A NEW SPECIES OF *TYPHLODROMUS* (*ANTHOSEIUS*) DE LEON (ACARI: MESOSTIGMATA: PHYTOSEIIDAE) FROM SAKHALIN ISLAND, RUSSIA

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ABSTRACT: *Typhlodromus* (*Anthoseius*) *levis* sp. n. (Acari: Phytoseiidae) is described and illustrated based on adult specimens collected from soil on the shore of Lake Tunaycha, Sakhalin Island, Russia.

KEY WORDS: Predatory mites, fauna, Typhlodromini, Sakhalin, taxonomy.

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INTRODUCTION

Members of family Phytoseiidae (Acari: Mesostigmata) are commonly used in Integrated Pest Management programs as biological agents of phytophagous arthropods, such as spider mites, thrips, whiteflies, and free living nematodes (McMurtry *et al.*, 2013).

The subgenus *Typhlodromus* (*Anthoseius*) De Leon (1959), belonging to the subfamily Typhlodrominae, is one of the largest groups of predators in the family Phytoseiidae, with about 390 described species, including synonyms (Kolodochka, 2006; Chant and McMurtry, 2007; Demite *et al.*, 2021, Döker *et al.*, 2021). The species in this subgenus can be distinguished from *Typhlodromus* (*Typhlodromus*) Scheuten, a closely related subgenus, by the presence of dorsal seta *S5* (Chant and McMurtry, 1994).

To date, four phytoseiid species have been recorded from Sakhalin Island, Russia, and this includes only one species from the subgenus *Typhlodromus* (*Anthoseius*), namely *Typhlodromus* (*Anthoseius*) *povtari* (Kolodochka, 1988). In this paper, we provide a complete description of a new species, *Typhlodromus* (*Anthoseius*) *levis* Khaustov and Döker sp. n., based on female and male specimens, collected from soil on Sakhalin Island, Russia.

MATERIALS AND METHODS

Soil samples were collected during a zoological expedition to Sakhalin Island, Russia, in August 2021. The mites were extracted using Berlese–Tullgren funnels and further preserved in vials with 96% ethanol. The specimens were cleared in lactophenol and mounted in Hoyer's medium for detailed morphological study. The taxonomic system follows that of Chant and McMurtry (2007).

The setal nomenclature for the dorsal idiosoma follows that of Lindquist and Evans (1965), as adapted by Rowell *et al.* (1978) and Chand and Yoshida-Shaul (1992). The setal nomenclature for the ventral idiosoma follows that of Chant and Yoshida-Shaul (1991). The chaetotaxy of legs and palps follows that of Evans (1963a, b). Adenotaxy and poroidotaxy nomenclature follows that of Athias-Henriot (1975) for the dorsal idiosoma, and Johnston and Moraza (1991) for the ventral idiosoma. The terminology of the morphological structures of spermatodactyl follows that of Beard (2001). Measurements are presented in micrometers (μm) as a mean, followed by a range in parentheses. Morphological observations, illustrations and measurements were prepared using the Axio Imager A2 compound microscope (Carl Zeiss, Germany), equipped with the differential interference contrast (DIC) and the phase contrast optical systems. Figures were prepared with Adobe Photoshop CS2 software using a graphic tablet Wacom Cintiq 16. Photomicrographs were taken with an AxioCam 506 camera (Carl Zeiss, Germany). Type materials are deposited at the mite collection of the Tyumen State University Museum of Zoology, Tyumen, Russia (TSUMZ).

SYSTEMATICS

Family Phytoseiidae Berlese, 1916
Genus *Typhlodromus* Scheuten, 1857
Subgenus *Anthoseius* De Leon, 1959

***Typhlodromus* (*Anthoseius*) *levis*
Khaustov and Döker sp. n.**

Figs. 1–6

Fig. 1. *Typhlodromus (Anthoseius) levis* sp.n., holotype female. A—dorsal idiosoma; 2—ventral idiosoma.

Diagnosis (adult female and male). Dorsal shield oval and elongated, smooth, with some anterolateral reticulations, with three pairs of solenostomes (*gd2*, *gd6*, and *gd9*). Dorsal setae smooth and setiform except *Z5*, slightly serrated in female, seta *z4* slightly displaced medially. Peritreme extending to level between *j1* and *j3*. Sternal shield smooth, with two pairs of setae, third seta *ST3* inserted on soft cuticle. Genital shield smooth. Ventrianal shield smooth, bearing four pairs of preanal setae and one pair of small rounded pores (*gv3*). Calyx of spermatheca tubular, with almost parallel walls, flaring distally; atrium nodular, incorporated to calyx. Fixed digit of chelicera with five teeth and pilus dentilis; movable digit with three teeth. Genu II with seven setae. Three macrosetae present on leg IV. Ventrianal shield of male with five pairs of preanal setae. Male spermatophoral process L-shaped.

Description: *Female* (n=12) (Figs. 1–5).

Dorsum (Figs. 1A, 5A). Dorsal setal pattern 12A:8A (setae *r3* and *R1* off shield). Dorsal shield oval and elongated, smooth, with some anterolateral reticulation, with slight waist at level of setae *R1*. Dorsal shield with three pairs of solenostomes (*gd2*, *gd6*, and *gd9*) and 13 pairs of visible poroids (*idl1* off shield). Muscle-marks (sigillae) visible mostly on podosoma, length of dorsal shield 340 (326–372), width (at level of *s4*) 178 (172–190), width (at level of *S2*) 173 (165–186). All dorsal setae smooth, except *Z5* slightly serrated, seta *z4* slightly displaced medially. Measurements of dorsal setae as follows: *j1* 23 (20–25), *j3* 24 (22–25), *j4* 15 (14–16), *j5* 15 (14–16), *j6* 18 (17–20), *J2* 16 (14–17), *J5* 6 (6–7), *z2* 13 (12–14), *z3* 21 (18–22), *z4* 25 (23–26), *z5* 15 (13–16), *Z4* 33 (31–36), *Z5* 52 (48–55), *s4* 27 (26–29), *s6* 30 (28–32), *S2* 27

Fig. 2. *Typhlodromus* (*Anthoseius*) *levis* sp.n., female. A—subcapitulum; B—chelicera; C—dorsal view of right palptarsus; D—spermathecae; E—dorsal view of right palp (trochanter-tibia); F—anterior margin of epistome.

(26–31), *S4* 26 (23–29), *S5* 25 (23–27), *r3* 19 (18–21) and *R1* 14 (12–16).

Peritreme. Extending to level between *j1* and *j3*, much closer to *j1*.

Venter (Figs. 1B, 5B, 5E). Ventral setal pattern 15:JV:ZV. Sternal shield slightly striated in holotype, smooth in paratypes, lightly sclerotized, with two pairs of setae (*ST1* and *ST2*), and two pairs of poroids (*iv1* and *iv2*); length (distance between base of seta *ST1* and poroid *iv2*) 51 (48–53) width (distance between bases of setae *ST2*) 61 (58–63); setae *ST3* situated on soft cuticle; setae *ST4* and pair of poroids *iv3* on small, poor sclerotized metasternal shields. Genital shield smooth, width (at level of setae *ST5*) 59 (54–64), pair of paragenital poroids *iv5* situated on soft cuticle. Ventri-

anal shield pentagonal with anterior margin convex, in some specimens with waist at level of setae *JV3*, with four pairs of pre-anal setae (*JV1*, *JV2*, *JV3* and *ZV2*), pair of para-anal seta (*PA*) and post-anal seta (*PST*), and a pair of small rounded pre-anal pores (*gv3*) posteromesad *JV3*, distance between pores 41 (37–45). Length of ventrianal shield 102 (94–113), width at level of setae *ZV2* 75 (69–81). Setae *ZV1*, *ZV3*, *JV4*, *JV5* and five pairs of poroids on soft cuticle surrounding ventrianal shield. Setae *JV5* smooth, 35 (33–38) long.

Gnathosoma (Figs. 2A–C, 2E–F, 5C). Anterior margin of epistome rounded and smooth. Hypostomal groove with seven transverse rows of denticles, each row with 2–3 teeth; subcapitular setae *h1*, *h2*, *h3* subequal in length 18 (17–19), slightly shorter

Fig. 3. *Typhlodromus (Anthoseius) levis* sp.n., female, right legs (trochanter-tibia). A—leg I; B—leg II; C—leg III; D—leg IV.

than palp coxal setae (*pc*) 21 (20–21). Chaetotaxy of palps: trochanter with two setae; femur with five setae; genu with six setae; tibia with 14 setae; tarsus with 15 setae and two-tined apotele. Length of palp 114 (110–117). Fixed digit of chelicera 27 (26–29) long with five teeth and pilus dentilis, movable digit 30 (28–31) long with three teeth.

Spermatheca (Figs. 2D, 5D). Calyx tubular, with almost parallel walls at basal and middle parts, flaring distally; atrium nodular, incorporated to base of calyx. Major duct broad at the junction to calyx, minor duct long and visible. Calyx length 19 (18–21).

Legs (Figs. 3, 4). Lengths of legs (base of coxae to base of pretarsus): leg I 352 (343–373);

Fig. 4. *Typhlodromus* (*Anthoseius*) *levis* sp. n., female, right tarsi (dorsal view). A—tarsus I, apical sensorial setal cluster area enlarged; B—tarsus II; C—tarsus III; D—tarsus IV.

Fig. 5. DIC micrographs of *Typhlodromus (Anthoseius) levis* sp. n., female. A—dorsal idiosoma; B—ventral idiosoma; C—chelicerae; D—spermatheca; E—posterior margin of sternal shield.

leg II 270 (262–284); leg III 276 (267–297); leg IV 377 (364–394). Chaetotaxy formulae of the segments as follows: Leg I: coxa 0 0/1 0/1 0, trochanter 1 0/1 1/2 1, femur 2 3/1 2/2 2, genu 2 2/1 2/1 2, tibia 2 2/1 2/1 2. Leg II: coxa 0 0/1 0/1 0, trochanter 1 0/1 0/2 1, femur 2 3/1 2/1 1, genu 2 2/0 2/0 1, tibia 1 1/1 2/1 1. Leg III: coxa 0 0/1 0/1 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, tibia 1 1/1 2/1 1. Leg IV: coxa 0 0/1 0/0 0, trochanter 1 1/1 0/2 0, femur 1 2/1 1/0 1, genu 1 2/1 2/0 1, tibia 1 1/0 2/1 1. Apical sensorial setal cluster of tarsus I with eight short modified setae and one elongated simple seta. Leg IV with three pointed macrosetae, *Sge* IV 29 (28–31), *Sti* IV 31 (29–33), *St* IV 62 (58–66). Other legs without macrosetae.

Male (n=1) (Fig. 6).

Dorsum (Fig. 6A). Dorsal setal pattern 12A:8A (setae *r3* and *R1* on shield). Dorsal shield oval, smooth, with some anterolateral and lateral reticulation, length of dorsal shield 264, width (at level

of *s4*) 163, width (at level of *S2*) 161. Dorsal shield with three pairs of solenostomes (*gd2*, *gd6* and *gd9*) and nine visible pairs of poroids. Muscle-marks (sigillae) visible mostly on podosoma. All dorsal setae smooth, seta *z4* slightly displaced medially as in adult female. Measurements of dorsal setae as follows: *j1* 18, *j3* 19, *j4* 13, *j5* 12, *j6* 14, *J2* 11, *J5* 6, *z2* 11, *z3* 17, *z4* 15, *Z4* 28, *Z5* 39, *s4* 21, *s6* 23, *S2* 20, *S4* 20, *S5* 17, *r3* 16 and *R1* 11.

Peritreme. Extending to level between *j1* and *j3*.

Venter (Fig. 6B). Ventral setal pattern 13:JV-4:ZV-3. Sternogenital shield smooth with a few lateral striae, with five pairs of setae (*ST1*–*ST5*) and three pairs of poroids (*iv1*, *iv2*, *iv3*); length (distance between bases of setae *ST1*–*ST5*) 107, width (distance between bases of setae *ST2*) 53. Ventrianal shield triangular, smooth, except few striae on anterolateral corners; with five pairs of pre-anal setae (*JV1*, *JV2*, *JV3*, *ZV1* and *ZV2*), a pair of para-anal seta (*PA*) and post-anal seta (*PST*), and a pair of

Fig. 6. *Typhlodromus* (*Anthoseius*) *levis* sp.n., male. A—dorsal idiosoma; B—ventral idiosoma; C—chelicera.

small rounded pre-anal pores (gv3) posteromesad JV3, distance between pores 35. Length of ventri-anal shield (from anterior to posterior margins) 106, width at level of anterolateral corners 138. Seta JV5 and two pairs of poroids (*ivo*, *ivp*) on soft cuticle surrounding ventrianal shield. Setae JV5 smooth, much longer than other ventral setae, 24 long.

Gnathosoma (Fig. 6C). Chaetotaxy of palps as in adult female. Fixed digit of chelicera 21 long, with four teeth and setiform pilus dentilis; movable digit 22 long with one tooth. Spermatodactyl foot L-shaped.

Legs. Length of legs (base of coxae to base of pretarsus): leg I 303; leg II 227; leg III 228; leg IV

309. Chaetotaxy formulae of the segments as in adult female. Leg IV with three pointed macrosetae, *Sge* IV 24, *Sti* IV 25, *St* IV 51.

Type materials. Holotype female, 11 female and one male paratypes, Korsakovsky District, Sakhalin Oblast, Russia, 46°51'N, 143°07'E, 10 August 2021, from soil on the shore of Lake Tunaycha, coll. A. A. Khaustov.

Etymology. The name of the species is derived from the Latin word “*levis*”, which means smooth and refers to the species’ smooth dorsal shield.

Differential diagnosis. Due to following unique combination of morphological characters—smooth dorsal shield (except some anterolateral striations),

three pairs of dorsal solenostomes (*gd2*, *gd6*, and *gd9*), two pairs of setae on sternal shield, four pairs of pre-anal setae on ventrianal shield, presence of small rounded pre-anal pores, three macrosetae on leg IV—*Typhlodromus (Anthoseius) levis* sp.n. is easily distinguished from most species of the subgenus *Anthoseius*. Nevertheless, *Typhlodromus (Anthoseius) levis* sp.n. is closely related to *T. (A.) votivus* (Meshkov, 1990) based on the shape of the calyx of spermatheca. However, the new species has three distinct macrosetae on leg IV, a movable digit of chelicera with three teeth, smooth dorsal and ventrianal shields and setae *ST3* inserted on soft cuticle. *T. (A.) votivus*, on the other hand, has only one short macrosetae on leg IV, two teeth on the movable digit of chelicera, well sclerotized, with reticulated area on opisthosoma, and reticulated ventrianal shield, setae *ST3* inserted on sternal shield. Additionally, the new species is also closely related to *T. (A.) cuii* Wu and Ou, 1998 and *T. (A.) zhongdianensis* Wu and Ou, in Wu *et al.* 2009, based on the smooth dorsal shield and on the similar lengths of dorsal setae. However, *Typhlodromus (Anthoseius) levis* sp.n. is distinctly different from the above-mentioned species based on the shape of the calyx of spermatheca: tubular in the new species as opposed to saccular in *T. (A.) cuii* and bell-shaped in *T. (A.) zhongdianensis*.

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