

## TAXONOMIC CONTRIBUTION TO THE KNOWLEDGE OF THE ORIBATID MITE GENUS *PROTORIBATES* (ACARI, ORIBATIDA, HAPLOZETIDAE)

Luis S. Subías<sup>1</sup>, Sergey G. Ermilov<sup>2\*</sup>, Umukusum Ya. Shtanchaeva<sup>1</sup> and Stefan Friedrich<sup>3</sup>

<sup>1</sup>Complutense University, Madrid, Spain

<sup>2</sup>X-BIO Institute, Tyumen State University, Tyumen, Russia

<sup>3</sup>SNSB-Bavarian State Collection of Zoology, Munich, Germany

\*corresponding author; e-mail: ermilovacari@yandex.ru

**ABSTRACT:** A new oribatid mite subgenus, *Protoribates* (*Perubates*) subgen. n. (Oribatida, Haplozetidae), with type species *Protoribates* (*Perubates*) *davidi* sp. n., is proposed from the primary evergreen lowland rainforest of Amazonian Peru. It differs from the nominate genus in the presence of lamellar cusps and extra porose areas on the notogaster. A new generic diagnosis of *Protoribates* is provided.

**KEY WORDS:** Haplozetid mites, systematics, generic diagnosis, new genus and species, morphology, Peru.

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### INTRODUCTION

*Protoribates* (Acari, Oribatida, Haplozetidae) was proposed by Berlese (1908) with *Oribata dentata* Berlese, 1883 as type species. At present, the genus comprises more than 90 species, which collectively have a cosmopolitan distribution, except for the Antarctic region (Subías 2004, updated 2021). Identification keys for some of them were presented by Balogh and Balogh (2002), Weigmann (2006), Bayartogtokh (2010), Walter and Latonas (2013), Corpuz-Raros (2014), Ermilov and Starý (2017). The history and problems of taxonomic study of *Protoribates* are summarized by Bayartogtokh and Shimano (2020).

During the taxonomic identification of a random set of Peruvian oribatid mites (Acari, Oribatida) received from the collections of the SNSB-Bavarian State Collection of Zoology (Munich, Germany), we found a new species belonging to the new subgenus of the genus *Protoribates* Berlese, 1908. The main goal of this paper is to propose *Protoribates* (*Perubates*) subgen. n., with *Protoribates* (*Perubates*) *davidi* sp. n. as type species. Additionally, we present a new revised generic diagnosis of *Protoribates*.

### MATERIALS AND METHODS

**Specimens.** Soil and litter samples were collected by hand from South America, Amazonian Peru, 09°37'S, 74°56'W, Huánuco Department, Puerto Inca Province, Yuyapichis District, Área de Conservación Privada, Panguana (biological field station), near the Yuyapichis River, 230–260 m a. s. l., upper soil and leaf litter in the primary evergreen lowland rainforest, April 23, 2016–May 9, 2016 (S. Friedrich, F. Wachtel and D. Hauth). Mites

were extracted using Winkler's apparatus in laboratory conditions into 75% ethanol over the course of a 10-day period.

**Observation and documentation.** Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the gastronotum. Notogastral width refers to the maximum width of the notogaster (behind pteromorphs) in dorsal view. Lengths of body setae were measured in lateral aspect. All body measurements are presented in micrometers (µm). Formulas for leg setation are given in parentheses according to the sequence trochanter–femur–genu–tibia–tarsus (femulus included). Formulas for leg solenidia are given in square brackets according to the sequence genu–tibia–tarsus. Drawings were made with a camera lucida using a Leica transmission light microscope “Leica DM 2500”.

**Terminology.** General morphological terminology used in this paper mostly follows that of F. Grandjean: see Travé and Vachon (1975) for references, Norton (1977) for leg setal nomenclature, and Norton and Behan-Pelletier (2009) for overview.

**Abbreviations.** *Prodorsum*: *pr*—prodorsal ridge; *lam*—lamella; *slam*—sublamella; *Al*—sublamellar porose area; *ro*, *le*, *in*, *bs*, *ex*—rostral, lamellar, interlamellar, bothridial, and exobothridial seta, respectively; *tu*—tutorium; *Ad*—dorsosejugal porose area; *D*—dorsophragma; *P*—pleurophragma. *Notogaster*: *Aa*, *A1–A5*—porose areas; *c*, *la*, *lm*, *lp*, *h*, *p*—setae; *ia*, *im*, *ip*, *ih*, *ips*—lyriforms; *gla*—opisthontal gland opening. *Gnathosoma*: *a*, *m*, *h*—subcapitular setae; *or*—adoral seta;

*d, l, sup, inf, cm, ul, sul, vt, lt*—palp setae;  $\omega$ —palp solenidion; *cha, chb*—cheliceral setae; *Tg*—Trägårdh's organ. *Epimeral and lateral podosomal regions*: *1a–c, 2a, 3a–c, 4a–c*—epimeral setae; *PdI, PdII*—pedotectum I, II, respectively; *dis*—discidium; *cpc*—circumpedal carina. *Anogenital region*: *g, ag, an, ad*—genital, aggenital, anal, and adanal setae, respectively; *iad*—adanal lyrifissure; *Amar*—marginal porose area; *po*—pre-anal organ. *Legs*: *Tr, Fe, Ge, Ti, Ta*—leg trochanter, femur, genu, tibia, tarsus, respectively; *pa*—porose area;  $\omega, \varphi, \sigma$ —leg solenidia; *e*—leg famulus; *d, l, v, bv, ev, ft, tc, it, p, u, a, s, pv, pl*—leg setae.

### SYSTEMATICS

Family Haplozetidae

Genus *Protoribates* Berlese, 1908

**Generic diagnosis.** *Adult.* Distinct sexual dimorphism absent. *Body size*: length about 400–1,100. *Integument*: Body surface microgranulate, foveolate, lineolate or without heavy sculpturing and ornamentation. *Prodorsum*: Rostrum rounded or truncate. Lamella long, narrow, without or with distal cusp. Translamella absent. Prolamella absent and present. Sublamella linear. Sublamellar porose area present. Tutorium ridge-like. Rostral, lamellar, interlamellar and exobothridial setae short, medium-sized or long, setiform or thickened; *ro* inserted dorsolaterally or laterally on the rostrum, *le* on end of lamella or between lamellar ends, *in* in interbothridial region. Bothridial seta well developed, setiform, clavate, fusiform, lanceolate or with unilaterally dilated head. Bothridium cup-shaped, often with lateral scale. Dorsosejugal porose area present or absent. Dorsophragma semi-oval or elongate longitudinally. *Notogaster*: Anterior margin of notogaster straight or convex medially. Pteromorph subtriangular, usually movable, large, curved ventrad. Octotaxic system with four\* (excluding double areas\*\*) or six pairs of widely spaced porose areas\*\*\*. Ten pairs of short or medium-sized, setiform notogastral setae. *Gnathosoma*. Subcapitulum diarthric. Palp with setation: 0–2–1–3–9(+ $\omega$ ); solenidion of palptarsus connected to eupathidium. Axillary sac-

cule absent. Trägårdh's organ of chelicera tapered. *Lateral podosomal and epimeral regions*: Pedotecta I and II represented by small lamina. Genal tooth absent. Custodium absent or present. Discidium and circumpedal carina present. Humeral porose areas *Am*, and *Al* absent, *Ah* absent or present. Epimeral setal formula: 3–1–3–3(2). *Anogenital region*: Four, five or six pairs of genital, one pair of aggenital, two pairs of anal and three pairs of adanal setae. Adanal lyrifissure located close and lateral to anal plate. Marginal porose area often present. *Legs*: Mono-, heterobi- or heterotridactylous. Tarsi I–IV, tibiae I–IV, femora I–IV, and trochanters III, IV with porose area.

Subgenus *Protoribates* (*Protoribates*) Berlese, 1908

Type species: *Oribata dentata* Berlese, 1883

**Subgeneric diagnosis.** Lamellar cusp absent. Notogaster with four pairs of widely spaced porose areas (excluding closely spaced double areas).

Subgenus *Protoribates* (*Perubates*) subgen.n.

Type species: *Protoribates* (*Perubates*) *davidi* sp.n.

**Subgeneric diagnosis.** Lamellar cusp present. Notogaster with six pairs of widely spaced porose areas.

**Etymology.** The name *Perubates* refers to the country of origin followed by 'bates'—a common suffix for generic names in Oripodoidea.

***Protoribates* (*Perubates*) *davidi* sp.n.**

Figs. 1–11

**Diagnosis.** As for subgenus. Body size: 713–780 × 464–531. Lamella about 2/3 the length of prodorsum; truncate cusp distinct. Rostral, lamellar and interlamellar setae setiform, barbed; *ro* shortest, *in* longest. Bothridial seta long, setiform, ciliate bilaterally. Notogastral setae short, setiform, thin, with attenuate tip, smooth. Six pairs of small, rounded porose areas. Epimeral and anogenital setae setiform, barbed.

**Description of adult.** *Measurements.* Body length: 713 (holotype, female), 713–780 (five paratypes, two males and three females); body width: 464 (holotype), 464–531 (five paratypes). No difference between males and females in body size.

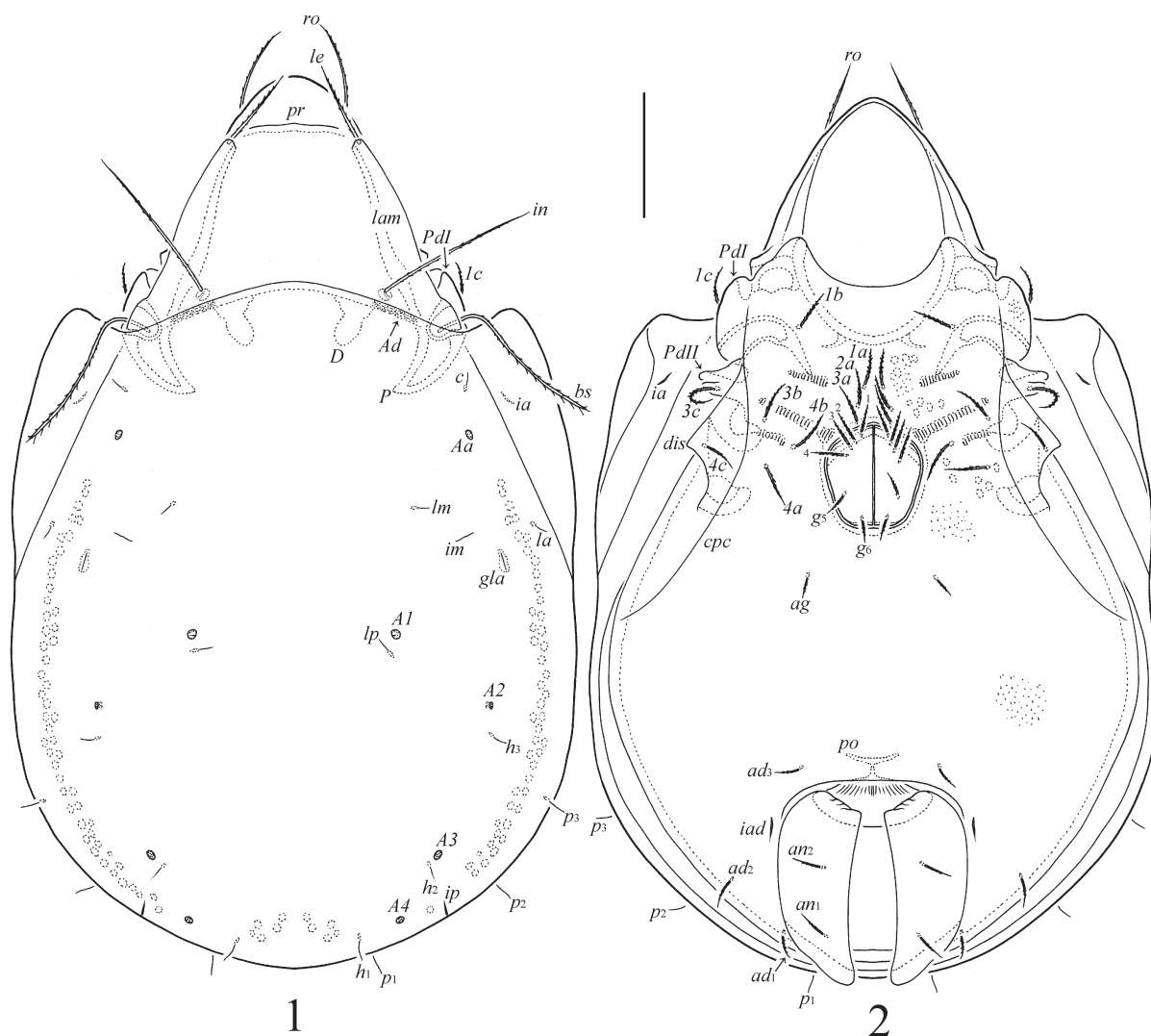
*Integument.* Body dark brown. Surface of body and all legs microgranulate (visible under high magnification, ×1,000).

*Prodorsum.* Rostrum rounded. Lamella about 2/3 the length of prodorsum. Lamellar cusp short, truncate. Sublamella very short. Sublamellar po-

\*Rarely, there are three pairs of notogastral porose areas, if posterior areas (A3) absent.

\*\**Protoribates magnus* (Aoki, 1982) with five pairs of porose areas due to double closely spaced A1.

\*\*\*Intraspecific variation of the octotaxic system (porose areas or sacculi in different specimens) was found in *Protoribates paracapucinus* (Mahunka, 1988) (see Weigmann and Ermilov 2016).



Figs. 1–2. *Protoribates (Perubates) davidi* sp. n., adult: 1—dorsal view; 2—ventral view (gnathosoma and legs omitted). Scale bar=100  $\mu$ m.

rose area oval (20–32  $\times$  12–24), located ventral to sublamella. Tutorium about 1/2 the length of lamella. Slight transverse ridge present before lamellar cusps; region between rostrum and this ridge slightly depressed. Rostral (61–69), lamellar (90–94) and interlamellar (143–151) setae setiform, barbed. Bothridial seta (143–151) setiform, ciliate bilaterally. Exobothridial seta (49–53) setiform, slightly barbed. Dorsesejugal porose area diffuse.

*Notogaster.* Notogastral setae (12–16) setiform, thin, with attenuate tip, smooth. Six pairs of small, rounded porose areas present; *Aa* (8–16) usually larger than others (4–8).

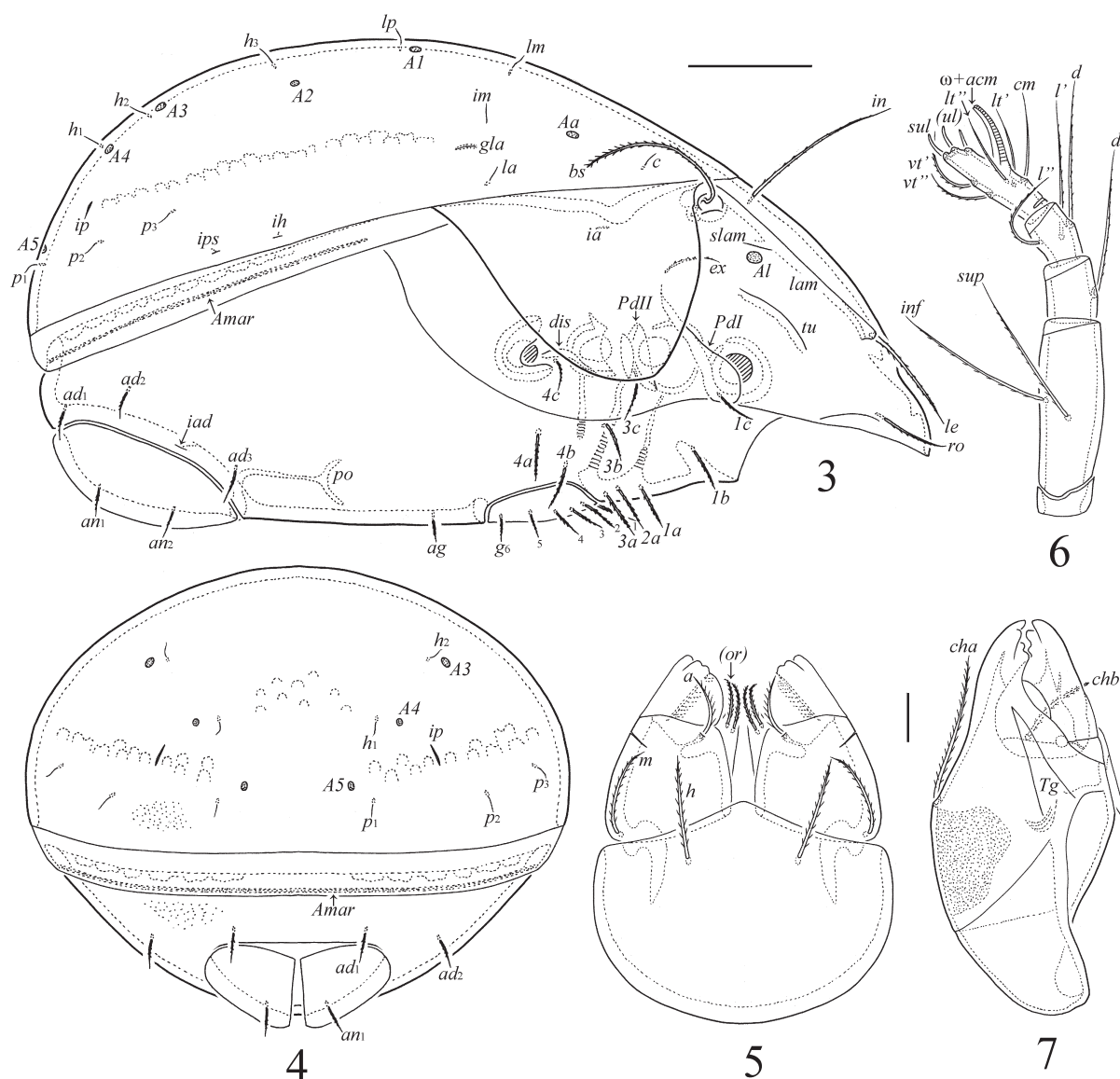
*Gnathosoma.* Subcapitulum size: 159–164  $\times$  114–123. Subcapitular (*a*, 28–32; *m*, *h*, 41–45) and adoral (20–24) setae setiform, barbed. Palp (114–123) with typical setal formula. Postpalpal seta (8)

spiniform, roughened. Chelicera (168–176) with two setiform, barbed setae (*cha*, 61–69; *chb*, 32–36).

*Epimeral and lateral podosomal regions.* Epimeral setae (3*c*, 49–53; others 41–45) setiform, barbed; 4*c* thinnest. Circumpedial carina long, directed to pedotectum I. Discidium triangular.

*Anogenital region.* Genital (*g*<sub>1</sub>–*g*<sub>4</sub>, 28–32; *g*<sub>5</sub>, *g*<sub>6</sub>, 20–24), aggenital (20–24), anal (24–28), and adanal (24–28) setae setiform, barbed. Adanal lyrifissure distinct. Marginal porose area complete, band-like. Preanal organ goblet-like.

*Legs.* Tridactylous, all claws slightly barbed on dorsal side. Lateral claws slightly swollen distally, thinner than median claw. Tibiae I and II with tubercle proximoventrally. Femur II with broadly rounded ledge distoventrally. Dorsoparaxial porose area on femora I–IV and on trochanters III, IV; proximoventral porose area on tarsi I–IV; and dis-



Figs. 3–7. *Protoribat (Perubates) davidi* sp. n., adult: 3—lateral view (gnathosoma and legs omitted); 4—posterior view; 5—subcapitulum, ventral view; 6—palp, left, antiaxial view; 7—chelicera, left, paraxial view. Scale bars=100  $\mu$ m (3, 4), 20  $\mu$ m (5–7).

toventral porose area on tibiae I–IV well visible. Formulas of leg setation and solenidia: I (1–5–3–4–20) [1–2–2], II (1–5–3–4–16) [1–1–2], III (2–3–1–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]; homology of setae and solenidia indicated in Table 1. Famulus of tarsus I short, erect, slightly swollen distally, inserted between solenidion  $\omega_2$  and seta *ft''*. Solenidion  $\omega_1$  on tarsi I,  $\omega_1$  and  $\omega_2$  on tarsus II and  $\sigma$  on genu III bacilliform; other solenidia setiform. Seta *l''* on genu I inserted on tubercle. Seta *s* on tarsus I eupathidial, inserted before setae *a'* and *a''*.

**Type deposition.** The holotype is deposited in the collection of the Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru (MUSM); four paratypes are deposited in the

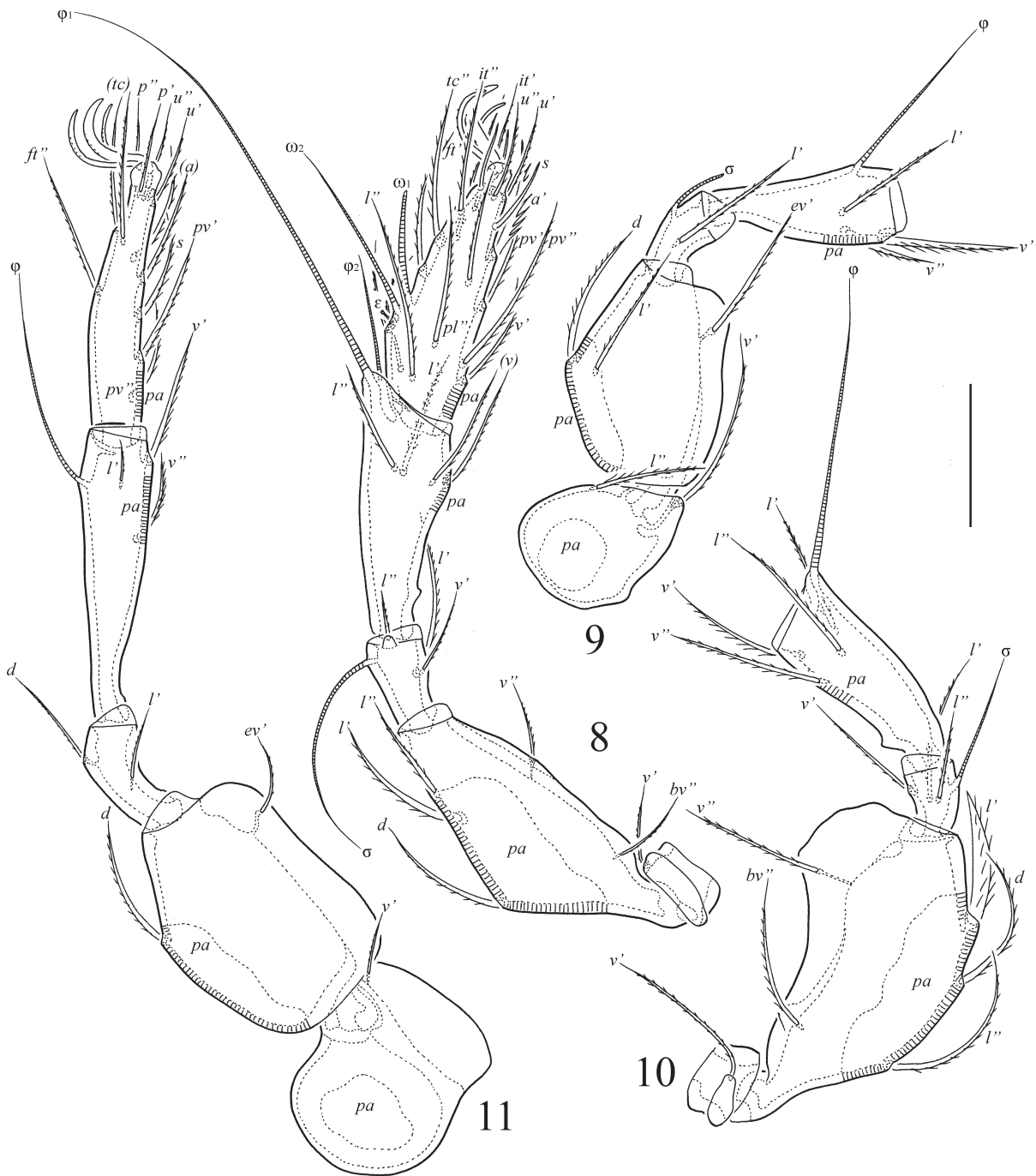
collection of the Tyumen State University Museum of Zoology, Tyumen, Russia; one paratype is deposited in the collection of the SNSB-Bavarian State Collection of Zoology, Munich, Germany. All specimens are preserved in 70% solution of ethanol with a drop of glycerol.

**Etymology.** The specific name *davidi* honors our friend and colleague, coleopterologist David Hauth (Fürstenfeldbruck and Marburg, Germany) for his companionship, expertise and help in collecting oribatid mites at the Panguana field station.

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Figs. 8–11. *Protoribates (Perubates) davidi* sp.n., adult: 8—leg I, right, anti-axial view; 9—leg II (tarsus omitted), left, anti-axial view; 10—leg III (tarsus omitted), left, anti-axial view; 11—leg IV, left, anti-axial view. Scale bar=50  $\mu$ m.

to Panguana; Franz Wachtel (Grünwald, Germany) for his expertise and assistance in the field; Dr. Gerardo Lamas Müller and Dr. Diana Silva Dávila (both of Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru) for cooperation; and the Servicio Nacional Forestal y de Fauna Silvestre (SERFOR) for issuing the collection and export permits (# 007-2014-SERFOR-DGGSPFFS and # 003052-SERFOR, respectively).

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Table 1

Leg setation and solenidia of *Protoribates* (*Perubates*) *davidi* sp.n.

Leg	<i>Tr</i>	<i>Fe</i>	<i>Ge</i>	<i>Ti</i>	<i>Ta</i>
I	v'	d, (l), bv'', v''	(l), v', σ	(l), (v), φ <sub>1</sub> , φ <sub>2</sub>	(ft), (tc), (it), (p), (u), (a), s, (pv), v', (pl), l'', ε, ω <sub>1</sub> , ω <sub>2</sub>
II	v'	d, (l), bv'', v''	(l), v', σ	(l), (v), φ	(ft), (tc), (it), (p), (u), (a), s, (pv), l'', ω <sub>1</sub> , ω <sub>2</sub>
III	v', l'	d, l', ev'	l', σ	l', (v), φ	(ft), (tc), (it), (p), (u), (a), s, (pv)
IV	v'	d, ev'	d, l'	l', (v), φ	ft'', (tc), (p), (u), (a), s, (pv)

Note: Roman letters refer to normal setae, Greek letters—to solenidia (except ε—famulus). Single quotation (') designates setae on the anterior and double quotation (')—setae on the posterior sides of a given leg segment. Parentheses refer to a pair of setae.