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REDESCRIPTION OF *WINTERSCHMIDTIA WICHMANNI* (ACARI: ASTIGMATA: WINTERSCHMIDTIIDAE) FROM AUSTRIA

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ABSTRACT: Phoretic deutonymphs of *Winterschmidtia wichmanni* (Türk and Türk, 1957) (Acari: Winterschmidtiidae) are redescribed based on specimens collected from *Pyrrhidium sanguineum* (Coleoptera: Cerambycidae) in Austria. While phoretic deutonymphs of *W. wichmanni* are similar to those of *W. nataliae* (Zachvatkin, 1941), they differ in the size of the idiosoma, the microsculpture of the dorsal idiosoma, the length of solenidia ω_1 and ω_2 on tarsus I, the size of the attachment organ and the absence of sclerotized structures laterad to the attachment organ.

KEY WORDS: astigmatid mites, morphology, phoretic deutonymph, Cerambycidae, Austria

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INTRODUCTION

The genus *Winterschmidtia* Oudemans (1923) currently comprises 18 species. Of them, 13 species are associated with bark beetles (Coleoptera: Curculionidae: Scolytinae) from the Palaearctic, Neotropical and Afrotropical realms (Kolesnikov *et al.* 2022; OConnor 2022). One species, *W. wichmanni* (Türk and Türk, 1957), was found phoretic on the longhorn beetle, *Pyrrhidium sanguineum* (Linnaeus, 1758) (Coleoptera: Cerambycidae). For four species, real associations are unknown: two species, *W. glossinarum* (Fain and Elsen, 1972) and *W. tsetse* (Fain and Elsen, 1972), were collected from tsetse flies, genus *Glossina* Wiedemann, 1830 (Diptera: Glossinidae); and two species, *W. lamtoensis* (Fain, 1974) and *W. elongata* Türk and Türk, 1957, were collected from soil and decaying wood, respectively (Türk and Türk 1957; Fain 1974) without data on phoretic hosts (Kolesnikov *et al.* 2022; OConnor 2022).

Türk and Türk (1957) described *Calvolia wichmanni* based on phoretic deutonymphs found on the subcortical beetle, *Pyrrhidium sanguineum*, from Germany. This species was originally insufficiently described, lacking many important diagnostic character states. Based on the material described below, OConnor (2022) moved this species to *Winterschmidtia* but did not provide a redescription of *W. wichmanni*. Kolesnikov *et al.* (2022) provided an illustrated key of the known species of *Winterschmidtia*, based on phoretic deutonymphs. However, *W. wichmanni* was omitted. In this paper, we provide a detailed redescription of phoretic deutonymphs of *W. wichmanni* collected from *Pyrrhidium sanguineum* in Austria.

MATERIALS AND METHODS

Winterschmidtia wichmanni, 19 phoretic deutonymphs, ex *Pyrrhidium sanguineum* (ventral thorax/abdomen), Austria: Niederösterreich, Ulrichskirchen, 48°24′04″N 16°29′35″E, [no date], leg. J. Spurny, slides with the voucher number "BMOC 78-0825-001". Host in the Cornell University Insect Collection (CUIC), Ithaca, NY, USA, with voucher label "Mites removed / B.M. OConnor / 78-0825-1". Two phoretic deutonymphs, ex *P. sanguineum* (ventral thorax/abdomen), Czech Republic: Jihočeský kraj [South Bohemia], vicinity of Jindřichův Hradec, March 2019, J. Kadlec coll. Voucher information: label on pin "Mites removed, B.M. OConnor 22-1117-001", host catalogued in UMMZ as UMMZI-160091; label on pin "Mites removed, B.M. OConnor 22-1117-002", host catalogued in UMMZ as UMMZI-226656. Nine specimens deposited in the CUIC; nine other specimens—in the University of Michigan Museum of Zoology, Ann Arbor, MI, USA (UMMZ); 3 slides—in the Tyumen State University Museum of Zoology, Tyumen, Russia (TSUMZ).

Photomicrographs were taken using a Leica DMC4500 digital camera attached to a Leica DM

2500 LED microscope equipped with DIC optics. Images were taken from multiple focal planes and assembled in Helicon Focus 7.6.4 Pro (algorithms A and [mostly] B) with subsequent manual editing (retouching) to render the essential detail from individual focal planes. Some of the layered images were merged in Adobe Photoshop 22.2.0.

The terminology of idiosomal chaetotaxy follows Griffiths *et al.* (1990) and the terminology of palp and leg chaetotaxy follows that of Grandjean (1939) and Griffiths (1970). The terminology of coxisternal setae follows Norton (1998). All measurements are given in micrometres (μm).

RESULTS

Winterschmidtia wichmanni
(Türk and Türk, 1957)
Calvolia wichmanni Türk and Türk, 1957: 166, Fig. 116.
Winterschmidtia wichmanni: OConnor 2022: 211.
(Figs. 1–4)

Diagnosis. *Phoretic deutonymph*. Idiosomal length 220–243 × 100–125. Central part of propodosomal and hysterosomal shields with closed, elongated, irregular cells (their width less than length of *si*). Setae *se* situated posteriad *si*, distance *si–se* shorter than distance from *se* to base of prodorsal shield. Ventrum absent. Anterior apodemes IV without projections. Attachment organ small. Pair of irregular sclerotized structures lateral to attachment organ absent. Solenidion ω_1 on tarsus I situated closer to middle of tarsus; ω_2 situated midway between ω_1 and base of tarsus, distance between tip of ω_2 and base of ω_1 shorter than length of ω_2. Seta *d* IV about as long as idiosomal length or longer; *w* IV nearly as long as hysterosomal length.

Redescription of phoretic deutonymphs. Body ovoid, widest at sejugal region. Idiosoma 1.8 times longer than width.

Gnathosoma (Figs. 1B, 2E, 3B, 4E) consists of short subcapitular remnant (subequal length and width) and short palps (slightly longer than wide); palps with filiform palpal solenidia ω apically, and setae *dm* dorsolaterally; *elcp* absent; gnathosoma covered by prodorsal shield, except distal parts of palps, ω and *dm*.

Dorsum (Figs. 1A, 3A). Idiosoma with two weakly sclerotized, finely punctate shields, both with well-developed longitudinal linear pattern. Central part of prodorsal shield with strongly elongate (many times longer than width), closed cells; cells irregular in shape and size; some medial cells slightly wider (width less than lengths of *si* or *se*) than lateral cells. Sculpture of hysterosomal shield is similar to that on prodorsal shield, formed by longitudinal lines with elongated, narrow, irregular cells (medial cells closed). Ocelli present at distal end of prodorsal shield; pigmented spots present, adjacent to each other. Setae *vi* longer than si and se, but slightly shorter than h_3, protruding propodosoma; *ve* absent; *si* distinctly anteromesad *se*, distance *si–se* distinctly shorter than distance from *se* to sejugal furrow; *scx* anteriad *si*; *si* and *se* short, *scx* three times longer than *si*. Sejugal furrow well-developed. Hysterosomal shield with 11 pairs of simple, filiform setae (c_1, c_2, c_p, d_1, d_2, e_1, e_2, f_2, h_1, h_2, h_3); setae h_3 distinctly longer than others, c_p situated ventrally. Distance d_1–c_1 18, d_1–e_1 58, c_1–c_2 22, ratio d_1–e_1/d_1–c_1 3.22, ratio c_1–c_2/d_1–c_1 1.22. Opisthonotal gland openings situated nearly equidistantly between setae c_2 and e_2. Of four fundamental pairs of cupules, only two pairs observed: *ia* between setae c_1 and c_2, and *im* between setae d_2 and e_2.

Venter (Figs. 1B, 3B). Coxal fields weakly sclerotized, finely punctate, without any well- developed pattern. Anterior apodemes of coxal fields I fused, forming sternum. Anterior apodemes of coxal fields II curved medially. Posterior apodemes of coxal fields II broad, curved medially. Sternum and anterior apodemes II not extending to level of coxal apodemes III. Free ends of sternum and anterior apodemes II forming weakly sclerotized portions, not extending to level of coxal apodemes III. Coxal fields II open, with anterior apodemes separate; posterior apodemes connected to each other. Coxal fields III closed; anterior apodemes of coxal fields III fused with each other and form a median sclerite; anterior apodemes of coxal fields IV fused to each other and connected to median sclerite of coxal fields III, without projections. Ventrum absent. Posterior apodemes IV short, transverse, positioned directly anterior to attachment organ. Borders of dorsal hysterosomal shield distinct; anterior lateral margins bent ventrally. Setae c_3 long, filiform, situated on ventral surface between legs II–III, far from dorsal shield. Coxal setae *1a* and *3a* vestigial, *4b* and *g* filiform, *4a* in form of small, rounded conoids. Genital region in posterior portion of coxal fields IV. Coxal setae *4b* situated at junctions of anterior coxal apodemes IV

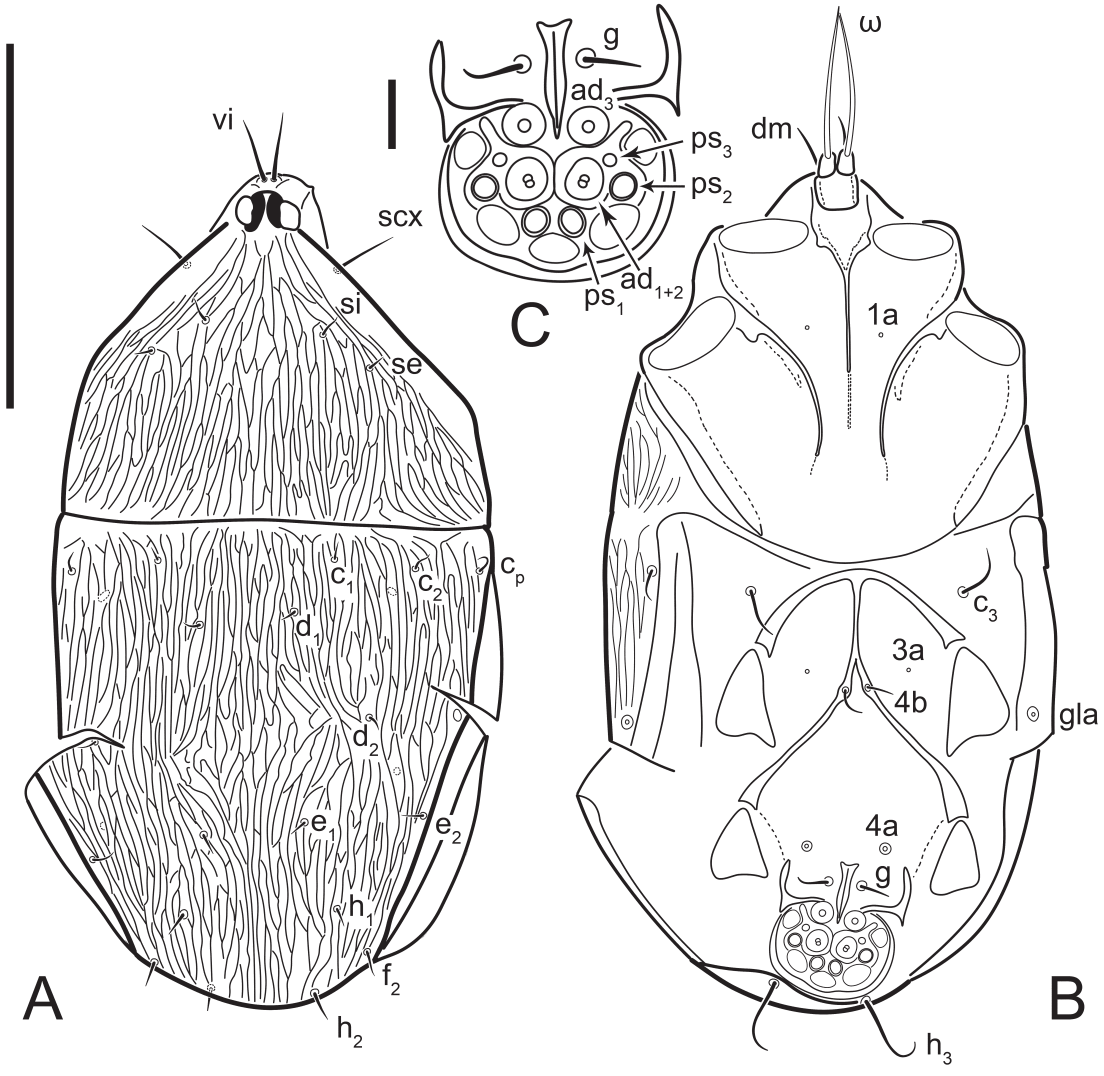

Fig. 1. *Winterschmidtia wichmanni* (Türk and Türk, 1957), phoretic deutonymph: A—dorsal view; B—ventral view; C—attachment organ. Scale bars 100 μm (A, B) and 10 μm (C).

and posterior median apodeme; genital setae laterad genital opening; *4a* distinctly anterolaterad *g*. Attachment organ posterior to coxal fields IV, small. Suckers ad_3 round, ad_{1+2} slightly larger, consisting of large sclerotized margins and surrounding paired vestigial alveoli. Pair of small refractile spots (ps_3) anterolaterad median suckers. Lateral conoidal setae ps_2 situated at level of line joining centers of median suckers; ps_1 posteriad ad_{1+2} and slightly mesad. Anterior and posterior lateral and posterior median cuticular conoids well- developed. Anus positioned between ad_3.

Legs (Figs. 2A–D, 4A–D). Legs short, all segments free, except tibia and tarsus IV fused into tibiotarsus. Legs I–II longer than legs III, legs III longer than legs IV. Trochanters I–III each with filiform seta (*pR* I–II, *sR* III). Femoral setae *vF* I–II and *wF* IV filiform. Genual setae *mG* and *cG* I–II filiform, seta *nG* III absent. Tibial setae *gT* I–II and *kT* III filiform, setae *hT* I–II absent. Tarsus I with three foliate setae (*ra*, *la*, *f*), seta *d* long, filiform, seta *e* small, adjacent with *d*, seta *wa* filiform, with a small tapered process, setae *p*, *q*, *aa* and *ba* absent. Tarsus II similar to tarsus I but lacks ω_2, ω_3, and famulus. Tarsus III with seven foliate setae (*w*, *r*, *s*, *p*, *q*, *e*, *f*) and long filiform seta *d* (approximately equal to length of leg III). Tibiotarsus IV with three foliate setae (*s*, *p*, *r*), one filiform seta *kT* and two very long setae *w* and *d*. Seta *d* 1.6 times longer than *w*. Solenidia ω_1 on tarsi I–II cylindrical, with rounded apices, situated approximately in middle of tarsus; ω_3 on tarsus I

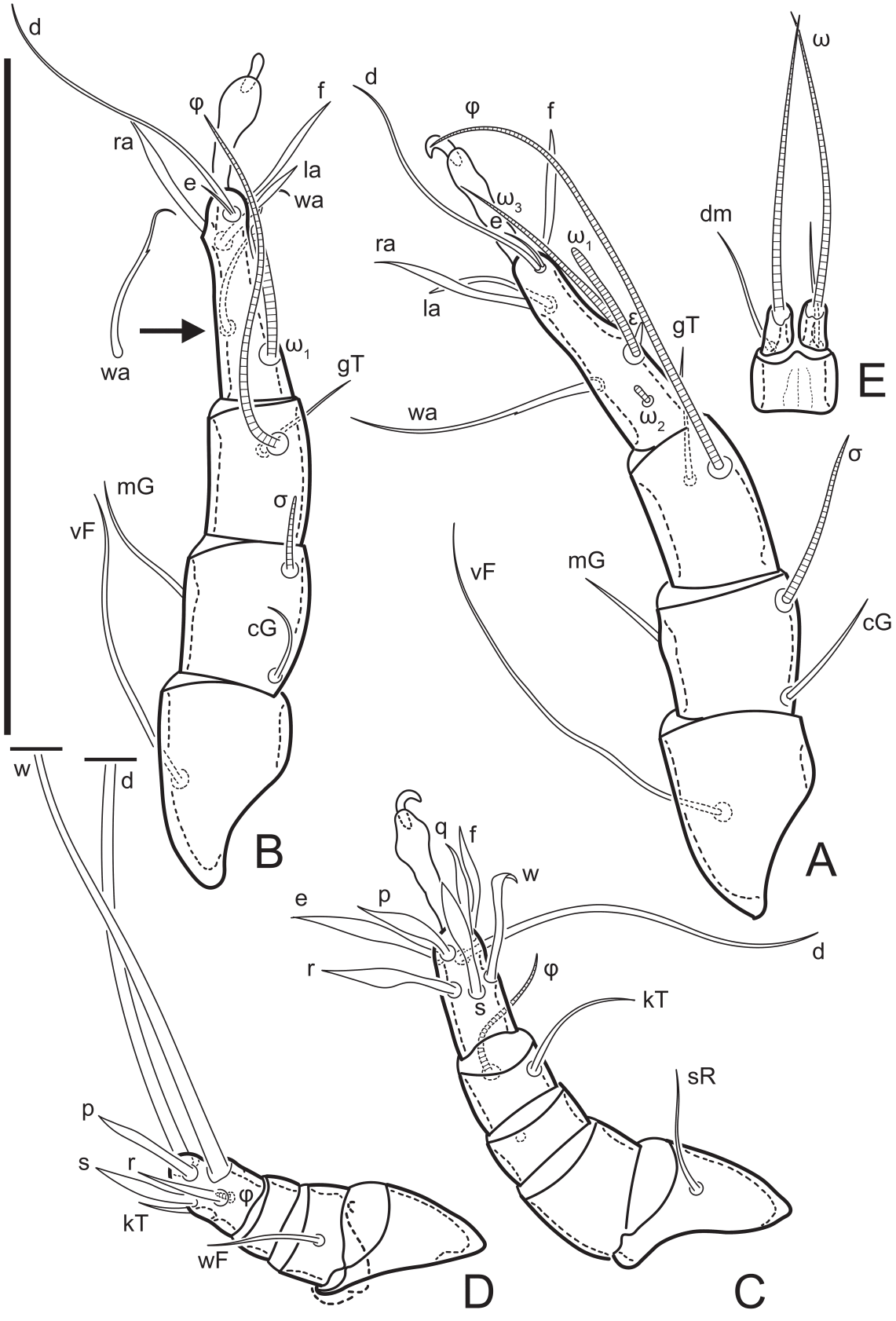

Fig. 2. *Winterschmidtia wichmanni* (Türk and Türk, 1957), phoretic deutonymph: A—leg I, left, posterior (antiaxial) view; B—leg II, left, posterior (antiaxial) view; C—leg III, left, ventral view; D—leg IV, left, ventral view; E—gnathosoma, ventral view. Scale bar 100 μm.

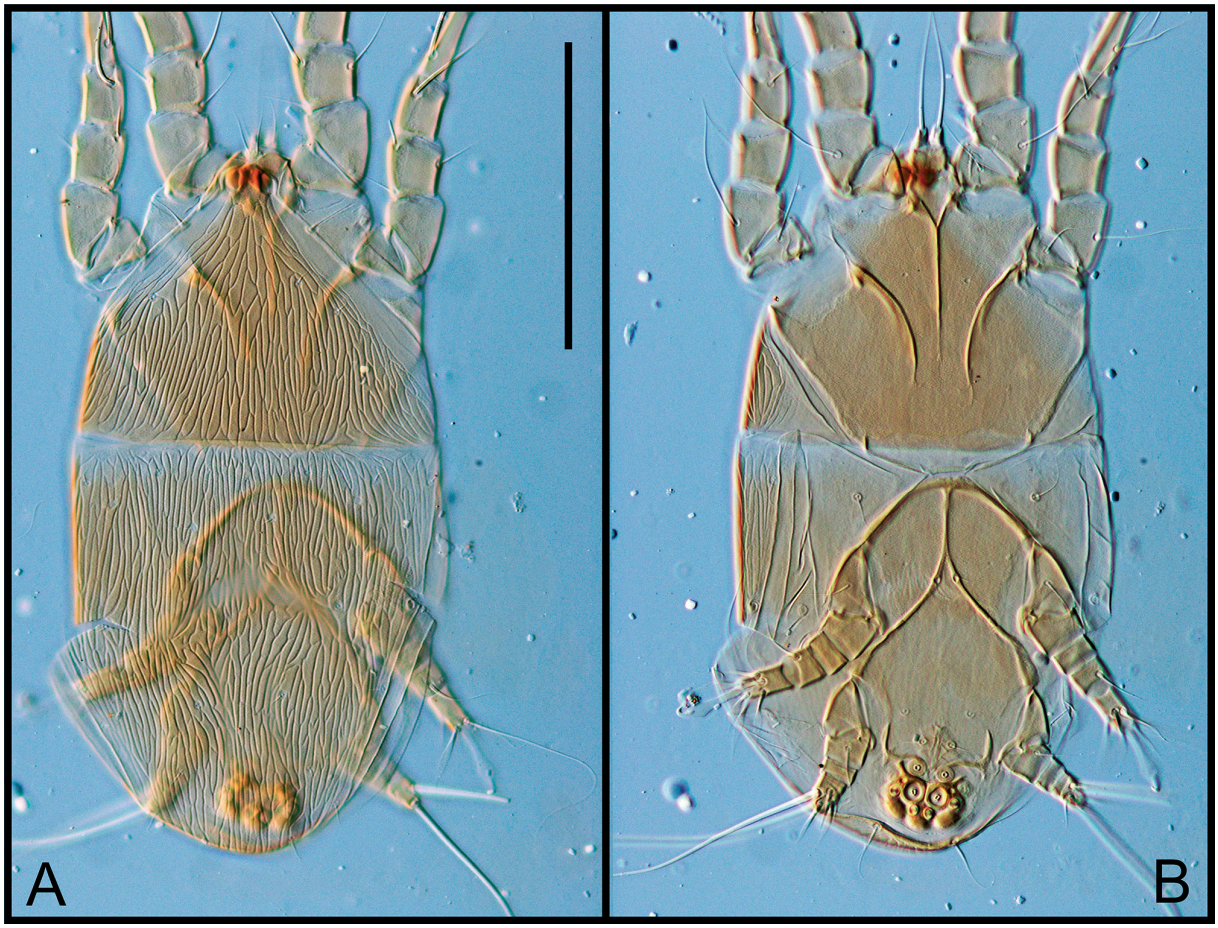

Fig. 3. *Winterschmidtia wichmanni* (Türk and Türk, 1957), phoretic deutonymph, DIC photomicrographs: A—dorsal view; B—ventral view. Scale bar 100 μm.

longer than ω_1, gradually tapering, situated slightly anteriad ω_1, length of ω_1 is greater than distance between base of tarsus I and ω_1; ω_2 of tarsus I short, with rounded tip, shifted from base of tarsus at distance approximately equal to its length; φ of tibiae I–II long, tapering; φ of tibiae III elongate, tapering; φ IV short and stout; σ of genu I elongate, slightly tapering, longer than ω_1; σ of genu II shorter, cylindrical; σ of genu III absent (represented by alveolus). Famulus ε of tarsus I short, pointed, adjacent to solenidion ω_1. Pretarsi I–III with membranous ambulacrum, with simple empodial claw, leg IV without pretarsus and claw.

Measurements (n = 1). Idiosomal length 243, width 124. Prodorsum length 85, width 117. Hysterosoma length 135. Subcapitular remnant length 10, width 13, free palp length 8, gnathosomal solenidion ω 44, *dm* 20. Sternum 29, apodeme II 38. Setae *vi* 19, *si* 7, *se* 6, *scx* 19, c_1 5, c_2 5, c_3 14, c_p 8, d_1 5, d_2 5, e_1 5, e_2 6, f_2 8, h_1 6, h_2 8, h_3 22, *4a* (max width) 3, *4b* 7, *g* 9. Length of attachment organ 26, width of attachment organ 35, ad_3 6, ad_{1+2} 7, ps_2 4, ps_1 5. Legs I: length 108, tarsus I 33, pretarsi I 21, ω_1 I 19, ω_2 I 3, ω_3 I 32, famulus 3, *f* I 18, *d* I 38, *e* I 7, *ra* I 25, *la* I 18, *wa* I 38, *gT* I 20, φ I 65, *mG* I 15, *cG* I 19, σ I 27, *vF* I 60, *pR* I 20. Leg II: length 104, tarsus II 32, pretarsi II 22, ω_1 II 21, *f* II 19, *d* II 47, *e* II 5, *ra* II 20, *la* II 17, *wa* II 23, *gT* II 17, φ II 50, *mG* II 20, *cG* II 12, σ II 11, *vF* II 45, *pR* II 14. Leg III: length 66, tarsus III 16, pretarsi III 21, *w* III 19, *r* III 20, *s* III 18, *p* III 16, *q* III 16, *e* III 23, *f* III 17, *d* III 55, φ III 20, *kT* III 20, *sR* III 18. Leg IV: length 49, tibiotarsus IV 14, *s* IV 15, *p* IV 116, *r* IV 13, *w* IV 130, *d* IV 250, *kT* IV 7, φ IV 3, *wF* IV 17.

Biology. This mite species was collected in three different countries in central Europe (Germany, Austria and the Czech Republic) from a single beetle species *Pyrrhidium sanguineum*, indicating a strong phoretic preference of the mite.

Differential diagnosis. The phoretic deutonymph of *Winterschmidtia wichmanni* is similar to that of *W. nataliae* (Zachvatkin, 1941), redescribed by Cooreman (1963), Khaustov (2000) and Kole-

snikov *et al.* (2022). However, the two species' deutonymphs differ in the following character states: in the central part of the prodorsal shield, the widths of the cells are shorter than the length

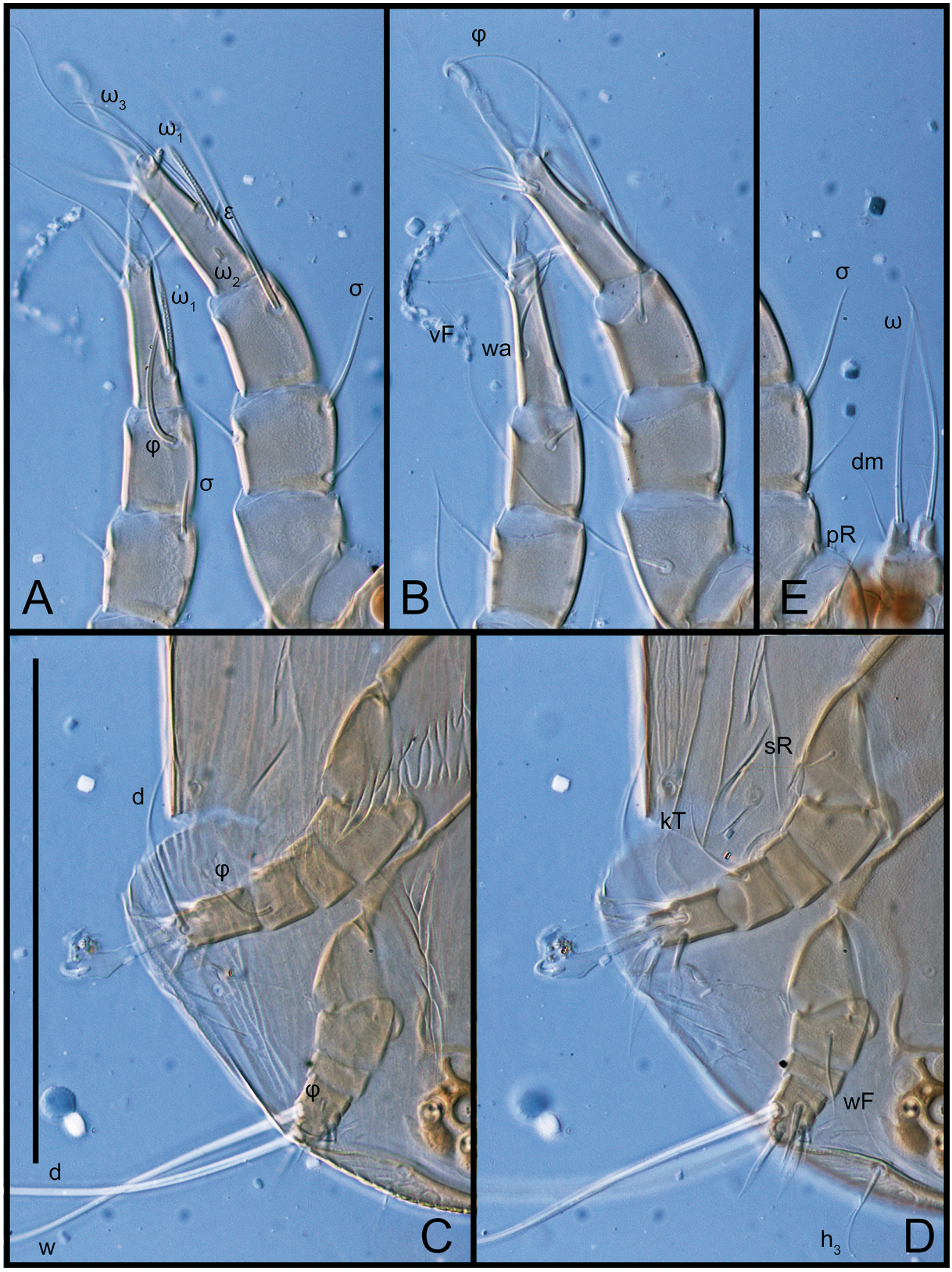

Fig. 4. *Winterschmidtia wichmanni* (Türk and Türk, 1957), phoretic deutonymph, DIC photomicrographs: A—legs I and II, left, posterior (antiaxial) view; B—legs I and II, left, anterior (paraxial) view; C—legs III and IV, left, dorsal view; D—legs III and IV, left, ventral view; E—gnathosoma, ventral view. Scale bar 100 μm.

of setae *si* (vs. subequal or longer in *W. nataliae*); tarsal solenidion ω_1 I is longer than the distance between solenidion and the base of tarsus I (vs. ω_1 I being the same length as the distance between solenidion and the base of tarsus I in *W. nataliae*); the distance between the tip of ω_2 and the base of ω_1 is shorter than the length of ω_2 (vs. longer in *W. nataliae*); the sclerotized structures laterad of the attachment organ absent (vs. present in *W. nataliae*, Fig. 13D in Kolesnikov *et al.* [2022]); the attachment organ is small, 26 × 35 (vs. 48 × 35 in *W. nataliae*); the idiosoma narrow, length/width 2.2–1.92 (vs. 1.57–1.59 in *W. nataliae*).

In addition, *W. wichmanni* and *W. tsetse* are the largest species in the genus: 220–243 × 100–125 (*W. wichmanni*) and 225 × 160 (*W. tsetse*) vs. 177–200 × 111–127 (*W. nataliae)*.

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