

NO DIFFERENCE IN THE JUVENILES OF TWO *TECTOCEPHEUS* SPECIES (ACARI: ORIBATIDA, TECTOCEPHEIDAE)

Tobias PFINGSTL* and Günther KRISPER

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*Institute of Zoology, Karl-Franzens University, Universitaetsplatz 2, 8010 Graz, Austria.
tobias.pfingstl@gmx.at (*corresponding author), guenther.krisper@uni-graz.at*

ABSTRACT — The juveniles of the parthenogenetic species *Tectocephus sarekensis* and *T. velatus* were obtained in rearing experiments and then analyzed morphologically. This is the first description of *T. sarekensis* juveniles and a re-description of *T. velatus* immatures. The comparison of the immatures of both species demonstrated that no obvious morphological differences are detectable. Although it is known that juvenile morphology may be very homogeneous within a genus, this is the first report of morphologically identical instars of two different oribatid species. The analysis of literature dealing with *Tectocephus* immatures generated ambiguous results as certain descriptions are partly incomplete and unclear. These problematic results may reflect difficulties in the identification of adult *Tectocephus* specimens. Only the nymphs of *T. alatus* could be clearly distinguished from *T. sarekensis* and *T. velatus* juveniles. Nevertheless, the overall juvenile morphology within the genus is homogeneous. The investigation of the eggs of *T. sarekensis* showed that the exochorion consists of coin-like formations that adhere to the endochorion whereas fibrous sticky material is dispersed between these coins.

KEYWORDS — development; taxonomy; parthenogenetic; exochorion; subspecies

INTRODUCTION

The genus *Tectocephus* Berlese, 1896 comprises some of the most frequent ubiquitous oribatid species with a worldwide distribution. Due to morphological variation the determination of *Tectocephus* species is uncertain. Numerous putative species have been described within this genus. Nübel-Reidelbach (1994) listed 29 taxa, but accepted only *T. velatus* (Michael, 1880) and *T. minor* Berlese, 1903 as valid species, with all the other taxa merged into a *T. velatus* complex due to the high variation found in different characters. Weigmann (2002) classified five morphotypes of *T. velatus* in Central Europe as subspecies: *T. velatus velatus* Michael

1880; *T. v. sarekensis* Trägårdh, 1910; *T. v. tenuis* Knülle, 1954; *T. v. alatus* Berlese, 1913 and *T. v. knuellei* Vanek, 1960. But Laumann *et al.* (2007) investigated the morphology as well as several molecular genetic aspects of *T. v. velatus* and *T. v. sarekensis* and concluded that these two taxa represent discrete species.

Despite the immense literature and controversy on *Tectocephus*, the knowledge of immature stages of this genus is limited. Grandjean (1934) sketched the larva and protonymph of *Tectocephus* sp., Haarløv (1957) described the tritonymphs of *T. alatus* and *T. velatus*, Nübel-Reidelbach (1994) specified the juvenile morphology of specimens that could not be

definitely assigned to a certain *Tectocephus* species and Chistyakov (1971, 1972) provided information on the postembryonic development of *T. velatus*.

As mentioned above, there are problems concerning the identification of the five *Tectocephus* species in Central Europe. The aim of this paper was to analyze the instars of at least of two of the formerly supposed subspecies of *Tectocephus* and to confirm their species status based on juvenile morphology. Therefore this paper gives detailed morphological information on all immature stages of the species *T. sarekensis* and *T. velatus*.

MATERIALS AND METHODS

Mosses were collected from phonolithe rocky habitats in Eastern Germany and litter of *Fagus sylvatica* was sampled in Austria. Collection areas: (1) Oberoderwitzer Spitzberg (Saxony, Germany), 14°41'30"E 50°57'40"N, 30 Sept. 2007, leg. Schmidt K.H. [allopatric *T. sarekensis* population]; (2) Lechwald, Graz (Styria, Austria), 15°27'48"E 47°05'01"N, 12 Oct. 2010, leg. Pfingstl T. [sympatric *T. velatus* and *T. minor* populations – ratio 63:9].

The sampled adults were determined using Weigmann's identification key (2006) and the parameter framework of Laumann *et al.* (2007).

For a clear assignment of the juveniles to the respective species controlled rearing experiments were conducted. Cylindrical polystyrol-containers supplied with plaster of Paris were used as rearing boxes and feeding was conducted with small pieces of lichens and mosses or thin layers of coccal green algae.

For investigation in transmitted light, juvenile specimens were preserved in ethanol (70%) and then embedded in BERLESE mountant. Observations, drawings and photographs were conducted with a differential interference contrast microscope (Olympus BH-2) equipped with a drawing attachment. Image stacks of nymphs were obtained by an Olympus Camedia C4040 zoom digital camera and layered with the software Combine ZP. The SEM-micrographs of the eggs were realised at the Research Institute for Electron Microscopy and Fine

Structure Research, Graz, University of Technology, with a Zeiss Leo Gemini DSM 982.

RESULTS

Juvenile stages of *T. sarekensis* and *T. velatus* — developmental common features.

Habitus — colour ranges from yellowish white to light brown. Gastronotic cuticle plicate.

Prodorsum — rostral setae (*ro*) spiniform and twice as long as lamellar setae. Lamellar setae (*le*) short and acuminate. Interlamellar setae (*in*) short, blunt, located between sensilla. One pair of minute exobothridial setae (*ex*). Sensillus (*ss*) clavate, flattened and spinose in distal third. Border of bothridium spiral-like, laterally opened.

Subcapitulum — diarthry, atelebasic dentate rutella with two teeth; first one spatulate-like and twice as large as second one, second tooth triangular and acute. Seta *h* thin and spiniform, setae *a* and *m* acuminate more than twice the length of *h*. Pedipalp pentamerous, chaetome 0-2-1-3-10 (solenidion included) (Figure 1). Tip of solenidion touching eupathidium *acm* forming an incomplete "corne double".

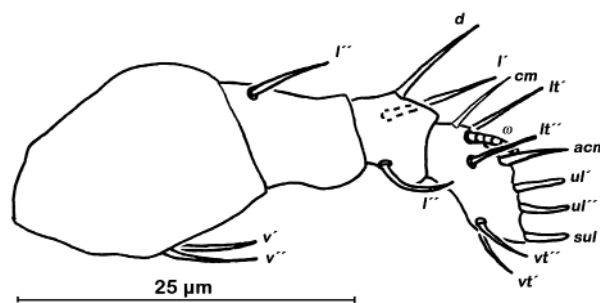
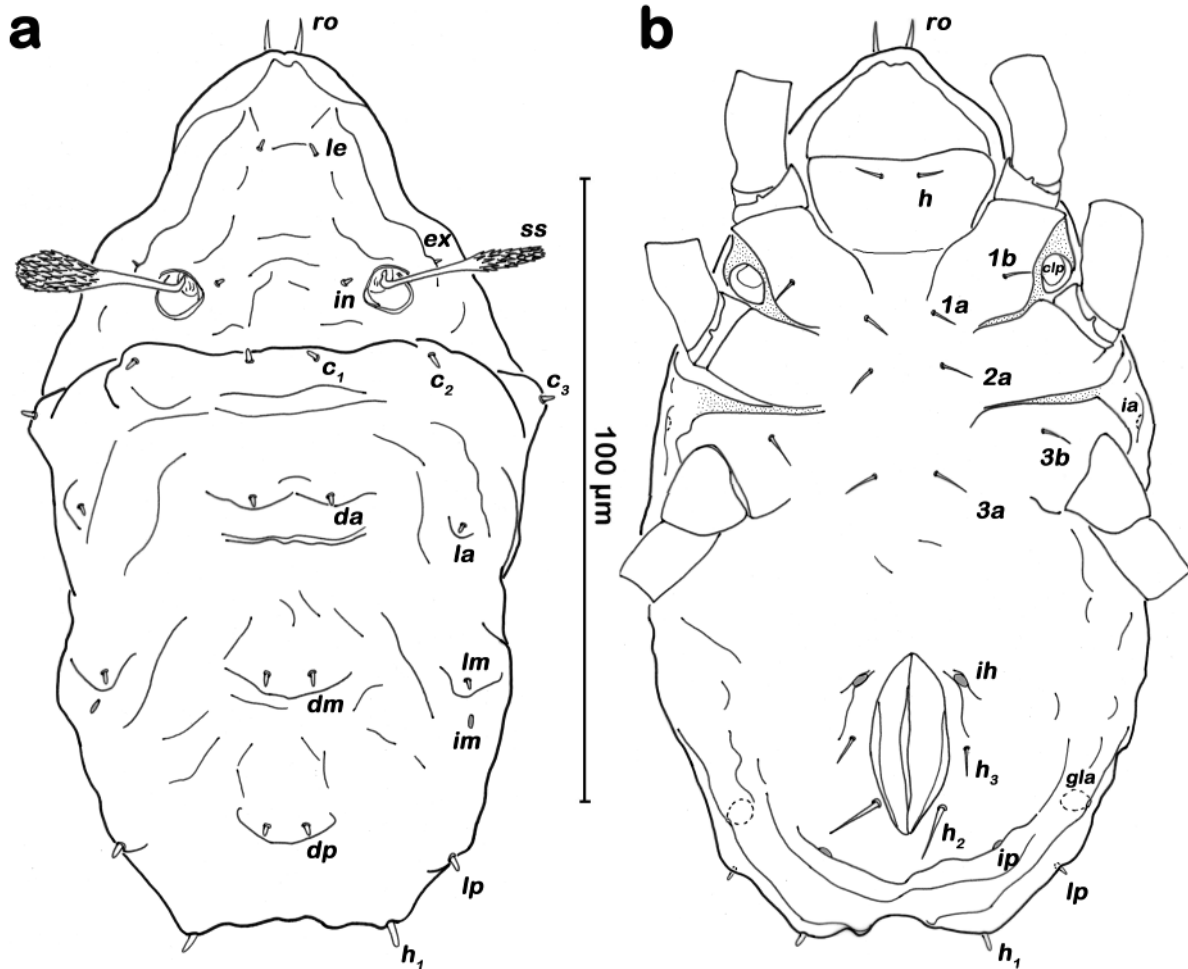


FIGURE 1: *Tectocephus velatus* deutonymph, right pedipalp anti-axial view.

Legs — dorsal setae *d* on genu and tibia coupled to solenidia in all stages. Tibia I equipped with a small apophysis, bearing solenidia. Solenidion ω_1 on all tarsi I falcate, coupled to seta *ft''* for part of length.

FIGURE 2: *T. sarekensis* larva. a – dorsal view; b – ventral view.*Tectocephus sarekensis*

Larva — Body length (N = 8): 169 – 188 µm, average 181 µm.

Gastronotic region (Figure 2a) — 12 pairs of notogastral setae present. Setae c_{1-3} , $da - dp$, $la - lp$ and h_1 small and robust. Cupule im situated posterior to seta lm . Cupule ia lateral on a level with sejugal furrow.

Ventral region of the idiosoma (Figure 2b) — epimeral setation (I-III): 3-1-2. Setae $1a$, $2a$, $3a$ arranged medially. Seta $1b$ situated in the middle of epimeral plate I on a level with Claparède organ. Seta $1c$ shaped valve like protecting Claparede's organ. Seta $3b$ close to trochanter III. Porous areas lo-

cated on apodemes 2, sejugal and 3. Seta h_3 short, seta h_2 conspicuously long and solid, both acuminate. Cupule ih located antero-laterally to anal aperture and cupule ip lateral near h_2 . Small opisthonotal glands situated laterally on a level with seta h_2 .

Legs (Figures 3a–c) — setation see Table 1.

Protonymph — Body length (N = 18): 185 – 231 µm, average 221 µm.

Gastronotic region (Figure 4a) — 15 pairs of notogastral setae, setae p_1 , p_2 and p_3 added in this stage.

Ventral region of idiosoma (Figure 4b) — cupule ips located anterior to anal aperture. Cupule ih dis-

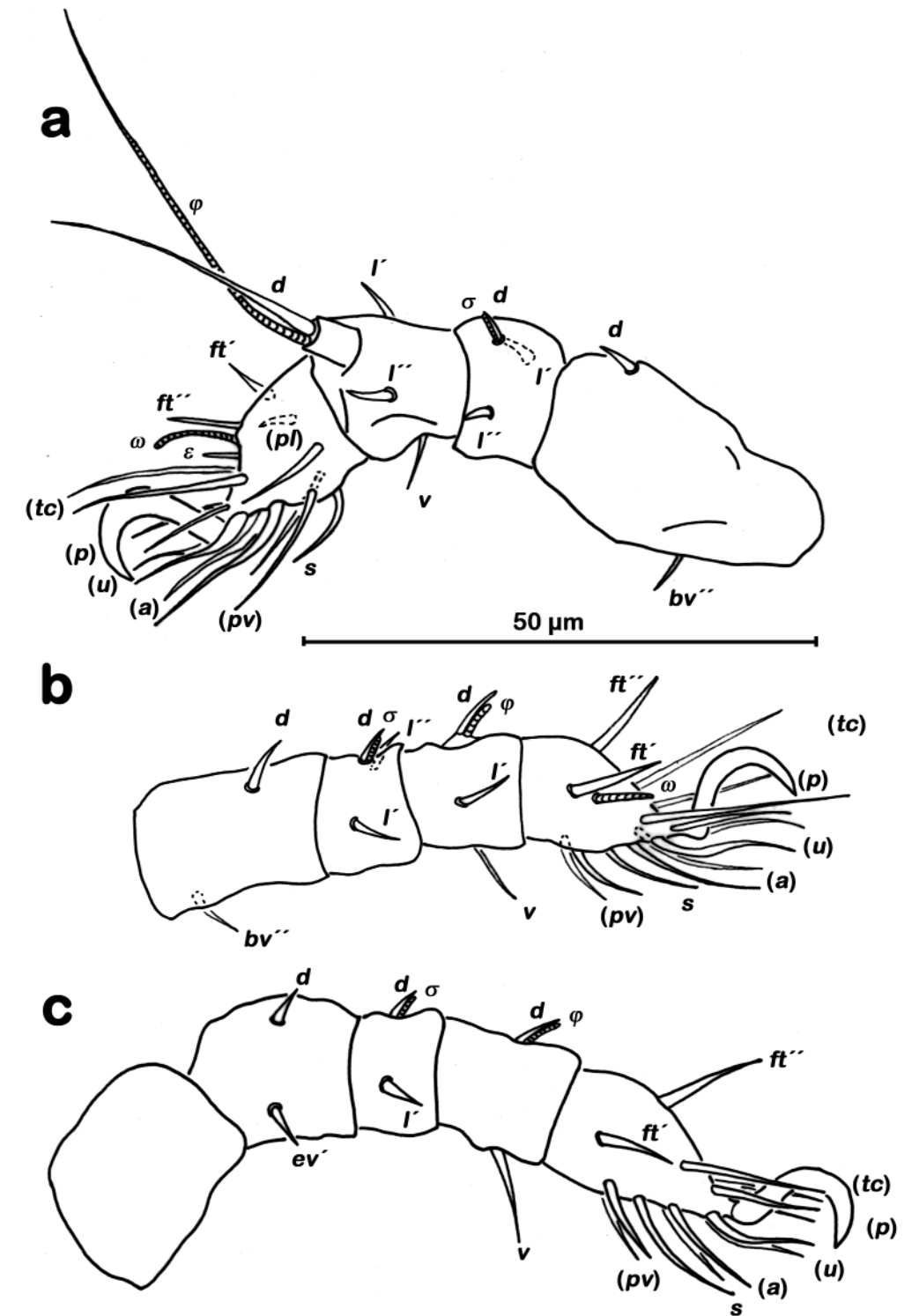
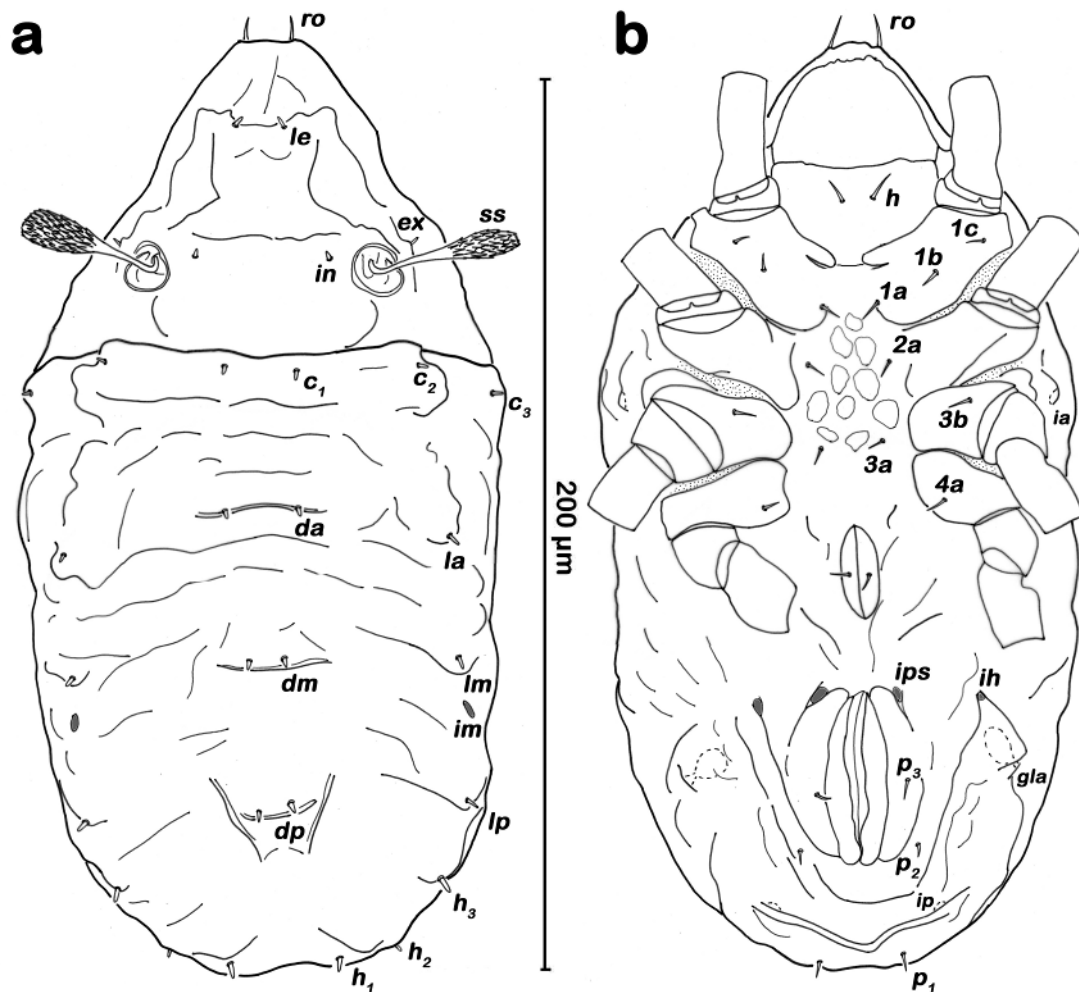


FIGURE 3: *T. sarekensis* larva left legs. a – leg I antiaxial view; b – leg II paraxial view; c – leg III antiaxial view.

FIGURE 4: *T. sarekensis* protonymph. a – dorsal view; b – ventral view.

placed laterally, next to opisthonotal gland. Setae p_3 and p_2 short and acuminate, flanking anal opening. Seta p_1 same shape, situated posteriorly. Genital region bearing one pair of genital setae. Epimeral setation (I–IV): 3-1-2-1. Seta $1c$ near lateral margin of epimeral plate I, close to trochanter. Seta $4a$ placed on epimeral plate IV close to median posterior margin. Median divided mentotectum looking like transverse incision on anterior median margin of epimeral plate I. Median lobes of this incision variable, rounded or tapered; shape of these lobes sometimes also varying between left and right. From this stage irregularly shaped round

and slightly elevated spots dispersed over median area between epimeral plates.

Legs (Figures 5a–d) — setation see Table 1.

Deutonymph — Body length ($N = 22$): 231 – 293 μm , average 266 μm .

Prodorsum — median prodorsal ridges assuming shape of definitive lamellae. Translamella distinct ridge.

Gastronotic region (Figures 6a and 10a) — 15 pairs of notogastral setae, no difference to protonymph.

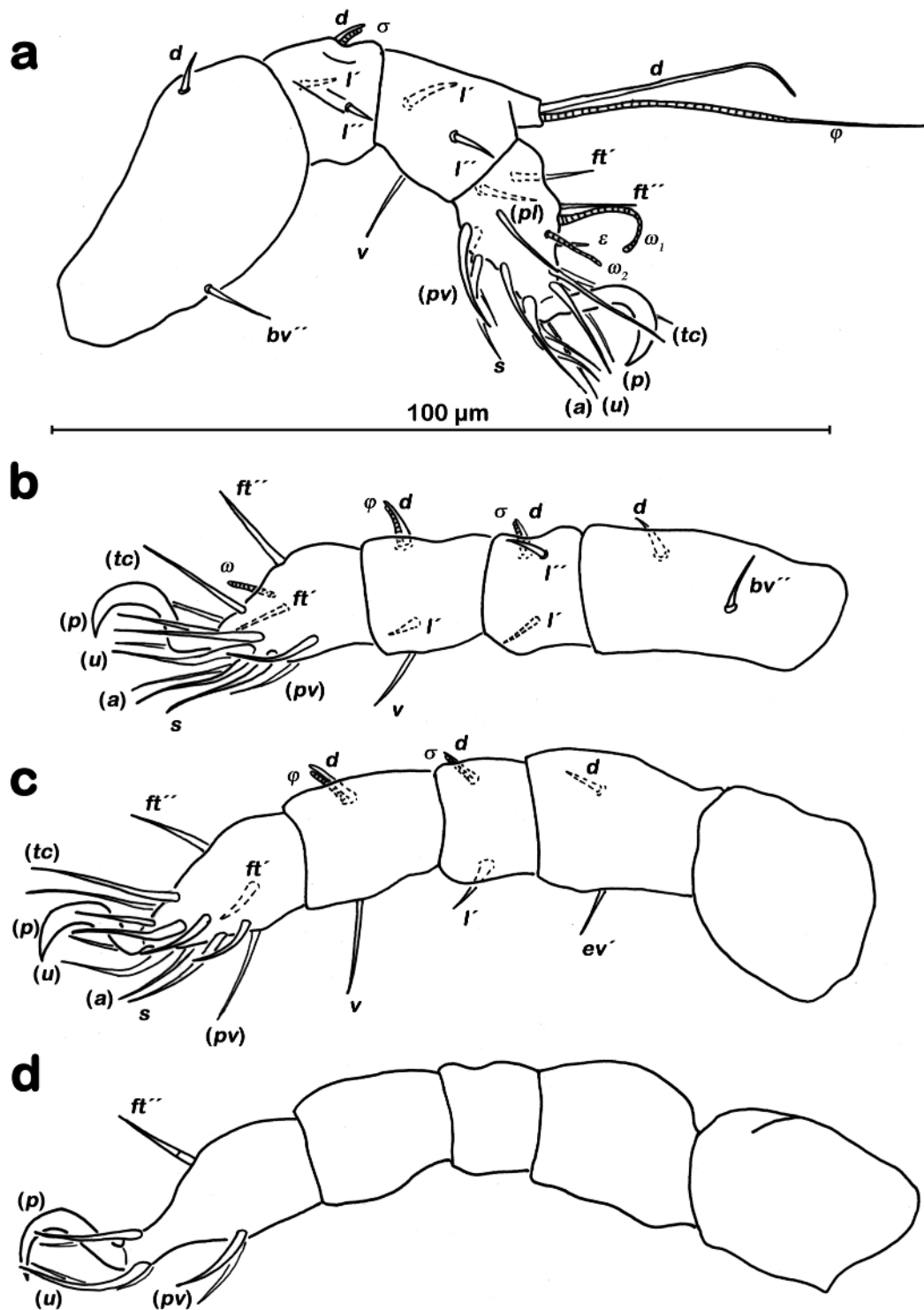


FIGURE 5: *T. sarekensis* protonymph legs. a – right leg I antiaxial view; b – left leg II antiaxial view; c – left leg III paraxial view; d – right leg IV antiaxial view.

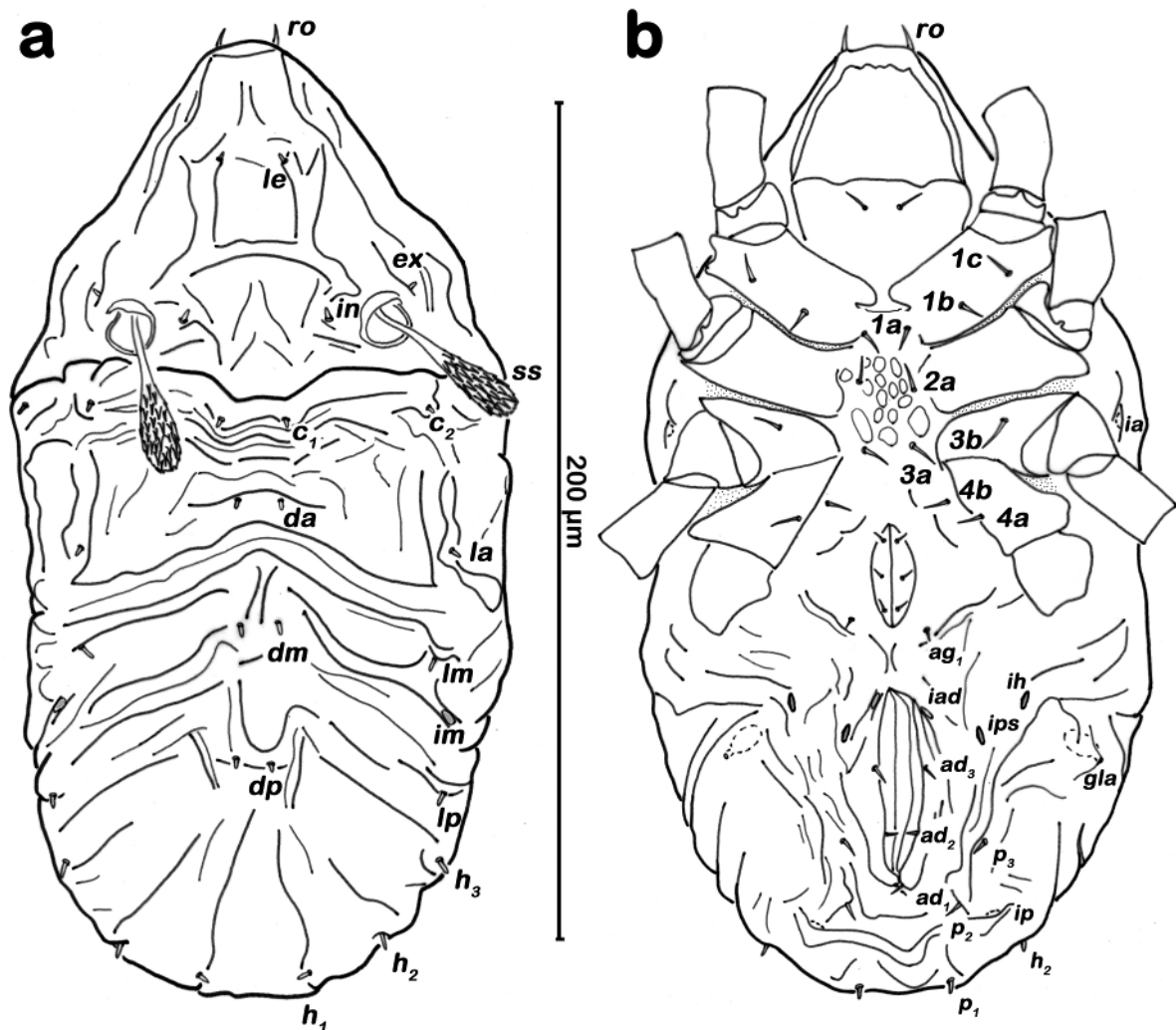


FIGURE 6: *T. sarekensis* deutonymph. a – dorsal view; b – ventral view.

Ventral region of idiosoma (Figures 6b and 10b) — adanal setae ad_1 – ad_3 short and acuminate, flanking anal valves. Cupule *iad* located near anterior border of anal aperture, cupule *ih* close to opisthonotal gland and *ips* situated slightly posterior between *iad* and *ih*. Three pairs of genital setae in row on genital valves (no variation). One pair of very short aggenital setae posterior and lateral to genital opening. Formula of epimeral setation (I–IV): 3-1-2-2. Seta *4b* located medially.

Legs (Figures 7a–d) — Setation see Table 1.

Tritonymph — Body length (N = 24): 283 – 353 μ m, average 318 μ m.

Gastronotic region (Figures 8a and 10c) — 15 pairs of notogastral setae, all the same shape as in proto- and deutonymph.

Ventral region of idiosoma (Figures 8b and 10d) — very short anal setae an_1 and an_2 on median margin of anal valves. Cupules same positions as

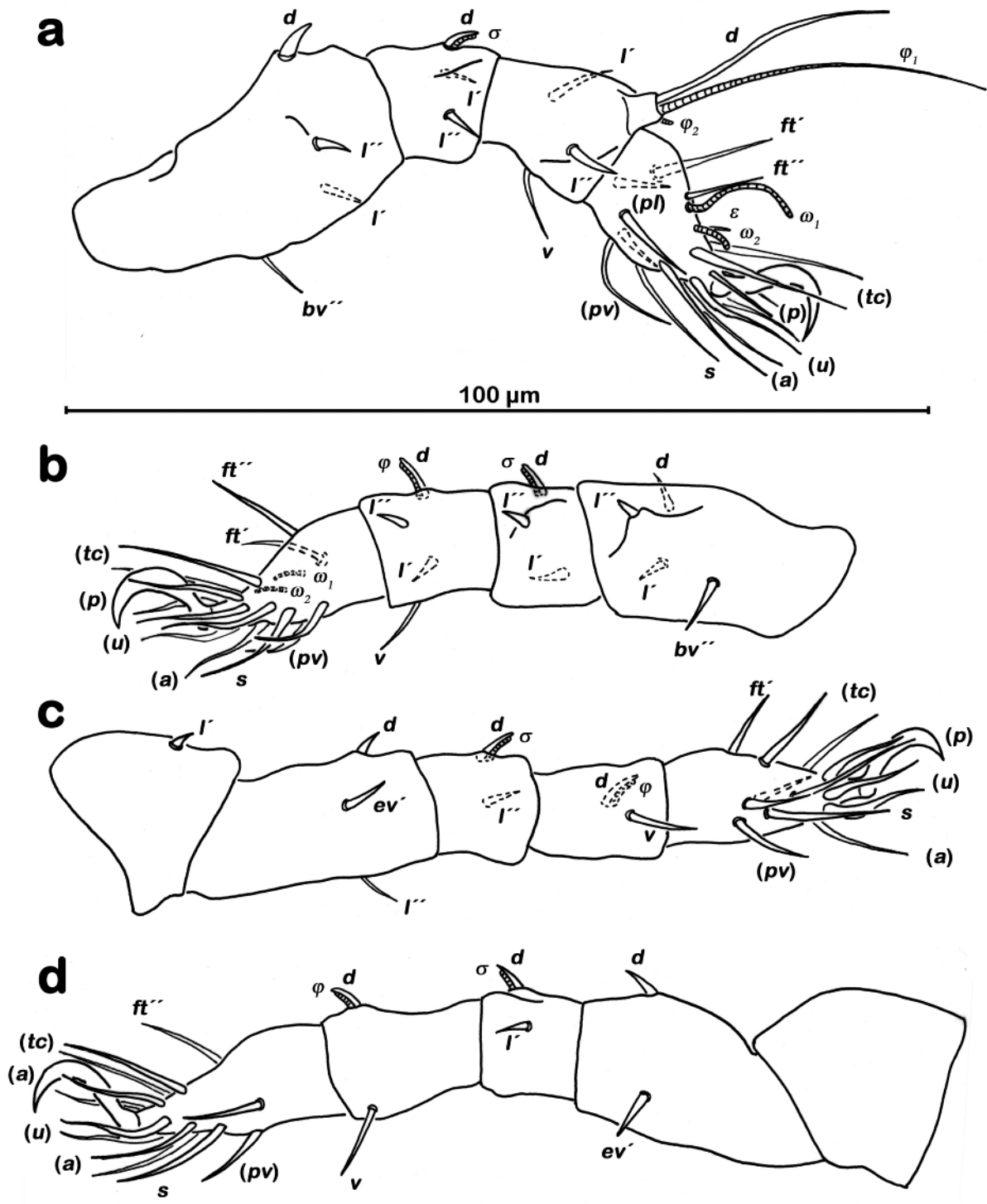


FIGURE 7: *T. sarekensis* deutonymph legs antiaxial view. a – right leg I; b – left leg II; c – left leg III; d – right leg IV.

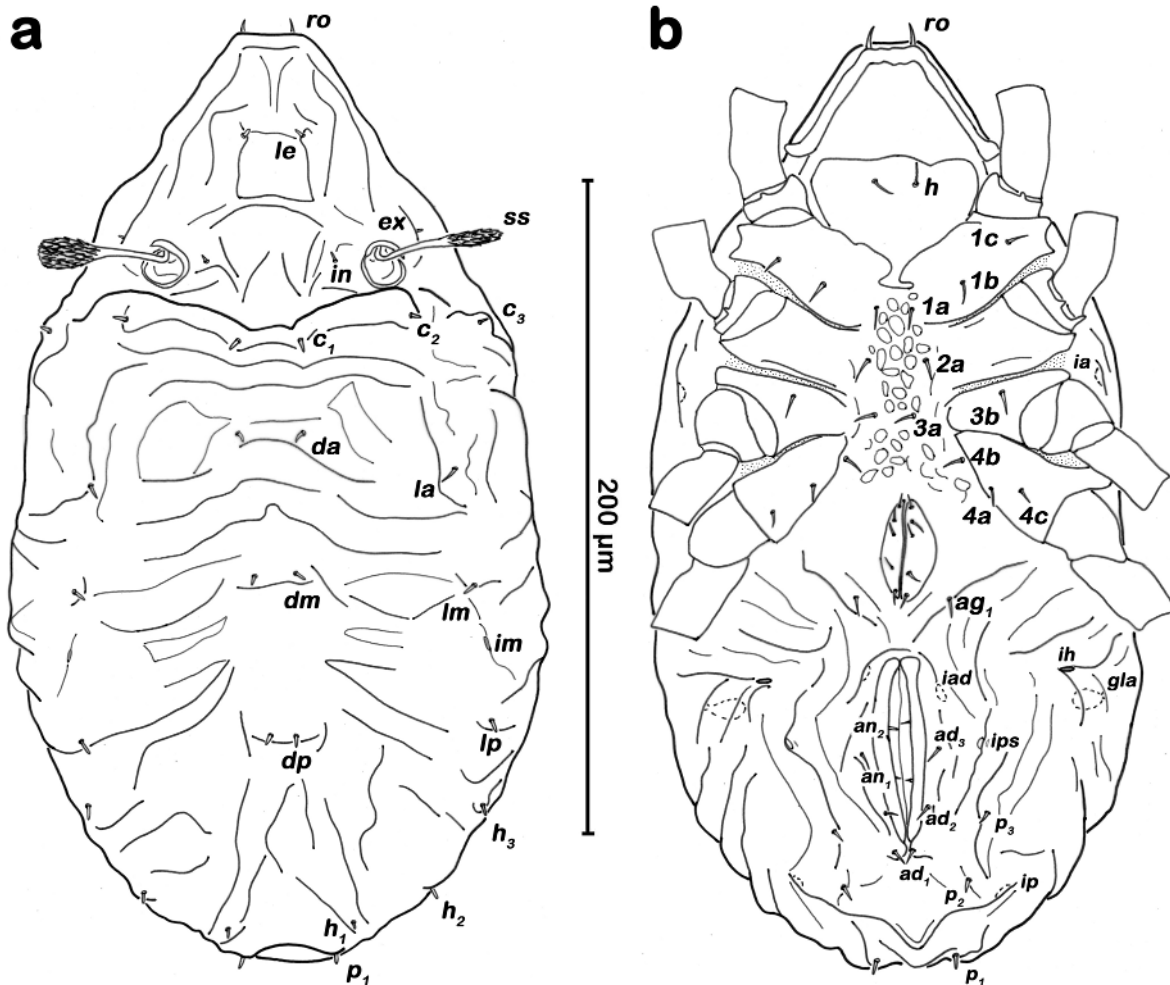


FIGURE 8: *T. sarekensis* tritonymph. a – dorsal view; b – ventral view.

in deutonymph. Five pairs of genital setae positioned in median row on genital valves (constant). Epimeral setation (I-IV): 3-1-2-3. Seta 4c located next to trochanter.

Legs (Figures 9a–d) — solenidia and chaetome see Table 1.

Eggs of *T. sarekensis* — The average number of eggs per gravid female was one, the observed maximum number was two. The size of the eggs of *T. sarekensis* is approximately 150 μm in length and 70 μm in diameter.

The color ranges from light brown to grey brown. The exochorion consists of flat and round coin like structures (diameter 3 – 6 μm) which are

attached to the endochorion. The surface of these elevations is uneven and fibrous sticky material is dispersed between these "coins" (Figures 11a–b).

Tectocephus velatus redescription

Larva — Body length (N = 5): 157 – 179 μm , average 168 μm .

Gastronotic region — 12 pairs of notogastral setae present. Setae $c_1 - 3$, $da - dp$, $la - lp$ and h_1 .

Ventral region of the idiosoma - epimeral setation (I-III): 3-1-2. Seta h_3 short, seta h_2 conspicuously long and solid, both acuminate. Porous areas located on apodemes 2, sejugal and 3.

Legs — setation see Table 1.

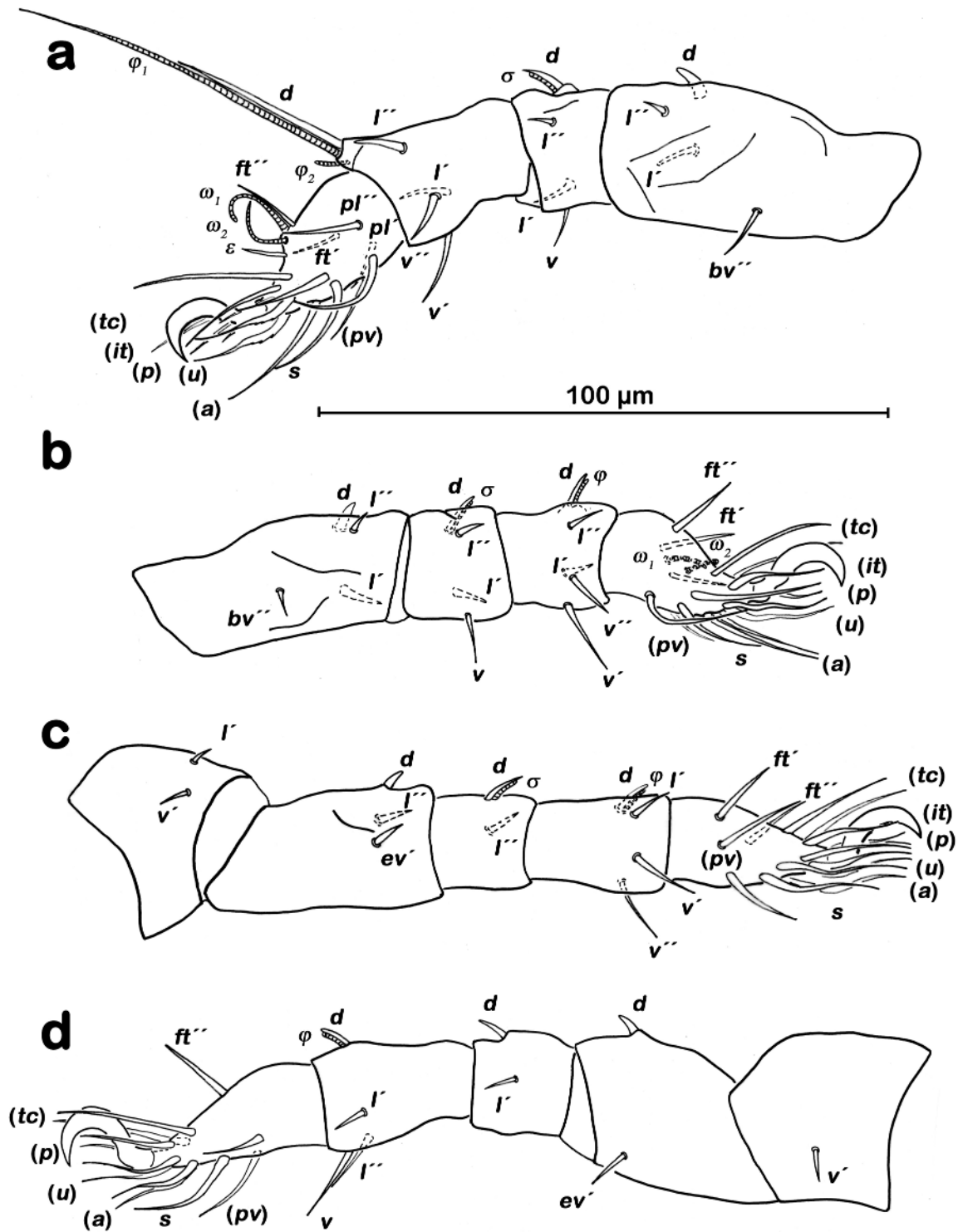


FIGURE 9: *T. sarekensis* tritonymph legs antiaxial view. a – left leg I; b – right leg II; c – left leg III; d – right leg IV.

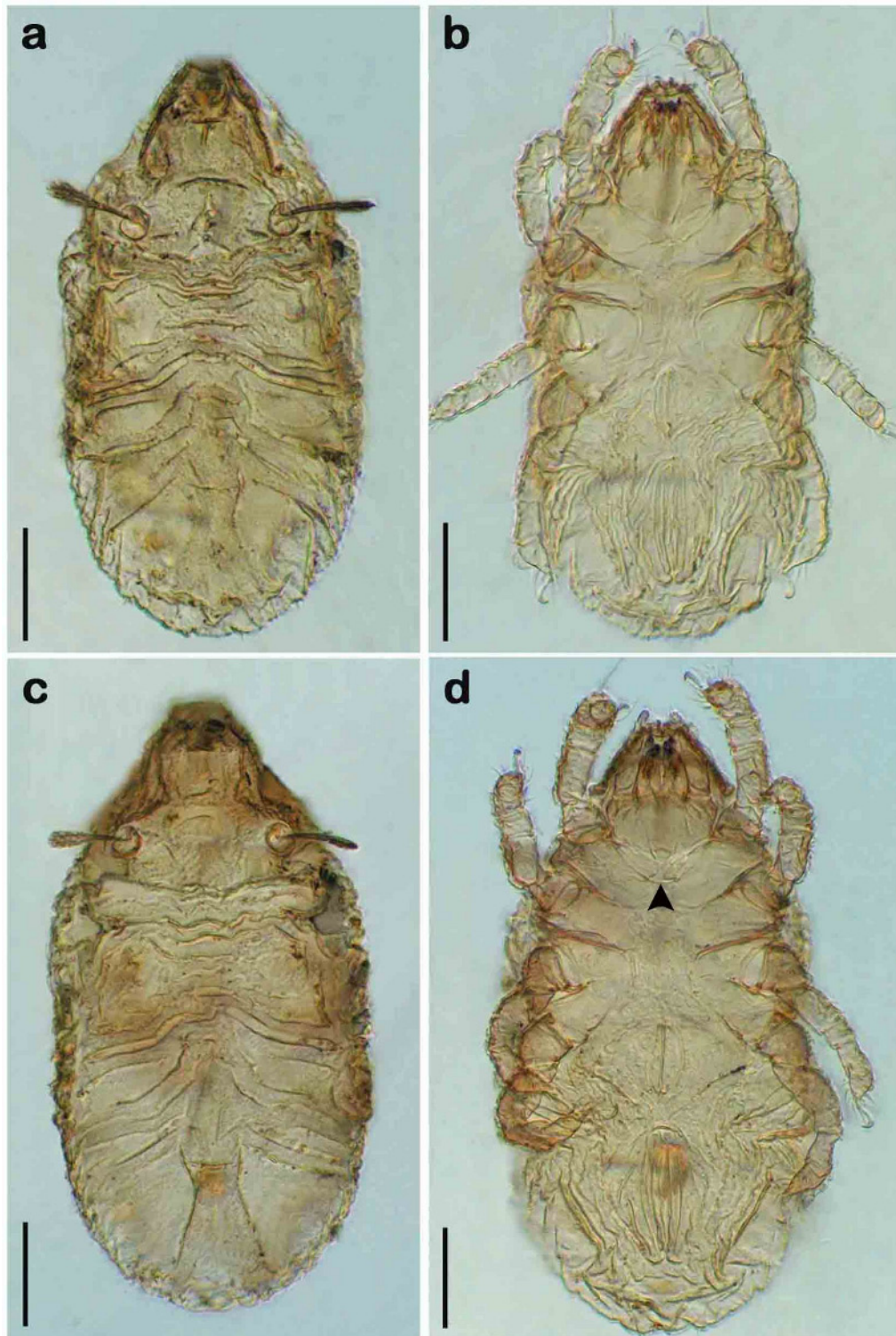
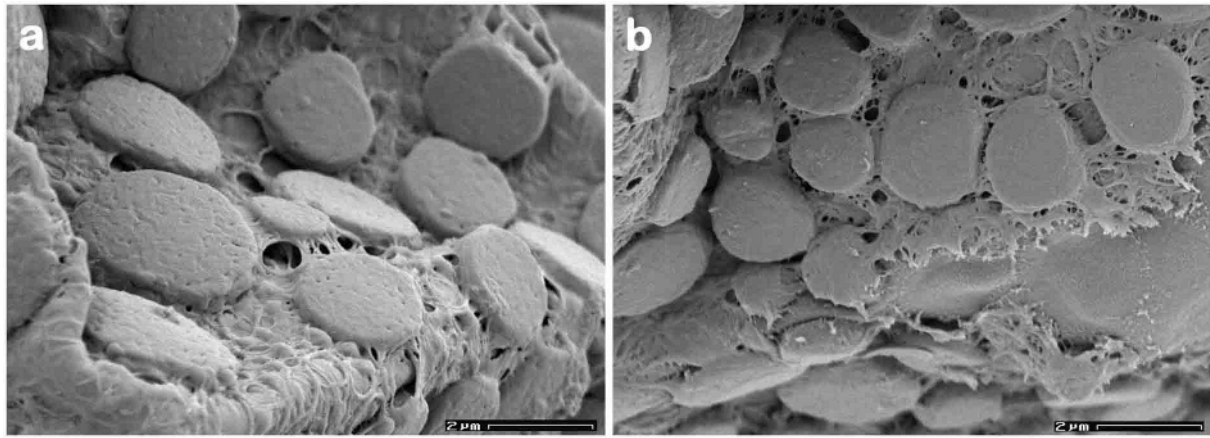


FIGURE 10: *T. sarekensis* LM-micrographs; scale bar = 50 μm . a – deutonymph dorsal view, layered from 15 sequentially focused images; b – deutonymph ventral view, 18 layered images; c – tritonymph dorsal view, 20 layered images; d – tritonymph ventral view, 20 layered images; arrowhead points to median divided mentotectum.

FIGURE 11: *T. sarekensis* SEM-micrographs of exochorion structures.TABLE 1: *Tectocephus sarekensis* and *T. velatus*; leg setation of all stages. First development of setae characterized by letters; () = pair of setae; – = no change with regard to the preceding stage; * setation of the adult according to Fujikawa (1988).

	Instars	Trochanter	Femur	Genu	Tibia	Tarsus	Chaetome	Solenidia
Leg I	Larva		d, bv''	$d, (l), \sigma$	$d, (l), v, \varphi_1$	$(ft), (tc), (p), (u), s, (a), (pv), (pl), \varepsilon, \omega_1$	0-2-3-4-16	1-1-1
	Protonymph		-	-	-	ω_2	0-2-3-4-16	1-1-2
	Deutonymph		(l)	-	φ_2	-	0-4-3-4-16	1-2-2
	Tritonymph	l'	-	v'	v''	(it)	1-4-4-5-18	1-2-2
	Adult*	-	v	d lost	d lost	l	1-5-3-4-19	1-2-2
Leg II	Larva		d, bv''	$d, (l), \sigma$	d, l', v, φ	$(ft), (tc), (p), (u), s, (a), (pv), \omega_1$	0-2-3-3-13	1-1-1
	Protonymph		-	-	-	-	0-2-3-3-13	1-1-1
	Deutonymph		(l)	-	l''	ω_2	0-4-3-4-13	1-1-2
	Tritonymph	l'	-	v	v''	(it)	1-4-4-5-15	1-1-2
	Adult*	-	v	d lost	d lost	-	1-5-3-4-15	1-1-2
Leg III	Larva		d, ev'	d, l', σ	d, v, φ	$(ft), (tc), (p), (u), s, (a), (pv)$	0-2-2-2-13	1-1-0
	Protonymph		-	-	-	-	0-2-2-2-13	1-1-0
	Deutonymph	l'	l'	-	-	-	1-3-2-2-13	1-1-0
	Tritonymph	v'	-	-	(l)	(it)	2-3-2-4-15	1-1-0
	Adult*	-	-	d lost	d lost	-	2-3-1-3-15	1-1-0
Leg IV	Protonymph					$ft'', (p), (u), (pv)$	0-0-0-0-7	0-0-0
	Deutonymph		d, ev'	d, l'	d, v, φ	$(tc), s, (a)$	0-2-2-2-12	0-1-0
	Tritonymph	v'	-	-	(l)	-	1-2-2-4-12	0-1-0
	Adult*	-	-	-	d lost	-	1-2-2-3-12	0-1-0

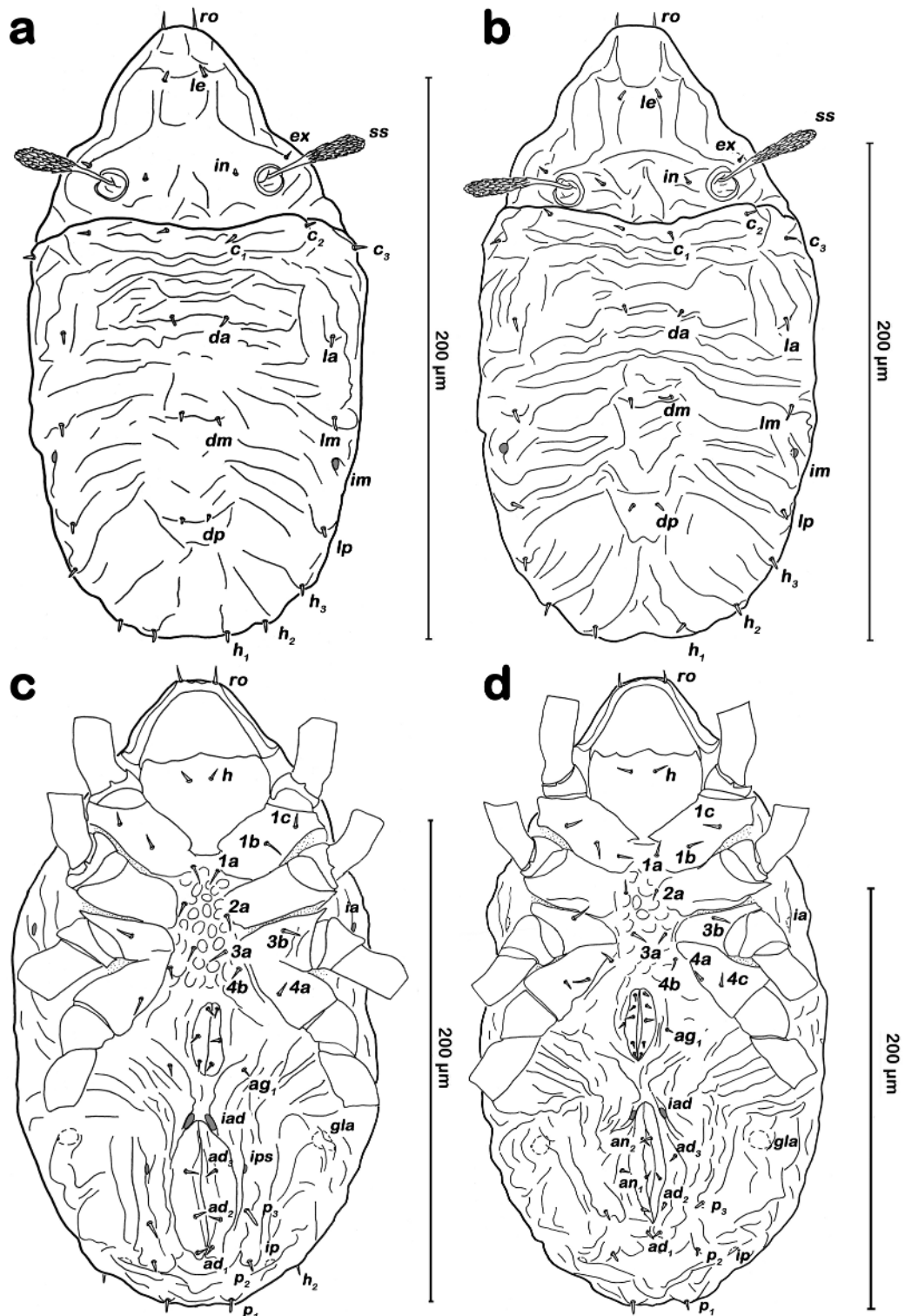


FIGURE 12: *T. velatus*. a – protonymph dorsal view; b – deutonymph dorsal view; c – deutonymph ventral view; d – tritonymph ventral view.

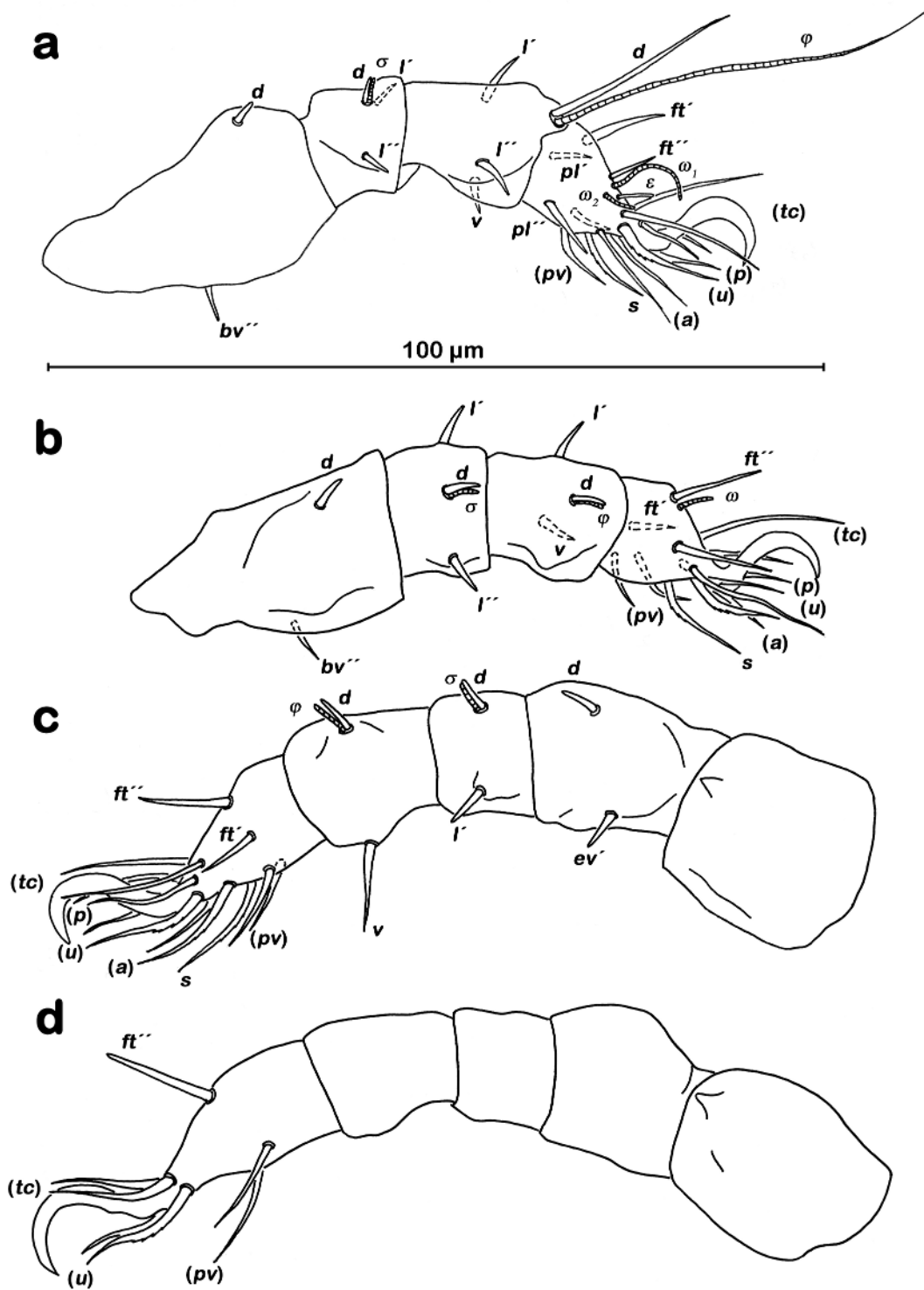


FIGURE 13: *T. velatus* protonymph right legs antiaxial view. a – leg I; b – leg II; c – leg III; d – leg IV.

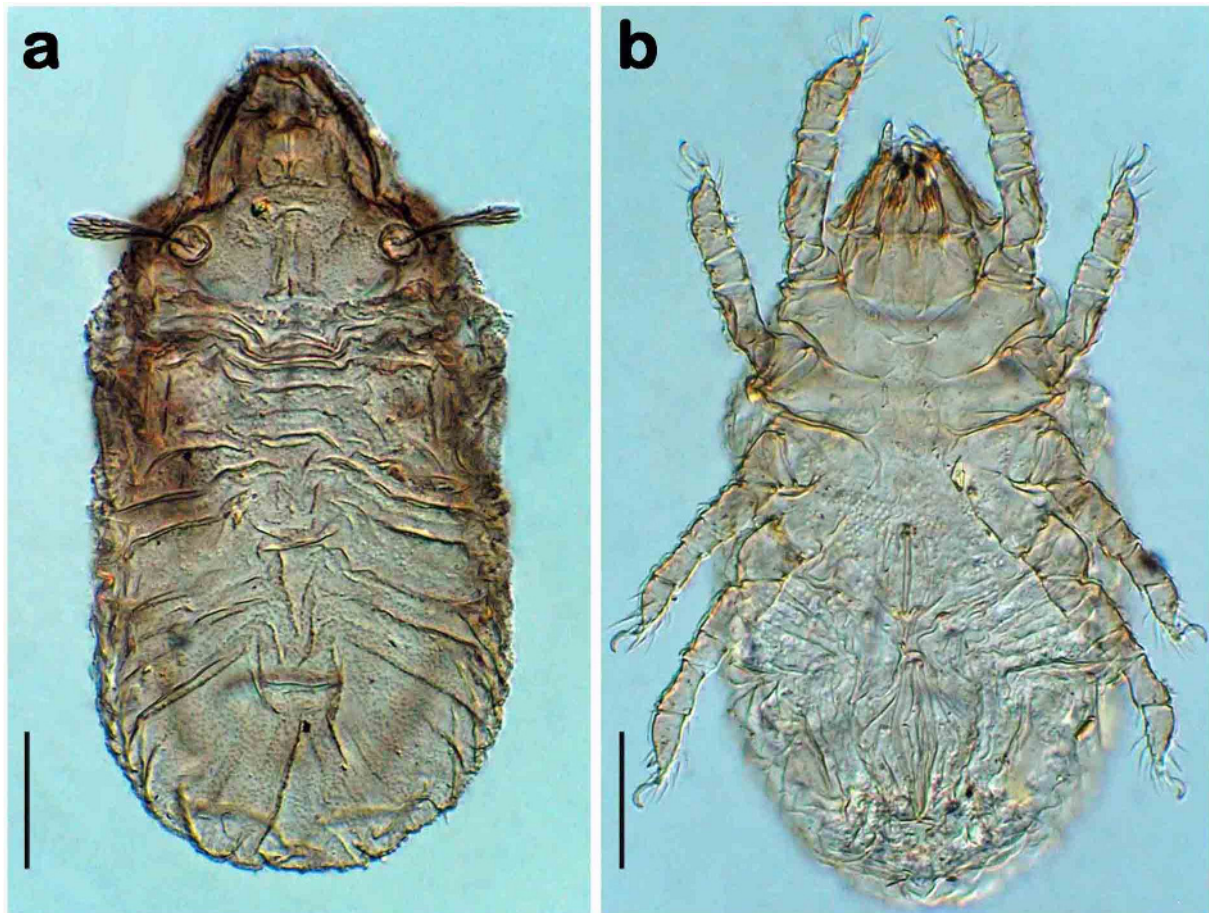


FIGURE 14: *T. velatus* LM-micrographs of tritonymph. a – dorsal view, layered from 17 sequentially focused images; b – ventral view, 11 layered images. Scale bar = 50 μm

Protonymph — Body length (N = 19): 200 – 237 μm , average 224 μm .

Prodorsum — median prodorsal ridges assuming shape of definitive lamellae. Translamella distinct ridge.

Gastronotic region (Figure 12a) — 15 pairs of notogastral setae, setae p_1 , p_2 and p_3 added in this stage.

Ventral region of idiosoma - One pair of genital setae. Epimeral setation (I-IV): 3-1-2-1. Median divided mentotectum; lobes variable in shape; same variation as in *T. sarekensis* nymphs. From this stage irregularly shaped round and slightly elevated spots dispersed over median area between epimeral plates.

Legs (Figures 13a–d) — setation see Table 1.

Deutonymph — Body length (N = 12): 237 – 286 μm , average 272 μm .

Gastronotic region (Figure 12b) — 15 pairs of notogastral setae.

Ventral region of idiosoma (Figure 12c) — Adanal setae ad_1 – ad_3 . Three pairs of genital setae (no variation). One pair of short aggenital setae. Formula of epimeral setation (I-IV): 3-1-2-2.

Legs — Setation see Table 1.

Tritonymph — Body length (N = 8): 289 – 341 μm , average 321 μm .

Gastronotic region (Figure 14a) — 15 pairs of notogastral setae.

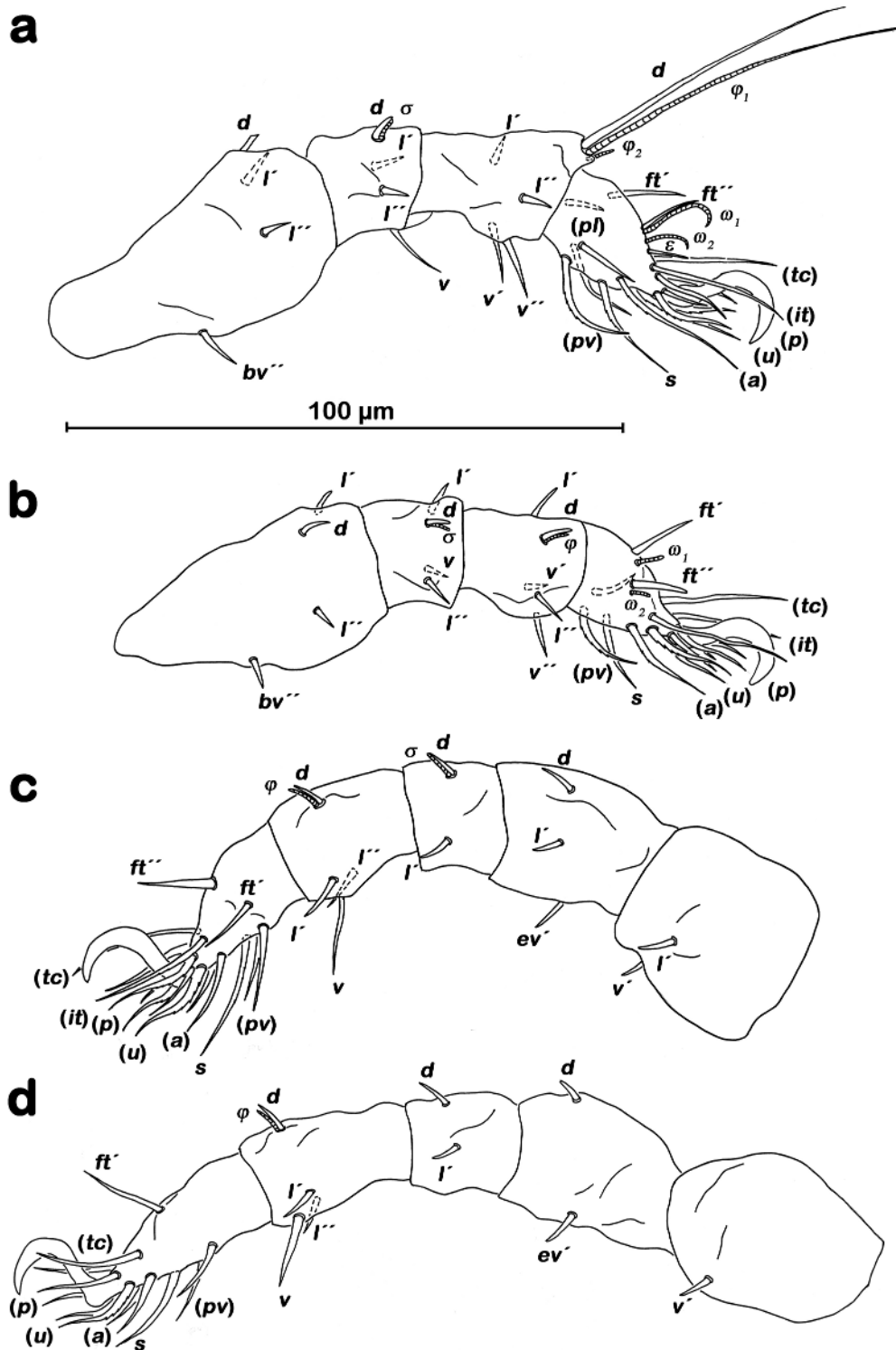


FIGURE 15: *T. velatus* tritonymph right legs antiaxial view. a – leg I; b – leg II; c – leg III; d – leg IV.

Ventral region of idiosoma (Figures 12d and 14b) — Anal setae an_1 and an_2 on median margin of anal valves. Five pairs of genital setae (constant). Epimeral setation (I–IV): 3-1-2-3.

Legs (Figures 15a–d) — solenidia and chaetome see Table 1.

DISCUSSION

The comparison of the morphology of immatures of *T. sarekensis* and *T. velatus* provides the astonishing result that no obvious morphological differences can be found. The juveniles of both species exhibit the same body size, developmental formulas and features, even the leg setation is exactly the same. It is known that instars of a single genus may show a homogeneous morphology, Seniczak (1992) for example reported that the juveniles of *Trhypochthonius* are strikingly similar with regard to body shape, colouration and ornamentation of cuticle and the development of setation on the prodorsum, gastronal, anogenital and coxisternal regions. Pfingstl *et al.* (2008) also showed that certain *Scutovertex* juveniles only differ in the shape of lateral setae on tibia I. There are several publications (e.g. Seniczak, 1994; Behan-Pelletier, 1997) reporting on very similar morphological traits of immatures within a genus but in all these cases at least one distinguishing character could be detected, accordingly the results of this study are exceptional. However, the parthenogenetic genus *Tectocephus* represents a group of morphologically similar species. *T. sarekensis* and *T. velatus* were formerly classified together with three other *Tectocephus* taxa as subspecies of a Central Europe species-complex (Weigmann, 2002) indicating a very close relationship among them. Molecular genetic data provided by Laumann *et al.* (2007) led to the conclusion that these first mentioned two groups are distinct species. Nevertheless, the complete conformity of the immatures points to a very close relationship of the two species.

The comparison of the present study to former mostly incomplete descriptions of juvenile instars of *Tectocephus* reveals some further interesting but also some arguable facts. The drawings

of the larva and protonymph of *Tectocephus* sp. made by Grandjean (1934) and his observations on the development of this genus (Grandjean, 1953) are completely consistent with our results. Iordansky and Shteyn-Margolina (1993) provided a dorsal depiction of a tritonymph of *T. velatus* which exhibits no obvious differences to the tritonymph of *T. sarekensis* and *T. velatus* described above. On the other hand Haarløv's description (1957) of the tritonymph of *T. velatus* shows a noticeable morphological deviation. The number of genital setae is only four and the aggenital setae are located directly near the genital valves on a level with the middle genital papilla. Such a configuration is unusual and four genital setae in the tritonymphal stage occur only in the distantly related genera *Malaconothrus* and *Carabodes* (Grandjean, 1949). Nübel-Reidelbach (1994) described the juveniles of *Tectocephus* sp. with a special focus on the tritonymph. She could not definitely assign the specimens to a certain species, but she ascribed them to be the offspring of *T. velatus*. The conspicuous length of the larval seta h_2 and the median divided mentotectum, which also can be found in immatures of *Unduloribates undulatus* (Pfingstl and Krisper, 2010), are mentioned in the text and the majority of morphological characters corresponds to the present study. Nübel-Reidelbach further depicted the characteristic falcate solenidion ω_1 on tarsus I; such falcate solenidia can also be found in juveniles of *Achipteria*, *Anachipteria* and *Parachipteria* (Seniczak, 1977), as well as in the immatures of *Ceratozetes mediocris* (Behan-Pelletier, 1984). But there are also deviant features in Nübel-Reidelbach (1994), for example a variable number of notogastral setae (12–13, p_2 , p_3 excluded) in the tritonymph. That is quite confusing, as all 15 notogastral setae are already present from the protonymphal stage, so why does this variation occur just in the tritonymph and not also in earlier stages? Furthermore Nübel-Reidelbach (1994) mentioned that aggenital setae first appear in the tritonymph, which would be exceptional, as Grandjean (1949) listed a formula concerning the development of aggenital setae for the genus *Tectocephus* which stated that these setae first appear in the deutonymph. In addition, he noted that the emergence of aggenital setae in the deutonymphal

stage is the most frequent case in Brachypylina. Furthermore the tritonymph depicted by Nübel-Reidelbach is lacking setae (*it*) on tarsus I which is unusual and there is one seta more in the text than on the figure of genu IV. Another confusing fact is the mention of spiracles ("Stigmen") on the gastronomic region as a diagnostic character. The description of *T. velatus* immatures of Chistyakov (1972) also shows certain obvious differences with the present study. The larva exhibits only two setae on epimeral plate I, but the author may have overlooked the third seta which is shaped valve like protecting Claparede's organ. Chistyakov detected only one seta on epimeral plate IV in the deutonymph, whereas the individuals studied herein always possessed two setae. However, most differences can be found in the leg solenidia and chaetome, as in nearly every stage and on every leg there are discrepancies between Chistyakov (1972) and our study (see Table 3). These divergences are serious and cannot be explained easily. But Chistyakov (1972) also provided information on the adults of *T. velatus* he used to rear the juveniles and a closer look at these data may offer a plausible explanation. The adults described by Chistyakov exhibit only seven pairs of notogastral setae, four pairs of genital setae and an epimeral setation of 3-1-3-2, whereas all other descriptions of *T. velatus* (Abd-el-hamid, 1965; Fujikawa, 1988; Nübel-Reidelbach, 1994; Perez-Iñigo, 1997 and Weigmann,

2006) mention 10 pairs of notogastral setae, six pairs of genital setae and epimeral setation of 3-1-2-3 for this species. The differing coxisternal setation of 3-1-3-2 presented by Chistyakov may be a result of an incorrect assignment of seta 4b on epimere III. Sidorchuk and Norton (2010) already demonstrated that it is common to wrongly assign the designation of this seta and that this misconception causes confusion. Nevertheless, the other morphological discrepancies may indicate that the specimens investigated by Chistyakov did not represent *Tectocephus velatus* but another *Tectocephus* species.

However, all of the described specimens show a very similar habitus as well as a similar type of plication to those described above. The only obviously diverging juvenile is the tritonymph of *T. alatus* (Haarløv, 1957) showing a short capitate sensillus, three pairs of genital setae and a surface pattern of large dots. Unfortunately Haarløv gives no further information on the morphology and he admits that it was difficult to estimate the number of anal and genital setae as this area was partly covered with dirt; accordingly a detailed comparison is not feasible.

In summary we can conclude that the juveniles depicted by Grandjean (1934) belonged either to *T. sarekensis* or to *T. velatus*. Concerning the immatures of *T. velatus* and *Tectocephus* sp. analyzed by Haarløv (1957), Chistyakov (1972) and Nübel-

TABLE 2: Comparison of selected characters of the juveniles of *Tectocephus* species. Formulas are given from larva to tritonymph. ? = no information available. DDCn3 = dorsal companion setae present from larva to tritonymph, absent in adult stage.

	<i>Tectocephus sarekensis</i>	<i>Tectocephus velatus</i> according to Haarløv (1957)	<i>Tectocephus alatus</i> according to Haarløv (1957)	<i>Tectocephus</i> sp. according to Nübel-Reidelbach (1994)
body length (µm)	(169-188)(185-231)(231-293)(283-353)	?	?	(170-179)(186-218)(225-244)(301-348)
notogastral setae number	12-15-15-15	?	?	?-?-?-12/13
notogastral setae shape	short, spiniform	short, spiniform	short, spiniform	short, spiniform
surface hysterosoma	plicate, small dots	plicate, small dots	plicate, large dots	plicate, small dots
sensillus	long, clavate, spinose	long, clavate, spinose	short, capitate, spinose	long, clavate, spinose
epimeral setation	(3-1-2)(3-1-2-1)(3-1-2-2)(3-1-2-3)	?	?	?-?-?(3-1-2-3)
genital setation	0-1-3-5	?-?-?-4	?-?-?-3	0-1-3-5
aggenital setation	0-0-1-1	?-?-?-1	?	?-?-?-1
adanal setation	0-0-3-3	?-?-?-3	?-?-?-3	0-0-3-3
anal setation	0-0-0-2	?-?-?-2	?-?-?-2	0-0-0-2
mentotectum	median divided	?	?	median divided
companion setae	DDCn3	?	?	DDCn3
solenidia <i>w</i> ₁ on tarsus I	strongly arcuated	?	?	strongly arcuated

Reidelbach (1994) a clear statement is not possible. The described differences diverge from the common scheme (Grandjean, 1949) and point either to inaccurate observations or to adults belonging to another *Tectocepheus* species. However, the tritonymph of *T. alatus* is clearly distinguishable from the nymphs of *T. sarekensis* and *T. velatus*; this is an indication that *T. alatus* is also a distinct species within the so called "*velatus*-complex" (Weigmann, 2002). Based on the consistent juvenile morphology of *T. sarekensis* and *T. velatus* we can further conclude that these two species show a closer relation to each other than to *T. alatus*.

The comparison of the juveniles of *T. sarekensis*

and *T. velatus* with the mostly incomplete descriptions of the same and other *Tectocepheus* immatures (Table 2) does not allow the definition of species specific characters but the overall juvenile morphology appears homogenous within the genus.

The further investigation of the larva and nymphs of each species of the "*velatus*-complex" (Weigmann, 2002) is necessary to elucidate how homogeneous the juvenile morphology of this group really is. Moreover this procedure could be an important tool to assess the relationships of the European *Tectocepheus* taxa.

TABLE 3: Comparison of chaetome and solenidia. *Tectocepheus velatus* present data versus data from Chistyakov (1972). Divergences are marked bold.

		<i>Tectocepheus velatus</i>		<i>T. velatus</i>	
		present data		Chistyakov (1972)	
	Instars	Chaetome	Solenidia	Chaetome	Solenidia
Leg I	Larva	0-2-3-4-16	1-1-1	?-2- 2 -3-16	1- 2 -1
	Protonymph	0-2-3-4-16	1-1-2	?-2-3- 3 -16	1- 2 -2
	Deutonymph	0-4-3-4-16	1-2-2	?- 3 -3-4-16	1-2-2
	Tritonymph	1-4-4-5-18	1-2-2	?-4-4-5- 16	1-2-2
	Adult	1-5-3-4-19	1-2-2	?-5-3-4- 18	1-2-2
Leg II	Larva	0-2-3-3-13	1-1-1	?-2-2-3-13	1-1-1
	Protonymph	0-2-3-3-13	1-1-1	?-2-3-3-13	1-1-1
	Deutonymph	0-4-3-4-13	1-1-2	?-3-3-4-13	1-1- 1
	Tritonymph	1-4-4-5-15	1-1-2	?-4-4-5- 13	1-1- 1
	Adult	1-5-3-4-15	1-1-2	?-5- 2 -4-15	1-1-2
Leg III	Larva	0-2-2-2-13	1-1-0	?-2-2-2-13	1-1-0
	Protonymph	0-2-2-2-13	1-1-0	?-2-2-2-13	1-1-0
	Deutonymph	1-3-2-2-13	1-1-0	?- 2 -2-2-13	1-1-0
	Tritonymph	2-3-2-4-15	1-1-0	?- 2 -2-4- 13	1-1-0
	Adult	2-3-1-3-15	1-1-0	?-3-1-3- 13	1-1-0
Leg IV	Protonymph	0-0-0-0-7	0-0-0	?-0-0-0-7	0-0-0
	Deutonymph	0-2-2-2-12	0-1-0	?-2-2-2-12	0- 0 -0
	Tritonymph	1-2-2-4-12	0-1-0	?-2-2-4-12	0-1-0
	Adult	1-2-2-3-12	0-1-0	?-2-2-3-12	0-1-0


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