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A NEW SPECIES OF *CERATOBATES* (ACARI, ORIBATIDA) FROM PERU AND A KEY TO KNOWN SPECIES OF THE GENUS

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The genus *Ceratobates* (Oribatida, Tegoribatidae) is recorded in Peruvian fauna for the first time. *Ceratobates pachiteaensis* sp. n., a new species, is described based on materials collected from soil and leaf litter in the Andean mountain forests. The main generic traits are summarized, and an identification key to known species of *Ceratobates* is provided.

Key words: oribatid mites, taxonomy, morphology, Peruvian fauna, Neotropical region.

INTRODUCTION

The genus *Ceratobates* (Acari, Oribatida) was proposed by Balogh and Mahunka (1969) with *Ceratobates pontiger* Balogh et Mahunka, 1969 as type species. At present, the systematic position of *Ceratobates* is problematic – there is no clear evidence in favour of placing the genus in a certain family; as earlier noted (Ermilov *et al*. 2017), it was included by different authors in Ceratozetidae, Chamobatidae, Oribatellidae, Austrachipteriidae, and Tegoribatidae. We support the placement of *Ceratobates* in Tegoribatidae (see explanation in Ermilov *et al*. 2017).

Currently, *Ceratobates* comprises five species (Balogh & Mahunka 1969, 1981, Pérez-Íñigo & Baggio 1985, Ermilov & Anichkin 2015, Ermilov *et al*. 2017), which are distributed in the Neotropical region (three species: *C. fornerisae* Pérez-Íñigo et Baggio, 1985, *C. pontiger* Balogh et Mahunka, 1969, *C. spathulatus* Balogh et Mahunka, 1981), South Africa (one species: *C. monosacculatus* Ermilov, Hugo-Coetzee et Khaustov, 2017) and Vietnam (one species: *C. cangioensis* Ermilov et Anichkin, 2015).

The main objectives of this paper are to describe and illustrate a new species of *Ceratobates* collected from the Peruvian Andes, summarize the generic traits, and present an identification key to the known species of *Ceratobates*.

METHODS

Observation and documentation. For measurement and illustration, specimens were mounted in lactic acid on temporary cavity slides. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the notogaster. Body width refers to the maximum width of the notogaster in dorsal view (behind pteromorphs). Lengths of body setae were measured in lateral aspect. All body measurements are presented in micrometers. Formulas for leg setation are given in parentheses according to the sequence trochanter-femur-genu-tibia-tarsus (famulus 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. Morphological terminology used in this paper 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*: *ro*, *le*, *in*, *bs* = rostral, lamellar, interlamellar, and bothridial seta, respectively; *tu* = tutorium; *gt* = genal tooth; *D* = dorsophragma; *P* = pleurophragma. *Notogaster*: *c*, *la*, *lm*, *lp*, *h*, *p* = setae; *Sa*, *S1-S3* = sacculi; *ia*, *im*, *ih*, *ips* = lyrifissures; *gla* = opisthonotal gland opening. *Gnathosoma*: *a*, *m*, *h* = subcapitular setae; *or* = adoral seta; *d*, *l*, *sup*, *inf*, *cm*, *ul*, *su*, *vt*, *lt* = palp setae; ω = palp solenidion; *cha*, *chb* = cheliceral setae; *Tg* = Trägårdh's organ. *Epimeral and lateral podosomal regions*: *1a–1c*, *2a*, *3a*, *3b*, *4a–4c* = epimeral setae; *Am* = humeral porose area; *cus* = custodium; *dis* = discidium; *cir* = circumpedal carina. *Anogenital region*: *g*, *ag*, *an*, *ad* = genital, aggenital, anal, and adanal seta, respectively; *iad* = adanal lyrifissure; *p.o.* = preanal organ; *Ap* = postanal porose area. *Legs*: *Tr*, *Fe*, *Ge*, *Ti*, *Ta* = trochanter, femur, genu, tibia, and tarsus, respectively; *p.a.* = porose area; ω, φ, σ = solenidia; ε = famulus; *d*, *l*, *v*, *bv*, *ev*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv*, *pl* = setae.

TAXONOMY

Family Tegoribatidae
Genus *Ceratobates* Balogh et Mahunka, 1969
Type species: *Ceratobates pontiger* Balogh et Mahunka, 1969

Main generic traits – Body small (length: 260–350); integument without heavy sculpturing and ornamentation; rostrum bi- or tridentate; lamella comparatively short, (shorter than length of prodorsum in lateral aspect), with small cusp having outer tooth (inner tooth absent or present); translamella absent; tutorial tip and genal tooth elongate triangular; rostral, lamellar and interlamellar setae setiform; bothridial seta clavate; bothridium with scales; dorsophragmata removed from each other; anterior margin of notogaster well developed; pteromorph immovable; lenticulus absent; posterior notogastral tectum present; posterior notogastral margin divided and overlapping medially or complete; nine (if p_3 absent) or ten pairs of notogastral setae setiform; octotaxic system as one or several (up to four pairs) sacculi; subcapitulum diarthric; axillary saccule absent or present; palp setation 0-2-1-3-9(+**ω**), with solenidion bacilliform, attached to eupathidium mediodistally; pedotectum I as

a large lamina; custodium short; discidium triangular; circumpedal carina present; porose areas *Ad*, *Am* and *Al* absent, *Ah* present; epimeral setal formula: 3-1-2-2[3]; seta *1c* often thickened; six pairs of genital, one pair of aggenital, two pairs of anal and two pairs of adanal setae; postanal porose area absent or present; all legs mono- or heterotridactylous; porose area present on femora I–IV and trochanters III, IV; leg genua I, II with ventral tooth; leg tarsus with or without seta *ft"*.

Ceratobates pachiteaensis sp. n.
(Figs 1, 2)

Diagnosis. Body length: 365–381. Rostrum bidentate. Lamellar cusp with long lateral tooth. Rostral seta setiform, barbed; lamellar and interlamellar setae thick, barbed; *ro* shortest, *in* longest. Bothridial seta long, clavate, slightly barbed; head elongate oval. All notogastral setae setiform, slightly barbed. Epimeres III, IV with two and three pairs of setae, respectively; *1c* of medium length, thickened, barbed; other setae and anogenital setae short, setiform, slightly barbed. Leg tarsi with one (in typical case) or three claws.

Description of adult. *Measurements*. Body length: 381 (holotype, female), 365–381 (four paratypes, two males and two females); notogaster width: 265 (holotype), 249–265 (four paratypes). No difference between males and females in size (in studied population).

Integument. Natural body color brown. Surface of body microsculpturing microgranulate; epimeral region, genital plate and subcapitular mentum hardly striate; antiaxial side of leg femora I-IV and trochanters III, IV with rounded end elongate tubercles. Podosomal part of body partially with granulate cerotegument.

Prodorsum. Rostrum bidentate, with two strong teeth and semi-rectangular incision between them. Lamella (without cusp) shorter than half of prodorsum; lamellar cusp short, with long (longer than distance between insertions of lamellar setae), thin lateral tooth. Rostral seta (65–73) setiform, barbed, mediodistally directed anteromediad. Lamellar (77–82) and interlamellar (102–110) thick, barbed. Bothridial seta (61–69) clavate, with longer stalk and shorter, elongate, slightly barbed head. Exobothridial seta not observed. Tutorial tip and genal tooth narrowly triangular. Dorsosejugal porose area not observed.

Notogaster. Pteromorph forming slight right angle laterally (visible in lateral aspect). All notogastral setae (*c*, *la*, *lm*, h_3: 28–32; *lp*, h_2: 20–24; h_1, p_1–p_3: 14–16) setiform, slightly barbed. Notogastral lyrifissure *ip* not observed; *ia*, *im*, *ih*, and *ips* visible. Opisthonotal gland opening distinct.

Gnathosoma. Subcapitulum size: 82–90 × 61–65. All subcapitular setae (*a*: 14–16; *m*, *h*: 20–24) setiform, slightly barbed. Adoral seta (6) setiform, roughened. Palp (length: 61–65) setation: 0-2-1-3-9(+ω). Postpalpal seta (4) spiniform, smooth. Axillary saccule not observed. Chelicera (length: 82–90) with two setiform, barbed setae (*cha*: 28–32; *chb*: 18–20).

Epimeral and lateral podosomal regions. Epimeral setal formula: 3–1–2–3. Seta *1c* (32) thickened, barbed; other setae (*1a*, *2a*, *3a*: 12; *1b*, *3b*, *4a*, *4b*, *4c*: 16) setiform, slightly barbed. Custodium, discidium and circumpedal carina well developed. Humeral porose area *Ah* poorly visible, oval; *Am* absent.

Anogenital region. Genital (g_1: 16–20; g_2–g_6: 16), aggenital (16), anal (16), and adanal (12) setae setiform, slightly barbed. Adanal lyrifissure located close and parallel to anal plate. Postanal porose area oval (10–12 × 4).

Legs. Holotype and three paratypes monodactylous; one paratype heterotridactylous. All claws slightly barbed dorsally. Paraxial porose area on femora I-IV and on trochanters III, IV distinct. Genua I, II with ventral tooth. Formulas of leg setation and solenidia:

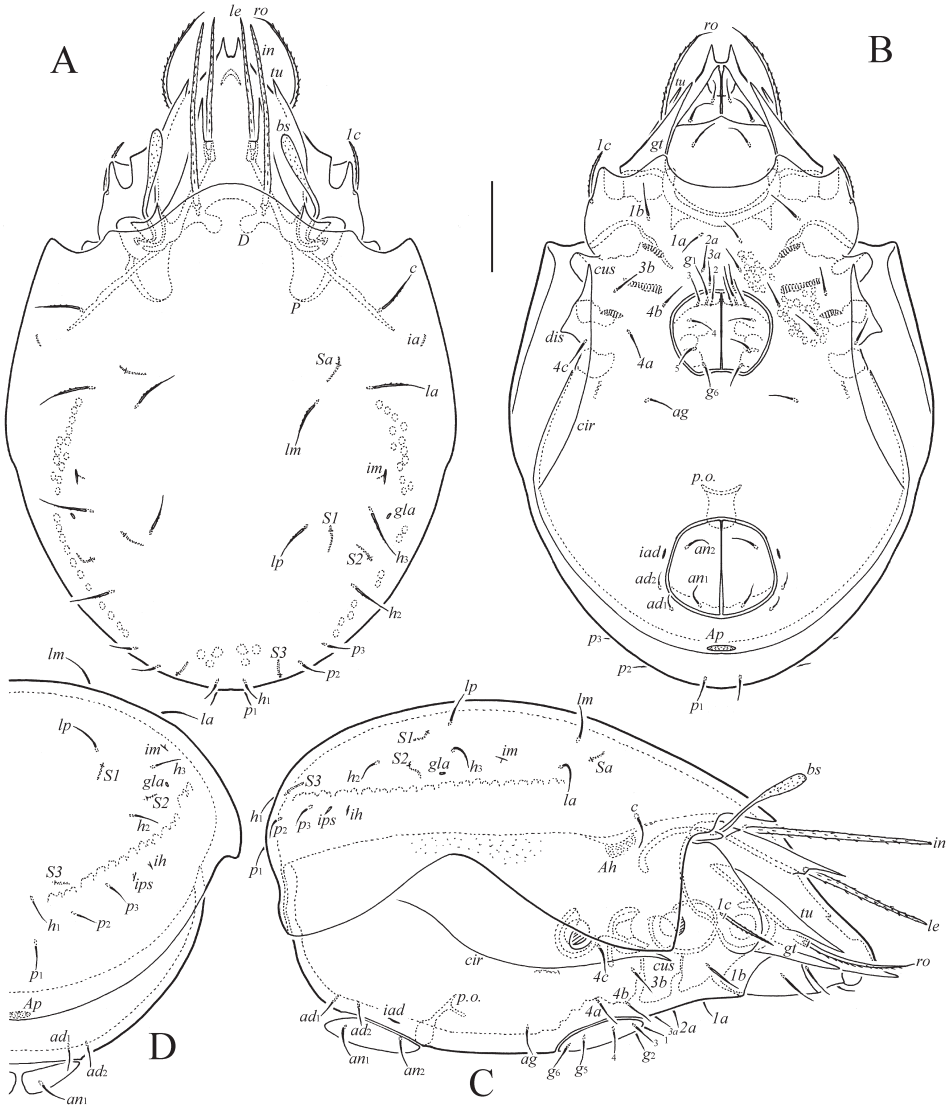

Fig. 1. *Ceratobates pachiteaensis* **sp. n.**, adult, legs not shown: A = dorsal view; B = ventral view; C = right lateral view; D = posterior view, right half. Scale bar 50 μm

I (1–5–3–4–18) [1–2–2], II (1–5–3–4–15) [1–1–2], III (2–3–1–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]; homologies of setae and solenidia indicated in Table 1. Famulus of tarsus I short, erect, slightly swollen distally, inserted before solenidion ω_1. Seta *s* of tarsus I eupathidial, located anterior to setae *a*. Tibia II and genua I, II with thick lateral (antiaxial) seta. Solenidion φ of tibia IV represented by alveolus.

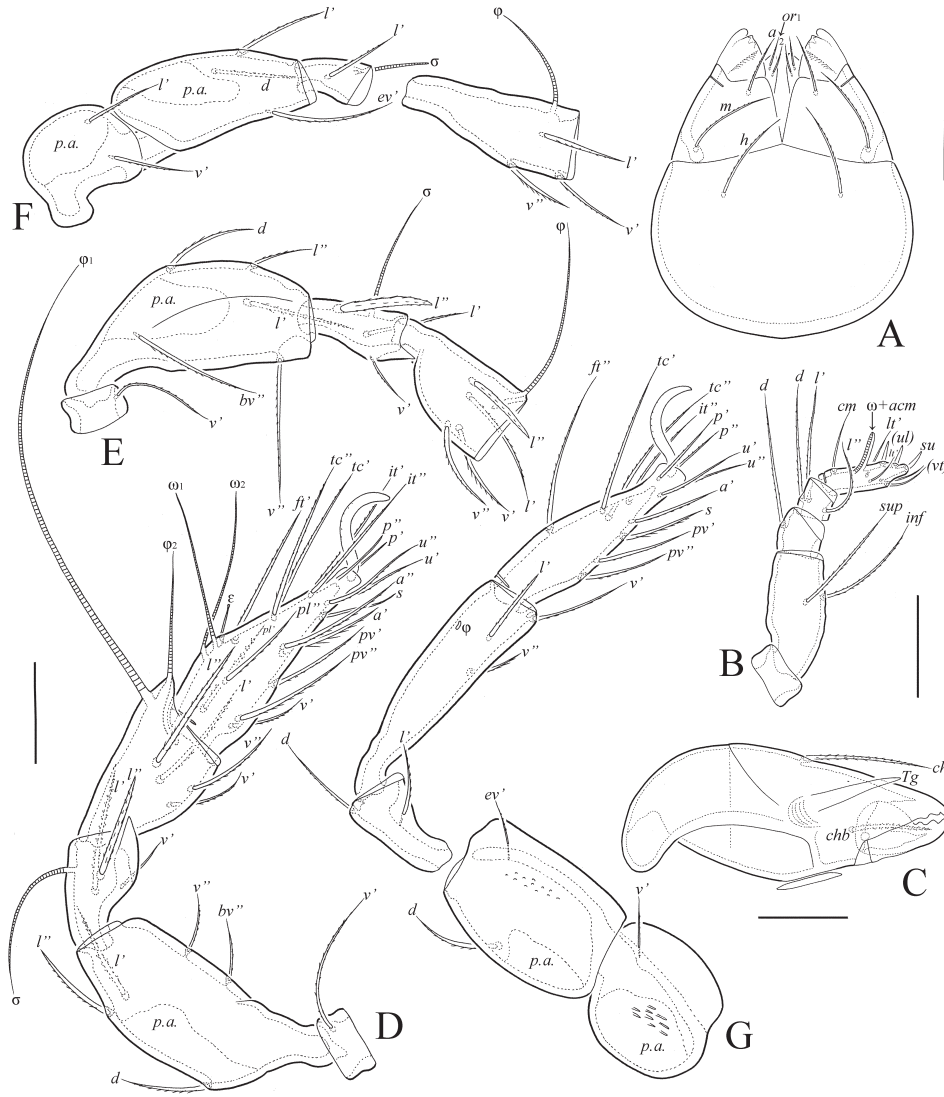

Fig. 2. *Ceratobates pachiteaensis* **sp. n.**, adult: A = subcapitulum, ventral view; B = palp, right, antiaxial view; C = chelicera, left, paraxial view; D = leg I, right, antiaxial view; E = leg II, without tarsus, right, antiaxial view; F = leg III, without tarsus, left, antiaxial view; G = leg IV, left, antiaxial view. Scale bar 20 μm

Table 1. Leg setation and solenidia of adult *Ceratobates pachiteaensis* **sp. n.**

Leg	*Tr*	*Fe*	*Ge*	*Ti*	*Ta*
I	*v′*	*d, (l), bv″, v″*	*(l), v′,* σ	*(l), (v),* φ_1, φ_2	*ft′, (tc), (it), (p), (u), (a), s, (pv), (pl), v′,* ε, ω_1, ω_2
II	*v′*	*d, (l), bv″, v″*	*(l), v′,* σ	*(l), (v),* φ	*(ft), (tc), (it), (p), (u), (a), s, (pv),* ω_1, ω_2
III	*l′, v′*	*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), it″, (p), (u), a′, s, (pv)*

Note: Roman letters refer to normal setae, Greek letters to solenidia (except ε = famulus); single quotation mark (′) designates setae on the anterior and double quotation mark (″) setae on the posterior side of a given leg segment; parentheses refer to a pair of setae. *– As alveolus

Material examined. Holotype (female) and three paratypes (two males and one female): South America, Peru, Central Peru, Andes, 09°54′30′′S, 76°03′48′′W, Huánuco Department, Pachitea Province, Molino District, W Molino, Monte Potrero, 2850–3100 m a.s.l., upper soil and leaf litter in a primary mountain cloud forest, 15–17.IV.2016 (S. Friedrich, F. Wachtel and D. Hauth). One paratype (one female): South America, Peru, Central Peru, Andes, 10°01′47′′S, 76°08′29′′W, Huánuco Department, Ambo Province, Conchamarca District, Pichcacocha Lakes, 3800 m a.s.l., upper soil and leaf litter in mountain forest, 9.IV.2016 (S. Friedrich, F. Wachtel and D. Hauth). Mites were extracted from samples into 75% ethanol using Winkler's apparatus.

Type deposition. The holotype is deposited in the collection of the Museo de Historia Natural, Universidad Nacional Mayor de San Marcos, Lima, Peru; four paratypes are deposited in the collection of the Tyumen State University Museum of Zoology, Tyumen, Russia. All specimens are preserved in 70% ethanol solution with a drop of glycerol.

Etymology. The species name refers to the place of origin of the holotype, Pachitea Province.

Remarks. *Ceratobates pachiteaensis* sp. n. differs from all representatives of the genus by the presence of comparatively long outer tooth of lamellar cusp (longer than distance between insertions of lamellar setae versus shorter than distance between insertions of lamellar setae).

KEY TO KNOWN SPECIES OF CERATOBATES
(modified after Ermilov & Anichkin 2015)

1 Interlamellar and dorsal notogastral setae minute (shorter than diameter of bothridium); inner tooth of lamellar cusp longer than outer tooth; body length: 295–336. Distribution: Vietnam.
Ceratobates cangioensis Ermilov et Anichkin, 2015.

– Interlamellar and dorsal notogastral setae comparatively long (longer than diameter of bothridium); inner tooth of lamellar cusp absent or shorter than outer tooth 2

2 Notogastral seta h_1 modified (differs from other notogastral setae in morphology) 3

– Notogastral seta h_1 not modified (similar to other notogastral setae in morphology) 4

3 Notogastral seta h_1 dilated distally; rostrum tridentate; 10 pairs of notogastral setae (p_3 present); body length: 262–279. Distribution: Neotropical region. *Ceratobates spathulatus* Balogh et Mahunka, 1981

– Notogastral seta h_1 bacilliform; rostrum bidentate; nine pairs of notogastral setae (p_3 absent); body length: 276. Distribution: Neotropical region. *Ceratobates fornerisae* Pérez-Íñigo et Baggio, 1985.

4 Rostrum bidentate; lamellar and interlamellar seta thick; outer tooth of lamellar cusp comparatively long (longer than distance between insertions of lamellar setae); body length: 365–381. Distribution: Peru. *Ceratobates pachiteaensis* **sp. n.**

– Rostrum tridentate; lamellar and interlamellar seta setiform; outer tooth of lamellar cusp comparatively short (shorter than distance between insertions of lamellar setae) 5

5 Centrodorsal notogastral setae comparatively short (*lm* = 1/3 of *lm-lm*); 10 pairs of notogastral setae (p_3 present); one pair of sacculi (*S1*) developed; body length: 340–348. Distribution: South Africa. *Ceratobates monosacculatus* Ermilov, Hugo-Coetzee et Khaustov, 2017

– Centrodorsal notogastral setae comparatively long (*lm* = 2/3 of *lm-lm*); nine pairs of notogastral setae (p_3 absent); four pair of sacculi (*Sa*, *S1*, *S2*, *S3*) developed; body length: 269–299. Distribution: Neotropical region. *Ceratobates pontiger* Balogh et Mahunka, 1969

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