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A REVIEW OF *RAPHIGNATHUS* (ACARI: RAPHIGNATHIDAE) OF ASIAN RUSSIA

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ABSTRACT: The genus *Raphignathus* Dugès (Acari: Raphignathidae) of Asian Russia is reviewed. *Raphignathus sakhalinensis* sp.n. is described based on female and male specimens collected from spruce bark on Sakhalin Island; *R. longipes* sp.n. is described based on female and male specimens collected from various regions of Russia (Bashkortostan, Tyumenskaya Oblast, the Respublika Altay and Kamchatka). *Raphignathus fani* Doğan and Ayyildiz and *R. ozkani* Doğan are recorded from Russia for the first time and redescribed. *Raphignathus gracilis* (Rack) is recorded from Asian Russia for the first time. A key to the species of *Raphignathus* of Russia is also provided.

KEY WORDS: Acarina, Raphignathoidea, systematics, morphology, key

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INTRODUCTION

The mite family Raphignathidae (Acari: Prostigmata) is a small group of predatory mites, which currently includes two genera and some 70 species distributed worldwide (Beron 2020; Khan *et al.* 2023). Khan *et al.* (2023) divided the genus *Raphignathus* into four subgenera based on the number of setae located on the dorsal interscutal cuticle in females. At the same time, the above authors ignored some species with poorly developed dorsal idiosomal shields (*Raphignathus evidus*, *R. hsiufui* and *R. johnstoni*) and considered them similar to immature stages. Since such subdivision into four subgenera was based on a single character state without any analysis of other morphological structures, it is ignored in this article.

The genus *Raphignathus* Dugès has been poorly studied in Russia. At present, six species have been recorded from Crimea, namely, *Raphignathus scutatus* Kuznetsov, 1976, *R. collegiatus* Atyeo, Baker and Crossley, 1961, *R. gracilis* (Rack, 1962), *R. kuznetsovi* Doğan and Ayyildiz, 2003, *R. ueckermanni* Koç and Kara, 2004 and *R. hecmatanaensis* Khanjani and Ueckermann, 2003 (Kuznetsov 1976; Khaustov and Sergeyenko 2014). No *Raphignathus* species have previously been reported from Asian Russia.

The present study describes two new species of *Raphignathus* collected from various parts of Asian Russia. In addition, two species are redescribed: *R. fani* Doğan and Ayyildiz and *R. ozkani* Doğan, recorded from Russia for the first time. The key to the species of *Raphignathus* of Russia is provided.

MATERIALS AND METHODS

Mites were collected from various habitats using Berlese funnels and mounted in Hoyer's medium. In the description below, the palpal, idiosomal and leg setations follows Grandjean (1939, 1944, 1946). The nomenclature of prodorsal setae follows Kethley (1990). All measurements are given in micrometers (μm) for the holotype, five paratypes (in parenthesis) and for the ranges of measurements of redescribed species. In the descriptions of leg setation, the number of solenidia is given in parenthesis. Mite morphology was studied using a Carl Zeiss AxioImager A2 compound microscope with phase contrast and DIC illumination. Photomicrographs were taken with an AxioCam ICc5 digital camera.

SYSTEMATICS

Family **Raphignathidae Kramer, 1877**

Genus ***Raphignathus*** Dugès, 1834
Type species: *Raphignathus ruberrimus* Dugès, 1834, by original designation.

***Raphignathus sakhalinensis* sp. n.**

(Figs. 1–5)

Description. *Female* (Figs. 1–3, 5A–C). Body ovate. Length of idiosoma 390 (405–415), maximum width 275 (295–315).

Idiosomal dorsum (Figs. 1A, 5B, C). Main part of idiosoma covered by punctate and non-striate shields; central shield with three pairs of setae (*vi*, *ve*, *c1*); lateral shields with three pairs of setae (*sci*, *sce*, *c2*), one pair of ocelli and weakly developed postocular bodies; opisthosomal shield with five

pairs of setae (*e*, *f, h1*, *h2*, *h3*); one pair of setae *d* located on tiny platelets between lateral and opisthosomal shields; one pair of small plates located posteromesad lateral shields; posterior margin of central shield straight (Fig. 5B); lateral edges of opisthosomal shield bent to ventral side. Cupules *ia* situated near posterior margin of lateral shields; cupules *im* situated near anterior margin of opisthosomal shield; cupules *ip* situated laterad setae *f*. All dorsal setae similar in shape, smooth, narrowly lanceolate, attenuate and weakly blunt-tipped, their maximum width near the base (Fig. 5C). Three pairs of pseudanal setae same shape as dorsal. Lengths of idiosomal setae: *vi* 37 (36–41), *ve* 42 (42–43), *sci* 44 (38–43), *sce* 42 (38–42), *c1* 37 (33–37), *c2* 42 (39–41), *d* 35 (34–36), *e* 35 (30–34), *f* 41 (39–44), *h1* 38 (33–39), *h2* 39 (38–39), *h3* 38 (35), *ps1* 26 (24–26), *ps2* 25 (26–27), *ps3* 26 (25–27).

Idiosomal venter (Fig. 1B). Coxisternal plates I–IV finely punctate; endopodal plates associated with coxisternal plates III–IV and punctate; genital plates punctate. Coxisternal formula: 3(*1a*, *1b*, *1c*)–1(*2c*)–3(*3a*, *3b*, *3c*)–1(*4c*); setae *4a*, *ag1*, and *ag2* situated on soft striated cuticle; three pairs of genital setae located on genital plates. All ventral setae thin, smooth and pointed, except weakly blunt-tipped *3b*. Cupules *ih* situated laterad setae *g2* on soft cuticle.

Gnathosoma (Figs. 2, 5A). Number of setae on palpal segments: Tr 0, Fe 3 (*d*, *l'*, *v"*), Ge 2 (*d*, *l"*), Ti 3 (*d*, *l'*, *l"*), Ta 8(1) (4 eupathidia *ul'ς*, *ul"ς*, *sulς*,

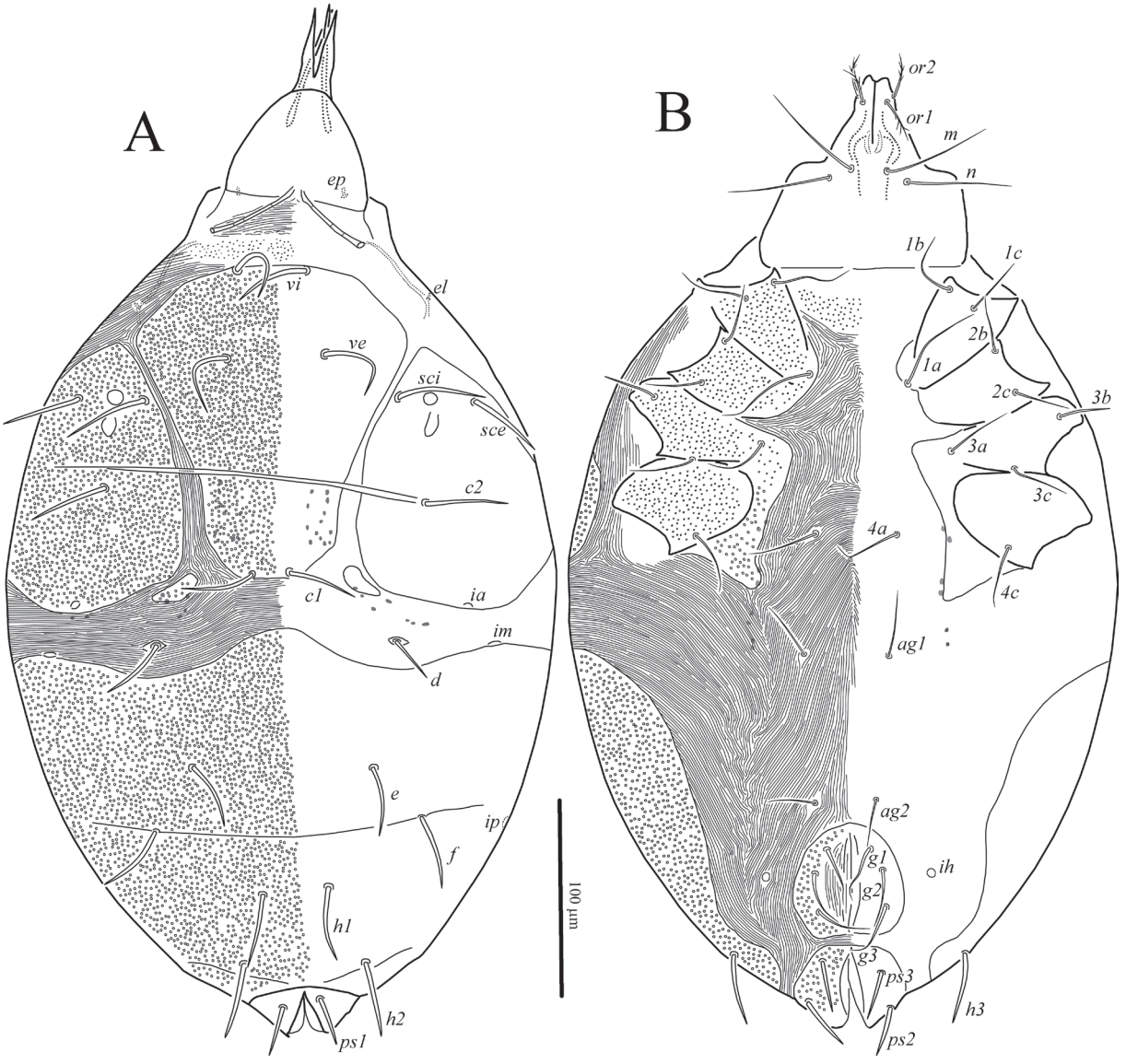

Fig. 1. *Raphignathus sakhalinensis* sp.n., female (holotype): A—dorsum of body; B—venter of body. Legs omitted.

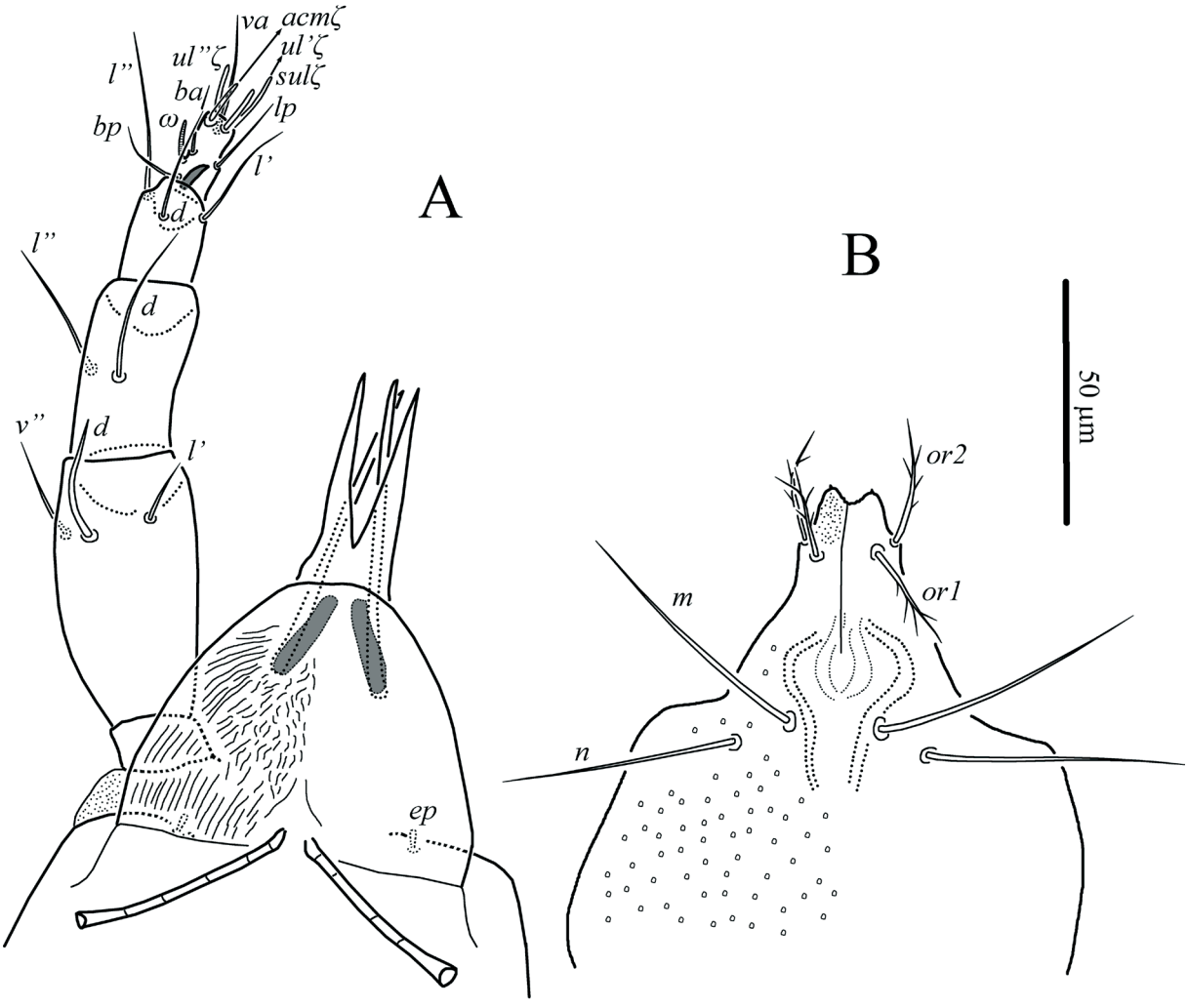

Fig. 2. *Raphignathus sakhalinensis* sp.n., female (holotype): A—gnathosoma, dorsal aspect; B—subcapitulum.

acmζ, 3 simple setae *ba*, *bp*, *lp*, and 1 solenidion *ω*); tarsal eupathidia smooth and blunt-tipped, other palpal setae pointed and smooth. Palpal supracoxal setae (*ep*) short, peg-like, situated under lateral parts of stylophore. Central part of stylophore with tangled striae (Fig. 5A). Rostrum of subcapitulum relatively long, its anterior margin with one pair of tiny papillae; all subcapitular setae pointed; setae *or1* and *or2* with long barbs, other setae smooth. Subcapitulum punctate. Length of cheliceral stylets 64 (62–70); length of palps 135 (130–135); length of palpal solenidion *ω* 8 (8).

Legs (Fig. 3). Lengths of legs: I 270 (265–270), II 230 (225), III 250 (255), IV 320 (315–320). Leg I (Fig. 3A). Coxae I posterodorsally with short peg-like leg supracoxal setae (*el*). Leg setation: Tr 1 (*v'*), Fe 6 (*d*, *l'*, *l"*, *v'*, *v"*, *bv"*), Ge 6 (*d*, *l'*, *l"*, *v'*, *v"*, *k*), Ti 5(1) (*d*, *l'*, *l"*, *v'*, *v"*, *φp*), Ta 19(2) (*p'ζ*, *p"ζ*, *tc'ζ*, *tc"ζ*, *ft'ζ*, *ft"ζ*, *pl'*, *pl"*, *u'*, *u"*, *a'*, *a"*, *vs*, *pv'*, *pv"*, *v'*, *v"*, *l'*, *l"*, *ω1*, *ω2*). Setae (*p*), (*tc*) and (*ft*) of tarsus smooth and blunt-tipped, eupathid-like; seta *k* of genu short, rod-like; seta *d* of femur weakly blunt-tipped, other setae pointed; setae (*a*), (*u*), *vs,* (*pv*) and (*v*) of tarsus barbed, other setae smooth. Solenidion *ω1* 14 (14–16) digitiform; solenidia *ω2* 13 (12–13) and *φp* 20 (19–20) uniformly thin with rounded tip. Leg II (Fig. 3B). Leg setation: Tr 1 (*v'*), Fe 5 (*d*, *l'*, *l"*, *v'*, *bv"*), Ge 6 (*d*, *l'*, *l"*, *v'*, *v"*, *k*), Ti 5(1) (*d*, *l'*, *l"*, *v'*, *v"*, *φ*), Ta 15(1) (*p'ζ*, *tc'ζ*, *tc"ζ*, *u'*, *u"*, *a'*, *a"*, *pl'*, *vs*, *pv'*, *pv"*, *v'*, *v"*, *l'*, *l"*, *ω*). Setae *p'* and (*tc*) of tarsus smooth, blunt-tipped, eupathid-like; seta *k* of genu rod-like; seta *d* of femur blunt-tipped, other setae pointed; setae (*a*), (*u*), *vs,* (*pv*), and (*v*) of tarsus barbed, other setae smooth. Solenidion *ω* 15 (14–15) digitiform; solenidion *φ* 18 (16–17)

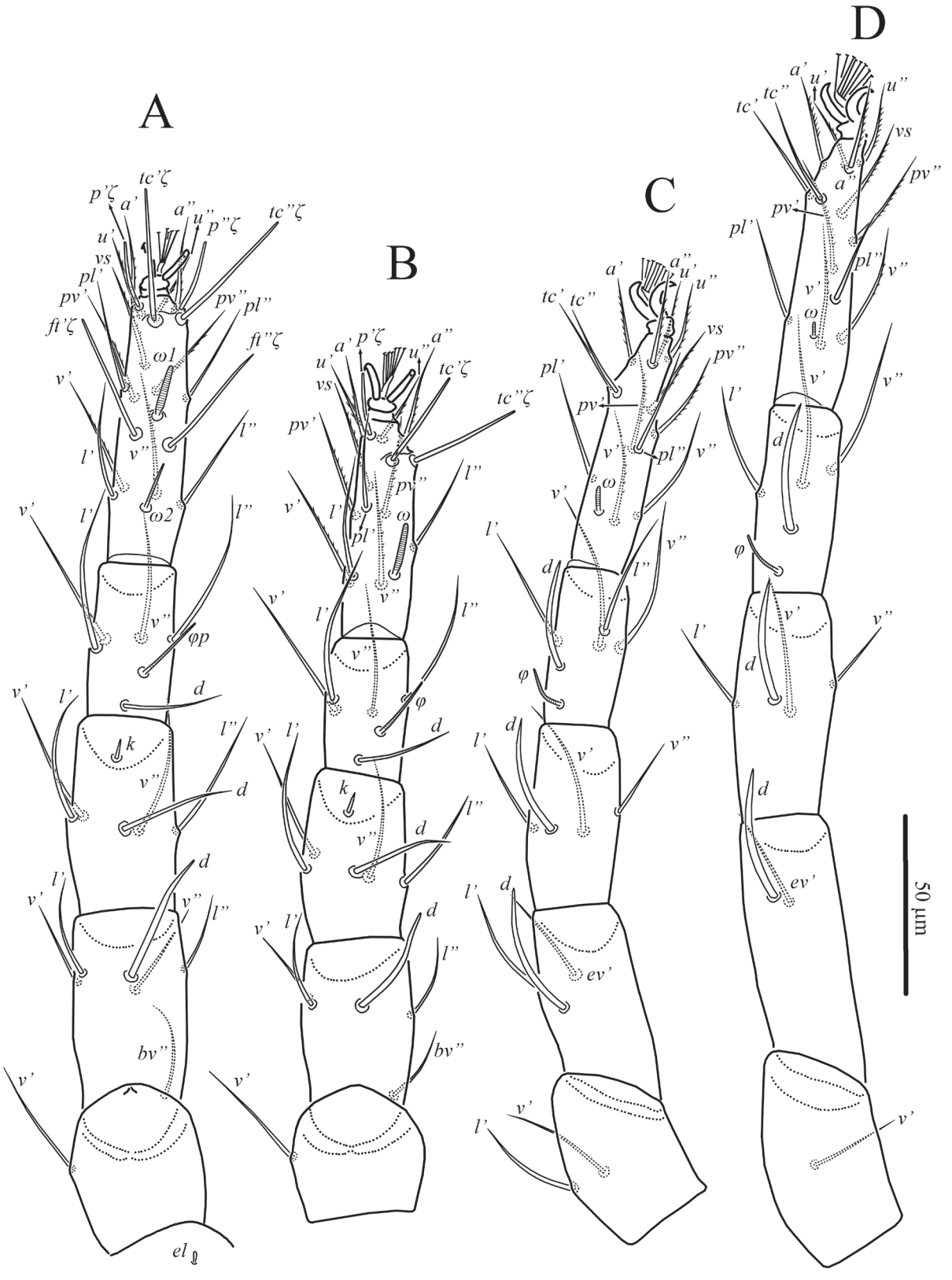

Fig. 3. *Raphignathus sakhalinensis* sp.n., female (holotype): A–D—right legs I–IV, respectively, dorsal aspect.

uniformly thin with rounded tip. Leg III (Fig. 3C). Leg setation: Tr 2 (*l'*, *v'*), Fe 3 (*d*, *l'*, *ev'*), Ge 4 (*d*, *l'*, *v'*, *v''*), Ti 5(1) (*d*, *l'*, *l''*, *v'*, *v''*, *φ*), Ta 13(1) (*tc'*, *tc''*, *pl'*, *pl''*, *u'*, *u''*, *a'*, *a''*, *vs*, *pv'*, *pv''*, *v'*, *v''*, *ω*).

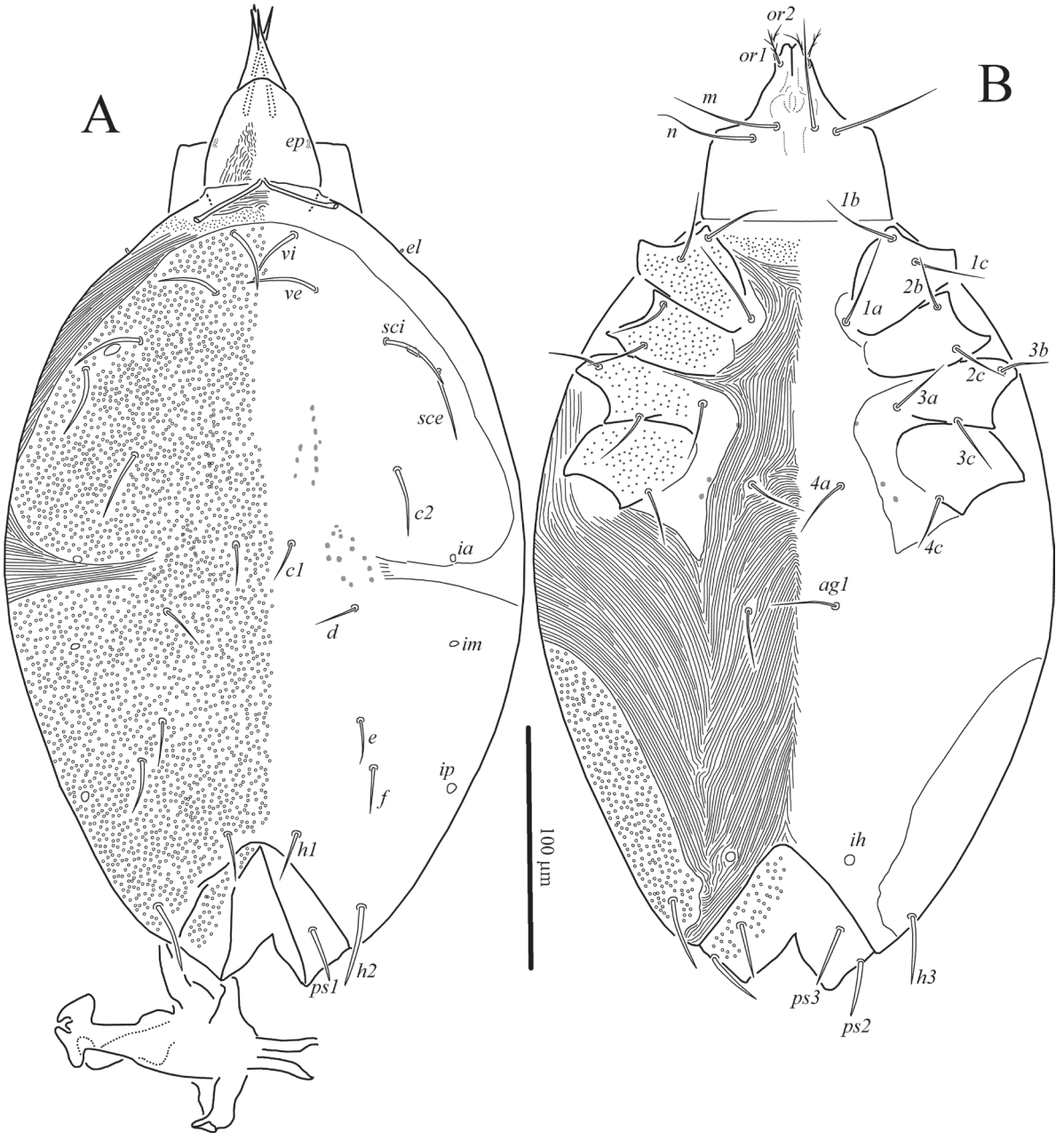

Fig. 4. *Raphignathus sakhalinensis* sp.n., male: A—dorsum of body; B—venter of body. Legs omitted.

Solenidion *ω* 7 (7) baculiform; solenidion *φ* 13 (14) uniformly thin with rounded tip. Setae *d* of femur, genu and tibia blunt-tipped, other setae pointed; setae (*a*), (*u*), *vs*, (*pv*) and (*v*) of tarsus barbed, other setae smooth. Leg IV (Fig. 3D). Leg setation: Tr 1 (*v'*), Fe 2 (*d*, *ev'*), Ge 4 (*d*, *l'*, *v'*, *v''*), Ti 4(1) (*d*, *l'*, *v'*, *v''*, *φp*), Ta 13(1) (*tc'*, *tc''*, *pl'*, *pl''*, *u'*, *u''*, *a'*, *a''*, *vs*, *pv'*, *pv''*, *v'*, *v''*, *ω*). Solenidion *ω* 4 (3) peg-like; solenidion *φ* 13 (12–13) uniformly thin with rounded tip. Setae *d* of femur, genu and tibia blunt-tipped, other setae pointed; setae (*a*), (*u*), *vs*, (*pv*) and (*v*) of tarsus barbed, other setae smooth.

Male (Figs. 4, 5D–F). Length of idiosoma 310, width 215.

Idiosomal dorsum (Fig. 4A). Idiosoma almost completely covered by single holodorsal shield with deep incisions at level of setae *c1*. Setae *c1*, *d*, *e*, *f*, and *h1* thin, pointed, other setae as in female. Aedeagus of complex shape (Fig. 4A). Lengths of dorsal setae: *vi* 27, *ve* 32, *sci* 31, *sce* 30, *c1* 17, *c2* 29, *d* 18, *e* 18, *f* 24, *h1* 21, *h2* 34, *h3* 30, *ps1* 23, *ps2* 25, *ps3* 23.

Idiosomal venter (Fig. 4B). Genital opening, all genital and *ag2* setae absent.

Gnathosoma as in female. Length of cheliceral stylets 47; length of palp 100; length of palpal solenidion ω 7.

Legs (Figs. 5D–F). Setation of legs as in female, except distinctly longer solenidia on tarsi I–IV (Figs. 5D–F). Length of legs: I 225, II 185,

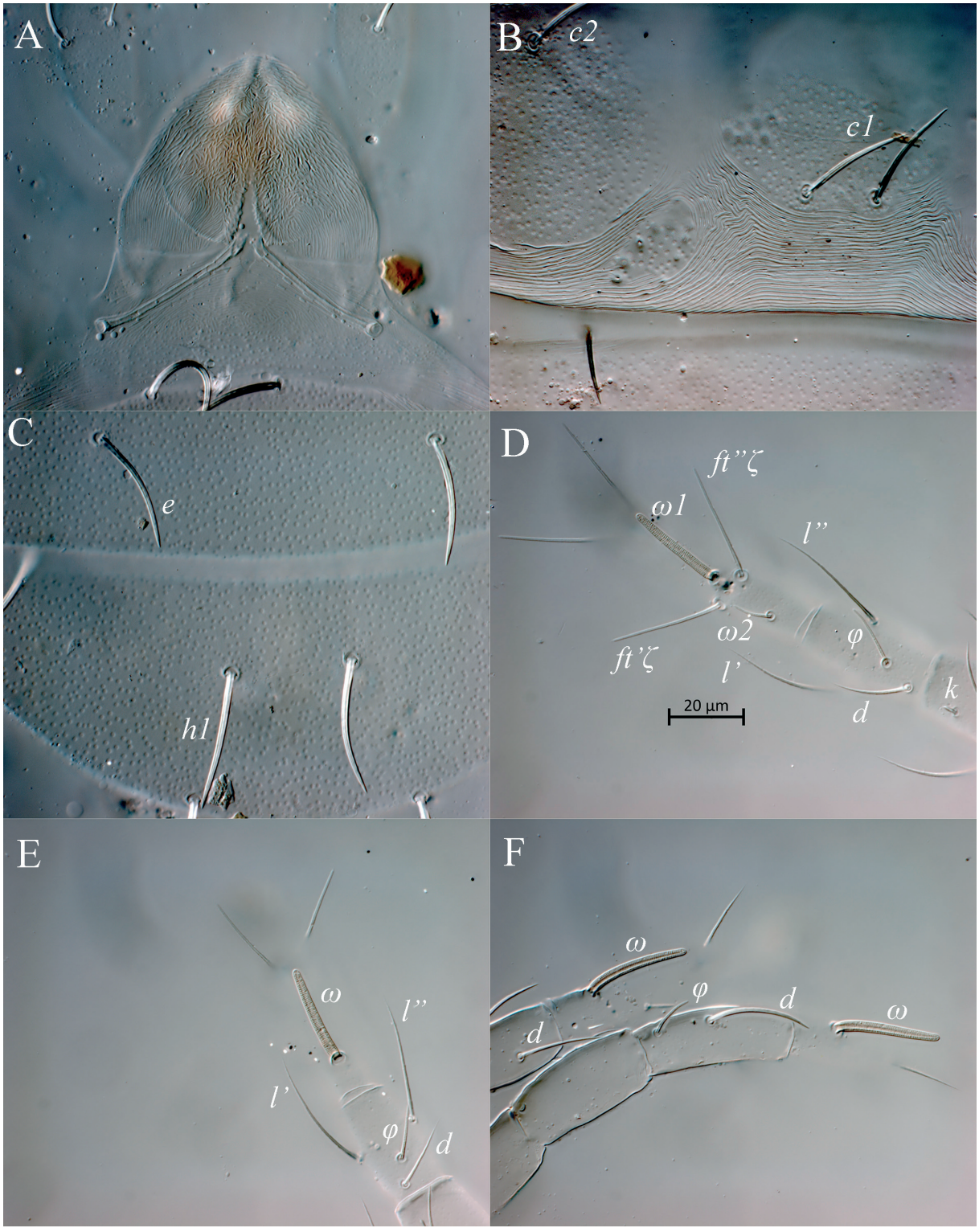

Fig. 5. DIC micrographs of *Raphignathus sakhalinensis* sp. n., female (A–C) and male (D–F): A—stylophore; B—metapodosoma, dorsal aspect; C—opisthosoma, dorsal aspect; D—tibia and tarsus I, dorsal aspect; E—tibia and tarsus II, dorsal aspect; F—tarsus III, genu, tibia and tarsus IV, dorsal aspect.

III 205, IV 245. Length of solenidia: *ω1*I 27, *ω2*I 10, *φp*I 18, *ω*II 27, *φ*II 15, *ω*III 29, *φ*III 13, *ω*IV 28, *φ*IV 13.

Immatures unknown.

Type material. Female holotype, slide № ZISP T-Raph-1, Russia, Sakhalin Island, vicinity of Yuzhno-Sakhalinsk, 46°59′N 142°49′E, 500 m a.s.l., on bark of spruce *Picea* sp., 13 August 2021, collected by A.A. Khaustov; paratypes: 2 females, 1 male, same data.

Type deposition. The holotype and two female paratypes are deposited in the collection of the Zoological Institute of RAS, St. Petersburg, Russia; male paratype is deposited in the collection of the Museum of Zoology, Tyumen State University, Tyumen, Russia.

Etymology. The name of the new species refers to its distribution on Sakhalin Island.

Differential diagnosis. The new species is very similar to *Raphignathus zhaoi* Hu, Jing and Liang, 1995, described from China (Fan and Yin 2000). The female and male specimens of the new species have the same structure of the dorsal idiosomal shields, same palpal and leg setation. The female of the new species could be distinguished from *R. zhaoi* in having distinctly narrower dorsal idiosomal setae with maximum width in the basal half (vs. dorsal idiosomal setae distinctly thickened, with maximum width in the distal half in *R. zhaoi* (see Fig. 12 in Fan and Yin (2000), Fig. 8 in Hu, Jing and Liang (1995), as well as Fig. 1 in Hu and Chen (1998) of *R. hongchengensis* Hu and Chen, 1998, junior synonym of *R. zhaoi*). The male of the new species differs from that of *R. zhaoi* in having setae *c1*, *d*, *e*, *f* and *h1* thin, pointed (vs. thickened, blunt-tipped, and widened in distal half in *R. zhaoi*).

Raphignathus longipes sp.n.

(Figs. 6–12)

Description. *Female* (Figs. 6–8, 10A, 11). Body ovate. Length of idiosoma 340 (355–400), maximum width 220 (250–280).

Idiosomal dorsum (Figs. 6A, 10A, 11A, B). Dorsal idiosomal shields strongly reduced; central shield poorly visible, striated, with three pairs of setae (*vi*, *ve*, *c1*); shield elongate posteriad setae *c1* and with transverse fold anteriad *c1* (Fig. 11A); lateral shields poorly defined, with three pairs of setae (*sci*, *sce*, *c2*), one pair of ocelli and weakly developed postocular bodies; posterior 2/3 of shield striated (Fig. 11A); opisthosomal shield with only two pairs of setae (*h1*, *h2*), striated anteriorly (Fig. 11B); four pairs of setae (*d*, *e*, *f*, *h3*) located on tiny platelets on soft cuticle. All cupules located on soft striated cuticle. All dorsal setae similar in shape, smooth, filiform, attenuate and pointed (Fig. 11B). Three pairs of pseudanal setae narrowly lanceolate, smooth and blunt-tipped. Lengths of idiosomal setae: *vi* 44 (42–47), *ve* 42 (40–43), *sci* 46 (44–46), *sce* 44 (40–44), *c1* 39 (38–39), *c2* 42 (40–43), *d* 39 (37–39), *e* 43 (38–40), *f* 44 (43–46), *h1* 40 (37–45), *h2* 41 (39–42), *h3* 36 (38–44), *ps1* 24 (22–24), *ps2* 23 (22–24), *ps3* 20 (20–23).

Idiosomal venter (Fig. 6B). Coxisternal plates I–IV smooth; endopodal plates not evident; genital plates striated. Coxisternal formula: 2(*1b*, *1c*)–1(*2c*)–2(*3b*, *3c*)–1(*4c*); setae *1a*, *3a*, *4a*, *ag1*, and *ag2* situated on soft striated cuticle; three pairs of genital setae located on genital plates. All ventral setae thin, smooth and pointed. Cupules *ih* situated laterad setae *g3* on soft cuticle.

Gnathosoma (Figs. 7, 11C). Number of setae on palpal segments: Tr 0, Fe 2 (*d*, *l'*), Ge 2 (*d*, *l''*), Ti 3 (*d*, *l'*, *l''*), Ta 8(1) (4 eupathidia *ul'ζ*, *ul''ζ*, *sulζ*, *acmζ*, 3 simple setae *ba*, *bp*, *lp*, and 1 solenidion *ω*); tarsal eupathidia smooth and blunt-tipped, other palpal setae pointed and smooth. Palpal supracoxal setae (*ep*) short, peg like, situated under lateral parts of stylophore. Central part of stylophore longitudinally striated (Fig. 11C). Rostrum of subcapitulum relatively long, its anterior margin with one pair of tiny papillae; all subcapitular setae pointed; setae *or1* and *or2* with long barbs, other setae smooth. Subcapitulum finely striated. Length of cheliceral stylets 43 (38–41); length of palps 145 (135–140); length of palpal solenidion *ω* 9 (9–10).

Legs (Figs. 8, 11D). All legs unusually long, leg IV distinctly longer than idiosoma, even in largest specimens (Fig. 10A). Lengths of legs: I 355 (345–350), II 310 (300–315), III 345 (345–350), IV 430 (420–425). Leg I (Figs. 8A, 11D). Coxae I posterodorsally with short peg-like leg supracoxal setae (*el*). Leg setation: Tr 1 (*v'*), Fe 6 (*d*, *l'*, *l''*, *v'*, *v''*, *bv''*), Ge 6 (*d*, *l'*, *l''*, *v'*, *v''*, *k*), Ti 5(1) (*d*, *l'*, *l''*, *v'*, *v''*, *φp*), Ta 19(2) (*p'ζ*, *p''ζ*, *tc'ζ*, *tc''ζ*, *ft'ζ*, *ft''ζ*, *pl'*, *pl''*, *u'*, *u''*, *a'*, *a''*, *vs*, *pv'*, *pv''*, *v'*, *v''*, *l'*, *l''*, *ω1*, *ω2*). Setae (*p*), (*tc*) and (*ft*) of tarsus smooth and blunt-tipped, eupathid-like; seta *k* of genu short, rod-like; other setae pointed and smooth. Solenidion *ω1* 6 (6–7) short, almost elliptical in outline (Fig. 11D); solenidia *ω2* 12 (11–13) and *φp* 19 (19–20) uniformly thin, with rounded tip. Leg II (Fig. 8B). Leg setation: Tr 1 (*v'*), Fe 5 (*d*, *l'*, *l''*, *v'*, *bv''*), Ge 6 (*d*, *l'*, *l''*, *v'*, *v''*, *k*), Ti 5(1) (*d*, *l'*, *l''*, *v'*, *v''*, *φ*), Ta 15(1) (*p'ζ*, *tc'ζ*, *tc''ζ*, *u'*, *u''*,

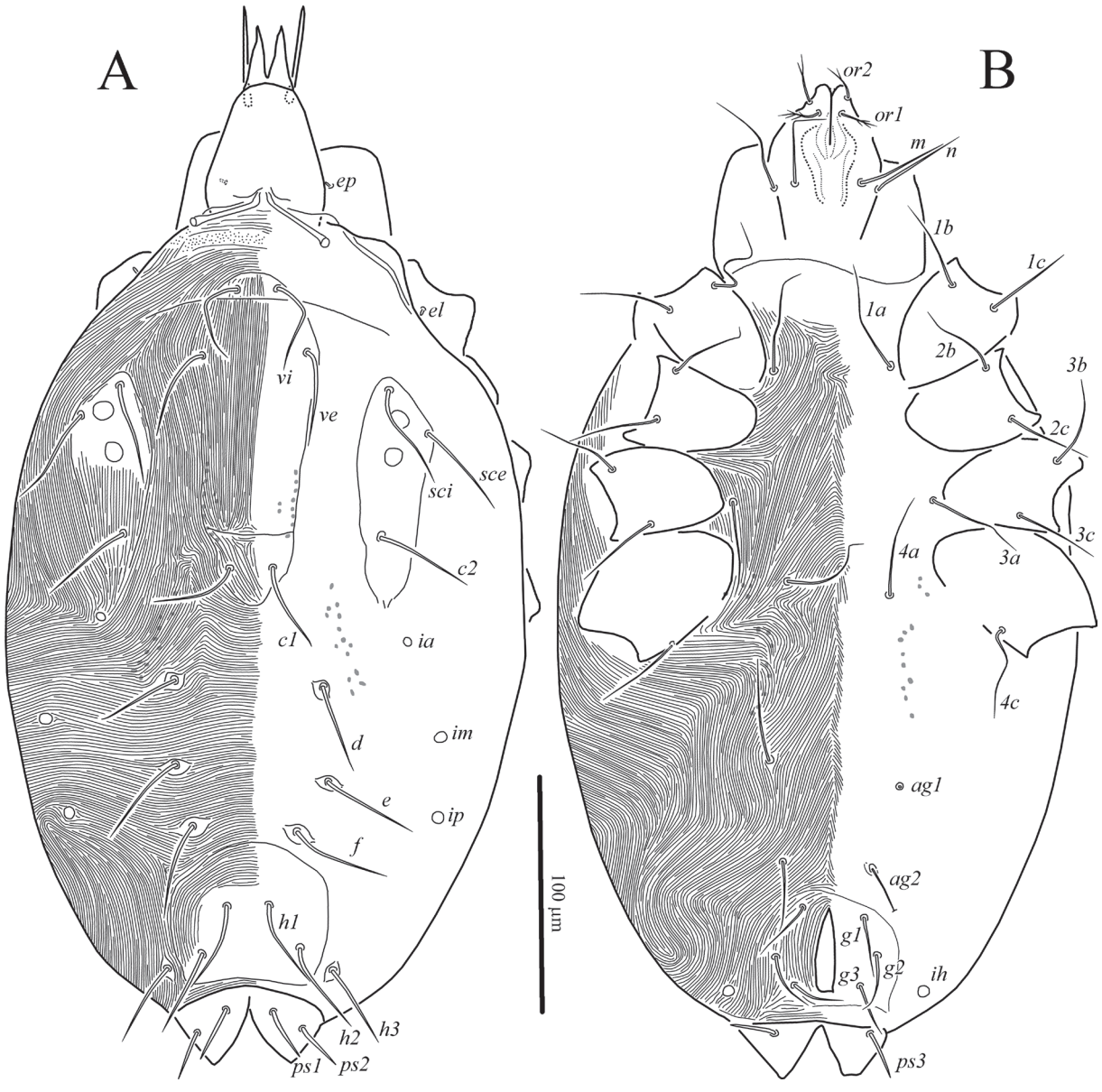

Fig. 6. *Raphignathus longipes* sp.n., female (holotype): A—dorsum of body; B—venter of body. Legs omitted.

a', *a''*, *pl'*, *vs*, *pv'*, *pv''*, *v'*, *v''*, *l'*, *l''*, *ω*). Setae *p'* and (*tc*) of tarsus smooth, blunt-tipped, eupathid-like; seta *k* of genu rod-like; other setae pointed and smooth. Solenidion *ω* 6 (6–7) short, almost elliptical in outline; solenidion *φ* 17 (16–17) uniformly thin with rounded tip. Leg III (Fig. 8C). Leg setation: Tr 2 (*l'*, *v'*), Fe 3 (*d*, *l'*, *ev'*), Ge 4 (*d*, *l'*, *v'*, *v''*), Ti 5(1) (*d*, *l'*, *l''*, *v'*, *v''*, *φ*), Ta 13(1) (*tc'*, *tc''*, *pl'*, *pl''*, *u'*, *u''*, *a'*, *a''*, *vs*, *pv'*, *pv''*, *v'*, *v''*, *ω*). Solenidion *ω* 3 (3) very short, egg-shaped; solenidion *φ* 14 (12–14) uniformly thin with rounded tip. All setae pointed; setae (*a*) and (*u*) of tarsus barbed, other setae smooth. Leg IV (Fig. 8D). Leg setation: Tr 1 (*v'*), Fe 3 (*d*, *l'*, *ev'*), Ge 4 (*d*, *l'*, *v'*, *v''*), Ti 4(1) (*d*, *l'*, *v'*, *v''*, *φp*), Ta 13 (*tc'*, *tc''*, *pl'*, *pl''*, *u'*, *u''*, *a'*, *a''*, *vs*, *pv'*, *pv''*, *v'*, *v''*). Solenidion *ω* absent; solenidion *φ* 12 (12–13) uniformly thin with rounded tip. All setae pointed; setae (*a*) of tarsus barbed, other setae smooth.

Male (Figs. 9, 10B, 12). Length of idiosoma 315–350, width 215–220.

Idiosomal dorsum (Figs. 9A, 10B). Only lateral shields with setae *sci* and *sce* poorly visible (Fig. 12A), remaining idiosomal dorsum striated; area between setae *c1*, *d*, *e*, *f*, and cupules *im* with wavy striae (Fig. 12B). All dorsal setae thin, pointed. Pseudanal setae narrowly lanceolate, smooth and blunt-tipped. Aedeagus of complex shape.

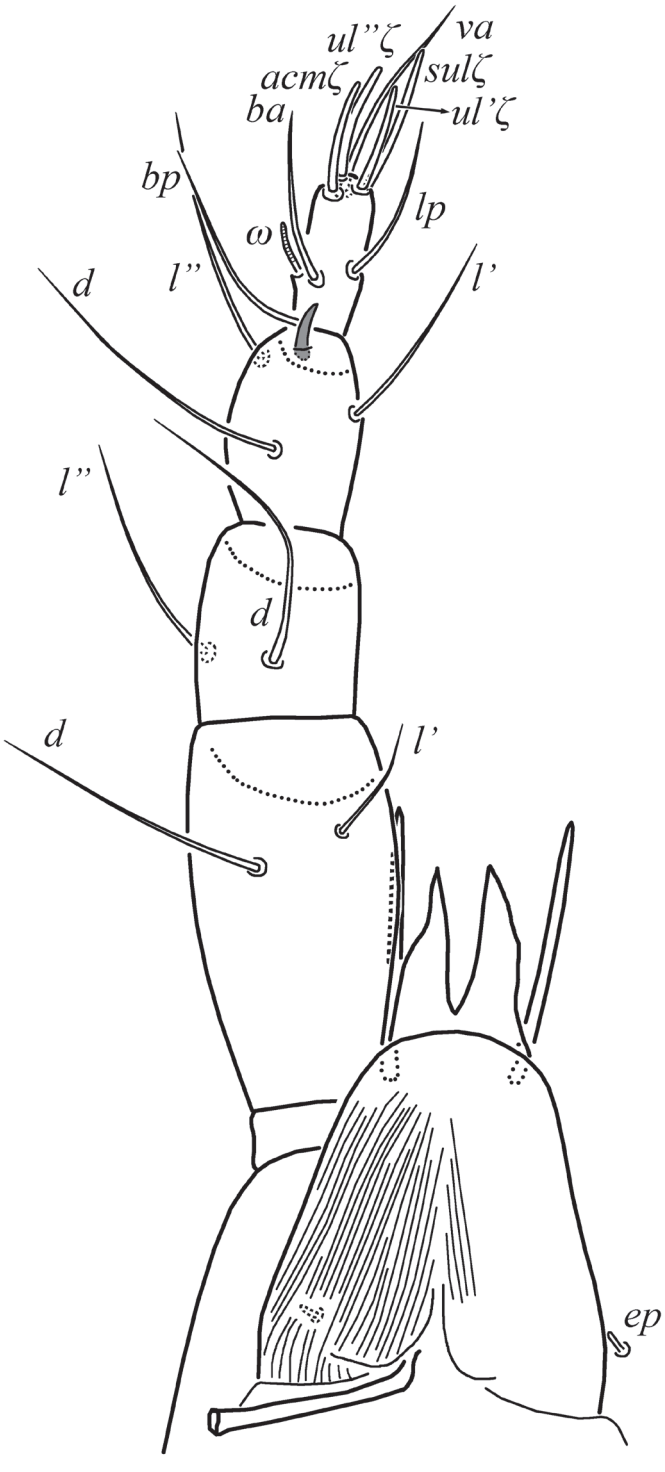

Fig. 7. *Raphignathus longipes* sp.n., female (holotype): gnathosoma, dorsal aspect.

Lengths of dorsal setae: *vi* 37–39, *ve* 32–33, *sci* 37–39, *sce* 33–39, *c1* 23–30, *c2* 29–34, *d* 22–24, *e* 25–27, *f* 29–31, *h1* 27–31, *h2* 34–41, *h3* 34, *ps1* 24, *ps2* 21–23, *ps3* 22–23.

Idiosomal venter (Fig. 9B). Genital opening and all genital setae absent; setae *ag2* present.

Gnathosoma as in female. Length of cheliceral stylets 24–35; length of palp 125–135; length of palpal solenidion *ω* 4–5.

Legs (Fig. 12C–F). Setation of legs as in female, except distinctly larger solenidia on tarsi I–III and presence of solenidion *ω* on tarsus IV

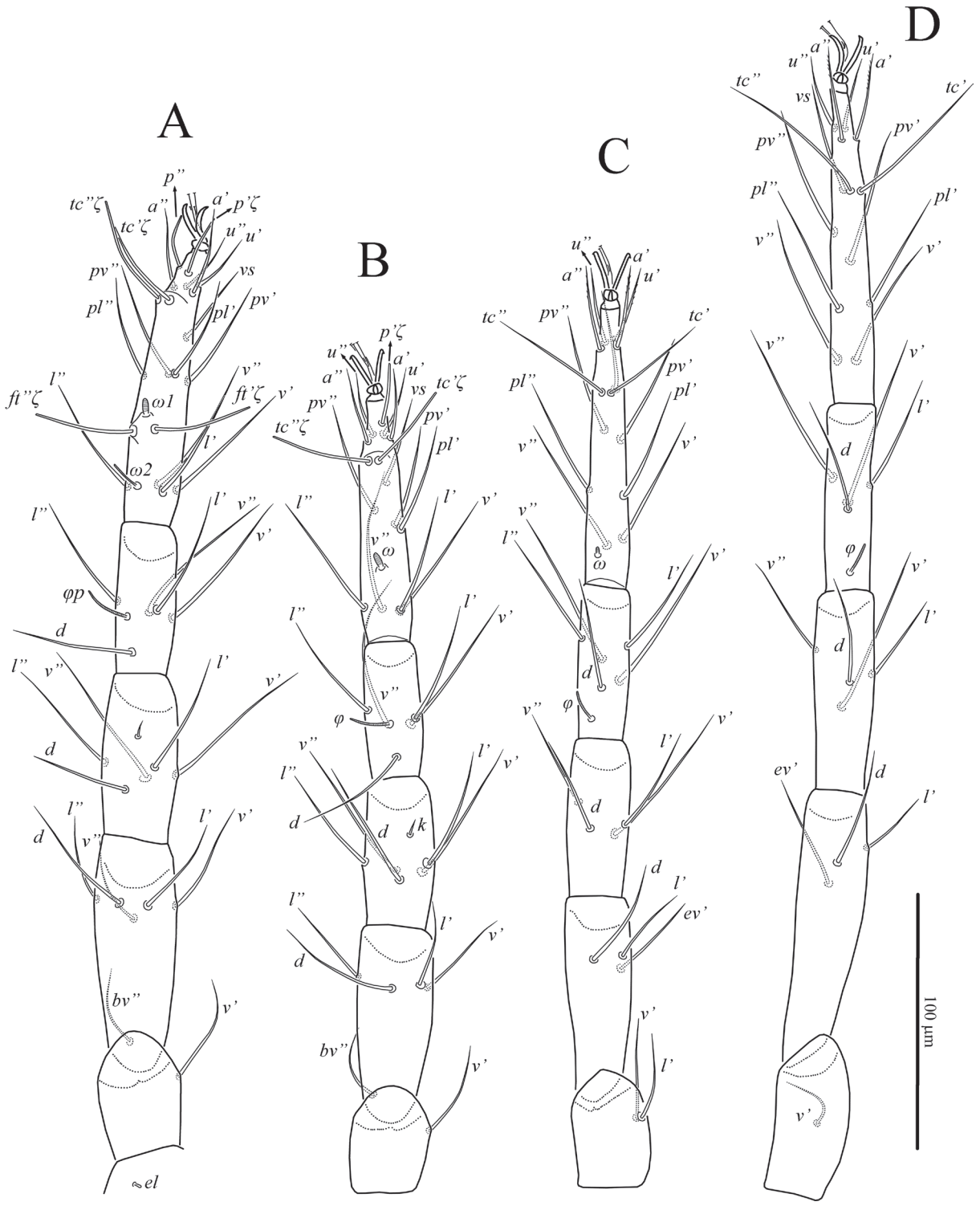

Fig. 8. *Raphignathus longipes* sp.n., female (holotype): A–D—left legs I–IV, respectively, dorsal aspect.

(Fig. 12C–F). Lengths of legs: I 330–340, II 290, III 335–340, IV 405. Lengths of solenidia: *ω1*I 9–15, *ω2*I 9–14, *φp*I 15–16, *ω*II 8–15, *φ*II 10–14, *ω*III 14, *φ*III 9–10, *ω*IV 14–15, *φ*IV 9–11.

Immatures unknown.

Type material. Female holotype, slide № ZISP T-Raph-2, Russia, Bashkortostan, Beloretskiy Rayon, Iremel' Mountain, 54°32′N 58°50′E, 1,400 m a.s.l., mountain tundra, moss and grassy soil, 19 August 2020, collected by A.A. Khaus-

tov; paratypes: 1 male, same data; 1 female, Russia, Tyumenskaya Oblast, vicinity of Lake Kuchak, in a nest of *Formica rufa*, 4 July 2014, collected by A. A. Khaustov; 1 male, Russia, Tyumenskaya Oblast, vicinity of Lake Kuchak, in *Sphagnum* moss near the bog, 4 July 2014, collected by A. A. Khaustov; 3 males, Russia, Kamchatka, vicinity of the town Elizovo, 53°11′N 158°22′E, in rotting bracket fungi, 3 August 2022, collected by A. A. Khaustov; 1 female, Russia, Kamchatka, vicinity of Petropavlovsk-Kamchatsky, 53°00′57.6″N 158°50′57.4″E, in grassy soil, collected by A. A. Khaustov; 1 female, Russia, the Respublika Altay, 50°18′57.6″N 87°42′59.0″E, in grassy soil, 2,205 m a. s. l, collected by A. A. Khaustov.

Type deposition. The holotype and one male paratype are deposited in the collection of the Zoological Institute of RAS, St. Petersburg, Russia, male paratype is deposited in the collection of the Museum of Zoology, Tyumen State University, Tyumen, Russia.

Etymology. The name of the new species is derived from Latin *longipes* meaning *long-legged* and refers to the species' unusually long legs.

Differential diagnosis. The new species is very similar to *Raphignathus evidus* Fan, 2000, described from China (Fan and Yin 2000). The female

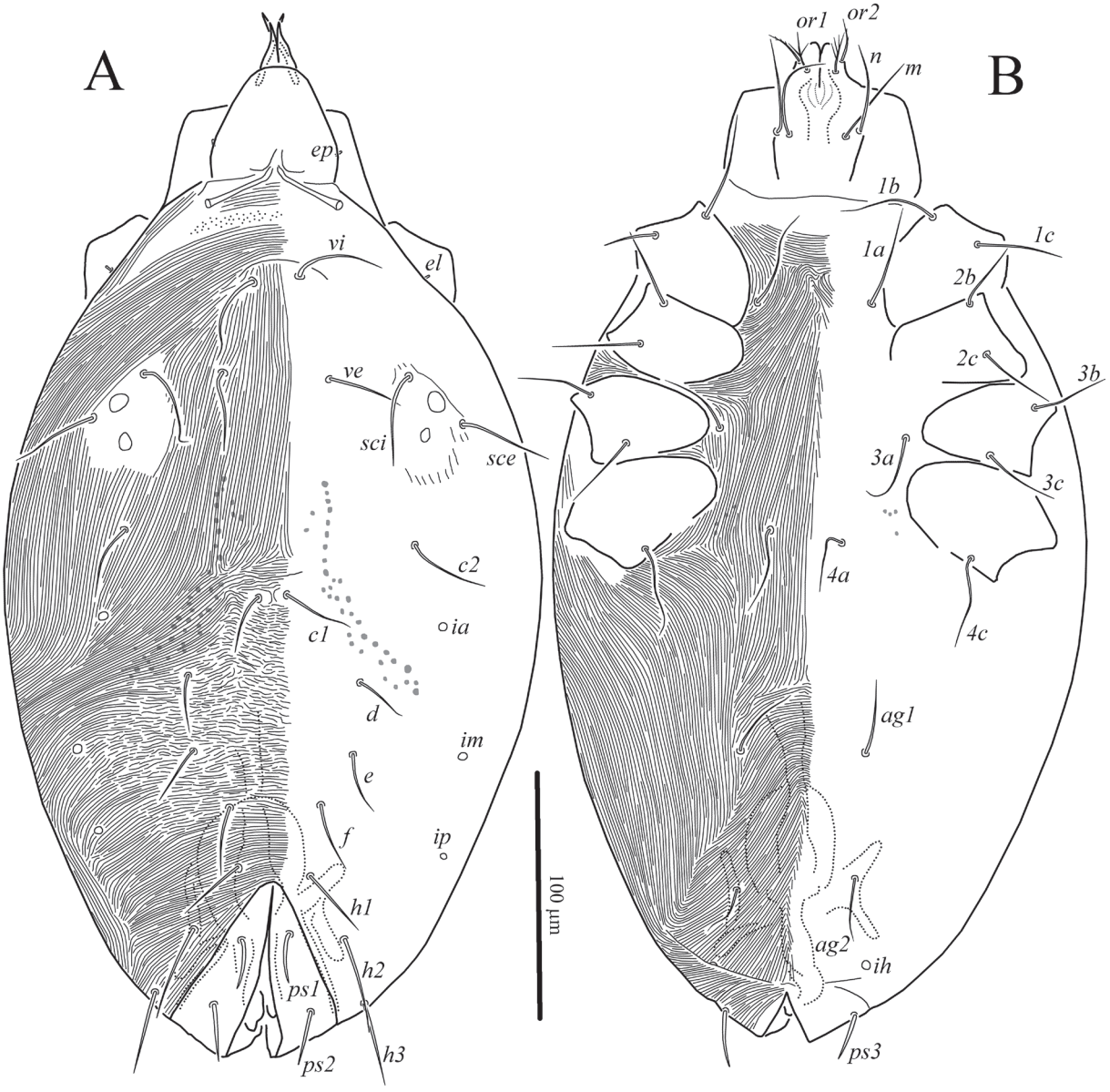

Fig. 9. *Raphignathus longipes* sp. n., male: A—dorsum of body; B—venter of body. Legs omitted.

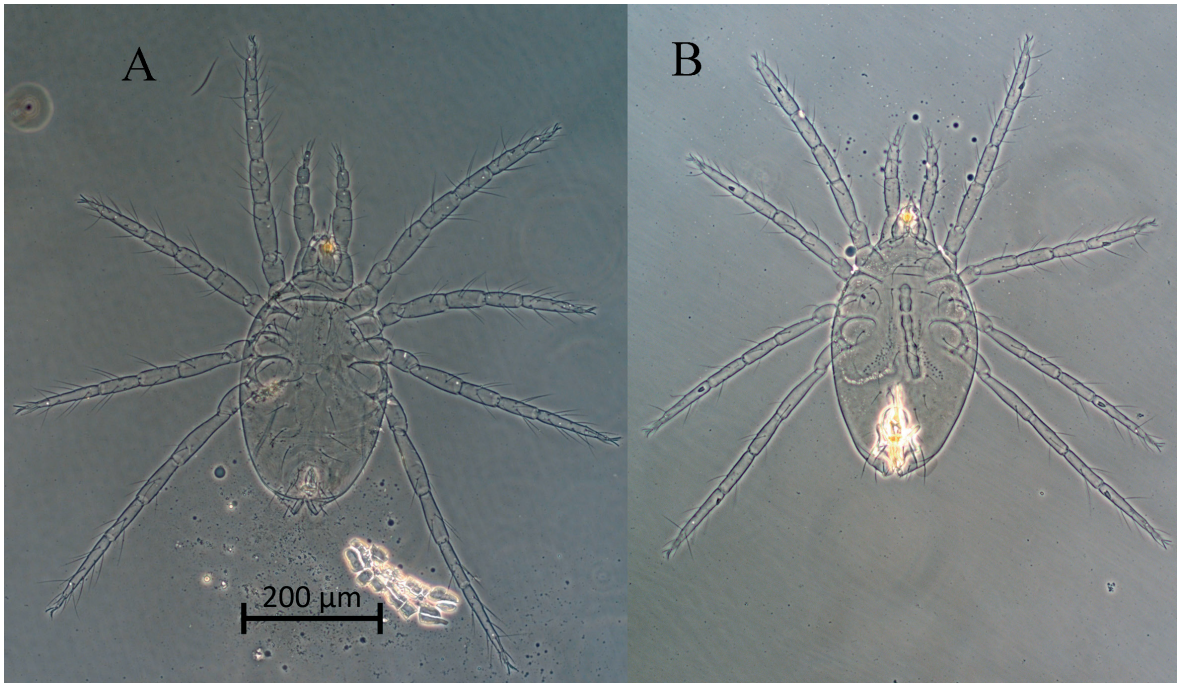

Fig. 10. Phase-contrast micrographs of *Raphignathus longipes* sp.n., female (A) and male (B): general view dorsally.

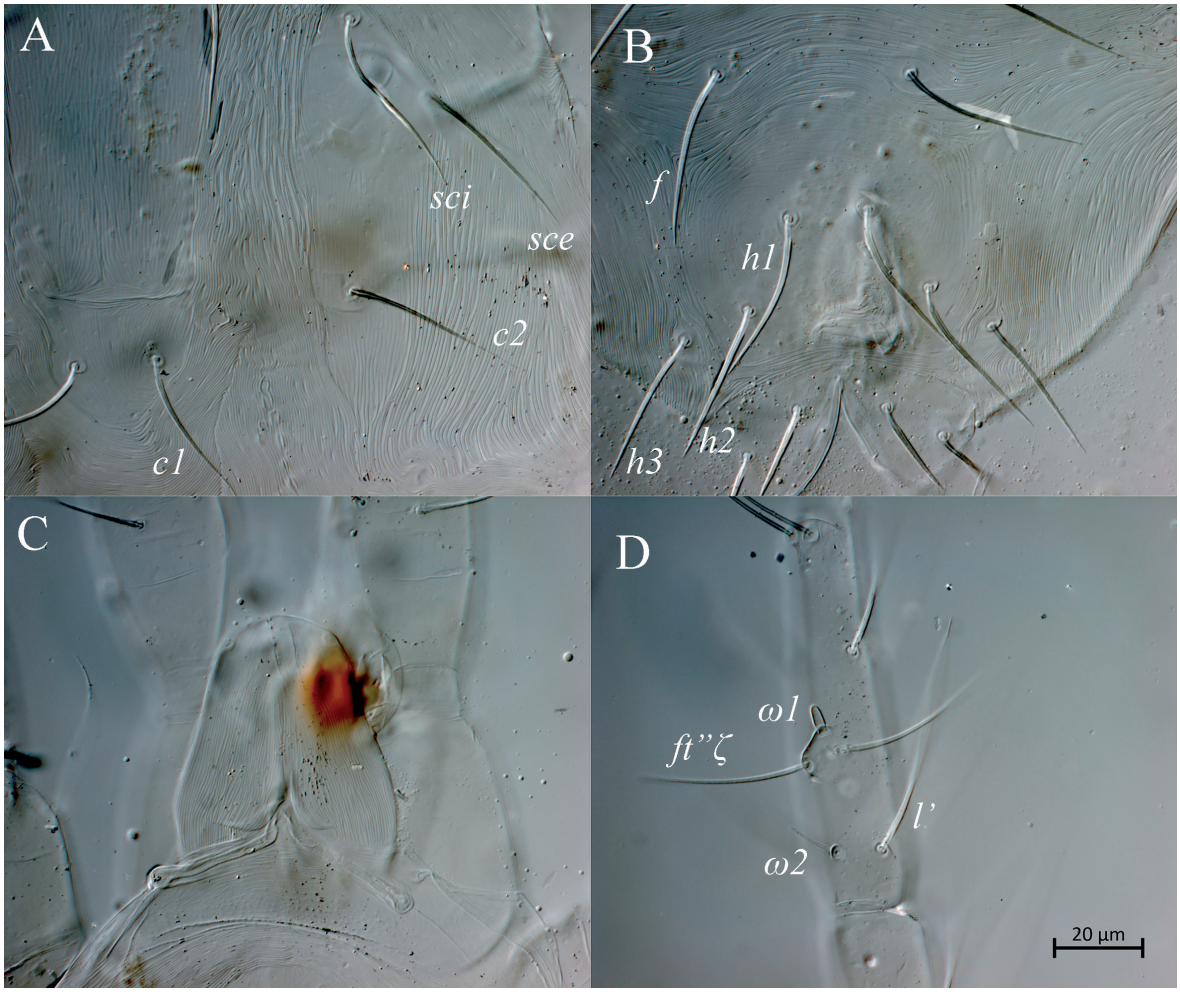

Fig. 11. DIC micrographs of *Raphignathus longipes* sp.n., female (holotype): A—central and lateral idiosomal shields; B—opisthosoma, dorsal aspect; C—stylophore; D—tarsus I, dorsal aspect.

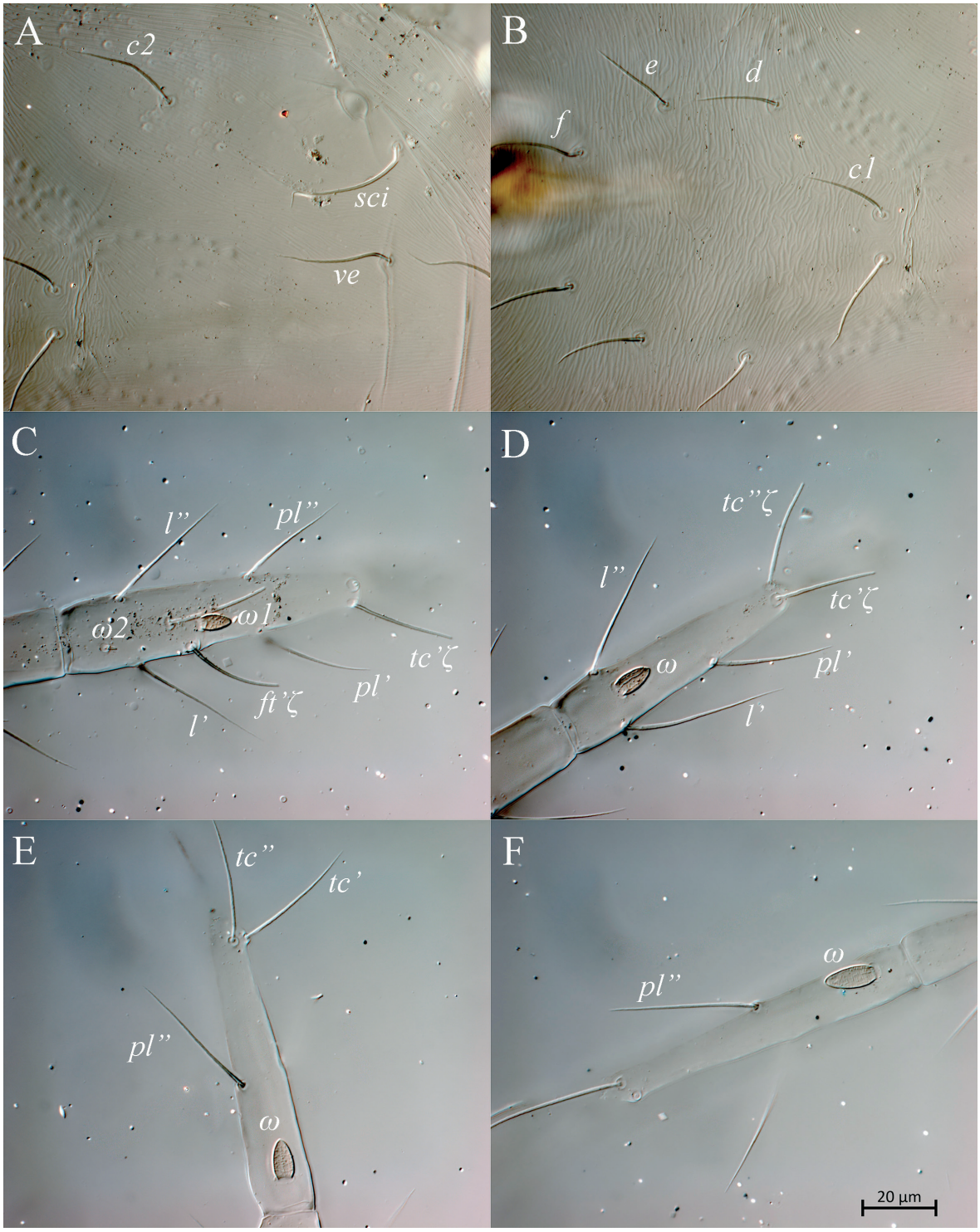

Fig. 12. DIC micrographs of *Raphignathus longipes* sp. n., male: A—lateral idiosomal shield; B—metapodosoma, dorsal aspect; C—tarsus I, dorsal aspect; D—tarsus II, dorsal aspect; E—tarsus III, dorsal aspect; F—tarsus IV, dorsal aspect.

of the new species has the same strongly reduced dorsal idiosomal shields, same palpal and leg setation. The female of the new species could be distinguished from *R. evidus* in having distinctly elongate, almost V-shaped posterior margin of the central idiosomal shield (vs. posterior margin of the central idiosomal shield short, almost straight in *R. evidus*); short solenidion *ω* of palptarsus, not reaching the anterior margin of palptarsus (vs. solenidion *ω* long, reaching the anterior margin of

palptarsus in *R. evidus*); and distinctly longer dorsal idiosomal setae.

Raphignathus fani Doğan and Ayyildiz, 2003

Raphignathus fani Doğan and Ayyildiz, 2003, 142 (Figs. 13–17)

Description. *Female* (Figs. 13–15). Body ovate. Length of idiosoma 346–455, maximum width 240–320.

Idiosomal dorsum (Fig. 13A). Dorsal shields punctate, central shield weakly striated medially; central shield with three pairs of setae (*vi*, *ve*, *c1*), its posterior margin more or less V-shaped; lateral shields large, with three pairs of setae (*sci*, *sce*, *c2*), one pair of ocelli and weakly developed postocular bodies; opisthosomal shield with five pairs of setae (*e*, *f*, *h1*, *h2*, *h3*); one pair of setae *d* located on tiny platelets between central and opisthosomal shields; without a pair of small plates posteromesad lateral shields; lateral edges of opisthosomal shield bent to ventral side. Cupules *ia* situated near posterior margin of lateral shields; cupules *im* situated on soft cuticle anterolaterad setae *e*; cupules *ip* situated laterad setae *f*. Setae *h2*, *h3*, and *ps1–3* blunt-tipped, other idiosomal setae pointed; setae *ps1–3* weakly serrate, other idiosomal setae smooth. Lengths of idiosomal setae: *vi* 25–38, *ve* 23–33, *sci* 27–39, *sce* 24–34, *c1* 20–29, *c2* 23–33, *d* 21–29, *e* 19–29, *f* 21–34, *h1* 21–35, *h2* 24–33, *h3* 26–35, *ps1* 22–26, *ps2* 21–28, *ps3* 20–26.

Idiosomal venter (Fig. 13B). Coxisternal plates I–IV finely punctate; endopodal plates associated

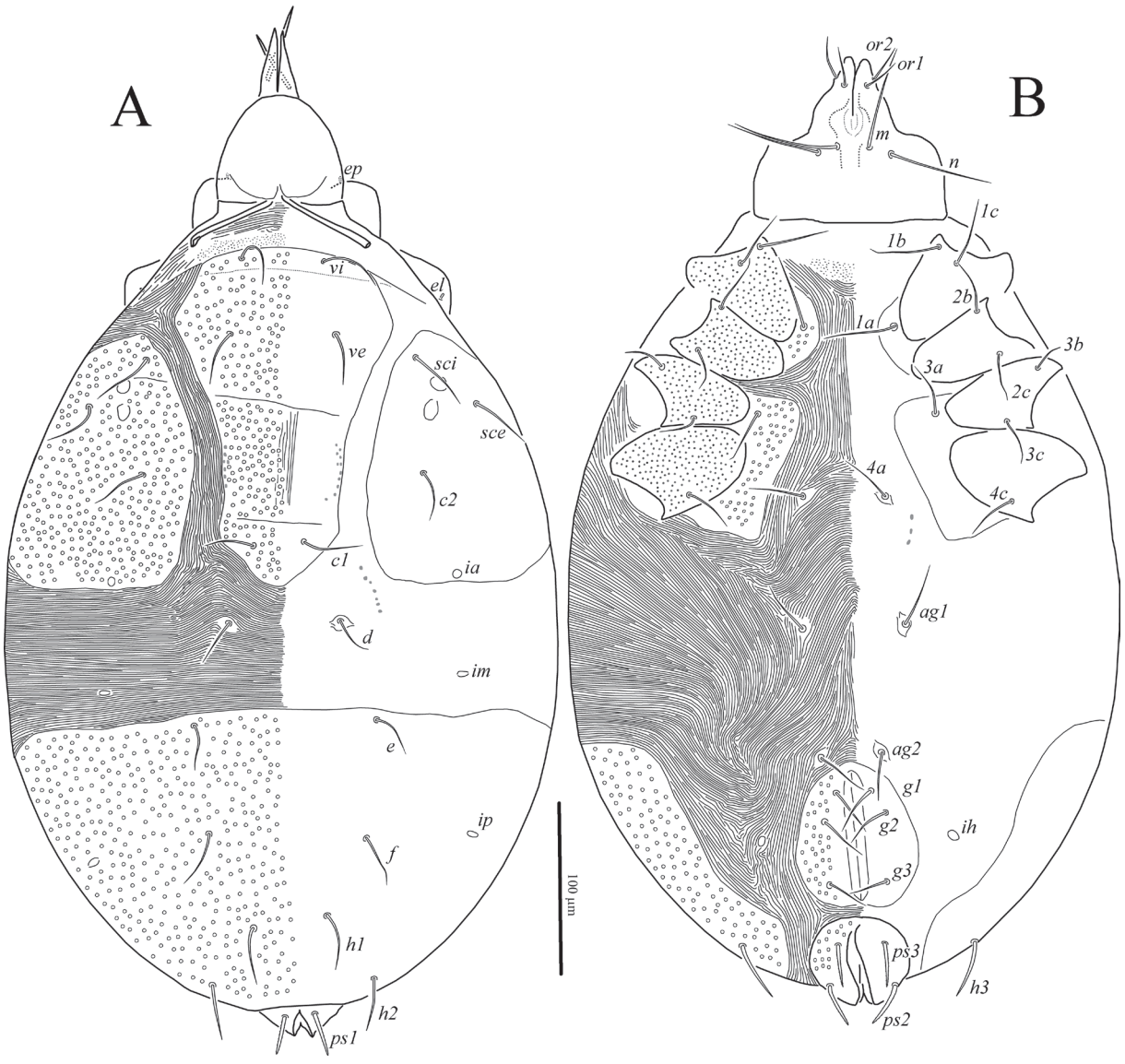

Fig. 13. *Raphignathus fani* Doğan and Ayyildiz, 2003, female: A—dorsum of body; B—venter of body. Legs omitted.

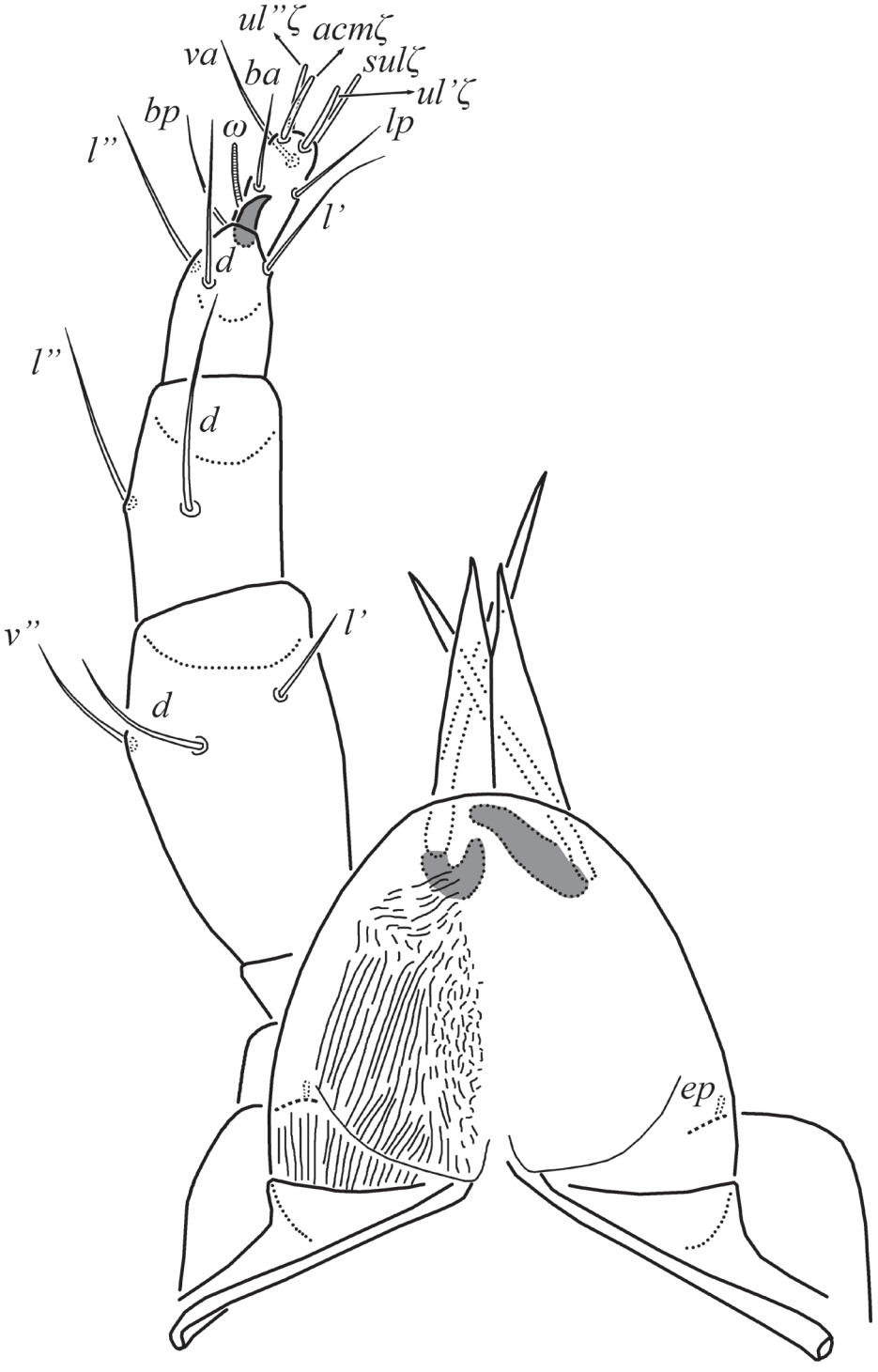

Fig. 14. *Raphignathus fani* Doğan and Ayyildiz, 2003, female: gnathosoma, dorsal aspect.

with coxisternal plates I–II and III–IV and punctate; genital plates punctate. Coxisternal formula: 2(*1b*, *1c*)–1(*2c*)–2(*3b*, *3c*)–1(*4c*); setae *1a* and *3a* situated on endopodal plates; setae *4a*, *ag1* and *ag2* situated on soft striated cuticle; three pairs of genital setae located on genital plates. All ventral setae thin, smooth and pointed, except weakly blunt-tipped *3b*. Cupules *ih* situated laterad setae *g2* on soft cuticle.

Gnathosoma (Fig. 14). Number of setae on palpal segments: Tr 0, Fe 3 (*d*, *l'*, *v''*), Ge 2 (*d*, *l''*), Ti 3 (*d*, *l'*, *l''*), Ta 8(1) (4 eupathidia *ul'ζ*, *ul''ζ*, *sulζ*,

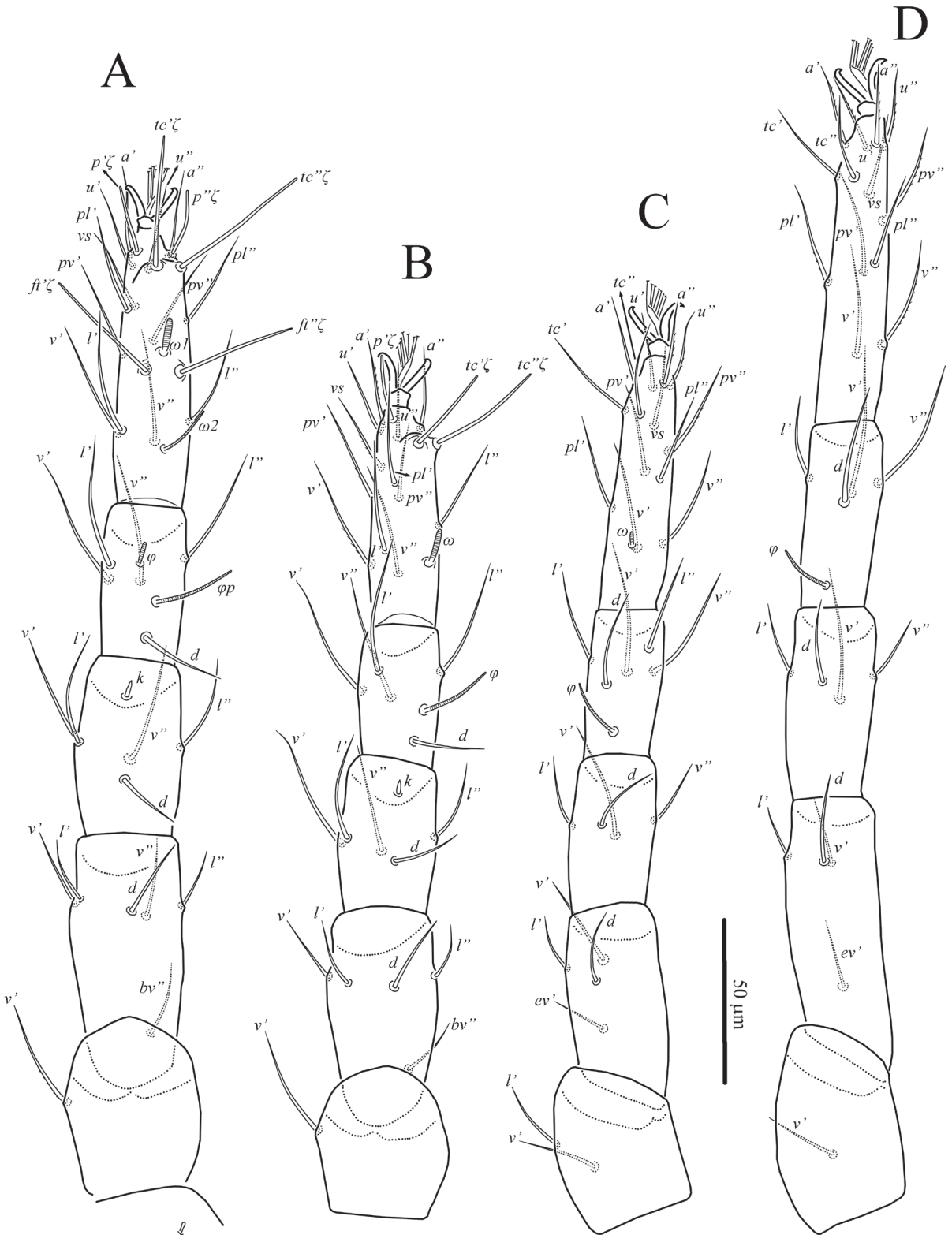

Fig. 15. *Raphignathus fani* Doğan and Ayyildiz, 2003, female: A–D—left legs I–IV, respectively, dorsal aspect.

acmς, 3 simple setae *ba*, *bp*, *lp*, and 1 solenidion *ω*); tarsal eupathidia smooth and blunt-tipped, other palpal setae pointed and smooth. Palpal supracoxal setae (*ep*) short, peg like, situated under lateral parts of stylophore. Central part of stylophore with tangled striae. Rostrum of subcapitulum relatively long; all subcapitular setae pointed and smooth. Subcapitulum punctate. Length of cheli-

ceral stylets 61–63; length of palps 120–140; length of palpal solenidion *ω* 9–10.

Legs (Fig. 15). Length of legs: I 240–290, II 195–245, III 195–275, IV 245–345. Leg I (Fig. 15A). Coxae I posterodorsally with short peg-like leg supracoxal setae (*el*). Leg setation: Tr 1 (*v'*), Fe 6 (*d*, *l'*, *l''*, *v'*, *v''*, *bv''*), Ge 6 (*d*, *l'*, *l''*, *v'*, *v''*, *k*), Ti 5(2) (*d*, *l'*, *l''*, *v'*, *v''*, *φ*, *φp*), Ta 19(2) (*p'ζ*, *p''ζ*, *tc'ζ*, *tc''ζ*, *ft'ζ*, *ft''ζ*, *pl'*, *pl''*, *u'*, *u''*, *a'*, *a''*, *vs*, *pv'*, *pv''*, *v'*, *v''*, *l'*, *l''*, *ω1*, *ω2*). Setae (*p*), (*tc*) and (*ft*) of tarsus smooth and blunt-tipped, eupathid-like; seta *k* of genu short, rod-like; other setae smooth and pointed. Solenidion *ω1* 10–11 digitiform; solenidia *ω2* 20–21 and *φp* 23–25 uniformly thin with rounded tip; solenidion *φ* 7 baculiform. Leg II (Fig. 15B). Leg setation: Tr 1 (*v'*), Fe 5 (*d*, *l'*, *l''*, *v'*, *bv''*), Ge 6 (*d*, *l'*, *l''*, *v'*, *v''*, *k*), Ti 5(1) (*d*, *l'*, *l''*, *v'*, *v''*, *φ*), Ta 15(1) (*p'ζ*, *tc'ζ*, *tc''ζ*, *u'*, *u''*, *a'*, *a''*, *pl'*, *vs*, *pv'*, *pv''*, *v'*, *v''*, *l'*, *l''*, *ω*). Setae *p'* and (*tc*) of tarsus smooth, blunt-tipped, eupathid-like; seta *k* of genu rod-like; other setae pointed; at least setae *a'*, *u'*, *vs*, *pv'*, and *v'* barbed,

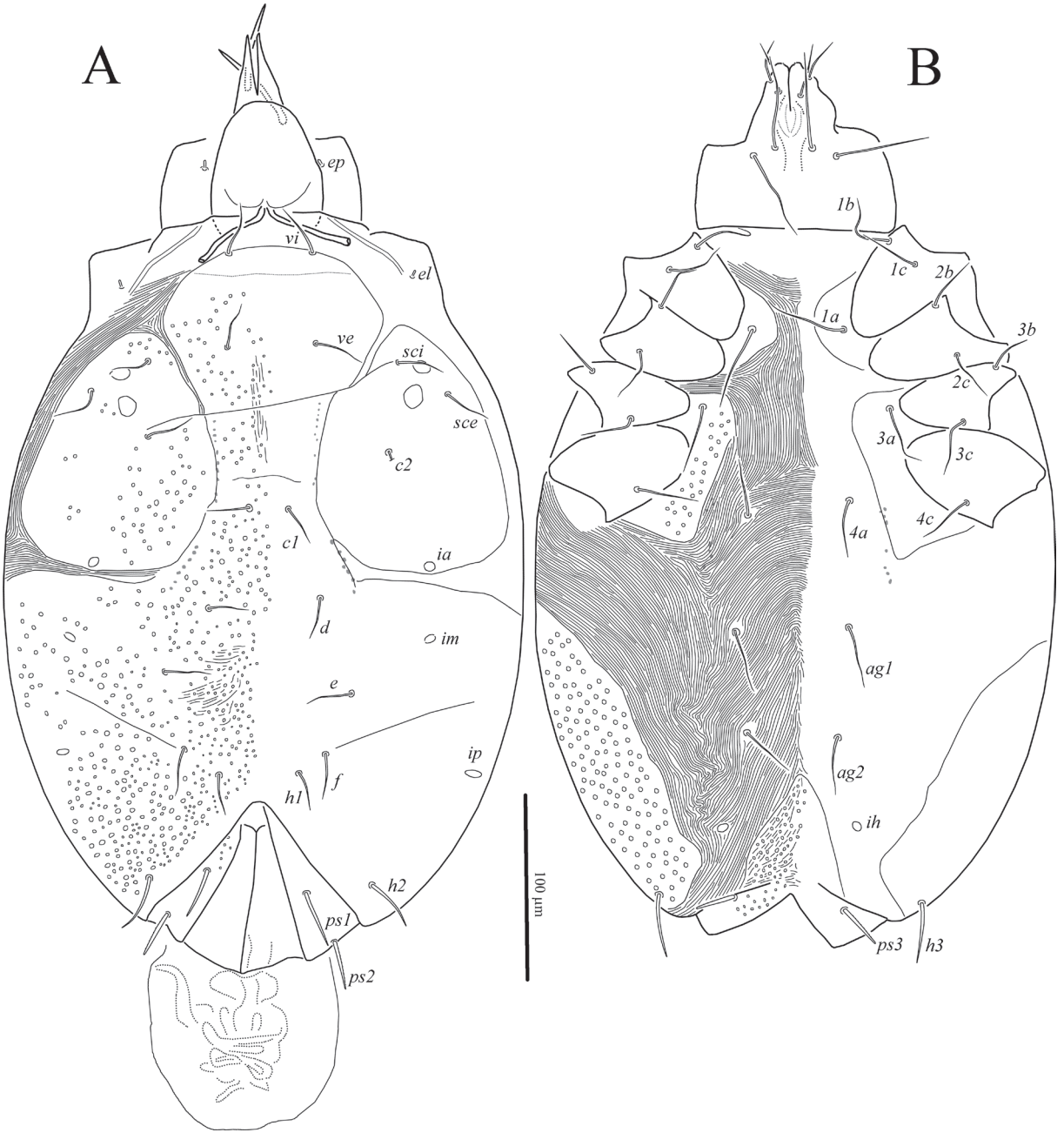

Fig. 16. *Raphignathus fani* Doğan and Ayyildiz, 2003, male: A—dorsum of body; B—venter of body. Legs omitted.

other setae smooth. Solenidion *ω* 8–10 digitiform; solenidion *φ* 17–23 uniformly thin with rounded tip. Leg III (Fig. 15C). Leg setation: Tr 2 (*l'*, *v'*), Fe 4 (*d*, *l'*, *v'*, *ev'*), Ge 4 (*d*, *l'*, *v'*, *v"*), Ti 5(1) (*d*, *l'*, *l"*, *v'*, *v"*, *φ*), Ta 13(1) (*tc'*, *tc"*, *pl'*, *pl"*, *u'*, *u"*, *a'*, *a"*, *vs*, *pv'*, *pv"*, *v'*, *v"*, *ω*). Solenidion *ω* 3–4 peg-like; solenidion *φ* 15–17 uniformly thin with rounded tip. All setae pointed; at least setae *a"*, *u"*, and *pv"* barbed, other setae smooth. Leg IV (Fig. 15D). Leg setation: Tr 1 (*v'*), Fe 4 (*d*, *l'*, *v'*, *ev'*), Ge 4 (*d*, *l'*, *v'*, *v"*), Ti 4(1) (*d*, *l'*, *v'*, *v"*, *φp*), Ta 13 (*tc'*, *tc"*, *pl'*, *pl"*, *u'*, *u"*, *a'*, *a"*, *vs*, *pv'*, *pv"*, *v'*, *v"*). Solenidion *ω* absent; solenidion *φ* 15–17 uniformly thin with rounded tip. All setae pointed; at least setae (*a*), (*u*), *pv"*, *v"*, and *pl'* barbed, other setae smooth.

Male (Figs. 16, 17). Length of idiosoma 385–420, width 270–280.

Idiosomal dorsum (Fig. 16A). Idiosoma almost completely covered by dorsal shields; central and opisthosomal shields fused; lateral shields separated from central shield by weak striae. Shape of idiosomal setae as in female. Lengths of dorsal setae: *vi* 27, *ve* 32, *sci* 31, *sce* 30, *c1* 17, *c2* 29, *d* 18, *e* 18, *f* 24, *h1* 21, *h2* 34, *h3* 30, *ps1* 23, *ps2* 25, *ps3* 23.

Idiosomal venter (Fig. 16B). Genital opening and all genital setae absent; setae *ag2* present.

Gnathosoma as in female. Length of cheliceral stylets 47; length of palp 100; length of palpal solenidion *ω* 7.

Legs (Fig. 17). Setation of legs as in female, except distinctly longer solenidia on tarsi I–III and presence of solenidion ω on tarsus IV (Fig. 17A–D). Lengths of legs: I 295–300, II 255–265, III 275–280, IV 330–335. Lengths of solenidia: *ω1*I 23–26, *ω2*I 20–22, *φ* 5–7, *φp*I 25–28, *ω*II 22–27, *φ*II 24–26, *ω*III 24, *φ*III 19–20, *ω*IV 25–29, *φ*IV 18–19.

Immatures unknown.

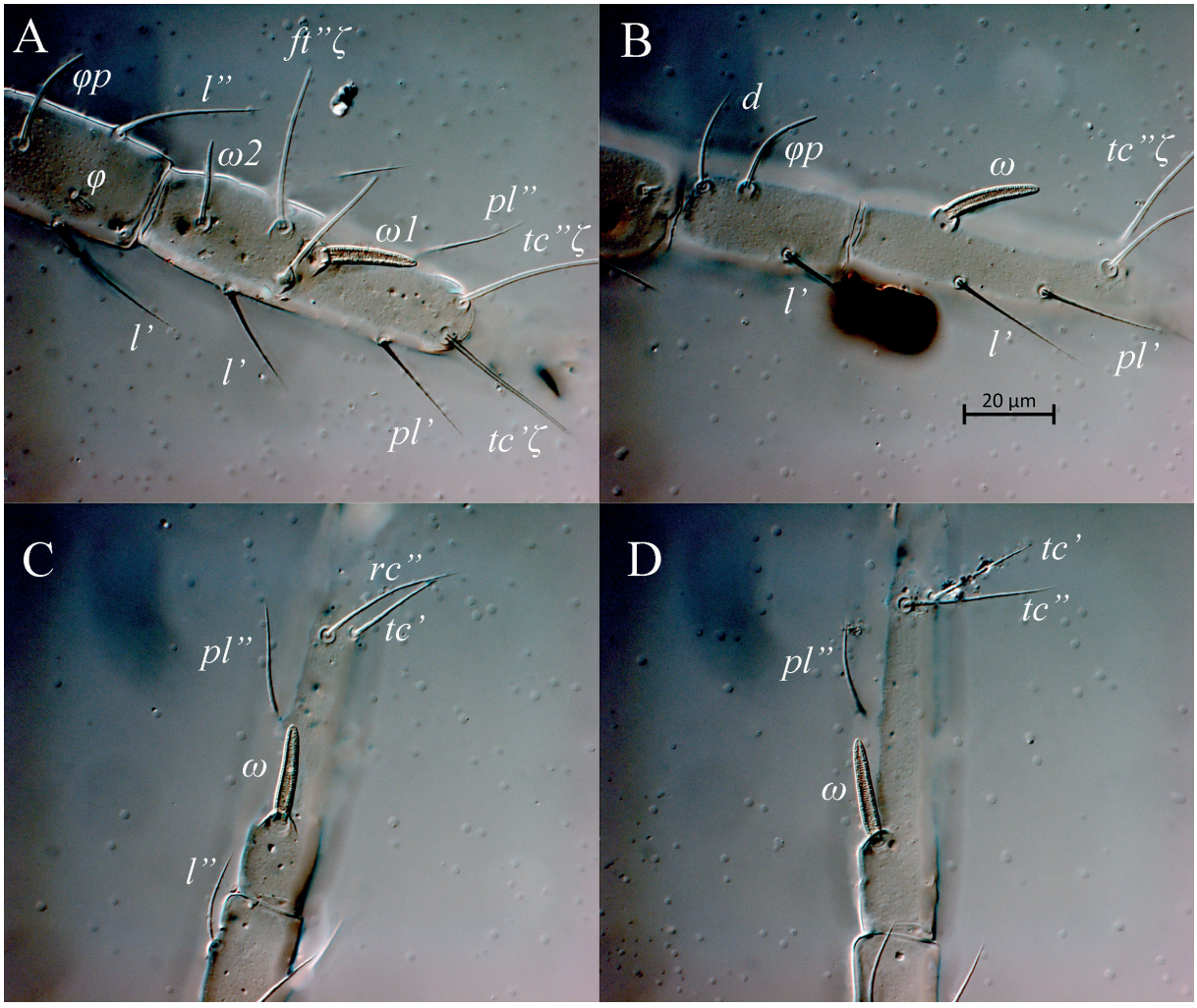

Fig. 17. DIC micrographs of *Raphignathus fani* Doğan and Ayyildiz, 2003, male: A–D—tarsi I–IV, respectively.

Material examined. One female, 1 male, Russia, Yamalo-Nenetskiy Avtonomnyy Okrug, Nadymskiy Rayon, 65°34′40.0″N 73°10′41.3″E, in lichens on ground, 16 July 2022, collected by A.A. Khaustov; 3 females, Russia, Novosibirskaya Oblast, Karasukskiy Rayon, 53°36′14.4″N 78°05′52.9″E, in sod, 8 June 2022, collected by A.A. Khaustov; 2 females, 1 male, Russia, the Respublika Altay, Ulaganskiy Rayon, 50°19′34.4″N 87°44′12.5″E, 2,580 m a.s.l., in sod, 13 July 2020, collected by A.A. Khaustov.

Remarks. Doğan and Ayyildiz (2003) described this species from sod in Erzurum, Turkey. Dönel and Doğan (2011) redescribed a female and described a male of *R. fani* from Turkey as well.

This is the first record of *R. fani* from Russia.

Raphignathus ozkani **Doğan, 2006**

Raphignathus ozkani Doğan, 2006, 373
(Figs. 18–20)

Description. *Female* (Figs. 18–20). Body ovate. Length of idiosoma 355–445, maximum width 230–330.

Idiosomal dorsum (Fig. 18A). Dorsal shields relatively small, major part of idiosoma striated. Dorsal shields punctate, central shield weakly striated medially; central shield with three pairs of setae (*vi*, *ve*, *c1*), its posterior margin more or less U-shaped; lateral shields narrow, with three pairs of setae (*sci*, *sce*, *c2*), one pair of ocelli and weakly developed postocular bodies; opisthosomal shield with three pairs of setae (*h1*, *h2*, *h3*); three pairs of setae (*d*, *e*, *f*) located on tiny plate-

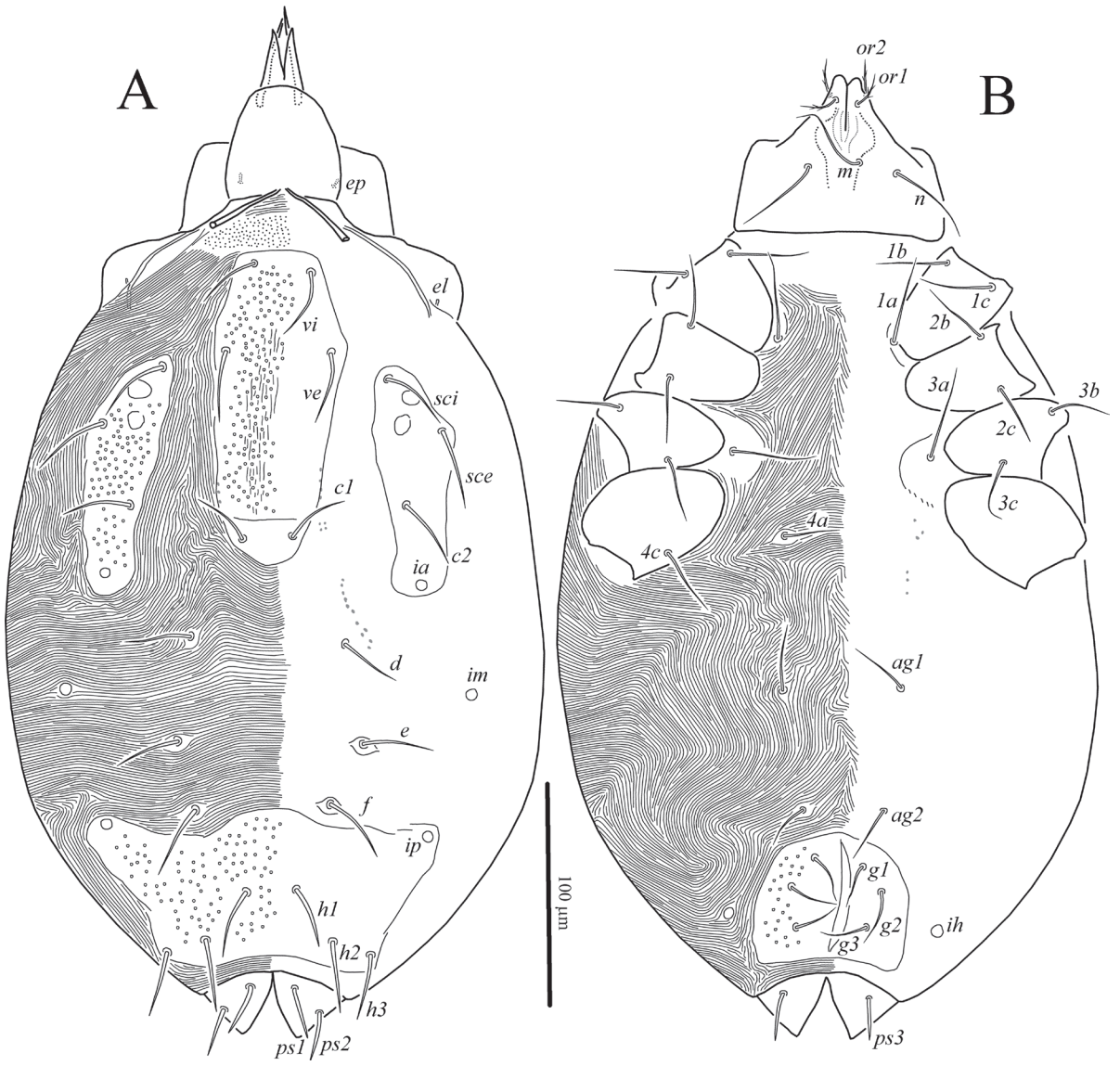

Fig. 18. *Raphignathus ozkani* Doğan, 2006, female: A—dorsum of body; B—venter of body. Legs omitted.

lets between central and opisthosomal shields; without a pair of small plates posteromesad lateral shields; lateral edges of opisthosomal shield not bent to ventral side. Cupules *ia* situated near posterior margin of lateral shields; cupules *im* situated on soft cuticle anterolaterad setae *e*; cupules *ip* situated in anterolateral corners of opisthosomal shield. Setae *h1*, *h2*, *h3* and *ps1–3* weakly blunt-tipped, other idiosomal setae pointed; all idiosomal setae smooth. Lengths of idiosomal setae: *vi* 32–36, *ve* 32–36, *sci* 33–37, *sce* 33–38, *c1* 26–30, *c2* 29–35, *d* 27–29, *e* 31–33, *f* 32–34, *h1* 31–32, *h2* 32–35, *h3* 30–35, *ps1* 24–26, *ps2* 24–25, *ps3* 22–24.

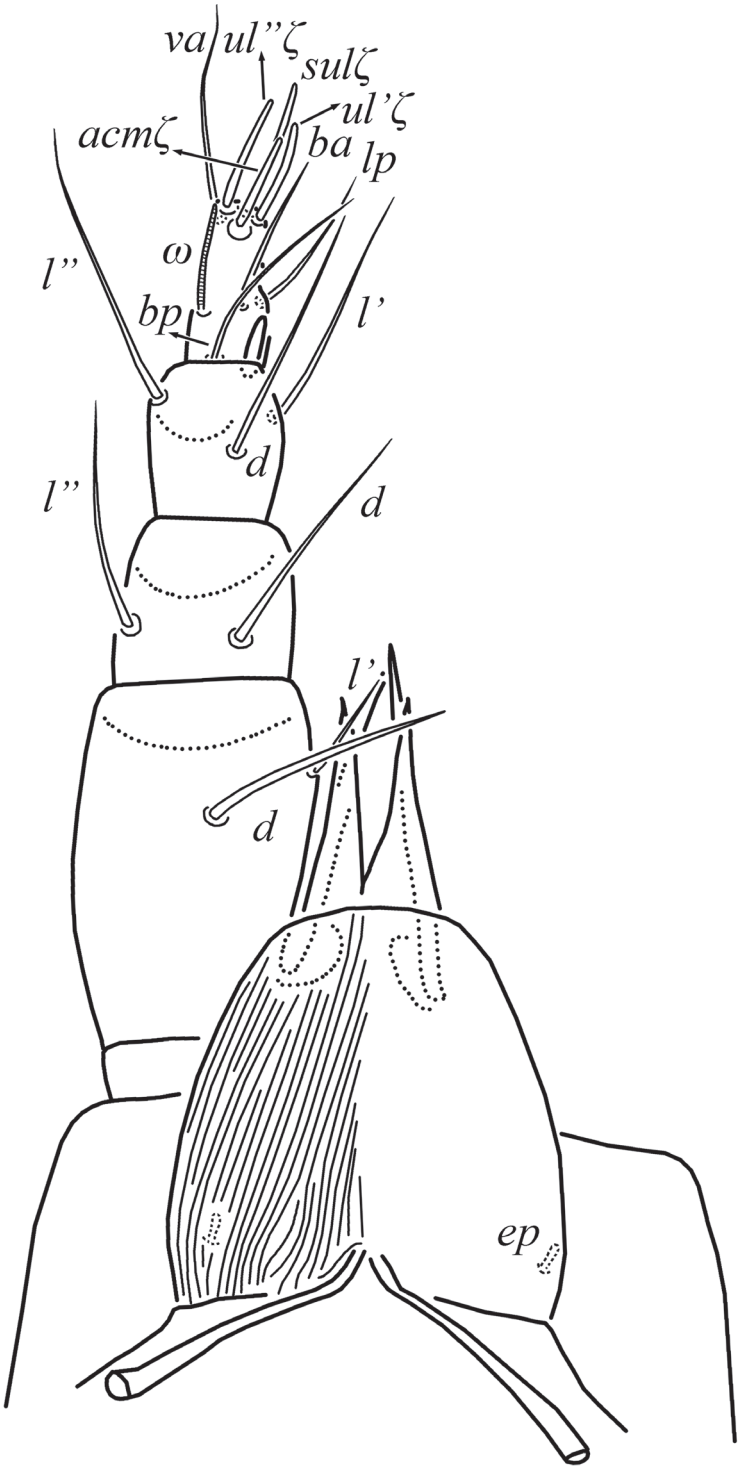

Fig. 19. *Raphignathus ozkani* Doğan, 2006, 2003, female: gnathosoma, dorsal aspect.

Idiosomal venter (Fig. 18B). Coxisternal plates I–IV finely punctate; endopodal plates poorly developed, smooth and associated with coxisternal plates I–II and III–IV; genital plates punctate. Coxisternal formula: 2(*1b*, *1c*)–1(*2c*)–2(*3b*, *3c*)–1(*4c*); setae *1a* and *3a* situated on endopodal plates; setae *4a*, *ag1*, and *ag2* situated on soft striated cuticle; three pairs of genital setae located on gen-

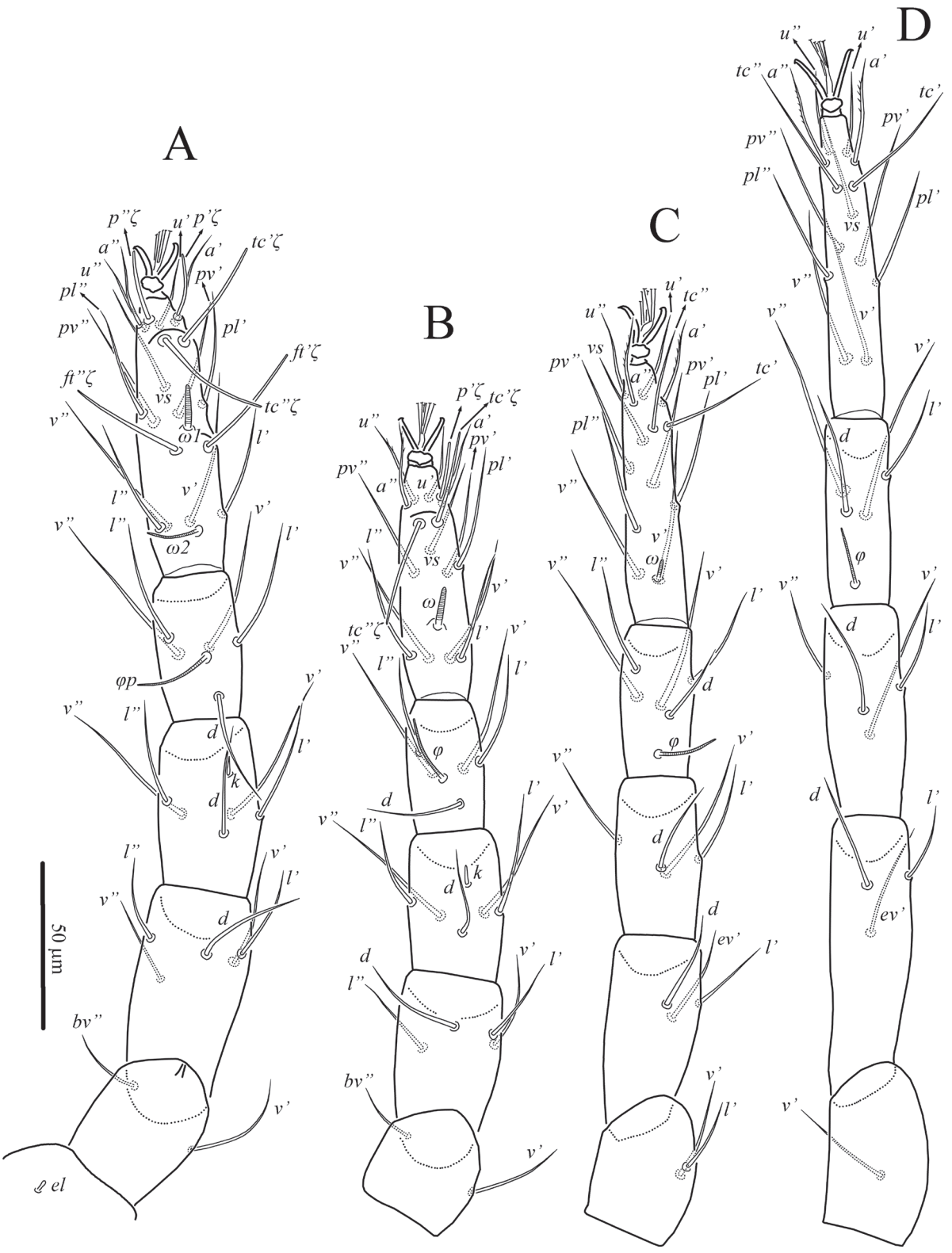

Fig. 20. *Raphignathus ozkani* Doğan, 2006, female: A–D—left legs I–IV, respectively, dorsal aspect.

ital plates. All ventral setae thin, smooth and pointed. Cupules *ih* situated laterad setae *g3* on soft cuticle.

Gnathosoma (Fig. 19). Number of setae on palpal segments: Tr 0, Fe 2 (*d*, *l''*), Ge 2 (*d*, *l''*), Ti 3 (*d*, *l'*, *l''*), Ta 8(1) (4 eupathidia *ul'ζ*, *ul''ζ*, *sulζ*, *acmζ*, 3 simple setae *ba*, *bp*, *lp*, and 1 solenidion *ω*); tarsal eupathidia smooth and blunt-tipped, other palpal setae pointed and smooth. Palpal supracoxal setae (*ep*) short, peg like, situated under lateral parts of stylophore. Stylophore with longitudinal striae. Rostrum of subcapitulum relatively long; all subcapitular setae pointed; setae *or1* and *or2* with long barbs, other setae smooth. Subcapitulum weakly punctate. Length of cheliceral stylets 32–43; length of palps 110–120; length of palpal solenidion *ω* 14–15.

Legs (Fig. 20). Length of legs: I 270–280, II 230–245, III 265–275, IV 325–345. Leg I (Fig. 20A). Coxae I posterodorsally with short peg-like leg supracoxal setae (*el*). Leg setation: Tr 1 (*v'*), Fe 6 (*d*, *l'*, *l''*, *v'*, *v''*, *bv''*), Ge 6 (*d*, *l'*, *l''*, *v'*, *v''*, *k*), Ti 5(1) (*d*, *l'*, *l''*, *v'*, *v''*, *φp*), Ta 19(2) (*p'ζ*, *p''ζ*, *tc'ζ*, *tc''ζ*, *ft'ζ*, *ft''ζ*, *pl'*, *pl''*, *u'*, *u''*, *a'*, *a''*, *vs*, *pv'*, *pv''*, *v'*, *v''*, *l'*, *l''*, *ω1*, *ω2*). Setae (*p*), (*tc*) and (*ft*) of tarsus smooth and blunt-tipped, eupathid-like; seta *k* of genu short, rod-like; other setae smooth and pointed. Solenidion *ω1* 12–13 digitiform; solenidia *ω2* 17–16 and *φp* 23–24 uniformly thin with rounded tip. Leg II (Fig. 20B). Leg setation: Tr 1 (*v'*), Fe 5 (*d*, *l'*, *l''*, *v'*, *bv''*), Ge 6 (*d*, *l'*, *l''*, *v'*, *v''*, *k*), Ti 5(1) (*d*, *l'*, *l''*, *v'*, *v''*, *φ*), Ta 15(1) (*p'ζ*, *tc'ζ*, *tc''ζ*, *u'*, *u''*, *a'*, *a''*, *pl'*, *vs*, *pv'*, *pv''*, *v'*, *v''*, *l'*, *l''*, *ω*). Setae *p'* and (*tc*) of tarsus smooth, blunt-tipped, eupathid-like; seta *k* of genu rod-like; other setae pointed; at least setae *a''* and *u''* barbed, other setae smooth. Solenidion *ω* 11–12 digitiform; solenidion *φ* 20–21 uniformly thin with rounded tip. Leg III (Fig. 20C). Leg setation: Tr 2 (*l'*, *v'*), Fe 3 (*d*, *l'*, *ev'*), Ge 4 (*d*, *l'*, *v'*, *v''*), Ti 5(1) (*d*, *l'*, *l''*, *v'*, *v''*, *φ*), Ta 13(1) (*tc'*, *tc''*, *pl'*, *pl''*, *u'*, *u''*, *a'*, *a''*, *vs*, *pv'*, *pv''*, *v'*, *v''*, *ω*). Solenidion *ω* 6–7 baculiform; solenidion *φ* 16–17 uniformly thin with rounded tip. All setae pointed; at least setae (*a*) barbed, other setae smooth. Leg IV (Fig. 20D). Leg setation: Tr 1 (*v'*), Fe 3 (*d*, *l'*, *ev'*), Ge 4 (*d*, *l'*, *v'*, *v''*), Ti 4(1) (*d*, *l'*, *v'*, *v''*, *φp*), Ta 13 (*tc'*, *tc''*, *pl'*, *pl''*, *u'*, *u''*, *a'*, *a''*, *vs*, *pv'*, *pv''*, *v'*, *v''*). Solenidion *ω* absent; solenidion *φ* 17–19 uniformly thin with rounded tip. All setae pointed; at least setae (*a*) barbed, other setae smooth.

Male and *immatures* unknown.

Material examined. One female, 1 male, Russia, the Respublika Altay, 50°42′49.5″N 84°56′56.5″E, 1,225 m a.s.l., moss in spruce forest, 12 June 2022, collected by A.A. Khaustov; 3 females, same locality, on bark of *Picea obovata*.

Remarks. This species was described from Turkey (Doğan 2006).

This is the first record of *R. ozkani* from Russia.

Raphignathus gracilis (Rack, 1962)

Acheles gracilis Rack, 1962, 281
Raphignathus gracilis: Atyeo 1963, 181

This species widely distributed in the Holarctic. It was recorded from Algeria, China, Egypt, Estonia, Germany, Hungary, Iran, Israel, Italy, Japan, Latvia, New Zealand, Poland, Slovakia, South Africa, Turkey, Ukraine, USA and Russia (Kuznetsov and Petrov 1984; Beron 2020). This species was redescribed several times from different countries (Atyeo 1963; Kuznetsov 1976; Fan and Zhang 2005).

This is the first record of *R. gracilis* from Asian Russia.

Material examined. 12 females, Russia, city of Tyumen, 57°10′21.4″N 65°36′25.5″E, in sod, 2 April 2023, collected by A.A. Khaustov; 3 females, Russia, Omskaya Oblast, Nazyvayevsky Rayon, 55°33′06.0″N 70°42′51.0″E, in sod, 26 August 2021, collected by A.A. Khaustov; 1 female, Russia, Kurganskaya Oblast, Zverinogolovsky Rayon, 54°24′31.6″N 64°49′00.3″E, in a nest of *Formica rufa*, 20 September 2019, collected by A.A. Khaustov.

Key to adult females of *Raphignathus* of Russia (based on females)

1. Tibia I with two solenidia (*φ*, *φp*) 2
— Tibia I with one solenidion (*φp*) 3
2. With a pair of small plates posterolaterad central idiosomal shield ..... *R. collegiatus*
— Without a pair of small plates posterolaterad central idiosomal shield ..... *R. fani*
3. Interscutal cuticle between central and opisthosomal shields with one pair of setae 4
— Interscutal cuticle between central and opisthosomal shields with more than one pair of setae ... 6
4. Posterior margin of central idiosomal shield with incision; solenidion on tarsus IV absent .... *R. ueckermanni*
— Posterior margin of central idiosomal shield without incision; solenidion on tarsus IV present 5

5. Dorsal idiosomal setae distinctly thickened, lanceolate, weakly barbed in distal half .... *R. kuznetsovi*
— Dorsal idiosomal setae narrow, smooth .... *R. sakhalinensis* sp.n.
6. Interscutal cuticle between central and opisthosomal shields with two pairs of setae 7
— Interscutal cuticle between central and opisthosomal shields with more than two pairs of setae ... 9
7. Palpfemur with two pairs of setae 8
— Palpfemur with three pairs of setae ... *R. scutatus*
8. With a pair of small plates posterolaterad central idiosomal shield ..... *R. hecmatanaensis*
— Without a pair of small plates posterolaterad central idiosomal shield ..... *R. gracilis*
9. Opisthosomal shield well developed, with three pairs of setae; cupules *ip* situated on opisthosomal shield ..... *R. ozkani*
— Opisthosomal shield strongly reduced, with two pairs of setae; cupules *ip* situated on soft cuticle .. .. *R. longipes* sp.n.

ACKNOWLEDGEMENTS

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