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# A NEW SPECIES OF *WINTERSCHMIDTIA* OUDEMANS (ACARI: ASTIGMATA: WINTERSCHMIDTIIDAE) FROM PERU

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ABSTRACT. Phoretic deutonymphs of *Winterschmidtia tawantinsuyuca* sp.n. (Acari: Winterschmidtiidae) are described from Peru. This is the fourth species of the genus recorded in the Neotropical realm. Similar to the three other Peruvian species, the new species is phoretic on bark beetles, but this is the first finding of *Winterschmidtia* on the beetles of the genus *Xyleborus* (Coleoptera: Curculionidae: Scolytinae). The new species differs from all others in the ornamentation on of its prodorsal shield.

KEY WORDS: astigmatid mites, morphology, taxonomy, phoretic deutonymph, Peru, bark beetles, *Xyleborus ferrugineus*

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## INTRODUCTION

The genus *Winterschmidtia* Oudemans, 1923 (Winterschmidtiinae) currently comprises 18 species. Phoretic deutonymphs of this genus are mainly associated with xylophilous insects—bark beetles (Coleoptera: Curculionidae: Scolytinae) and longhorn beetles (Coleoptera: Cerambycidae) (Kolesnikov, Khaustov, OConner *et al*. 2022; Kolesnikov, Khaustov, Petrov *et al.* 2022; OConnor 2022)—feeding on eggs, as well as dead adults and larvae inside bark beetle galleries (Kiełczewski and Seniczak 1972; Seniczak 1977). Presumably, each species of *Winterschmidtia* is specific to a particular species of bark beetles (Khaustov 2000; Kolesnikov, Khaustov, OConner *et al*. 2022; Kolesnikov, Khaustov, Petrov *et al.* 2022;). According to Oconnor (2022) and Kolesnikov Khaustov, OConner *et al*. (2022), the associations between two species—*Winterschmidtia glossinarum* (Fain and Elsen, 1971) and *W. tsetse* (Fain and Elsen, 1972)—described from a few specimens collected from the African Glossinidae (Diptera) (Fain 1971; Fain and Elsen 1972) are probably accidental. Two species—*W. lamtoensis* (Fain, 1974) and *W. elongate* Türk and Türk, 1957—were collected from soil and decaying wood, respectively (Türk and Türk 1957; Fain 1974); no data on phoretic hosts were provided (Kolesnikov, Khaustov, OConner *et al*. 2022; Kolesnikov, Khaustov, Petrov *et al.* 2022; Oconnor 2022). *Winterschmidtia* was first established based on adult morphology. However, most species were described based on phoretic deutonymphs (16 species). Females of only two species—*W. crassisetosa* Willmann, 1939 and *W. elongate*—are known (Kolesnikov, Khaustov, Petrov *et al.* 2022; Oconnor 2022). The taxonomy of the genus is based primarily on the phoretic deutonymphs' morphology (Khaustov 2000; Kolesnikov, Khaustov, Petrov *et al.* 2022). Kolesnikov, Khaustov, Petrov *et al.* (2022) provided an illustrated key to the known species of *Winterschmidtia*, based on phoretic deutonymphs.

Initially, *Winterschmidtia* species have been recorded from Europe, Asia and Africa; however, three species from Peru were later described (Kolesnikov, Khaustov, Petrov *et al.* 2022). During our research of mites phoretic on bark beetles in Peru, we found deutonymphs of the fourth, new species of *Winterschmidtia*, phoretic on *Xyleborus ferrugineus* (Fabricius, 1801). The species is described herein. This is the first record of phoresy of *Winterschmidtia* on *Xyleborus* Eichhoff, 1864.

## MATERIALS AND METHODS

Host bark beetles were collected with the help of window traps in the Peruvian Yunga (a foothill forest) and preserved in 95% ethanol. The external surfaces and subelytral cavities of beetles were examined for phoretic mites. Mites were mounted in lactic acid on temporary cavity slides for measurements and illustrations. In the descriptions and in the key, the idiosomal chaetotaxy follows Griffiths *et al.* (1990), the terminology of coxisternal setae follows Norton (1998) and the leg chaeto- and solenidiotaxy follow Grandjean (1939) and Griffiths (1970). All measurements are given in micrometers (μm).

The types are deposited in the Zoological Institute of the Russian Academy of Sciences, St. Petersburg, Russia (ZISP) as slide-mounted mites in Hoyer's medium.

Photomicrographs were taken with an Euromex Color HD-Ultra (5MPs) digital camera attached to a Bioptic C-400 compound microscope equipped with DIC optics. The images were taken from multiple focal planes and assembled in the Helicon Focus 7.6.4 Pro (algorithms A and mostly B), with subsequent manual editing (retouching) to add the fine details that were missing from the individual focal planes. Parts of the layered images were combined in Adobe Photoshop 22.2.0.

## RESULTS

### Family **Winterschmidtiidae**

Genus ***Winterschmidtia* Oudemans, 1923**
Type species: *Suidasia* (?) *hamadryas* Vitzthum, 1923

***Winterschmidtia tawantinsuyuca* sp. n.**
(Figs. 1–3)

**Type material.** Holotype and two paratypes (phoretic deutonymphs)—PERU: Junín region, 15 km NW of Satipo, h ~1,300 m a.s.l., near the Rio Venado Village, ex *Xyleborus ferrugineus*, 11°11′35.2″S 74°46′07.0″W, 24–26 Sept. 2017, A. Sokolov leg.

**Description of phoretic deutonymphs.** Body ovoid, widest at sejugal region. Idiosoma 1.6 times longer than wide.

Gnathosoma (Figs. 1B, 2E) 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; supracoxal setae *elcp* absent; light spot in area of setae *h* present; 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 longitudinal linear pattern. Prodorsal shield with wavy lines (with bridges, transverse septa are mostly absent (some are incomplete)) converging in medial axis, forming elongated cells of different lengths and open posteriorly; distance between all lines on prodorsal shield wide (4–6), approximately equal to length of setae *si*. Sculpture on hysterosomal shield formed by longitudinal lines with few oblong cells, often open; sculpture in center same as in other hysterosomal areas. Ocelli present at distal end of prodorsal shield; pigmented spots present, adjacent to each other. Setae *vi* slightly 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* two 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 $h_3$ slightly longer than $e_2$, $f_2$ and $h_2$, $c_p$ situated ventrally; $c_1$ anteriad $d_1$. Distances $d_1$–$c_1$ 15, $d_1$–$e_1$ 30, $c_1$–$c_2$ 24, ratio $d_1$–$e_1$/$d_1$–$c_1$ 2, ratio $c_1$–$c_2$/$d_1$–$c_1$ 1.6. 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). Coxisternal fields weakly sclerotized, finely punctate, without any well-developed pattern. Anterior apodemes of coxisternal fields I fused, forming sternum. Anterior apodemes of coxisternal fields II curved medially. Posterior apodemes of coxisternal 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. Coxisternal fields II open, with anterior apodemes separate; posterior apodemes connected to each other. Coxisternal fields III closed; anterior apodemes of coxisternal fields III fused with each other and form median sclerite; anterior apodemes of coxisternal fields IV fused to each other and connected to median sclerite of coxisternal 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 coxisternal fields IV. Coxal setae *4b* situated at junctions of anterior coxal apodemes IV and posterior median apodeme; genital setae laterad genital opening; *4a* distinctly anterolaterad *g*. Attachment organ posterior to coxisternal fields IV, medium size. Suckers $ad_3$ round, $ad_{1+2}$ slightly larger, consisting of large sclerotized margins and surrounding paired vesti-

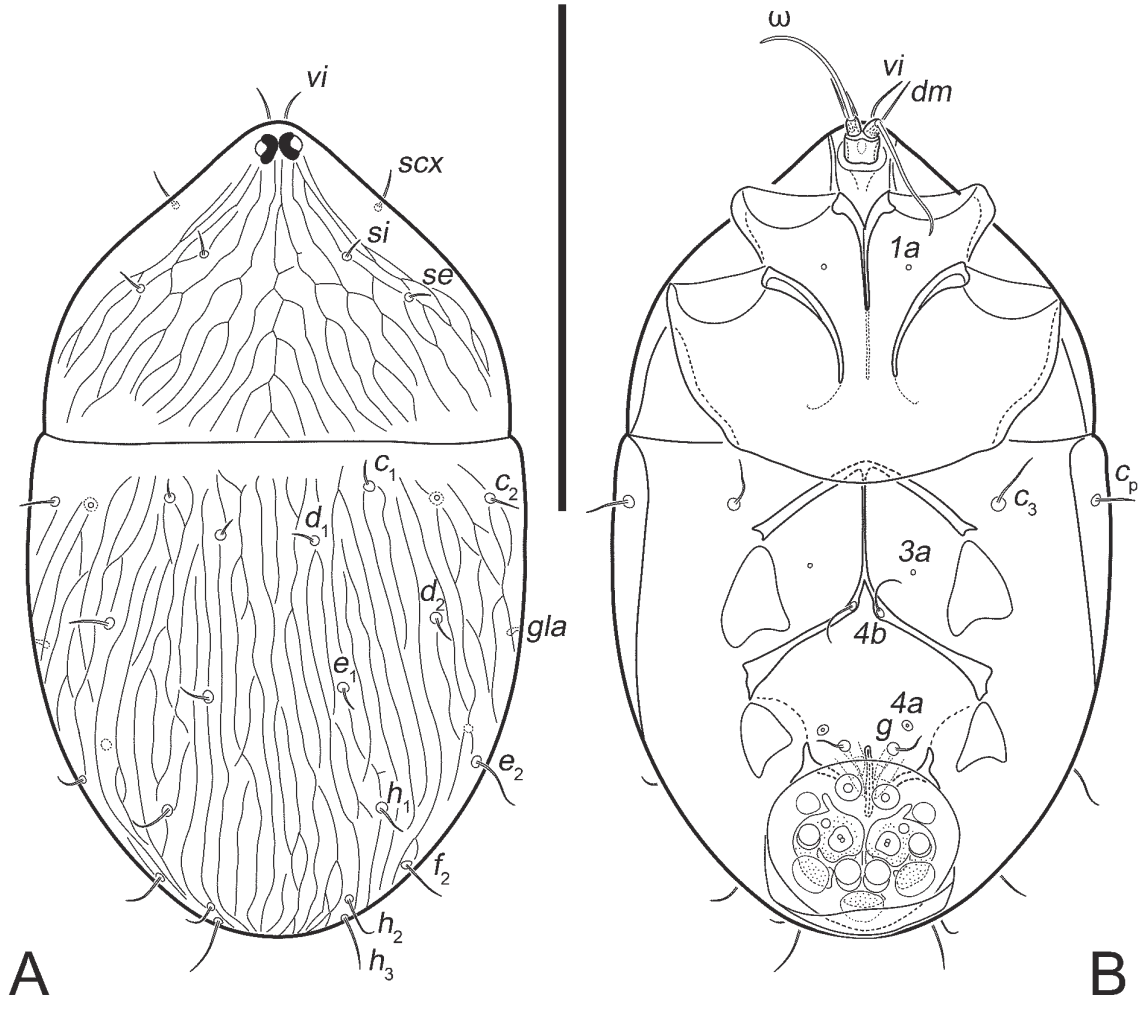


Fig. 1. *Winterschmidtia tawantinsuyuca* sp.n., phoretic deutonymph: A—dorsal view; B—ventral view. Scale bar—100 μm.

gial 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). 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, *wF* IV shorter than other setae on leg IV. 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. Tarsi I and II with two distinct foliate setae (*ra*, *la*) and one slightly foliate seta *f*; seta *d* long, filiform; seta *e* small, adjacent with *d*; seta *wa* filiform, with small tapered process; setae *p*, *q*, *aa* and *ba* absent. Tarsus III with seven foliate setae (*w*, *r*, *s*, *p*, *q*, *e*, *f*) and filiform seta *d* (shorter than 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* 2.1 times longer than *w*. Solenidia $\omega_1$ on tarsi I–II cylindrical, with extended apices, situated slightly posteriorly to middle of tarsus; $\omega_3$ on tarsus I longer than $\omega_1$, gradually tapering, situated slightly anteriad $\omega_1$, length of $\omega_1$ greater than distance between base of tarsus I and $\omega_1$; $\omega_2$ of tarsus I short, with rounded tip, situated somewhat more basal and posterior to $\omega_1$; φ of tibiae I–II long, tapering; φ of tibiae III elongate, tapering; φ IV slightly elongate, almost reaches base of *d*; σ of genu I elongated, slightly tapering, longer than $\omega_1$, reaches base of φ; σ of genu II shorter, cylindrical, not reaches base of φ; σ of genu

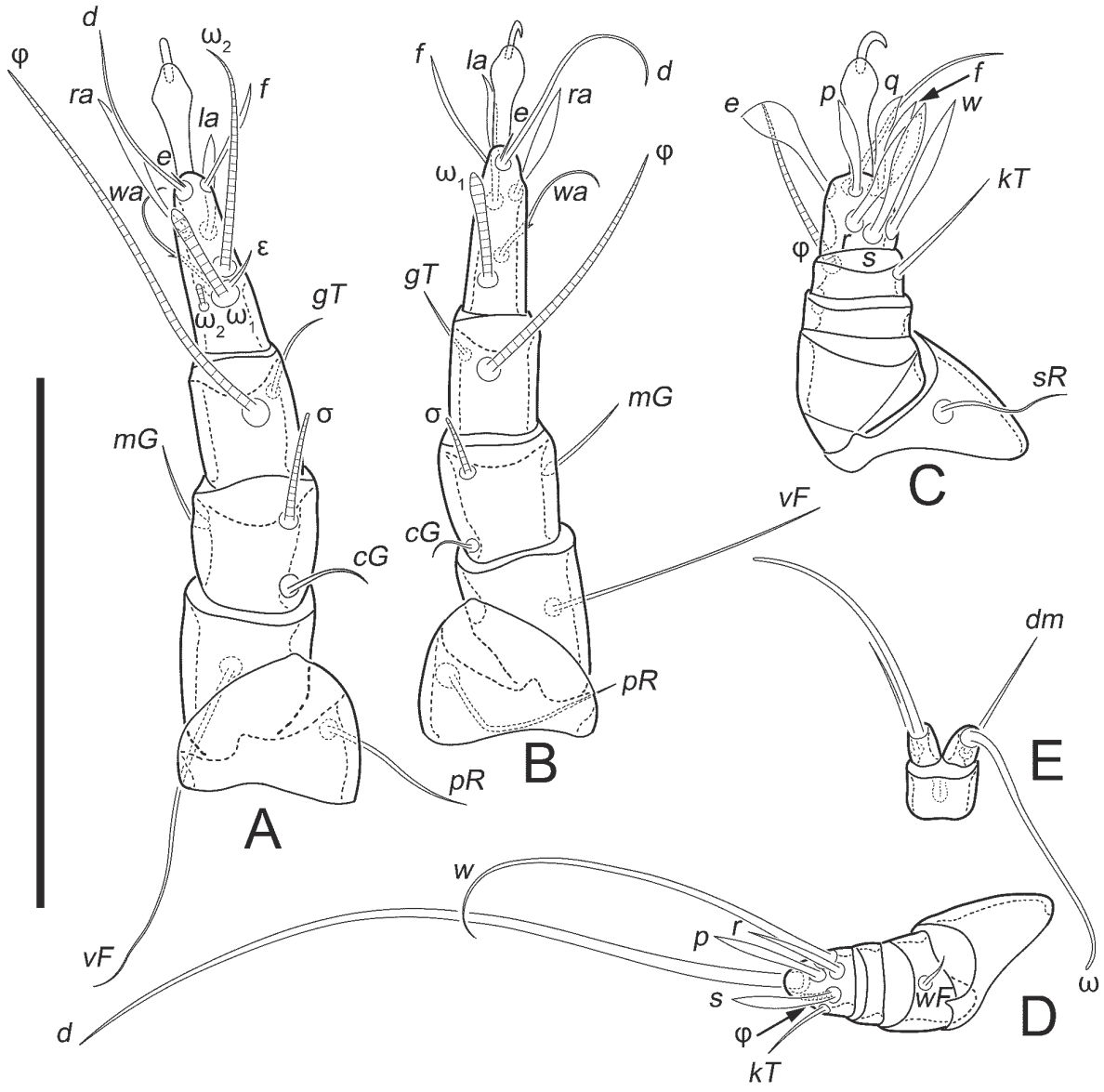


Fig. 2. *Winterschmidtia tawantinsuyuca* sp.n., phoretic deutonymph: A—left leg I, dorsal view; B—right leg II, ventral view; C—left leg III, ventral view; D—left leg IV, ventral view; E—gnathosoma, ventral view. Scale bar—50 μm.

III absent (represented by alveolus). Famulus ε of tarsus I elongated, longer than $\omega_2$, pointed, adjacent to solenidion $\omega_1$. Pretarsi I–III with membranous ambulacrum, with simple empodial claw, leg IV without pretarsus and claw.

Measurements (n=1). Idiosomal length 160, width 97. Prodorsum length 63, width 93. Hysterosoma length 97. Subcapitular remnant length 6, width 7, free palp length 3, gnathosomal solenidion ω 30, *dm* 11. Sternum 18, anterior apodeme II 26. Setae *vi* 8, *si* 5, *se* 5, *scx* 8, $c_1$ 5, $c_2$ 7, $c_3$ 11, $c_p$ 8, $d_1$ 5, $d_2$ 5, $e_1$ 5, $e_2$ 10, $f_2$ 10, $h_1$ 7, $h_2$ 10, $h_3$ 12, *4a* (max width) 3, *4b* 10, *g* 6. Length of attachment organ 34, width of attachment organ 38, $ad_3$ 5, $ad_{1+2}$ 9, $ps_2$ 5, $ps_1$ 5. Legs I: length 62, tarsus I 19, pretarsi I 14, $\omega_1$ I 10, $\omega_2$ I 2, $\omega_3$ I 21, famulus 4, *f* I 11, *d* I 20, *e* I 2, *ra* I 15, *la* I 10, *wa* I 15, *gT* I 9, φ I 40, *mG* I 9, *cG* I 9, σ I 11, *vF* I 35, *pR* I 16. Leg II: length 56, tarsus II 16, pretarsi II 12, $\omega_1$ II 11, *f* II 11, *d* II 20, *e* II 3, *ra* II 12, *la* II 12, *wa* II 14, *gT* II 7, φ II 27, *mG* II 9, *cG* II 6, σ II 6, *vF* II 28, *pR* II 20. Leg III: length 31, tarsus III 8, pretarsi III 14, *w* III 14, *r* III 12, *s* III 15, *p* III 8, *q* III 8, *e* III 10, *f* III 10, *d* III 20, φ III 16, *kT* III 14, *sR* III 14. Leg IV: length 26, tibiotarsus IV 7, *s* IV 10, *p* IV 10, *r* IV 9, *w* IV 38, *d* IV 70, *kT* IV 7, φ IV 4, *wF* IV 4.

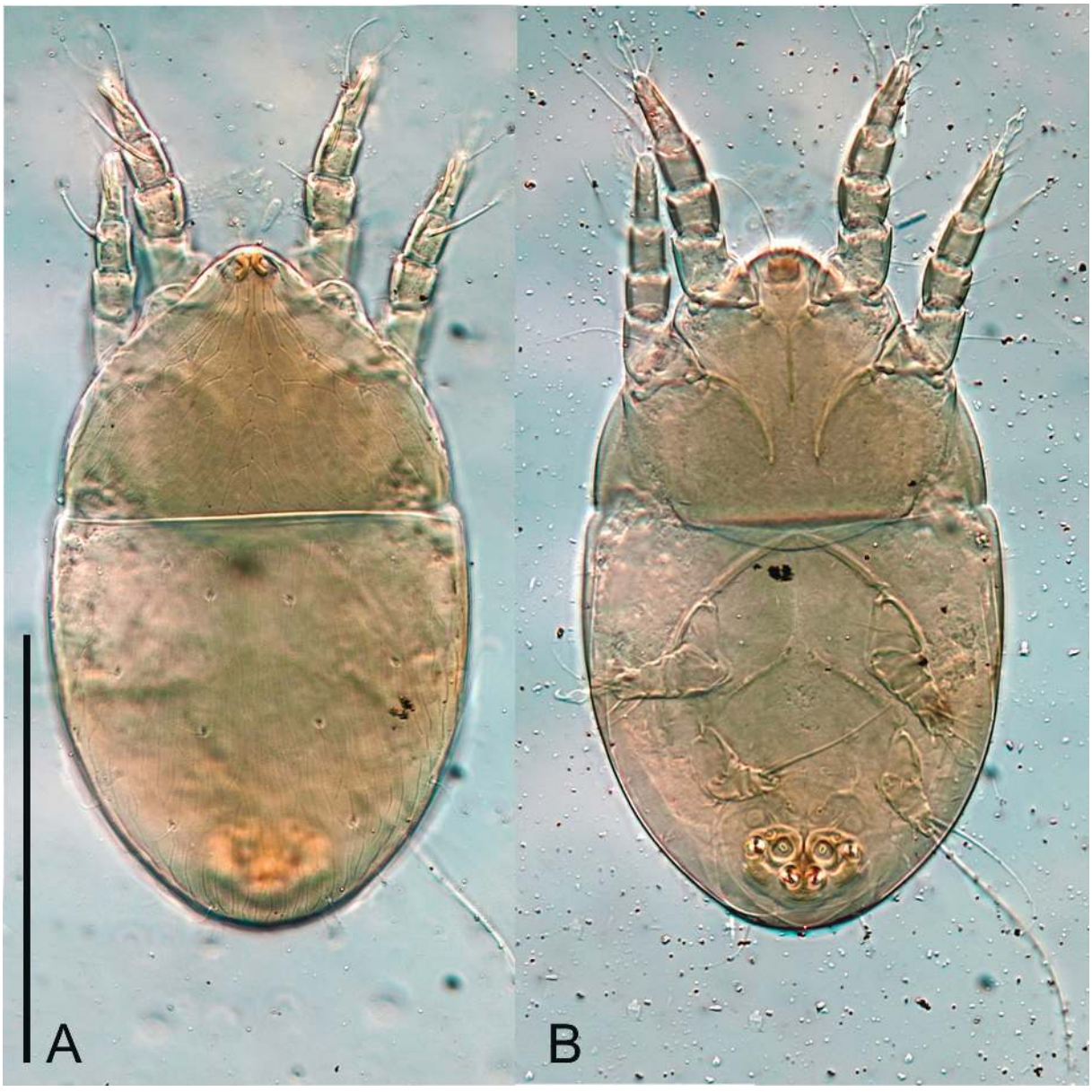


Fig. 3. *Winterschmidtia tawantinsuyuca* sp.n., phoretic deutonymph, DIC photomicrographs: A—dorsal view; B—ventral view. Scale bar—100 μm.

*Adults and other stages*. Unknown.

**Differential diagnosis.** The phoretic deutonymph of *Winterschmidtia tawantinsuyuca* sp.n. differs from that of all other species in the character of the linear pattern on the prodorsal shield: wavy lines, with bridges, transverse septa mostly absent (some incomplete), converging in medial axis, forming elongated cells of different lengths open posteriorly, distances between all lines on the prodorsal shield wide, approximately equal to the length of setae *si*. *Winterschmidtia parallela* Kolesnikov, Khaustov, Petrov and Klimov, 2022 has similar wavy lines (with bridges), but these lines are parallel (not converging in medial axis). *Winterschmidtia elliptica* (Zachvatkin, 1941) has wavy lines, forming elongated cells, but the bridges are absent and the lines do not converge in medial axis. *Winterschmidtia circumspectans* (Vitzthum, 1920) and *W. villifronsi* Khaustov, 2000 have widely spaced lines on the medial part of the prodorsal shield, but these lines are smooth (*W. circumspectans*) or, if wavy, then without bridges and forming polygonal cells (closed or unclosed), the width of which is noticeably greater than between the lateral lines (*W. villifronsi*). In both *W. circumspectans* and *W. villifronsi* the lines do not converge

in medial axis. *Winterschmidtia alekhini* Kolesnikov, Khaustov, Petrov and Klimov, 2022, *W. reducta* Kolesnikov, Khaustov, Petrov and Klimov, 2022 and *W. tsetse* (Fain and Elsen, 1971) have reticulated linear patterns on the prodorsal shields. In all other species with smooth or wavy lines (without bridges), these lines do not converge in medial axis, forming various cells, with the distance between all lines on the prodorsal shield noticeably shorter than the length of setae *si*. In addition, *W. tawantinsuyuca* sp.n. differs from other Peruvian species in the following characteristics: solenidion $\omega_2$ well developed (vs. vestigial in *W. reducta*); solenidion σ I reaches the base of φ (vs. not reaching the base of φ in *W. alekhini*); solenidion φ IV almost reaches the base of *d* IV (vs. φ IV noticeably not reaching the base of *d* in *W. alekhini* and *W. parallela*); medial part of hysterosomal shield without or with rare cells (vs. medial part with numerous cells in *W. alekhini* and *W. reducta*); seta *w* IV twice as long as *d* IV (vs. seta *w* more than twice as long as *d* in *W. reducta* or seta *w* less than twice as long as *d* in *W. parallela*).

**Etymology.** The name of the new species is derived from *Tawantinsuyu*—Quechua for the "Realm of the Four Parts"—the self-name of the Inca civilization, the largest empire in pre-Columbian America, with an administrative, political, and military center in modern-day Peru.

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