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Three new species and new records of *Pediculaster* (Acari: Pygmephoridae) from Western Siberia, Russia

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Original research

ABSTRACT

Three new species of *Pediculaster*: *P. tjumeniensis* **sp. nov.**, *P. bisetus* **sp. nov.**, and *P. rarus* **sp. nov.** are described from rotting wood in Western Siberia. *P. tjumeniensis* is described based on phoretic and non-phoretic females and larva; *P. bisetus* and *P. rarus* are described based on phoretic females only. *Pediculaster camerikae* Khaustov, 2008, *P. montanus* Khaustov, 2008, and *P. dudinskyi* Khaustov, 2011 are recorded for the first time from Asia, the latter species is also recorded for the first time from Russia. Unusual character states of *P. tjumeniensis* larva are discussed.

Keywords Pygmephoroidea; systematics; morphology; female dimorphism; larva; fauna
Zoobank http://zoobank.org/D86736C3-28A9-427D-B243-41BF5C93465A

Introduction

The genus *Pediculaster* Vitzthum, 1931 (Acari: Pygmephoroidea) is one of the largest in the family Pygmephoridae and comprises more than 100 described species in the world fauna (Khaustov *et al.* 2014; Khaustov 2015). *Pediculaster*-mites are fungivorous and inhabit a great variety of habitats, e.g. soil, litter, mosses, dung, nest material, decaying organic material (Camerik and Kheradmand 2010). Several species are considered as pests of mushrooms in commercial mushroom-houses (Cross and Kaliszewski 1988). Mites of the genus *Pediculaster* are characterized by the presence of two morphologically different forms of females: non-phoretic or "normal" and phoretic (Camerik *et al.* 2006; Martin 1978). Most *Pediculaster* species are phoretic on various Diptera, especially associated with cattle dung (Camerik 2010). Little is known about *Pediculaster* mites inhabiting rotting wood and forest litter. Only few species were described from rotting wood: *P. fusarii* (Smiley and Moser, 1976) collected from the galleries of bark beetles from USA (Smiley and Moser 1976), *P. dudinskyi* Khaustov, 2011 collected from a tree hole from Ukraine (Khaustov 2011), *P. ermilovi* Khaustov, 2015 and *P. lignarius* Khaustov, 2015 collected from rotting wood in Western Siberia (Khaustov, 2015). Khaustov (2015) reviewed mites of the genus *Pediculaster* of Russia and provided the key to phoretic females of Palaearctic species. Only two species, *P. ermilovi* and *P. lignarius* have been described and recorded from Western Siberia so far.

During the study of heterostigmatic mites of Western Siberia, three new species of *Pediculaster* were found in the samples of rotting wood. Moreover, three species, *P. dudinskyi* Khaustov, 2011, *P. camerikae* Khaustov, 2008b, and *P. montanus* Khaustov, 2008b were recorded from the Asia for the first time.

Materials and methods

Mites were collected from samples taken from decaying trees and cow dung, using Berlese funnels. They were posteriorly cleared in lactic acid and mounted in Hoyer's medium. The

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terminology for the idiosoma and legs follows that of Lindquist (1986); the nomenclature of subcapitular setae and the designation of cheliceral setae follow those of Grandjean (1944, 1947), respectively. The systematics of Pygmephoroidea follows that of Khaustov (2004, 2008a). All measurements are given in micrometers (μm) for the holotype and paratypes (in parentheses). For leg chaetotaxy, the number of solenidia is given in parentheses. Mite morphology was studied using a Carl Zeiss AxioImager A2 compound microscope with phase contrast and DIC illumination. Photomicrographs were taken with Hitachi KP-HD20A digital camera.

Abbreviations: **ap1-ap5** apodemes 1-5, **appr** prosternal apodeme, **appo** poststernal apodeme, **apsej** sejugal apodeme, **Tr** trochanter, **Fe** femur, **Ge** genu, **Ti** tibia, **Ta** tarsus, **TiTa** tibiotarsus, **ass** accessory setigenous structure, **sol** solenidion, **ags** anterior genital sclerite, **pgs** posterior genital sclerite, **mgs** median genital sclerite, **php 1-3** pharyngeal pumps 1-3.

Systematics

Family Pygmephoridae Cross, 1965

Genus *Pediculaster* Vitzthum, 1931

Type species: *Pygmephorus mesembrinae* Canestrini, 1881, by original designation.

Pediculaster tjumeniensis sp. nov.

Zoobank: 9C126801-3491-4277-8757-9C9AE42FB5BD

(Figs 1–9A)

Description

Phoretic female (Figs 1–3, 9A) — Length of idiosoma 265 (200–305), width 140 (105–160).

Gnathosoma (Figs 1, 9A) – Length of gnathosomal capsule 26 (23–27), width 29 (28–32). Dorsal median apodeme weakly developed. All gnathosomal setae pointed; setae *cha*, *chb* and *dFe* with few very small barbs, other gnathosomal setae smooth. Palp tibiotarsus with well-developed blunt-tipped claw and tiny eupathid-like seta; palps ventrally with well-developed solenidion and mushroom-shaped accessory setigenous structure. Php 1 small, bow-shaped, located inside gnathosomal capsule; php 2 and 3 oval (Fig. 9A), situated close to each other on long oesophagus and far separated from php 1. Lengths of gnathosomal setae: *cha* 10 (8–12), *chb* 14 (10–15), *dFe* 13 (9–13), *dGe* 18 (12–18), *m* 16 (11–16).

Idiosomal dorsum (Fig. 1A) – All dorsal shields with numerous small round dimples. Stigmata small, oval, one-chambered and associated with long tracheal trunks. All dorsal setae blunt-ended and barbed; trichobothria sc_1 short, spherical. Cupules *ia* on tergite D and *ih* on tergite H very small, round. Lengths of dorsal setae: v_1 29 (22–29), v_2 30 (25–32), sc_2 57 (43–58), c_1 40 (29–40), c_2 48 (35–52), *d* 43 (32–45), *e* 24 (17–24), *f* 45 (30–45), h_1 37 (27–38), h_2 14 (10–16). Distances between setae: v_1–v_1 10 (10–12), v_2–v_2 31 (26–32), sc_2–sc_2 46 (41–53), c_1–c_1 44 (33–49), c_1–c_2 30 (21–34), *d*–*d* 73 (52–78), *e*–*f* 21 (15–23), *f*–*f* 45 (32–51), h_1–h_1 51 (34–52), h_1–h_2 18 (14–19).

Idiosomal venter (Fig. 1B) – Ventral plates with numerous small round dimples. Setae 1*b* and 2*a* pointed; other ventral setae blunt-ended; setae ps_1 and ps_3 smooth, over ventral setae weakly barbed; setae 2*a* much longer than other ventral setae; in one specimen left seta 2*c* abnormally long and pointed. Ap1, ap2 and apsej well developed and joined with appr; ap3 and ap4 well developed and joined with appo; ap5 weaker sclerotized than other apodemes and joined with appo. Posterior margin of poststernal plate evenly rounded, without median lobe. Anterior and posterior genital sclerites long and narrow; median genital sclerite small, oval. Lengths of ventral setae: 1*a* 19 (15–19), 1*b* 26 (18–29), 1*c* 17 (14–17), 2*a* 43 (38–48), 2*b* 18 (4–19), 2*c* 16/20 (14–17), 3*a* 18 (14–20), 3*b* 16 (13–17), 3*c* 19 (14–21), 4*a* 16 (12–17), 4*b* 19 (15–22), 4*c* 18 (13–20), ps_1 8 (5–8), ps_2 26 (17–27), ps_3 7 (4–9).

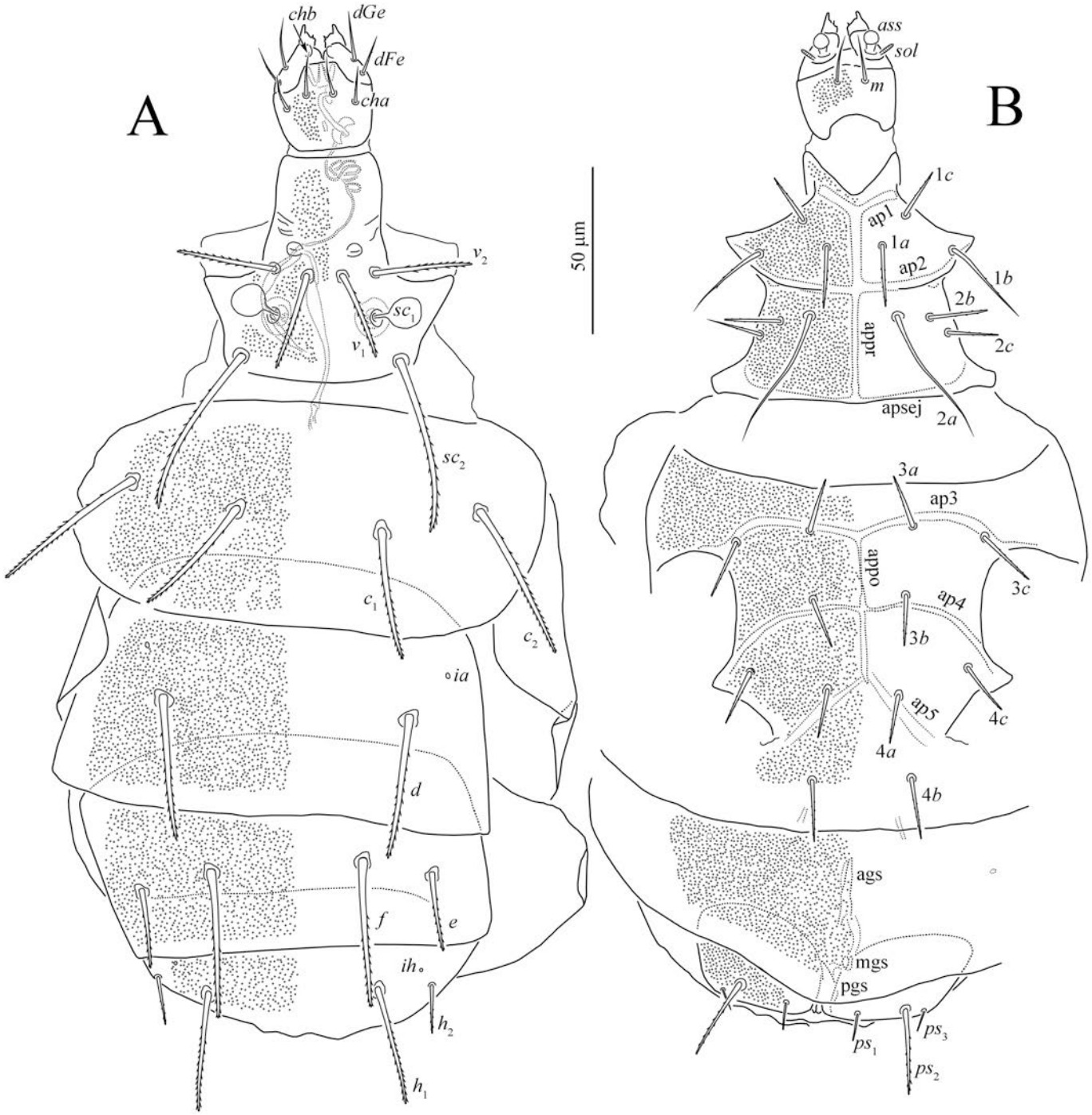


Figure 1 *Pediculaster tjumeniensis* **sp. nov.**, phoretic female: A – dorsum of the body, B – venter of the body. Legs omitted.

Legs (Figs 2, 3) – Leg I (Fig. 2A). Leg setation: Tr 1 (*v'*), Fe 4 (*d*, *l'*, *l''*, *v''*), Ge 4 (*l'*, *l''*, *v'*, *v''*), TiTa 17(4) (*d*, *l'*, *l''*, *v'*, *v''*, *k*, *pl'*, *pl''*, *p'*, *p''*, *tc'*, *tc''*, *ft'*, *ft''*, *s*, *pv'*, *pv''*, ω_1, ω_2, φ_1, φ_2). Tibiotarsus slightly thickened, distinctly wider than genu. Lengths of solenidia ω_1 14 (11–14), ω_2 11 (9–11), φ_1 9 (7–9), φ_2 9 (8–10); solenidion φ_1 slightly clavate, other solenidia finger-shaped. Setae (*p*), (*tc*) and (*ft*) eupathid-like; seta *d* of femur smooth, spatulate distally; seta *k* of tibiotarsus smooth and weakly blunt-ended; setae *l'* of femur and (*l*) of genu blunt-ended and barbed; other leg setae (except eupathidia) pointed and barbed. Leg II (Fig.

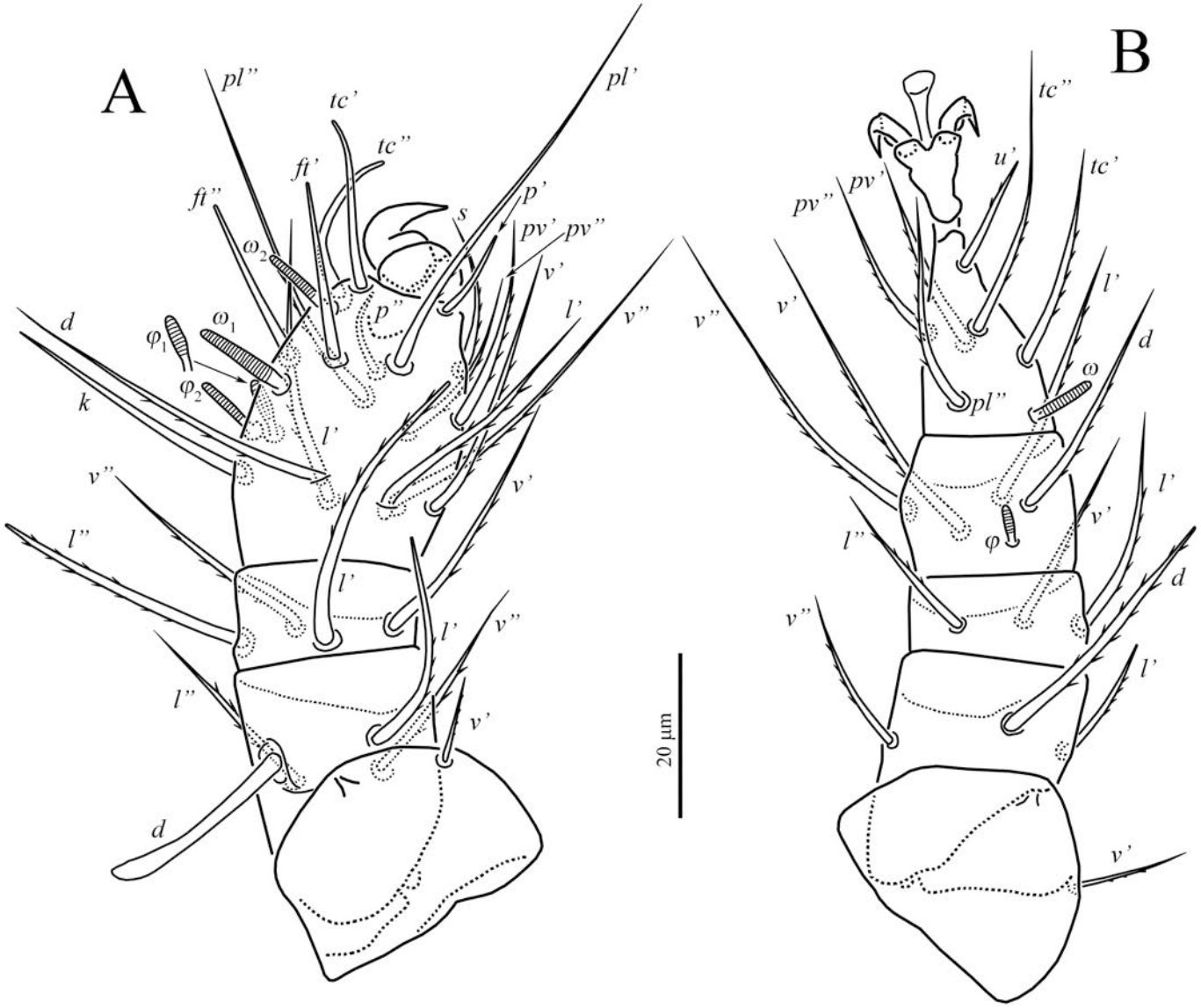


Figure 2 *Pediculaster tjumeniensis* **sp. nov.**, phoretic female: A – left leg I, dorsal aspect, B – left leg II, dorsal aspect.

2B). Leg setation: Tr 1 (v'), Fe 3 (*d*, *l'*, *v''*), Ge 3 (*l'*, *l''*, *v'*), Ti 4(1) (*d*, *l'*, *v'*, *v''*, *φ*), Ta 6(1) (*pl''*, *tc'*, *tc''*, *pv'*, *pv''*, *u'*, *ω*). Solenidia *ω* 9 (7–9) and *φ* 5 (4–5) finger-shaped. Tarsal claws with thickened basal half; empodium long and narrow, with widened tip. All leg setae barbed; setae *d*, *l'* of femur and *u'* of tarsus blunt-ended, other leg setae pointed. Leg III (Fig. 3A). Leg setation: Tr 1 (*v'*), F2 3 (*d*, *v'*), Ge 2 (*l'*, *v'*), Ti 4(1) (*d*, *l'*, *v'*, *v''*, *φ*), Ta 6 (*pl''*, *tc'*, *tc''*, *pv'*, *pv''*, *u'*). Claws and empodium as on tarsus II. Solenidion *φ* 4 (3–4) weakly clavate. All leg setae barbed; setae *d*, *v'* of femur and *l'* of genu blunt-ended, other leg setae pointed. Leg IV (Fig. 3B). Leg setation: Tr 1 (*v'*), Fe 2 (*d*, *v'*), Ge 1 (*v'*), Ti 4(1) (*d*, *l'*, *v'*, *v''*, *φ*), Ta 6 (*pl''*, *tc'*, *tc''*, *pv'*, *pv''*, *u'*). Claws simple, hooked, empodium narrower than on tarsi II and III. Solenidion *φ* 3 (2–3) rod-like. All leg setae barbed; seta *v'* of femur blunt-ended, other leg setae pointed.

Non-phoretic female (Figs 4–6) — Length of idiosoma 240–300, width 125–150.

Gnathosoma (Fig. 4) – Length of gnathosomal capsule 27–31, width 33–38. Gnathosoma and pharyngeal pumps in general as in phoretic female, but cheliceral setae and seta *dFe* smooth. Lengths of gnathosomal setae: *cha* 9–11, *chb* 14–15, *dFe* 13–14, *dGe* 15–16, *m* 17–19.

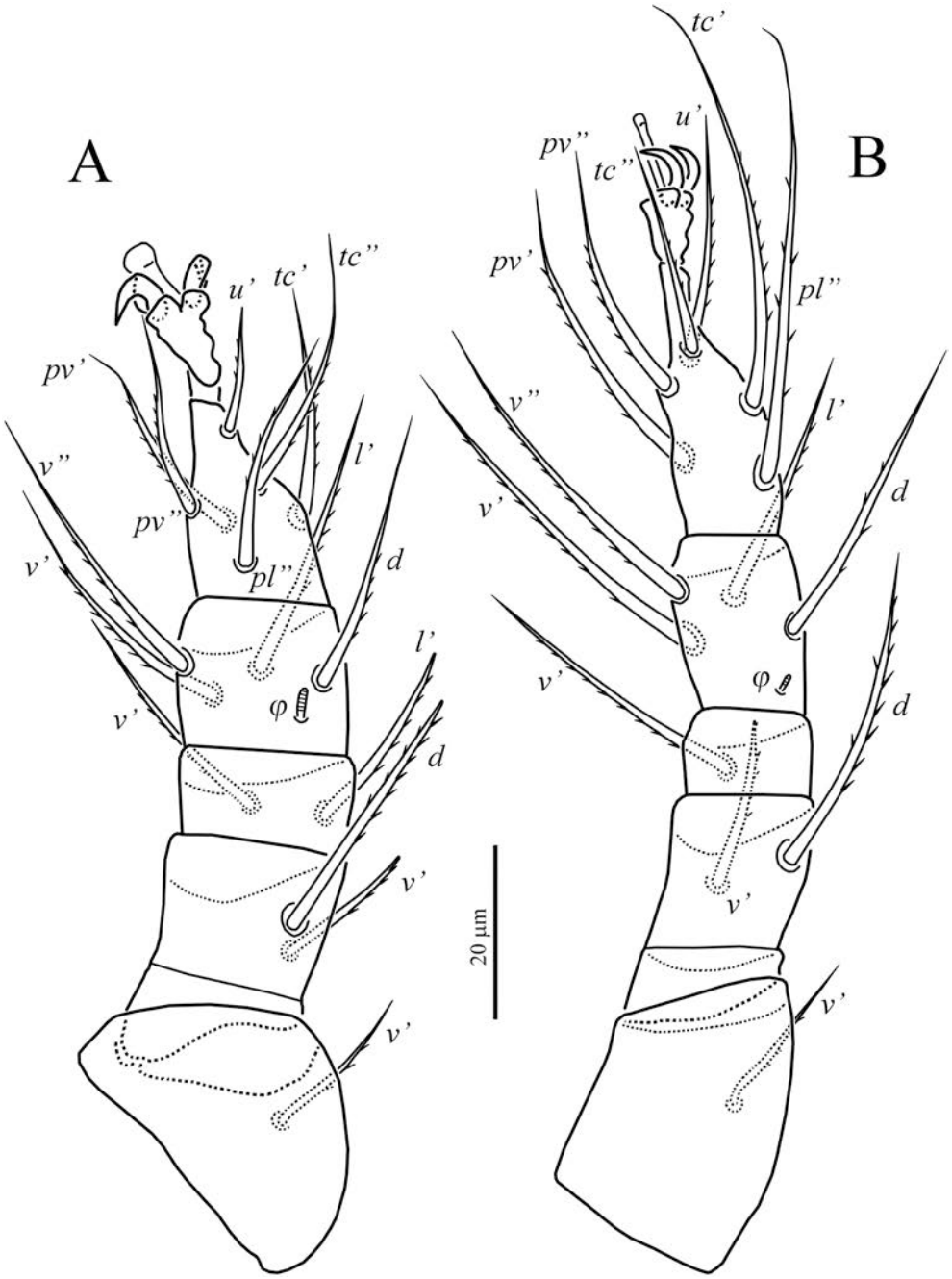


Figure 3 *Pediculaster tjumeniensis* **sp. nov.**, phoretic female: A – left leg III, dorsal aspect, B – left leg IV, dorsal aspect.

Idiosomal dorsum (Fig. 4A) – as in phoretic female, but dorsal sclerites weaker sclerotized and dimples smaller, difficult to discern. Lengths of dorsal setae: v_1 19–23, v_2 19–24, sc_2 37–44, c_1 26–31, c_2 39–44, *d* 28–36, *e* 15–20, *f* 27–39, h_1 23–33, h_2 6–8. Distances between setae: v_1–v_1 11–12, v_2–v_2 28–32, sc_2–sc_2 29–33, c_1–c_1 40–45, c_1–c_2 25–34, *d*–*d* 61–70, *e*–*f* 16–18, *f*–*f* 42–45, h_1–h_1 45–49, h_1–h_2 14–15.

Idiosomal venter (Fig. 4B) – similar to that of phoretic female, but plates weaker sclerotized and dimples smaller; setae 2*a* normally not very long and blunt-ended, and only in one specimen left seta 2*a* long and pointed and similar to that of phoretic female. Apsej indistinct; ap5 stronger

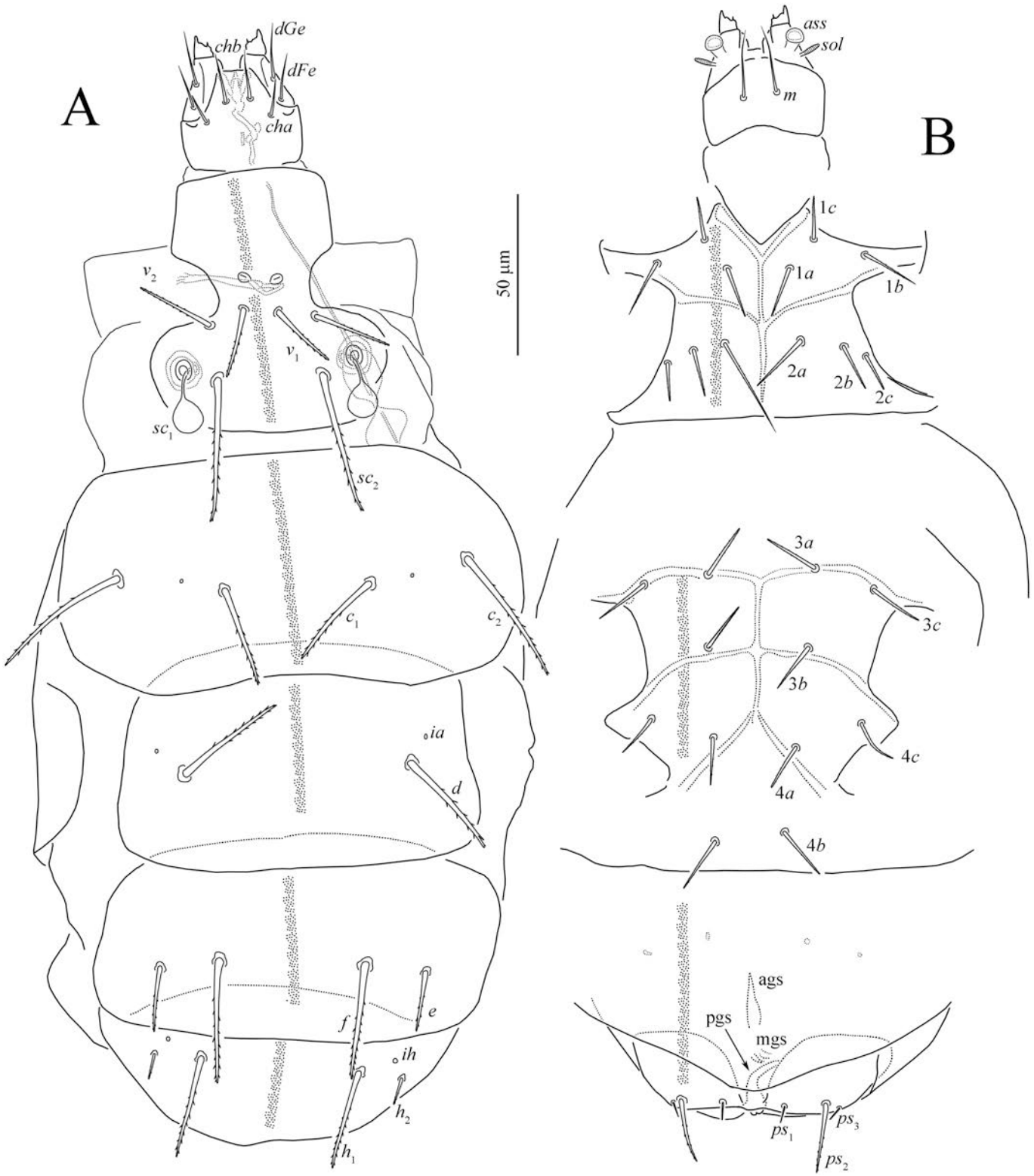


Figure 4 *Pediculaster tjumeniensis* **sp. nov.**, non-phoretic female: A – dorsum of the body, B – venter of the body. Legs omitted.

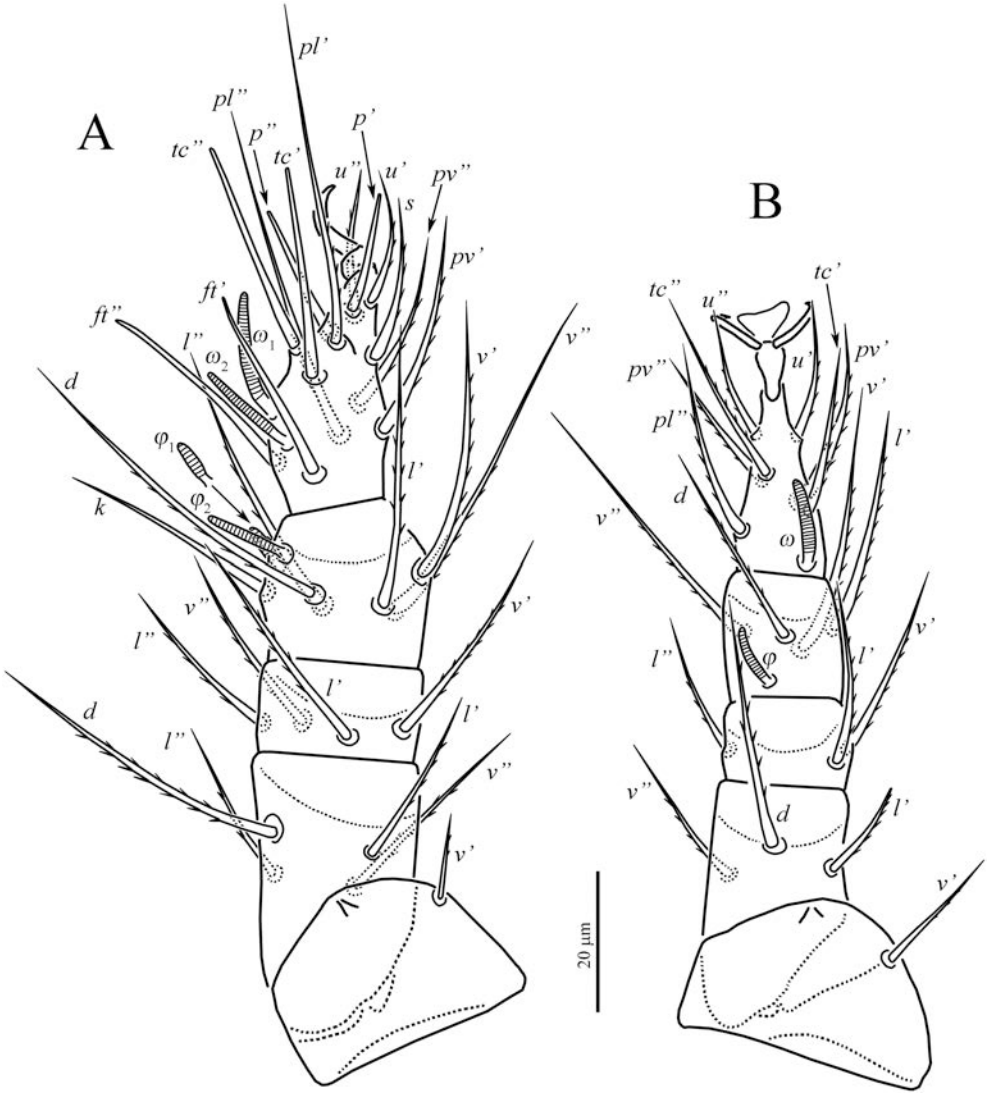


Figure 5 *Pediculaster tjumeniensis* **sp. nov.**, non-phoretic female: A – left leg I, dorsal aspect, B – left leg II, dorsal aspect.

sclerotized than in phoretic female. Lengths of ventral setae: 1*a* 13–15, 1*b* 13–18, 1*c* 11–15, 2*a* 14–33, 2*b* 12–16, 2*c* 10–13, 3*a* 14–18, 3*b* 13–17, 3*c* 14–18, 4*a* 12–15, 4*b* 13–18, 4*c* 14–15, ps_1 6, ps_2 17–22, ps_3 4–5.

Legs (Figs 5, 6) – Leg I (Fig. 5A). Tibia and tarsus separated. Tarsal claw simple, hooked. Leg setation: Tr 1 (*v'*), Fe 4 (*d*, *l'*, *l"*, *v"*), Ge 4 (*l'*, *l"*, *v'*, *v"*), Ti (6)(2) (*d*, *l'*, *l"*, *v'*, *v"*, *k*, φ_1, φ_2), Ta 13(2) (*pl'*, *pl"*, *p'*, *p"*, *tc'*, *tc"*, *ft'*, *ft"*, *s*, *pv'*, *pv"*, *u'*, *u"*, ω_1, ω_2). Lengths of solenidia ω_1 16–19, ω_2 13–15, φ_1 6–8, φ_2 10–11; solenidion φ_1 clavate, other solenidia finger-shaped. Setae (*p*), (*tc*) and (*ft*) eupathid-like; seta *k* of tibiotarsus smooth and weakly blunt-ended; other leg setae (except eupathidia) pointed and barbed. Leg II (Fig. 5B). Leg setation: Tr 1 (*v'*), Fe 3 (*d*, *l'*, *v"*), Ge 3 (*l'*, *l"*, *v'*), Ti 4(1) (*d*, *l'*, *v'*, *v"*, φ), Ta 7(1) (*pl"*, *tc'*, *tc"*, *pv'*, *pv"*, *u'*, *u"*, ω). Solenidia ω 11–12 and φ 8–9 finger-shaped. Tarsal claws simple, hooked; empodium short and wide. All leg setae barbed; seta *l'* of femur blunt-ended, other leg setae pointed. Leg III (Fig. 6A). Leg setation: Tr 1 (*v'*), Fe 2 (*d*, *v'*), Ge 2 (*l'*, *v'*), Ti 4(1) (*d*, *l'*, *v'*, *v"*, φ), Ta 7 (*pl"*, *tc'*, *tc"*, *pv'*, *pv"*, *u'*, *u"*). Claws and empodium as on tarsus II. Solenidion φ 6–7 finger-shaped. All leg setae barbed; seta *v'* of femur blunt-ended, other leg setae pointed. Leg IV (Fig. 6B).

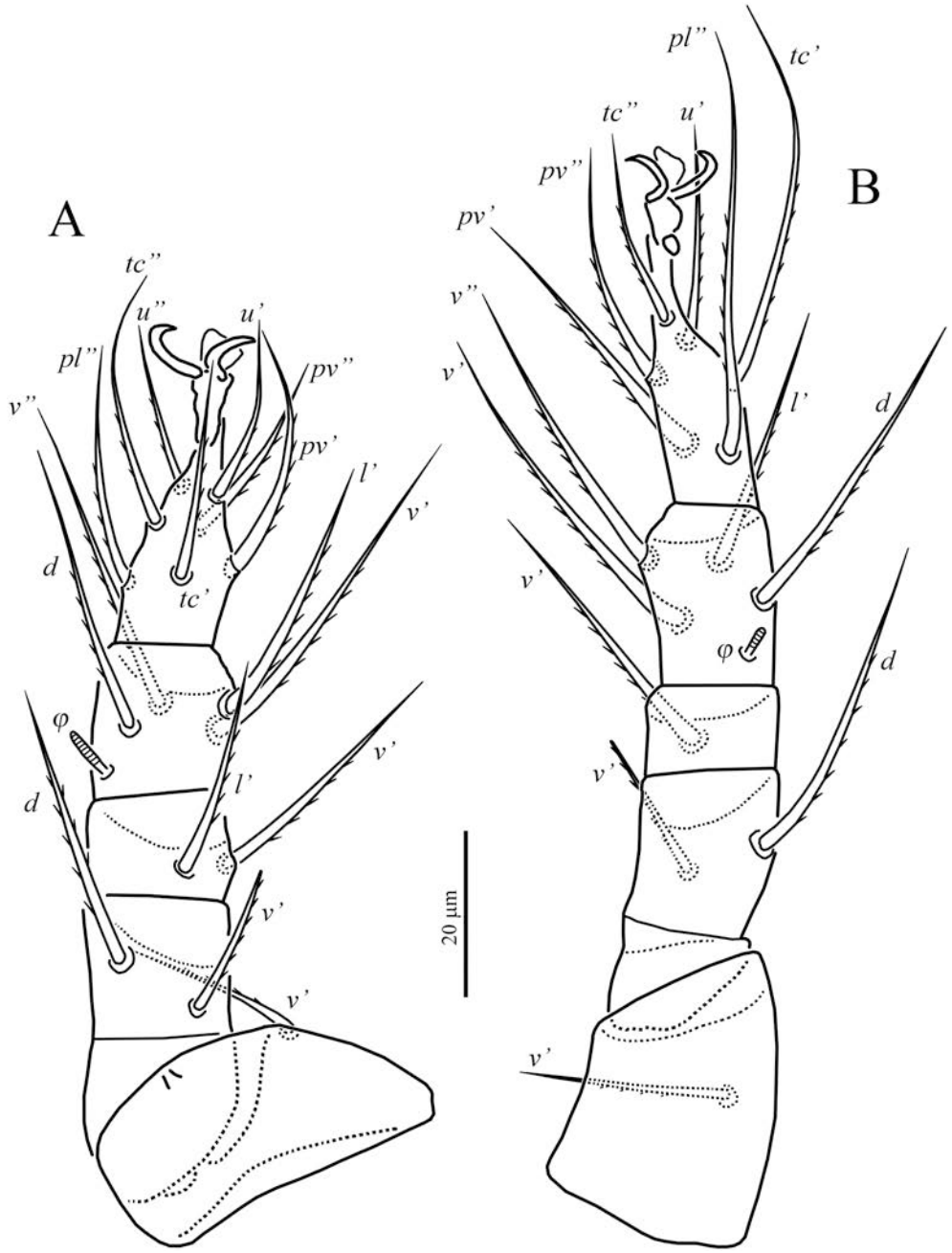


Figure 6 *Pediculaster tjumeniensis* **sp. nov.**, non-phoretic female: A – left leg III, dorsal aspect, B – left leg IV, dorsal aspect.

Leg setation: Tr 1 (*v'*), Fe 2 (*d*, *v'*), Ge 1 (*v'*), Ti 4(1) (*d*, *l'*, *v'*, *v"*, *φ*), Ta 6 (*pl"*, *tc'*, *tc"*, *pv'*, *pv"*, *u'*). Claws and empodium as on tarsi II and III. Solenidion *φ* 3–4 rod-like. All leg setae barbed; seta *v'* of femur blunt-ended, other leg setae pointed.

Larva (Figs 7, 8) — Length of idiosoma 195–215, width 105–115.

Gnathosoma (Figs 7, 8) – Length of gnathosomal capsule 27–30, width 31–34. Cheliceral setae *cha* short and thick, other gnathosomal setae smooth and pointed; setae *chb* absent. Dorsal median apodeme absent. Accessory setigenous structure distinctly shorter than palpal solenidion. Subcapitulum with two pairs of setae (*m*, *n*). Lengths of gnathosomal setae: *cha* 3–4, *dFe* 9–10, *dGe* 12–14, *m* 14–15, *n* 10–11. Pharyngeal pumps 2 and 3 as in female, php 1

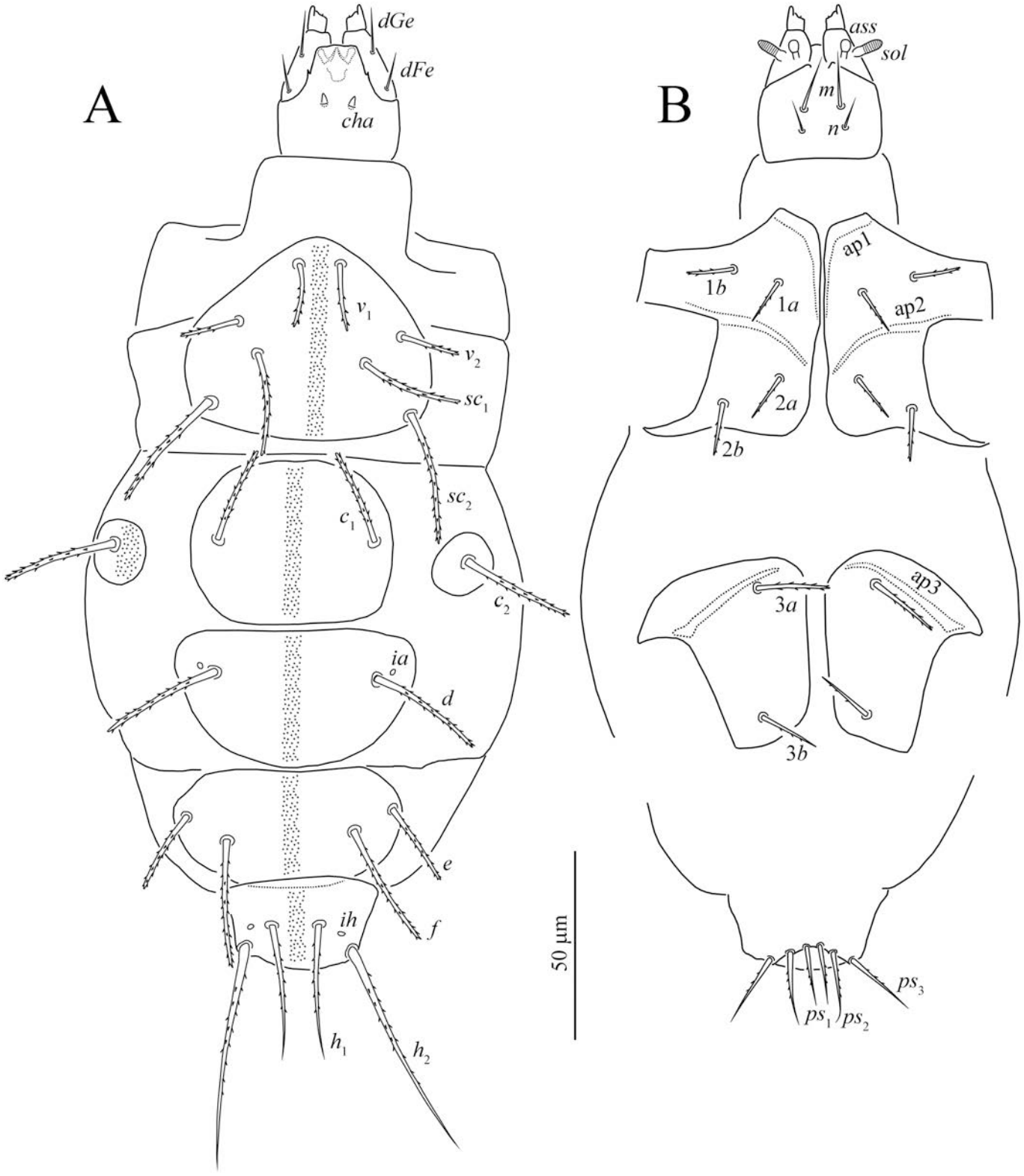


Figure 7 *Pediculaster tjumeniensis* **sp. nov.**, larva: A – dorsum of the body, B – venter of the body. Legs omitted.

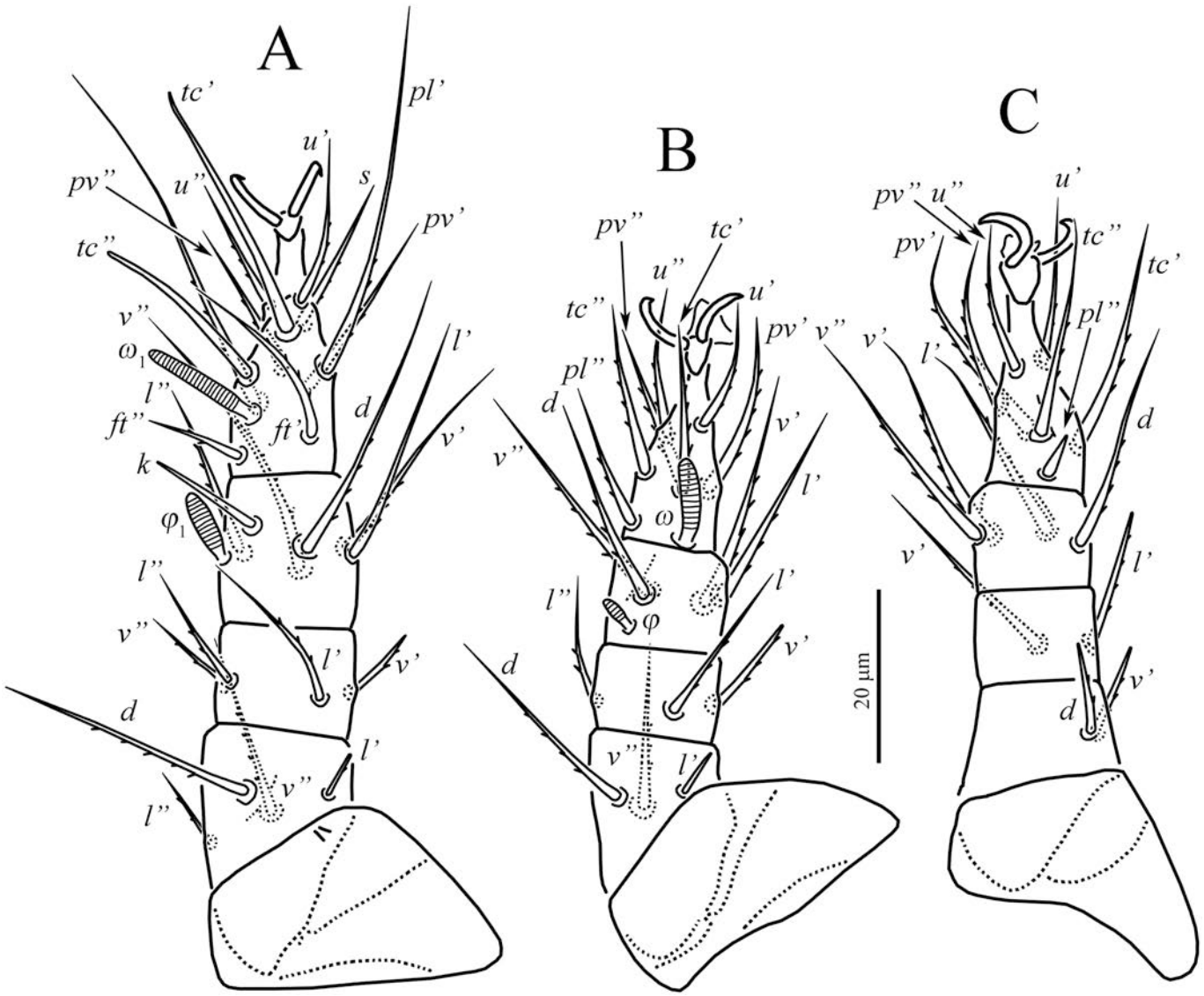


Figure 8 *Pediculaster tjumeniensis* **sp. nov.**, larva: A – left leg I, dorsal aspect, B – left leg II, dorsal aspect, C – left leg III, dorsal aspect.

small, bow-shaped and situated on the short distance from php 2 inside propodosoma.

Idiosomal dorsum (Fig. 7A) – Prodorsum with one trapezium-shaped shield with four pairs of setae; tergite C divided into three plates, one median with one pair of setae c_1 and two laterals with setae c_2; tergites D, EF and H with same number of setae as in females. All dorsal setae strongly barbed; setae h_1 and h_2 pointed, other dorsal setae blunt-ended. Tergites D and H with small round cupules *ia* and *ih*, respectively. All dorsal shields with small round dimples. Lengths of dorsal setae: v_1 14–18, v_2 12–16, sc_1 21–29, sc_2 30–35, c_1 23–26, c_2 25–31, *d* 25–33, *e* 18–23, *f* 29–35, h_1 28–35, h_2 59–63. Distances between setae: v_1–v_1 9–11, v_2–v_2 41–45, sc_1–sc_1 28–29, sc_2–sc_2 49–53, c_1–c_1 40–42, *d*–*d* 43, *e*–*f* 11–12, *f*–*f* 33–34, h_1–h_1 12–14, h_1–h_2 10–11.

Idiosomal venter (Fig. 7B) – Coxal fields I-III separated medially and with two pairs of setae each. Ap1, ap2 and ap3 well developed; other apodemes absent. All ventral setae barbed; setae $ps_{1\text{-}3}$ pointed, other ventral setae blunt-ended. Lengths of ventral setae: 1*a* 11–13, 1*b* 11–13, 2*a* 12–13, 2*b* 12–14, 3*a* 15–20, 3*b* 12–16, ps_1 14–16, ps_2 17–20, ps_3 18–20.

Legs (Fig. 8) – Leg I (Fig. 8A). Tarsus with two simple hooked claws; empodium absent.

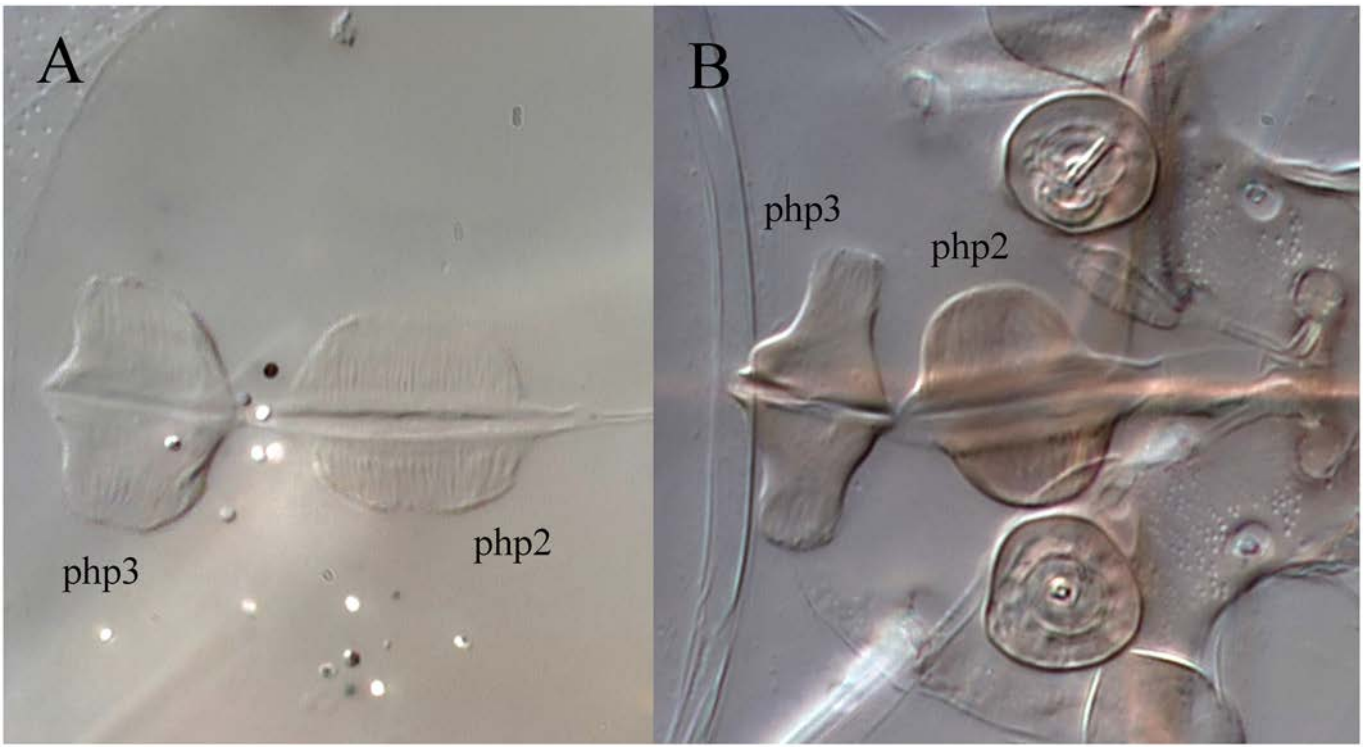


Figure 9 DIC micrographs of pharyngeal pumps II and III of phoretic females: A – *Pediculaster tjumeniensis* **sp. nov.**,, B – *Pediculaster bisetus* **sp. nov**.

Leg setation: Tr 0, Fe 4 (*d*, *l'*, *l"*, *v"*), Ge 4 (*l'*, *l"*, *v'*, *v"*), Ti (6)(1) (*d*, *l'*, *l"*, *v'*, *v"*, *k*, φ_1), Ta 11(1) (*pl'*, *pl"*, *tc'*, *tc"*, *ft'*, *ft"*, *s*, *pv'*, *pv"*, *u'*, *u"*, ω_1). Lengths of solenidia ω_1 10–14, φ_1 7–9; solenidion ω_1 finger-shaped; solenidion φ_1 clavate. Setae (*tc*) eupathid-like; seta *k* of tibiotarsus smooth and weakly blunt-ended; setae *l'* of femur and *v'* of genu blunt-ended and barbed, other leg setae (except eupathidia) pointed and barbed. Leg II (Fig. 8B). Leg setation: Tr 0, Fe 3 (*d*, *l'*, *v"*), Ge 3 (*l'*, *l"*, *v'*), Ti 4(1) (*d*, *l'*, *v'*, *v"*, φ), Ta 7(1) (*pl"*, *tc'*, *tc"*, *pv'*, *pv"*, *u'*, *u"*, ω). Solenidia ω 8–10 and φ 4–5 finger-shaped. Tarsal claws simple, hooked; empodium short and wide. Seta *l'* of femur smooth and blunt-ended; seta *v'* of genu barbed and blunt-ended, other leg setae pointed and barbed. Leg III (Fig. 8C). Leg setation: Tr 0), F2 3 (*d*, *v'*), Ge 2 (*l'*, *v'*), Ti 4 (*d*, *l'*, *v'*, *v"*), Ta 7 (*pl"*, *tc'*, *tc"*, *pv'*, *pv"*, *u'*, *u"*). Claws and empodium as on tarsus II. Solenidion φ absent. Seta *pl"* of tarsus spine-shaped, smooth; setae *d*, *v'* of femur and *l'* of genu blunt-ended and barbed, other leg setae pointed and barbed. Femur not divided into basi- and telofemur.

Male unknown.

Type material — Phoretic female holotype slide ZISP T-Pygm-004: Russia, Tyumen Province, Tyumen, "Zatyumenskiy park", 57°09' N, 65°26' E, in the rotting log of birch, 21 April 2019, A.A. Khaustov leg. Paratypes: 7 phoretic females, same data as holotype; 4 phoretic and 4 non-phoretic females, same locality and collector, 10 July 2019; 2 phoretic females and 7 larvae, same locality and collector, 26 April 2019.

Type deposition — The holotype and 4 phoretic females paratypes are deposited in the collection of the Zoological Institute of RAS, Saint Petersburg, Russia; other paratypes are deposited in the mite collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

Etymology — The name of the new species refers to its distribution in Tyumen city, the capital of Tyumen Province, Russia.

Differential diagnosis — Phoretic female of the new species is most similar to *P. sellnickianus* (Rack, 1964) and *P. limosinae* Samsinak, 1984 (not separable morphologically from *P. sellnickianus*) by the presence of three pairs of setae on coxal fields I and II, setae ps_2 longer than ps_3, and setae 2*a* much longer than 2*b*. The new species can be distinguished from *P. sellnickianus* by having setae c_2 clearly longer than c_1 (setae c_1 and c_2 subequal in *P. sellnickianus*), by the presence of ap5 (ap5 absent in *P. sellnickianus*), and setae *e* no more than twice longer than h_2 (setae *e* more than 3 times longer than h_2 in *P. sellnickianus*). Non-phoretic female of the new species is most similar to *P. permagnus* (Rack, 1971) but can be distinguished from it by longer distance between setae *e* and *f*, which less than 3 times shorter than distance *f-f* (*e-f* about 4 times shorter than *f-f* in *P. permagnus*), by solenidion φ_2 distinctly longer than φ_1 (solenidia φ_2 and φ_1 subequal in *P. permagnus*), and by much longer solenidion ω_2, which reaching far beyond the base of solenidion ω_1 (solenidion ω_2, much shorter and not reaching base of solenidion ω_1 in *P. permagnus*). Larva of the new species can be distinguished from all described larvae of *Pediculaster* by the presence of setae *n* on subcapitulum (setae *n* absent in all described larvae of *Pediculaster*).

Pediculaster bisetus sp. nov.

Zoobank: 4AAFFE22-DC6F-40FD-B423-D666234F4DD3

(Figs 9B–12)

Description

Phoretic female (Figs 9B–12) — Length of idiosoma 210 (210–240), width 96 (105–115).

Gnathosoma (Figs 9B, 10) – Length of gnathosomal capsule 20 (20–21), width 21 (22–24). Dorsal median apodeme weakly developed. All gnathosomal setae smooth; setae *cha* and *chb* blunt-ended, other gnathosomal setae pointed. Palp tibiotarsus with well-developed blunt-tipped claw and tiny eupathid-like seta; palps ventrally with well-developed solenidion and mushroom-shaped accessory setigenous structure. Php 1 small, bow-shaped, located inside gnathosomal capsule; php 2 oval, php 3 with lateral "wings" (Fig. 9B), both pumps situated close to each other on long oesophagus and far separated from php 1. Lengths of gnathosomal setae: *cha* 6 (6), *chb* 8 (7–8), *dFe* 6 (6–8), *dGe* 7 (7–10), *m* 12 (12–13).

Idiosomal dorsum (Fig. 10A) – All dorsal shields with numerous small round dimples. Stigmata small, oval, one-chambered and associated with long tracheal trunks. Setae *e* and h_2 smooth, other dorsal setae barbed; setae h_2 pointed, other dorsal setae blunt-ended; trichobothria sc_1 short, spherical. Cupules *ia* on tergite D and *ih* on tergite H very small, round. Lengths of dorsal setae: v_1 22 (21–23), v_2 21 (18–21), sc_2 36 (36–40), c_1 24 (24–29), c_2 31 (31–39), *d* 29 (29–36), *e* 8 (8–13), *f* 31 (31–38), h_1 29 (29–34), h_2 5 (5–7). Distances between setae: v_1–v_1 8 (7–9), v_2–v_2 22 (21–22), sc_2–sc_2 31 (31–34), c_1–c_1 33 (33–39), c_1–c_2 20 (20–23), *d*–*d* 49 (49–61), *e*–*f* 6 (5–7), *f*–*f* 49 (49–59), h_1–h_1 44 (44–53), h_1–h_2 5 (5–8).

Idiosomal venter (Fig. 10B) – Ventral plates with numerous small round dimples. Setae 1*b* pointed, other ventral setae blunt-ended; setae ps_2 barbed, over ventral setae smooth. Setae 2*b* on coxal fields II absent. Ap1, ap2 and apsej well developed and joined with appr; ap3 and ap4 well developed and joined with appo; ap5 weaker sclerotized than other apodemes and joined with appo. Posterior margin of poststernal plate with weak median lobe. Anterior and posterior genital sclerites long and narrow; median genital sclerite small, oval. Lengths of ventral setae: 1*a* 10 (9–11), 1*b* 13 (13–14), 1*c* 9 (9), 2*a* 10 (10–12), 2*c* 7 (6–8), 3*a* 10 (10–12), 3*b* 10 (10–11), 3*c* 12 (12), 4*a* 9 (9–10), 4*b* 12 (11–14), 4*c* 10 (10–12), ps_1 4 (4–5), ps_2 16 (14–16), ps_3 3 (3).

Legs (Figs 11, 12) – Leg I (Fig. 11A). Leg setation: Tr 1 (*v'*), Fe 4 (*d*, *l'*, *l"*, *v"*), Ge 4 (*l'*, *l"*, *v'*, *v"*), TiTa 17(4) (*d*, *l'*, *l"*, *v'*, *v"*, *k*, *pl'*, *pl"*, *p'*, *p"*, *tc'*, *tc"*, *ft'*, *ft"*, *s*, *pv'*, *pv"*, ω_1, ω_2, φ_1, φ_2). Tibiotarsus cylindrical, as wide as genu. Lengths of solenidia ω_1 8 (8–9), ω_2 4 (4), φ_1 7 (7), φ_2 4 (4–5); all solenidia clavate. Setae (*p*), (*tc*) and (*ft*) eupathid-like; seta *d* of femur smooth, spatulate distally; seta *pl'* of tibiotarsus smooth and pointed; setae *v'* of trochanter and *k* of tibiotarsus smooth or with one barb and blunt-ended; setae *l'* of femur and (*l*) of genu blunt-ended and barbed; other leg setae (except eupathidia) pointed and barbed. Leg II (Fig.

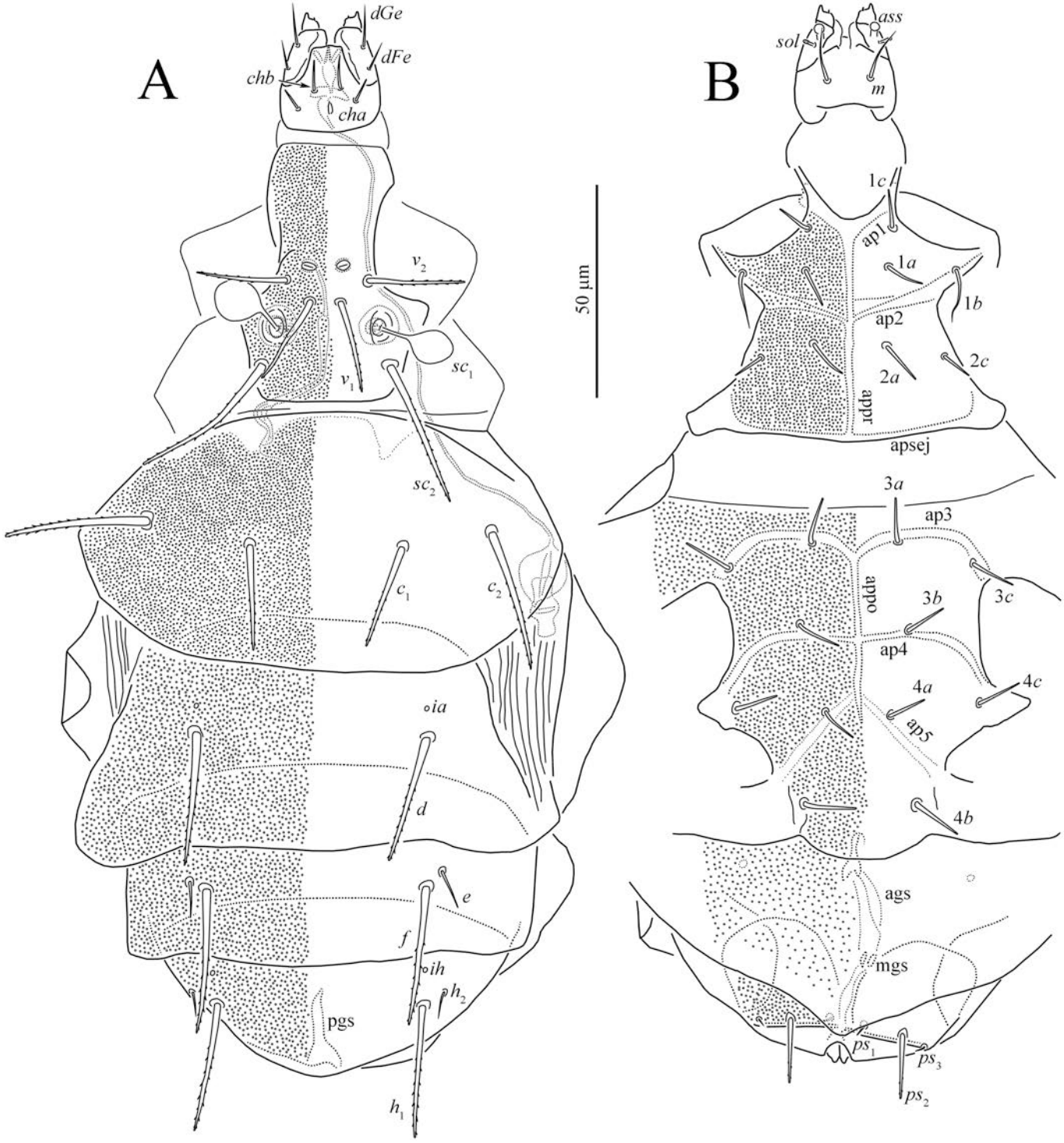


Figure 10 *Pediculaster bisetus* **sp. nov.**, phoretic female: A – dorsum of the body, B – venter of the body. Legs omitted.

11B). Leg setation: Tr 1 (*v'*), Fe 3 (*d*, *l'*, *v"*), Ge 3 (*l'*, *l"*, *v'*), Ti 4 (*d*, *l'*, *v'*, *v"*), Ta 6(1) (*pl"*, *tc'*, *tc"*, *pv'*, *pv"*, *u'*, *ω*). Solenidion *ω* 5 (5) clavate, solenidion *φ* absent, but pore-like structure situated on its typical insertion point. Tarsal claws with thickened basal half; empodium long and narrow, with widened tip. Setae *v'* of trochanter and *l'* of femur smooth and blunt-ended; setae *d* of femur and *u'* of tarsus blunt-ended and barbed, other leg setae pointed. Leg III (Fig.

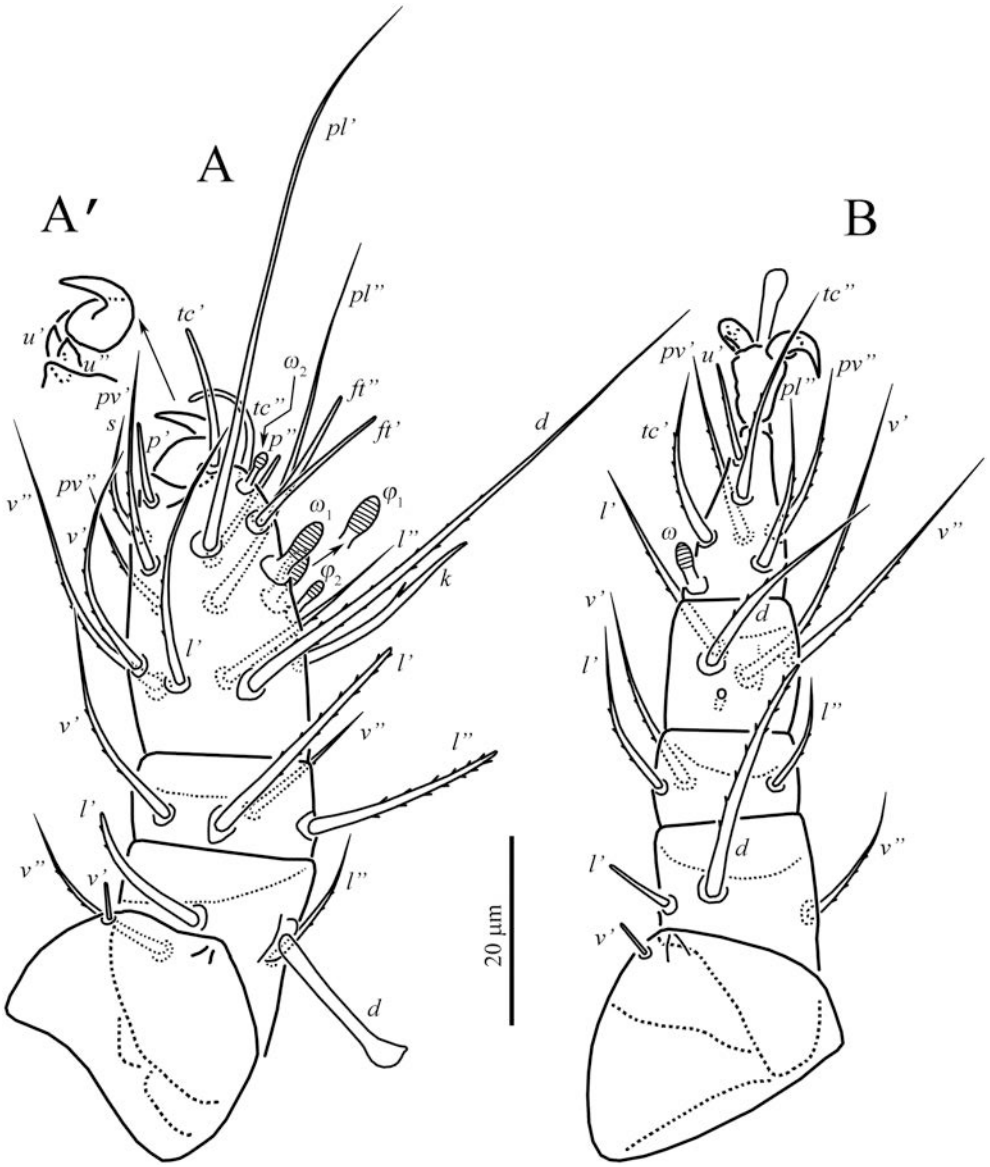


Figure 11 *Pediculaster bisetus* **sp. nov.**, phoretic female: A – right leg I, dorsal aspect, B – right leg II, dorsal aspect.

12A). Leg setation: Tr 1 (*v'*), F2 3 (*d*, *v'*), Ge 2 (*l'*, *v'*), Ti 4 (*d*, *l'*, *v'*, *v''*), Ta 6 (*pl''*, *tc'*, *tc''*, *pv'*, *pv''*, *u'*). Claws and empodium as on tarsus II. Solenidion *φ* absent, but pore-like structure situated on its typical insertion point. All leg setae barbed; setae *v'* of trochanter, *d*, *v'* of femur and *u'* of tarsus blunt-ended, other leg setae pointed. Leg IV (Fig. 12B). Leg setation: Tr 0, Fe 2 (*d*, *v'*), Ge 1 (*v'*), Ti 4 (*d*, *l'*, *v'*, *v''*), Ta 6 (*pl''*, *tc'*, *tc''*, *pv'*, *pv''*, *u'*). Claws simple, hooked, empodium as on tarsi II and III. Solenidion *φ* absent, but pore-like structure situated on its typical insertion point. All leg setae barbed; setae *d* and *v'* of femur blunt-ended, other leg setae pointed.

Non-phoretic female, male and larva unknown.

Type material — Phoretic female holotype slide ZISP T-Pygm-005: Russia, Tyumen Province, Tyumen, "Zatyumenskiy park", 57°09' N, 65°26' E, in the rotting log of birch, 29 September 2019, A.A. Khaustov leg. Paratypes: 11 phoretic females, same data as holotype.

Type deposition — The holotype and 2 phoretic female paratypes are deposited in the

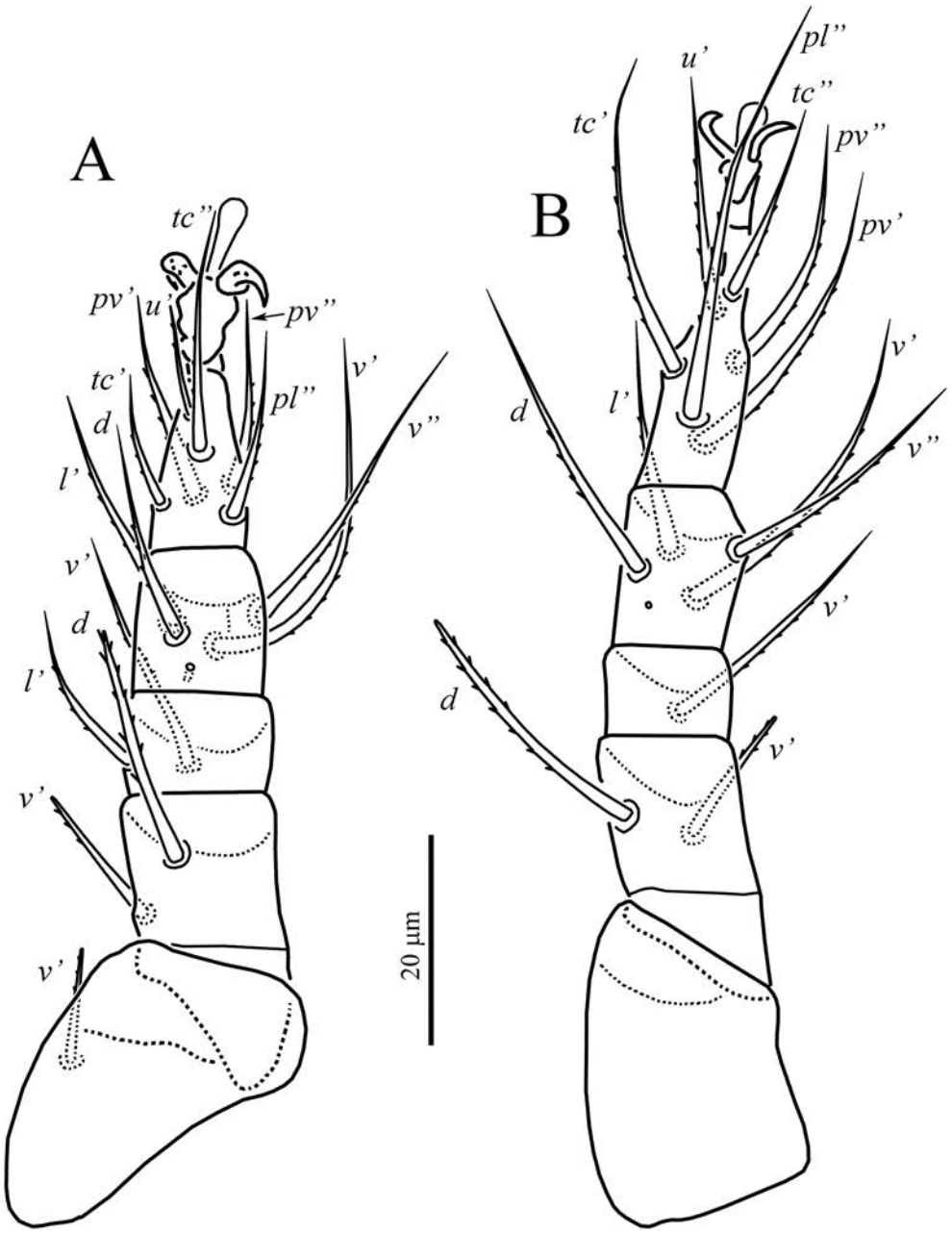


Figure 12 *Pediculaster bisetus* **sp. nov.**, phoretic female: A – right leg III, dorsal aspect, B – right leg IV, dorsal aspect.

collection of the Zoological Institute of RAS, Saint Petersburg, Russia; other paratypes are deposited in the mite collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

Etymology — The name of the new species is a combination of two Latin words *bi* meaning *two* and *seta* meaning *bristle* and refers to presence of two pairs of setae on coxal fields II.

Differential diagnosis — The new species is most similar to *P. athiasae* (Wicht, 1970) by the presence of three pairs of setae on coxal fields I, two pairs of setae on coxal fields II, subequal setae v_1 and v_2 and well-developed ap5. The new species can be distinguished from the latter in having one-chambered stigmata (two-chambered in *P. athiasae*), by smooth setae *e* (setae *e* barbed in *P. athiasae*), by the absence of seta on trochanter IV (trochanter IV with seta

in *P. athiasae*), and distinctly shorter dorsal body setae (dorsal body setae distinctly longer in *P. athiasae*).

Pediculaster rarus sp. nov.

Zoobank: B3B6E53C-F601-46F5-A384-38011767AB4F

(Figs 13–15)

Description

Phoretic female (Figs 13–15) — Length of idiosoma 280, width 130.

Gnathosoma (Fig. 13) – Length of gnathosomal capsule 25, width 29. Dorsal median apodeme well developed. All gnathosomal setae smooth; setae *cha* blunt-ended, other gnathosomal setae pointed. Palp tibiotarsus with well-developed blunt-tipped claw and tiny eupathid-like seta; palps ventrally with well-developed solenidion and mushroom-shaped accessory setigenous structure. Php 1 small, bow-shaped, located distinctly outside gnathosomal capsule; php 2 and php 3 oval, situated close to each other on long oesophagus and far separated from php 1. Lengths of gnathosomal setae: *cha* 7, *chb* 11, *dFe* 8, *dGe* 15, *m* 17.

Idiosomal dorsum (Fig. 13A) – All dorsal shields with numerous small round dimples. Stigmata small, oval, one-chambered and associated with long tracheal trunks. All dorsal setae blunt-ended; setae h_2 smooth, other dorsal setae barbed; trichobothria sc_1 short, spherical. Cupules *ia* on tergite D and *ih* on tergite H very small, round. Tergites C, D, and EF with porous areas as illustrated. Lengths of dorsal setae: v_1 25, v_2 24, sc_2 46, c_1 32, c_2 39, *d* 35, *e* 22, *f* 38, h_1 36, h_2 6. Distances between setae: v_1–v_1 11, v_2–v_2 26, sc_2–sc_2 35, c_1–c_1 36, c_1–c_2 25, *d*–*d* 50, *e*–*f* 14, *f*–*f* 43, h_1–h_1 37, h_1–h_2 13.

Idiosomal venter (Fig. 13B) – Ventral plates with numerous small round dimples. Setae 1*b*, 1*c*, 2*b*, 3*c*, 4*b*, and 4*c* pointed, other ventral setae blunt-ended; setae ps_2 barbed, other ventral setae smooth; setae 2*b* much longer than other ventral setae; setae ps_2 situated distinctly anteriad ps_1. Ap1, ap2 and apsej well developed and joined with appr; ap3 and ap4 well developed and joined with appo; ap5 weaker sclerotized than other apodemes and joined with appo. Posterior margin of poststernal plate evenly rounded, without median lobe. Anterior and posterior genital sclerites long and narrow; median genital sclerite indistinct. Lengths of ventral setae: 1*a* 10, 1*b* 14, 1*c* 12, 2*a* 12, 2*b* 73, 2*c* 13, 3*a* 16, 3*b* 13, 3*c* 20, 4*a* 12, 4*b* 21, 4*c* 19, ps_1 7, ps_2 7, *ps*3 27.

Legs (Figs 14, 15) – Leg I (Fig. 14A). Leg setation: Tr 1 (*v'*), Fe 4 (*d*, *l'*, *l"*, *v"*), Ge 4 (*l'*, *l"*, *v'*, *v"*), TiTa 17(4) (*d*, *l'*, *l"*, *v'*, *v"*, *k*, *pl'*, *pl"*, *p'*, *p"*, *tc'*, *tc"*, *ft'*, *ft"*, *s*, *pv'*, *pv"*, ω_1, ω_2, φ_1, φ_2). Tibiotarsus cylindrical, slightly wider than genu. Lengths of solenidia ω_1 21, ω_2 11, φ_1 7, φ_2 6; solenidion φ_1 clavate, other solenidia finger-shaped. Setae (*p*), (*tc*) and (*ft*) eupathid-like; eupathidium *p"* very short (Fig. 14A′); seta *d* of femur smooth, spatulate distally; setae *v'* of trochanter and *pl'* of tibiotarsus smooth and pointed; seta *k* of tibiotarsus smooth and weakly blunt-ended; other leg setae (except eupathidia) pointed and barbed. Leg II (Fig. 11B). Leg setation: Tr 1 (*v'*), Fe 3 (*d*, *l'*, *v"*), Ge 3 (*l'*, *l"*, *v'*), Ti 4(1) (*d*, *l'*, *v'*, *v"*, φ), Ta 6(1) (*pl"*, *tc'*, *tc"*, *pv'*, *pv"*, *u'*, ω). Solenidion ω 10 finger-shaped, solenidion φ 3 weakly clavate, situated in depression. Tarsal claws with thickened basal half; empodium long and narrow, with widened tip. Setae *v'* of trochanter and *tc"* of tarsus smooth and pointed; setae *u'* of tarsus blunt-ended and barbed, other leg setae pointed and barbed. Leg III (Fig. 15A). Leg setation: Tr 1 (*v'*), Fe 2 (*d*, *v'*), Ge 2 (*l'*, *v'*), Ti 4(1) (*d*, *l'*, *v'*, *v"*, φ), Ta 6 (*pl"*, *tc'*, *tc"*, *pv'*, *pv"*, *u'*). Claws and empodium as on tarsus II. Solenidion φ 3 weakly clavate, situated in depression. Seta *tc"* of tarsus smooth and pointed; setae *v'* of femur and *u'* of tarsus blunt-ended and barbed, other leg setae pointed and barbed. Leg IV (Fig. 15B). Leg setation: Tr 1 (*v'*), Fe 2 (*d*, *v'*), Ge 1 (*v'*), Ti 4 (*d*, *l'*, *v'*, *v"*), Ta 6 (*pl"*, *tc'*, *tc"*, *pv'*, *pv"*, *u'*). Claws simple, hooked, empodium as on tarsi II and III. Solenidion φ absent, but pore-like structure situated on its typical insertion point. All leg setae pointed and barbed.

Non-phoretic female, male and larva unknown.

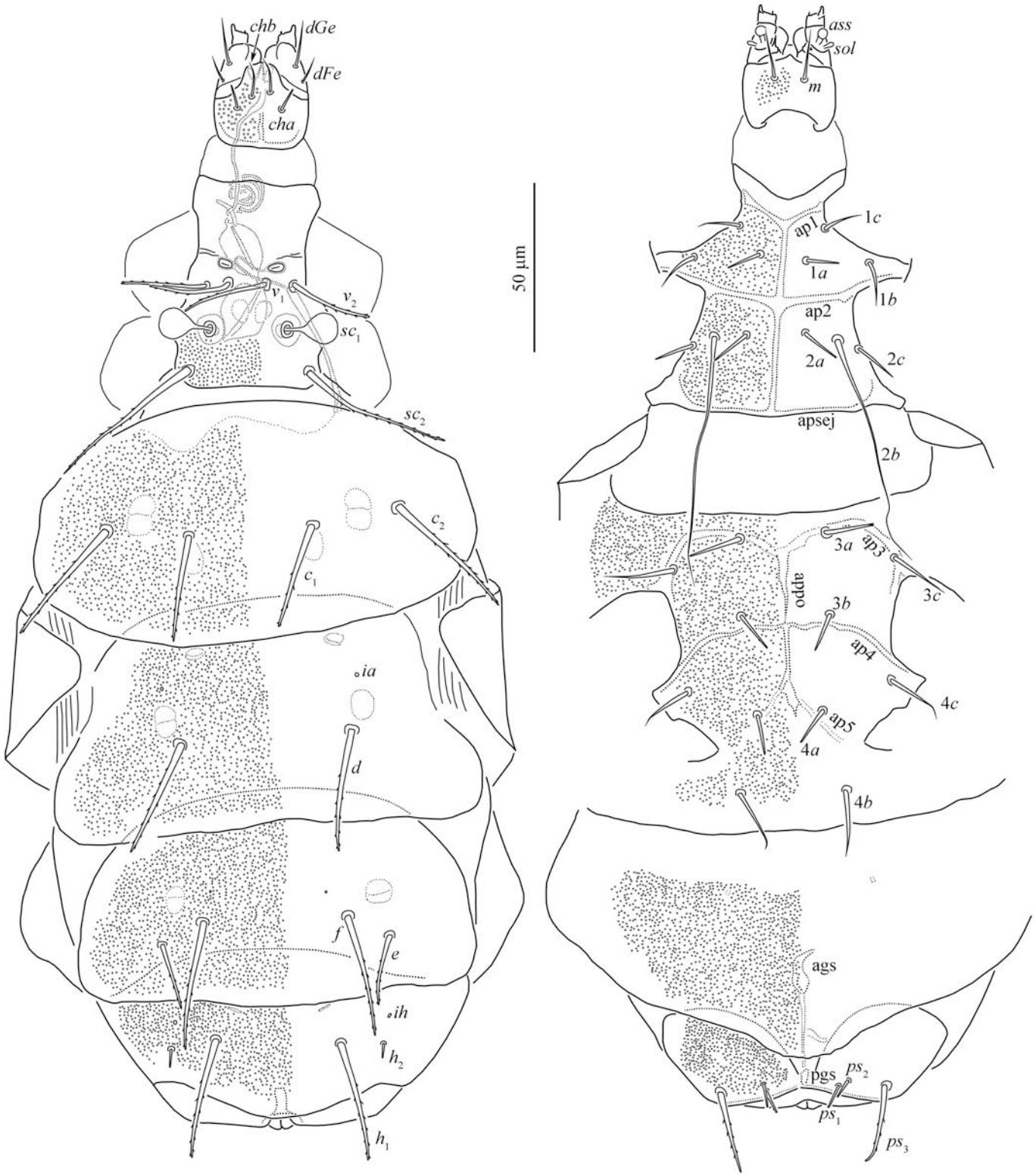


Figure 13 *Pediculaster rarus* **sp. nov.**, phoretic female: A – dorsum of the body, B – venter of the body. Legs omitted.

Type material — Phoretic female holotype slide ZISP T-Pygm-006: Russia, Tyumen Province, Tyumen district, vicinity of lake Kuchak, 57°21'N, 66°03'E, in rotting stamp, 26

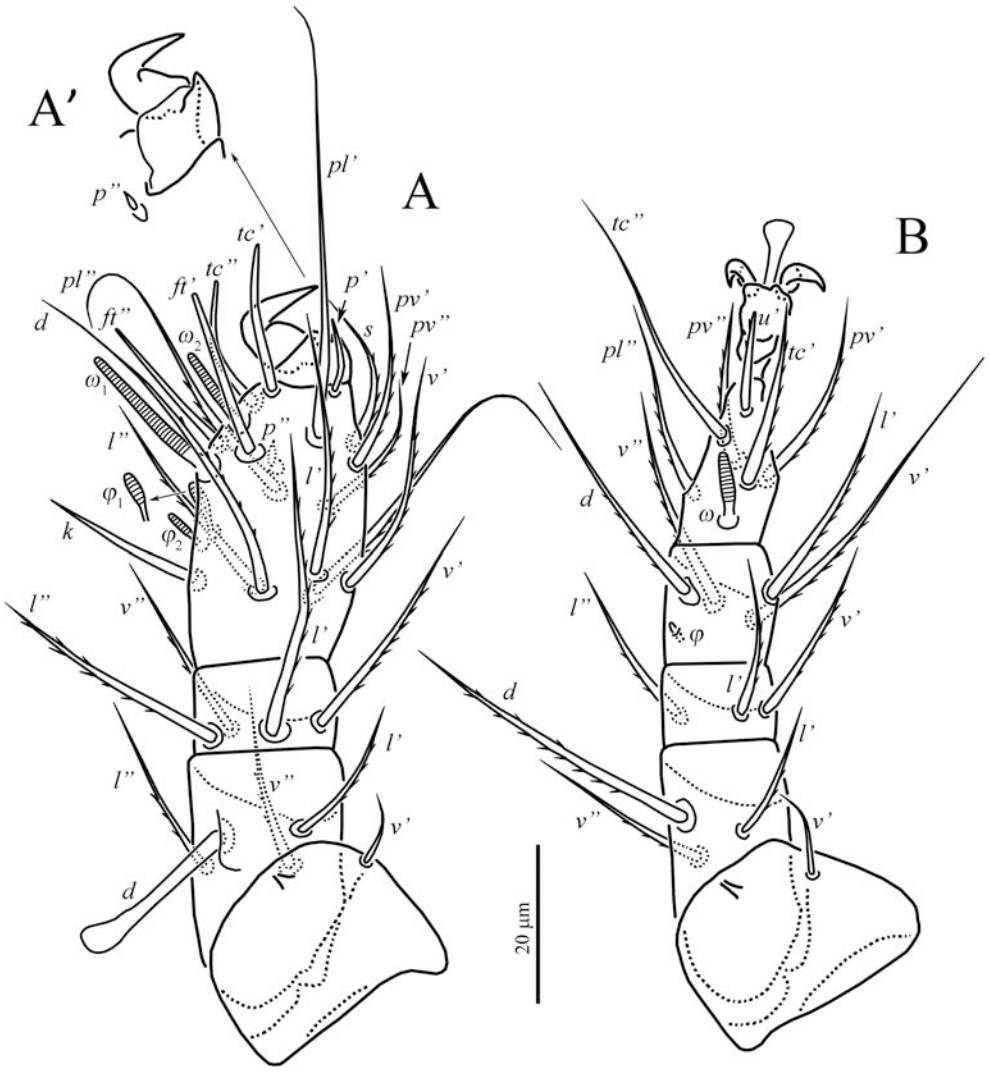


Figure 14 *Pediculaster rarus* **sp. nov.**, phoretic female: A – left leg I, dorsal aspect, B – left leg II, dorsal aspect.

September 2018, A.A. Khaustov leg.

Type deposition — The holotype is deposited in the collection of the Zoological Institute of RAS, Saint Petersburg, Russia.

Etymology — The name of the new species is derived from Latin *rarus* meaning *rare* and refers to its rareness.

Remark — The new species is described based on single specimen. However, it is in good condition and very well differs from closely related species. All attempts to collect additional specimens were unsuccessful.

Differential diagnosis — The new species is most similar to *P. chistyakovi* Khaustov and Ermilov, 2008 by the presence of three pairs of setae on coxal fields I and II, setae ps_3 distinctly longer than ps_2, setae v_1 and v_2 subequal, and setae 2*b* much longer than 2*a*. The new species can be distinguished from the latter in having setae sc_2, c_2, *f*, and h_1 blunt-ended (setae sc_2, c_2, *f*, and h_1 pointed in *P. chistyakovi*), by setae ps_2 situated distinctly anteriad ps_1 (setae ps_2 and ps_1 situated on the same level in *P. chistyakovi*), by much shorter setae *d* on femur and tibia IV which not exceed beyond tip of tarsus (setae *d* on femur and tibia IV very long and exceed beyond tip of tarsus in *P. chistyakovi*), and by the presence of ap5 (ap5 absent in *P. chistyakovi*).

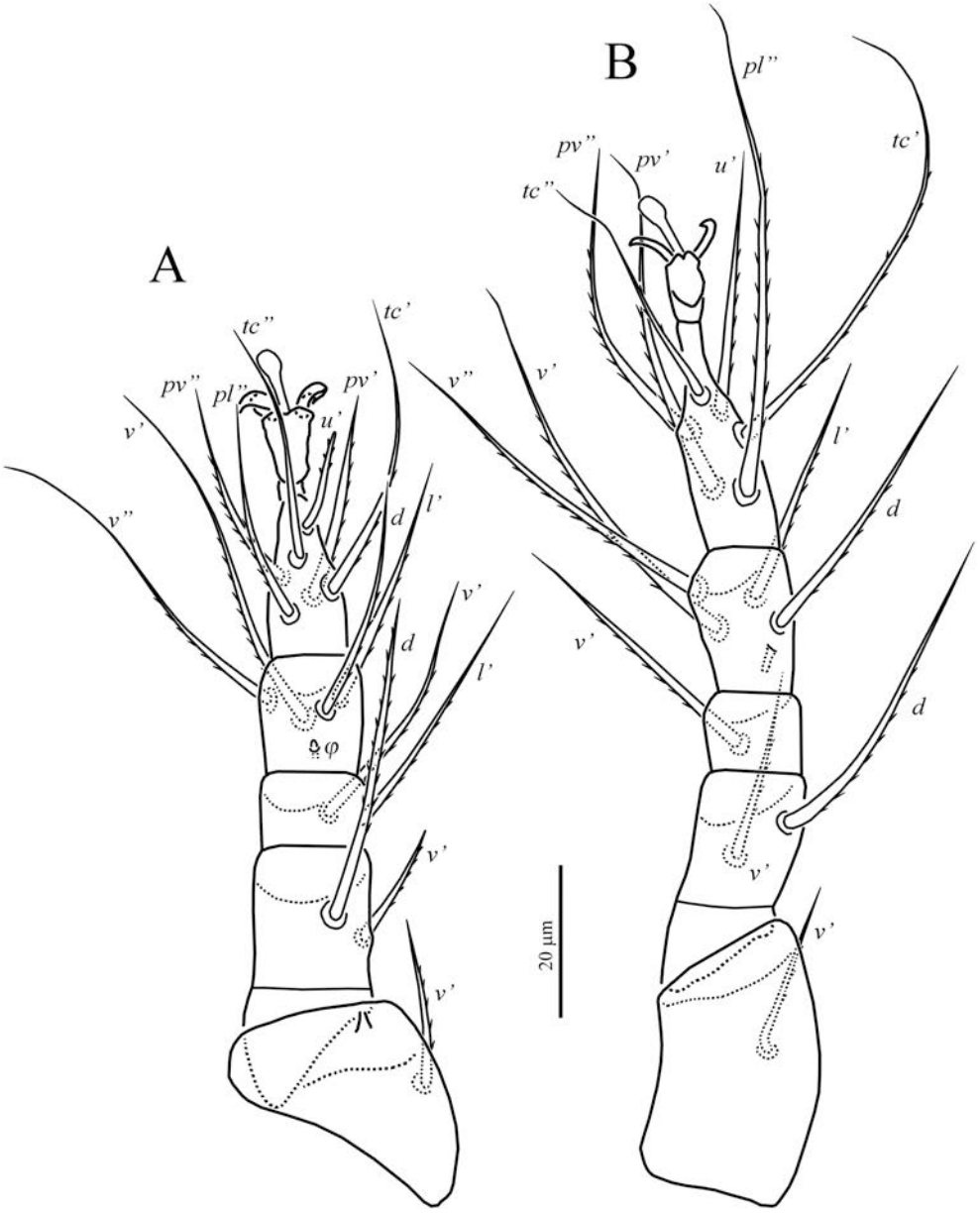


Figure 15 *Pediculaster rarus* **sp. nov.**, phoretic female: A – left leg III, dorsal aspect, B – left leg IV, dorsal aspect.

Pediculaster dudinskyi Khaustov, 2011

Pediculaster dudinskyi Khaustov, 2011, 265, Figs 1–5.

Phoretic female of this species was described from a tree hole of poplar in Western Ukraine (Khaustov 2011).

This is the first record of *P. dudinskyi* from Asia and Russia.

Material examined — One phoretic female, Russia, Tyumen Province, Tyumen, "Zatyumenskiy park", 57°09' N, 65°26' E, in the rotting log of birch, 26 April 2019, A.A. Khaustov leg.

Pediculaster camerikae Khaustov, 2008

Pediculaster camerikae Khaustov, 2008b, 166, Figs 25–29.

Phoretic female of this species was described from the cow dung in Crimea (Khaustov 2008b).

This is the first record of *P. camerikae* from Asia.

Material examined — Four phoretic females, Russia, Kurgan prov., Zverinogolovskiy distr., vicinity of settl. Ukrainets, 54°24′N 64°49′E, in cow dung, 20.09.2019, A.A. Khaustov leg.

Pediculaster montanus Khaustov, 2008

Pediculaster montanus Khaustov, 2008b, 162, Figs 13–24.

Phoretic female and male of this species were described from the cow dung in Crimea (Khaustov 2008b).

This is the first record of *P. montanus* from Asia.

Material examined — 30 phoretic females, 2 males, Russia, Kurgan prov., Zverinogolovskiy distr., vicinity of settl. Ukrainets, 54°24′N 64°49′E, in cow dung, 20.09.2019, A.A. Khaustov leg.

Discussion

Larval stage is currently described only for five species of *Pediculaster*: *P. fusarii* (Smiley and Moser, 1976), *P. mesembrinae* (Canestrini, 1881), *P. morelliae* Rack, 1974, *P. permagnus* (Rack, 1971), and *P. pseudomanicatus* Camerik, 2001 (Smiley and Moser 1978; Martin 1978; Camerik 2001; Camerik *et al.* 2006). All described larvae are very similar morphologically and differ mainly by the lengths of setae and number of cheliceral setae (setae *chb* present or absent). The description of larva in *P. tjumeniensis* **sp. nov.** revealed several unusual characters. The most remarkable is the presence of two pairs of subcapitular setae (setae *n* present). The presence of subcapitular setae *n* is unknown in all described pygmephoroid mites, including available descriptions of larval stages. Occasionally, the abnormal seta *n* was recorded in adult female of scutacarid mite *Pygmodispus latisternus* Paoli (Khaustov 2008a). In larva of *P. tjumeniensis* **sp. nov.** subcapitular setae *n* present in all seven studied larvae and undoubtedly is not abnormal. The presence of this plesiomorphic character is most likely a result of an evolutionary reversion rather than retention. Other unusual characters found in *P. tjumeniensis* **sp. nov.** larvae are the absence of the solenidion on tibia III and spiniform seta *pl"* on tarsus III. These characters could be used in the future not only for separation of species but probably also for creating of species-groups or subgenera in the genus *Pediculaster*.

Acknowledgements

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