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First record of Linotetranidae (Acari: Tetranychoidea) from Russia, with description of a new species

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Original research

ABSTRACT

Adult female of *Linotetranus sibiriensis* **n. sp.** (Acari: Tetranychoidea) collected from soil sample in Kurgan Region of Russia is described. This is the first record of the family Linotetranidae from Russia and northernmost in Palaearctic. Thanks to the use of a scanning electron microscope, three pairs of adoral setae were detected in Linotetranidae. A key to species of *Linotetranus* is also provided.

Keywords Prostigmata; systematics; morphology; phytophagy; SEM microscopy; Western Siberia
Zoobank http://zoobank.org/739617CE-53BB-4AAE-BF15-D741D75D8F1D

Introduction

Linotetranidae is a small group of phytophagous mites distributed on all continents, except Antarctica. Linotetranidae inhabit mostly dryland soils and associated with crown and roots of grasses (Walter *et al.* 2009). Until now, the family Linotetranidae comprises four genera and 18 described species (Meyer and Ueckermann 1997; Beard and Walter 2004; Tassi *et al.* 2020). The genus *Linotetranus* Berlese, 1910 is the largest in the family and includes 14 described species, namely: *L. cylindricus* Berlese, 1910; *L. achrous* Baker and Pritchard, 1953; *L. protractulus* Athias-Henriot, 1961; *L. mirabebensis* André, 1996; *L. amiculus* Meyer and Ueckermann, 1997; *L. annae* Meyer and Ueckermann, 1997; *L. edenvillensis* Meyer and Ueckermann, 1997; *L. ramosus* Meyer and Ueckermann, 1997; *L. niknami* Bagheri and Haddad, 2008; *L. anatolicus* Doğan and Dönel, 2010; *L. astragalusi* Khanjani *et al.*, 2011; *L. iraniensis* Khanjani *et al.*, 2011; *L. eghbaliani* Khanjani *et al.*, 2012; and *L. faemensis* Tassi and Duarte, 2020 (Berlese 1910; Baker and Pritchard 1953; Athias-Henrio 1961; André 1996; Meyer and Ueckermann, 1997; Bagheri *et al.* 2008; Doğan *et al.* 2010; Khanjani *et al.* 2011, 2012; Tassi *et al.* 2020). In the Palaearctic Linotetranidae is currently known only from southern regions: Italy, Turkey and Iran (Berlese 1910; Bagheri *et al.* 2008; Doğan *et al.* 2010; Khanjani *et al.* 2011, 2012).

Here we describe and illustrate the first representative of the family Linotetranidae from Russia and northernmost in Palaearctic.

Material and methods

The mite specimens were collected from a soil sample using Berlese funnels. Most of collected mite specimens were cleared in lactic acid and mounted in Hoyer's medium. Several specimens were preserved in 96% ethanol. The terminology follows that of Lindquist (1985). All measurements are given in micrometers (μm) for holotype and range of measurements for five paratypes (in parentheses). For leg chaetotaxy, the number of solenidia is given in parentheses. For SEM microscopy several alcohol-preserved mites were dried in a JFD 320

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freeze drying device (JEOL, Japan), dusted with gold and scanned with a JEOL–JSM-6510LV SEM microscope. Mite morphology was studied using a Carl Zeiss AxioImager A2 (Carl Zeiss, Germany) compound microscope with phase contrast and differential interference contrast (DIC) illumination.

Abbreviations

ZIRAS—Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia, TSUMZ—Tyumen State University, Museum of Zoology, Tyumen, Russia

Systematics

Family *Linotetranidae* Baker and Pritchard, 1953

Genus *Linotetranus* Berlese, 1910

Type species: *Linotetranus cylindricus* Berlese, 1910, by original designation.

Linotetranus sibiriensis n. sp.

Zoobank: 698BAB08-F2E2-4C8E-A061-7CBF4F9951FD

(Figs 1–6)

Description

Female — (Figs 1–6). Body elongate. Length of idiosoma 325 (315–330), width 155 (145–170).

Gnathosoma – (Figs 2, 5B, C). Palpal setation: Tr 0, Fe 1 (*d*), Ge 0, Ti 2 (*d*, *l″*), Ta 5(1) (*a*, *b*, *c*, *ul′*, *ul″ζ*, *ω*). All setae of femur and tibia weakly barbed; all tarsal setae smooth; seta *ul″* blunt-tipped, eupathid-like, other tarsal setae pointed; solenidion *ω* ovate in outline (Fig. 5C). Palpal supracoxal setae (*ep*) short, peg-like. Subcapitulum elongate, finely striated (Fig. 5B), with one pair of subcapitular setae *m* and three pairs of adoral setae *or1*-*or3*; all setae pointed; setae *or2* very short and smooth, other setae weakly barbed.

Idiosomal dorsum – (Figs 1A, 4A, B). All dorsal shields with distinct elongate reticulate pattern, except for smooth area posteriad setal row *f* (Fig. 4A, B); hysterosoma with transverse furrows anteriad setae *d1* and posteriad setae *e1–e3*. Setae *e4* present; all dorsal setae barbed; setae *v1* not modified, slender and barbed; setae *f2* weakly blunt-tipped, other setae pointed. Length of dorsal setae: *v1* 22 (20–25), *v2* 44 (43–46), *sc1* 80 (73–83), *sc2* 93 (88–95), *c1* 23 (23–28), *c2* 44 (35–48), *c3* 94 (76–94), *c4* 87 (80–89), *d1* 20 (20–24), *d2* 32 (32–41), *d3* 78 (72–79), *e1* 13 (10–14), *e2* 37 (34–45), *e3* 64 (58–68), *e4* 40 (33–43), *f1* 16 (15–18), *f2* 24 (24–25), *f3* 120 (119–121), *h1* 33 (29–33), *h2* 135 (126–135), *h3* 65 (61–66), *h4* 34 (30–34).

Idiosomal venter – (Figs 1B, 4C, D, 5A, 6). Propodosomal venter finely striated between legs I–II and with ovate microsculpture posteriad legs; metapodosomal venter with elongate reticulate pattern (Fig. 4D); genital and anal areas finely striated, other parts of ventral opisthosoma with ovate microsculpture. All ventral setae pointed; setae *1a*, *3a*, *3b*, 4a, *4b*, *ag1*, *ag2*, *g1–g3* smooth; setae *ps1–3* weakly barbed; setae *1b*, *1c*, *2b* and *2c* distinctly barbed. Internal genitalia with long and narrow insemination canal (Fig. 6). Length of ventral setae: *1a* 92 (88–96), *1b* 27 (26–28), *1c* 21 (17–21), *2b* 19 (19–37), *2c* 64 (62–67), *3a* 38 (38–41), *3b* 18 (18–19), *4a* 39 (30–39), *4b* 18 (17–19), *ag1* 30 (27–30), *ag2* 16 (16–18), *g1* 16 (15–16), *g2* 9 (9–10), *g3* 8 (8–13), *ps1* 16 (15–16), *ps2* 15 (14–16), *ps3* 13 (12–13).

Legs – (Figs 3, 5D). Leg I (Figs 3A, 5D). Leg setation: Tr 1 (*v′*), Fe 5 (*d*, *l′*, *l″*, *v′*, *bv″*), Ge 5 (*d*, *l′*, *l″*, *v′*, *v″*), Ti 5(1) (*d*, *l′*, *l″*, *v′*, *v″*, *φ*), Ta 11(2) (*p′ξ*, *p″ξ*, *tc′*, *tc″ξ*, *ft′*, *ft″*, *a′*, *a″*, *u′*, *u″*, *pl″*, *ω1*, *ω2*). All solenidia ovate in outline (Fig. 5D); solenidion *φ* located ventrally anterolaterad seta *v″*; length of solenidia: *ω1* 6 (6), *ω2* 4 (4), *φ* 3 (3). Setae (*p*) and *tc″* of tarsus smooth, blunt-tipped, eupathid-like; setae (*u*) smooth and pointed; other setae barbed and pointed. Setae

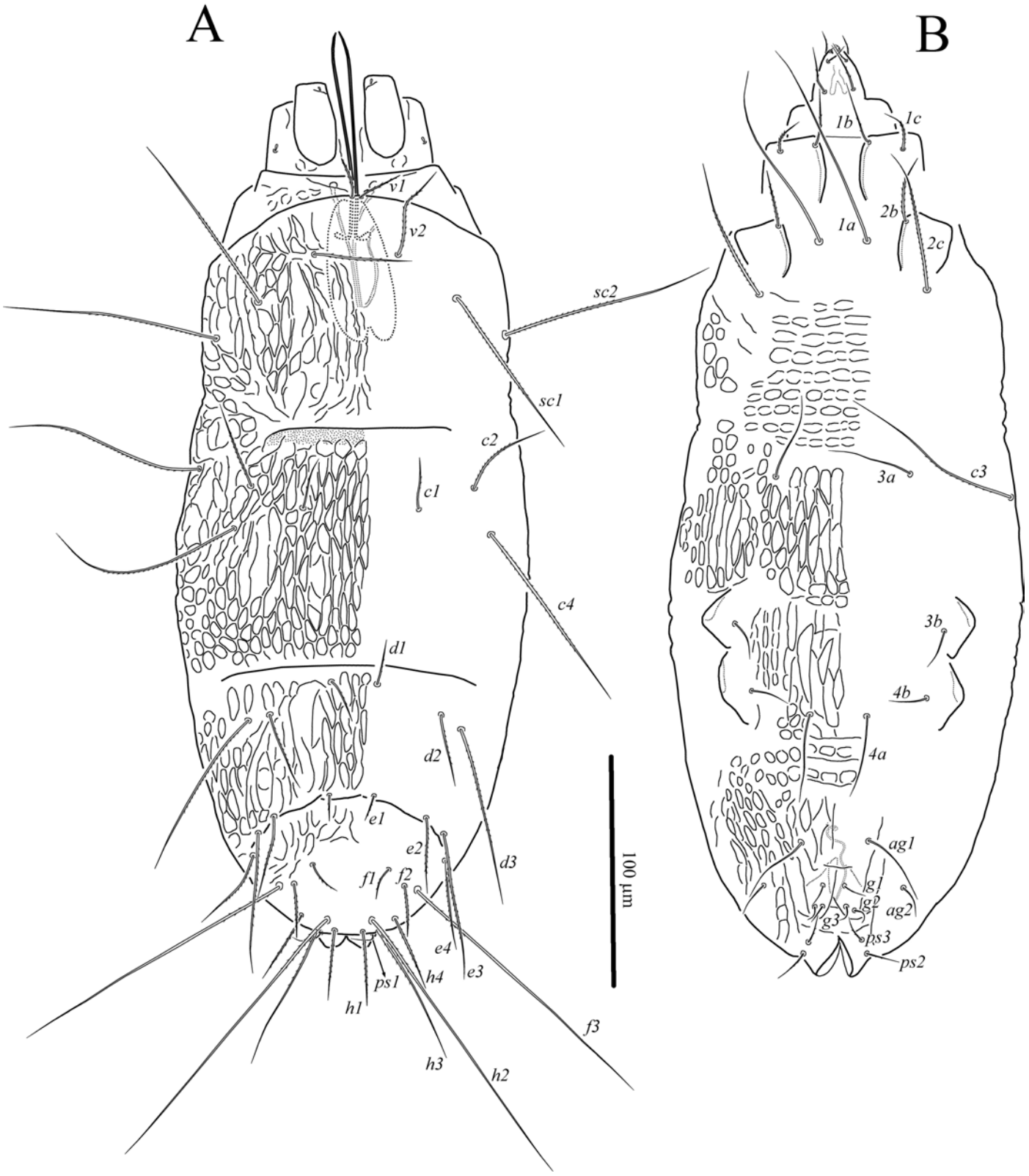


Figure 1 *Linotetranus sibiriensis* **n. sp.**, female: A – dorsum of body, B – venter of body. Legs omitted.

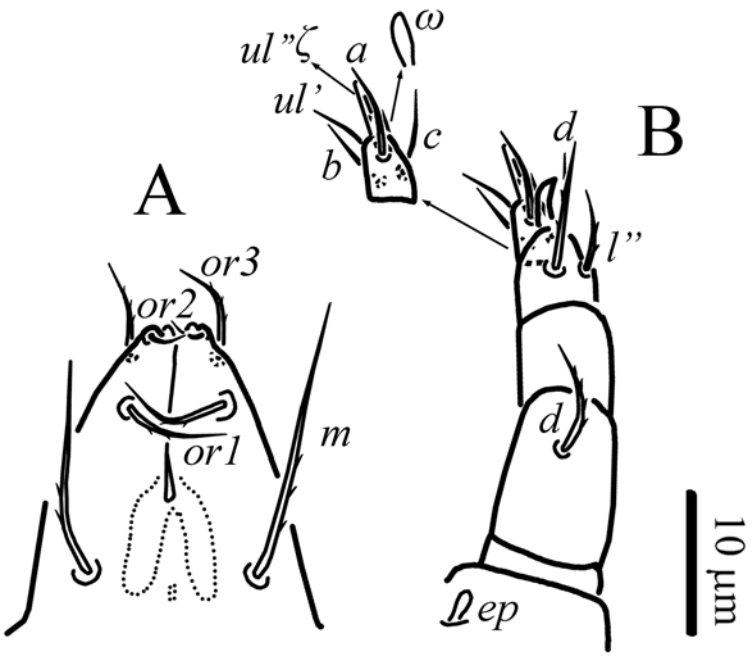


Figure 2 *Linotetranus sibiriensis* **n. sp.**, female: A – subcapitulum, B – right palp, dorsal aspect.

(*tc*) situated on short protuberances. Leg supracoxal seta (*el*) short, peg-like. Leg II (Fig. 3B). Leg setation: Tr 1 (*v′*), Fe 3 (*d*, *v′*, *bv″*), Ge 2 (*l′*, *l″*), Ti 4 (*d*, *l″*, *v′, v″*), Ta 7(1) (*tc′*, *tc″*, *ft′*, *ft″*, *u′*, *u″*, *pl″*, *ω*). Solenidion *ω* 6 (5–6) ovate in outline. All setae barbed; seta *l′* of genu weakly blunt-tipped; other setae pointed. Leg III (Fig. 3C). Leg setation: Tr 1 (*v′*), Fe 2 (*d*, *ev′*), Ge 1 (*v′*), Ti 3 (*d*, *v′, v″*), Ta 4 (*ft′*, *ft″*, *u′*, *u″*). All setae barbed; setae (*v*) of tibia and *ft″* of tarsus weakly blunt-tipped; other setae pointed. Leg IV (Fig. 3D). Leg setation: Tr 0, Fe 1 (*ev′*), Ge 0, Ti 4 (*d*, *l″*, *v′, v″*), Ta 4 (*ft′*, *ft″*, *u′*, *u″*). All setae barbed; setae (*v*) of tibia and *ft″* of tarsus weakly blunt-tipped; other setae pointed.

Male and immatures unknown.

Type material

Holotype female, slide ZISP T-Lin-1, Russia, Kurgan Region, Petuknovsky District, vicinity of lake Medvezh′ye, 14 October 2022, soil in the steppe, 55°14′11″N 68°01′15″E, coll. A. A. Khaustov and V.A. Khaustov; paratypes: 32 females, same data.

Type deposition

The holotype female and two paratypes females are deposited in the collection of ZIRAS; other paratypes are deposited in the collection of the TSUM Z.

Differential diagnosis

Female of the new species is most similar to *Linotetranus astragalusi* and *L. eghbaliani*, described from Iran (Khanjani *et al.* 2011, 2012) sharing the following characters: setae *e4* present, three pairs of genital setae, palpgenu without seta, palptibia with two setae, genu I with five setae, setae *h2* the longest dorsal setae. The new species differs from *L. eghbaliani* in having setae *v1* not modified (vs. setae *v1* bifurcate in distal part in *L. eghbaliani*); in

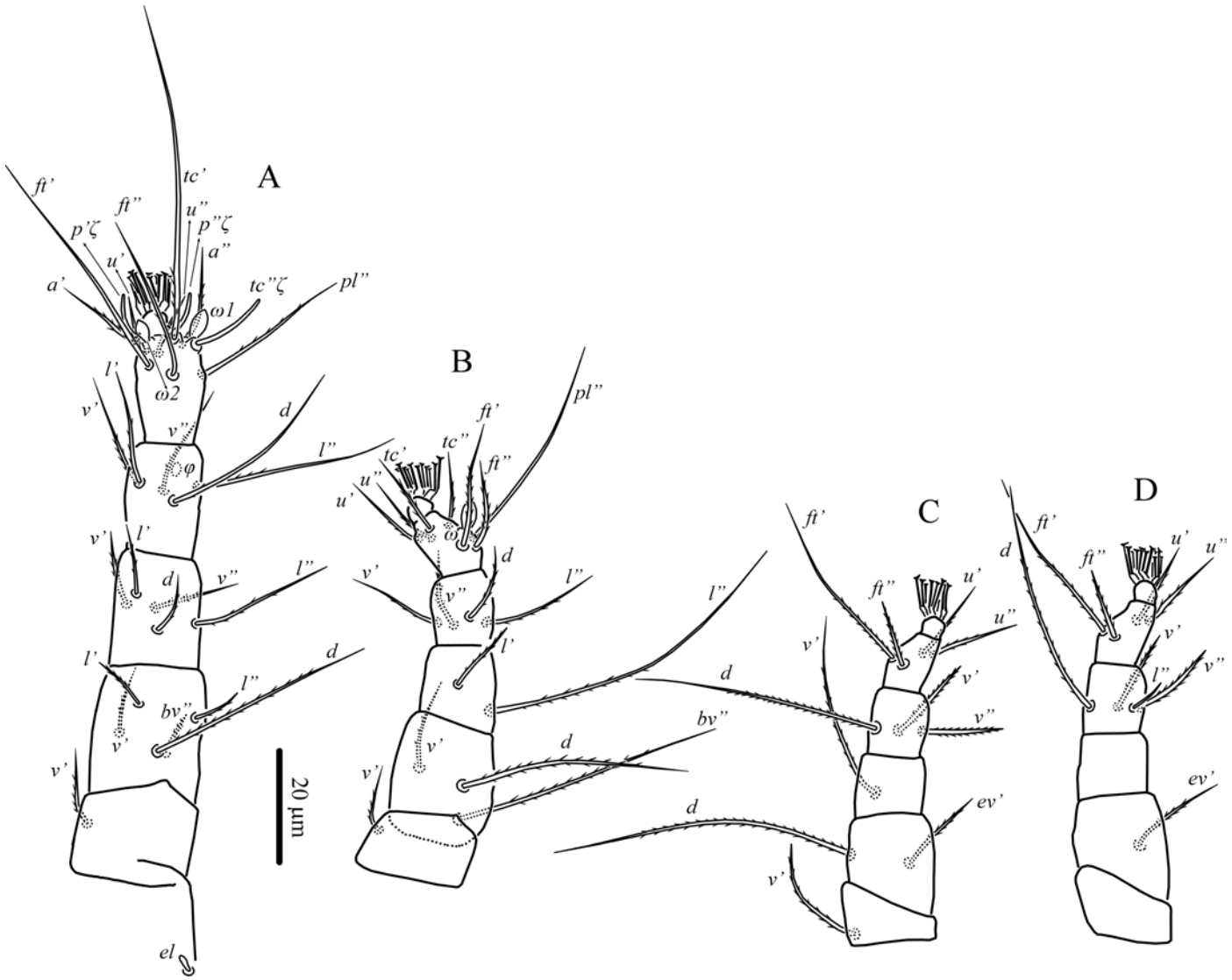


Figure 3 *Linotetranus sibiriensis* **n. sp.**, female: A-D – right legs I-IV, dorsal aspect.

having seta *d* of tibia I very long, subequal to *l″* of tibia I (*d* almost twice shorter than *l″* in *L. eghbaliani*); and in having different setal lengths *sc2* 88–95, *d2* 32–41, *d3* 72–79, *e2* 34–45, *f2* 24–25, *h1* 29–33, *h4* 30–34 (vs. *sc2* 75–79, *d2* 50–57, *d3* 87–89, *e2* 55–60, *f2* 32–34, *h1* 41–45, *h4* 41–43 in *L. eghbaliani*). The new species differs from *L. astragalusi* in having seta *ft′* on tarsi III and IV more than twice longer than *ft″* (vs. setae *ft′* and *ft″* on tarsi III and IV subequal in *L. astragalusi*); in having seta *pl″* on tarsus II distinctly longer than combined length of tibia and tarsus II (vs. seta *pl″* on tarsus II approximately as long as tarsus II in *L. astragalusi*); in having seta *v′* on femur II shorter than length of femur II (vs. seta *v′* on femur II almost as long as combined length of femur and genu II in *L. astragalusi*); and in having different setal lengths *v2* 43–46, *c1* 23–28, *d1* 20–24, *e2* 34–45, *e4* 33–43, and *h2* 126–135 (vs. *v2* 32–34, *c1* 16–17, *d1* 14–16, *e2* 27–30, *e4* 27–29, and *h2* 152–153 in *L. astragalusi*).

Etymology

The name of the new species *sibiriensis* refers to its geographical distribution in Western Siberia.

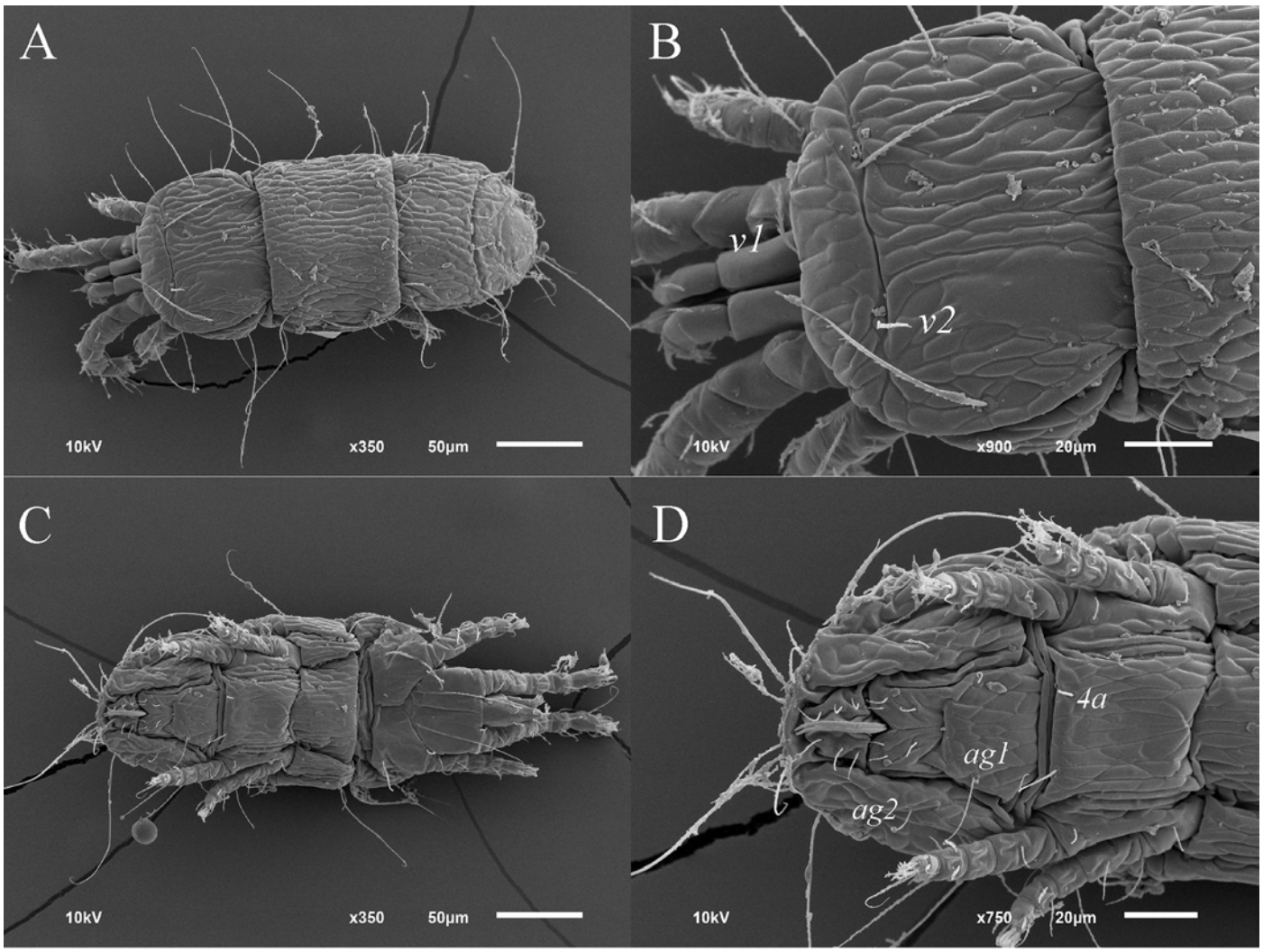


Figure 4 SEM micrographs of *Linotetranus sibiriensis* **n. sp.**, female: A – general view dorsally, B – prosoma, dorsal aspect, C – general view ventrally, D – hysterosoma, ventral aspect.

Key to the world species of *Linotetranus*

Based on females (after Tassi *et al.* 2020, with modifications).

1. Setae *e4* absent 2
— Setae *e4* present 3

2. Palpgenu with one seta . . . . . *L. achrous*
— Palpgenu without seta . . . . . *L. faemensis*

3. Three pairs of genital setae 4
— Two pairs of genital setae . . . . . *L. ramosus*

4. Dorsal opisthosoma posterior setae *e1* smooth or with irregular striae 5
— Dorsal opisthosoma posterior setae *e1* transversely striated . . . . . *L. protractulus*

5. Palptibia with one seta 6

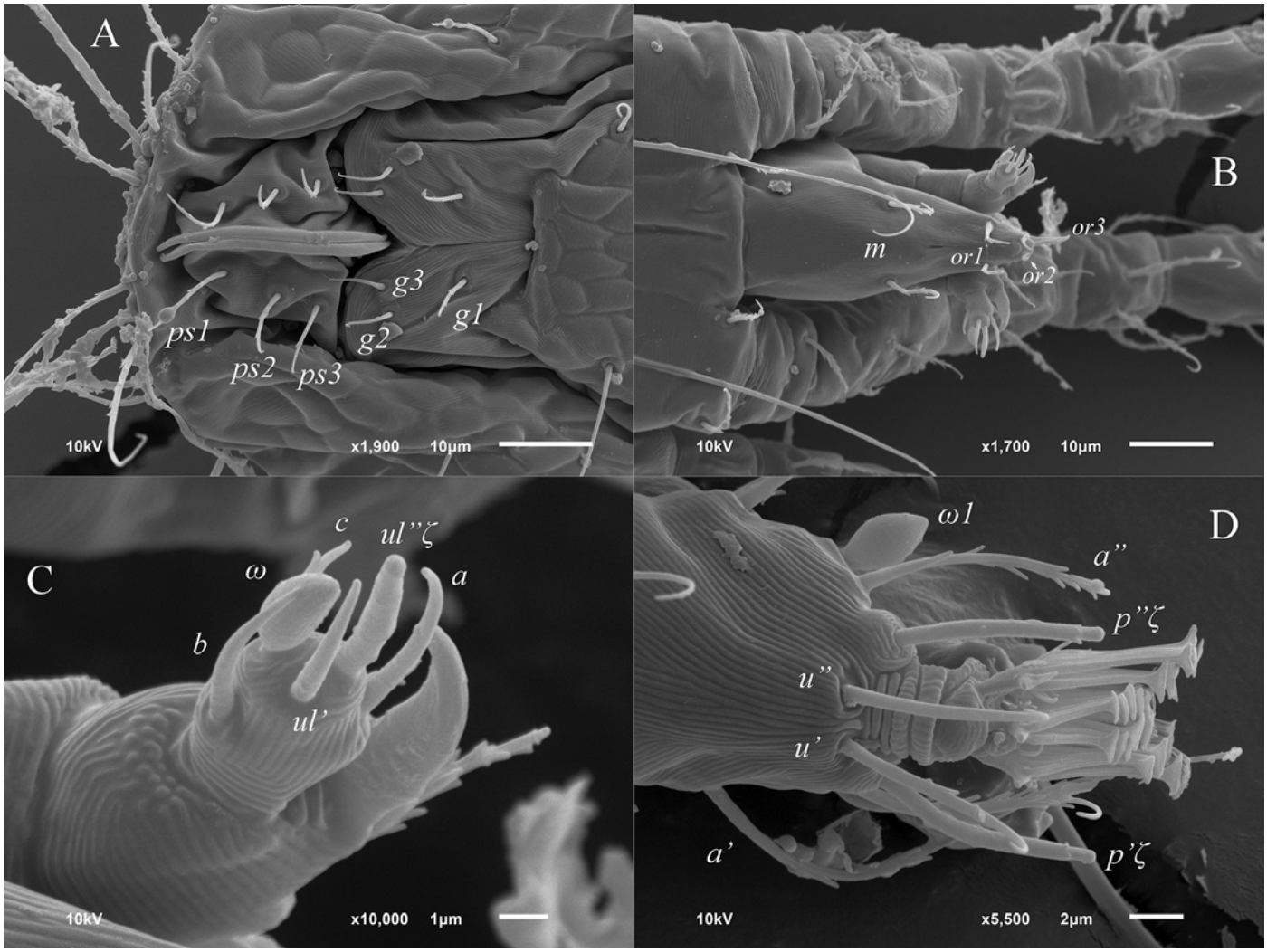


Figure 5 SEM micrographs of *Linotetranus sibiriensis* **n. sp.**, female: A – ano-genital area, B – gnathosoma, ventral aspect, C – tibia and tarsus of right palp, ventrolateral aspect, D – right tarsus I, ventral aspect.

— Palptibia with two setae 7

6. Palpgenu with one seta . . . . . *L. cylindricus*
— Palpgenu without seta . . . . . *L. amiculus*

7. Genu I with five setae 8
— Genu I with four setae . . . . . *L. edenvillensis*

8. Palpgenu without seta 9
— Palpgenu with seta 14

9. Tibia III with three setae 10
— Tibia III with four setae . . . . . *L. mirabebensis*

10. Setae *f3* subequal or shorter than *h2* 11
— Setae *f3* distinctly longer than h2 . . . . . *L. annae*

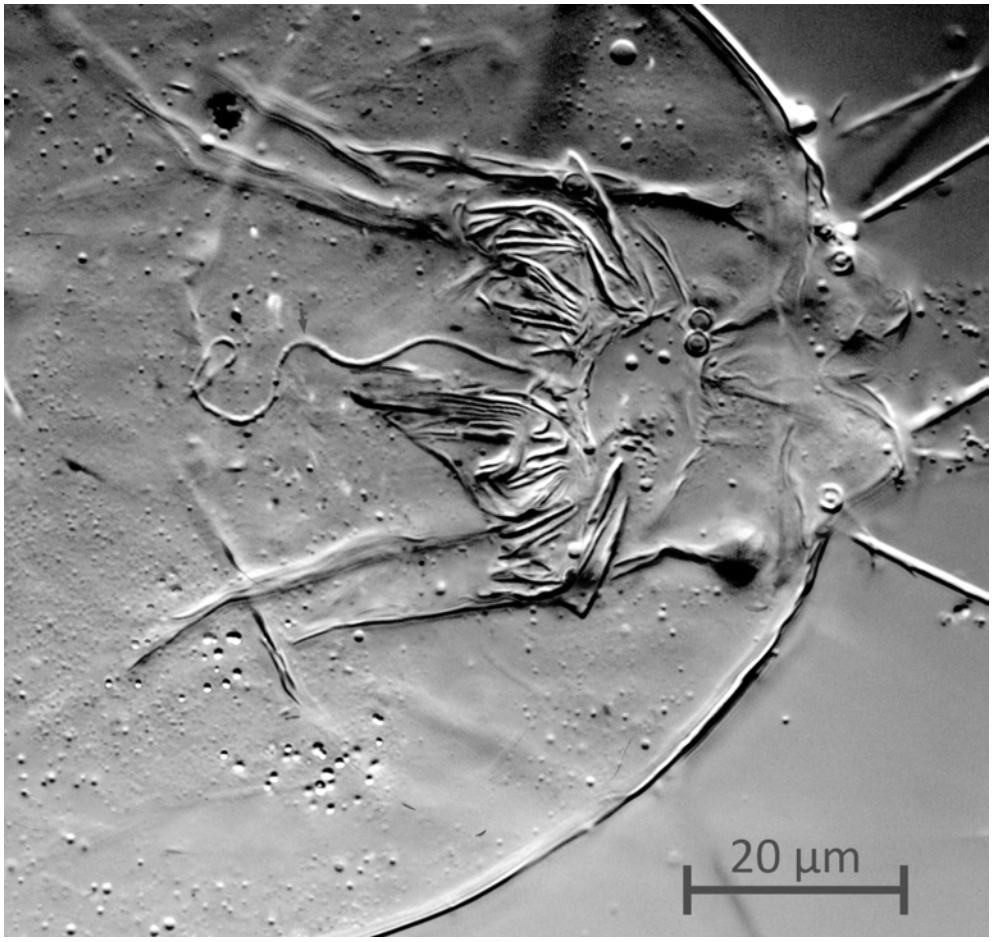


Figure 6 DIC micrograph of *Linotetranus sibiriensis* **n. sp.**, female: internal genitalia, arrows point to insemination canal.

11. Palptarsus with one eupathidium; hysterosoma dorsally without two pairs of smooth rosettes between setal rows *d* and *e*; bases of setae *v1* almost contiguos 12
— Palptarsus with three eupathidia; hysterosoma dorsally with two pairs of smooth rosettes between setal rows *d* and *e*; bases of setae *v1* widely separated . . . . . *L. anatolicus*

12. Setae *v1* not bifurcate distally 13
— Setae *v1* bifurcate distally . . . . . *L. eghbaliani*

13. Seta *ft′* on tarsi III and IV more than twice longer than *ft″*; seta *pl″* on tarsus II distinctly longer than combined length of tibia and tarsus II; seta *v′* on femur II shorter than length of femur II . . . . . *L. sibiriensis* **n. sp.**
— Setae *ft′* and *ft″* on tarsi III and IV subequal in length; seta *pl″* on tarsus II approximately as long as tarsus II; seta *v′* on femur II almost as long as combined length of femur and genu II . . . . . *L. astragalusi*

14. Setae *l″* on genua I and II distinctly longer than other setae on segments; setae *e2* 54–66 . . . . . *L. niknami*
— Setae *l″* on genua I and II subequal with other setae on segments; setae *e2* 95–115 . . . . . *L. iraniensis*

Discussion

During this research and using of electron microscopy we found three pairs of adoral setae in *Linotetranus*. One of them (designated as *or2* on Fig. 2A) is very small and hardly visible in light microscope, however clearly discernible on the SEM image (Fig. 6B). Most likely these setae were missed in all previous descriptions of Linotetranidae. Three pairs of adoral setae in Linotetranidae are correlated with same number in Tetranychidae (Lindquist 1985).

In some previous articles authors designated posterolateral setae on coxisternal fields II as *2a* (Beard and Walter 2004; Doğan *et al.* 2010; Khanjani *et al.* 2011, 2012; Tassi *et al.* 2020). Yet, according to the phylogenetic analysis of Eleutherengona provided by Bochkov *et al.* (2008), setae *2a* are absent in the superfamilies Tetranychoidea, Raphignathoidea and Cheyletoidea. For this reason, in our work, we designated this pair of setae as *2c* and homologous to those in sister-family Tenuipalpidae.

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