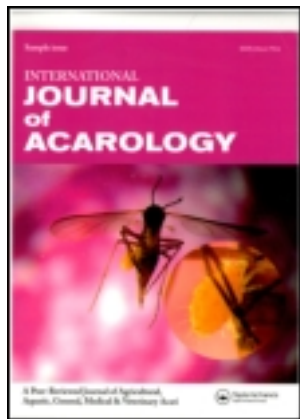


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### Re-description of *Dendroptus flexus* (Livshitz, Mitrofanov & Sharonov, 1979) (Acari: Heterostigmatina: Tarsonemidae) with notes on the newly found males and larvae of this species and its proposed generic affiliation

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## Re-description of *Dendroptus flexus* (Livshitz, Mitrofanov & Sharonov, 1979) (Acari: Heterostigmata: Tarsonemidae) with notes on the newly found males and larvae of this species and its proposed generic affiliation

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*Tarsonemus flexus* Livshitz, Mitrofanov & Sharonov, 1979 is re-described based on females and newly discovered males and larvae from Hungary; its systematic position is also discussed. As a result, the species is transferred to the genus *Dendroptus* Kramer, 1876. It is speculated that the genus may contain at least two parallel phylogenetic lines.

**Keywords:** tarsonemid; gall mites; Hungary; Crimea; taxonomy; new combination

### Introduction

*Tarsonemus flexus* Livshitz, Mitrofanov & Sharonov, 1979 has been scarcely recorded since its primary publication. Thanks to the finding of new individuals in the rich tarsonemid material originating from Hungarian city greens; the senior author could perform re-examination of this species. Its presence in our collecting was first published in Ripka et al. (1997), then nicknamed “*Dendroptus* sp. 2”. The new taxonomic status was initially introduced in the Fauna Europaea internet database (Magowski 2011).

This work is intended to present proper taxonomic descriptions of *T. flexus* females and newly discovered males and larvae and to provide a rationale base for the provisional transfer of this species from the genus *Tarsonemus* Canestrini & Fanzago, 1876 to the genus *Dendroptus* Kramer, 1876 sensu Lindquist, 1986.

### Materials and methods

Specimens were collected manually from samples of foliage and bark of plants. They were subsequently transferred into polyvinyl lactophenol (PVL) mounting medium and enclosed in microscopic slides. Examination, measurements and drawings were done with Olympus BX50 phase-contrast microscope supplied with drawing attachment.

The nomenclature of morphology follows that of Lindquist (1986). All measurements are expressed in micrometres (µm); missing data are indicated by a question mark. Length and width of pharynx of all instars include posterior glandular bodies. Length of male idiosoma includes copulatory complex without terminal hyaline fringe. Lengths and proportions of legs are compared excluding pretarsi and trochanters.

Abbreviations used in the descriptions are as follows: PrS, prodorsal shield; PrP, propodosomal ventral plate;

MtP, metapodosomal ventral plate; C, D, CD, EF, H, HPs, Ps are tergites and shields; Ta, tarsus; Tb, tibia; Tbt, tibiotarsus; Fe, femur; Ge, genu; Fege, femorogenu; and ap. 1–1 and ap. 2–2, distances between anterolateral ends of apodemes 1–1 and 2–2, respectively. Leg chaetotaxy expresses the number of non-solenidial setae; numbers of solenidia are separated in parentheses and “+” marks a fusion of segments. Setae flanking pretarsi – Ta I *u'* and Ta II and III *u'* and *p'* (the latter only in males) – are excluded from the count (due to their weak discernibility); however, spine-like setae Ta I *s* and Ta II–III *u'* are included.

Abbreviations of institutions where the examined material is deposited are as follows: DATE, Department of Animal Taxonomy and Ecology, A. Mickiewicz University, Poznań, Poland; DSAFE, Department of the Science of Agriculture Food and Environment, University of Foggia, Foggia, Italy; HNHM, Hungarian Natural History Museum, Budapest, Hungary; NFCSO, National Food Chain Safety Office, Directorate of Plant Protection, Soil Conservation and Agri-environment, Budapest, Hungary; NBG, Nikita Botanical Gardens-National Scientific Center, Yalta, Crimea, Ukraine.

Family **Tarsonemidae** Canestrini & Fanzago, 1876  
Subfamily **Tarsoneminae** Canestrini & Fanzago, 1876  
Tribe **Steneotarsonemini** Lindquist, 1986  
Genus ***Dendroptus*** Kramer, 1876 sensu Lindquist, 1986  
Subgenus ***Dendroptus*** sensu Sharonov & Mitrofanov, 1986  
***Dendroptus (Dendroptus) flexus*** (Livshitz, Mitrofanov & Sharonov, 1979) **comb. nov.**  
(Figures 1–17, 18A–C)

*Tarsonemus flexus* Livshitz, Mitrofanov & Sharonov, 1979, p. 24, Fig. 50.

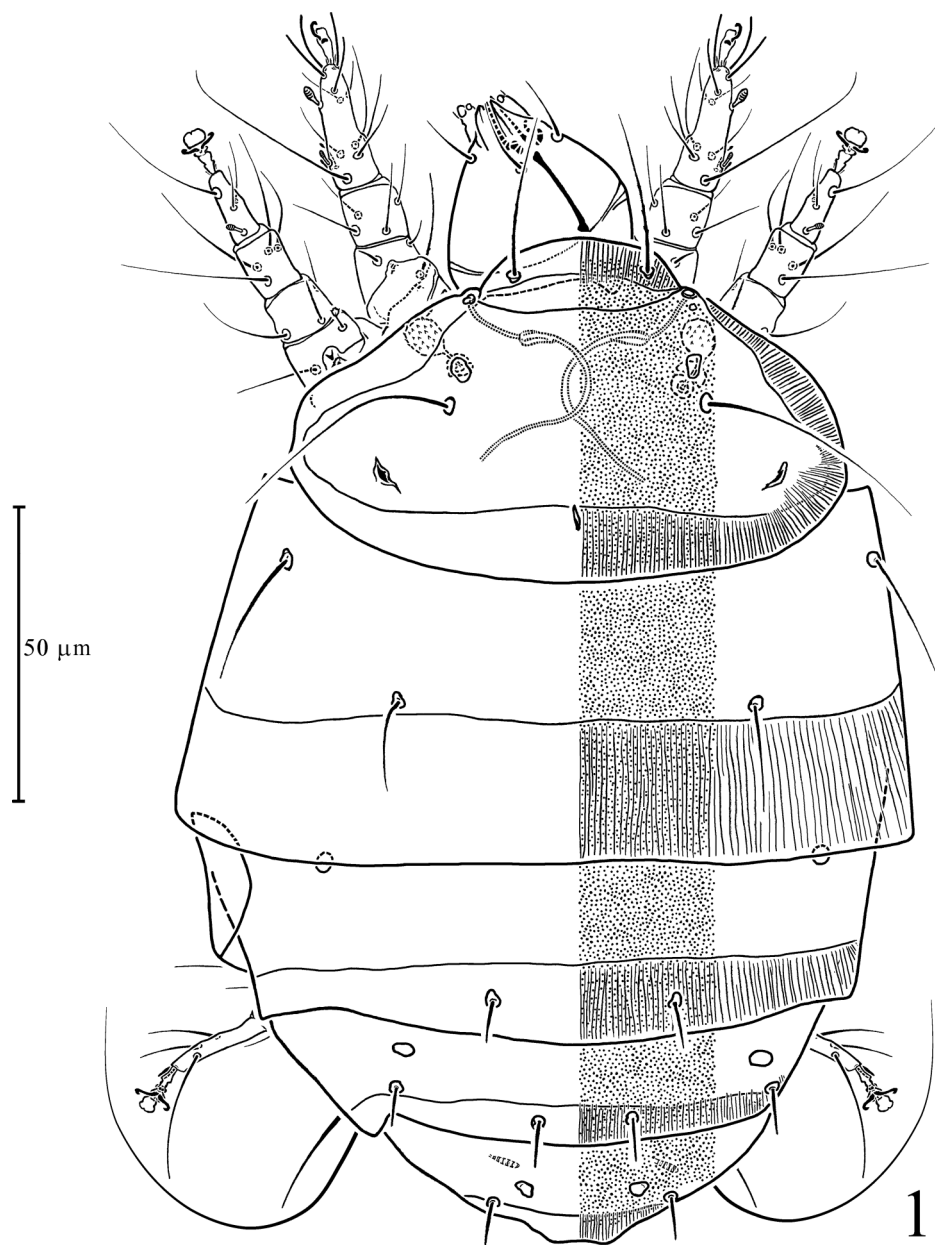


Figure 1. *Dendroptus flexus* female – dorsum.

*Materials examined (non-types)*

Ukraine: 4 females on *Myrtus communis* L., Nikita Botanical Gardens, Crimea, Ukraine, 3 March 1970, coll. unknown; in the slide N 1332/4 (NBG) together with the holotype of *Tarsonemus (S.) egregius* (Livshitz, Mitrofanov & Sharonov, 1982).

Hungary: 22 females, 6 males, 5 larvae in the erineum (among the “hairs”) caused by *Eriophyes tiliae* Pagenstecher, 1857, on the leaves of *Tilia cordata* Mill., park, Keszthely, 25 July 1994 (734; slides 01 & 02–DATE, 03 & 04 – NFCSO), leg. G. Ripka (Ripka et al. 1997); 2 females in the leaf galls and around the opening of the bead leaf galls (on the leaf underside) caused by *Aceria cephalonea* (Nalepa, 1922) and *A. macrochela* (Nalepa, 1891) on *Acer campestre* L., park, Keszthely, 25 July 1994

(735, 736 – HNHM), leg. G. Ripka (Ripka et al. 1997); 1 female ex *Pyrus pyraeaster* (L.) Burgsd., botanical garden, district 8th Budapest, 4 January 1995 (787 – HNHM), leg. G. Ripka; 2 females ex *Escallonia “Langleyensis”*, botanical garden, distr. 11th Budapest, 28 January 1995 (800 – NFCSO); leg. G. Ripka; 1 female and 1 male ex *Celastrus orbiculatus* Thunb., botanical garden, distr. 11th Budapest, 2 September 1998 (991 – DSAFE), leg. G. Ripka (Ripka et al. 2005); 1 female ex *Fontanesia phillyreoides* Labill. ssp. *fortunei* (Carr.) Yalt., park, distr. 14th Budapest, 24 August 2010 (1244 – DATE), leg. G. Ripka.

*Types*

Holotype female: ex European cornel *Cornus mas* L., near town Alupka, Crimea, Ukraine, 18 January 1971, coll.

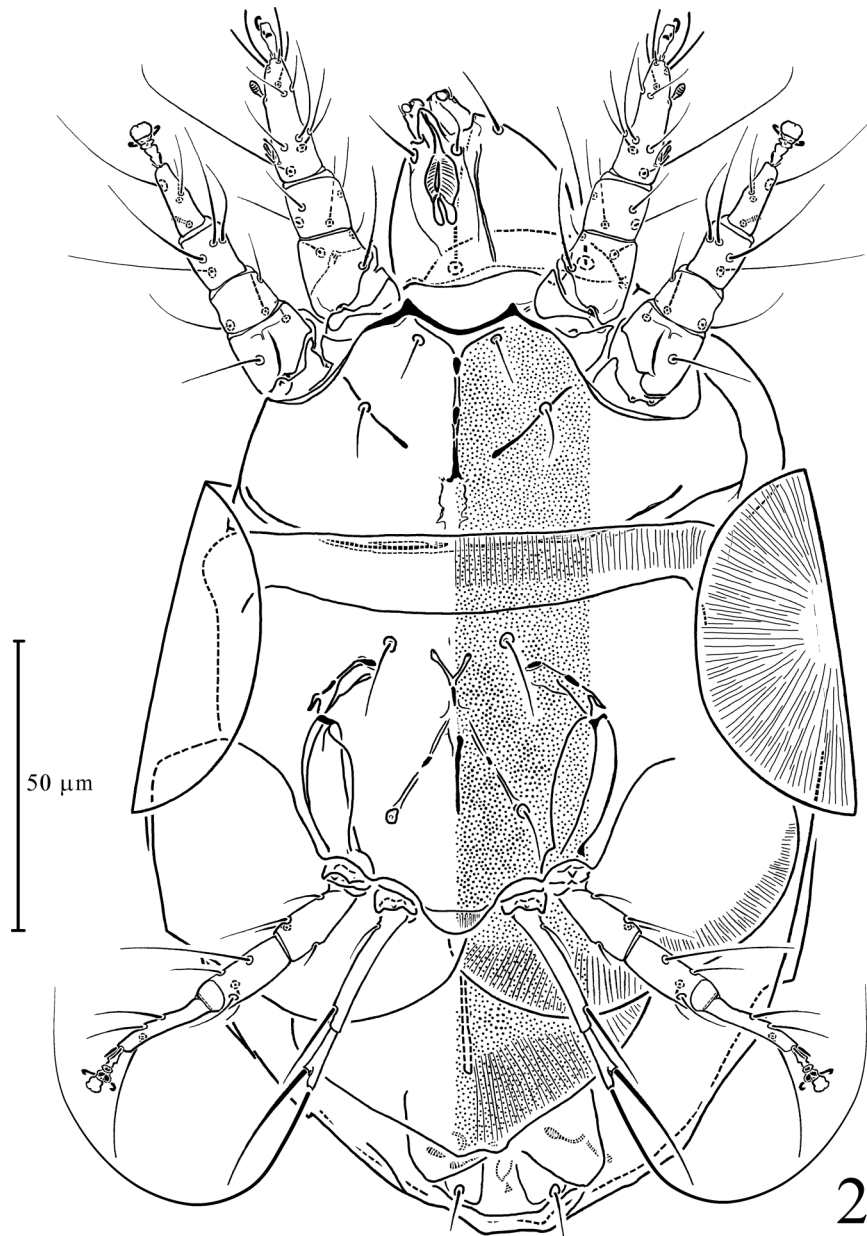


Figure 2. *Dendroptus flexus* female – venter.

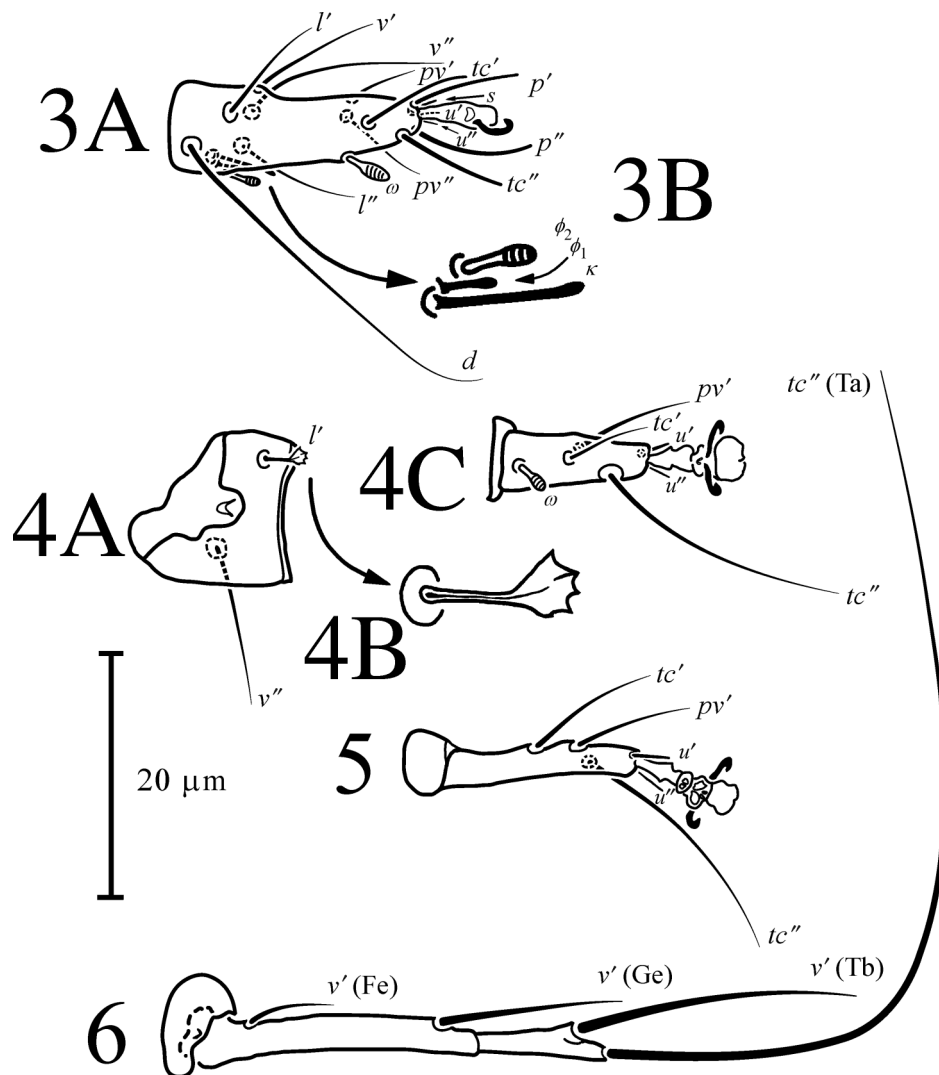
unknown; paratypes – 16 females, collection data as for holotype (none studied).

#### Diagnosis

Adults and larvae: claws moderately well developed; tarsal setiform I and spine-like II setae  $pl''$  absent; setae  $pv''$  missing from tarsi II and III. Tibial I solenidion  $\phi_1$  present but vestigial; eupathidium  $k$  untypically formed as a rod with slightly swollen tip. Femur I missing seta  $l''$ , femur II missing  $d$ . Adults: none of ventral podosomal setae particularly elongate. Females: dorsal opisthosomal setae from  $d$  to  $h$  short, stiff; ventral opisthosomal setae  $ps$  short, slender; seta  $l'$  on femur II with unique distal duck foot-shape expansion. Males: tarsal famulus  $ft'$  missing; tibial III seta  $l'$  setiform; femorogenu IV without lobate flange. Larvae: seta  $pv'$  missing from Ta II.

#### Description

*Female* (Figures 1–6, 18A). Gnathosoma: capsule rounded-triangular in outline, with apex and palpi forming short snout. Pharynx as wide as  $0.2\times$  of basal width of the gnathosoma, and as long as  $0.4\text{--}0.3\times$  of ventral length of the gnathosomal capsule. External walls and musculature well developed with fine, oblique striation, internal part moderately sclerotized. Glandular bodies prominent, adjacent posteriorly to the pharynx. Postpalpal setae ( $pp$ ) indiscernible. Setae  $dgs \sim 1.3\times$  as long as  $vgs$ , reaching only to the apices of palpi. Cheliceral stylets and levers moderate in size, occupying  $\sim 0.33\times$  of dorsal length of gnathosomal capsule. Palpi small, only slightly longer than wide at the base, arranged contiguously and somewhat convergently, protruding slightly beyond the apex of the capsule. Each palpus with small rounded palptarsus ventrolaterally,



Figures 3–6. *Dendroptus flexus* female – legs: 3–tibia-tarsus I (3A – dorsolateral aspect, 3B – tibial sensory cluster, dorsal aspect close-up), 4–femur and tarsus II (4A – femur; 4B – femoral seta  $l'$  close-up; 4C – tarsus, dorsal aspect), 5–tarsus III (ventral aspect), 6–trochanter, femorogenu and tibiotarsus IV (ventral aspect).

tiny rounded process apically and one minute seta, laterally at the base of palptarsus. Palptibial claw minute, hardly discernible.

Idiosomal dorsum (length =  $1.6 \times$  width): relative lengths of dorsal setae (mean values –  $v_1$ :  $sc_1$ :  $sc_2$ :  $c_2$ :  $c_1$ :  $d$ :  $e$ :  $f$ :  $h$ ): 1: 0.4: 1.4: 0.7: 0.6: 0.3: 0.3: 0.3: 0.3. Prodorsal shield (PrS) with concave posterior edge,  $\sim 1.6 \times$  as wide posteriorly as long medially; prodorsomedial apodeme in form of short but apparent, thick line. Rostral shieldlet broadly arcuate – convex anteriorly,  $\sim 3 \times$  wider than long. Setae  $v_1$  tapered, setiform, pointed and indistinctly barbed; separated by a distance shorter than ( $\sim 0.8 \times$ ) their lengths. Sensilli  $sc_1$  typically clavate, nearly twice as long as wide, with well-defined head covered with minute spines. Tracheal tubes (besides somewhat expanded atrial segments) equally narrow along its length. Pits  $v_2$  located in line between seta  $sc_2$  and  $v_1$  on either side, roughly at the same level with  $sc_1$ , i.e. somewhat anteriorly of the mid-length of PrS. Setae  $sc_2$  located at a mid length of prodorsal

shield, reaching with their tips beyond the posterior edge of the PrS, separated by a distance slightly larger ( $0.9 \times$ ) than their lengths. Setae  $c_2$  reaching with their tips at  $0.7 \times$  of the distance to the bases of  $c_1$ . The latter pair separated by a distance of  $\sim 4 \times$  their lengths, reaching to half of the distance between their bases and the posterior edge of tergite C; located posteriad of the level of  $c_2$ . Setae  $d$  reaching with their tips slightly beyond the posterior edge of tergite D, separated by a distance of  $4\text{--}4.3 \times$  their lengths. Setae  $e$  as long as  $f$ ; the latter pair separated by a distance approaching  $2 \times$  their lengths, located somewhat posteriad of the line of setae  $e$ . Setae  $h$  separated by a distance of nearly  $4 \times$  of their lengths; sub-equal to or slightly longer than  $e$  and  $f$ . Dorsal opisthosomal setae  $c_1$  and  $c_2$  tapered, setiform, pointed; remaining ones ( $d$ ,  $e$ ,  $f$ ,  $h$ ) stiff, weakly tapered, bluntly pointed. Surface of dorsal sclerites covered with uniform, fine, dimpled ornament.

Idiosomal venter: apodemes 1 well defined, joined with anteromedian apodeme; the latter defined only to the level

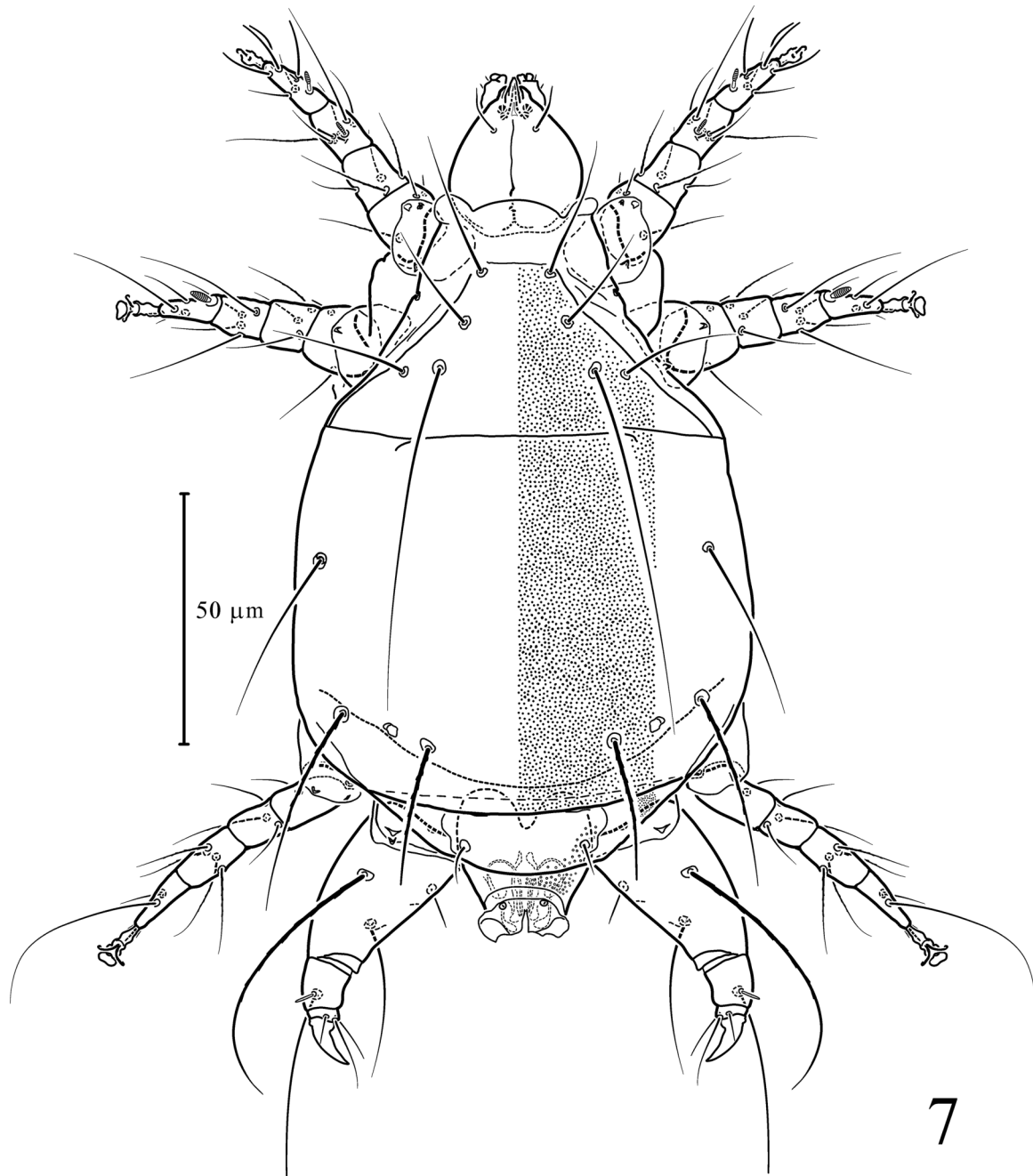


Figure 7. *Dendroptus flexus* male – dorsum.

of posteromedian extremities of apodemes 2; diffusing further posteriorly in a form of indistinct breast platelet. Apodemes 2 not joined with anteromedian apodeme. Sejugal apodeme bipartite, in a form of weakly curved arch on each side, separated medially by apparent discontinuity. Setae *1a* located slightly below apodemes 1, separated by a distance of  $\sim 1.4\times$  of their lengths. Setae *2a* inserted on apodemes 2, distally from their mid-lengths, at the distance between their bases of  $2.5\text{--}3\times$  of their lengths; both pairs slender, pointed. Propodosomal plate with anterior edge between distal ends of apodemes 1 well concave; with lateral ridges between trochanters I and II apparently convex. Apodemes 3 and 4 well expressed; apodemes 4

posterolaterally reaching to insertions of setae *3b*; posteromedian apodeme typically developed with apparent anterior bifurcation. Setae *3a* inserted in a distance of  $\sim 1.5\times$  their lengths each to another and  $\sim 2\times$  of their lengths from bases of *3b*, separated by a distance somewhat smaller than that between *3b*. Setae *3b* separated by a distance of over  $2\times$  their lengths; longer than *3a*; both pairs tapering, slender and pointed. Anterior edge of metapodosomal plate nearly straight; plate weakly undulate posterolaterally between trochanters III and IV. Tegula rounded, semicircular,  $\sim 2\times$  wider than long. Trochanters IV separated by the interval of  $\sim 2\times$  their widths. Setae *ps* slender, thin, pointed, separated by a distance  $\sim 2\text{--}2.4\times$  their lengths.

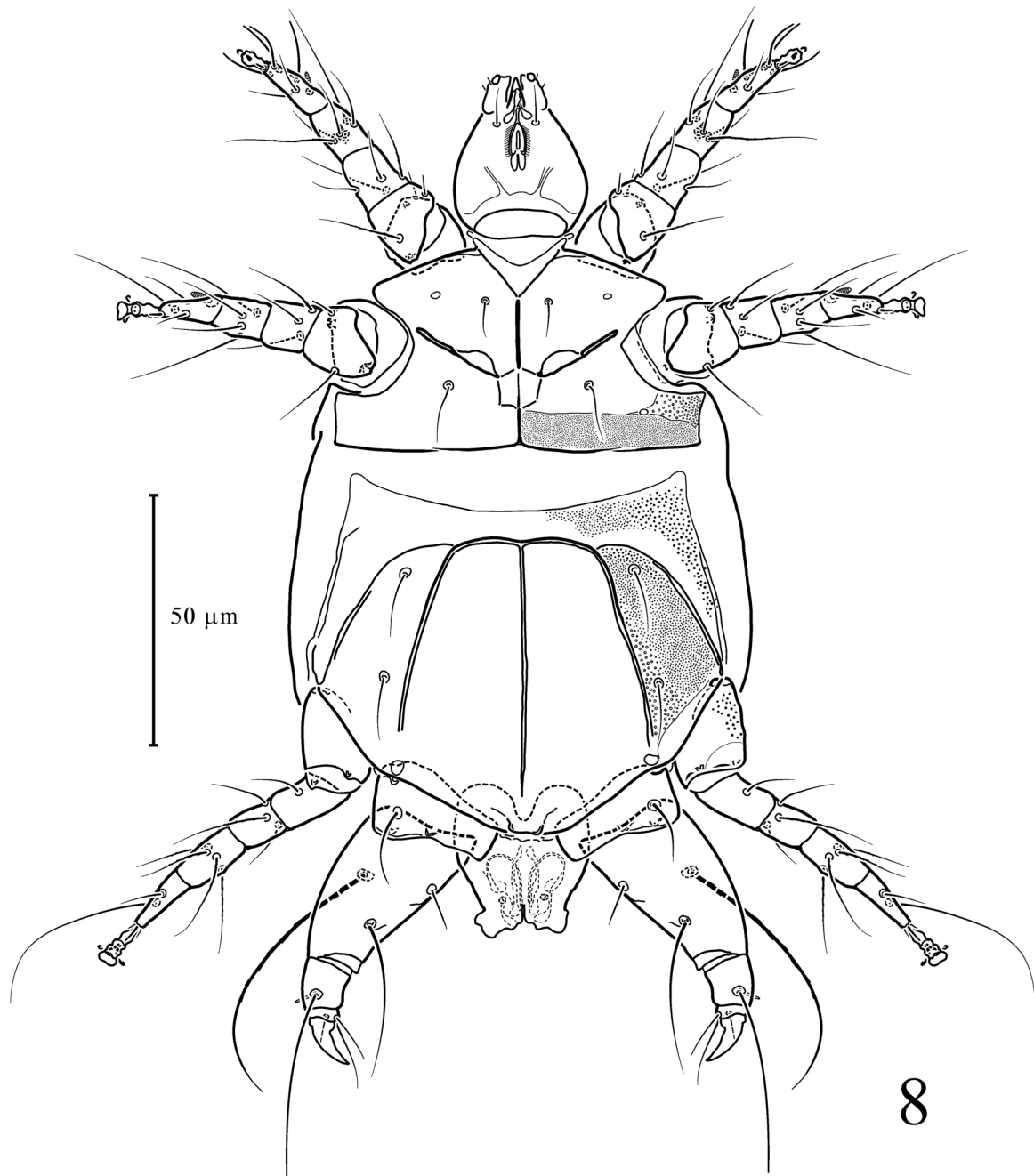
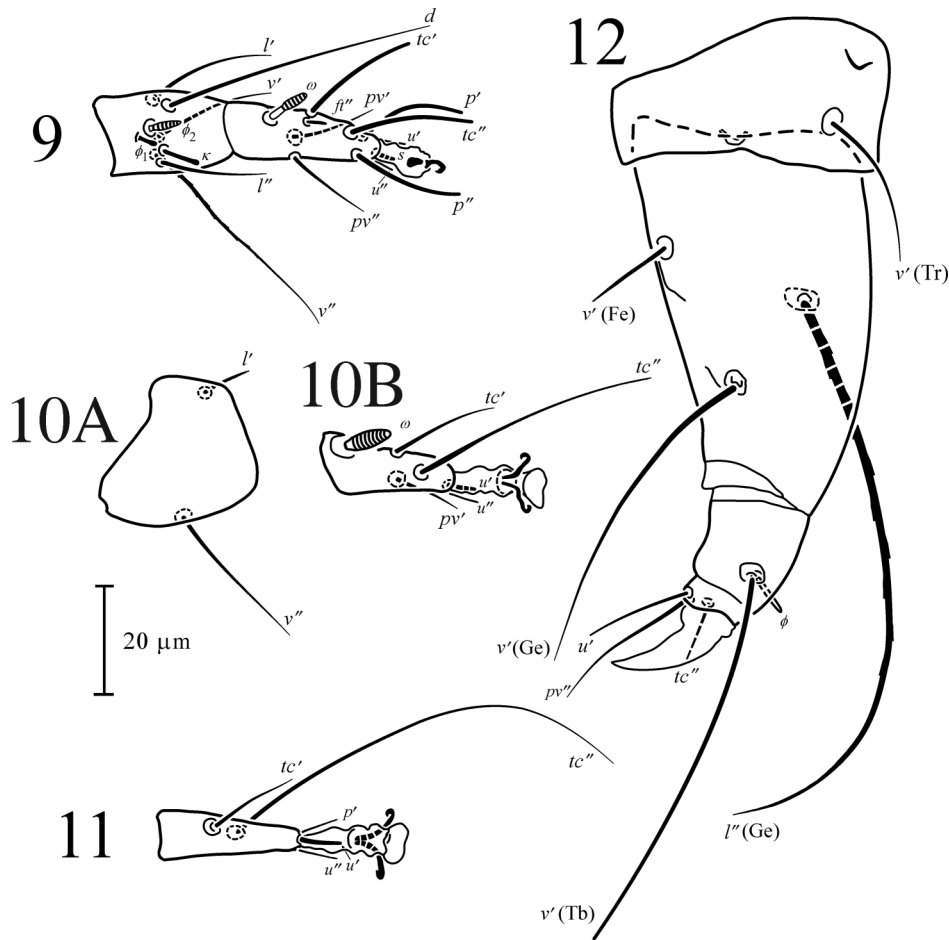


Figure 8. *Dendroptus flexus* male – venter.

Legs – proportions of free segments of legs: (I: II: III: IV): 1: 1.0: 1.1: 0.8. Leg chaetotaxes (for Fe, Ge, Tb and Ta, respectively): I: 3-4-6( $2\phi$ ) + 7( $1\omega$ ); II: 2-3-4-4( $1\omega$ ); III: 1 + 3-4-4. Leg I: claw hooked, medium sized, similar in size to those of tarsi II and III. Pretarsus with the typical basal stalk, ambulacrum somewhat expanded distally. Spine-like subunguinal seta *s* small, weak (though not thin), pointed, similar to setae *u'* on tarsi II and III. Unguinal setae *u'* and *u''* flanking pretarsus minute, hardly discernible. Tibiotarsus over  $2.5\times$  longer than wide at base. Eupathidia *p''* and *p'* inserted apically; *tc'* and *tc''* located subapically, the latter one slightly proximad of the former; *p''* being slightly longer than the remaining three.

Solenidion  $\omega$  typically club-like, the largest of all solenidia, with head subequal in length to pedicel. Tibial solenidion  $\phi_2$  slim, clavate, apparently shorter than tarsal  $\omega$ ; located contiguously with  $\phi_1$  and famulus *k*. Solenidion  $\phi_1$  very small, almost rod-like; in contrast, famulus *k* slim, with somewhat swollen tip, clearly the longest of all in the cluster. Seta *l'* on genu tapering, similar to the others on the segment, smooth. Femoral seta *l''* missing from segment, *l'* short, *d* similar but slightly stouter, both tapering and pointed. Leg II: claws medium-sized, curved; empodium typically rounded, pad-like. Seta *u'* somewhat stouter than *s* on Ta I; *u''* hair-like. Tarsal solenidion  $\omega$  smaller than that on tarsus I. Seta *pl''* absent; seta *tc''* over  $2\times$  longer than



Figures 9–12. *Dendroptus flexus* male – legs: 9 – tibia and tarsus I (dorsal aspect), 10 – femur and tarsus II (10A – femur, 10B – tarsus, dorsal aspect), 11 – tarsus III (ventral aspect), 12 – trochanter, femorogenu, tibia and tarsus IV (ventral aspect).

$pv'$ , reaching far beyond tip of empodium; seta  $pv''$  missing. Tibia with seta  $d$  the longest and  $l'$  the shortest; genual seta  $l'$  barbed, stiff. Femur without ventral lobe; seta  $l'$  short, with very characteristic “duck foot” ending; seta  $d$  missing. Leg III: claws and empodium similar to those of tarsus II. Seta  $tc''$  clearly ( $\sim 2\times$ ) longer than other setae on segment; seta  $pv''$  missing. Femoral seta  $v'$  well discernible; seta  $v'$  clearly longer than subequal  $l'$  and  $l''$  on genual part of a segment. Leg IV: free segments of leg IV approximately as long as combined length of femorogenu and tibia III. Femorogenu slightly over  $2\times$  as long as tibiotarsus. Tarsal seta  $tc'' \sim 2\times$  as long as free segments of leg IV. Tibial seta  $v'$  approximately as long as femorogenu; stiff. Genual seta  $v'$  stiff, reaching with its tip beyond base of tibial  $v'$ . Femoral seta  $v'$  twice shorter and thinner than genual  $v'$ . All setae of the leg IV pointed and smooth.

Measurements (average  $\pm$  SD, spread in parentheses; eight specimens from the sample “734”, slide 01) – body and tagmata: length of body:  $213.8 \pm 9.3$  (202–228); length of idiosoma:  $189.5 \pm 8.2$  (180–205); width of idiosoma:  $121.5 \pm 6.0$  (110–130); length of gnathosoma:  $38.6 \pm 2.5$  (35–42); width of gnathosoma:  $33.6 \pm 1.2$  (32–35); length of pharynx:  $13.6 \pm 0.5$  (13–14); width of pharynx:  $5.9 \pm 0.4$  (5–6);  $dgs$ :  $13.5 \pm 1.6$  (11–15);  $vgs$ :  $10.5 \pm 0.8$  (9–11).

Idiosomal dorsum: length of PrS:  $64.1 \pm 1.8$  (60–65); width of PrS:  $102.4 \pm 2.7$  (99–106). Lengths of setae:  $v_1$ :  $29.8 \pm 0.9$  (29–31);  $sc_1$ :  $13.1 \pm 1.0$  (12–15);  $sc_2$ :  $43.0 \pm 1.8$  (40–46);  $c_2$ :  $21.5 \pm 1.1$  (20–23);  $c_1$ :  $16.9 \pm 1.7$  (14–19);  $d$ :  $8.3 \pm 0.5$  (8–9);  $e$ :  $8.3 \pm 0.5$  (8–9);  $f$ :  $8.5 \pm 0.5$  (8–9);  $h$ :  $8.6 \pm 0.5$  (8–9). Distances between setae and stigmata ( $sti$ ):  $v_1-v_1$ :  $24.6 \pm 0.7$  (24–26);  $sti-sti$   $39.5 \pm 1.7$  (38–43);  $sc_1-sc_1$ :  $41.1 \pm 2.2$  (39–46);  $sc_2-sc_2$ :  $47.3 \pm 2.5$  (44–51);  $c_2-c_2$ :  $99.4 \pm 5.6$  (88–107);  $c_1-c_1$ :  $63.9 \pm 2.5$  (60–67);  $c_1-c_2$ :  $31.3 \pm 2.2$  (29–34);  $d-d$ :  $35.5 \pm 2.7$  (31–38);  $e-e$ :  $68.5 \pm 3.6$  (61–71);  $f-f$ :  $15.5 \pm 2.1$  (11–18);  $e-f$ :  $27.4 \pm 1.2$  (26–29);  $h-h$ :  $32.8 \pm 2.1$  (30–36). Idiosomal venter: lengths of setae:  $1a$ :  $10.5 \pm 0.8$  (9–11);  $2a$ :  $12.0 \pm 1.9$  (9–15);  $3a$ :  $13.9 \pm 1.9$  (11–16);  $3b$ :  $10.7 \pm 1.2$  (10–12);  $ps$ :  $7.9 \pm 1.0$  (7–9). Distances between setae:  $1a-1a$ :  $13.8 \pm 0.7$  (13–15);  $2a-2a$ :  $33.3 \pm 1.0$  (32–35);  $3a-3a$ :  $21.4 \pm 1.1$  (20–23);  $3b-3b$ :  $24.9 \pm 1.1$  (23–26);  $ps-ps$ :  $17.1 \pm 0.4$  (17–18). Length of PrP:  $41.6 \pm 1.4$  (39–43); width of PrP:  $83.8 \pm 3.1$  (80–89); ap. 1–1:  $21.0 \pm 0.8$  (20–22); ap. 2–2:  $40.9 \pm 1.1$  (39–42); length of tegula  $7.9 \pm 0.8$  (7–9); width of tegula  $16.5 \pm 1.1$  (15–18). Leg segments and leg setae (lengths): Tbt I:  $23.1 \pm 1.0$  (22–25); Ta I  $\omega$ :  $5.4 \pm 0.5$  (5–6); Tb I  $\phi_2$ :  $3.1 \pm 0.6$  (2–4); Tb I  $\phi_1$ :  $2.0 \pm 0.3$  (1.5–2.5); Tb I  $k$ :  $6.6 \pm 0.5$  (6–7); Ta II  $\omega$ :  $4.3 \pm 0.5$  (4–5); Tbt IV:  $11.4 \pm 0.5$  (11–12); Ta IV



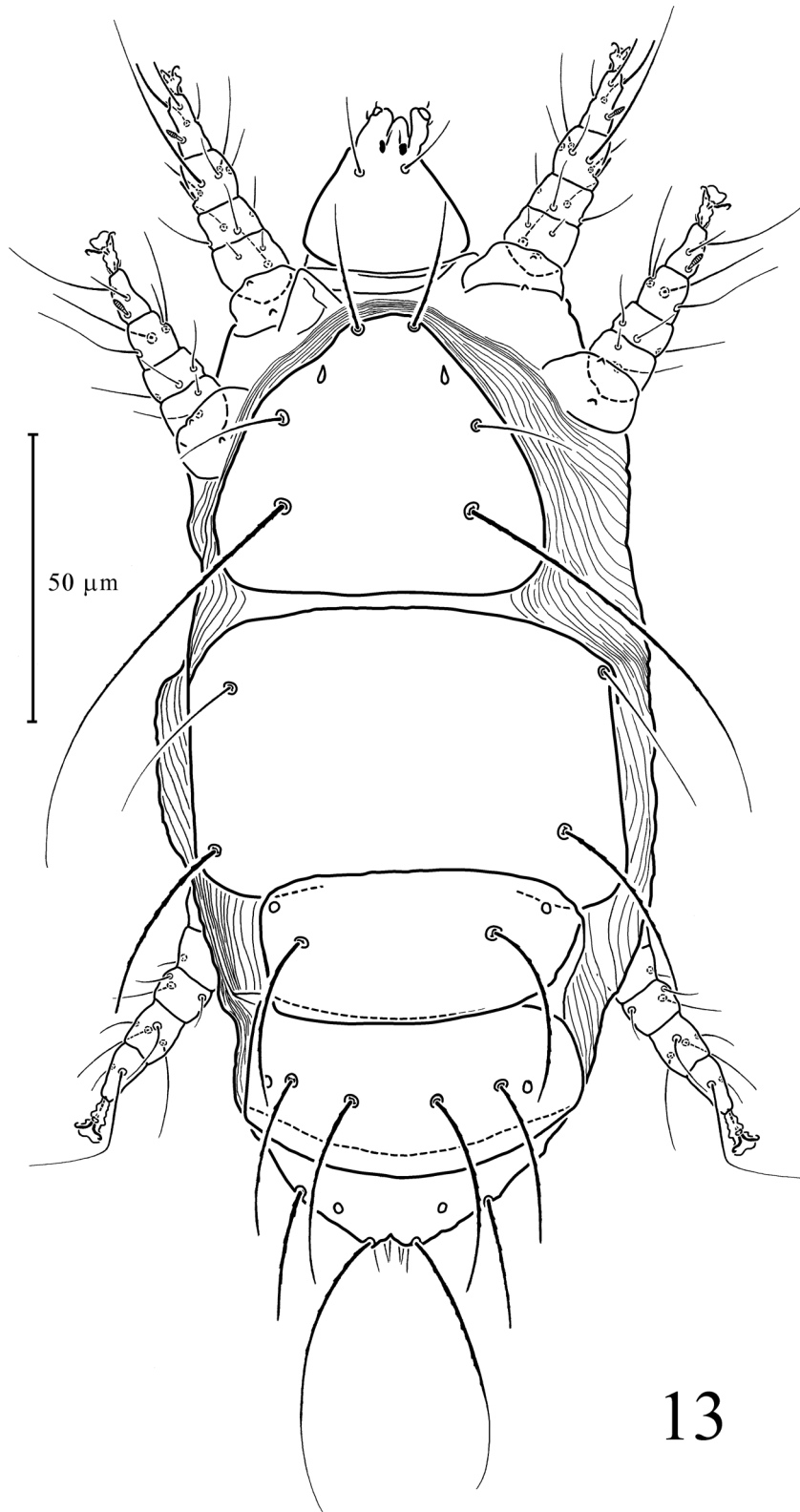


Figure 13. *Dendroptus flexus* larva – dorsum.

$tc''$ :  $81.4 \pm 2.2$  (77–84);  $Ti\ IV\ v'$ :  $26.6 \pm 0.5$  (26–27);  $Fege\ IV$ :  $27.6 \pm 0.7$  (26–28);  $Ge\ IV\ v'$ :  $16.8 \pm 0.7$  (16–18);  $Fe\ IV\ v'$ :  $9.4 \pm 0.9$  (8–11).

*Male* (Figures 7–12, 18B). Gnathosoma: shape similar to that of female, though less robust. Pharynx as wide as

$\sim 0.2\times$  of basal width and as long as  $0.4\times$  ventral length of gnathosomal capsule; with large, discernible, ovoid glandular bodies. Postpalpal (*pp*) setae indiscernible. Setae *dgs* slightly longer than *vgs*, not reaching beyond the apices of palpi. Cheliceral stylets and levers weak, apparently

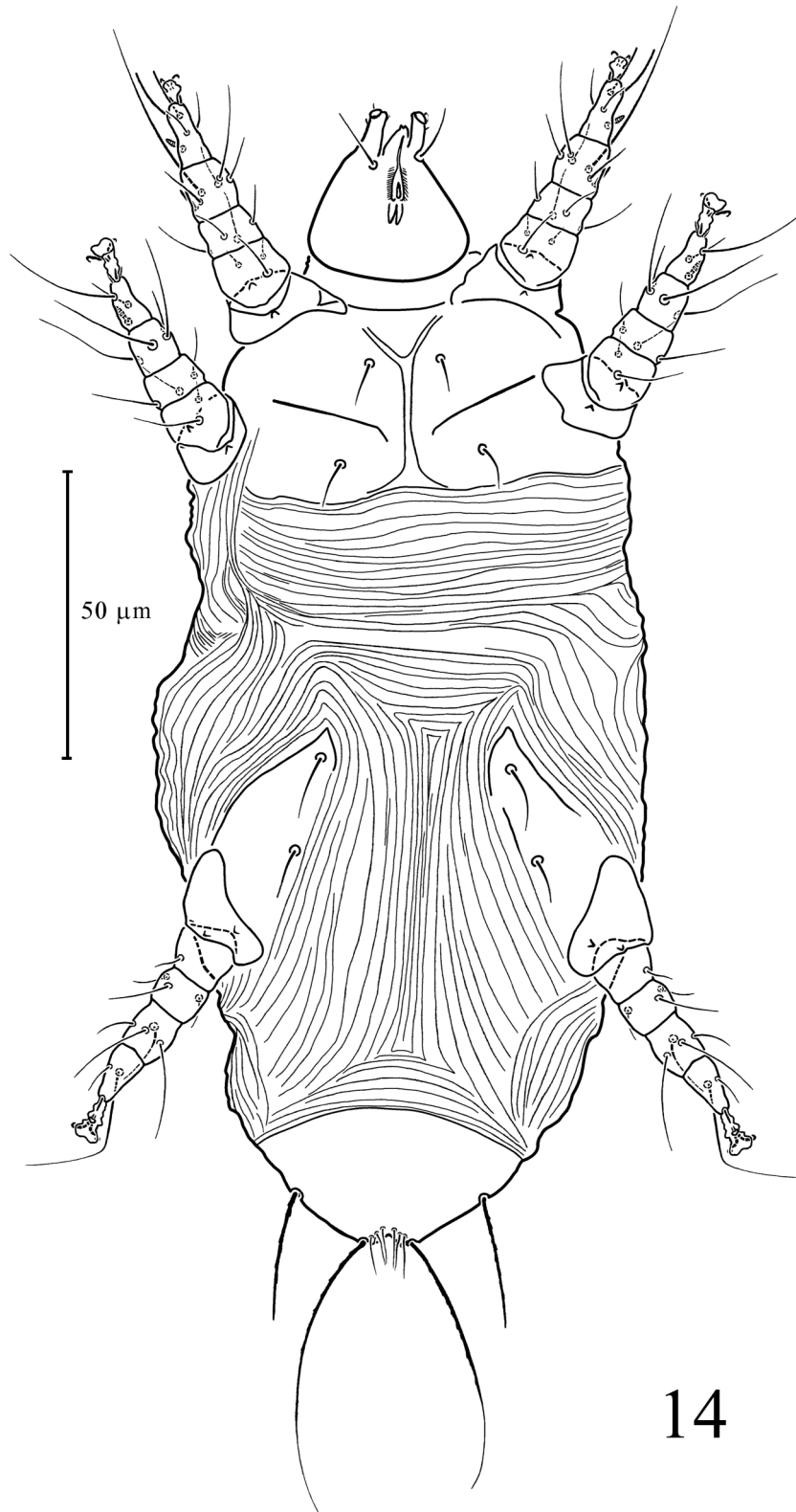
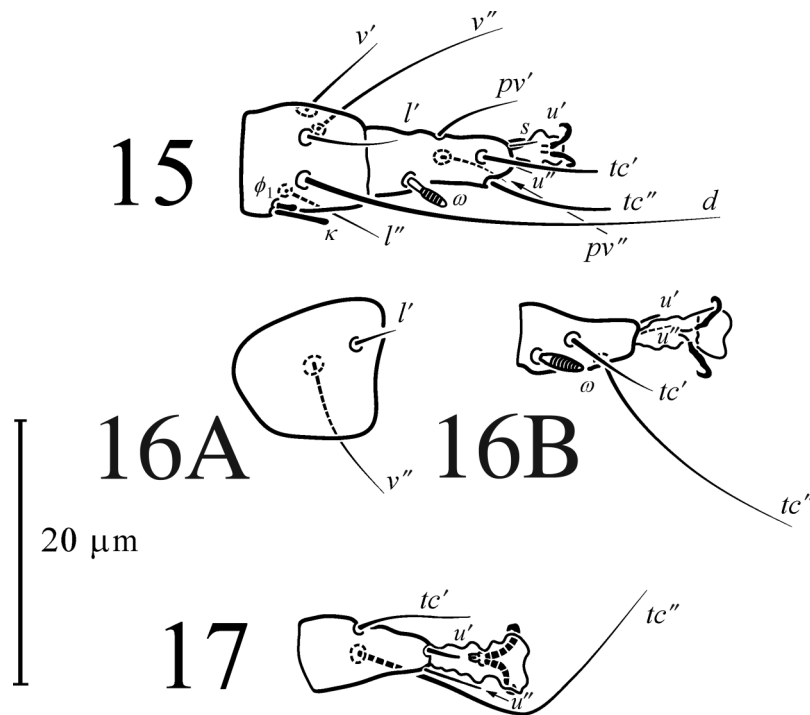


Figure 14. *Dendroptus flexus* larva – venter.

smaller than those in female. Palpi built similarly to those of female.

Idiosomal dorsum (length =  $1.6 \times$  width): relative length of dorsal setae ( $v_1$ :  $v_2$ :  $sc_1$ :  $sc_2$ :  $c_2$ :  $c_1$ :  $d$ :  $f$ ): 1: 0.7: 2.5: 0.8: 1.3: 1.6: 0.9: 0.3. Prodorsal shield subtrapezoidal

with straight truncated anterior and nearly straight posterior edges,  $\sim 1.7 \times$  wider posteriorly than long medially. Prodorsal setae collectively tapering, slender, pointed, finely (sometimes indistinctly) barbed. Distance between  $v_1$  bases as long as half of their lengths. Setae  $v_2$  located in



Figures 15–17. *Dendroptus flexus* larva – legs: 15 – tibia and tarsus I (dorsal aspect), 16 – femur and tarsus II (16A – femur, 16B – tarsus, dorsal aspect), 17 – tarsus III (ventral aspect).

line with  $v_1$  and  $sc_1$ ; setae  $sc_2$  on each side displaced laterally of that line. Setae  $sc_1$  located behind mid-length of prodorsal shield,  $sc_2$  nearly at the same level;  $sc_1$  reaching with about 4/5th of their lengths beyond posterior edge of PrS, separated by a distance of  $\sim 0.4\times$  their lengths. Setae  $c_2$  reaching with their tips beyond bases of  $c_1$ . Setae  $c_1$  longer than  $d$ , both reaching far beyond posterior edge of shield CD;  $c_1$  separated by a distance to each another of  $\sim 1.6\times$  their length, and less than half their length from bases of  $d$ . Setae  $d$  separated by a distance of  $1.4\times$  their lengths; setae  $f$  separated by a distance of  $\sim 2.5\times$  their lengths. Setae  $h$  minute, hardly exceeding in length their areoles. Genital capsule about as long as wide, with hyaline rim relatively small, but discernible. Accessory stylets slim, supported with motivators occupying less than half the length of genital capsule when protracted. Cupule  $ia$  located in line between bases of  $c_1$  and  $d$  on each side; cupule  $im$  indiscernible. Dorsal opisthosomal setae  $c_2$  and  $f$  nearly smooth, slender, pointed,  $c_1$  and  $d$  barbed; slightly thicker and less tapering. Surface of dorsal sclerites covered with fine dimpled ornament, somewhat more prominent on lateral parts of EF tergite and genital capsule.

Idiosomal venter: apodemes 1 well sclerotized; antero-medial apodeme with short discontinuity at the level of posteromedian extremities of apodemes 2, which separated from the former apodeme. Sejugal apodeme discernible, indistinctly tripartite, defined very weakly in some specimens. Setae  $1a$  separated by a distance of  $\sim 1.3\times$  their lengths. Setae  $2a$  only slightly longer than  $1a$ , separated by a distance of  $\sim 2.2\times$  their lengths. Ventral propodosomal plate with posterior extremity slightly bi-convex; with

uniform, very fine, dimpled ornament, more pronounced in marginal portions of coxal fields II. Setae  $3a$  about as long as  $0.6\times$  the length of  $3b$ , separated by a distance clearly longer than their lengths from bases of  $3b$ , and by a distance of  $\sim 3.5\times$  their lengths each to another, but still smaller than that between  $3b$ . Setae  $3b$  separated by interval nearing  $3\times$  their lengths. All podosomal setae slender, pointed. Apodemes 3, 4 and posteromedian one well developed, with anterior edges well pronounced and clearly uniting. Ornament of coxal fields III and anterolateral fields of ventral metapodosomal plate finely dimpled; dimples being larger and more sparsely arranged towards lateral margins of metapodosomal plate; as well as those in the regions of coxal fields III adjacent to apodemes 3. Coxal fields IV very finely dimpled, almost smooth.

Legs – proportions of free segments of legs (I: II: III: IV): 1: 0.9: 1.0: 1.0. Leg chaetotaxes: I: 3-4-6( $2\phi$ )-8( $1\omega$ ); II: 2-3-4-4( $1\omega$ ); III: 1-3-4-3. Leg I: claw typically hooked, similar to that in female, and to those of tarsi II and III. Seta  $s$  blunt, spine-like, similar to seta  $u'$  of tarsus II. Tarsus  $\sim 2.8\times$  longer than wide at base. Eupathidium  $p'$  subequal in length to  $p''$ , both located subapically;  $tc''$  longer and located somewhat more proximally than  $p'$  and  $p''$ ;  $tc'$  subequal to  $tc''$  but located at the transverse midline of the tarsus. Solenidion  $\omega$  with head elongate, subequal to Ta II  $\omega$ ; of tarsal eupathidia only  $fl''$  retained ( $fl'$  absent). Tibial I sensory cluster composed as in female, the difference being that the eupathidium  $k$  located somewhat distally from  $\phi_2$  and  $\phi_1$ . Seta  $l'$  on genu similar to others on its segment, with sparse barbs. Femur I with seta  $l'$  and  $d$  pointed, slender, short;  $l''$  missing,  $v'$  barbed. Leg II: claws moderate,

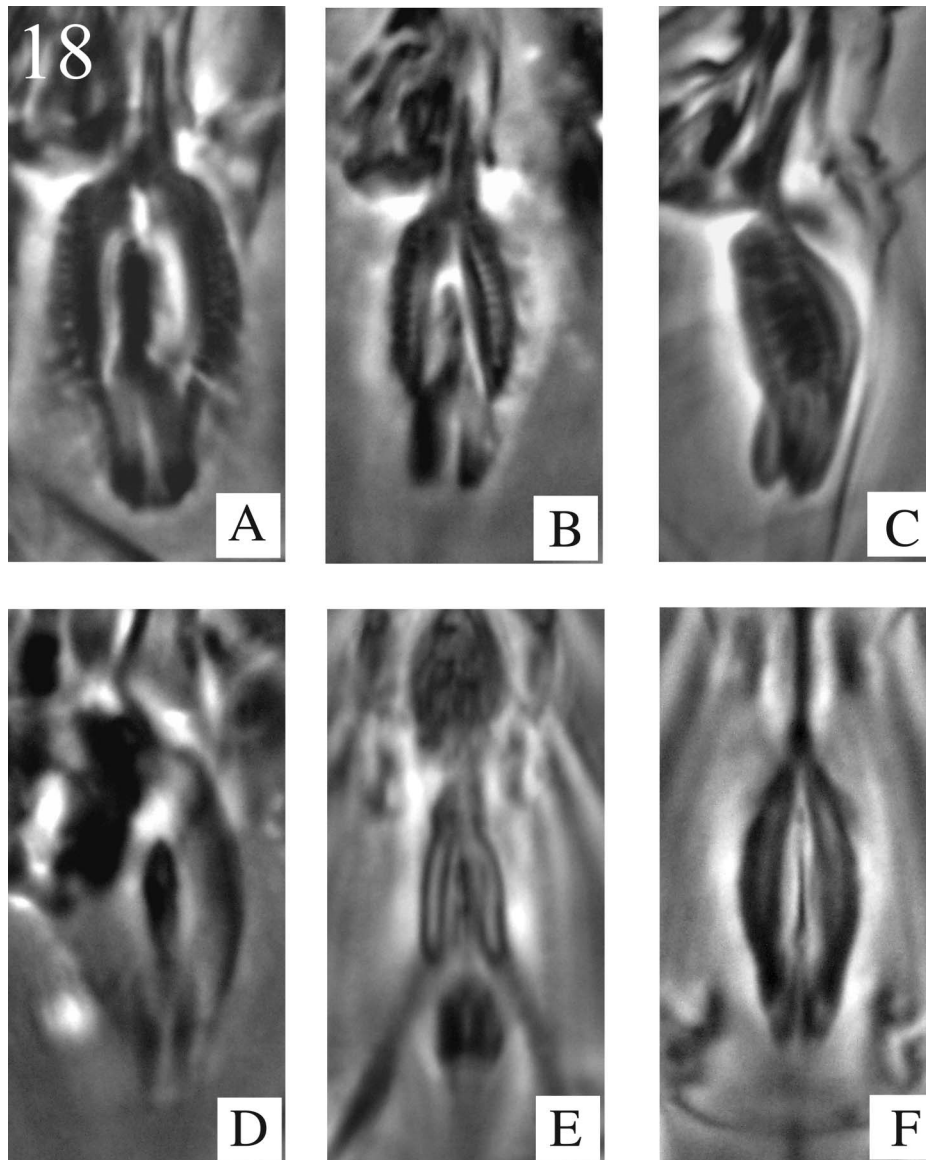


Figure 18. Comparison of various types of pharyngeal structures in genera *Dendroptus* and *Tarsonemus*: 18A – *D. flexus* female, 18B – *D. flexus* male, 18C – *D. flexus* larva, 18D – *D. willmanni* female, 18E – *T. fusarii* female, 18F – *T. bifurcatus* female.

empodium medium, pad-like. Seta  $u'$  spine-like,  $u''$  thin, stiff, hardly discernible. Seta  $tc''$  over twice longer than  $tc'$ , reaching with more than half of its length beyond the tip of the empodium. Solenidion  $\omega$  somewhat larger than that on tarsus I, with apparently larger head. Tibial setae  $d$  and  $v''$  approximately twice longer than  $l'$  and  $v'$ . Genua seta  $l'$  barbed, slender; seta  $l''$  on femur slender and short, on a contrary to that of a female simple,  $d$  missing. Leg III: claws and empodium as those of leg II. Seta  $tc''$  markedly (over  $4\times$ ) longer than  $tc'$  ( $pv''$  missing). Setae on tibia, genu and femur slender, pointed, sparsely barbed. Femoral seta  $v'$  similar in form and length to genua  $l'$  and  $l''$ ; genua  $v'$  markedly longer than formers. Leg IV – Free segments of leg IV (excluding claw) slightly shorter than those of leg III. Tarsus separated from tibia. Tarsal claw weakly curved, with acute tip, over  $2\times$  longer than wide at the base and nearly as long as tarsus combined with tibia. Tarsus with

three setae;  $pv''$  the longest and  $tc''$  – the shortest. Tibia sub-quadrangular; solenidion  $\phi$  medium-sized, rod-like, with smooth head. Tibial seta  $v'$  slender, smooth, distally blunt, slightly longer than femorogenu IV. Femorogenu less than  $2\times$  as long as wide at the base. Genua seta  $v'$  attenuated, slender, smooth;  $l''$  the longest on femorogenu, tapering, sharply pointed, barbed, as long as about  $1.3\times$  the length of combined femorogenu, tibia and tarsus IV. Seta Fe  $v'$  on femorogenu stiff, nearly  $2\times$  shorter than Tr  $v'$ .

Measurements (two specimens from the sample “734”, slide 01) – body and tagmata: length of body: 180; 178; length of idiosoma: 153; 150; width of idiosoma: 93; 93; length of gnathosoma: 34; 33; width of gnathosoma: 28; 29; length of pharynx: 12; 12; width of pharynx: 5; 5;  $dgs$ : 12; 12;  $vgs$ : 11; 11. Idiosomal dorsum: length of PrS: 49; 47; width of PrS: 82; 78. Lengths of setae:  $v_1$ : 30; 30;  $v_2$ : 21; 22;  $sc_1$ : 73; 75;  $sc_2$ : 25; 25;  $c_2$ : 39; 38;  $c_1$ : 45; 48;  $d$ :

28; 28;  $f$ : 9; 11;  $h$ :?; 2.5. Distances between setae:  $v_1-v_1$ : 15; 14;  $v_2-v_2$ : 22; 22;  $sc_1-sc_1$ : 33; 33;  $sc_2-sc_2$ : 47; 48;  $c_2-c_2$ : 79; 82;  $c_1-c_1$ : 73; 74;  $c_1-c_2$ : 31; 35;  $d-d$ : 38; 40;  $f-f$ : 24; 25;  $c_1-d$ : 20; 18;  $h-h$ : 9; 9. Idiosomal venter: lengths of setae:  $1a$ :?; 10;  $2a$ : 12; 13;  $3a$ : 13; 14;  $3b$ :?; 21. Distances between setae:  $1a-1a$ : 13; 12;  $2a-2a$ : 28; 28;  $3a-3a$ : 47; 47;  $3b-3b$ : 57; 57. Length of PrP: 36; 36; width of PrP: 74; 75; ap. 1-1: 16; 18; ap. 2-2: 40; 41; length of genital capsule: 30; 30; width of genital capsule: 28; 29. Leg segments and leg setae (lengths): Ta I: 15; 16; Ta I  $\omega$ : 5; 5; Tb I  $\phi_2$ : 3.5; 3; Tb I  $\phi_1$ : 2; 2; Tb I  $k$ : 4; 4; Ta II  $\omega$ : 5; 6. Claw IV length: 10; 12; claw IV width: 5; 5; Tb + Ta IV: 13; 14; Tb IV  $v'$ : 38; 38; Tb IV  $\phi$ : 5; 5; Fege IV: 35; 34; Ge IV  $v'$ : 35; 32; Ge IV  $l''$ : 60; 60; Fe IV  $v'$ : 8; 9.

*Larva* (Figures 13–17, 18C). Gnathosoma: shape subtriangular, similar in size to that of a male, slightly longer than wide. Pharynx as wide as  $\sim 0.2 \times$  the basal width, and  $0.3 \times$  as long as the ventral length of gnathosoma; built similarly to that in adults, but less sclerotized. Glandular bodies very small but discernible; postpalpal ( $pp$ ) setae indiscernible. Setae  $dgs$  slightly longer than  $vgs$ , both reaching to the apices of palpi. Cheliceral stylets and levers minute. Palpi similar to those of female, each with one seta apically and one in the distal third of the palp length. Palptibial claw indiscernible.

Idiosomal dorsum (length =  $1.9 \times$  width): relative length of setae: ( $v_1$ :  $sc_1$ :  $sc_2$ :  $c_2$ :  $c_1$ :  $d$ :  $e$ :  $f$ :  $h_2$ :  $h_1$ ): 1.0: 0.9: 3.5: 1.3: 1.6: 1.4: 1.3: 1.7: 1.1: 2.3. Setae  $v_1$  and  $sc_1$  slender, pointed, though the former slightly stronger and barbed. Setae  $sc_2$  located in posterior  $0.7 \times$  of prodorsal shield length, reaching with  $0.8 \times$  their length beyond the posterior edge of prodorsal shield, in a distance each to another lesser than half of their length. Setae  $c_2$  slender, smooth;  $c_1 \sim 1.3 \times$  of the  $c_2$  in length; spaced by a distance of  $1.4-1.8 \times$  their lengths; weakly tapering, barbed. Setae  $d$ ,  $f$  and  $h_1$  weakly tapering, bluntly ended and apparently barbed;  $h_2$  the longest on opisthosomal dorsum, slender, pointed and sparsely barbed. Cupuli  $ia$  set well anterolaterally related to setae  $d$ , the latter reaching with over half of their length beyond the posterior edge of tergite D; arranged in a distance equal to their lengths. Setae  $e$  located in a distance of  $\sim 0.4 \times$  their length from  $f$ ; the latter  $\sim 1.3 \times$  longer than the former, in a reciprocal distance smaller than half of their lengths. Cupuli  $im$  placed somewhat laterally of  $e$  bases, almost in same transverse line. Setae  $h_2$  separated by a distance of  $1.3-1.4 \times$  their lengths; setae  $h_1$  over twice as long as  $h_2$  and  $\sim 6-7 \times$  as long as a distance between their bases. Cupuli  $ih$  well discernible, located medially and slightly posteriad of line of  $h_2$ . Dorsal shielding smooth.

Idiosomal venter: apodemes 1 and 2 and anteromedian apodeme weakly expressed; the latter separated from apodemes 2. All ventral podosomal setae short, slender, pointed;  $1a$  located somewhat posteriorly of apodemes 1, in a distance each to another slightly longer than their length. Setae  $2a$  located half-way between apodemes 2 and posterior edges of coxal fields II, in a distance of nearly  $3 \times$  their lengths one to another. Propodosomal plate weakly

defined anteriorly and wavy on each side posteriorly. Setae  $3a$  slightly longer than  $3b$ , in a distance of nearly  $1.5 \times$  of their length from bases of  $3b$ . Three pairs of minute setae  $ps$  symmetrically arranged between bases of  $h_1$  on the HPs segment. Propodosomal plate and coxal fields III smooth.

Legs – proportions of free segments of legs (I: II: III): 1: 0.9: 1. Leg chaetotaxy: I: 3-4-6( $1\phi$ )-5( $1\omega$ ); II: 2-3-4-3( $1\omega$ ); III: 1-3-4-3. Leg I: claws smaller than those of legs II and III. Subunguinal seta  $s$  spine-like, smaller than unguinal setae  $u'$  II and III. Tarsus  $\sim 2.2 \times$  longer than wide at the base. Eupathidia  $tc'$  and  $tc''$  subequal in length, located subapically. Solenidion  $\omega$  with swollen head, slightly smaller than Ta II  $\omega$ ; both similar to those of the male rather than the female. Tibial solenidion  $\phi_1$  minute, clearly shorter than famulus  $k$ ; both arranged contiguously as in female. Seta  $l''$  the longest of all on genu,  $l'$  shorter,  $v'$  and  $v''$  subequal, shortest. Femoral seta  $l'$  short, slender, pointed;  $d$  similar but slightly stouter. Leg II: claws medium sized, thin; empodium medium, pad-like. Tarsal setae  $pl''$  and  $pv'$  lacking. Seta  $tc''$  over  $2 \times$  longer than  $tc'$ , reaching far beyond the distal edge of empodium. Genu seta  $l'$  the shortest on the segment; other setae over  $2 \times$  longer, subequal each to another. Seta  $l'$  on femur simple, small, pointed; similar to that of male;  $d$  missing. Leg III: claws and empodial pad similar to those of leg II, though slightly stronger. Tarsal seta  $tc''$  over  $3 \times$  longer than  $tc'$ , reaching far beyond the distal end of empodium; tarsal  $pv''$  missing. All tibial setae slender, pointed,  $d$ ,  $v'$  and  $v''$  longer, attenuate;  $l'$  the shortest and  $v''$  the longest on tibia.

Measurements (two specimens from the sample “734”, slides 01 and 04) – body and tagmata: length of body: 200; 195; length of idiosoma: 174; 165; width of idiosoma: 87; 94; length of gnathosoma: 31; 35; width of gnathosoma: 30; 30; length of pharynx: 10; 11; width of pharynx: 4; 5;  $dgs$ : 13; 13;  $vgs$ : 11; 11. Idiosomal dorsum: length of PrS: 50; 51; width of PrS: 62; 62. Lengths of setae:  $v_1$ : 23; 24;  $sc_1$ : 21; 19;  $sc_2$ : 80; 83;  $c_2$ : 30; 30;  $c_1$ : 34; 42;  $d$ : 30; 34;  $e$ : 29; 33;  $f$ : 36; 42;  $h_2$ : 24; 26;  $h_1$ : 51; 57. Distances between setae:  $v_1-v_1$ : 10; 10;  $sc_1-sc_1$ : 34; 35;  $sc_2-sc_2$ : 34; 36;  $c_2-c_2$ : 67; 82;  $c_1-c_1$ : 62; 58;  $c_1-c_2$ : 29; 28;  $d-d$ : 34; 33;  $e-e$ : 38; 38;  $f-f$ : 16; 15;  $e-f$ : 12; 12;  $h_2-h_2$ : 34; 33;  $h_1-h_1$ : 9; 8. Idiosomal venter: lengths of setae:  $1a$ : 9; 10;  $2a$ : 9; 10;  $3a$ : 12; 13;  $3b$ : 9; 10;  $ps_1$ : 6; 7;  $ps_2$ : 7; 8. Distances between setae:  $1a-1a$ : 13; 12;  $2a-2a$ : 26; 26;  $3a-3b$ : 17; 18;  $ps_1-ps_1$ : 3; 2;  $ps_2-ps_2$ : 7; 4.5. Length of PrP: 29; 32; width of PrP: 65; 63; ap. 1-1: 16; 16; ap. 2-2: 47; 42; length of HPs: 25; 25; width of HPs: 46; 42. Leg segments and leg setae (lengths): Ta I: 13; 12; Ta I  $\omega$ : 3; 3.5; Tb I  $\phi_1$ : 1.5; 2; Tb I  $k$ : 5; 5; Ta II  $\omega$ : 4; 4.

## Discussion

*Dendroptus flexus* is a peculiar species in several respects. Somewhat bizarre form of the seta  $l'$  on femur II of females with its characteristic lobate ending resembling duck foot in shape is unique and has never been recorded among tarsonemids before.

The species generic affiliation is not entirely clear, since it shares some morphological characteristics with both *Tarsonemus* and *Dendroptus*. Characters more typical of *Tarsonemus* are general body dimensions (smaller) and habitus (more rounded and compact), relatively weak cheliceral stylets, retention of tibial solenidion  $\phi_1$  on leg I (though apparently reduced), lack of extensively elongate setae on podosomal venter in adults, short and stiff dorsal opisthosomal setae on tergites D, EF and H in female and lack of pronounced flange of femorogenu IV in male. While the above form of dorsal opisthosomal seta is generally considered derived character state in *Tarsonemus*, in *Dendroptus* such interpretation is unsure. However, it should be stressed that the majority (but one – form of dorsal opisthosomal setae) of above-mentioned character states are considered plesiomorphies, e.g. by Lindquist (1986) and therefore bear little significance according to rules of cladistic systematics.

An affiliation within genus *Acaronemus* Lindquist & Smiley, 1978 can also be tentatively considered due to reduced setal count of femora II and tarsi. However, many characters (claws, habitus of adults, podosomal setae and ventral apodemes) reveal different states in both *D. flexus* and *Acaronemus*. Tarsal setae I s and II–III u', even though weak, are still hardly comparable with the condition found in *Acaronemus*.

Character states that have ultimately motivated our decision on provisional inclusion of *T. flexus* within *Dendroptus* are primarily the structure of a pharynx (Figure 18) – typical for most of the well-known *Dendroptus* species, and the reductive chaetotaxy of legs, approaching the one expressed by Lindquist (1986) in his renewed diagnosis of this genus (otherwise one of the two oldest tarsonemid generic taxa). Because pharyngeal structures characterize (to some extent) tarsonemid genera and subordinate units (Lindquist 1973, 1986), they can provide a base for comparisons. *Dendroptus flexus* pharynx (Figure 18A–C) shows similarities with that of, e.g. *D. willmanni* Schaarschmidt, 1959 (Figure 18D) in broad external part and partial embracing small and narrow glandular bodies (sometimes referred to as “salivary glands”). Pharyngeal structures typical of two major branches of the genus *Tarsonemus* are clearly different: that of, e.g. *T. fusarii* Cooreman, 1941 (Figure 18E) is narrow and well separated from glandular bodies, and that of *T. bifurcatus* Schaarschmidt, 1959 (Figure 18F) is narrow-elongate, fully embracing glandular bodies. An additional argument is provided by the occurrence of *D. flexus* specimens collected in association with common gall-making eriophyoids, which is considered indicative for *Dendroptus*.

Among three currently recognized subgenera of *Dendroptus*, namely *D. s. str.*, *Hemidendroptus* Magowski, 2012 and *Eudendroptus* Sharonov & Mitrofanov, 1986, *D. flexus* fits broadly within the nominative subgenus. Even though retention of tibial I solenidion  $\phi_1$  (in its reduced form) makes *D. flexus* comparable with the most primitive *Dendroptus* species – *D. fennicum* (Oudemans, 1936)

(whose adults retain both rudimentary solenidion  $\phi_1$  on tarsus I and spine-like seta  $pl''$  on tarsus II), the latter reveals more typical generic character states – elongate setae on ventral metapodosoma and well-pronounced adaxial flange on femorogenu IV of males. Thus, it is possible that *D. flexus* represents an early outshoot of *Dendroptus s. str.* evolution, parallel with species of the subgenus *Eudendroptus*. Such parallel development may also suggest that the genus *Dendroptus* is a conglomerate of more than one evolutionary derivation and, in fact, would not be a monophyletic group.

While the tentative placement of the “*flexus*” in the genus *Dendroptus s. lato* does not improve the diagnostic status of the latter and may be seen as controversial, it is still more reasonable than keeping it within *Tarsonemus*, as there is no single derived character state that may support such affiliation.

In general, resolving the phylogenetic status of currently recognized *Dendroptus sensu lato* poses two fundamental problems: first, improve the knowledge on existing species of this genus, most of which present outdated or inadequate descriptions, and second, find the point of divergence (or divergences) in the Tarsoneminae subfamily tree from which this genus might have emerged. While the former task requires extensive revision of species included in the genus, the latter, even more problematic, involves critical revision of the tribe Steneotarsonemini Lindquist, 1986 in the context of its parent subfamily.

The natural habitat of *D. flexus* can provisionally be determined as foliage of woody plants – deciduous trees and shrubs in Eastern and Central Europe. Besides the data presented in the present work, there is one literature record by Uzhevskaya (2002), who identified singular specimen(s) of *T. flexus* on *Poa bulbosa* L. (bulbous bluegrass) in Northern Prichernomorje Region; however, this material has not been studied by us. Life and particularly feeding habits remain unknown; however, it is worth mentioning that the largest examined population (ex. *Tilia cordata*, Keszthely, Hungary, 25 July 1994) was found in the erineum of *Eriophyes tiliae*, common eriophyid gall-making mite. Another one (with similar collection data) was located in the leaf galls and around the opening of the bead leaf galls of *Aceria cephalonea* and *A. macrochela*. Thus, it may suggest a kind of relationship recorded for *Dendroptus* mites feeding on erineal growth of gall tissue generated by eriophyoids (Beer 1963; Lindquist 1986), or even feeding upon eriophyoid eggs (Lindquist 1986), but again, no such observation exists for *D. flexus*.

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