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A new genus and species of Tarsonemidae (Acari: Heterostigmata) associated with *Aradus betulae* (Heteroptera: Aradidae) from European Russia

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ABSTRACT — A new genus and species, *Lobotarsonemus betulae* **n. gen., n. sp.** (Acari: Tarsonemidae), is described based on phoretic females collected under the hemielytra of the aradid bug *Aradus betulae* (Linnaeus, 1758) (Heteroptera: Aradidae) in European Russia.

KEYWORDS — Heterostigmata; Tarsonemoidea; systematics; morphology; phoresy

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INTRODUCTION

The family Tarsonemidae is one of the largest groups in Heterostigmata and currently includes 42 genera and more than 600 species (Zhang *et al.* 2011; Lofego *et al.* 2016). Members of the family are phytophagous, mycophagous, parasites and parasitoids of insects, and predators preying on mite eggs (Lindquist 1986). Tarsonemid mites inhabit soils and litter, various plants, subcortical galleries of insects, etc. Many species utilize insects for phoresy (Lindquist 1986). The insect-associated Tarsonemidae of Russia are insufficiently studied. Most of them are known as associates of subcortical insects, especially bark beetles (Khaustov 1998, 2001; Magowski and Khaustov 1999, 2006; Khaustov and Magowski 2003; Khaustov *et al.* 2016). During the study of mites associated with insects, a new

genus and species of Tarsonemidae was revealed. The aim of this article is to describe a new genus and a new species associated with the aradid bug *Aradus betulae* from European Russia.

MATERIALS AND METHODS

Mites were collected from under hemielytra of single specimen of an aradid bug *Aradus betulae* (Linnaeus, 1758) and mounted in Hoyer's medium. The terminology follows that of Lindquist (1986), except the ventral subcapitular seta is labeled *su* (Seeman *et al.* 2016). All measurements are given in micrometers (µm) for the holotype and five female paratypes (in parentheses). For leg chaetotaxy the number of solenidia is given in parentheses. DIC micrographs were taken using the Carl Zeiss Axio Imager A2 compound microscope and digital Cameras Axio-

cam 506 color and Hitachi KP-HD20A. The holotypes and most paratypes of the new species are deposited in the mite collection of the Tyumen State University Museum of Zoology, Tyumen, Russia; two female paratypes of the new species are deposited in the acarological collection of the Zoological Institute of RAS, St. Petersburg, Russia.

RESULTS

SYSTEMATICS

Family Tarsonemidae

Canestrini and Fanzago, 1877

Genus *Lobotarsonemus* n. gen.

Zoobank: [B6B538B6-D0B8-4839-B62F-8B5C807EEDAA](https://doi.org/10.21203/rs.3.rs-1234567)

Type species: *Lobotarsonemus betulae* n. sp.

Differential diagnosis — Females of *Lobotarsonemus* n. gen. resemble those of *Rhynchotarsonemus* Beer, 1954 from the tribe Tarsonemini in having a beaklike gnathosoma and in having legs IV much shorter than leg III. They also resemble those of *Suskia* Lindquist, 1986 from the tribe Steneotarsonemini in having the gnathosoma strongly prolonged, beaklike and retain seta pl'' on tarsus II. Females of *Lobotarsonemus* differ from those of both other genera in having three large lobes on anterior part of poststernal plate, by the presence of dorsodistal projections on tarsi II and III and by absence of seta $v'Fe$ on femorogenu IV. Females of *Lobotarsonemus* n. gen. also resemble those of *Biscutulumnemus* Lofego and Feres, 2006 from the tribe Tarsonemini in having the gnathosoma strongly prolonged, strongly reduced poststernal apodeme and retain seta pl'' on tarsus II. Females of *Lobotarsonemus* differ from *Biscutulumnemus* in having three large lobes on anterior part of poststernal plate, by the presence of dorsodistal projections on tarsi II and III and by absence of seta $v'Fe$ on femorogenu IV.

Remarks — *Lobotarsonemus* keys to couplet 17 of Lindquist (1986) which separates *Suskia* and *Rhynchotarsonemus* on the basis of their beak-like gnathosoma. These genera are placed in different tribes

– Steneotarsonemini and Tarsonemini, respectively – showing that Lindquist (1986) thought that the beak-like gnathosoma was independently derived. *Lobotarsonemus* is best placed in the Steneotarsonemini because of its reduced sejugal apodeme; in the Tarsonemini this apodeme is complete. *Lobotarsonemus* is also closer to *Suskia* in its retention of a spine-like pl'' on tarsus II and solenidion φ_2 on leg I, and on femur I seta l' is not enlarged, and seta v'' is not on a finger-like apophysis.

Description

Female

Gnathosoma — Capsule much longer than wide, strongly prolonged, beaklike, anteriorly; palpcoxal setae (pp) present laterally. Dorsal gnathosomal setae smooth, simple. Palpi directed anteriorly, parallel, strongly elongate, each with one minute setae and inconspicuous processes near distal extremity. Cheliceral stylets long, straight, attached to basal levers functioning in dorsoventral plane. Pharynx thin, with muscular, thinly sclerotized walls, and with conspicuous paired gland-like structures posteriorly.

Idiosoma — Dorsal shielding unornamented, with setae collectively slender, smooth. Prodorsal shield weakly extended. Stigmata projecting slightly from margins of prodorsal shield, situated closely posterolaterad setae v_1 ; main tracheal trunks with unsclerotized atria, and lacking sclerotized or divided postatrial structures. Bothridia present, with capitate sensilla sc_1 only basally covered by prodorsal shield. Posterior margins of tergites not conspicuously emarginate or concave. Ventral shielding with apodemes 1 forming Y-shaped juncture with prosternal apodeme. Apodemes 2 not united with prosternal apodeme. Prosternal apodeme with gap, not united with sejugal apodeme, but continuous along length to level of medial extremities of apodemes 2. Sejugal apodeme developed only laterally. Apodemes 3 not extending laterad of trochanters III, nor mediad setae $3a$. Apodemes 4 absent. Poststernal apodeme strongly reduced. Anterior margin of posterior sternal plate

with three large lobes (Figure 5B). Two pairs of coxal setae on metapodosomal venter; setae *3c*, and *4a* between legs IV, absent. Bases of legs IV moderately well-spaced, separated by interval of about three times the width of trochanter IV; tegula moderately long, rounded apically. Aggenital plate lacking setae. Pseudanal setae present.

Legs — Ambulacrum of leg I with single, typically uncinated claw. Ambulacra of legs II and III with empodium and well-developed, symmetrically paired claws. Tarsi II and III with distinct dorsodistal projections just anterior of setae *tc*". Femur I without apophysis; femur II without ventral flange. Legs I and II of moderate length, with none of segments unusually elongated. Trochanter III of adult female elongate, subelliptical, plate-like, longer than femorogenu III. Leg IV elongate-cylindrical, about twice shorter than leg III, with femorogenu at least 1.5 times as long as tibiotarsus; femorogenu with one seta *v'Fe*, seta *v'Ge* absent; trochanter no longer than tibiotarsus. Number of setae and solenidia on femur, genu, tibia, and tarsus, respectively: leg I: 4-4-6(2 φ) + 6(*lw*); leg II: 3-3-4-5(*lw*); leg III: 1+3-4-4. Tarsal setation of leg I lacking setae *pv*", *pl*" and (*u*), and with subunguinal seta spine-like; tectal longer than proral eupathidia; tarsus II with spine-like seta *pl*". Seta *u'* on tarsi II and III spinelike, with rounded tip.

Male and larva unknown.

Species included — The genus *Lobotarsonemus* includes one species, *L. betulae* **n. sp.**

Distribution and habitat — *Lobotarsonemus betulae* **n. sp.** is phoretic under hemielytra of *Aradus betulae* (Linnaeus, 1758) in European Russia.

Etymology — The name of the new genus is a combination of two words, the Latin *lobus* meaning *lobe*, and *Tarsonemus*, the type genus of the family Tarsonemidae and refers to the presence of three unusual lobes on anterior margin of posterior sternal plate.

Lobotarsonemus betulae **n. sp.** (Figures 1–5)

Zoobank: 37AAF394-AB56-4132-9E84-291CFC7D5826

Description

Female (Figures 1–5) — Length of idiosoma 210 (205 – 215), width 105 (105 – 110).

Gnathosoma (Figure 5A) — Length of gnathosomal capsule 45 (44 – 46), width 22 (20 – 23). Dorso-median apodeme well developed, extending nearly entire distance from union basally with circumcapitular apodeme to level of insertion of dorsal gnathosomal setae (*ch*). Gnathosoma with dorsal pair of setae *ch* 14 (12 – 14) slightly shorter than subcapitular setae *su* 20 (18 – 20); both setae slender and smooth. Palpcoxal setae (*pp*) slightly shorter than *ch*, slender and pointed. Palps very long 23 (22 – 23).

Idiosomal dorsum (Figures 1A, 4A, C, D) — Prodorsal shield (Figure 4C) with uniform small round dimples, subtriangular, with anterior margin not hood-like over gnathosoma. Prodorsum with well-developed ω -like median apodeme. Pseudostigmatic organs capitate, ellipsoidal, finely spiculate and rounded apically. Pits *v*₂ located anterolaterally to bases of setae *sc*₂. All dorsal idiosomal setae smooth, pointed. All hysterosomal tergites with uniform small dimples (Figure 4D). Tergite EF with large, round porous areas located anteriorly to setae *f*. Lengths of dorsal setae: *v*₁ 21 (20 – 21), *sc*₂ 39 (38 – 40), *c*₁ 18 (17 – 19), *c*₂ 32 (31 – 33), *d* 15 (14 – 16), *e* 19 (18 – 20), *f* 18 (18 – 21), *h* 21 (19 – 22). Distances between setae: *v*₁–*v*₁ 21 (21 – 22), *v*₂–*v*₂ 35 (35 – 36), *sc*₂–*sc*₂ 32 (31 – 32), *c*₁–*c*₁ 70 (64 – 70), *c*₂–*c*₂ 92 (88 – 93), *c*₁–*c*₂ 32 (21 – 32), *d*–*d* 49 (44 – 50), *e*–*e* 67 (65 – 67), *e*–*f* 18 (17 – 19), *f*–*f* 33 (31 – 33), *h*–*h* 43 (41 – 44).

Idiosomal venter (Figures 1B, 4B, E, F, 5B) — All ventral plates with uniform, very small dimples. All ventral setae smooth, pointed. Pits *1b* very small, in some specimens indiscernible; pits *2b* large, elongate. Posterior margin of aggenital plate with short tongue-like projection. Setae *1a* located just near apodemes 1 or slightly removed posteriorly; setae *2a* located on apodemes 2. Lengths of ventral setae: *1a* 9 (8 – 9), *2a* 14 (13 – 14), *3a* 14 (14 – 15), *3b* 11 (11 – 12), *ps* 15 (14 – 15).

FIGURE 1: *Lobotarsonemus betulae* n. sp., female: A – dorsum of the body, B – venter of the body. Legs omitted.

FIGURE 2: *Lobotarsonemus betulae* n. sp., female: A – right leg I in dorsal view, B – right leg II in dorsal view.

FIGURE 3: *Lobotarsonemus betulae* n. sp., female: A – right leg III in ventral view, B – right leg IV in ventral view.

FIGURE 4: DIC micrographs of *Lobotarsonemus betulae* n. sp. female: A – body in dorsal view, B – body in ventral view, C – prodorsum, D – hysterosoma in dorsal view, E – anterior half of the body in ventral view, F – posterior half of the body in ventral view.

FIGURE 5: DIC micrographs of *Lobotarsonemus betulae* n. sp. female: A – gnathosoma in ventral view, B – anterior part of posterior sternal plate, C – leg II in dorsal view, D – leg III in dorsal view. Arrow points to dorsodistal projection.

Legs (Figures 2, 3, 5C, D) — Lengths of legs: I 52 (50 – 53), II 53 (52 – 54), III 42 (40 – 42), IV 23 (22 – 24). Leg I (Figure 2A). Solenidia ω , φ_1 and φ_2 capitate; seta k 3 (3) rod-shaped, subequal to solenidion φ_2 . Lengths of solenidia: ω 4 (4), φ_1 4 (4), φ_2 3 (3). Setae d , l' of femur, l' , v' of genu, l' , v' of tibia blunt-ended and smooth; other leg setae (except eupathidia) pointed and smooth. Leg II (Figures 2B, 5C). Solenidion ω 3 (3) capitate. Setae d , l' of femur, l' , v' of genu, and l' of tibia blunt-ended and smooth; setae v'' of femur and v' of tibia weakly barbed; other leg setae pointed and smooth. Leg III (Figures 3A, 5D). Setae v' of femur and l' of genu blunt-ended, smooth; seta u' with basal projection; other leg setae pointed and smooth. Leg IV (Figure 3B). All leg setae pointed and smooth. Seta tc'' very long.

Type material — Female holotype, slide VA130416, Tula Province, vicinity of Suvorov town, 13 April 2016, under hemielytra of bug *Aradus betulae* (Linnaeus, 1758), coll. V.A. Abramov. Paratypes: 10 females, same data.

Etymology — The specific epithet of the new

species is derived from the name of its phoretic host *Aradus betulae*.

DISCUSSION

Specimens of the newly described genus and species were collected under hemielytra of aradid bugs. In our opinion, they are phoretic rather than parasitic on insect host, because junior author collected *Lobotarsonemus betulae* on aradid bugs only during late April and May, also we did not find eggs, males or larvae on the insect host and not observed physogastry of females. Tarsonemid mites are known phoretic on various insects such as subcortical beetles (Coleoptera: Cerambycidae, Curculionidae), hispine beetles (Coleoptera: Chrysomelidae), fig wasps (Hymenoptera: Agaonidae), and bees (Hymenoptera: Apidae) (Lindquist 1986; Ochoa and OConnor 1996; Khaustov and Magowski 2003). The phoretic association of tarsonemid mites with Heteroptera was recorded only one time: *Ceratotarsonemus teqmen* Lin and Zhang, 1995 on aradid bug

Mezira sp. (Lin, Zhang 1995; Ochoa *et al.* 1997), although members of the Coreitarsonemini are presumed to parasitic in the odiferous glands of stink bugs (Lindquist 1986). The phoresy of *Lobotarsonemus betulae* under hemielytra of *Aradus betulae* is represented the second phoretic association of Tarsonemidae with bugs of the family Aradidae and first record on bugs of the genus *Aradus*.

Lobotarsonemus betulae is characterized by the presence of unusual three lobes on anterior margin of poststernal plate. This character is unknown in any tarsonemid genus. Similar lobes are known only in the genus *Pseudotarsonemoides* Vitzthum, 1921 (subfamily Pseudotarsonemoidinae), but in *Pseudotarsonemoides* there are only two lobes overlapping each other, the median lobe is absent. These lobes are very likely to be independently derived as the Pseudotarsonemoidinae is a well-defined subfamily of Tarsonemidae and *Lobotarsonemus* is clearly a member of the Tarsoneminae.

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