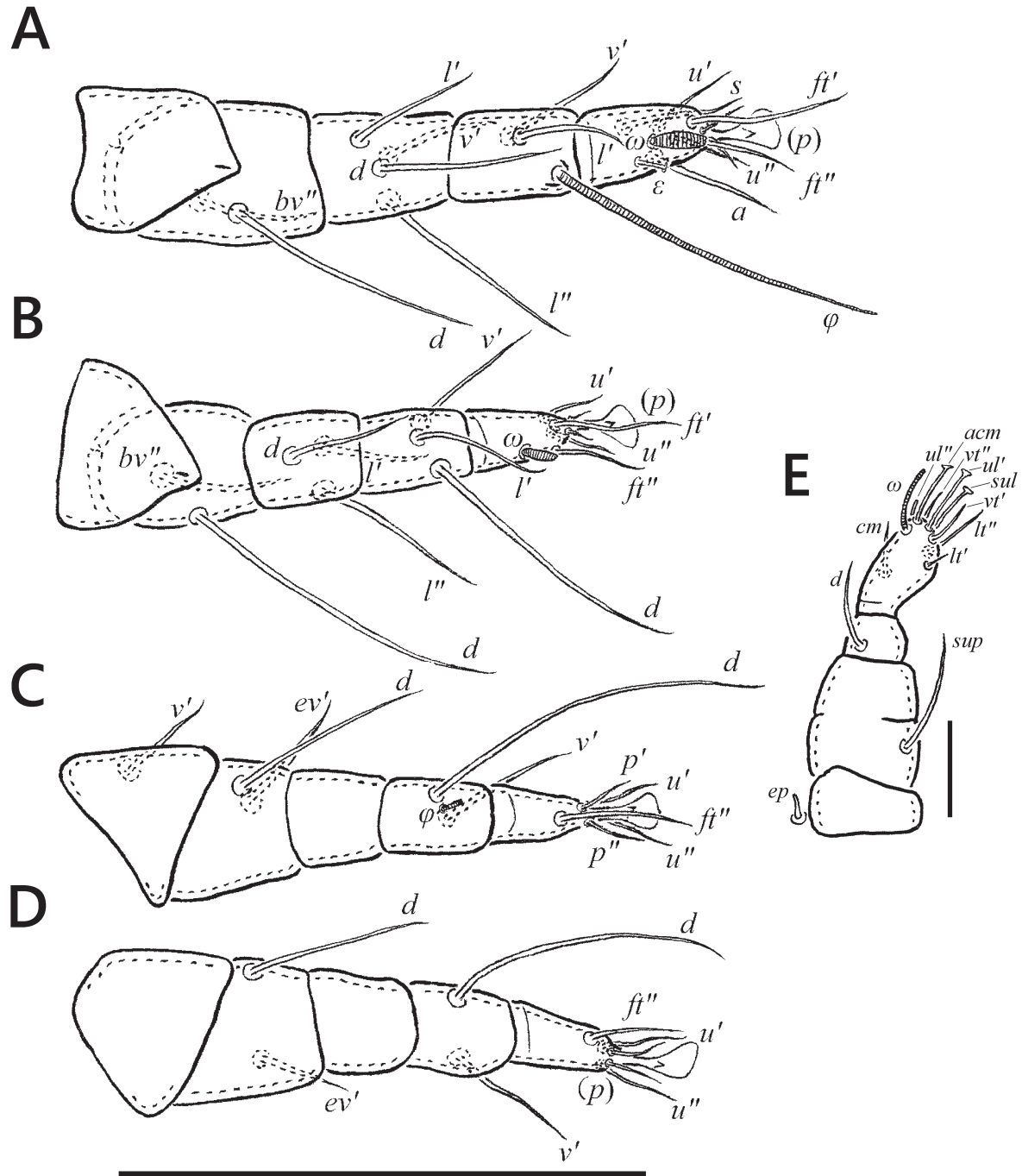


Fig. 6. *Paralycus aokii* sp. nov., deutonymph: A, leg I, right, dorsal view; B, leg II, right, dorsal view; C, leg III, right, dorsal view; D, leg IV, right, dorsal view; E, palp, left, dorsal view. Scale bar, 50 μ m (A–D), 10 μ m (E).

late Professor Jun-ichi Aoki, who made a great contribution to the knowledge of oribatid mite diversity, mainly in East Asia.

Remarks

Paralycus aokii sp. nov. is similar to *P. parasiti* and *P. pricei* Kolesnikov, OConnor, Ermilov & Klimov, 2023 in having four pairs of genital setae and the presence of epimeral seta 4a.

However, *P. aokii* sp. nov. differs from these species in the following characteristics: gastrontal setae f_1 and h_1 longer, reaching the bases of the following pair of setae (f_1 and h_1 not reaching the bases of the next row setae in *P. parasiti* and *P. pricei*); epimeral seta 2a shorter, not reaching the base of 1a (exceeding the base of 1a in *P. parasiti*); genual seta v' on leg I present (absent in *P. pricei*); genual seta d on leg II present (absent in *P. pricei*); body

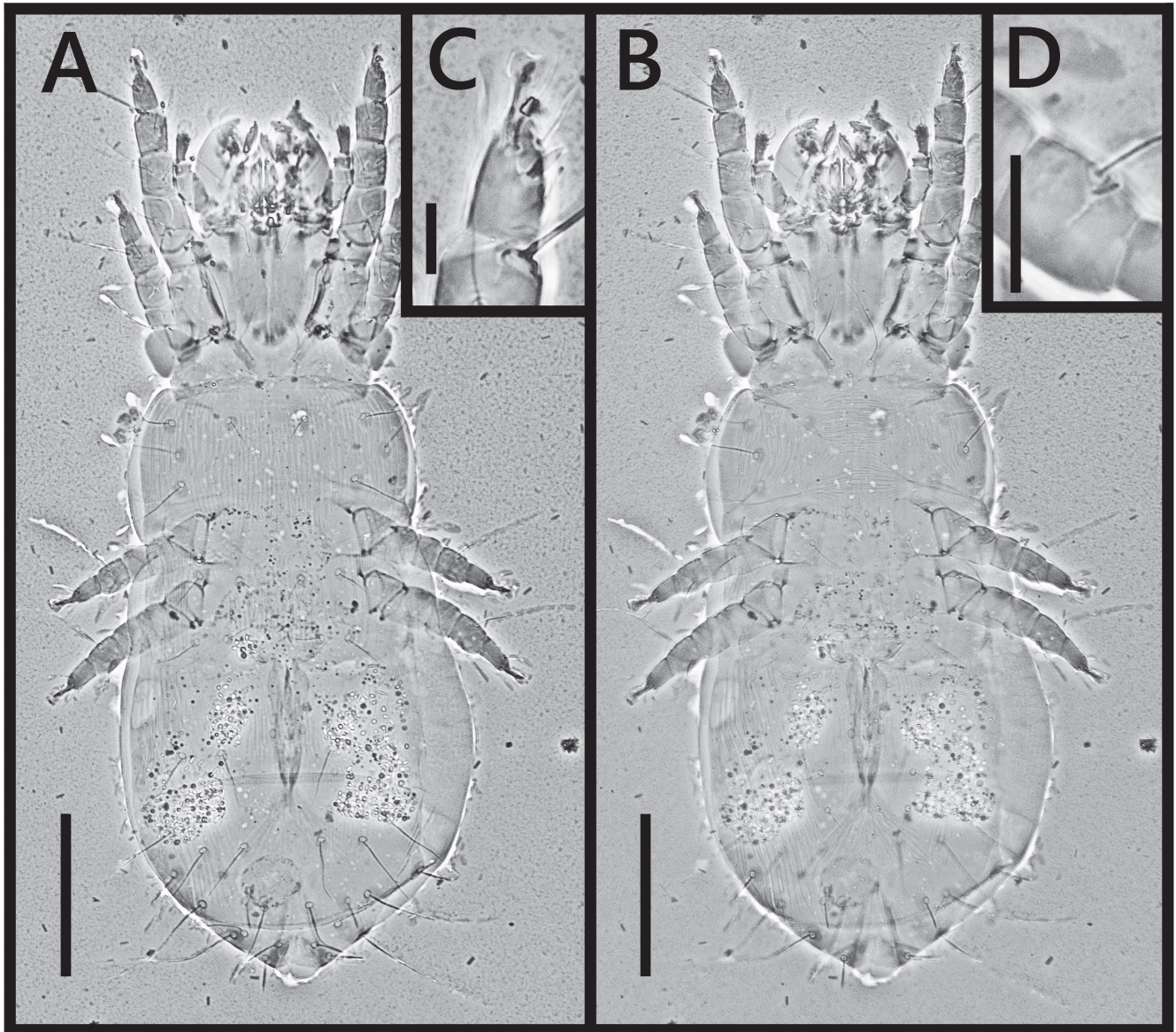


Fig. 7. *Paralycus shibai* sp. nov., female, light microscope images: A, dorsal view; B, ventral view; C, solenidion σ I; D, solenidion ϕ I. Scale bar, 50 μ m (A, B), 10 μ m (C, D).

size large, exceeding 250 (not reaching 250 in *P. parasiti* and *P. pricei*). *Paralycus pyrigerus* (Berlese, 1905) also has long gastrontal setae f_1 and h_1 , but *P. aokii* sp. nov. has shorter setae c_2 , d_1 , e_1 , which do not reach the bases of the next pair of setae (extending beyond these bases in *P. pyrigerus*).

***Paralycus shibai* Oshima & Shimano sp. nov.**

[Japanese name: Shiba-oboro-dani]

(Figures 7–9)

Type material

Holotype: adult female, Japan, Yashima, Takamatsu-

shi, Kagawa-ken, 13-V-1984, coll. M. Shiba from the bark of *Pinus* sp. (Shiba Collection). Three paratypes: females; same data as for holotype.

Type deposition

All type specimens were deposited in the Collection of Arachnida, Department of Zoology, National Museum of Nature and Science, Tokyo (NSMT) [collection numbers: holotype NSMT-Ac 14750 and paratype NSMT-Ac 14751–14753].

Diagnosis. Female

Rostral seta reaching half length of chelicera. Bases of la-

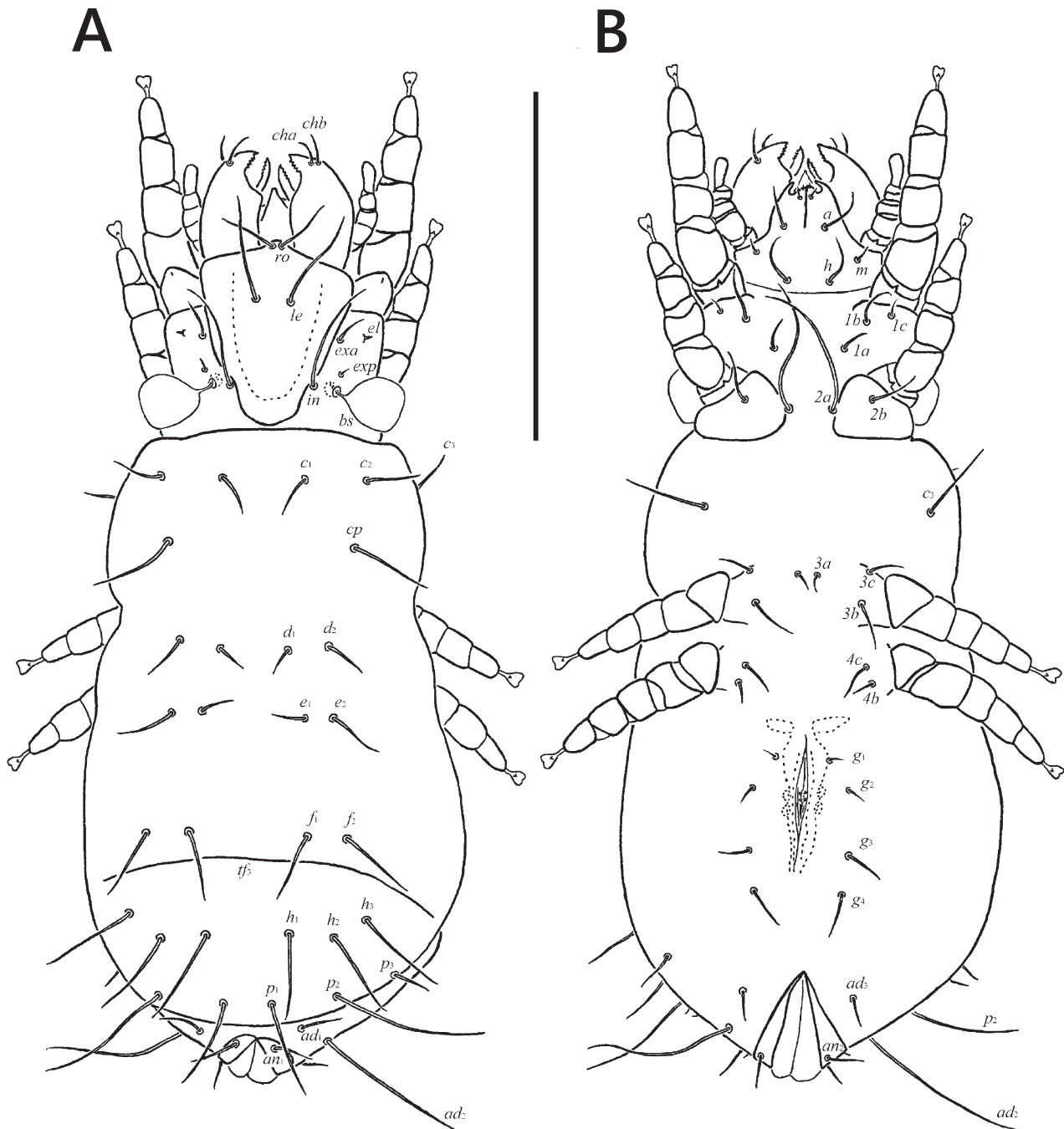


Fig. 8. *Paralcycus shibai* sp. Nov., female: A, dorsal view; B, ventral view. Scale bar, 100 μ m.

mellar setae separated to each other. Cheliceral seta *cha* shorter than half length of chelicera. Gastronotal setae *c*₁, *d*₁, *e*₁, and *f*₁ not reaching bases of next row of setae; *h*₁ reaching base of *p*₁. Epimeral seta *2a* long, exceeding tip of *1a*. Epimeral seta *4a* absent. Four pairs of genital setae present; distance *g*₂–*g*₃ > *g*₃–*g*₄ > *g*₁–*g*₂. Leg trochanteral formula 0-0-1-0. Genu I with four setae (*d*, *l* and *v'*), genu II with three setae (*d*, *l*). Solenidion ω of tarsus I not expanding in middle; solenidion ϕ of tibia III short.

Description. Female

Measurements. Idiosomal length 224, width 108.

Integument. Colorless in living, elongate and weakly sclerotized. Prodorsal shield (except its posterior part), legs and coxae smooth. Dorsal side (except segment P), ventral side, chelicerae (basal part), and ovipositor finely striated.

Gnathosoma. Subcapitulum (32 $\times$ 42) with three pairs of filiform, smooth setae (*a* 10; *m* 5; *h* 12) and two pairs of fili-

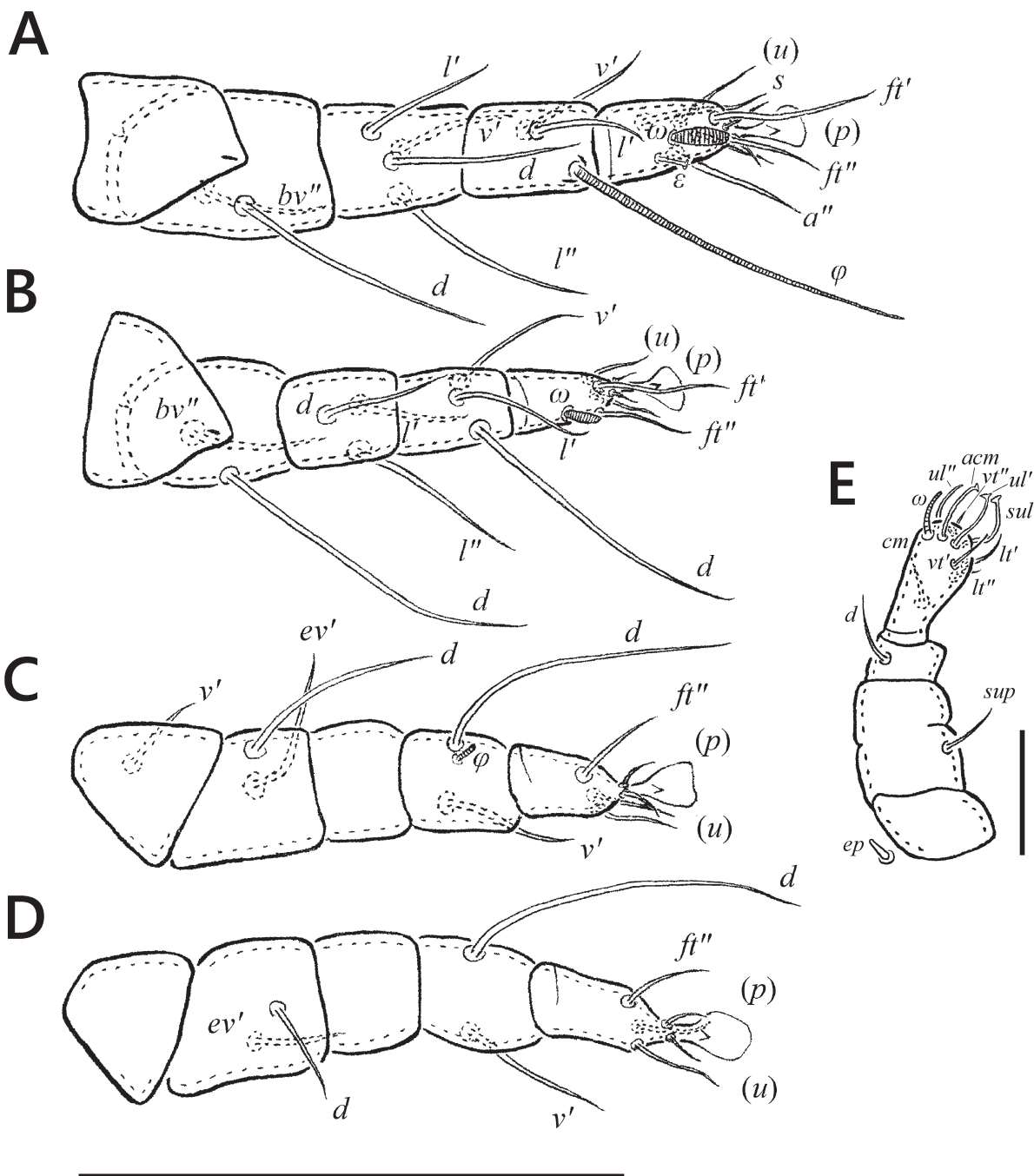


Fig. 9. *Paralycus shibai* sp. nov., female: A, leg I, right, dorsal view; B, leg II, right, dorsal view; C, leg III, right, dorsal view; D, leg IV, right, dorsal view; E, palp, left, dorsal view. Scale bars, 50 μ m (A–D), 10 μ m (E).

form and smooth adoral setae (3, 4). Palp (33) simple, with four free segments; femur and genu separated by incomplete suture. Palpal setae formula: 0-1-0-1-9+ ω , including four eupathidia (*sul*, *acm*, *ul*; *sul*, *acm*, *ul'* with expanded tips); *inf* absent. Postpalpal seta (*ep* 2) blunt. Chelicera large (31), with two filiform and smooth setae (*cha* 10; *chb* 7); *cha* shorter than half of chelicera length. Pharyngeal cupola long, reaching level of *bs*.

Prodorsum. Mid-dorsal region covered with shield-shaped plate, bearing two pairs of filiform and smooth setae (*ro* 18; *le* 28); *ro* reaching half length of chelicera. Bases of setae *le* separated to each other. In dorsolateral region, three pairs of filiform setae (*in*, *exa*, *exp*) and one pair of clavate bothridial setae (*bs*) present; *in* (37) and *exa* (14) smooth, *exp* short (5) and simple, *bs* (20 $\times$ 14) smooth.

Notogaster. Notogaster divided into four regions by three transverse scissures. Sixteen pairs of notogastral setae present. Four pairs of setae in region of segment C: c_1 (11), c_2 (17), c_3 (23) and c_p (25). Four pairs of setae in region of segment DE; d_1 (10), d_2 (12), e_1 (11) and e_2 (15). Two pairs of setae in region of segment F; f_1 (19) and f_2 (24). Segments H and P fused with six pairs of setae: h_1 (22), h_2 (29), h_3 (28), p_1 (26), p_2 (39) and p_3 (10). All gastronotal setae filiform and smooth, not expanded at their bases. Seta c_1 not reaching base of c_p ; d_1 not reaching base of e_1 ; e_1 not reaching base of f_1 ; f_1 not reaching base of h_1 ; h_1 reaching base of p_1 . Seta p_2 longer than p_1 . Notogastral cupules absent.

Epimeral and podosomal regions. Epimeral setation 3-2-3-2; $1a$ (6), $1b$ (13), $1c$ (6), $2a$ (39), $2b$ (12), $3a$ (5), $3b$ (13), $3c$ (7), $4b$ (9) and $4c$ (6) filiform and smooth. Seta $2a$ conspicuously long, exceeding tip of $1a$. Bases of $3a$ close to each other. Seta $4a$ absent. One pair of triangular supracoxal setae (el 2) with rounded tips.

Anogenital region. Four pairs of genital setae: g_1 (4), g_2 (6), g_3 (10) and g_4 (12). Distance $g_2-g_3 > g_3-g_4 > g_1-g_2$. Two pairs of minutes eugenital setae (2) and two pairs of genital papillae within genital orifice. Three pairs of adanal setae: ad_1 (14), ad_2 (46), ad_3 (9) and two pairs of anal setae: an_1 (11), an_2 (10). All anogenital setae filiform and smooth. Aggenital setae absent. Genital, anal and adanal plates absent. Genital tracheae reduced and represented by short cavities.

Legs. Relatively short. Measurements (total length from trochanter to tarsus, pretarsus excluded): I 63, II 50, III 45, and IV 50. Leg structure simple with highly visible five segments. Famulus ϵ of tarsus I bacilliform, thin and expanded at end; other setae filiform and smooth. Solenidion ω of tarsus I 5×1 not expanding in middle; ω of tarsus II 2×1 small and not expanding in middle. Solenidion ϕ of tibia I elongated and attenuate; ϕ of tibia III short (2) and bacilliform. Formula of leg setation (from trochanter to tarsus, solenidia in brackets): I 0-2-4-2 (1) -9 (1); II 0-2-3-3-6 (1); III 1-2-0-2 (1) -5; IV 0-2-0-2-5. Claws absent on all tarsi, each tarsus with a minute empodial remnant and caruncle-like membrane.

Male

Unknown.

Immatures

Unknown.

Etymology

This species is named in honor of our esteemed colleague Professor Minoru Shiba who is contributing greatly to the knowledge of prostigmatid mite diversity in Japan, and who collected specimens used in this study.

Remarks

Paralycus shibai sp. nov. and *P. pyrigerus* have long gastronotal seta h_1 , but *P. shibai* sp. nov. has shorter setae c_2 , d_1 , e_1 and f_1 , which do not reach the bases of the next pair of setae (extending beyond these bases in *P. pyrigerus*). None of other described species has both of the following characteristics; four pairs of genital setae and the absence of epimeral seta $4a$.

Key to species of genus *Paralycus*

An updated key to the species of the genus *Paralycus* based on Kolesnikov *et al.* (2023)

1. Gastronotal setae d_1 , e_1 and f_1 reaching the bases of setae in the next row 2
 - Gastronotal setae d_1 , e_1 , f_1 , or some of them, not reaching the bases of setae in the next row 3
2. Gastronotal seta c_1 reaching the level of seta c_p
 - *P. parvulus* (Price, 1973)
 - Gastronotal seta c_1 not reaching the level of seta c_p
 - *P. pyrigerus* (Berlese, 1905)
3. Epimeral seta $4a$ present 4
 - Epimeral seta $4a$ absent 10
4. Five pairs of genital setae 5
 - Three or four pairs of genital setae 6
5. Cheliceral seta cha longer than half the length of chelicera.
 - Genu II with two setae *P. raulti* (Lavoipierre, 1946)
 - Cheliceral seta cha shorter than half the length of chelicera.
 - Genu II with three setae
 - *P. longior* Fan, Li & Xuan, 1996
6. Four pairs of genital setae 7
 - Three pairs of genital setae 9
7. Genu I with three setae
 - *P. pricei* Kolesnikov, OConnor, Ermilov & Klimov, 2023
 - Genu I with four setae 8
8. Gastronotal seta f_1 reaching the base of h_1 ; epimeral seta $2a$ reaching the base of $1a$ *P. aokii* sp. nov.
 - Gastronotal seta f_1 not reaching the base of h_1 ; epimeral seta $2a$ not reaching the base of $1a$
 - *P. parasiti* Zhang & Li, 2001

9. Rostral setae longer than half length of chelicera; gastronotal seta f_1 reaching the base of h_1 ; genual setation 4-3-0-0
..... ***P. chongqingensis* Fan, Li & Xuan, 1996**
- Rostral setae shorter than half the length of chelicera; gastronotal seta f_1 not reaching the base of h_1 ; genual setation 4-2-0-0 ***P. lavoipierrei* (Price, 1973)**
10. Five pairs of genital setae
..... ***P. nortoni* Xu, Zhu, Wu & Zhang, 2020**
- Three or four pairs of genital setae 11
11. Four pairs of genital setae ***P. shibai* sp. nov.**
- Three pairs of genital setae 12
12. Bases of lamellar setae le adjacent; setae f , h , p_1 , and p_2 widened at bases
***P. daeira* Kolesnikov, OConnor, Ermilov & Klimov, 2023**
- Bases of lamellar setae le well separated; gastronotal setae not widened
***P. persephone* Kolesnikov, OConnor, Ermilov & Klimov, 2023**

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References

- Behan-Pelletier, V. and Lindo, Z., 2023. Chapter 2. Form and function. pp. 7–32, *In*: Oribatid Mites: Biodiversity, Taxonomy and Ecology (auths. Behan-Pelletier, V. and Lindo, Z.), CRC Press, Boca Raton, Florida.
- Berlese, A., 1905. Acari nuovi. Materiali pel Manipulus V. *Redia*, 2: 231–238.
- Fan, Q.-H., Li, L.-S. and Xuan, J.-Y., 1996. Two new species of the genus *Paralycus* from Sichuan, China (Acari: Pediculochelidae). *Acta Zootaxonomica Sinica*, 21: 174–178.
- Grandjean F., 1953. Essai de classification des Oribates (Acariens). *Bulletin de la Société Zoologique de France*, 78: 421–446.
- Klimov, P. B., OConnor, B. M., Chetverikov, P. E., Bolton, S. J., Pepato, A. R., Mortazavi, A. L., Tolstikov, A. V., Bauman, G. R. and Ochoa, R., 2017. Comprehensive phylogeny of acariform mites (Acariformes) provides insights on the origin of the four-legged mites (Eriophyoidea), a long branch. *Molecular Phylogenetics and Evolution*, 119: 105–117.
- Kolesnikov, V. B., OConnor, B. M., Ermilov, S. G. and Klimov, P. B., 2023. A Review of the Asexual Mite Genus *Paralycus* Womersley, 1944 (Acari: Oribatida: Pediculochelidae), with Description of Three New Species and a Key to Species of the World. *Diversity*, 15: 160.
- Lavoipierre, M., 1946. A new acarine parasite of bees. *Nature*, 158: 130.
- Norton, R. A., OConnor, B. M. and Johnston, D. E., 1983. Systematic relationships of the Pediculochelidae (Acari: Acariformes). *Proceeding of the Entomological Society of Washington*, 27: 97–99.
- Norton, R. A. and Behan-Pelletier, V., 2009. Chapter 15. Suborder Oribatida. pp. 430–564, *In*: A Manual of Acarology, Third Edition (eds. Kranz, G. and Walter, D. E.), Texas Tech University Press, Lubbock, Texas.
- Pepato, A. R. and Klimov, P. B., 2015. Origin and higher-level diversification of acariform mites – evidence from nuclear ribosomal genes, extensive taxon sampling, and secondary structure alignment. *BMC Evolutionary Biology*, 15: 178.
- Price, D. W., 1973. Genus *Pediculochelus* (Acarina: Pediculochelidae), with notes on *P. raulti* and descriptions of two new species. *Annals of the Entomological Society of America*, 66: 302–307.
- Schubart, H., 1975. Morphologische Grundlagen für die Klärung der Verwandtschaftsbeziehungen innerhalb der Milbenfamilie Ameronothridae (Acari, Oribatei). *Zoologica*, 123: 23–91.
- Shiba, M., 1991. Prostigmata. pp. 32–37, figs. 97–114, *In*: Pictorial Keys to Soil Animals of Japan (ed. Aoki, J.), Tokai University Press, Tokyo. [In Japanese]
- Shiba, M., 1999. Prostigmata. pp. 211–311, *In*: Pictorial Keys to Soil Animals of Japan (ed. Aoki, J.), Tokai University Press, Tokyo. [In Japanese]
- Womersley, H., 1944. Australian Acarina, families Alycidae and Nanorchestidae. *Transactions of the Royal Society of South Australia*, 68: 133–143.
- Xu, Y., Zhu, Y.-Z., Wu, J.-Q. and Zhang, F.-P., 2020. A new species of the genus *Paralycus* from Fujian, China. *Acarologia*, 60: 481–487.
- Zhang, A.-H. and Li, Y.-R., 2001. A new species of the genus *Paralycus* from Chongqing, China. *Journal of Southwest Agricultural University*, 23: 317–318.