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Two new species and new country records of *Eustigmaeus* (Trombidiformes: Prostigmata: Stigmaeidae) in Japan

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Abstract. The genus *Eustigmaeus* Berlese, 1910 contains over 140 known species distributed worldwide, including parasites of sandflies and moss-feeders. Here, we examine the taxonomic status of five previously unidentified species of *Eustigmaeus* from Japan. Two species with broad geographic ranges in Shikoku and Honshu islands are described as *E. specialis* sp. nov. and *E. saxicola* sp. nov. *Eustigmaeus grandis* Khaustov, 2019 is recorded for the first time in Japan and exhibits considerable morphological variation. The remaining two species are tentatively identified as *E.* cf. *etruscus* (Berlese, 1910) and *E.* cf. *clavatus* (Canestrini & Fanzago, 1876).

Keywords. Acariformes, Raphignathoidea, taxonomy, phytophagy, moss.

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Introduction

The stigmaeid genus *Eustigmaeus* Berlese, 1910 currently comprises 144 valid species, and is distributed worldwide (Doğan 2025). Species in this genus are found in a variety of habitats, including litter, bark, lichen, and moss (Gerson 1972; Fan *et al.* 2016; Beron 2020; Doğan & Doğan 2024; Ikeda *et al.* 2024a, 2025). Six species have been identified as insect parasites (Chaudhri 1965; Abonnenc 1970; Zhang & Gerson 1995; Reeves *et al.* 2008; Majidi *et al.* 2019). Recently, Ikeda *et al.* (2024b) investigated moss-feeding *Eustigmaeus* in Japan and revealed greater diversity than previously recognized, recognizing 10 taxonomic units based on morphological characters and a molecular phylogenetic analysis of mitochondrial cytochrome *c* oxidase subunit I (COI) sequences. Five of these species have since been identified as *E. imadae* Ikeda & Nakano, 2024, *E. extremiorientalis* Khaustov, 2016, *E. asper* Ikeda & Nakano, 2025, *E. pseudolacunus* Khaustov, Kravchenko & Kazakov, 2023, and *E. rhodomelus* (Koch, 1841) (Ikeda *et al.* 2024a, 2025). However, the remaining five units, each clearly distinguishable from other Japanese species of *Eustigmaeus* and one another (see Ehara 1980), remain unresolved.

We herein elucidate the taxonomic status of these five units based on detailed morphological assessments. *Eustigmaeus* spp. 2 and 3 sensu Ikeda *et al.* (2024b) are described as new to science. *Eustigmaeus* sp. 6 sensu Ikeda *et al.* (2024b), with additional materials from Shikoku and Honshu, is identified as *E. grandis* Khaustov, 2019, and morphological variation among populations is documented. *Eustigmaeus* spp. 5 and 10 sensu Ikeda *et al.* (2024b) are treated as *E.* cf. *etruscus* (Berlese, 1910) and *E.* cf. *clavatus* (Canestrini & Fanzago, 1876), respectively.

Material and methods

Mites were collected directly from mosses using tweezers under a microscope or extracted from substrates using a Berlese-Tullgren funnel. The specimens were stored in 70% ethanol until they were mounted in Hoyer's medium. Each specimen was examined using an Olympus BX53 light microscope and photographed using a Canon EOS Kiss X7 digital camera mounted on the same microscope. The holotype of *E. kauaiensis* Swift, Gerson & Goff, 1985, deposited at the Bernice Pauahi Bishop Museum, was also examined for comparison with the Japanese specimens. The terminology follows that of Grandjean (1944, 1946), Norton (1977), Kethley (1990), and Fan & Zhang (2005). Leg lengths were measured from the edge of the trochanter to the edge of the tarsus, excluding the claw and eupodium. Chelicera length was measured from its base to the tip of the fixed digit; stylet length was measured from the end attached to the basilar sclerite to the protruding end. Chelicera and stylet measurements were taken in dorsal view. Measurements of the holotype are given first, followed by the minimum and maximum values in parentheses, for newly described species. All measurements are expressed in micrometers (μm). The Japanese specimens examined in this study were deposited in the Zoological Collection of Kyoto University.

Abbreviations for morphological terms

Gnathosoma

m = anterior pair of subcapitular seta
n = posterior pair of subcapitular seta
or1 = internal pair of adoral seta
or2 = external pair of adoral seta

Idiosoma

1a, *1b*, *1c* = setae associated with base of leg I
2b, *2c* = setae associated with base of leg II
3a, *3b*, *3c* = setae associated with base of leg III
4a, *4b*, *4c* = setae associated with base of leg IV
ag1 = first (anteriormost) pair of aggenital setae
ag2 = second pair of aggenital setae
ag3 = third pair of aggenital setae
c1 = internal pair of setae on first (anteriormost) transverse region of hysterosoma
c2 = external pair of setae on first transverse region of hysterosoma
d1 = internal pair of setae on second transverse region of hysterosoma
d2 = external pair of setae on second transverse region of hysterosoma
e1 = internal pair of setae on third transverse region of hysterosoma
e2 = external pair of setae on third transverse region of hysterosoma
f1 = seta on fourth transverse region of hysterosoma
h1 = internal pair of setae on fifth transverse region of hysterosoma
h2 = external pair of setae on fifth transverse region of hysterosoma
ps1 = first pair of pseudanal setae
ps2 = second pair of pseudanal setae
ps3 = third pair of pseudanal setae

sce = external pair of scapular setae
sci = internal pair of scapular setae
ve = external pair of vertical setae
vi = internal pair of vertical setae

Palp and legs

ζ = eupathidia
φ = solenidion on tibia I
φp = proximal solenidia on tibiae
ω = solenidia on tarsi of palp and legs
a = anterolateral setae on tarsi of legs
acm, ul, sul = eupathid setae on palpal tarsus
bp, ba, lp, va = setae on palpal tarsus
bv = basiventral setae of legs I and II
d = dorsal setae on palp and legs
el = supracoxal setae of leg I
ep = supracoxal setae of palp
ev = basiventral setae of legs III and IV
ft = fastigial setae on tarsi of legs
l = lateral setae on palp and legs
p = proral setae on tarsi of legs
pl = primilateral setae on tarsi of legs
tc = tectal setae on tarsi of legs
u = unguinal setae on tarsi of legs
v = ventral setae on palp and legs
vs = ventral subunguinal setae on tarsi of legs

Institutional abbreviations

BPBM = Bernice Pauahi Bishop Museum, Hawaii, USA
KUZ = Zoological Collection of Kyoto University, Kyoto, Japan

Results

Taxonomy

Order Trombidiformes Reuter, 1909
Superfamily Raphignathoidea Kramer, 1877
Family Stigmaeidae Oudemans, 1931
Genus *Eustigmaeus* Berlese, 1910

Eustigmaeus specialis Ikeda & Nakano sp. nov.
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Figs 1–6; Table 1

Eustigmaeus sp. 2 – Ikeda *et al.* 2024b: 734, fig. 4.

Diagnosis

The new species shares the following character states with *E. kauaiensis*, *E. parakauaiensis* Kapaxidi, Stathakis & Papadoulis, 2013, and *E. zhengyii* Hu & Zhu, 1994: idiosomal lengths of 300 to 400 μm; an elongate major callosity is situated laterally to the prodorsal shield; dorsal seta *sci* is minute; seta *e1* is longer than *f1*; and aggenital shield bears two pairs of setae. However, the new species can be

distinguished from *E. parakauaiensis* by the presence of enlarged, irregularly shaped dimples on the anterior part of the prodorsal shield (Figs 1–2). It also differs from *E. zhengyii* in having a genu II with four setae and tarsus IV with eight setae (Table 1). The new species is most similar to *E. kauaiensis* in overall dorsal seta lengths. However, the dimples on the hysterosomal shield are medium-sized with sharply defined edges in the new species, whereas they are small with ill-defined edges in *E. kauaiensis* (Figs 1–2, 7). It also differs from *E. kauaiensis* in the number of setae on trochanter III (Table 1).

Etymology

The specific epithet '*specialis*' (Latin adjective meaning 'specialized') refers to the apparent high host specificity of the species, associated with mosses of the genus *Philonotis* Brid. (Ikeda *et al.* 2024b). We propose the Japanese name 'Sawagoke-maruhishidani', derived from the Japanese name *Philonotis*.

Type material

Holotype

JAPAN – **Honshu** • ♀; Wakayama, Arita, Aritagawa; 34°01′58.5″ N, 135°23′36.8″ E; 270 m a.s.l.; 10 Oct. 2021; S. Ikeda leg.; from moss on wet concrete wall along the mountain path; locality code 24 in Ikeda *et al.* (2024b); KUZ Z4626.

Paratype

JAPAN – **Honshu** • 1 ♀; same data as for holotype; KUZ Z4628.

Other material examined

JAPAN – **Honshu** • 2 ♀♀; Hiroshima, Onomichi; 34°27′06.3″ N, 133°13′34.1″ E; 10 m a.s.l.; 26 Mar. 2021; S. Ikeda leg.; from moss on a wet stone by the river; locality code 14 in Ikeda *et al.* (2024b); GenBank no. LC789962 (COI); KUZ Z4661, KUZ Z4829 • 1 ♀; Wakayama, Shingu, Kumanogawanishi; 33°45′46.4″ N, 135°49′45.1″ E; 80 m a.s.l.; 11 Oct. 2021; S. Ikeda leg.; from moss on dripping rock face along the pavement road; locality code 23 in Ikeda *et al.* (2024b); KUZ Z4711 • 1 ♀; same data as for holotype; GenBank no. LC789943 (COI); KUZ Z4802 • 2 ♀♀; Shizuoka, Hamamatsu, Tenryu; 34°58′11.6″ N, 137°48′45.3″ E; 180 m a.s.l.; 22 Apr. 2022; S. Ikeda leg.; from moss on wet concrete wall along the pavement road; locality code 27 in Ikeda *et al.* (2024b); GenBank no. LC789967 (COI); KUZ Z4703, KUZ Z4811 • 2 ♀♀; Shizuoka, Shizuoka, Aoi; 35°08′33.1″ N, 138°19′49.0″ E; 250 m a.s.l.; 21 Apr. 2022; S. Ikeda leg.; from moss on wet rock face along the pavement road; locality code 28 in Ikeda *et al.* (2024b); GenBank no. LC789963 (COI); KUZ Z4709, KUZ Z4830. – **Shikoku** • 1 ♀; Kochi, Takaoka, Yusuhara; 33°27′57.0″ N, 132°53′27.8″ E; 860 m a.s.l.; 27 Sep. 2021; S. Ikeda leg.;

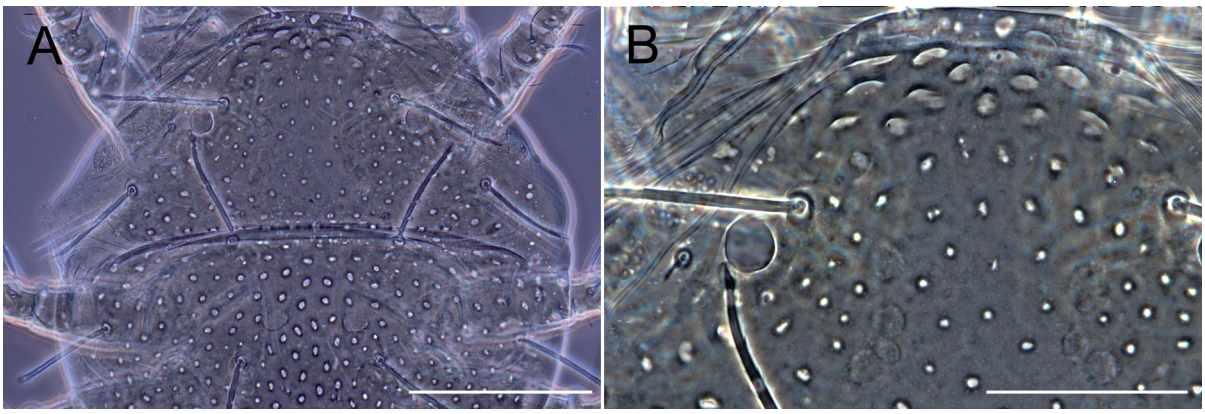

Fig. 1. *Eustigmaeus specialis* Ikeda & Nakano sp. nov., holotype, ♀, KUZ Z4626. **A**. Dorsal shields. **B**. Dimples and punctation on prodorsal shield. Scale bars: A = 100 μm; B = 50 μm.

from moss on dripping concrete wall along the pavement road; locality code 2 in Ikeda *et al.* (2024b); KUZ Z4719 • 2 ♀♀; Ehime, Toon; 33°44′36.0″ N, 132°56′05.1″ E; 630 m a.s.l.; 1 Mar. 2021; S. Ikeda leg.; from moss on dripping concrete wall along the pavement road; locality code 5 in Ikeda *et al.* (2024b); GenBank no. LC789948 (COI); KUZ Z4527, KUZ Z4804 • 1 ♀; Tokushima, Naka, Naka; 33°46′58.9″ N, 134°09′18.6″ E; 470 m a.s.l.; 31 Jul. 2021; S. Ikeda leg.; from moss on dripping rock face along the mountain path; locality code 6 in Ikeda *et al.* (2024b); GenBank no. LC789965 (COI); KUZ Z4809 • 3 ♀♀; Tokushima, Naka, Naka; 33°48′48.4″ N, 134°18′07.8″ E; 270 m a.s.l.; 31 Jul. 2021; S. Ikeda leg.; from moss on wet rock face along the mountain path; locality code 7 in Ikeda *et al.* (2024b); GenBank no. LC789950 (COI); KUZ Z4704, KUZ Z4807, KUZ Z4844 • 2 ♀♀; Tokushima, Myozai, Kamiyama; 33°55′58.8″ N, 134°15′04.0″ E; 600 m a.s.l.; 11 Sep. 2021; S. Ikeda leg.; from moss on wet soil along the pavement road; locality code 10 in Ikeda *et al.* (2024b); KUZ Z4708, KUZ Z4709 • 1 ♀; Tokushima, Myozai, Kamiyama; 33°56′34.6″ N, 134°14′32.4″ E; 420 m a.s.l.; 7 May 2022; R. Miyoshi leg.; from moss on a wet boulder by the stream; locality code 11 in Ikeda *et al.* (2024b); KUZ Z4697 • 1 ♀; Tokushima, Mima, Anabuki, Anabukigawa; 34°01′24.7″ N, 134°09′01.9″ E; 50 m a.s.l.; 11 Sep. 2021; S. Ikeda leg.; from mosses on a wet boulder and dripping rock face by the river; locality code 13 in Ikeda *et al.* (2024b); KUZ Z4652.

Description of females (n = 15)

Measurements. Idiosomal length 320 (293–360), idiosomal width 266 (237–276).

Idiosomal dorsum (Figs 1–3). Two large shields almost completely cover idiosomal dorsum. Dorsal shields sclerotized. Dimples oval or nearly round; small or absent on central part of prodorsal shield but enlarged, irregularly shaped on its anterior part (Fig. 3). Distances between dimples greater than

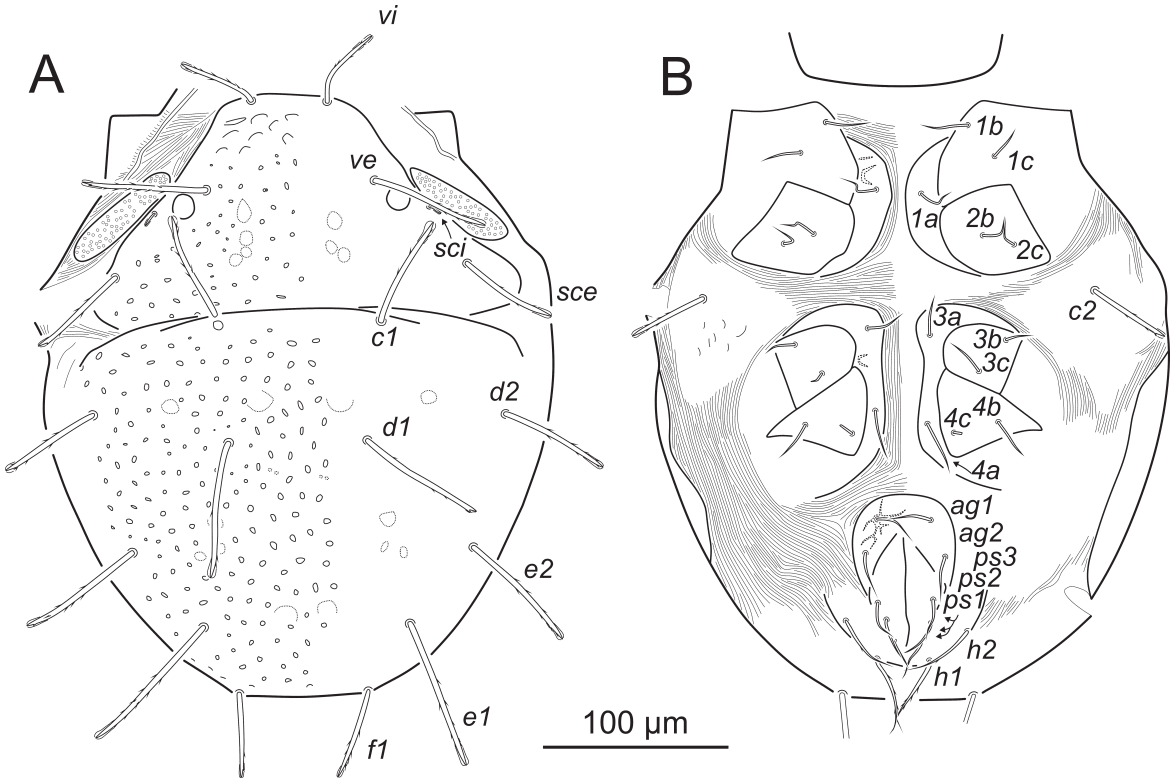

Fig. 2. *Eustigmaeus specialis* Ikeda & Nakano sp. nov., holotype, ♀, KUZ Z4626. **A**. Idiosomal dorsum. **B**. Idiosomal venter. Punctation is not shown. Setae of *c1* (left), *3c* (left), and *4c* are broken. Abbreviations: see Material and methods.

their diameters. Shield surface minutely punctate (Fig. 1B). Fossettes as illustrated (Fig. 2A). Ocelli present. Lateral margin of hysterosomal shield weakly sclerotized. One pair of oval and large callosity positioned on pleural membrane close to prodorsal shield, length at longest part 65 (64–94). Suranal shield located ventrally, and sclerotized with punctate surface. Suranal setae pointed with minute barbs. Dorsal setae rod-like with bluntly pointed tips and sparsely barbed, hyaline sheaths evident near tips. Lengths of dorsal setae: *vi* 43 (39–56), *ve* 61 (59–78), *sci* 8 (9–11), *sce* 53 (51–66), *c1* 58 (49–70), *c2* 41 (39–51), *d1* 73 (63–81), *d2* 58 (52–69), *e1* 80 (70–92), *e2* 68 (61–81), *f1* 45 (47–59), *h1* 39 (37–45), *h2* 29 (29–36). Distances between setae: *vi–vi* 40 (32–41), *ve–ve* 91 (84–95), *sci–sci* 147 (142–161), *sce–sce* 188 (178–212), *vi–ve* 53 (48–60), *ve–sci* 30 (30–37), *sci–sce* 38 (29–40), *c1–c1* 89 (78–94), *d1–d1* 73 (66–90), *d2–d2* 221 (214–242), *e1–e1* 110 (97–114), *e2–e2* 181 (168–190), *f1–f1* 68 (63–82), *h1–h1* 29 (22–32), *h2–h2* 63 (65–77), *c1–d1* 63 (55–73), *c1–d2* 81 (78–91), *e1–d2* 129 (121–146), *d1–d2* 74 (72–91), *d1–e1* 100 (88–112), *d1–e2* 78 (73–84), *d2–e2* 78 (72–89), *e1–e2* 52 (49–60), *e1–f1* 39 (22–47), *h1–h2* 26 (23–31).

Idiosomal venter (Fig. 2B). Humeral shield punctate with amorphous shallow dimples. Coxisternal plates of legs minutely punctate, posterior part of leg II coxisternal plate faintly reticulated or not.

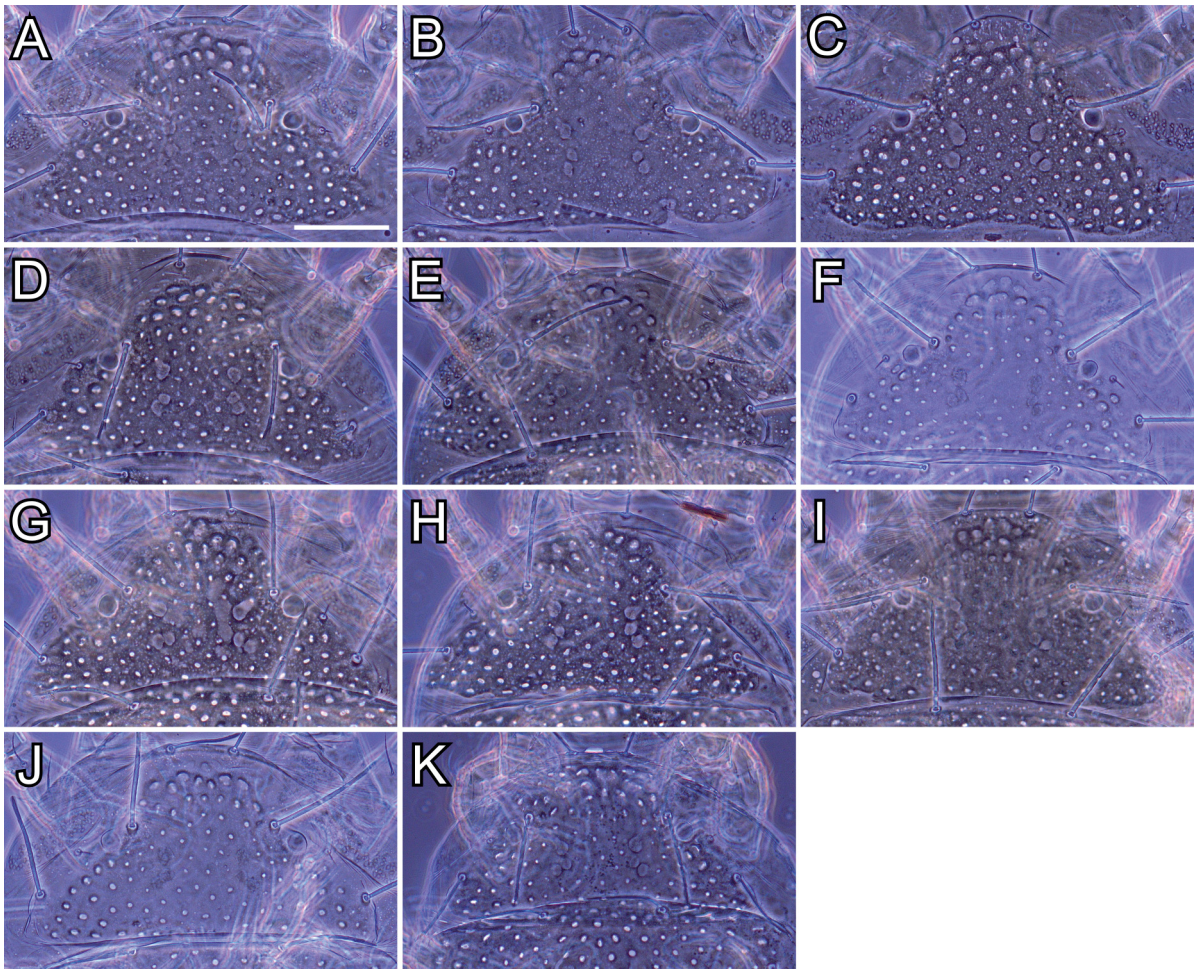

Fig. 3. *Eustigmaeus specialis* Ikeda & Nakano sp. nov., intraspecific variation on dorsal shield ornamentation ♀. **A**. KUZ Z4527. **B**. KUZ Z4652. **C**. KUZ Z4661. **D**. KUZ Z4697. **E**. KUZ Z4703. **F**. KUZ Z4704. **G**. KUZ Z4705. **H**. KUZ Z4708. **I**. KUZ Z4711. **J**. KUZ Z4719. **K** KUZ Z4844. All photos are at the same magnification. Scale = 50 μm.

Endopodal plates punctate and reticulated, and separated medially. Aggenital plate punctate and faintly reticulated, with two pairs of aggenital setae. Anal cover with three pairs of simple pseudanal setae. Lengths of setae: *ag1* 21 (21–27), *ag2* 23 (20–26), *ps1* 24 (18–27), *ps2* 25 (19–26), *ps3* 22 (21–27).

Gnathosoma (Fig. 4). Dorsal surface of chelicera punctate. Chelicera and its short movable digit 98 (89–101) and 23 (21–28) in length, respectively. Seta *l′* on palpal tibia short, finger-like. The other palpal setae of femur, genu, and tibia sparsely barbed and pointed. For palptarsal setae, *acmζ*, (*ulζ*), and *sulζ* smooth with blunt tips, *ω* finger-shaped, the other setae smooth and pointed. Counts of palpal setae from trochanter to tarsus: 0, 3, 2, 3, 6 + *ω*. Supracoxal seta *ep* short, needle-like, located laterally. Ventral surface of subcapitulum punctate. Rostrum short. Adoral seta *or2* smooth, thickened, and curved with a blunt tip. Setae *m*, *n*, and *or1* pointed, smooth or sparsely barbed. Lengths of setae: *m* 21 (17–23), *n* 23 (21–26), *or1* 5 (7–9), *or2* 11 (10–14). Distances between subcapitular setae: *m–m* 26 (25–29), *n–n* 38 (33–40), *m–n* 17 (13–19).

Legs (Figs 5–6). Leg lengths: leg I 197 (185–218), leg II 163 (150–172), leg III 156 (146–181), leg IV 190 (176–203). Empodium with three pairs of tenant hairs. Counts of setae on leg I–IV: coxae 2 + *el*, 2, 2, 2; trochanters 1, 1, 2, 1; femora 6, 5, 3, 2; genua 3 + 1*k*, 3 + 1*k*, 1, 1; tibiae 5 + 1*φ* + 1*φp*, 5 + 1*φp*, 5 + 1*φp*, 5 + 1*φp*; tarsi 13 + 1*ω*, 9 + 1*ω*, 7 + 1*ω*, 7 + 1*ω*. Leg I (Fig. 5A). Supracoxal seta *el* short, spine-like. Leg setae *d* of tibia, (*ft*), (*tc*), and (*p*) of tarsus eupathid-like. Seta *d* of femur, *d* and (*l*) of genu sparsely barbed and pointed (or bluntly pointed), with (or without) hyaline sheaths. Setae *v′* of trochanter, *bv″*, (*v*),

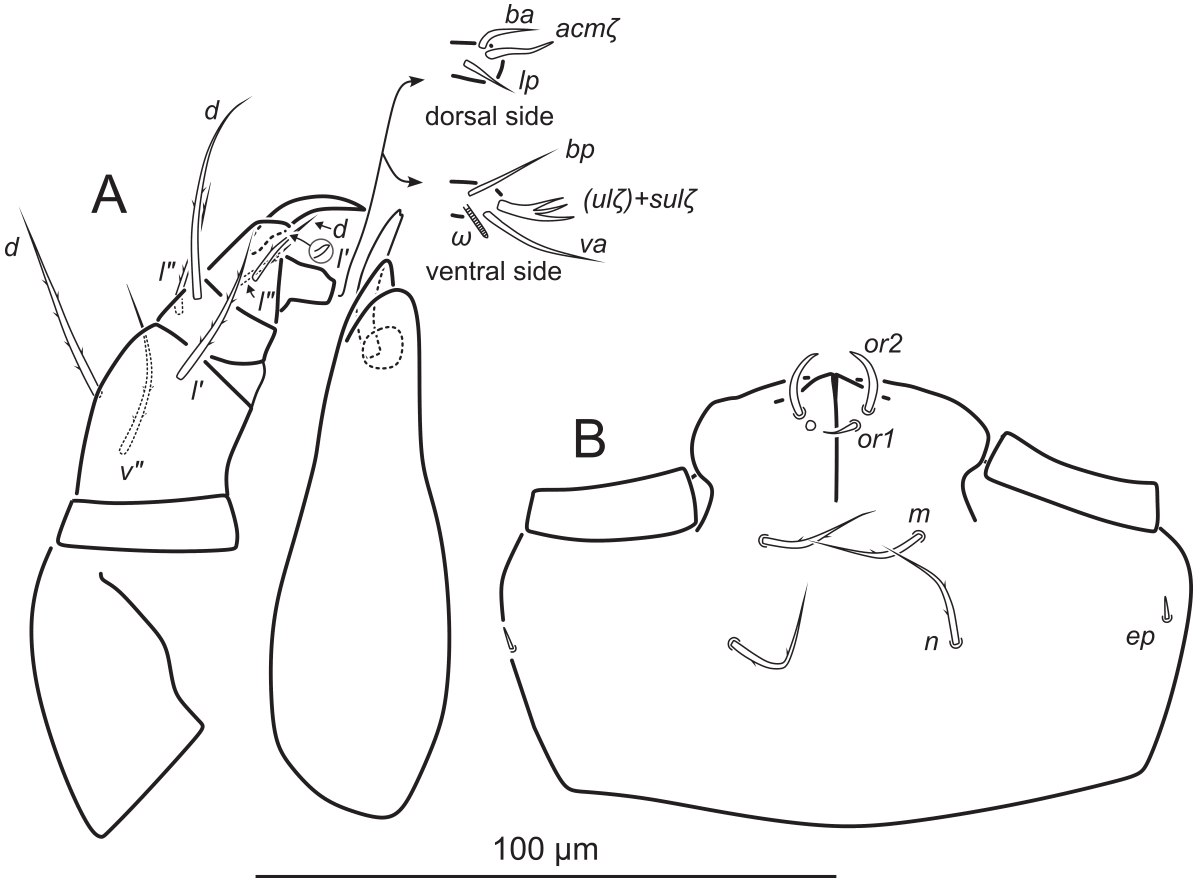

Fig. 4. *Eustigmaeus specialis* Ikeda & Nakano sp. nov., holotype, ♀, KUZ Z4626. **A**. Left palp and chelicera. **B**. Ventral view of subcapitulum. Punctation is not shown. Left *or1* lost. Abbreviations: see Material and methods.

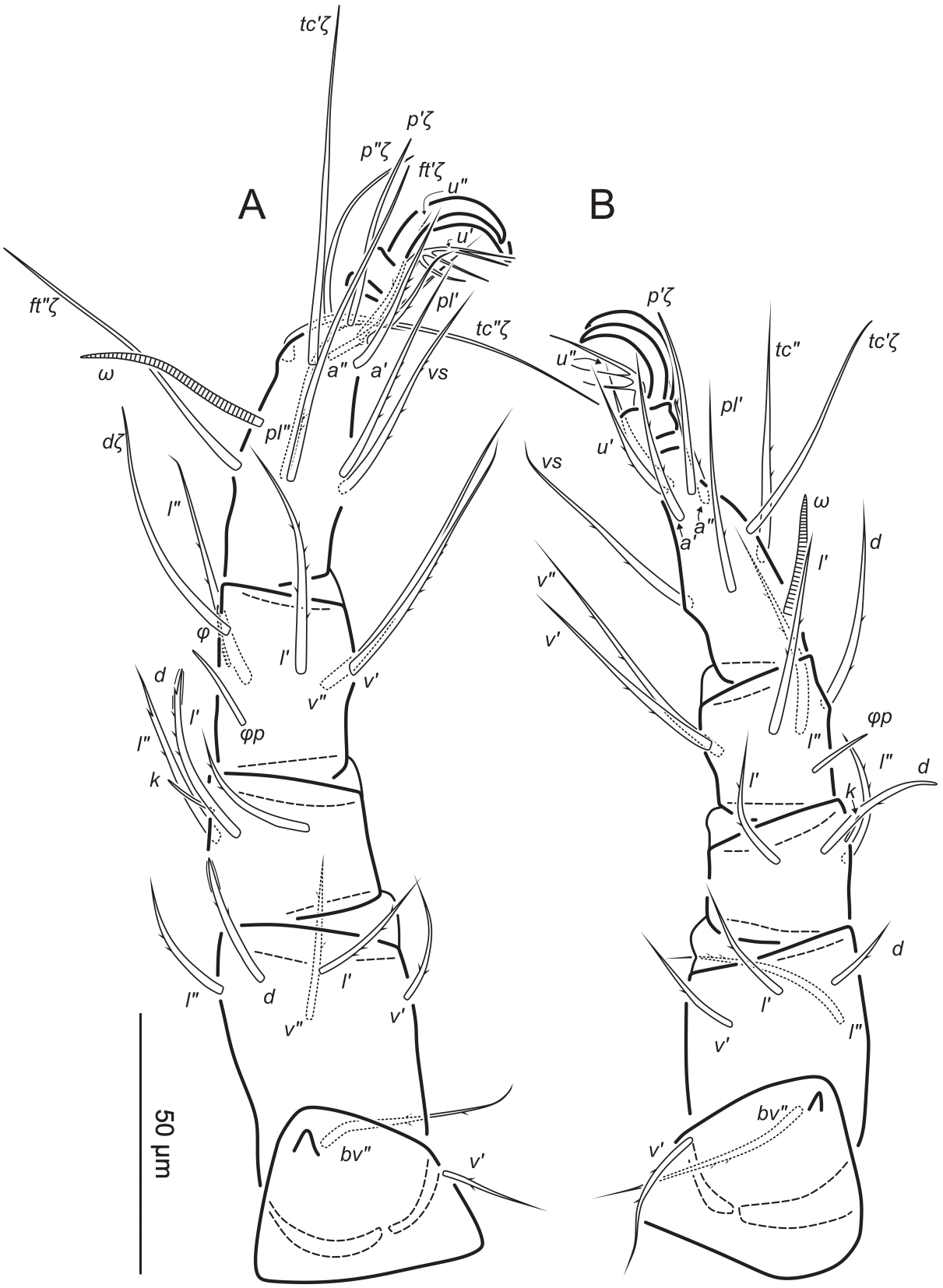

Fig. 5. *Eustigmaeus specialis* Ikeda & Nakano sp. nov., holotype, ♀, KUZ Z4626. **A**. Left leg I, dorsal view. **B**. Right leg II, dorsal view. Abbreviations: see Material and methods.

and (*l*) of femur, (*v*) and (*l*) of tibia, *vs* and (*pl*) of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated or smooth. Solenidion *ω* and *φ* baculiform with round tips, *φp* attenuate. Seta *k* needle-shaped. Seta lengths: *k* 10 (10–14), *φp* 18 (12–21), *φ* 11 (9–15), *ω* 37 (33–40). Leg II (Fig. 5B). Leg setae *tc′* and *p′* of tarsus eupathid-like. Setae *d* of genu sparsely barbed and pointed (or bluntly

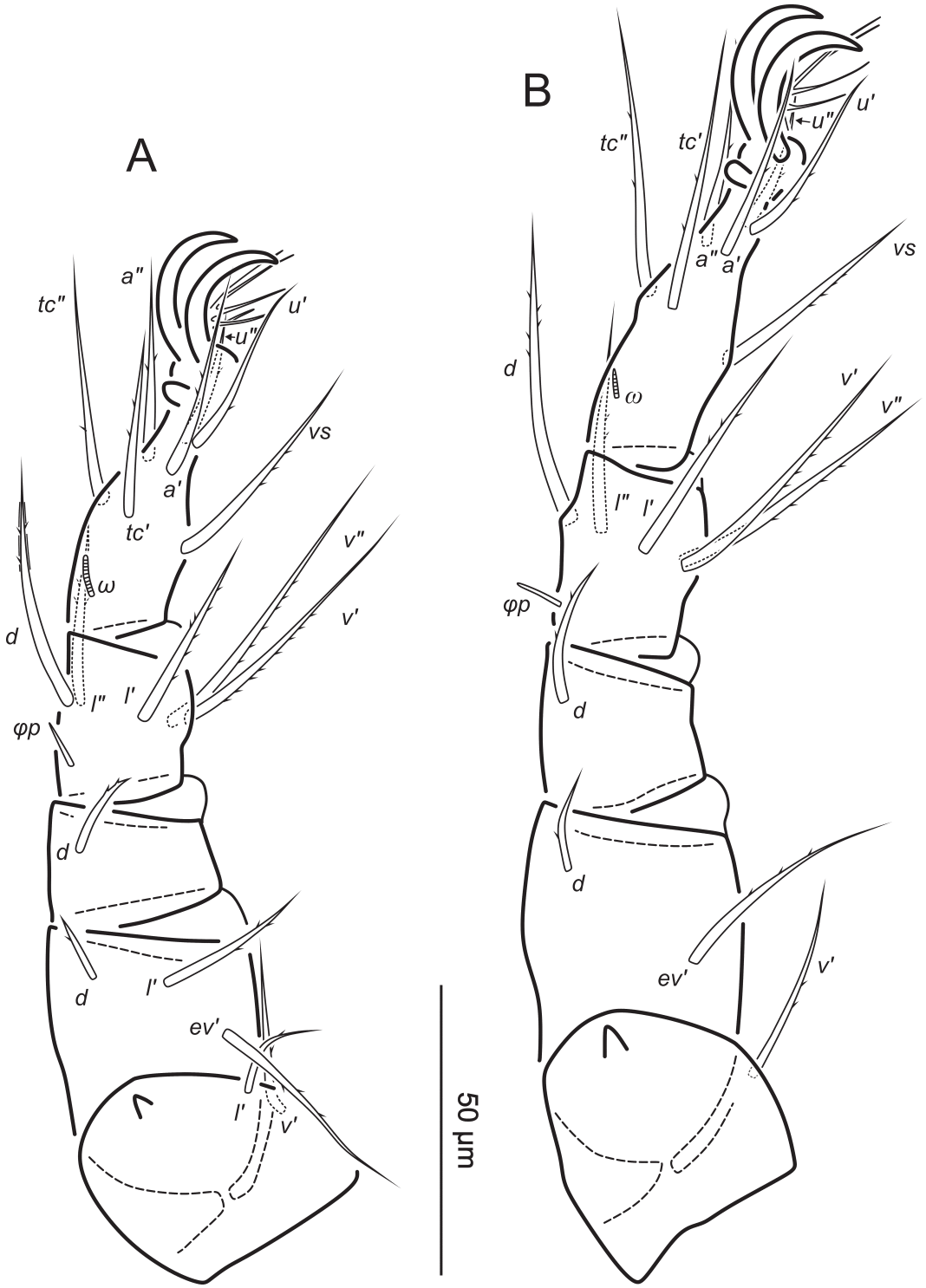

Fig. 6. *Eustigmaeus specialis* Ikeda & Nakano sp. nov., holotype, ♀, KUZ Z4626. **A**. Left leg III, dorsal view. **B**. Left leg IV, dorsal view. Abbreviations: see Material and methods.

Table 1 (continued on next page). Comparisons of morphological characters among *Eustigmaeus specialis* sp. nov., *E. kauaiensis* Swift, Gerson & Goff, 1985, *E. zhengyii* Hu & Zhu, 1994, and *E. parakauaiensis* Kapaxidi, Stathakis & Papadoulis, 2013. * = relative distance between subcapitular setae; — = no data.

Species	*E. specialis* sp. nov.	*E. kauaiensis*	*E. kauaiensis*	*E. zhengyii*	*E. parakauaiensis*	*E. parakauaiensis*	*E. parakauaiensis*
References	This study	Swift *et al.* (1985)	Fan (2002)	Hu & Zhu (1994)	Kapaxidi *et al.* (2013)	Khaustov (2023)	Doğan (2005, 2025)
Material	Types and Non-types	Types	Non-types	Types	Types	Non-types	Non-types
No. of examined specimens	n = 15	n = 10	—	n = 8	n = 7	n = 3	n = 67
Idiosomal dimensions							
Length	293–360	312–359	325	308.9 ± 14.2	335–376	285–310	307–341
Width	237–276	270-294	289	271.0 ± 9.9	266–321	225–250	200–268
Dorsal setae lengths and ratio							
vi	39–56	47–60	—	52.3 ± 2.4	50–61	50–59	47
ve	59–78	65–79	—	84.6 ± 7.3	72–83	65–79	72
sci	8–11	9–12	—	12.0 ± 2.6	18	17–19	13–18
sce	51–66	50–62	—	66.0 ± 3.8	68–76	56–64	47
c1	49–70	59–74	—	72.0 ± 2.4	61–79	51–62	53
c2	39–51	32–42	—	49.7 ± 1.9	47–54	45–49	36–47
d1	63–81	68–82	—	90.5 ± 5.1	79–97	67–72	70
d2	52–69	53–63	—	72.6 ± 5.6	79–86	68–80	53
e1	70–92	74–88	—	98.4 ± 2.4	101–115	88–99	92–112
e2	61–81	62–74	—	88.8 ± 3.8	97–112	88–102	80
f1	45–59	62–71	—	65.1 ± 3.8	68–79	69–70	60–75
h1	37–45	38–44	—	44.9 ± 1.3	40–47	44–46	39–47

Table 1 (continued). Comparisons of morphological characters among *Eustigmaeus specialis* sp. nov., *E. kauaiensis* Swift, Gerson & Goff, 1985, *E. zhengyii* Hu & Zhu, 1994, and *E. parakauaiensis* Kapaxidi, Stathakis & Papadoulis, 2013. * = relative distance between subcapitular setae; — = no data.

Species	*E. specialis* sp. nov.	*E. kauaiensis*	*E. kauaiensis*	*E. zhengyii*	*E. parakauaiensis*	*E. parakauaiensis*	*E. parakauaiensis*
h2	29–36	29–35	—	38.5 ± 0.9	32–43	38–39	32–40
ve*/*sci	5.9–8.3	5.91 [a)]	≈ 7 [b)]	7.05	4.33	3.8–4.1 [c)]	5.5 [d)]
Ventral and gnathosomal characters							
Callosity length	64–94	85–98	—	—	71–89	—	—
Endopodal shield	Reticulated	Reticulated	Reticulated	Reticulated	Reticulated	Not-reticulated	Reticulated
R.D. subcap.*	m–m < n–n	m–m ≈ n–n	—	m–m < n–n	m–m < n–n	m–m < n–n [d)]	—
Leg setation and setae ratios							
Coxa	2-2-2-2	2-2-2-2 [e)]	2-2-2-2	2-2-2-2	2-2-2-2	2-2-2-2	2-2-2-2
Trochanter	1-1-2-1	1-1-1-1	1-1-1-1	1-1-2-1	1-1-2-1	1-1-2 [e)]-1	1-1-2-1
Femur	6-5-3-2	6-5-3-2	6-5-3-2	6-5-3-2	6-5-3-2	6-5-3-2	6-5-3-2
Genu	4-4-1-1	4-4-1-1	4-4-1-1	4-3-1-1	4-4-1-1	4-4-1-1	4-4-1-1
Tibia	5(2)-5(1)-5(1)-5(1)	5(2)-5(1)-5(1)-5(1)	5(2)-5(1)-5(1)-5(1)	5(2)-5(1)-5(1)-5(1)	5(2)-5(1)-5(1)-5(1)	5(2)-5(1)-5(1)-5(1)	5(2)-5(1)-5(1)-5(1)
Tarsus	13(1)-9(1)-7(1)-7(1)	13(1)-9(1)-7(1)-7(1) [f)]	13(1)-9(1)-7(1)-7(1)	13(1)-9(1)-7(1)-7 [g)]	13(1)-9(1)-7(1)-7(1)	13(1)-9(1)-7(1)-7(1)	13(1)-9(1)-7(1)-7(1)
kI*/*kII	1.7–3.0	≈ 1	—	—	≈ 2	≈ 2	—

[a)] Calculation based on the seta values of the holotype in the reference.
[b)] Data derived from the descriptions in the references.
[c)] Calculation based on the maximum and minimum values of each seta.
[d)] Calculation based on the seta values in Doğan (2005).
[e)] Data based on the illustrations in the reference.
[f)] Revised after examination of the holotype.
[g)] The original description reported tarsus IV as 7, which probably indicated lack of solenidion ω.

pointed), with (or without) hyaline sheaths. Setae *v′* of trochanter, *bv″*, *v′*, (*l*), and *d* of femur, (*l*) of genu, (*v*), (*l*), and *d* of tibia, *vs*, *pl′*, and *tc″* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated or smooth. Solenidion *ω* baculiform with round tip, *φp* attenuate. Seta *k* needle-shaped. Seta lengths: *k* 5 (4–9), *φp* 13 (10–16), *ω* 23 (21–28). Leg III (Fig. 6A). Setae *d* of genu and tibia sparsely barbed and pointed (or bluntly pointed), with (or without) hyaline sheaths. Setae *v′* and *l′* of trochanter, *ev″*, *l′*, and *d* of femur, (*v*) and (*l*) of tibia, *vs* and (*tc*) of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated or smooth. Solenidion *ω* baculiform with round tip, *φp* attenuate. Seta lengths: *φp* 7 (5–11), *ω* 7 (5–11). Leg IV (Fig. 6B). Setae *d* of genu and tibia sparsely barbed and pointed (or bluntly pointed), with (or without) hyaline sheaths. Setae *v′* of trochanter, *ev′* and *d* of femur, (*l*) and (*v*) of tibia, (*tc*) and *vs* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated or smooth. Solenidion *ω* finger-shaped, *φp* attenuate. Seta lengths: *φp* 7 (4–8), *ω* 5 (3–7).

Host plants

Four species of Bartramiaceae Schwägr. and one species of Mniaceae Schwägr. have been recorded (Ikeda *et al.* 2024b): Bartramiaceae, *Philonotis falcata* (Hook.) Mitt., *P. thwaitesii* Mitt., *P. hastata* (Duby) Wijk & Margad., and *P. turneriana* (Schwägr.) Mitt.; Mniaceae, *Pohlia* sp.

Distribution

Known from Honshu and Shikoku in the Japanese Archipelago.

Remarks

The new species belongs to a species complex including three morphologically similar members, *E. kauaiensis*, *E. parakauaiensis*, and *E. zhengyii* (see Diagnosis). Although the dorsal seta length ratio of *ve*/*sci* has been used as a key diagnostic character for distinguishing these species (Hu & Zhu 1994; Fan 2002; Table 1), it showed substantial variation within the new species, even between two specimens from the same locality (KUZ Z4704: 5.9; KUZ Z4844: 7.3). Therefore, the utility of this diagnostic character should be reassessed in the light of intraspecific variation. The examined specimens also showed considerable intraspecific variation in prodorsal shield ornamentation: dimples on the prodorsal shield disappear middorsally in KUZ Z4652, Z4704, and Z4711, whereas evident in KUZ Z4661 and Z4708 (Fig. 3). However, pairwise genetic distances based on COI sequences among populations from seven localities were relatively small (<3.7% difference using the K2P model; Ikeda *et al.* 2024b), indicating that this morphological variation was not correlated with genetic distance.

Eustigmaeus kauaiensis Swift, Gerson & Goff, 1985
Fig. 7

Eustigmaeus kauaiensis Swift, Gerson & Goff, 1985: 375, figs 1–4.

Material examined

Holotype

USA – **Hawaii** • ♀; Kaua'i, Kapaa; 26 Sep. 1980; M.L. Coff leg.; moss on hau tree (*Hibiscus tiliaceus* L.); 1 m above ground; BPBM 13,430.

Supplementary redescription

Idiosomal dorsum (Fig. 7). Dorsal dimples oval or nearly round; minute with ill-defined edges in central areas of shields; enlarged and irregularly shaped on anterior part of prodorsum, remaining dimples slightly enlarged toward idiosomal margin. Distances between dimples greater than their diameters.

Legs. Counts of setae on tarsi I–IV: 13 + 1*ω*, 9 + 1*ω*, 7 + 1*ω*, 7 + 1*ω*.

Fig. 7. *Eustigmaeus kauaiensis* Swift, Gerson & Goff, 1985, holotype, ♀, BPBM 13,430. Dorsum. Scale bar = 100 μm.

Distribution

Known from Kauai Island, Hawaii, USA, and Guizhou, Jiangxi, Hainan, and Hubei provinces in China (Swift *et al.* 1985; Fan 2002).

Remarks

Although the original description of *E. kauaiensis* stated that its dorsal dimples were "prominent, oval or nearly round, distances between dimples greater than their diameters, small in central areas of propodosoma and hysterosoma", the illustration did not clearly depict this character (Swift *et al.* 1985). Re-examination of the holotype revealed that the dimples on the hysterosomal shield are minute relative to those of *E. specialis* sp. nov. (Fig. 7). In addition, the number of setae on tarsus IV is eight (including solenidion *ω*), not seven as originally reported (Swift *et al.* 1985), and is amended here. The remaining features of the original description are coincident with those of the holotype.

Eustigmaeus saxicola Ikeda & Nakano sp. nov.
urn:lsid:zoobank.org:act:3EC403CA-4EAC-4036-8674-C5AD764CDC68
Figs 8–12

Eustigmaeus sp. 3 – Ikeda *et al.* 2024b: 734, fig. 4.

Diagnosis

The new species shares the following characteristics with *E. manus* Rimando & Corpuz-Raros, 1997, *E. brevirostris* (Wood, 1971), and *E. capellus* Chaudhri, 1965: dorsal shields bear dimples each enclosed in a reticulum, dorsal seta *sci* is minute, callosity is absent, tarsus IV is without solenidion *ω*, and aggenital shield bears three pairs of setae (Chaudhri 1965; Wood 1971; Rimando & Corpuz-Raros 1997). However, the new species is distinguishable from the three congeners by several characteristics. Dorsal setae are relatively short and the distance between setae *d1* is much longer than that of *c1*, whereas dorsal setae are elongate in *E. capellus* and *E. manus* and setae *c1*, *d1*, and *e1* are arranged in a straight line in *E. capellus* according to the description and fig. 15 in Chaudhri (1965). Clavate dorsal setae are rounded and smooth in outline, frequently bearing pronounced spines only at the terminal tip, never deeply branched (vs with heavy barbs at the distal part in *E. capellus*; with deeply trifurcate projections in *E. brevirostris* and *E. manus*). Trochanter III has one seta (vs two setae in *E. brevirostris*).

Etymology

The specific name of the new species is a noun in apposition to the generic name, combination of the Latin words '*saxum*' ('rock face') and '*cola*' ('inhabitant'), derived from its ecology. We propose the Japanese name "Kougyoku-maruhishidani" for this species. 'Kougyoku' means 'ruby' in Japanese and refers to the appearance of the species when alive, which exhibits a shiny red color due to light reflecting from the dimples on the dorsal shields.

Type material

Holotype

JAPAN – **Honshu** • ♀; Hyogo, Shiso, Ichinomiya, 35°09′13.8″ N, 134°39′42.0″ E; 550 m a.s.l.; 29 Mar. 2021; S. Ikeda leg.; from moss on dripping rock face along the pavement road; locality code 17 in Ikeda *et al.* (2024b); KUZ Z4553.

Paratypes

JAPAN – **Honshu** • 2 ♀♀; same data as for holotype; KUZ Z4581, KUZ Z4554.

Other material examined

JAPAN – **Honshu** • 3 ♀♀; Hiroshima, Akita; 34°35′59.3″ N, 132°12′27.7″ E; 370 m a.s.l.; 30 Mar. 2021; S. Ikeda leg.; from moss on wet rock face along the mountain path; locality code 16 in Ikeda *et al.* (2024b); KUZ Z4723, KUZ Z4547, KUZ Z4724 • 1 ♀; same data as for holotype; GenBank no. LC789949 (COI); KUZ Z4805 • 3 ♀♀; Hyogo, Yabu, Oya, Tendaki; 35°20′03.4″ N, 134°36′50.4″ E; 430 m a.s.l.; 29 Mar. 2021; S. Ikeda leg.; from moss on wet rock face along the mountain path; locality code 19 in Ikeda *et al.* (2024b); KUZ Z4548, KUZ Z4549, KUZ Z4552 • 3 ♀♀; Nara, Yoshino, Higashiyosihno; 34°24′48.7″ N, 136°00′50.8″ E; 350 m a.s.l.; 13 Oct. 2021; S. Ikeda leg.; from moss on wet soil along the pavement road; locality code 26 in Ikeda *et al.* (2024b); GenBank no. LC789944 (COI); KUZ Z4728, KUZ Z4825, KUZ Z4863 • 2 ♀♀; Shizuoka, Shizuoka, Aoi, Umegashima; 35°18′31.3″ N, 138°20′12.8″ E; 1000 m a.s.l.; 21 Apr. 2022; S. Ikeda leg.; from moss on a wet rock face along the pavement road; locality code 30 in Ikeda *et al.* (2024b); KUZ Z4731, KUZ Z4732 • 2 ♀♀; Saitama, Chichibu; 35°59′41.3″ N, 138°45′48.0″ E; 900 m a.s.l.; 27 Oct. 2021; S. Ikeda leg.; from moss on wet rock face along the pavement road; locality code 33 in Ikeda *et al.* (2024b); GenBank no. LC789972 (COI); KUZ Z4702, KUZ Z4803. – **Shikoku** • 3 ♀♀; Kochi, Shimanto; 33°02′08.0″ N, 132°52′19.2″ E; 100 m a.s.l.; 18 Apr. 2021; S. Ikeda leg.; from moss on a wet rock in the stream; locality code 1 in Ikeda *et al.* (2024b); GenBank no. LC789974 (COI); KUZ Z4560, KUZ Z4725, KUZ Z4812 • 4 ♀♀; Tokushima, Mima; 33°57′54.3″ N, 134°11′02.4″ E; 280 m a.s.l.; 22 May 2021; S. Ikeda leg.; from moss on wet rock face along the pavement road; locality code 12 in Ikeda *et al.* (2024b); GenBank no. LC789973 (COI); KUZ Z4564, KUZ Z4566, KUZ Z4727, KUZ Z4806.

Description of females (n = 19)

Measurements. Idiosomal length 434 (407–457), idiosomal width 338 (305–338).

Idiosomal dorsum (Figs 8–9). Two large shields almost completely cover idiosomal dorsum. Dorsal shields sclerotized; circular dimples bear crinkled rims and disappear around seta insertions; thick subcuticular reticulum entirely evident except for less-sclerotized lateral margins. Shield surface minutely punctate (Fig. 8B). Fossettes as illustrated (Fig. 9A). Ocelli present. Lateral margin of prodorsal and hysterosomal shield weakly sclerotized with shallow dimples. Clavate dorsal setae frequently with a few pronounced barbs near tips, with evident hyaline sheaths; seta *f1* with minute barbs; seta *sci* minute. Suranal shield located ventrally, with amorphous dimples enclosed in subcuticular reticulum. Suranal setae bluntly pointed with minute barbs; seta *h1* with hyaline sheath near tips; seta *h2* with (KUZ Z4581) or without (KUZ Z4553 and Z4554) the sheath. Lengths of dorsal setae: *vi* 31 (30–43), *ve* 42 (41–49), *sci* 5 (5–8), *sce* 31 (27–40), *c1* 24 (24–31), *c2* 23 (23–32), *d1* 27 (24–33), *d2* 24 (23–30), *e1* 27 (27–37),

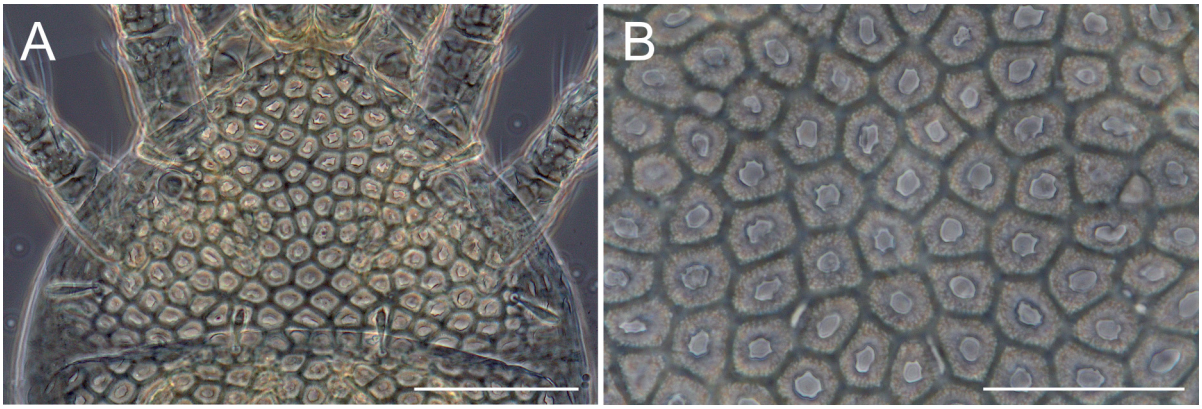

Fig. 8. *Eustigmaeus saxicola* Ikeda & Nakano sp. nov., holotype, ♀, KUZ Z4553. **A**. Dorsal shields. **B**. Dimples and punctation on hysterosomal shield. Scale bars: A = 100 μm; B = 50 μm.

e2 30 (26–33), *f1* 49 (47–58), *h1* 47 (37–47), *h2* 34 (26–35). Distances between setae: *vi–vi* 41 (30–44), *ve–ve* 134 (114–138), *sci–sci* 209 (196–219), *sce–sce* 251 (246–275), *vi–ve* 84 (69–86), *ve–sci* 45 (45–55), *sci–sce* 49 (45–66), *c1–c1* 87 (87–102), *d1–d1* 172 (146–172), *d2–d2* 295 (269–306), *e1–e1* 130 (117–132), *e2–e2* 224 (205–234), *f1–f1* 84 (78–94), *h1–h1* 39 (33–45), *h2–h2* 84 (77–94), *c1–d1* 114 (100–125), *c1–d2* 124 (108–126), *e1–d2* 164 (158–173), *d1–d2* 73 (69–86), *d1–e1* 98 (93–108), *d1–e2* 75 (62–78), *d2–e2* 117 (106–117), *e1–e2* 58 (45–68), *e1–f1* 47 (40–61), *h1–h2* 30 (25–36).

Idiosomal venter (Fig. 9B). Callosity absent. Humeral shield with amorphous dimples enclosed in subcuticular reticulum. Coxisternal plates of legs minutely punctate and reticulated. Endopodal plates punctate and reticulated with setae *1a* and *3a*, separated medially. Aggenital plate punctate and reticulated, with three pairs of simple aggenital setae; seta *ag3* longer than the others. Anal cover with three pairs of simple pseudanal setae; seta *ps2* shorter than the others. Lengths of setae: *ag1* 10 (9–12), *ag2* 10 (10–12), *ag3* 15 (15–19), *ps1* 15 (15–20), *ps2* 5 (5–10), *ps3* 12 (12–16).

Gnathosoma (Fig. 10). Dorsal surface of chelicera punctate and reticulated. Chelicera and its short movable digit 113 (102–119) and 32 (29–34) in length, respectively. Palpal setae of *d* and *l′* on femur barbed and bluntly pointed. Seta *l′* on tibia short, Y-shaped. The other palpal setae of femur, genu, and tibia barbed and pointed. For palptarsal setae, *acm*ζ, (*ul*ζ), and *sul*ζ smooth with blunt tips, *ω* finger-shaped, *va* pointed with sparse barbs, other setae smooth and pointed. Counts of palpal setae from trochanter to tarsus: 0, 3, 2, 3, 6 + *ω*. Supracoxal seta *ep* short, corn-like, located dorsolaterally. Ventral surface of subcapitulum punctate with thick reticulum. Rostrum short. Adoral seta *or2* smooth, thickened, and curved with a blunt tip. Setae *m*, *n*, and *or1* smooth and pointed. Lengths of setae: *m* 20 (17–26),

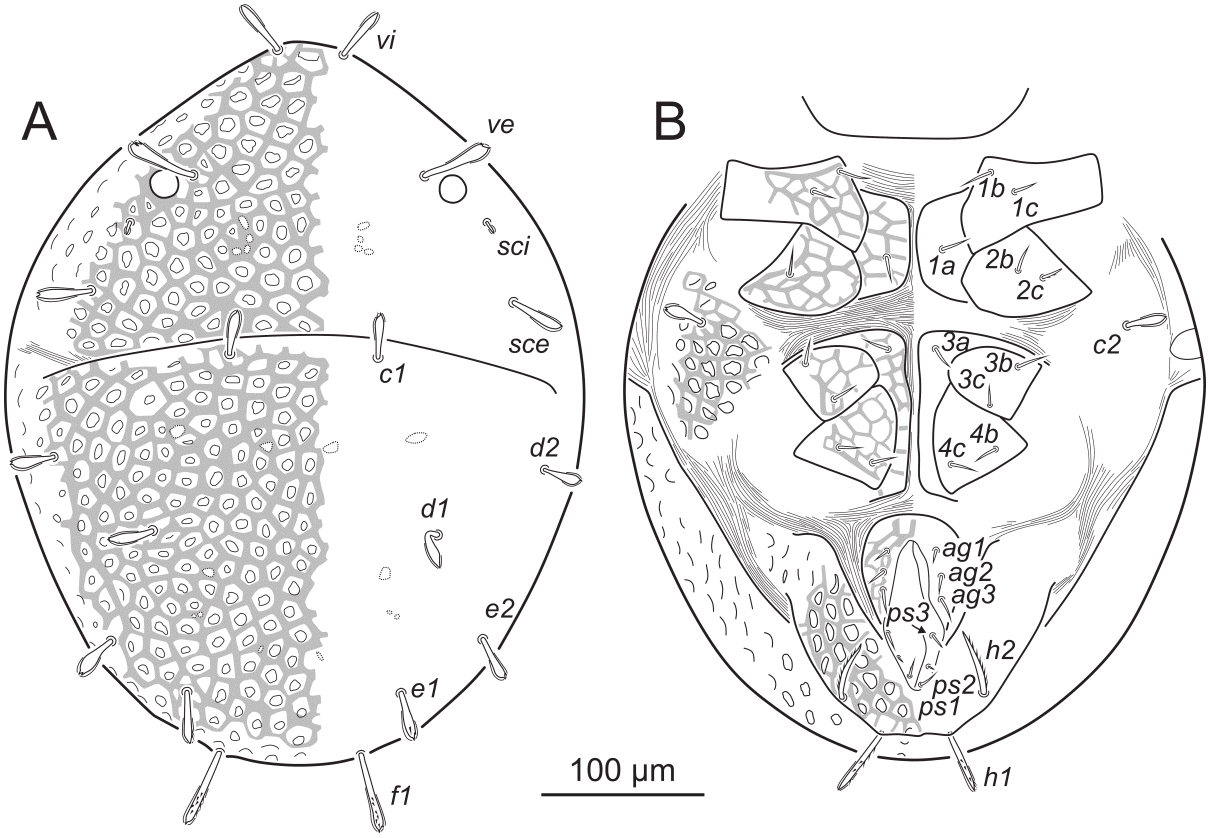

Fig. 9. *Eustigmaeus saxicola* Ikeda & Nakano sp. nov., holotype, ♀, KUZ Z4553. **A**. Idiosomal dorsum. **B**. Idiosomal venter. Punctation is not shown. Abbreviations: see Material and methods.

n 18 (16–21) *or1* 13 (13–16), *or2* 12 (12–14). Distances between subcapitular setae: *m–m* 28 (26–28), *n–n* 33 (28–35), *m–n* 16 (16–21).

Legs (Figs 11–12). Leg lengths: leg I 218 (199–224), leg II 193 (184–197), leg III 199 (186–204), leg IV 227 (209–227). Empodium with three pairs of tenant hairs. Counts of setae on leg I–IV: coxae 2 + *el*, 1 (2 for right coxa in KUZ Z4553 and KUZ Z4702), 2, 2; trochanters 1, 1, 1, 1; femora 6, 5, 3, 2; genua 3 + 1*k*, 3 + 1*k*, 1, 1; tibiae 5 + 1*φ* + 1*φp*, 5 + 1*φp*, 5 + 1*φp*, 5 + 1*φp*; tarsi 13 + 1*ω*, 9 + 1*ω*, 7 + 1*ω*, 7. Leg I (Fig. 11A). Supracoxal seta *el* short, corn-like. Leg setae *d* of tibia, (*ft*), (*tc*), and (*p*) of tarsus eupathid-like. Setae *d* and *l″* of femur, *d* and (*l*) of genu, and (*l*) of tibia sparsely barbed and bluntly pointed, hyaline sheaths evident near tips; setae *bv″* and *v″* of femur with or without hyaline sheath. Setae *v′* of trochanter, *v′* and *l′* of femur, (*v*) of tibia, and (*pl*) and *vs* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus smooth or slightly serrated. Solenidia *ω* and *φ* baculiform with rounded tips, *φp* attenuate. Seta *k* long needle-shaped. Seta lengths: *k* 6 (6–8), *φp* 12 (12–14), *φ* 8 (7–8), *ω* 21 (18–23). Leg II (Fig. 11B). Leg setae *tc′* and *p′* of tarsus and *d* of tibia eupathid-like. Setae *bv″*, *d*, and *l″* of femur, *d* and (*l*) of genu, (*l*) of tibia sparsely barbed and bluntly pointed, with or without hyaline sheath. Setae *v′* of trochanter, *v′* and *l′* of femur, (*v*) of tibia, *tc″*, *pl′*, and *vs* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus smooth or slightly serrated. Solenidion *ω* baculiform with round tip, *φp* attenuate. Seta *k* needle-shaped. Seta lengths: *k* 4 (4–6), *φp* 8 (6–11), *ω* 14 (14–17). Leg III (Fig. 12A). Setae *d* and *l′* of femur, *d* of genu, *d* and (*l*) of tibia sparsely barbed and bluntly pointed, with hyaline sheath. Setae *v′* of trochanter, *ev″* of femur, (*v*) of tibia, (*tc*) and *vs* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus smooth or slightly serrated. Solenidion *ω* finger-shaped, *φp* attenuate. Seta lengths: *φp* 7 (5–8), *ω* 6 (5–7). Leg IV (Fig. 12B). Setae *d* of femur, *d* of genu, *d* and (*l*) of tibia sparsely barbed

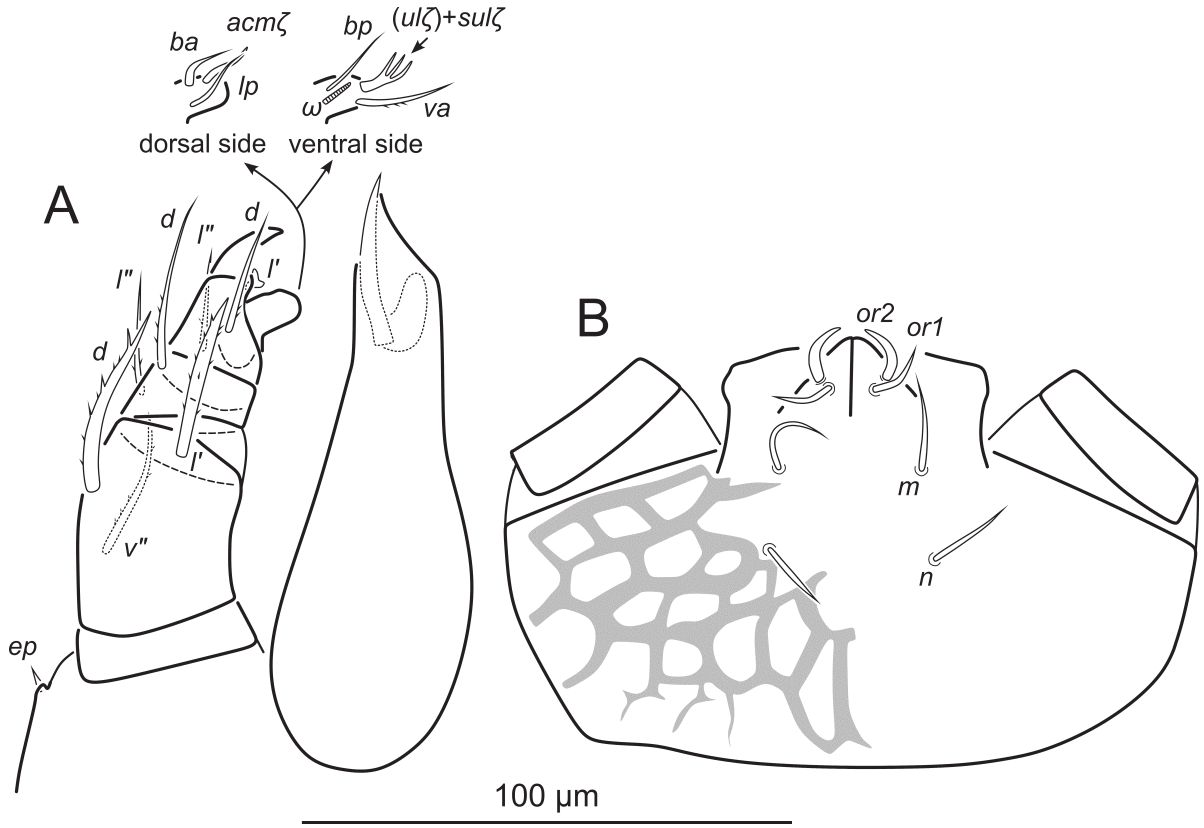

Fig. 10. *Eustigmaeus saxicola* Ikeda & Nakano sp. nov., holotype, ♀, KUZ Z4553. **A**. Left palp and chelicera. **B**. Ventral view of subcapitulum. Punctation is not shown. Abbreviations: see Material and methods.

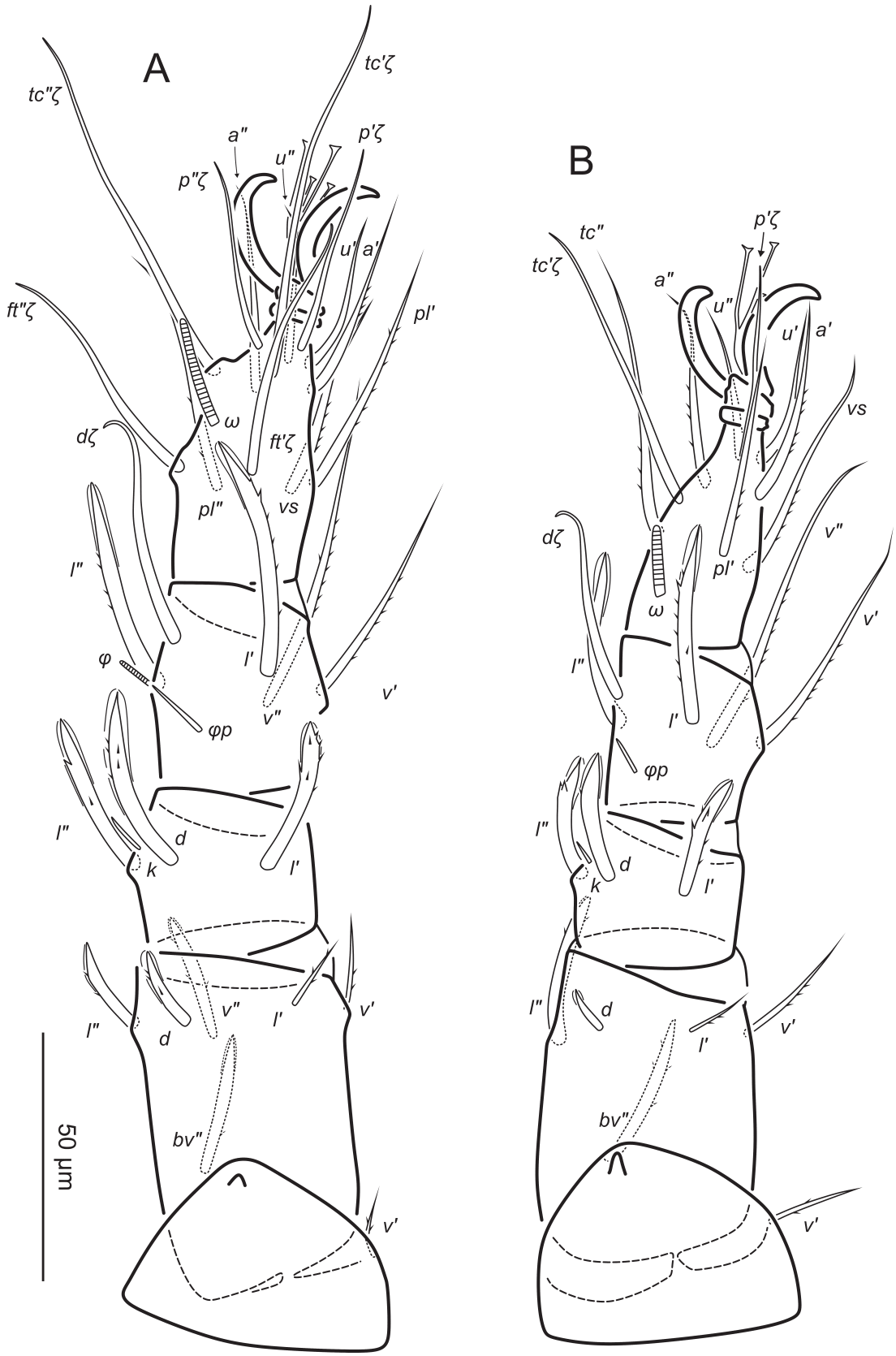

Fig. 11. *Eustigmaeus saxicola* Ikeda & Nakano sp. nov., holotype, ♀, KUZ Z4553. **A**. Left leg I, dorsal view. **B**. Left leg II, dorsal view. Abbreviations: see Material and methods.

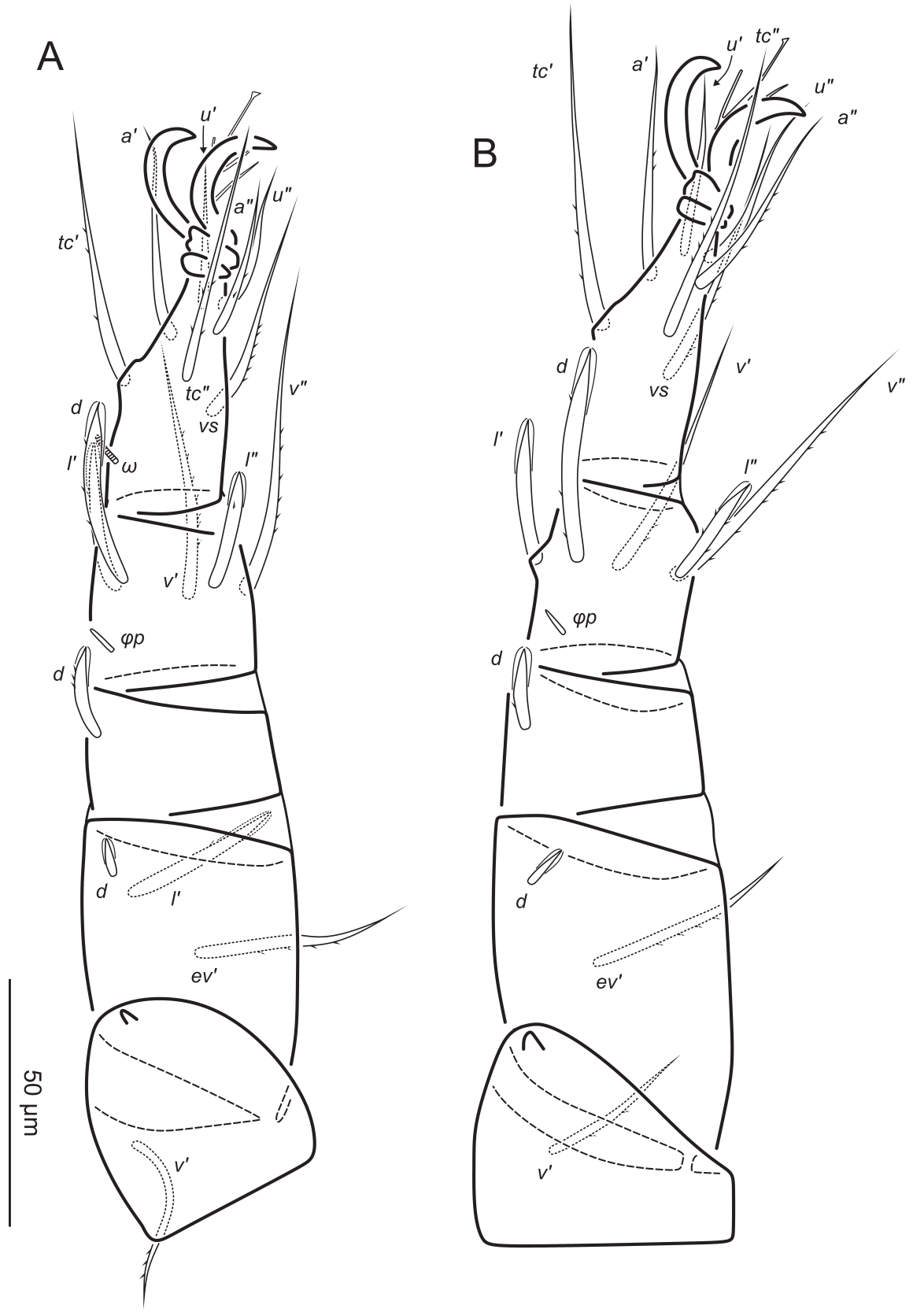

Fig. 12. *Eustigmaeus saxicola* Ikeda & Nakano sp. nov., holotype, ♀, KUZ Z4553. **A**. Right leg III, dorsal view. **B**. Right leg IV, dorsal view. Abbreviations: see Material and methods.

and bluntly pointed, with hyaline sheath. Setae *v′* of trochanter, *ev′* of femur, (*v*) of tibia, (*tc*) and *vs* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus smooth or slightly serrated. Solenidion *ω* absent. Seta lengths: *φp* 5 (5–7).

Host plants

Five species of Pottiaceae Hampe, one species of Amphidiaceae M.Stech, one species of Ditrichaceae Limpr., one species of Brachytheciaceae Schimp., and one species of Bartramiaceae? have been recorded (Ikeda *et al.* 2024b) as host plants. Pottiaceae, *Chionoloma subduriusculum* (Müll. Hal.) M.Menzel., *C. orthodontum* (Müll.Hal.) M.Alonso, M.J.Cano & J.A.Jiménez, *C. tenuirostre* (Hook. & Taylor) M.Alonso, M.J.Cano & J.A.Jiménez, *Trichostomum brachydontium* Bruch, *Anoectangium thomsonii* Mitt.; Amphidiaceae, *Amphidium mougeotii* (Bruch & Schimp.) Schimp.; Ditrichaceae, *Ceratodon purpureus* (Hedw.) Brid.; Brachytheciaceae, *Brachythecium helminthocladum* Broth. & Paris; Bartramiaceae? *Philonotis*? sp.

Distribution

Known from Honshu and Shikoku in the Japanese Archipelago.

Remarks

This species was collected from Honshu and Shikoku Islands, Japan. Despite the geographical distances, little morphological variation and low COI genetic divergence (<2.4% difference using the K2P model) were observed among specimens from eight localities (Ikeda *et al.* 2024b). A phylogenetic analysis in Ikeda *et al.* (2024b) showed that the five sequences of this species represent monophyly. This species tends to be collected from rock faces along paved roads or mountain paths and uses dicranid moss lineages as host plants (Ikeda *et al.* 2024b).

Eustigmaeus cf. ***etruscus*** (Berlese, 1910)
Figs 13–17

Eustigmaeus sp. 5 – Ikeda *et al.* 2024b: 734, fig. 4.

Material examined

JAPAN – **Shikoku** • 5 ♀♀; Ehime, Kamiukena, Kumakogen; 33°43′52.7″ N, 132°56′16.8″ E; 1020 m a.s.l.; 16 Mar. 2021; S. Ikeda leg.; from moss colony on wet concrete wall along the paved road; locality code 4 in Ikeda *et al.* (2024b); KUZ Z4591, KUZ Z4739, KUZ Z4743, KUZ Z4779, KUZ Z4795.

Description of females (n = 5)

Measurements. Idiosomal length 473–526, idiosomal width 366–413.

Idiosomal dorsum (Figs 13–14). Two large shields almost completely cover idiosomal dorsum. Dorsal shields heavily sclerotized; prominent circular dimples enclosed in subcuticular reticulum. Shield surface minutely punctate (Fig. 13B). Fossettes as illustrated (Fig. 14A). Ocelli present. Lateral margin of prodorsal and hysterosomal shield weakly sclerotized, bumpy. Suranal shield located ventrally, with amorphous dimples and thick a reticulum. Suranal seta *h2* pointed with minute barbs. Dorsal setae rod-like with bluntly pointed tips, sparsely barbed, hyaline sheaths evident near tips. Lengths of dorsal setae: *vi* 50–61, *ve* 76–87, *sci* 17–30, *sce* 45–49, *c1* 52–57, *c2* 30–35, *d1* 58–70, *d2* 44–48, *e1* 70–84, *e2* 51–59, *f1* 69–77, *h1* 45–54, *h2* 36–41. Distances between setae: *vi–vi* 27–37, *ve–ve* 132–149, *sci–sci* 250–283, *sce–sce* 309–339, *vi–ve* 83–89, *ve–sci* 65–81, *sci–sce* 49–58, *c1–c1* 105–124, *d1–d1* 73–95, *d2–d2* 327–355, *e1–e1* 139–147, *e2–e2* 255–279, *f1–f1* 107–126, *h1–h1* 45–52, *h2–h2* 104–110, *c1–d1* 89–95,

c1–d2 130–147, *e1–d2* 171–180, *d1–d2* 127–132, *d1–e1* 129–140, *d1–e2* 122–132, *d2–e2* 109–114, *e1–e2* 68–78, *e1–f1* 56–69, *h1–h2* 38–41.

Idiosomal venter (Fig. 14). One pair of oval and large callosity positioned on pleural membrane near prodorsal shield, length at longest part 70–86. Humeral shield with amorphous dimples and a thick reticulum. Coxisternal plates of legs minutely punctate and reticulated. Endopodal plates reticulated and separated medially. Aggenital plate punctate and reticulated, with two pairs of simple aggenital setae. Anal cover with three pairs of simple pseudanal setae. Lengths of setae: *ag1* 20–26, *ag2* 19–24, *ps1* 17–21, *ps2* 18–22, *ps3* 23–24.

Gnathosoma (Fig. 15). Dorsal surface of chelicera punctate. Chelicera and its short movable digit 91–106 and 29–33 in length, respectively. Seta *l′* on palpal tibia short, cone-like. The other palpal setae of femur, genu, and tibia sparsely barbed and pointed. For palptarsal setae, *acm*ζ, (*ul*ζ), and *sul*ζ smooth with blunt tips, *ω* finger-shaped, *va* sparsely barbed, other setae smooth and pointed. Counts of palpal setae from trochanter to tarsus: 0, 3, 2, 3, 6 + *ω*. Supracoxal seta *ep* short, needle-like, located dorsolaterally. Ventral surface of subcapitulum punctate. Rostrum short. Adoral seta *or2* smooth, thickened, and curved with a blunt tip. Setae *m*, *n*, and *or1* smooth and pointed. Lengths of setae: *m* 18–24, *n* 19–25, *or1* 11–14, *or2* 12–13. Distances between subcapitular setae: *m–m* 31–34, *n–n* 36–44, *m–n* 17–20.

Legs (Figs 16–17). Leg lengths: leg I 236–257, leg II 193–214, leg III 213–236, leg IV 246–273. Empodium with three pairs of tenant hairs. Counts of setae on leg I–IV: coxae 2 + *el*, 2, 2, 2; trochanters 1, 1, 1, 1; femora 6, 5, 3, 2; genua 3 + 1*k*, 3 + 1*k*, 1, 1; tibiae 5 + 1*φ* + 1*φp*, 5 + 1*φp*, 5 + 1*φp*, 5 + 1*φp*; tarsi 13 + 1*ω*, 9 + 1*ω*, 7 + 1*ω*, 7 + 1*ω*. Leg I (Fig. 16A). Supracoxal seta *el* short, needle-like. Leg setae *d* of tibia, (*ft*), (*tc*), and (*p*) of tarsus eupathid-like. Setae *d* of femur and genu sparsely barbed and bluntly pointed, hyaline sheaths evident near tips. Setae *l″* of femur, (*l*) of genu, *l′* of tibia sparsely barbed and bluntly pointed (setae *l″* on genu and *l′* on tibia also with hyaline sheath in KUZ Z4795). Setae *v′* of trochanter, *bv″*, (*v*), and *l′* of femur, *l″* and (*v*) of tibia, and (*pl*) and *vs* of tarsus barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated. Solenidia *ω* and *φ* baculiform with rounded tips, *φp* attenuate. Seta *k* long needle-shaped. Seta lengths: *k* 15–17, *φp* 17–19, *φ*10–11, *ω* 25–30. Leg II (Fig. 16B). Leg setae *tc′* and *p′* of tarsus and *d* of tibia eupathid-like. Setae *d* of genu sparsely barbed and bluntly pointed, with or without hyaline sheath. Setae *d* and *l″* of femur, (*l*) of genu sparsely barbed and bluntly pointed (setae *l″* on genu also with hyaline sheath in KUZ Z4795). Setae *v′* of trochanter, *v′*, *bv″*, and *l′* of femur, (*l*) and (*v*) of tibia, *tc″*, *pl′*, and *vs* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated. Solenidion *ω* baculiform with round tip, *φp* attenuate. Seta *k* needle-shaped. Seta lengths: *k* 7–8, *φp* 17, *ω*15–22. Leg III (Fig. 17A). Setae *d* of tibia sparsely barbed and bluntly pointed, with or without

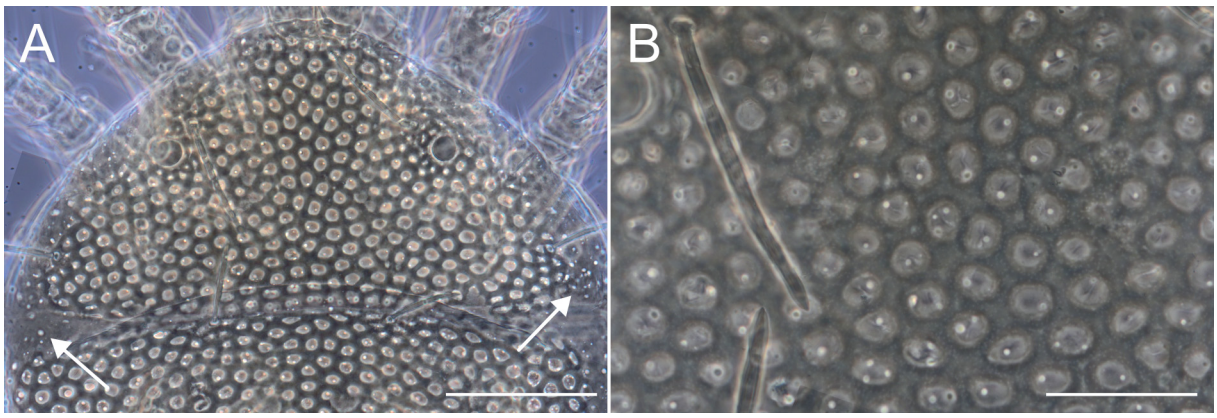

Fig. 13. *Eustigmaeus* cf. *etruscus* (Berlese, 1910), ♀, KUZ Z4779. **A**. Prodorsal shield, droplets are arrowed. **B**. Dimples, vacuoles, and punctation on prodorsal shield. Scale bars: A = 100 μm; B = 40 μm.

hyaline sheath. Setae *d* of femur and genu sparsely barbed and bluntly pointed. Setae *v′* of trochanter, *ev″* and *l′* of femur, (*l*) and (*v*) of tibia, and (*tc*) and *vs* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated. Solenidion *ω* finger-shaped, *φp* attenuate. Seta lengths: *φp* 10–13, *ω* 6–8. Leg IV (Fig. 17B). Seta *d* of tibia sparsely barbed and pointed, with hyaline sheath. Seta *d* of genu sparsely barbed and bluntly pointed, with hyaline sheath. Seta *d* of femur sparsely barbed and bluntly pointed, with or without hyaline sheath. Setae *v′* of trochanter, *ev′* of femur, (*l*) and (*v*) of tibia, (*tc*) and *vs* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated. Solenidion *ω* spoon-shaped, *φp* attenuate. Seta lengths: *φp* 5–6, *ω* 4–5.

Host plants

Two species of Bryaceae Rchb. and one species of Hypnales W.R.Buck & Vitt have been recorded (Ikeda *et al.* 2024b): Bryaceae, *Rosulabryum capillare* (Hedw.) J.R.Spence and *Imbribryum paradoxum* (Schwägr.) Ochyra & Bedn.-Ochyra; Hypnales fam. et gen. unespecified.

Distribution

Known from Shikoku in the Japanese Archipelago.

Remarks

The examined specimens resemble *E. granulosus* (Wood, 1966), *E. erzincanensis* Doğan, 2005, *E. baguioensis* (Rimando & Corpuz-Raros, 1997), and *E. etruscus* (Berlese, 1910) in having a large body size, rod-like dorsal setae, dorsal shields with circular, prominent dimples, a single pair of callosities, presence of seta *4a*, and two pairs of aggenital setae (Berlese 1910; Wood 1966, 1973; Rimando &

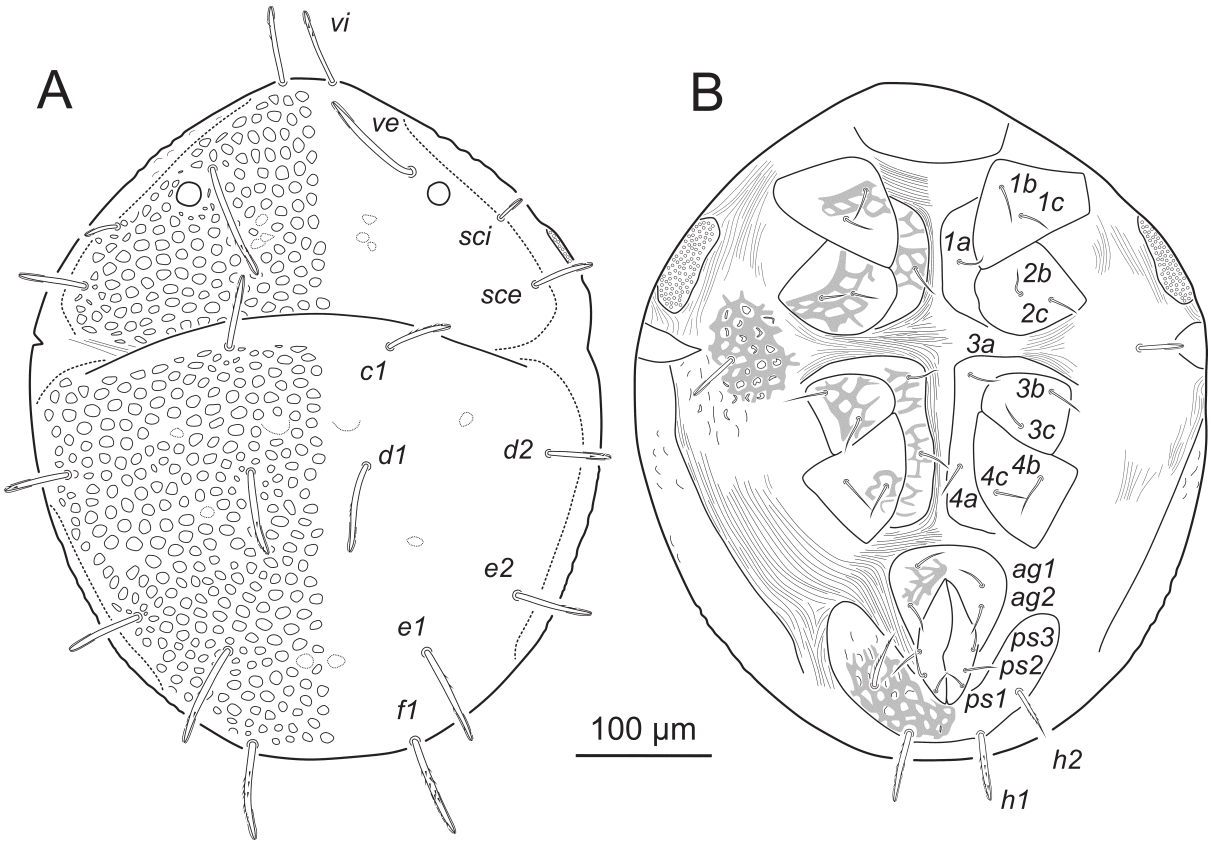

Fig. 14. *Eustigmaeus* cf. *etruscus* (Berlese, 1910), ♀, KUZ Z4779. **A**. Idiosomal dorsum. **B**. Idiosomal venter. Punctation and dorsal shields reticulum are not shown. Abbreviations: see Material and methods.

Corpuz-Raros 1997; Doğan 2005). The examined specimens are most similar to *E. etruscus* based on the dorsal ornamentation, dorsal seta lengths, and shape and position of callosities. However, the examined species and *E. etruscus* differ in certain morphological characters. The ratio of the length of dorsal setae to body dimensions of *E. etruscus* is slightly greater than that in the examined specimens (according to Wood 1973: fig. 9). In addition, *E. etruscus* has thick-walled cells of distinct reticulum on the dorsal shields, while the reticulum appears faint in the present species (Wood 1973; Fig. 13). Lastly, the trochanter of leg III bears two setae in *E. etruscus* but bears only one in the present species (Wood 1973; Fig. 17). However, the redescription lacks detailed measurements and photographs (Wood 1973); therefore, revisiting its type specimens is essential to resolve the taxonomic issue.

One or several vacuoles were observed within individual dimples on the dorsal shields of the examined specimens (Fig. 13). This characteristic has been emphasized in the descriptions of *E. erzincanensis*, *E. erciyesiensis* Doğan, Ayyildiz & Fan, 2003, *E. baguioensis*, and *E. parvisetus* (Chaudhri, 1965) (Chaudhri 1965; Rimando & Corpuz-Raros 1997; Doğan *et al.* 2003; Doğan 2005). The examined species may share the same character state with these species. However, droplets with a similar appearance to vacuoles were also observed around the specimens, raising the possibility that those vacuoles are artifacts (Fig. 13A). Although the identity and taxonomic significance of those vacuoles and droplets remain uncertain, those features do not affect the taxonomic conclusion of the examined species at present.

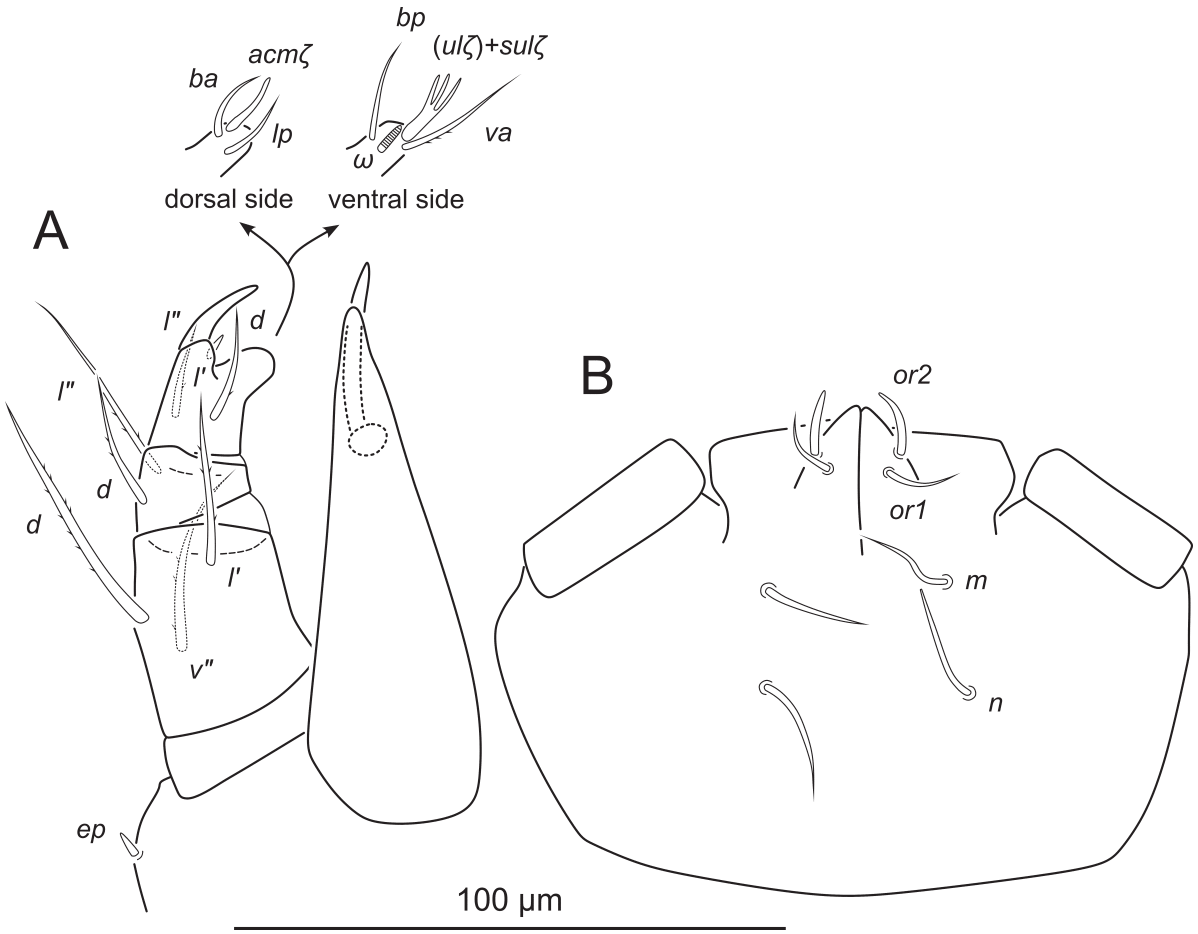

Fig. 15. *Eustigmaeus* cf. *etruscus* (Berlese, 1910), ♀, KUZ Z4779. **A**. Left palp and chelicera. **B**. Ventral view of subcapitulum. Punctation is not shown. Abbreviations: see Material and methods.

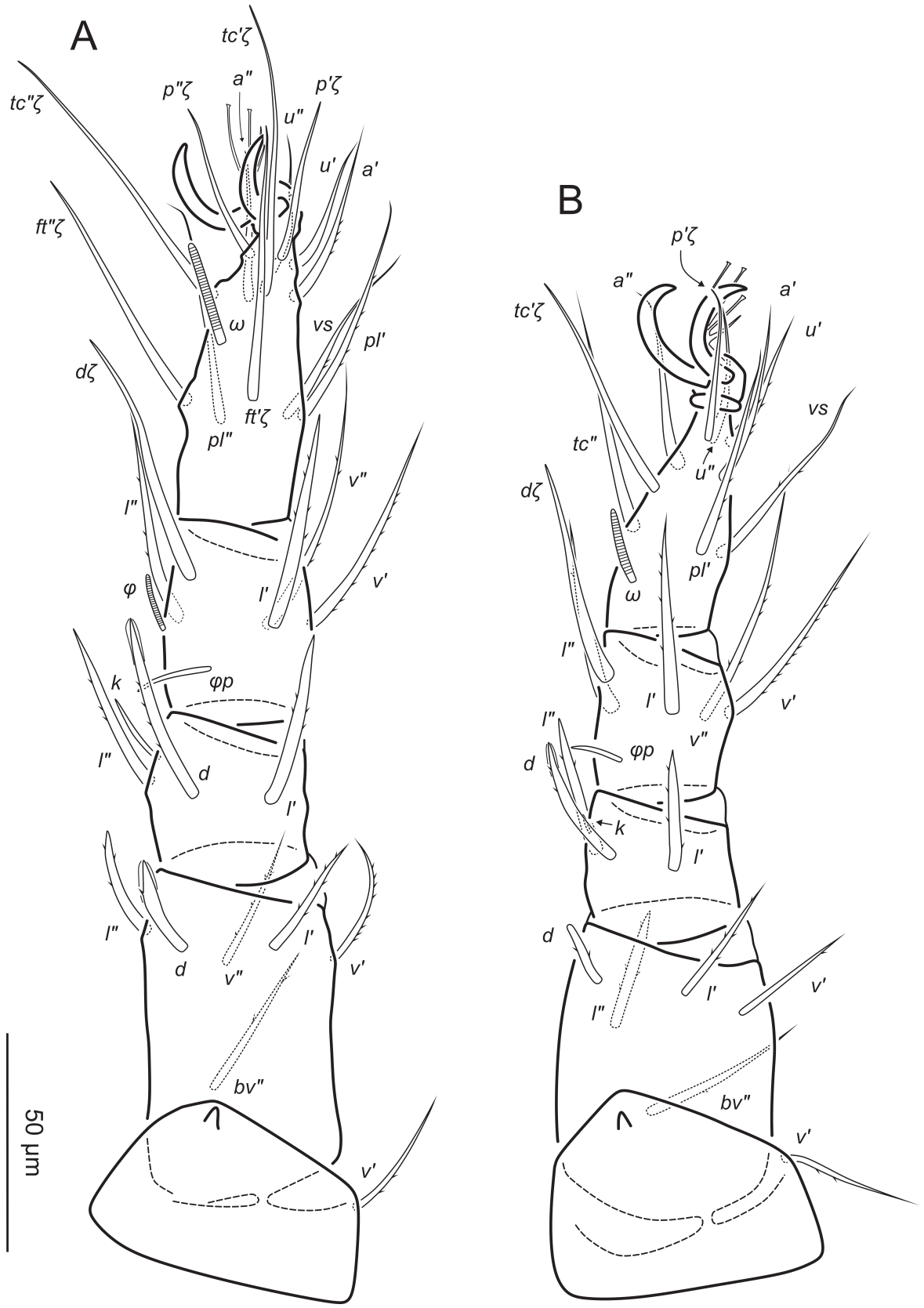

Fig. 16. *Eustigmaeus* cf. *etruscus* (Berlese, 1910), ♀, KUZ Z4743. **A**. Left leg I, dorsal view. **B**. Left leg II, dorsal view. Abbreviations: see Material and methods.

Fig. 17. *Eustigmaeus* cf. *etruscus* (Berlese, 1910), ♀, KUZ Z4743. **A**. Left leg III, dorsal view. **B**. Left leg IV, dorsal view. Abbreviations: see Material and methods.

Eustigmaeus grandis Khaustov, 2019
Figs 18–19; Table 2

Eustigmaeus grandis Khaustov, 2019: 164, figs 14–17.

Eustigmaeus sp. 6 – Ikeda *et al.* 2024b: 734, fig. 4.

Material examined

JAPAN – **Honshu** • 1 ♀; Nagano, Nagano, Mt Togakushi; 21 May 1999; M. Shiba leg.; from moss on bark of *Aesculus turbinata* Blume; KUZ Z5166. – **Shikoku** • 3 ♀♀; Tokushima, Mima, Koyadaira; 33°52′31.5″ N, 134°05′46.3″ E; 1360 m a.s.l.; 22 May 2021; S. Ikeda leg.; from mosses on the wet concrete wall and nearby along a pavement road; locality code 8 in Ikeda *et al.* (2024b); GenBank no. LC789954 (COI); KUZ Z4729, KUZ Z4561, KUZ Z4817 • 1 ♀; Ehime, Mt Higashi-akaishi; 5 Oct. 2002; M. Shiba leg.; from moss on rock by the stream; KUZ Z5167 • 1 ♀; Ehime, Mt Ishizuchi; 14 Nov. 2011; M. Shiba leg.; from moss on rock; KUZ Z5168.

Description of females (n = 5)

Measurements. Idiosomal length 428–514, idiosomal width 327–418.

Idiosomal dorsum (Figs 18–19). Two large shields almost completely cover idiosomal dorsum. Dorsal shields heavily sclerotized; circular dimples bear crinkled rims and disappear around seta insertions; thick subcuticular reticulum entirely evident. Shield surface minutely punctate. Fossettes as illustrated (Fig. 18A). Ocelli present. Lateral margin of prodorsal and hysterosomal shield weakly sclerotized, bumpy. Suranal shield located ventrally, with amorphous dimples enclosed in subcuticular reticulum. Suranal setae bluntly pointed with minute barbs. Dorsal setae brush-like distally. Lengths of dorsal setae: *vi* 34–62, *ve* 46–78, *sci* 37–55, *sce* 34–48, *c1* 39–62, *c2* 29–39, *d1* 40–63, *d2* 36–51, *e1* 48–71, *e2* 42–59, *f1* 54–75, *h1* 42–53, *h2* 33–36. Distance between setae: *vi–vi* 24–39, *ve–ve* 124–140, *sci–sci* 215–260, *sce–sce* 304–359, *vi–ve* 75–90, *ve–sci* 59–75, *sci–sce* 56–69, *c1–c1* 98–123, *d1–d1* 174–189, *d2–d2* 325–378, *e1–e1* 131–159, *e2–e2* 236–285, *f1–f1* 103–128, *h1–h1* 37–50, *h2–h2* 86–117, *c1–d1* 102–128, *c1–d2* 119–147, *e1–d2* 180–193, *d1–d2* 81–103, *d1–e1* 110–116, *d1–e2* 58–68, *d2–e2* 103–111, *e1–e2* 71–87, *e1–f1* 29–43, *h1–h2* 30–47.

Idiosomal venter (Fig. 18). Two pairs of callosities positioned on lateral margins of idiosomal shields, major callosity bigger than minor one, longest part 30–34 and 21–26 in length, respectively. Humeral shield with amorphous dimples enclosed in subcuticular reticulum. Humeral setae distally brush-like (KUZ Z5167) or barbed and bluntly pointed. Coxisternal plates of legs minutely punctate and faintly reticulated. Endopodal plates reticulated and separated medially. Aggenital plate punctate and reticulated, with two pairs of aggenital setae. Anal cover with three pairs of pseudanal setae. Lengths of setae: *ag1* 16–20, *ag2* 14–20, *ps1* 11–17, *ps2* 9–14, *ps3* 13–17.

Gnathosoma. Dorsal surface of chelicera punctate. Chelicera and its short movable digit 103–121 and 23–27 in length, respectively. Seta *l′* on palpal tibia short with widened end. Palpfemoral seta *d* deeply barbed and bluntly pointed. The other palpal setae of femur, genu, and tibia barbed and pointed. For palptarsal setae, *acm*ζ, (*ul*ζ), and *sul*ζ smooth with blunt tips, *ω* finger-shaped, *va* pointed with sparse barbs, other setae smooth and pointed. Counts of palpal setae from trochanter to tarsus: 0, 3, 2, 3, 6 + *ω*. Supracoxal seta *ep* short, cone-like, located dorsolaterally. Ventral surface of subcapitulum punctate and reticulum present in KUZ Z4729 and Z4561. Rostrum short. Adoral seta *or2* smooth, thickened, and curved with a blunt tip. Setae *m*, *n*, and *or1* smooth and pointed. Lengths of setae: *m* 16–22, *n* 15–23, *or1* 10–13, *or2* 15–18. Distances between subcapitular setae: *m–m* 27–33, *n–n* 33–41, *m–n* 13–19.

Legs. Leg lengths: leg I 191–238, leg II 168–207, leg III 165–211, leg IV 202–243. Empodium with three pairs of tenant hairs. Counts of setae on leg I–IV: coxae 2 + *el*, 2, 2, 2; trochanters 1, 1, 2, 1 or 1, 1, 1, 1; femora 6, 5, 3, 2; genua 3 + 1*k*, 3 + 1*k*, 1, 1; tibiae 5 + 1*φ* + 1*φp*, 5 + 1*φp*, 5 + 1*φp*, 5 + 1*φp*; tarsi 13 + 1*ω*, 9 + 1*ω*, 7 + 1*ω*, 7 + 1*ω*. Leg I. Supracoxal seta *el* short, spine-like. Leg setae (*ft*), (*tc*), and (*p*) of tarsus eupathid-like. Seta lengths: *k* 7–10, *φp* 16–21, *φ* 7–10, *ω* 24–30. Leg II. Leg setae *tc′* and *p′* of tarsus eupathid-like. Seta lengths: *k* 5–6, *φp* 13–17, *ω* 15–19. Leg III. Seta lengths: *φp* 8–10, *ω* 3–6. Leg IV. Seta lengths: *φp* 6–9, *ω* 3–5.

Host plants

One species of Brachytheciaceae, *Brachythecium rivulare* Schimp., has been recorded (Ikeda *et al.* 2024b).

Distribution

Known from the Russian Far East (Khaustov 2019) as well as Honshu and Shikoku in the Japanese Archipelago.

Remarks

The examined specimens share the following combination of characteristics with *E. grandis*: dorsal shields with dimples, each enclosed by a reticulum, brush-like dorsal setae, the presence of seta *e2*, two pairs of callosities, and two pairs of aggenital setae. Although this combination of character states restricts the examined specimens to *E. grandis* in the genus, considerable morphological variation was observed among populations (Table 2). The variation, including variation in idiosomal dimensions, dorsal seta

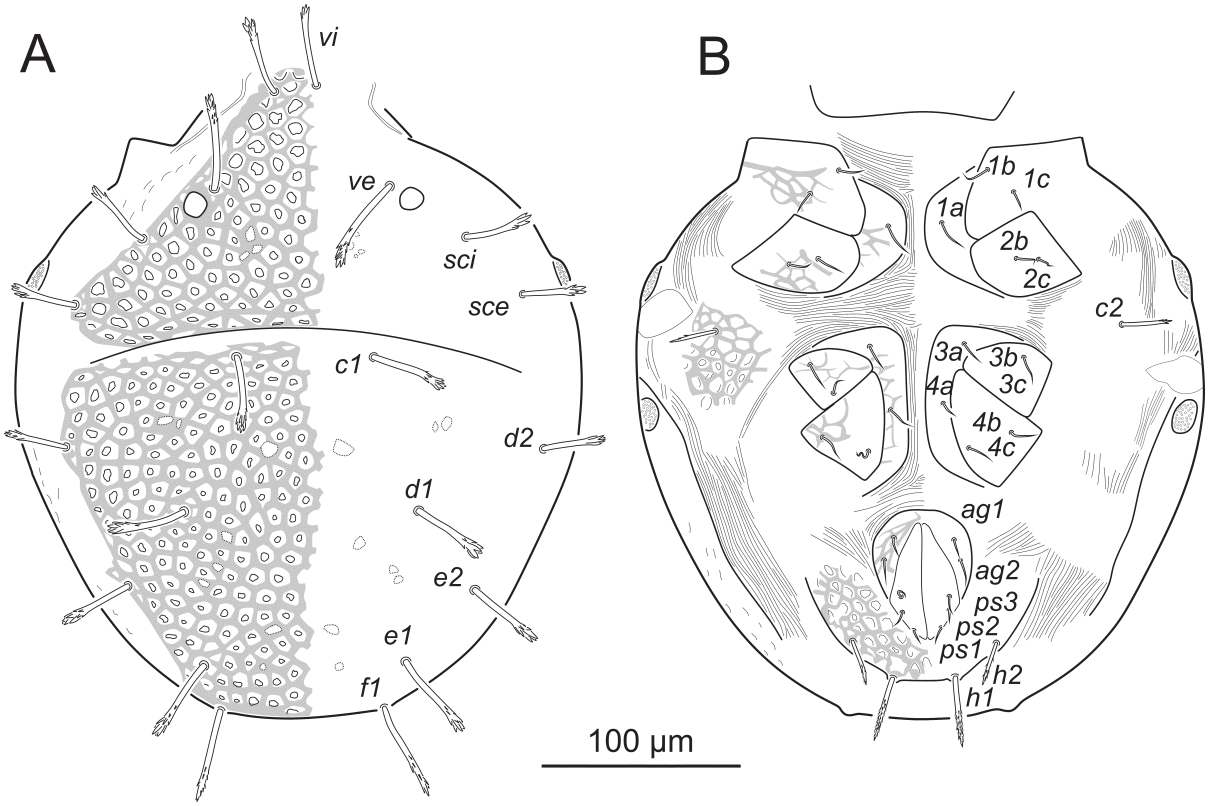

Fig. 18. *Eustigmaeus grandis* Khaustov, 2019, ♀, KUZ Z4561. **A**. Idiosomal dorsum. **B**. Idiosomal venter. Punctation is not shown. Abbreviations: see Material and methods.

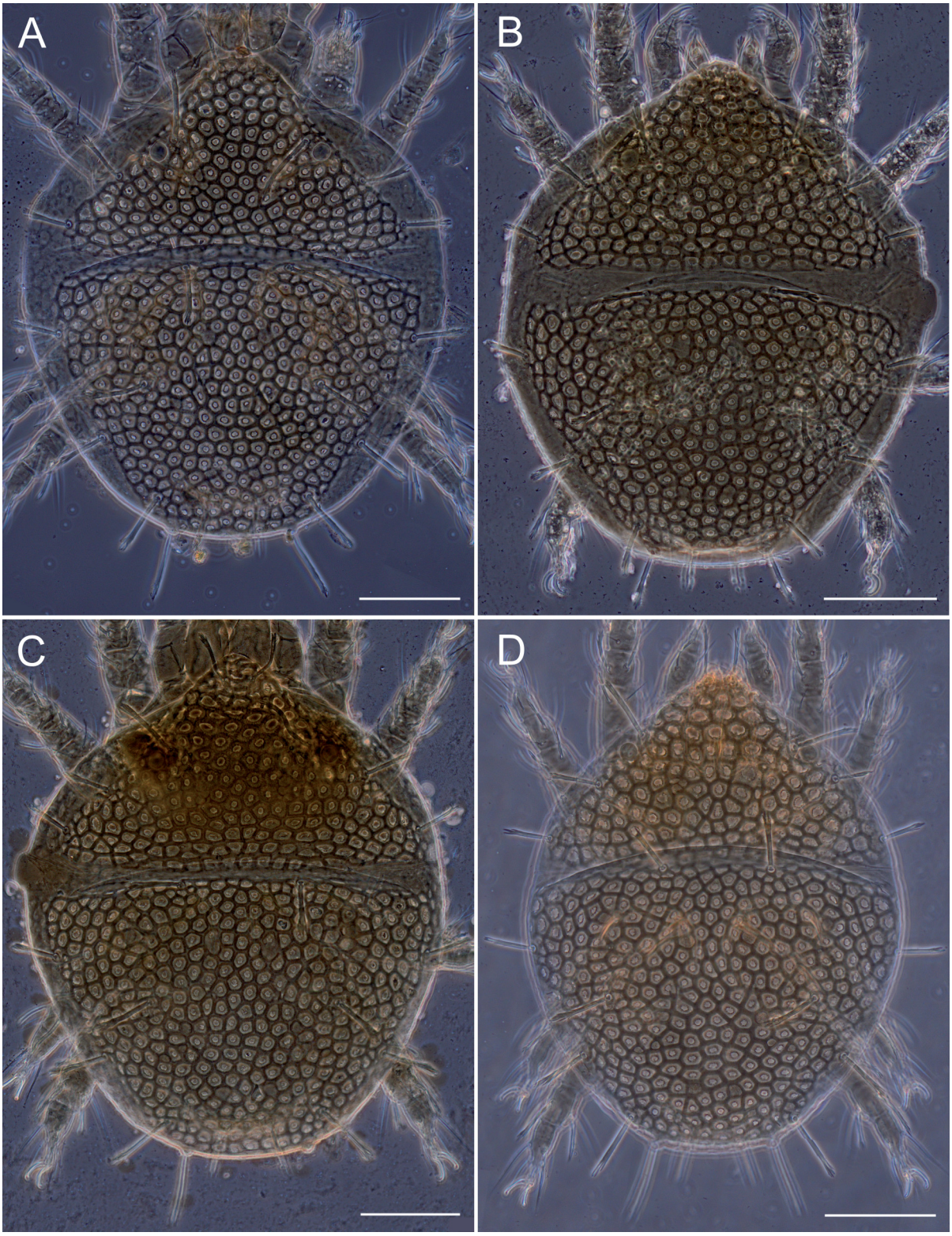

Fig. 19. *Eustigmaeus grandis* Khaustov, 2019, ♀. Intraspecific variation of dorsal characteristics. **A**. KUZ Z4561. **B**. KUZ Z5166. **C**. KUZ Z5167. **D**. KUZ Z5168. Scale bars = 100 μm.

Table 2 (continued on next page). Comparisons of morphological characters among specimens of *Eustigmaeus grandis* Khaustov, 2019.

Species	*E. grandis* (Nagano)	*E. grandis* (Ehime: Mt Ishizuchi)	*E. grandis* (Ehime: Mt Higashi-akaishi)	*E. grandis* (Tokushima)	*E. grandis*
Reference	This study	This study	This study	This study	Khaustov (2019)
Material	Non-types	Non-types	Non-types	Non-types	Types
No. of examined specimens for measurements	n = 1	n = 1	n = 1	n = 2	n = 8
Idiosomal dimensions					
Length	428	436	514	490–500	385–435
Width	327	346	418	354–370	325–345
Dorsal setae lengths and ratios					
vi	34	50	56	59–62	44–48
ve	46	58	69	72–78	47–53
sci	37	44	48	52–55	38–43
sce	34	43	44	48	34–39
c1	39	46	53	57–62	34–43
c2	29	33	35	34–39	29–31
d1	40	59	59	60–63	41–44
d2	36	45	46	48–51	36–37
e1	48	64	71	65–66	46–47
e2	42	55	59	58–59	41–45
f1	54	73	74	74–75	51–53
h1	42	48	53	52	42–46
h2	33	34	33	34–36	27–33
ve*/*sci					

Table 2 (continued). Comparisons of morphological characters among specimens of *Eustigmaeus grandis* Khaustov, 2019.

Species	*E. grandis* (Nagano)	*E. grandis* (Ehime: Mt Ishizuchi)	*E. grandis* (Ehime: Mt Higashi-akaishi)	*E. grandis* (Tokushima)	*E. grandis*
Leg setation					
Coxa	2-2-2-2	2-2-2-2	2-2-2-2	2-2-2-2	2-2-2-2
Trochanter	1-1-2-1	1-1-1-1 (Left) 1-1-2-1 (Right)	1-1-1-1	1-1-1-1	1-1-2-1
Femur	6-5-3-2	6-5-3-2	6-5-3-2	6-5-3-2	6-5-3-2
Genu	4-4-1-1	4-4-1-1	4-4-1-1	4-4-1-1	4-4-1-1
Tibia	5(2)-5(1)-5(1)-5(1)	5(2)-5(1)-5(1)-5(1)	5(2)-5(1)-5(1)-5(1)	5(2)-5(1)-5(1)-5(1)	5(2)-5(1)-5(1)-5(1)
Tarsus	13(1)-9(1)-7(1)-7(1)	13(1)-9(1)-7(1)-7(1)	13(1)-9(1)-7(1)-7(1)	13(1)-9(1)-7(1)-7(1)	13(1)-9(1)-7(1)-7(1)

lengths, and the number of setae on trochanter III (Table 2; Fig. 19), was continuous, making it difficult to delineate the species boundary. The genetic distance based on COI sequences between specimens from the type locality and the Tokushima population was 6.1% (Ikeda *et al.* 2024b); however, comparable data for specimens from other localities are lacking. Obtaining molecular data from additional localities may help to delineate species boundaries. Here, *Eustigmaeus* sp. 6 is identified as *E. grandis* based on the shared major morphological characteristics.

We propose the Japanese name 'Oo-maruhishidani' for this species. 'Oo' means 'large' in Japanese and corresponds to the meaning of the specific epithet (*grandis*).

Eustigmaeus cf. ***clavatus*** (Canestrini & Fanzago, 1876)
Figs 20–24

Eustigmaeus sp. 10 – Ikeda *et al.* 2024b: 734, fig. 4.

Material examined

JAPAN – **Honshu** • 5 ♀♀; Mie, Watarai, Minamiise; 34°21′54.9″ N, 136°41′30.7″ E; 100 m a.s.l.; 14 Oct. 2021; S. Ikeda leg.; from moss on a wet soil along the mountain path; locality code 25 in Ikeda *et al.* (2024b); GenBank no. LC789970 (COI); KUZ Z4721, KUZ Z4722, KUZ Z5711, KUZ Z5712, KUZ Z4824.

Description of females (n = 4)

Measurements. Idiosomal length 364–411, idiosomal width 292–327.

Idiosomal dorsum (Figs 20–21). Two large shields almost completely cover idiosomal dorsum. Dorsal shields sclerotized; dimples varied in size and disappear around seta insertions; thick subcuticular reticulum entirely evident except for less-sclerotized lateral margins. Shield surface minutely punctate (Fig. 20B). Fossettes as illustrated (Fig. 21A). Ocelli present. Dorsal setae slightly clavate with bluntly pointed tips, sparsely barbed, hyaline sheath evident near tips. Suranal shield located ventrally, with shallow dimples enclosed in subcuticular reticulum. Suranal setae rod-like with bluntly pointed tips, minutely barbed, with hyaline sheath. Lengths of dorsal setae: *vi* 48–58, *ve* 61–73, *sci* 37–49, *sce* 53–58, *c1* 45–57, *c2* 39–42, *d1* 55–60, *d2* 48–54, *e1* 62–72, *e2* 52–60, *f1* 63–72, *h1* 48–55, *h2* 35–40. Distances between setae: *vi–vi* 30–36, *ve–ve* 105–109, *sci–sci* 185–190, *sce–sce* 231–239, *vi–ve* 61–72, *ve–sci* 44–50, *sci–sce* 44–51, *c1–c1* 81–95, *d1–d1* 123–133, *d2–d2* 245–260, *e1–e1* 127–133, *e2–e2* 199–206,

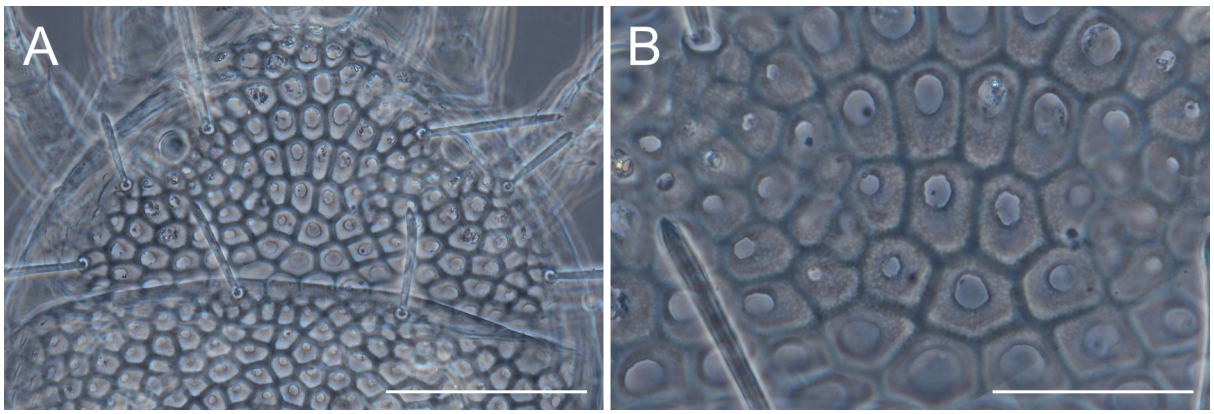

Fig. 20. *Eustigmaeus* cf. *clavatus* (Canestrini & Fanzago, 1876), ♀, KUZ Z4721. **A**. Prodorsal shield. **B**. Dimples and punctation on prodorsal shield. Scale bars: A = 100 μm; B = 40 μm.

fl–fl 89–94, *h1–h1* 37–39, *h2–h2* 84–91, *c1–d1* 96–105, *c1–d2* 99–114, *e1–d2* 131–143, *d1–d2* 61–67, *d1–e1* 95–98, *d1–e2* 65–72, *d2–e2* 80–93, *e1–e2* 48–53, *e1–fl* 36–43, *h1–h2* 25–31.

Idiosomal venter (Fig. 21). Callosity absent. Humeral shield sub-triangular, punctate, shallow dimples enclosed in subcuticular reticulum. Coxisternal plates of legs minutely punctate and faintly reticulated. Endopodal plates reticulated and separated medially. Aggenital plate punctate and reticulated, with three pairs of sparsely barbed setae, *ag3* slightly longer than others. Anal cover sclerotized and reticulated. Three pairs of pseudanal setae sparsely barbed and pointed, *ps1* also thickened. Lengths of setae: *ag1* 13–14, *ag2* 14–17, *ag3* 23–25, *ps1* 21–28, *ps2* 18–23, *ps3* 23–27.

Gnathosoma (Fig. 22). Dorsal surface of chelicera punctate. Chelicera and its short movable digit 89–98 and 28–33 in length, respectively. Seta *l′* on palpal tibia short, heart-shaped. Palpfemoral seta *d* sparsely barbed and bluntly pointed. The other palpal setae of femur, genu, and tibia barbed and pointed. For palptarsal setae, *acm*ζ, (*ul*ζ), and *sul*ζ smooth with blunt tips, *ω* finger-shaped, *va* sparsely barbed, other setae smooth and pointed. Counts of palpal setae from trochanter to tarsus: 0, 3, 2, 3, 6 + *ω*. Supracoxal seta *ep* short, cone-shaped, located dorsolaterally. Ventral surface of subcapitulum punctate with or without subcuticular reticulum. Rostrum short. Adoral seta *or2* smooth, thickened and curved with blunt tip. Setae *m* and *or1* smooth and pointed. Seta *n* pointed with sparse barbs. Lengths of setae: *m* 20–22, *n* 22–24, *or1* 12–14, *or2* 11–13. Distances between subcapitular setae: *m–m* 27–29, *n–n* 31–36, *m–n* 15–17.

Legs (Figs 23–24). Leg lengths: leg I 200–210, leg II 172–179, leg III 174–179, leg IV 204–213. Empodium with three pairs of tenant hairs. Counts of setae on leg I–IV: coxae 2 + *el*, 2, 2, 2; trochanters

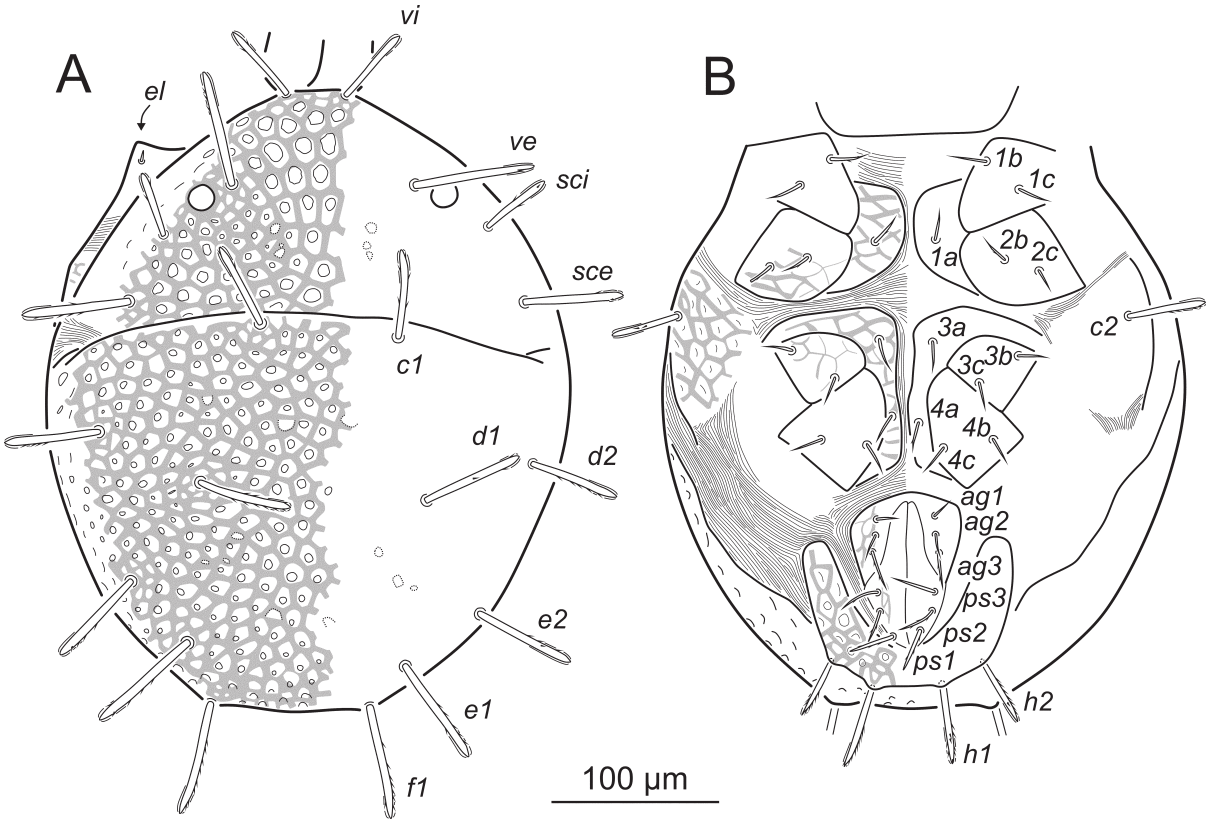

Fig. 21. *Eustigmaeus* cf. *clavatus* (Canestrini & Fanzago, 1876), ♀, KUZ Z4721. **A**. Idiosomal dorsum. **B**. Idiosomal venter. Punctation is not shown. Abbreviations: see Material and methods.

1, 1, 2, 1; femora 6, 5, 3, 2; genua 3 + 1*k*, 3 + 1*k*, 1, 1; tibiae 5 + 1*φ* + 1*φp*, 5 + 1*φp*, 5 + 1*φp*, 5 + 1*φp*; tarsi 13 + 1*ω*, 9 + 1*ω*, 7 + 1*ω*, 7. Leg I (Fig. 23A). Supracoxal seta *el* short, needle-like. Leg setae *d* of tibia, (*ft*), (*tc*), and (*p*) of tarsus eupathid-like. Setae *d* of femur, *d* and (*l*) of genu, sparsely barbed and bluntly pointed, with hyaline sheath. Setae (*l*) of tibia sparsely barbed and pointed, with hyaline sheath. Setae *l″* of femur sparsely barbed and bluntly pointed (also with hyaline sheath in KUZ Z5711 and Z5712). Setae *v′* of trochanter, *bv″*, (*v*), and *l′* of femur, (*v*) of tibia, and (*pl*) and *vs* of tarsus barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated. Solenidia *ω* and *φ* baculiform with rounded tips, *φp* attenuate. Seta *k* needle-shaped. Seta lengths: *k* 8, *φp* 14–16, *φ* 8–10, *ω* 18–20. Leg II (Fig. 23B). Leg setae *tc′* and *p′* of tarsus and *d* of tibia eupathid-like. Setae *bv″*, *d*, and *l″* of femur, *d* and (*l*) of genu sparsely barbed and bluntly pointed, with hyaline sheath. Setae (*l*) of tibia sparsely barbed and pointed, with hyaline sheath. Setae *v′* of trochanter, *v′* and *l′* of femur, (*v*) of tibia, *tc″*, *pl′*, and *vs* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated. Solenidion *ω* baculiform with round tip, *φp* attenuate. Seta *k* needle-shaped. Seta lengths: *k* 5–8, *φp* 10–13, *ω*12–13. Leg III (Fig. 24A). Setae *l′* of trochanter, *d* and *l′* of femur, *d* of genu, *d* and (*l*) of tibia sparsely barbed and bluntly pointed, with hyaline sheath. Setae *v′* of trochanter, *ev″* of femur, (*v*) of tibia, (*tc*) and *vs* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated. Solenidion *ω* finger-shaped, *φp* attenuate. Seta lengths: *φp* 11–12, *ω* 5–7. Leg IV (Fig. 24B). Seta *d* of femur, *d* of genu, *d* and (*l*) of tibia sparsely barbed

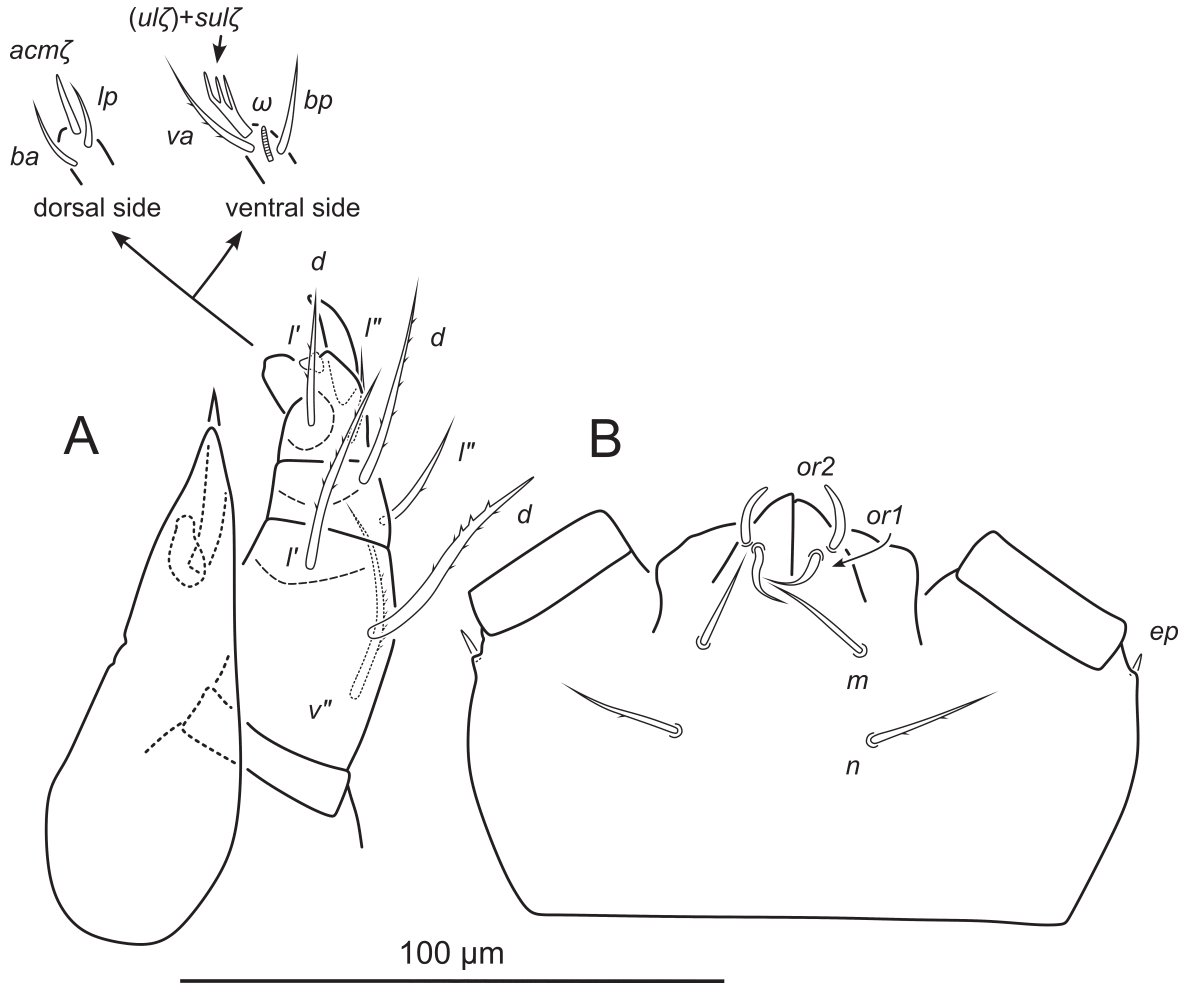

Fig. 22. *Eustigmaeus* cf. *clavatus* (Canestrini & Fanzago, 1876), ♀, KUZ Z4721. **A**. Right palp and chelicera. **B**. Ventral view of subcapitulum. Punctation is not shown. Abbreviations: see Material and methods.

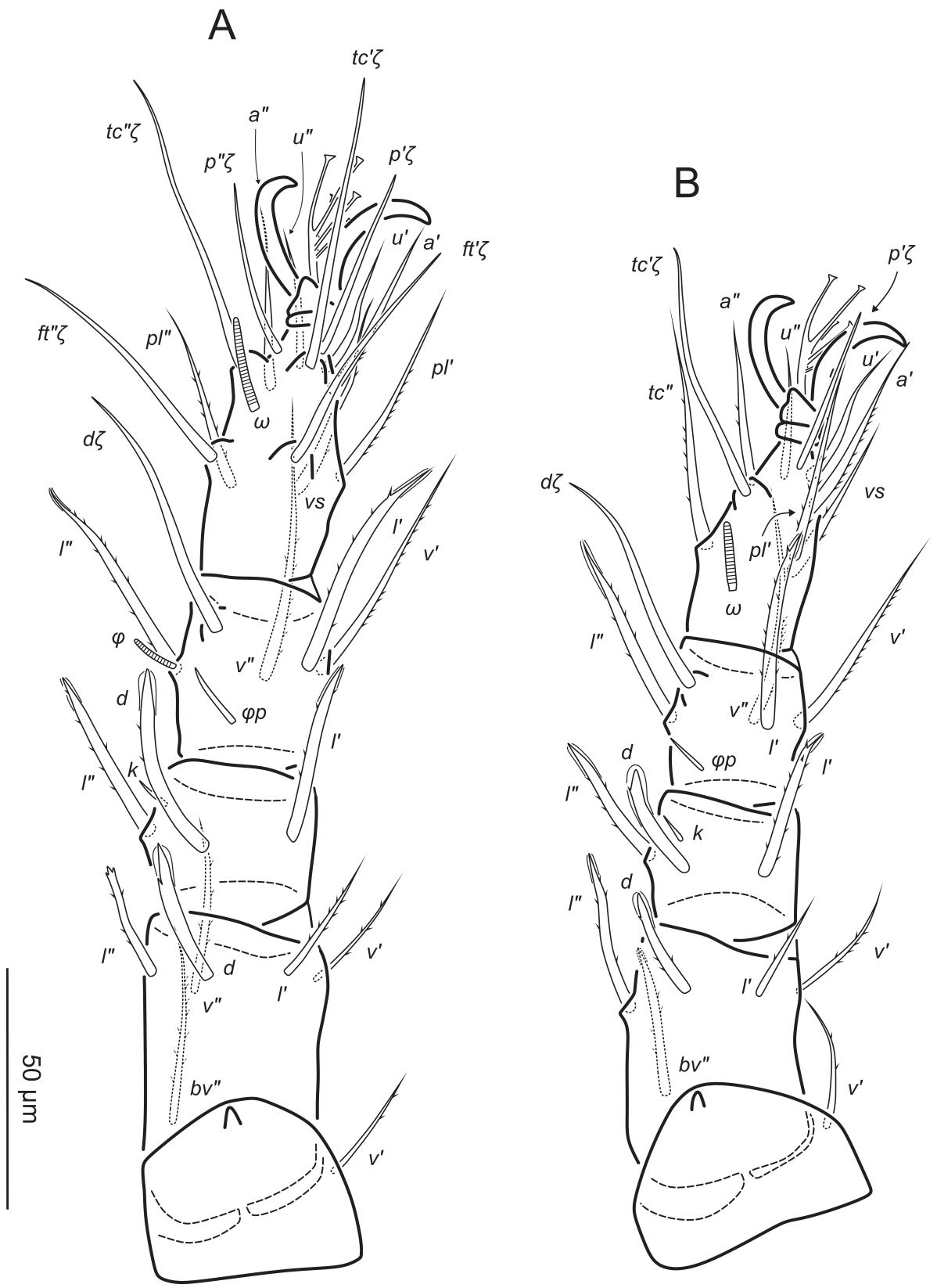

Fig. 23. *Eustigmaeus* cf. *clavatus* (Canestrini & Fanzago, 1876), ♀, KUZ Z4721. **A**. Left leg I, dorsal view. **B**. Left leg II, dorsal view. Abbreviations: see Material and methods.

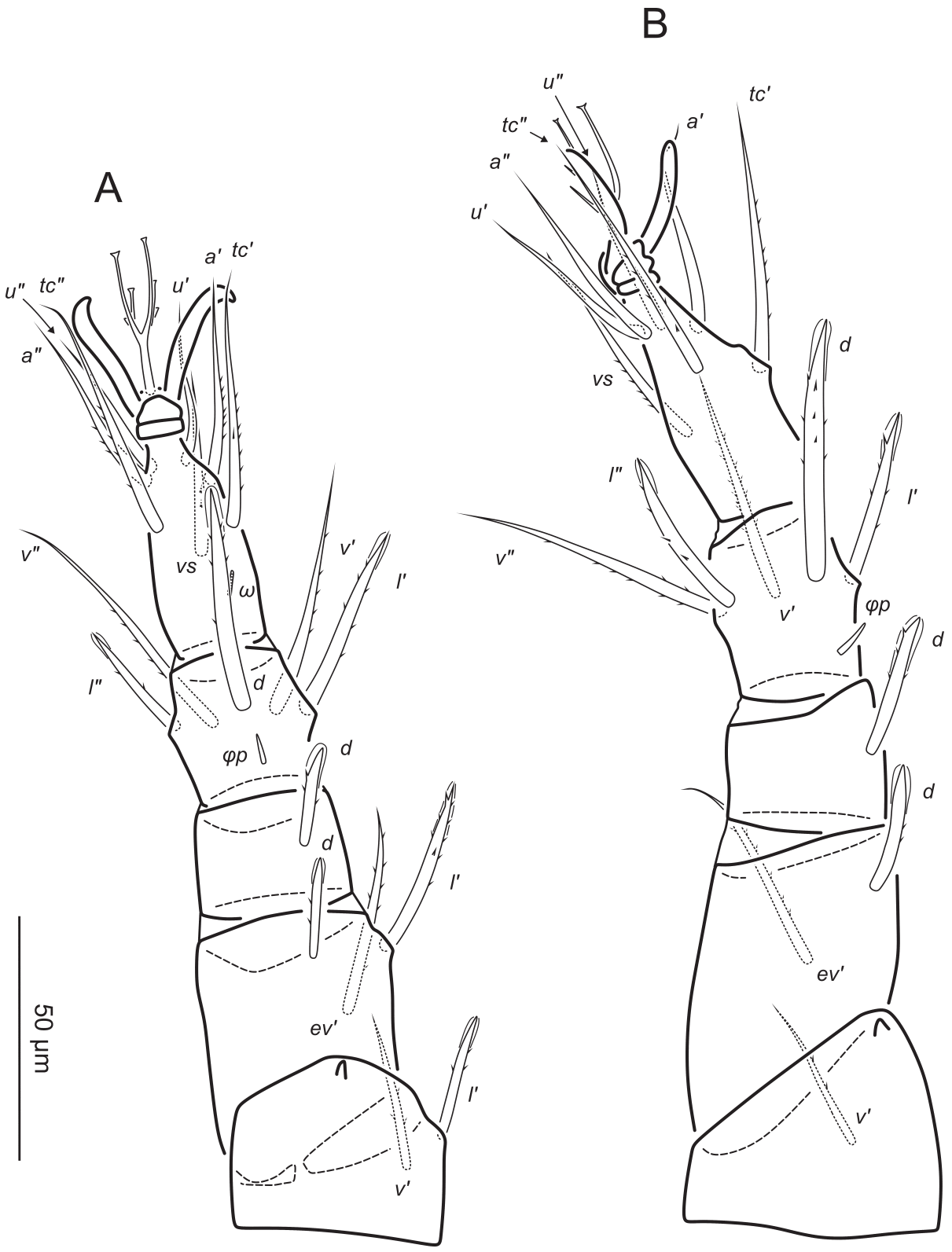

Fig. 24. *Eustigmaeus* cf. *clavatus* (Canestrini & Fanzago, 1876), ♀, KUZ Z4721. **A**. Left leg III, dorsal view. **B**. Left leg IV, dorsal view. Abbreviations: see Material and methods.

and bluntly pointed, with hyaline sheath. Setae *v′* of trochanter, *ev′* of femur, (*v*) of tibia, (*tc*) and *vs* of tarsus sparsely barbed and pointed. Setae (*a*) and (*u*) of tarsus slightly serrated. Solenidion *φp* attenuate. Seta lengths: *φp* 12.

Host plants

One species of Pottiaceae and one species of Leskeaceae Schimp. have been recorded (Ikeda *et al.* 2024b): Pottiaceae, *Weissia* sp.; Leskeaceae, *Haplocladium microphyllum* (Sw. ex Hedw.) Broth.

Distribution

Known from Honshu in the Japanese Archipelago.

Remarks

Eustigmaeus clavatus was originally described as *Caligonus clavatus* from Maser and Padova, Italy (Canestrini & Fanzago 1876). Subsequently, this species was widely recorded in Italy (Berlese 1883, 1885; Canestrini 1889; Wood 1973; Bernini *et al.* 1995). Although the morphological features of these Italian specimens were only superficially described, detailed descriptions were later provided based on North American material (Summers 1957; Summers & Price 1961). Wood (1973) re-examined Italian specimens housed in the Berlese collection and, by comparisons with the descriptions given in those publications, confirmed the identification of the North American material.

Eustigmaeus clavatus has been recorded in Austria, Canada, China, Italy, Poland, Russia, Slovakia, Switzerland, Ukraine, and the USA (Beron 2020) and its identification has largely relied on the descriptions by Summers & Price (1961) or Wainstein & Kuznetsov (1978) based on the specimen(s) from Russia (Khaustov *et al.* 2023). However, the identity of North American species described by Summers & Price (1961) and true *E. clavatus* remains uncertain because a redescription based on the type material is lacking (Khaustov *et al.* 2023). In addition, Khaustov *et al.* (2023) pointed out that *E. clavatus* sensu Wainstein & Kuznetsov (1978) is conspecific with *E. jiangxiensis* Hu, Chen & Huang, 1996 based on characters such as the lack of seta *4a*.

The present specimens are most similar to *E. clavatus* sensu Summers & Price (1961), sharing prominent circular dimples enclosed in evident subcuticular reticulum on dorsal shields, slightly clavate dorsal setae with sheath, a medium-length seta *sci*, the absence of callosity, three pairs of aggenital setae, and the absence of *ω* on tarsus IV. However, the description in Summers & Price (1961) lacks some measurements and details of the leg structures, leaving open the possibility that the Japanese species is a distinct taxon. Therefore, we tentatively identified the examined specimens as *E. clavatus* sensu Summers & Price (1961). Revisiting the type specimen of *E. clavatus*, as well as the specimens examined in Summers (1957) and Summers & Price (1961), is necessary to determine the taxonomic status of the examined specimens.

Discussion

Until recently, only four species in the genus *Eustigmaeus* – *E. anauniensis* (Canestrini, 1889), *E. lirellus* (Summers & Price, 1961), *E. segnis* (Koch, 1836), and *E. arcuatus* (Chaudhri, 1965) – were formally documented in Japan (Ehara 1980). However, recent studies by Ikeda *et al.* (2024a, 2025), together with the present study, have advanced our understanding of species richness in Japan. These descriptions of 10 species from 39 localities in 13 prefectures across Honshu and Shikoku increase the number of known Japanese species of *Eustigmaeus* to 14.

Nine species in *Eustigmaeus* were included in a molecular phylogenetic analysis in Ikeda *et al.* (2024b). This analysis recovered two clades corresponding to the character states of callosities. One clade,

including *E. asper*, *E. rhodomelus*, *E. pseudolacunus*, *E. ottavii* (Berlese, 1910), *Villersia jamaliensis* (Khaustov, 2014) [which may be regarded as a member of *Eustigmaeus* (Ikeda *et al.* 2024b; Doğan 2026)], *E. acidophilus* (Wood, 1972), *E. imadae*, *E. tjumeniensis* Khaustov & Tolstikov, 2014, *E. grandis*, and *E. extremiorientalis*, was characterized by having two pairs of callosities. The other clade included species with one pair, including *E. specialis* sp. nov., *E. parvisetus*, and *E. erzincanensis*. Species lacking callosities were not assigned to these two clades.

The shape and location of callosities are regarded as highly specific taxonomic characters in species of the genera *Eustigmaeus* and *Villersia* Oudemans, 1927 (Khaustov 2019). These character states may indeed be phylogenetic signals within members of these genera (Ikeda *et al.* 2024b). Such signals may prove useful for the genus-group revision in the future. As Doğan (2026) highlighted the need to re-evaluate three nominal genera, *Eustigmaeus*, *Villersia*, and *Ledermuelleriopsis* Willmann, 1953, based on recent morphological and phylogenetic studies, we consider that their taxonomic status should be further tested by additional phylogenetic evidence. Reconstructing a robust phylogeny, together with detailed morphological examination, may also help clarify the function of callosities and the evolution of their presence and number.

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