Discovery of *Scolotydaeus tauricus* (Kuznetsov, 1973) (Acari, Trombidiformes, Paratydeidae) in a rock-inhabiting crustose lichen in Southwest Germany

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Abstract
The mite species *Scolotydaeus tauricus,* so far only known from Yalta on the Crimean Peninsula, was found in a leprose crustose lichen on the mountain Königstuhl in Heidelberg. This is the first record of the family Paratydeidae for Germany. The adult, larva and nymphs of the *Scolotydaeus* from Heidelberg are described. The juvenile stages of *Scolotydaeus tauricus* are up to now unknown. Aspects of the taxonomy, morphology and ecology of this species are discussed.

Kurzfassung
Entdeckung von *Scolotydaeus tauricus* (Kuznetsov, 1973) (Acari, Trombidiformes, Paratydeidae) in einer Gestein bewohnenden Krustenflechte in Südwestdeutschland
Die Milbenspezies *Scolotydaeus tauricus*, bisher nur bekannt aus Yalta auf der Halbinsel Krim, wurde in einer leprösen Krustenflechte auf dem Berg Königstuhl in Heidelberg gefunden. Dies ist der Erstnachweis der Familie Paratydeidae für Deutschland. Der Adultus, die Larve sowie die Nymphen des *Scolotydaeus* aus Heidelberg werden beschrieben. Die Jungstadien von *Scolotydaeus tauricus* sind bis jetzt unbekannt. Aspekte der Taxonomie, Morphologie und Ökologie dieser Art werden diskutiert.

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1 Introduction

The Paratydeidae Baker, 1949 are a small family of enigmatic soft bodied, slender mites. Rarely collected, they are especially abundant in soils of arid and semi-arid regions, and members of the family have, for example, been found in the Negev desert in Israel (Ukabi et al., 2009) and in biological soil crusts in the Chihuahuan desert in Mexico (Neher et al. 2009). The 21 species of the Paratydeidae, including the two fossil ones recently described from late Eocene Rovno amber by Klimov et al. (2019), at the present time are distributed amongst three genera (Khaustov 2017), namely *Neotydeus* Baker, 1950, *Tanytydeus* Theron, Meyer & Ryke, 1969 and *Scolotydaeus*, which was erected by Berlese in 1910.

In the present paper the discovery of the species *Scolotydaeus tauricus* (Kuznetsov, 1973) in Heidelberg is noted and commented on. This represents the first record of the mite family Paratydeidae in Germany. *Scolotydaeus tauricus* has up to now only been known from 11 specimens found in the Nikita Botanical Garden in the village Nikita near Yalta in Crimea where they were collected by the Russian acarologist Nikolay Nikolayevich Kuznetsov in April 1971 and June 1972 from the plant litter layer under the bush *Arbutus unedo* and under the evergreen oak *Quercus ilex*, respectively (Kuznetsov 1973). Originally called *Walytydeus tauricus* by its author, the species was many years later recombined to *Scolotydaeus tauricus* by Khaustov (2017).

The *Scolotydaeus tauricus* adult males from the Königstuhl population are described in this publication, supplementing the information on adult males of the taxon given by Khaustov (2017) for the Yalta specimens, and the morphology of the mites from the Yalta and from the Heidelberg sites, which are very far apart, is compared. Females of the species are also examined. In addition, the larva and nymphs of *Scolotydaeus tauricus*, which so far are unknown, will be described here. In the concluding section some aspects of the taxonomy, morphology and ecology of this species will be discussed.

2 Material and methods

Six adult males, three adult females, four tritonymphs (1 presumptive female, 3 presumptive males), two deutonymphs, one protonymph and one larva of *Scolotydaeus tauricus* were collected by the present author in April 2016 on the Königstuhl mountain in Heidelberg, Germany at an altitude of 430 m from a leprose crustose lichen, mostly *Lepraria membranacea* (Dickson) Vainio,

growing on sandstone rock of the Lower Triassic Buntsandstein lithostratigraphic unit. Two adult males, one adult female and one larva were collected by the present author from similar lichen on rock at the same site already in April 2007. The identification of the lichen bases largely on Wirth (1995).

Mites were extracted from the collected lichen either by hand using a fine brush or by using a Berlese funnel. They were fixed in 70 % ethanol, macerated with 40 - 80 % lactic acid and observed and photographed under a brightfield compound microscope. Living specimens were examined with a stereo microscope. Descriptions and measurements are based on intact or dissected specimens mounted in temporary cavity slides or on semi-permanent slides. Length measurements of structures are in micrometers and follow them in parentheses. Leg length is measured in lateral aspect from the proximal margins of the trochanter to the base of the claw. The distance between setae of the idiosoma is determined between central insertion points of setal pairs. Setal lengths in the species diagnosis are those of the three adult male paratypes of *Scolotydaeus tauricus* as presented by Khaustov (2017). Descriptions of the juvenile stages concentrate on characters that differ from those of the adults and change during ontogeny.

The general morphological terms and abbreviations used in this paper derive from Krantz (2009) and Walter et al. (2009). Their application to the Paratydeidae follows Khaustov (2017). An explanatory list of the abbreviations used in the text and the illustrations follows the references section. Two adult males of *Scolotydaeus tauricus* were deposited as voucher specimens in the acarology collection of the Department of Zoology of the State Museum of Natural History Karlsruhe.

3 Results

Description of the *Scolotydaeus tauricus* (Kuznetsov, 1973) from Heidelberg

3.1 Diagnosis

Adult: Empodium of legs II-IV elongate, about as long as associated claws. Counts of setae and solenidia on free segments of legs I-IV are: trochanters: 0, 1, 1, 0; femora: 3/5, 3, 3, 1/2 (femora I and IV divided into basi- and telofemur); genua 7 + σ, 3 + σ, 1, 2; tibiae 8 + φ, 4 + φ, 3 + φ, 3; tarsi: 14 + ω1 + ω2, 7 + ω, 4, 5. Tarsus of leg III with 4 setae (*tc'*, *tc"*, *u'*, *u"*). Seta *d* of the tibia of leg I non-eupathidial. Palptarsus with only 2 eupathidia namely *sulξ* and *ul"ξ*. Seta *sci* (39–41 µm) longer than *sce* (23–26 µm). Dorsal idiosomal setae *c1*, *d*, *e*, *f1* short (13–17 µm), each seta of a pair with a length distinctly less than the distance between their insertion points. Adult female with 4 pairs of aggenital setae and 6 pairs of genital setae. Nymphs with elongate empodium on pretarsus II-IV, and tarsus of leg III with 4 setae.

3.2 Differential diagnosis

Scolotydaeus tauricus adults differ from those of *S. anatolicus* Dönel et al., 2012, *S. corticicola* Flechtmann, 1992, *S. lootsi* (Theron et al., 1969) and *S. uralensis* Khaustov, 2017 in each of the following traits: empodium of legs II-IV elongate and about as long as associated claws; tarsus III with 4 setae. They can be distinguished from the deutonymph of *Scolotydaeus alexanderi* (Baker, 1949) in the same way. Similarly based on the original species descriptions and the redescription of *Scolotydaeus alexanderi*, *S. lootsi* and *S. tauricus* by Khaustov (2017), *S. tauricus* also differs from the deutonymph of *S. alexanderi,* as well as from the adults of the remaining species mentioned except *S. anatolicus* in possessing a palptarsus with only 2 eupathidia. *Scolotydaeus alexanderi* according to the account of Khaustov (2017) is characterized by much longer setae *c1*, *d*, *e* and *f1* and by very much shorter empodia on the claws of legs II-IV than the adult and nymphs of *S. tauricus*.

The single specimen of *Scolotydaeus vlaskini* Klimov et al., 2019, a tritonymph, possesses shorter dorsal hysterosomal setae *c1*, *d*, *e*, *f1* and *h1* (all measuring 8 µm); as well as much shorter empodial claws on legs II to IV than the corresponding material from Heidelberg, based on a comparison with the description of *S. vlaskini* by Klimov et al. (2019). *Scolotydaeus tauricus* further differs from *S. vlaskini* in possessing one seta less on tarsus II, missing seta *a'*. Adult females of *S. tauricus* described by Kuznetsov (1973) differ from those of *Scolotydaeus anatolicus* (Dönel et al. 2012), *S. bacillus* Berlese, 1910 (Theron et al. 1969) and *S. uralensis* (Khaustov 2017) in that these all show more than 6 pairs of genital setae. For other species of the genus the adult females have not yet been described.

3.3 Adult male

Gnathosoma

Palpi (28) short, linear, non-raptorial, four segmented, with femur fused to genu. Palptrochan-

ter very short, about a quarter the length of the femurgenu. Palptarsus situated terminally, with thumb-claw complex absent. Palpal chaetotaxy: trochanter 0, femurogenu 2 (*dFe*, *dGe*), tibia 3 (*d*, *l'*, *l"*), tarsus 7 (*ba*, *bp*, *va*, *vp*, *sulξ*, *ul'*, *ul"ξ*) + solenidion *ω*. Setae *ul"ξ* and *sulξ* eupathidial, remaining palpal setae simple. Solenidion *ω* (3) short, thick, erect, not fused along its length with palptarsus. A minute, stubby, blunt ended unbarbed supracoxal seta *ep* (3) located dorsally on each palpcoxa. Chelicerae (36) short. Cheliceral bases close together but free, not fused. Movable digit of chelicera distinctly sclerotized, without teeth, slender, distally strongly pointed, scimitar- or hook-like in lateral view. Fixed cheliceral digit strongly reduced, shorter than movable digit, anterior the rotation point only very faintly sclerotized. Chelicerae with fine striations and bearing a strong, elongate single dorsal seta *cha*. Basal seta *chb* absent. Subcapitulum with two pairs of subcapitular setae, *m* and *n*, and two pairs of adoral setae *or1* and *or2*. Setae *m*, *or1* and *or2* subequal in length. Seta *n* clearly longer than any of these. All setae of chelicera and subcapitulum slender and smooth. Lateral lips slightly granulate on their anterior paraxial region, apparently with tiny sclerites and forming the preoral cavity. Dorsal lip smooth, triangular in dorsal perspective and much shorter than lateral lips. Rutella absent.

Peritremes and trachea

Two stigmata situated between the bases of the chelicerae, from each of which a distally widened, chambered peritreme extends laterally along the cheliceral bases. Trachea elongate, branching into further trunks, extending to posterior body region.

Idiosoma (Figs 1-5)

Body elongate, cylindrical. Dorsal hysterosoma with folds between setal rows *c* – *d* and between *h* – *ps*. In one specimen transverse sutures were also seen between rows *d* – *e*, between *e* – *f* as well as between *f* – *h*. Dorsal idiosoma divided into 4 to 7 regions by transverse folds. Sejugal groove distinct, separates prosoma and hysterosoma. Idiosomal length 413 - 457 µm, maximum width 120 - 132 µm. Ratio of idiosomal length to width about 3,5:1. Colour of living animal orange. Cuticle semi-transparent. Idiosoma soft, mostly covered with fine longitudinal striae. Prodorsum subtriangular in dorsal perspective. Length of prodorsum 181 µm, width of prodorsum 136 µm.

Figure 1. Living *Scolotydaeus tauricus* adult from Heidelberg. – All photographs: RAYMOND A. LAMOS.

Naso strongly reduced. A weakly defined crista-like prodorsal shield extends in the midline along the length of the prodorsum, narrowing posteriorly. Prodorsum with three pairs of smooth setiform setae (*sci*, *sce*, *ve*). Setae *sce* (28) laterally inserted. Trichobothrial seta *sci* (41) more than three times the length of seta *ve* (12) and inserted in a small cup-like base. Two pairs of oval ocelli laterad seta *sci* with lenses of anterior pair well developed. Maximum diameter of anterior ocellus 8,5 µm. Posterior ocellus (7,2 µm) smaller than anterior ocellus, more laterally positioned, and indistinct. Opisthosoma with 12 smooth setal pairs, excluding anal, aggenital and genital setae. Segment C dorsally with short rod-like setae *c1* (15) and laterally with slender, elongate setae *c2* (56). Setal pair *3a* ventrally inserted. Cupule *ia* visible ventrolaterally on segment C. Segments D-PS with short rod-like setal pairs *d* (14), *e* (13), *f1* (17), *h1* (24), *ps1* (21), and slender acuminate setae *f2* (43), *h2* (48), *ps2* (31) and *ps3* (41). Median cupule *im* sited anterolaterad seta *e1*. Cupule *ip* situated between setae *f1* and *f2*. Cupule *ih* located anterolaterad seta *ps3*. Coxae fused to body. Coxae I and II adjoining. Coxae III and IV similarly bordering. Coxa II separated from coxae III by a substantial longitudinal gap of 60-70 µm, which equals the length of the combined coxae III-IV. Setae of coxal fields I-IV are: I [*1a* (37), *1b* (17), *1c* (11), *1d* (13)], II [*2a* (27), *2b* (28), *2c* (10)], III [*3b* (42), *3c* (16)], IV [*4a* (21), *4b* (10)]. Seta *3a* (18) inserted in the region between coxa II and III. Setation formula of coxae I-IV is 4-3-3-2. Coxal setae smooth, thin. Anal opening situa-

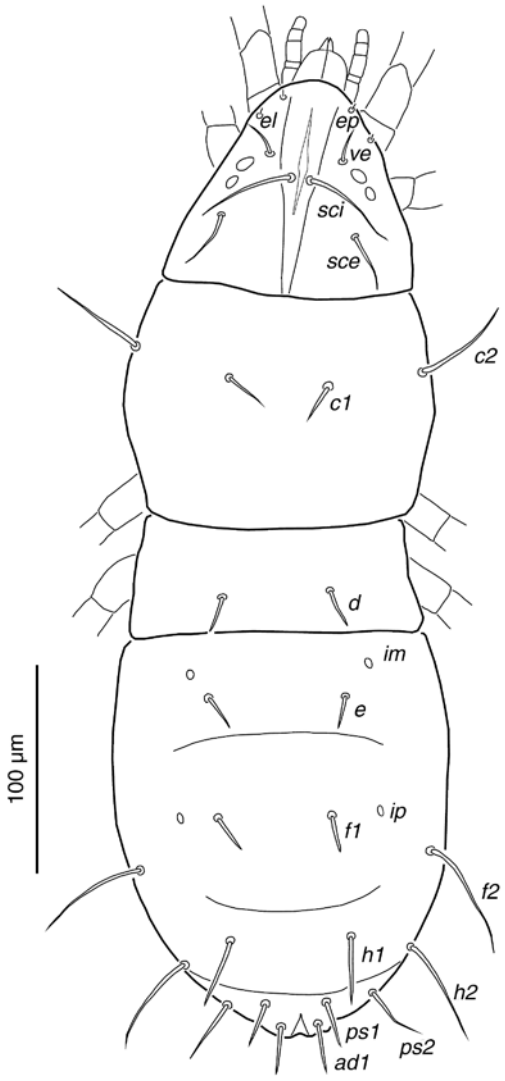

Figure 2. *Scolotydaeus tauricus* adult male, dorsal view.

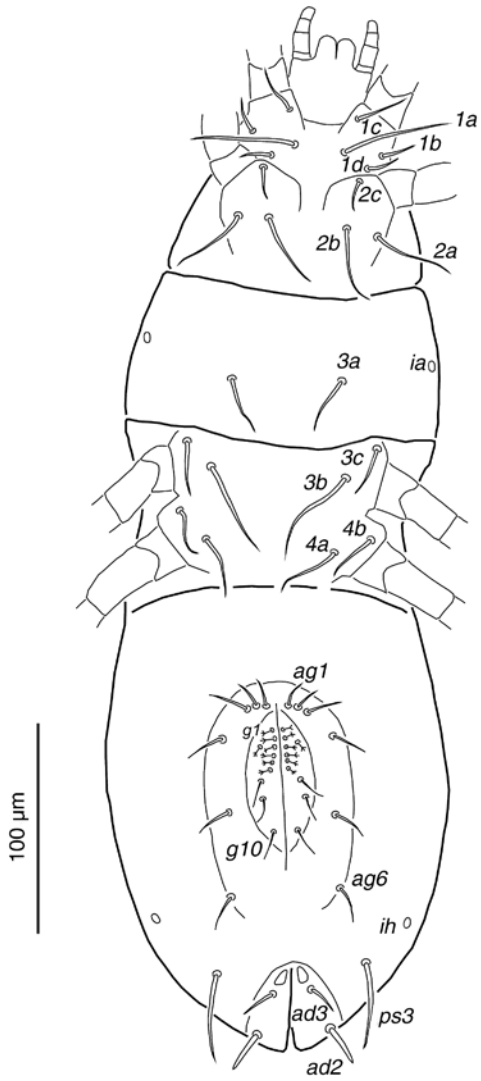

Figure 3. *Scolotydaeus tauricus* adult male, ventral view.

ted posteriorly. Adanal setae *ad1*, *ad2* and *ad3* (18-23) short, smooth, rod-like, acuminate. Anal and genital shields separated by a distinct gap. Genital opening flanked by 6 pairs of aggenital setae (*ag1-ag6*) and 10 pairs of genital setae (*g1-g10*). Setae *ag1-ag6* (11-16) smooth, short. Setae *g1-g7* (7) tiny, forked, inserted very close to genital slit and midline of body except for *g4* which is laterally inserted. Setae *g8-g10* (15) longer, not forked or barbed, inserted distinctly more laterally than *g1-g6*. Spermatopositor strongly reduced or absent. Three pairs of indistinct genital papillae present, *Va*, *Vm*, *Vp*. The minute setae *k1, k2, and k3*, were not seen, but may have been present. Behind the genital opening the huge and conspicuous testes as well as a large strongly sclerotized internal genital complex with a granulate base are seen. The latter displays 10 pairs of eugenital setae or seta-like structures: an anterior group of 4 short, thin, smooth setae (*eu1 – eu4*), a middle group of 3 thick, elongate spine-like setae (*eu5 - eu7*) and a posterior group of 3

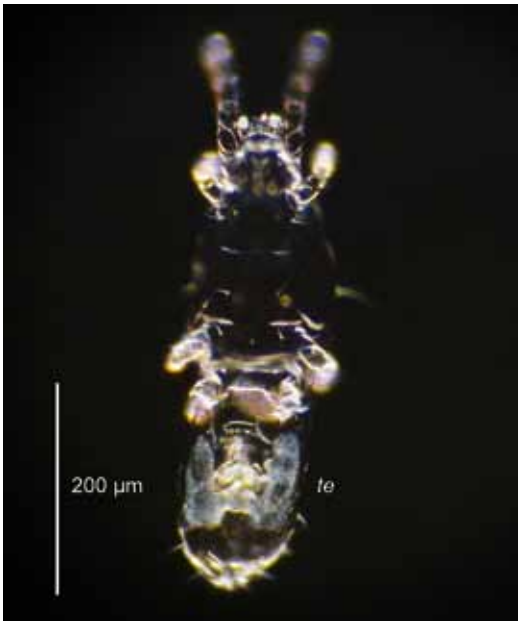

Figure 4. *Scolotydaeus tauricus* adult male; darkfield view of a cleared specimen showing the large lobes of the testes flanking the sclerotized genital complex.

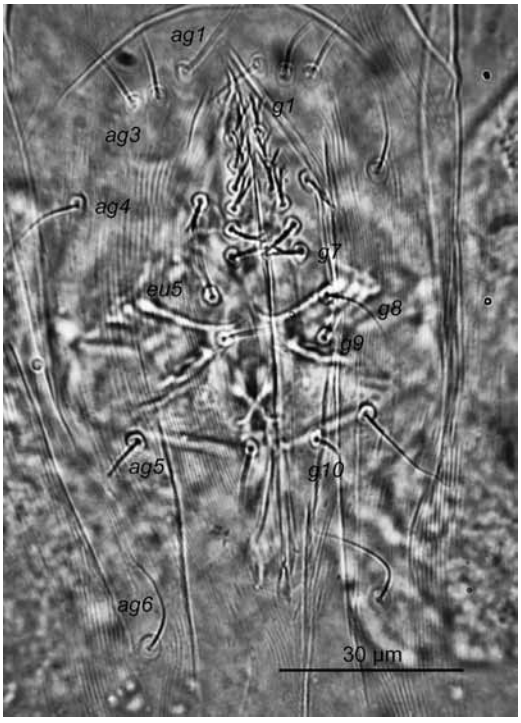

Figure 5. *Scolotydaeus tauricus* adult male; ventral view of genital region showing the external integumental striae, genital and aggenital setae and also internal structures such as the enlarged eugenital seta *eu5*.

short, thin setae (*eu8* – *eu10*). Seta *eu5* is mostly asymmetrically bifurcate and is distinctly longer and thicker than setae *eu6* and *eu7*, which are not split. In one male both setae *eu5* were non-bifurcate.

Legs (Figs 6, 7)

All legs possess six free articulating segments: trochanter, femur, genu, tibia, tarsus and pretarsus, with the coxae being fused to the body. A short, blunt-ended, smooth supracoxal seta *el* (3) located dorsally on the coxa of leg I. In legs I and IV femur subdivided into a basifemur and a telofemur. Femur is undivided in legs II and III. Leg I longest. The leg lengths are: I: 151 µm, II: 95 µm, III: 104 µm, IV: 122 µm. Relative lengths of legs I-IV: 1,59: 1: 1,09: 1,28. Tarsus bears a short pretarsus with a pair of smooth sickle shaped claws on all legs. Pulvillus absent. Claws and empodia without tenent hairs. Empodium of leg I very short, less than a third the length of the associated claws. Claw of leg I short. Claws of legs II-IV longer. Empodia of legs II-IV clawlike, elongate, about 0.8 – 1 x length of associated claws. Leg chaetotaxy, with number of solenidia in brackets behind the setal score: tarsus I: 14(2) (*ft'ξ*, *ft"ξ*, *tc'ξ*, *tc"ξ*, *p'ξ*, *p"ξ*, *pv'*, *pv"*, *pl"*, *s*, *u'*, *u"*, *a '*, *a"*, *ω1, ω2*); tarsus II: 7(1) (*p'ξ, Ɛ*, *tc'*, *tc"*, *u'*, *u"*, *p"*, *ω*); tarsus III: 4 (*tc'*, *tc"*, *u'*, *u"*); tarsus IV: 5 (*tc*, *u'*, *u"*, *p'*, *p"*); tibia I: 8(1) (*l'ξ*, *l1'*, *l1"*, *d*, *v'*, *v"*, *l"*, k, *φ*); tibia II: 4(1) (*v'*, *v"*, *d*, *l', φ*); tibia III: 3(1) (*v'*, *v"*, *d*, *φ)*; tibia IV: 3 (*v'*, *v"*, *d*); genu I: 7(1) (*l1'*, *l1"*, *v'*, *v"*, *l'*, *l"*, d, *σ*); genu II: 3(1) (*l'*, *l"*, *d, σ*); genu III: 1 (*l'*); genu IV: 2 (*v'*, *d*); femur I: 3/5 (*bv"*, *l1'*, *d1*, *v'*, *v"*, *l'*, *l"*, *d*); femur II: 3 (*bv"*, *l'*, *d*); femur III: 3 (*ev'*, *v'*, *d*); femur IV: 1/2 (*ev'*, *v'*, *d*); trochantera I and IV: 0; trochantera II-III: 1 (*v'*). Leg chaetotaxy formulae: I: 0-3/5-7(1)-8(1)-14(2); II: 1-3-3(1)-4(1)-7(1); III: 1-3-1-3(1)-4; IV: 0-1/2-2-3-5. Tibia and tarsi without sensory pits. All solenidia erect, not recumbent or sunken. Leg setae smooth. Unguinal setae on tarsi II-IV forked; not forked on tarsus I. Seta *tc"* blunt tipped on tarsus II. Setae (*tc*) blunt tipped on tarsus III. Seta *tc* blunt tipped on tarsus IV. Seta *l'ξ* on tibia I, setae *ft'ξ*, *ft"ξ*, *p'ξ*, *p"ξ*, *tc'ξ*, *tc"ξ* on tarsus I, and seta *p'ξ* on tarsus II are eupathidial.

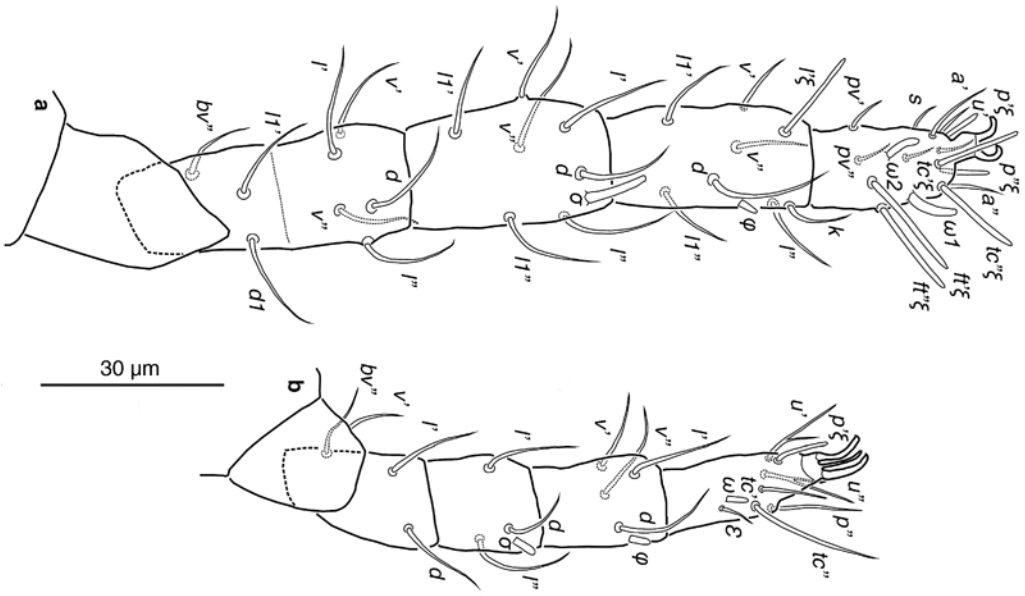

Figure 6. *Scolotydaeus tauricus* adult male. a) leg I, dorsal view. b) leg II, dorsal view.

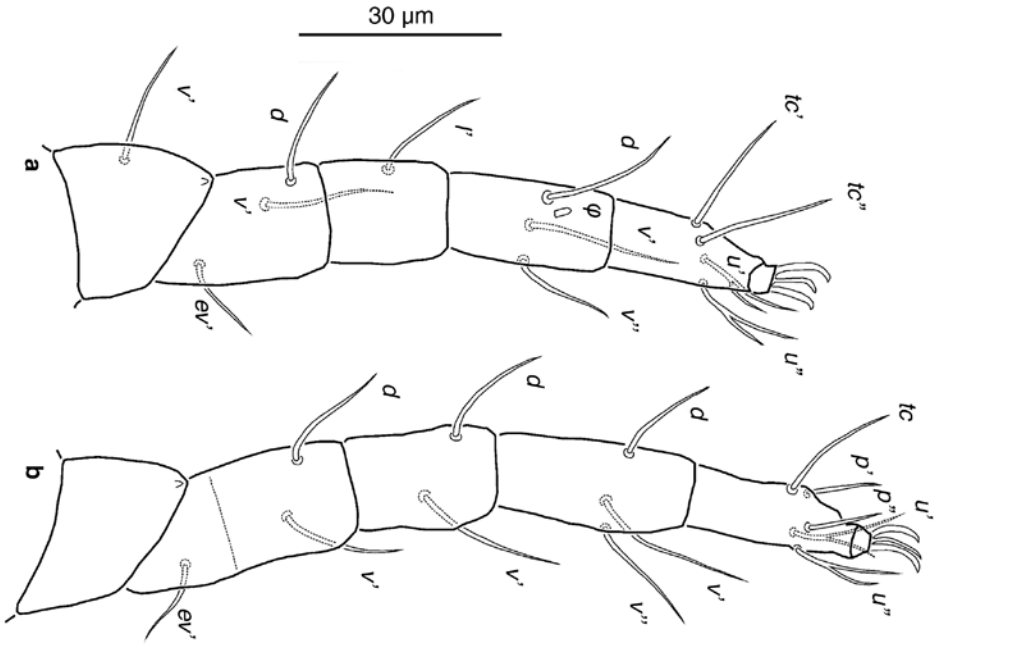

Figure 7. *Scolotydaeus tauricus* adult male. a) leg III, dorsal view. b) leg IV, dorsal view.

3.4 Adult female (Fig. 8)
Idiosomal length 428 - 442 µm, maximum width 111 - 118 µm. Female similar in general appearance to the male except for the genital region. Genital opening slightly longer than in male and with anterior and posterior undulating margins. Six pairs of unbranched, smooth genital setae and 3-4 pairs of smooth aggenital setae present. Eugenital setae absent. Ovipositor not visible, either strongly reduced or absent.

3.5 Larva (Figs 9-11)
Gnathosoma very similar to that of the adult, except smaller. Palpi short (18). Palpal chaetotaxy: trochanter 0, femurogenu 2 (*dFe*, *dGe*), tibia 3 (*d*, *l'*, *l"*), tarsus 7 (*ba*, *bp*, *va*, *vp*, *sulξ*, *ul'*, *ul"ξ*) + solenidion *ω*. Setae *ul"ξ* and *sulξ* eupathidial, remaining palpal setae simple. Chelicera short (20). Subcapitulum with a pair of each of setae *m* and *n*, as well as one pair of adoral setae *or1*. Setae *or2* absent.
Body elongate with an idiosomal length of 259 µm and a width of 80 µm in a slightly compressed specimen. Ratio of idiosomal length to width is 3,24:1. Prodorsum with three pairs of smooth setiform setae (*sci*, *sce*, *ve*). Setae *sce* (13) laterally inserted. Trichobothrial seta *sci* (28) elongate, more than three times the length of the short seta *ve* (8). Two pairs of oval ocelli laterad seta *sci*. Maximum diameter of anterior ocellus 5.8 µm. Posterior ocellus somewhat smaller (5 µm). Idiosomal segment C dorsally with short rod-like setae *c1* (12) and laterally with slender, elongate setae *c2* (38). Segments D-PS with short rod-like setal pairs *d* (14), *e* (14), *f1* (18), *h1* (18), *ps1* (12) and slender acuminate setae *f2* (36), *h2* (31). Median cupule *im* situated anterolaterad seta *e*. Cupule *ip* situated dorsal to seta *f2*. Coxal field II separated from coxal field III by a longitudinal gap of 58 µm. Setae of coxal fields I-III are: I [*1a* (19), *1b* (12)], II [*2a* (16)], III [3a (19), *3b* (24)]. Seta *3a* (22) inserted in the region between coxal fields II and III. All idiosomal setae are without barbs. Setation formula of coxae I-III is 2-1-2. Urstigma present on coxa I. Seta *1c* modified as a scale covering urstigma (not included in coxal setal formula). Cupule *ia* visible ventrolaterally on segment C, positioned laterally to seta *3a*. Cupule *ih* located anterolaterad seta *ps3*. Pseudanal setae *ps2* (12) and *ps3* (11) present. Adanal, aggenital, eugenital and genital setae absent. Genital opening missing. Genital papillae and setae *k* were not seen, presumed absent.

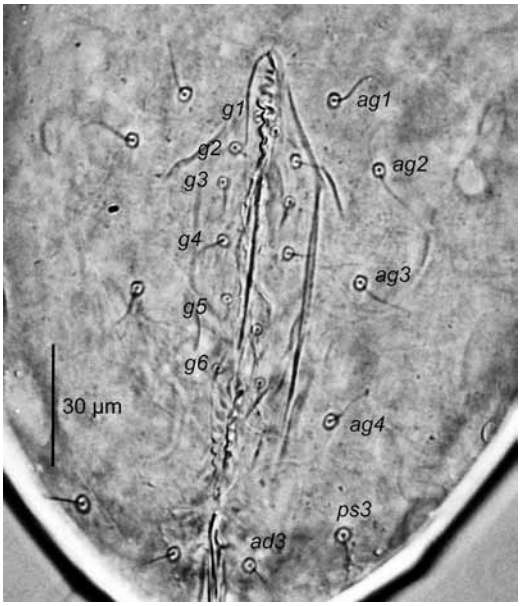

Figure 8. *Scolotydaeus tauricus* adult female; genital area in ventral view.

Three pairs of legs present with leg IV absent. In the first pair of legs the femur is not subdivided into a basifemur and a telofemur. Femur also undivided in legs II and III. Leg lengths: I (103 µm), II (73 µm), III (78 µm). Relative lengths of legs I-III: 1,42: 1: 1,07. Leg I chaetotaxy: femur 7 (*d*, *l'*, *l"*, *v'*, *v"*, *d1*, *bv"*); genu 7(1) (*d*, *l'*, *l"*, *v'*, *v"*, *l1'*, *l1"*, *σ*); tibia 8(1) (*d*, *l'*, *l"*, *v'*, *v"*, *k*, *l1'*, *l1"*, *φ*); tarsus 12(1) (*p'ξ*, *p"ξ*, *tc'*, *tc"*, *ft'*, *ft"*, *u'*, *u"*, *s*, *pl"*, *pv'*, *pv"*, *ω1*). Leg II chaetotaxy: femur 3 (*d*, *l'*, *bv"*); genu 3(1) (*d*, *l'*, *l"*, *σ*); tibia 4(1) (*d*, *l'*, *v'*, *v"*, *φ*); tarsus 6(1) (*p'ξ*, *tc'*, *tc"*, *u'*, *u"*, *ε*, *ω*). Leg III chaetotaxy: femur 3 (*d*, *v'*, *ev'*); genu 1 (*l'*); tibia 3(1) (*d*, *v'*, *v"*, *φ*); tarsus 4 (*tc'*, *tc"*, *u'*, *u"*). Trochantera I-III without setae. Chaetotaxy formulae: leg I: 0-7-7(1)-8(1)-12(1); leg II: 0-3-3(1)-4(1)-6(1); leg III: 0-3-1-3(1)-4. Unguinal setae on tarsi II-III forked; not forked on tarsus I. Only setae *p'ξ* and *p"ξ* on tarsus I and seta *p'ξ* of tarsus II eupathidial. Seta *tc"* of tarsus I, seta *tc"* of tarsus II and setae *tc"* and *tc"* of tarsus III blunt-tipped. All legs bear 2 sickle shaped claws and an empodium on each pretarsus. Empodia clawlike. Claws relative to the body length much larger in larva than in adult. Empodium of leg I a little shorter than claws. Empodium of legs II and III slightly longer than claws.

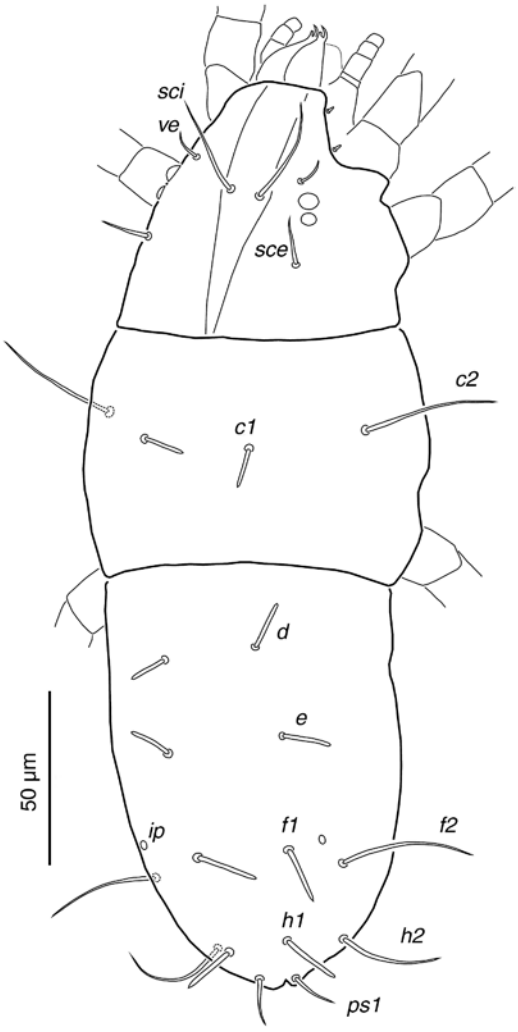

Figure 9. *Scolotydaeus tauricus* larva, dorsal view.

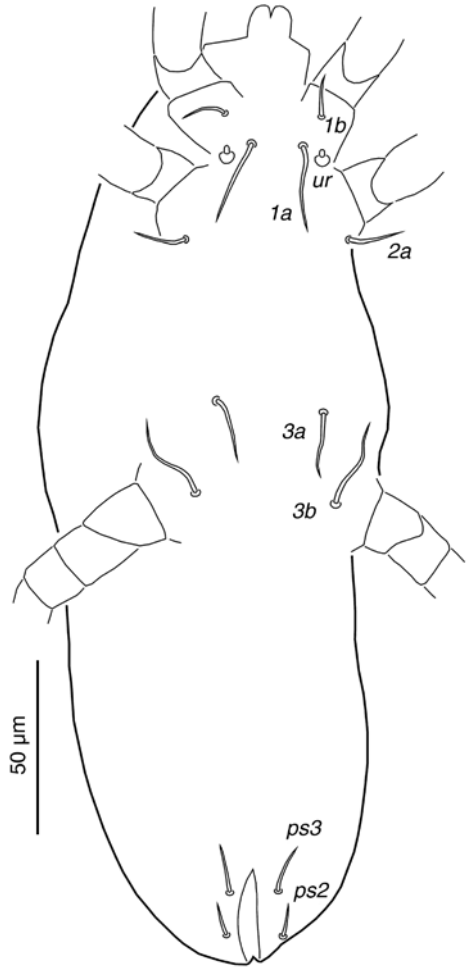

Figure 10. *Scolotydaeus tauricus* larva, ventral view.

3.6 Protonymph (Figs 12, 13)
Idiosomal length 295 µm. Body width 88 µm. Gnathosoma similar to larva except subcapitulum with setae *or1* and *or2* both present. Dorsal idiosoma generally like that of larva. Ventrally with for presence of 3 pairs of adanal setae *ad1-ad3* and genital area with short genital opening present and with one pair of smooth aggenital setae *ag1* flanking this. Genital setae absent. One pair of genital papillae (*Va*) and one pair of setae *k1* presumably present. Urstigma absent. Setation formula of coxal fields is 4-2-3-0 with setae *1c*, *1d* present on coxa I, seta *2b* on coxa II and seta *3c* on coxa III. Seta *3a* is included in setal field III although it lies anterior to this. Coxal field IV is without setae. Four pairs of legs present. Femora of legs I and IV not subdivided. Chaetotaxy of leg I similar to that of larva except for presence of non-eupathidial setal pair *a'*, *a"* of the tarsus, and for setae *ft'ξ*, *tc'ξ*, *tc"ξ* of the tarsus being eupathidial. In the protonymphal leg I illustrated (Fig. 12a) the seta *p"ξ* was anomalously absent. Leg II chaetotaxy: trochanter *v'*; femur *d*, *l'*, *bv"*; genu *d*, *l'*, *l"*, *σ*; tibia *d*, *l'*, *v'*, *v"*, *φ*; tarsus *p' ξ*, *p"*, *tc'*, *tc"*, *u'*, *u"*, *ε*, *ω*. Leg III chaetotaxy: trochanter *v'*; femur *d*, *v'*, *ev'*; genu *l'*;

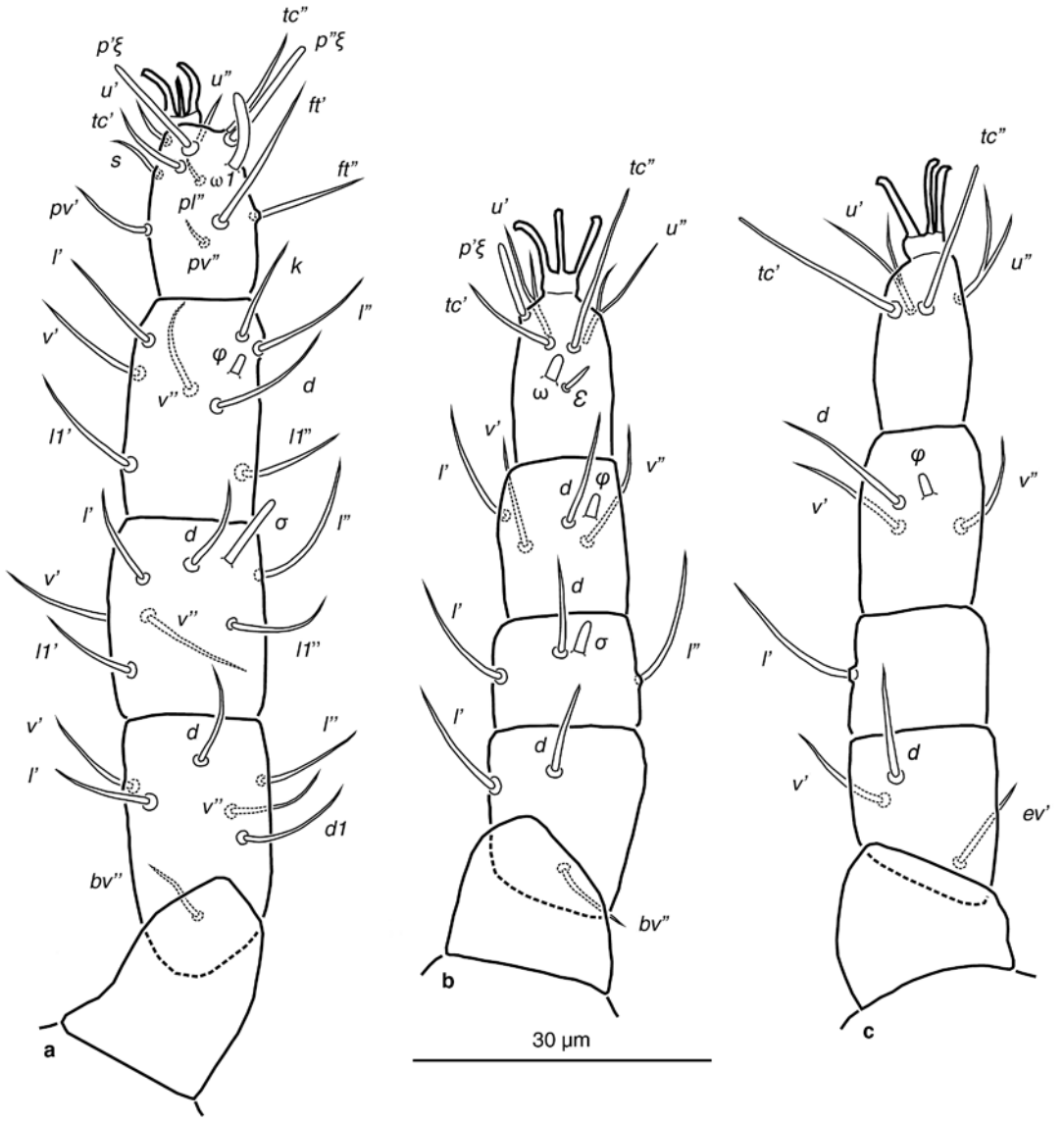

Figure 11. *Scolotydaeus tauricus* larva. a) leg I. b) leg II. c) leg III. All in dorsal view.

tibia *d*, *v'*, *v"*, *φ*; tarsus *tc'*, *tc"*, *u'*, *u"*. Legs II and III are alike to that of the adult. Leg IV chaetotaxy: trochanter and femur without setae; genu *d*, *v'*; tibia *d*, *v';* tarsus *tc*, *u'*, *u"*. Unguinal setae on tarsus IV forked. Chaetotaxy formulae: leg I: 0-7-7(1)-8(1)-14(1); leg II: 1-3-3(1)-4(1)-7(1); leg III: 1-3-1-3(1)-4; leg IV: 0-0-2-2-3.

3.7 Deutonymph (Fig. 14)

Idiosomal length 340 µm. Body width 92 µm. Gnathosoma as in protonymph. Dorsal idiosoma similar to protonymph. Ventrally with a more developed genital area with 2 pairs of smooth genital setae (*g1*, *g2*) and 2 pairs of smooth aggenital setae (a*g1*, *ag2*) present. Two pairs of genital pa-

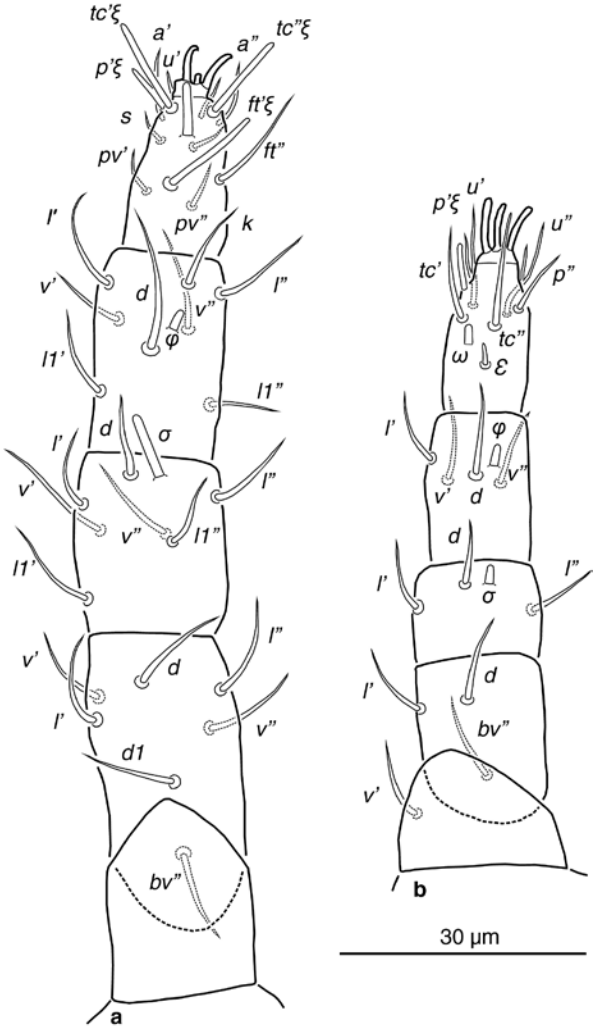

Figure 12 *Scolotydaeus tauricus* protonymph. a) leg I. b) leg II. Both in dorsal view.

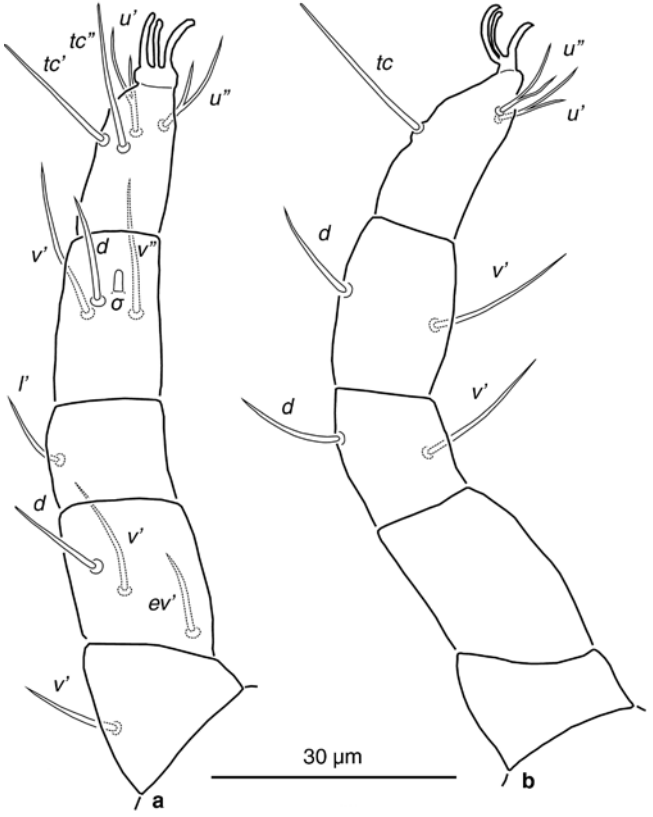

Figure 13. *Scolotydaeus tauricus* protonymph. a) leg III in dorsal view. b) leg IV in dorsolateral to lateral view.

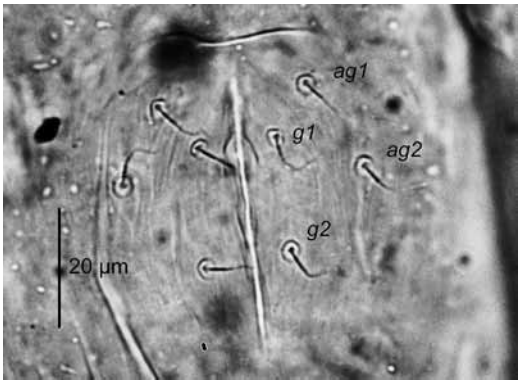

Figure 14. *Scolotydaeus tauricus* deutonymph; genital area in ventral view.

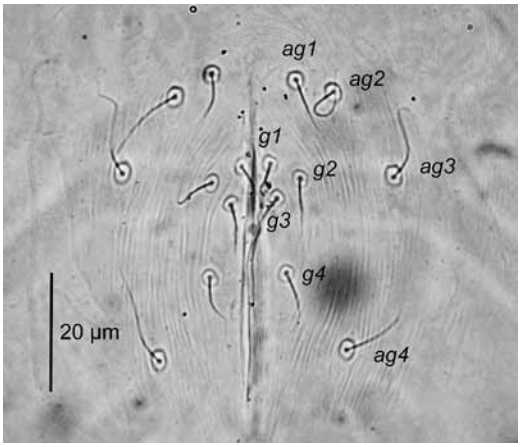

Figure 15. *Scolotydaeus tauricus* tritonymph; presumptive male; genital area in ventral view.

pillae (*Va*, *Vm*) as well as setae *k1*, *k2* probably present. The setation of coxal fields I-IV differs from that of the protonymph in that setae *2c* and *4a* are present. Chaetotaxy of legs II and III similar to that of protonymph. Chaetotaxy formulae of legs: I: 0-2/5-7(1)-8(1)-14(2); IV: 0-1/2-2-3-5. Tarsus of leg I with solenidion *ω2* and with femur I subdivided into a basifemur and a telofemur. Femur IV similarly subdivided. Tibia I with eupathidial seta *l'ξ*. Tarsus I with seta *ft"ξ* eupathidial. On leg IV femoral setae *d*, *v'*, *ev'*, tibial seta *v"* as well as tarsal setae *p'*, *p"* are deutonymphal in origin. The setation of the deutonymphal leg IV corresponds to that of the adult.

3.8 Tritonymph (Figs 15-17)

Idiosomal length 415 µm. Body width 97 µm. Gnathosoma similar to that of the adult. Coxal field IV with seta *4b*. Dorsal idiosomal setation is alike to that of the adult. Tritonymph differs from deutonymph in a more developed genital area. Two types of tritonymph found. In type I, the presumptive male tritonymph, the distance between the insertion points of the anteriormost genital seta *g1* and seta *g3* was two times or more than that of the type II, the presumptive female and the insertion points of setae *g3* were much closer together. Presumptive male tritonymphs possess 4 pairs of aggenital setae as opposed to the 3 pairs of the presumptive female tritonymph and may show rudiments of the interior genital complex of the adult male. Genital setae and aggenital setae both smooth and unbranched in all tritonymphs. Both tritonymph types very likely with inconspicuous genital papillae *Va*, *Vm*, *Vp* and minute setae *k1*, *k2*, *k3* as in *Scolotydaeus uralensis*. Leg chaetotaxy formulae as in the deutonymph except for presence of seta *l1'* on the basifemur of leg I and thereby similar to adult.

An overview of the ontogeny of the leg chaetotaxy in *Scolotydaeus tauricus* is presented in Table 1. Here the setal structures are indicated at the developmental stage where they are first added, and are assumed present in the later stages. A dash indicates that no additions occur. Where a seta is not added but is instead just transformed into a eupathidium, this is indicated by boldface letters.

4 Discussion

Diagnoses of the taxa

The diagnosis of the Paratydeidae here follows that given by KHAUSTOV (2017, p. 153) which, as the preceding description shows, fully applies to the specimens from Heidelberg. These furthermore clearly show the distinguishing features of the genus *Scolotydaeu*s, as the taxon was recently diagnosed by KHAUSTOV (2017), which include the presence of eyes, having erect solenidia on the palptarsus and leg tarsi, and displaying distinctly bifurcate setae (*u*) on tarsi II-IV. A diagnosis of the species *Scolotydaeus tauricus* is not given by KHAUSTOV (2017). However, he presents a determination key to species of *Scolotydaeus* and some information from this, in combination with the original species descriptions, has been used in the differential diagnosis of *S. tauricus* in the present publication.

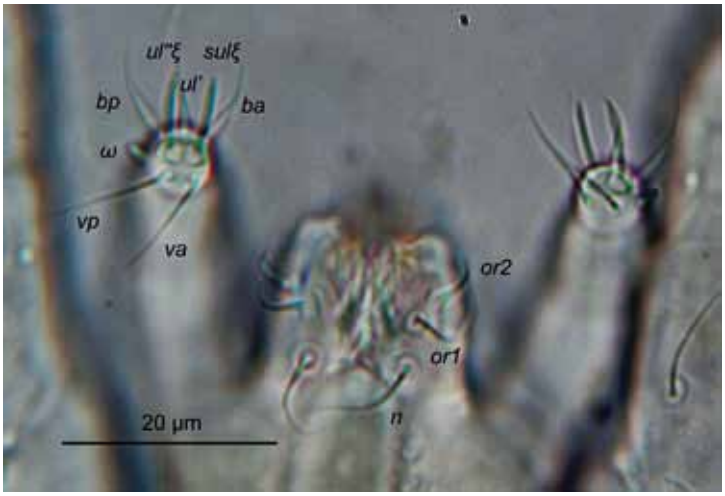

Figure 16. *Scolotydaeus tauricus* tritonymph, ventral view of gnathosoma, focusing on the subcapitular setae and the palptarsus with the latter being slightly angled towards the observer. The lateral subcapitular setae *m* are out of the plane of focus.

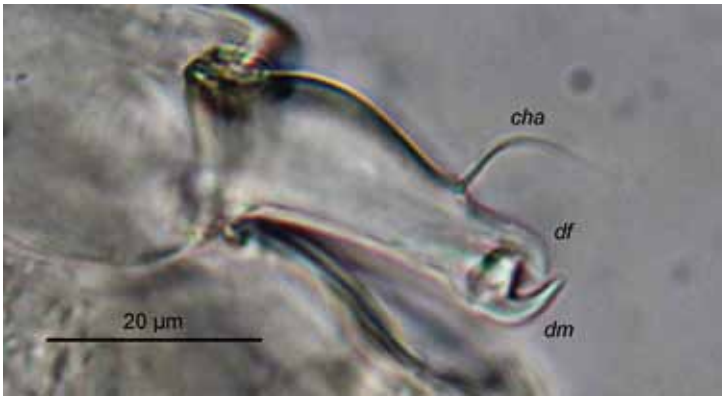

Figure 17. *Scolotydaeus tauricus* tritonymph; chelicera; lateral view.

Comparison of the Heidelberg and the Crimean *Scolotydaeus tauricus*

Overall, the adult male *Scolotydaeus tauricus* from Heidelberg demonstrates a good agreement in its morphology to that of the *S. tauricus* from Crimea, the male of which was well described by Khaustov (2017). Besides the data featured in the diagnosis they also share a great likeness in the lengths of the idiosomal setae, and similar idiosomal and leg lengths. The Heidelberg *Scolotydaeus* female also corresponds well to the female of *S. tauricus* described by Kuznetsov (1973). The number of genital and aggenital setae in both the Heidelberg male and in the female is identical to that of the male and female, respectively, of the Crimean *S. tauricus*.

The Heidelberg *Scolotydaeus* adult male may be distinguished from those of the Crimean *S. tauricus* by displaying slightly longer pseudanal setae *ps2* with these measuring 31 µm instead of 21–22 µm, by the idiosomal setae *c1*, *d*, *e*, *f1*, *h1*, *ps1*, *ad1*, *3c*, *ps2*, *ad2* being smooth, instead of with minute barbs, and by the setae *f2, h2* and *ps3* similarly being smooth instead of with minuscule barbs at their basal part. In the Heidelberg *Scolotydaeus* male the aggenital setal pair *ag1* is smooth instead of branched as in the Crimean *S. tauricus* and the eugenital seta *eu5* is somewhat differently shaped. Furthermore, the Heidelberg *Scolotydaeus* male possesses claws on leg II which are about a third longer than those of leg I, whereas these are of about equal length in the Crimean *S. tauricus* male according to Khaustov (2017).

The morphological differences between the Crimean *Scolotydaeus tauricus* and the Heidelberg *Scolotydaeus* are here interpreted as being intraspecific in nature. More data on the variability

of the potentially distinguishing characteristics listed above, within both the Crimean and the Baden-Württemberg *S. tauricus* populations, are needed to assess whether or not the *Scolotydaeus* discovered in Germany possibly represents a new subspecies of *S. tauricus*. It is quite likely that a molecular analysis will detect significant genetic divergence between the Heidelberg and the Yalta populations of *S. tauricus*.

Distinction between *Scolotydaeus tauricus* and *S. bacillus*

The type species of *Scolotydaeus* is the little known *Scolotydaeus bacillus* BERLESE, 1910. Surprisingly none of the species of *Scolotydaeus*, including *S. tauricus*, so far possesses a satisfactory differential diagnosis with regard to this species. In the very short account of *S. bacillus* by BERLESE (1910), based on a single specimen, no eyes are mentioned or depicted and the species was accordingly assumed not to possess any eyes by BAKER (1949, 1950). About two decades later THERON et al. (1969) presented a concise description of a male and a female mite of *S. bacillus* from the Berlese Collection in Florence. They noted that the species possesses a single pair of indistinct eyes. Subsequently both FLECHTMANN (1992) and SEEMAN & WALTER (2000) employed this trait in their differential diagnosis and species key of *Scolotydaeus*, respectively. It is very likely instead, though, that *S. bacillus*, like all other species of *Scolotydaeus*, actually displays two pairs of lateral eyes. Incidentally, *Scolotydaeus tauricus* itself was mistakenly described

Table 1. Ontogeny of leg chaetotaxy in *Scolotydaeus tauricus*.

	trochanter	femur	genu	tibia	tarsus
leg I					
larva	–	*d*, (*l*), (*v*), *d1*, *bv"*	*d*, (*l*), (*v*), (*l1*), *σ*	*d*, (*l*), (*v*), *k*, (*l1*), *φ*	(*pξ*), (*tc*), (*ft*), (*u*), *s*, *pl"*, (*pv*), *ω1*
protonymph	–	–	–	–	(*a*), (***tcξ***), ***ft'ξ***
deutonymph	–	–	–	***l'ξ***	***ft"ξ***, *ω2*
tritonymph	–	*l1'*	–	–	–
adult	–	–	–	–	–
leg II					
larva	–	*d*, *l'*, *bv"*	*d*, (*l*), *σ*	*d*, *l'*, (*v*), *φ*	*p'ξ*, (*tc*), (*u*), *ε*, *ω*
protonymph	*v'*	–	–	–	*p"*
deutonymph	–	–	–	–	–
tritonymph	–	–	–	–	–
adult	–	–	–	–	–
leg III					
larva	–	*d*, *v'*, *ev'*	*l'*	*d*, (*v*), *φ*	(*tc*), (*u*)
protonymph	*v'*	–	–	–	–
deutonymph	–	–	–	–	–
tritonymph	–	–	–	–	–
adult	–	–	–	–	–
leg IV					
protonymph	–	–	*d*, *v'*	*d*, *v'*	*tc*, (*u*)
deutonymph	–	*d*, *v'*, *ev'*	–	*v"*	(*p*)
tritonymph	–	–	–	–	–
adult	–	–	–	–	–

by Kuznetsov (1973) as possessing only one pair of eyes. The more posterior second pair of lateral eyes or postocular bodies is typically smaller and less conspicuous than the anterior one in *Scolotydaeus* and easy to overlook.

In the most recent species key of *Scolotydaeus,* the one by Khaustov (2017: p. 176), the eyes of *S. bacillus* are not mentioned and the species is distinguished from *S. tauricus* on the basis of: "Setae *f2* and *h2* relatively short, not whip-like, distinctly shorter than distance between setae *f1-f2* and *h1-h2*, respectively". This characterization applies to the illustration of *S. bacillus* by Theron et al. (1969, Fig. 29) but conflicts strongly with the depiction of the dorsal side of the species by Berlese (1910, Tab. 28, Fig. 13) himself. The latter draws the lateral hysterosomal setae *f2* and *h2* as being elongate with *f2* equal in length to the distance *f1-f2* and with *h2* measuring twice the distance *h1-h2* in length. The appearance and relative lengths of the hysterosomal setae *f1*, *f2*, *h1*, *h2* are very similar in the *S. bacillus* portrayed by Berlese and in *S. anatolicus* and *S. tauricus*. Elongate, distally slender setae *f2* and *h2* are a typical trait of *Scolotydaeus* although short setae *f2*, *h2* are known from the Nearctic paratydeid mite *Neotydeus ardisanneae* Baker, 1950 which was described by Baker (1950) and redescribed by Khaustov (2017).

Berlese (1910) illustrates *Scolotydaeus bacillus* with two elongate claws and no empodia on the pretarsi of legs II, III and IV. In the diagnosis of *Scolotydaeus*, Berlese (1910: p. 214) accordingly states in Latin: "Ambulacra uncis duobus tantum constituta, pulvillo nullo". Baker (1949: p. 119) mentions that Berlese had written the following text in a copy of the journal Redia on the page margin next to the description of *S. bacillus*: "ambulacra uncis duobus magnis inter quos unus stat minimus basalis quasi calcaneum." This may be translated as: "ambulacra are two large hooks between which stands a tiny basalis, like a calcaneum." Berlese therefore had amended his earlier diagnosis in now stating, in more modern terminology, that the pretarsi of *S. bacillus* possess two large claws and a tiny empodium. It is likely that this statement applies not only to the pretarsus of leg I, but also to the pretarsus of legs II-IV. In this case the adults of *S. tauricus* may be distinguished from *S. bacillus* in showing elongate empodia on legs II-IV.

The illustration by Berlese (1910) of *Scolotydaeus bacillus* shows longer setae *c1* and longer setae at the posterior of the idiosoma, namely *ps2* and one of the adanal setae, than are present in *S. tauricus*. On the other hand, in this respect it also differs greatly from the figures 29 and 31 in Theron et al. (1969) who portray these setae as being short. *Scolotydaeus bacillus* females have 6 pairs of aggenital setae and 10 pairs of genital setae (Theron et al. 1969), thereby differing from those of *S. tauricus*. However, the intraspecific variability of these traits in the Paratydeidae is almost unstudied. An exception is given by Fuangarworn (2015: p. 112), who discovered significant variation in both aggenital (5 - 6) and genital (5 - 8) setal counts in a small sample of females of *Tanytydeus kakadu* Seeman & Walter, 1999 originating from Thailand.

It is not known if the incomplete description of *S. bacillus* by Theron et al. (1969) is based in part on the type specimen or on mites originating from the same geographical locality as the holotype. It is evidently still necessary to redescribe *S. bacillus* in detail, based on sample material from the type locality in Palermo in Sicily, latinized as "Panormitani" by Berlese (1910), to confirm and detect the differences and shared traits between *Scolotydaeus bacillus* and other members of its genus, including also the *S. tauricus* from Heidelberg.

Morphology of the juvenile stages of *Scolotydaeus tauricus*

The larva and nymphs of *S. tauricus* have so far not been described. The ontogenetic development of the Heidelberg *Scolotydaeus tauricus* conforms to the typical general pattern outlined for the Paratydeidae by Khaustov (2017: p. 153) and is very similar to that of *Scolotydaeus uralensis*, the only species of its genus so far for which all developmental stages have been documented. The *Scolotydaeus tauricus* nymphs differ from those of *S. uralensis* amongst others in their longer empodia on pretarsi II-IV and in displaying only 4 setae instead of 5 on the tarsus of leg III. In both cases the *S. tauricus* nymphs retain the presumably plesiomorph larval character state.

A notable finding of the present study is that the male and female tritonymphs of *Scolotydaeus tauricus* may differ in their external morphology. Labelling the tritonymphal genital setae in a practical fashion sensu Khaustov (2017: p. 181, Fig. 28) with the anteriormost genital setae being *g1* and without necessarily assuming genital setae with the same number to be homologous between the nymphal stages and also between

tritonymphs and adults, it could be observed that the setae of pair *g3* were inserted distinctly more closely together to each other in the presumptive male tritonymphs than in the presumptive female one. Weakly sclerotized rudiments of a part of the male genital apparatus were visible in two presumptive male tritonymphs. The distance between the insertion points of setae *g1* to those of *g3* was about twice as long in the presumed female tritonymph than it was in the presumed male ones, and the former possessed 3 pairs of aggenital setae as opposed to the 4 pairs of the latter. A similar pattern in the arrangement of the insertions of the genital and aggenital setae has been illustrated by KHAUSTOV (2017: p. 181, Fig. 28 C) for tritonymphs of *Scolotydaeus uralensis*, the only case so far in which nymphal sexual dimorphism has been noted to occur in the Paratydeidae.

The male tritonymphs of *Scolotydaeus uralensis* were classified as being male by KHAUSTOV (2017) on the basis of their branched genital setae which were absent in the females. Such branched genital setae were not seen in presumptive male tritonymphs of the Heidelberg *Scolotydaeus*, but it is very likely that the arrangement of the insertion points of the genital setae itself is as significant a trait in distinguishing males and females at tritonymph level, as it is in adults of the species. A larger sample size of specimens examined is necessary to conclusively prove this though. Neither FUANGARWORN (2015) for the Paratydeidae *Tanytydeus kakadu* SEEMAN & WALTER, 1999 and *T. egyptiacus* (SOLIMAN, 1974) nor KHAUSTOV et al. (2019) for *T. theroni* which was proposed as new by them, note any morphological differences between male and female tritonymphs and do not distinguish amongst these.

Distribution and ecology of *Scolotydaeus*

Mites of the genus *Scolotydaeus* have until now only very rarely been encountered in the world. *Scolotydaeus lootsi* was detected in Potchefstroom in South Africa (THERON et al. 1969), while *S. corticicola* and *S. alexanderi* originate from Brazil (FLECHTMANN 1992) and Mexico (BAKER 1949, VAZQUEZ-ROJAS et al. 2019) respectively. One fossil species of the genus, *S. vlaskini* from the Ukraine (KLIMOV et al. 2019) and four extant ones are known from the Palaearctic realm. Besides the material collected in Heidelberg, *Scolotydaeus tauricus* has up to the present publication only been found at its type locality at Yalta (KUZNETSOV 1973, KHAUSTOV 2017). The species *S. uralensis* similarly is recorded from only one location, the Zyuratkul National Park in the Southern Ural region of Russia (KHAUSTOV 2017). *Scolotydaeus anatolicus* is so far known from two individuals described by DÖNEL, DOGAN & SEEMAN (2012) originating from two sites in Anatolia in Turkey. *Scolotydaeus bacillus* is known from Italy (BERLESE 1910). THOR (1932: p. 90), whose full surname is THORKELSEN, mentions collecting a single *S. bacillus* in Oslo in Norway in 1927 and, as translated by me from his German text, describes this as:

"The body is extraordinarily narrow and long (4 times as long as it is wide) and consists of 3 distinct regions (thorax and 2 abdominal regions). The thorax with a length of 45 µ and a width of 28 µ laterally possesses two elongate, anteriorly converging folds or chitinous ridges as well as 1 pair of elongate fine sensory hairs which are in large lateral pores, far removed from each other. I assume that BERLESE's (Fig. 13) is not quite correct in these matters, otherwise the Norwegian specimen would belong to another species."

THOR (1932) gives a body length for the specimen of only 160 µm, which is considerably shorter than the idiosomal length of the larvae of the only two *Scolotydaeus* species for which this stage or the protonymphs are known, based on the data of KHAUSTOV (2017) and the present publication. The elongate prodorsal sensory setae which THOR (1932) mentions in this citation, correspond to the internal pair of scapular setae *sci* in modern terminology. The right and left seta *sci* insert very close to each other, near the parasaggital plane in all known species of *Scolotydaeus*. This makes it unlikely that the specimen discovered by THOR belongs to the genus *Scolotydaeus.* THOR´s (1932) description is also far too brief and incomplete to permit one to attempt a secure identification at genus or species-level, even if the mite he saw may have belonged to the Paratydeidae.

The discovery of *Scolotydaeus tauricus* in Heidelberg is the first time that a mite belonging to the genus *Scolotydaeus* and also the family Paratydeidae has been found to occur in Germany. The acarine family is so far not listed as being present in this country in the relevant literature or in online sources such as the taxonomic databases of the Global Biodiversity Information Facility (2021) and the Fauna Europaea (2021). The GBIF (2021) lists several records of the Paratydeidae for the Netherlands such as that by WOUTERS & DIMMERS (2019). These are apparent-

ly the only specimens of the Paratydeidae that have been documented for Central Europe so far, besides those from Heidelberg. The Dutch specimens were not identified to the level of genus or species. It would be very interesting to find out if one or more of these mites are conspecific to those from Heidelberg.

It is very probable that *Scolotydaeus tauricus* has been living on the Königstuhl for at least many thousands of years and that its present day occurrence there is not linked to the current global warming. The Königstuhl and surrounding area were periglacial areas during the last ice ages and not covered by ice, and the mountain has been relatively free from human interference. At the Königstuhl the species was only noted to be present in crustose lichen growing on rocks. This fits in well with the habitats in which other *Scolotydaeus* have been collected, which include moss, plant litter, tree bark, tree branches and a bird nest (Berlese 1910, Baker 1949, Flechtmann 1992, Dönel et al. 2012, Khaustov 2017, García-Ayala et al. 2020). *Scolotydaeus vlaskini* was found embedded in amber and this also contained plant remains (Klimov et al. 2019). *Scolotydaeus lootsi*, though, has been taken from pasture soil (Theron et al. 1969). The evidence so far suggests that *Scolotydaeus* favours the upper soil layer and especially above soil habitats, but may possibly also be found in deeper soil, especially in arid, hot environments such as deserts.

Very little is known about the food of *Scolotydaeus*. The species of the genus are listed as feeding on nematodes and arthropods and are also considered to be likely to ingest fungi (Neher et al. 2009). The lichen microhabitat of the Heidelberg *Scolotydaeus tauricus* suggests that the latter mode of nutrition may indeed be the case for this species. Potential acarine predators of the Heidelberg *Scolotydaeus*, found in the same lichen samples, were *Bdella semiscutata* Thor, 1930 and *Cunaxa setirostris* (Hermann, 1804), both belonging to the Prostigmata as well as the mesostigmatan *Amblyseius stramenti* Karg, 1965.

An adult *Scolotydaeus tauricus* in a petri dish was measured by me to move forward at a speed of about 0,58 body lengths/second which corresponds to 97 cm/hour. The species is therefore relatively rapid when there is a stimulus for it to move. This may aid in its short range dispersal and in the colonization of new habitats. Transport by birds may possibly play a role in long distance dispersal.

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List of abbreviations

Gnathosoma

or1	adoral seta of 1st pair of subcapitulum
or2	adoral seta of 2nd pair of subcapitulum
ba, bp	basal setae on palptarsus
cha	dorsal seta of chelicera
d	dorsal seta of palptibia
df	fixed digit of chelicera
dFe	most proximal seta of palp femurogenu
dGe	most distal seta of palp femurogenu
dm	mobile digit of chelicera
ep	supracoxal seta of palpcoxa
l	lateral seta of palptibia
m	anterior subcapitular seta
n	posterior subcapitular seta
sul	subultimal seta of palptarsus
ul	ultimal seta of palptarsus
va, vp	ventral setae of palptarsus
ω	solenidion of palptarsus

Dorsal idiosoma

c1	seta of innermost 1st pair in the 1st row on the hysterosoma
c2	seta of outer 2nd pair in the 1st row on the hysterosoma
d	seta in the 2nd row on the hysterosoma
e	seta in the 3rd row on the hysterosoma
f1	seta of innermost first pair in the 4th row on the hysterosoma
f2	seta of outer 2nd pair in the 4th row on the hysterosoma
h1	seta of innermost 1st pair in the 5th row on the hysterosoma
h2	seta of outer 2nd pair in the 5th row on the hysterosoma
im	middle cupule on hysterosoma
ip	posterior cupule on hysterosoma
sce	external scapular seta
sci	internal scapular seta
ve	external vertical seta

Ventral idiosoma

1a	seta of 1st pair associated with the coxae of leg I
1b	seta of 2nd pair associated with the coxae of leg I
1c	seta of 3rd pair associated with the coxae of leg I
1d	seta of 4th pair associated with the coxae of leg I
2a	seta of 1st pair associated with the coxae of leg II
2b	seta of 2nd pair associated with the coxae of leg II
2c	seta of 3rd pair associated with the coxae of leg II
3a	seta of 1st pair associated with the coxae of leg III, but situated between coxa II and III
3b	seta of 2nd pair associated with the coxae of leg III
3c	seta of 3rd pair associated with the coxae of leg III
4a	seta of 1st pair associated with the coxae of leg IV
4b	*seta of* 2nd pair associated with the coxae of leg IV
ad1	seta of 1st pair of adanal setae

ad2	seta of 2nd pair of adanal setae
ag1	aggenital seta of anterior 1st pair
ag6	aggenital seta of 6th pair
eu1	eugenital seta of anterior 1st pair
eu10	eugenital seta of 10th pair
g1	genital seta of 1st pair
g10	genital seta of 10th pair
ia	anterior cupule of hysterosoma
ih	hindmost cupule of hysterosoma
k1-k3	miniature setae associated with genital papillae
ps1	pseudanal seta of 1st pair
ps2	pseudanal seta of 2nd pair
ps3	pseudanal seta of 3rd pair
Va	anterior genital papilla
Vm	middle genital papilla
Vp	posterior genital papilla

Legs

a	antilateral seta of tarsus I
bv	basiventral seta of femora I, II
d	dorsal seta
d1	second dorsal seta of a segment
el	supracoxal seta of coxa of leg I
ev	basiventral seta of femora III, IV
ft	fastigial seta of tarsus
l	lateral seta
l1	one of 2nd pair of lateral setae on a segment
p	proral seta of tarsus
pl	primilateral seta of tarsus
pv	primiventral seta of tarsus
tc	tectal seta of tarsus
u	unguinal seta of tarsus
v	ventral seta
κ	sensillum
σ	genual solenidion
φ	tibial solenidion
Ɛ	famulus
ω	tarsal solenidion
ω1	anterior solenidion of tarsus I
ω2	posterior solenidion of tarsus I

An abbreviation of the name of a seta followed by a single prime symbol ' such as in *u'* indicates that the seta is here inserted on the anterior leg surface if the mite is imagined with the legs or palps perpendicular to the long axis of the body. Analogously a setal name associated with a double prime as in *u"* signifies that a seta in the same leg or palp position is here inserted on the posterior surface. Where a setal notation is placed in parentheses as in (v) this refers to a setal pair and in this case would be the equivalent of writing: *v'* and *v"*. The symbol *ξ* positioned behind a setal abbreviation as in *tc"ξ* shows that the seta is an eupathidion.