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TAXONOMIC CONTRIBUTION TO KNOWLEDGE OF THE ORIBATID MITE GENUS *CAUCASEREMAEUS* (ACARI: ORIBATIDA: EREMAEIDAE)

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ABSTRACT: We present a revised generic diagnosis of *Caucaseremaeus* (Oribatida: Eremaeidae). The redescription of *Caucaseremaeus krivolutskyi* Shtanchaeva and Subías, 2006 is presented, based on the paratype (Armenia) and on the specimens collected from the Republic of Abkhazia. In addition, remarks on the family placement of *Caucaseremaeus* are provided.

KEY WORDS: eremaeid mite, taxonomy, redescription, morphology, Abkhazia

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INTRODUCTION

The oribatid mite genus *Caucaseremaeus* (Acari: Oribatida: Eremaeidae) was described by Shtanchaeva and Subías (2006), with *Caucaseremaeus krivolutskyi* Shtanchaeva and Subías, 2006 as type species, based on adults from Armenia. At present, the genus comprises only the type species, which is distributed in the Caucasus (Armenia, Azerbaijan, Georgia) preferring mainly the soil-liter of mountain forests (Shtanchaeva and Subías 2010; Murvanidze and Mumladze 2016).

Among the mite material collected from Abkhazia, we found more than 20 specimens of *C. krivolutskyi*. The original description (Shtanchaeva and Subías 2006) of this species is incomplete (in particular, it excludes the descriptions of the gnathosoma and legs) and contains some morphological inaccuracies (including characteristics on generic level). The main goals of our paper are the following: to revise the generic diagnosis of *Caucaseremaeus*; to present a redescription of *C. krivolutskyi* based on the paratype and the additional material from Abkhazia; to summarize the species' main morphological traits, which will help with its identification in the future.

MATERIALS AND METHODS

Specimens. One paratype of *C. krivolutskyi*: Armenia, Tavush Province, vicinities of Dilijan, 1,900 m a.s.l., soil in a mountain oak forest, 26 October 1987 (M.B. Potapov and N.A. Kuznetsova).

Twenty-four specimens of *C. krivolutskyi*: Abkhazia, 43°15′58.67″N, 40°28′43.63″E, Gudauta District, Bzyb Range, 1,010 m a.s.l., soil-litter in a mountain mixed forest, 19 July 2023 (V.M. Salavatulin and V.A. Khaustov).

Observation and documentation. Two samples (250 cm^3 each) of soil-litter were collected using a knife and a small shovel. Mites were extracted into 75% ethanol using Berlese's funnels (without electric lamps) over five days in laboratory conditions.

For the measurement and illustration purposes, specimens were mounted in lactic acid on temporary cavity slides. Some specimens were placed for one or two days in a concentrated (5%) potassium hydroxide solution for the enlightenment of the body surface and to dissolve the cerotegument. All measurements are provided in micrometers (μm); body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the notogaster; other structures were oriented to avoid parallax errors; notogastral width refers to the maximum in dorsal aspect; setal lengths were measured perpendicular to their long axis, accounting for curvature. 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 DM 2500 light microscope; for SEM microscopy alcohol preserved mites were dusted with silver and scanned with the aid of a TESCAN Mira3 LMU SEM microscope.

Terminology. Morphological terminology used in this paper mostly follows that of papers on Eremaeidae (e.g., Behan-Pelletier 1993; Ermilov and Ryabinin 2020); additionally, see Norton (1977) for leg setal nomenclature, and Norton and Behan-Pelletier (2009) for overview.

Abbreviations. *Prodorsum*: *cos*—costula; *tcos*—transcostula; *mc*—medial carina; *lc*—lateral carina; *ro*, *le*, *in*, *bs*, *ex*—rostral, lamellar, interlamellar, bothridial and exobothridial setae, respectively. *Notogaster*: *cr*—crista; *c*, *l*, *h*, *p*—setae; *ia*, *im*, *ip*, *ih*, *ips*—lyrifissures; *gla*—opisthonotal gland opening. *Gnathosoma*: *a*, *m*, *h*—subcapitular setae; *or*—adoral seta; *d*, *l*, *cm*, *acm*, *ul*, *su*, *lt*, *vt*, *inf*, *sup*—palp setae; ω—palp solenidion; *cha*, *chb*—cheliceral setae; *Tg*—Trägårdh's organ. *Epimeral and lateral podosomal regions*: *1a*, *1b*, *1c*, *2a*, *3a*, *3b*, *3c*, *4a*, *4b*, *4c*—epimeral setae; *z*—aperture of supracoxal gland; *PdI*, *PdII*—pedotecta I and II, respectively; *dis*—discidium. *Anogenital region*: *g*, *ag*, *an*, *ad*—genital, aggenital, anal and adanal setae, respectively; *ian*—anal lyrifissure; *iad*—adanal lyrifissure; *po*—preanal organ. *Legs*: *Tr*, *Fe*, *Ge*, *Ti*, *Ta*—trochanter, femur, genu, tibia and tarsus, respectively; *pa*—porose area; ε—famulus; *d*, *l*, *v*, *ev*, *bv*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv*, *pl*—setae; ω, σ, φ—solenidia.

TAXONOMY

Family **Eremaeidae**

Genus ***Caucaseremaeus*** **Shtanchaeva and Subías, 2006**

Type species: *Caucaseremaeus krivolutskyi* Shtanchaeva and Subías, 2006

Generic diagnosis. *Adult*. With character states of Eremaeidae (Behan-Pelletier 1993; Norton and Behan-Pelletier 2009). *Body size*: Large (length more than 600). *Integument*: Body and legs covered by thick layer of cerotegument. Surface foveolate-reticulate. *Prodorsum*: Rostrum rounded. Costulae longitudinal, parallel; transcostula present; additionally, lateral carinae and system of dorsal carinae present. Rostral, lamellar, interlamellar, and exobothridial setae well developed, setiform; bothridial seta with head. *Notogaster*: Anterior notogastral margin convex medially, without tubercles. Ten pairs of notogastral setae setiform. *Gnathosoma*. Subcapitulum diarthric. Palp setation: 0–2–1–3–9(+ω). Chelicera chelate–dentate. *Epimeral and lateral podosomal regions*: Epimeral setal formula: 3–1–3–3. Pedotectum I represented by medium-sized scale, pedotectum II represented by small scale. Circumpedal carina absent. Discidium present. *Anogenital region*: Six pairs of genital, one pair of aggenital, three pairs of anal, three pairs of adanal setae. Postanal process and posteromarginal sclerite absent. *Legs*: Heterotridactylous. All femora with ventroantiaxial keel. Porose area present on all femora and on trochanters III, IV (vs. absent on all tarsi and tibiae).

Caucaseremaeus krivolutskyi **Shtanchaeva and Subías, 2006**

(Figs. 1–21)

Diagnosis. Body length: 690–780. Costula with small quadrangular cusp. Lateral side of prodorsum with two carinae. Prodorsal, notogastral and ventral setae setiform, barbed; bothridial seta clavate or fusiform, barbed. Epimere I with medial triangular carina. Leg trochanters III, IV with small triangular process anterodorsally.

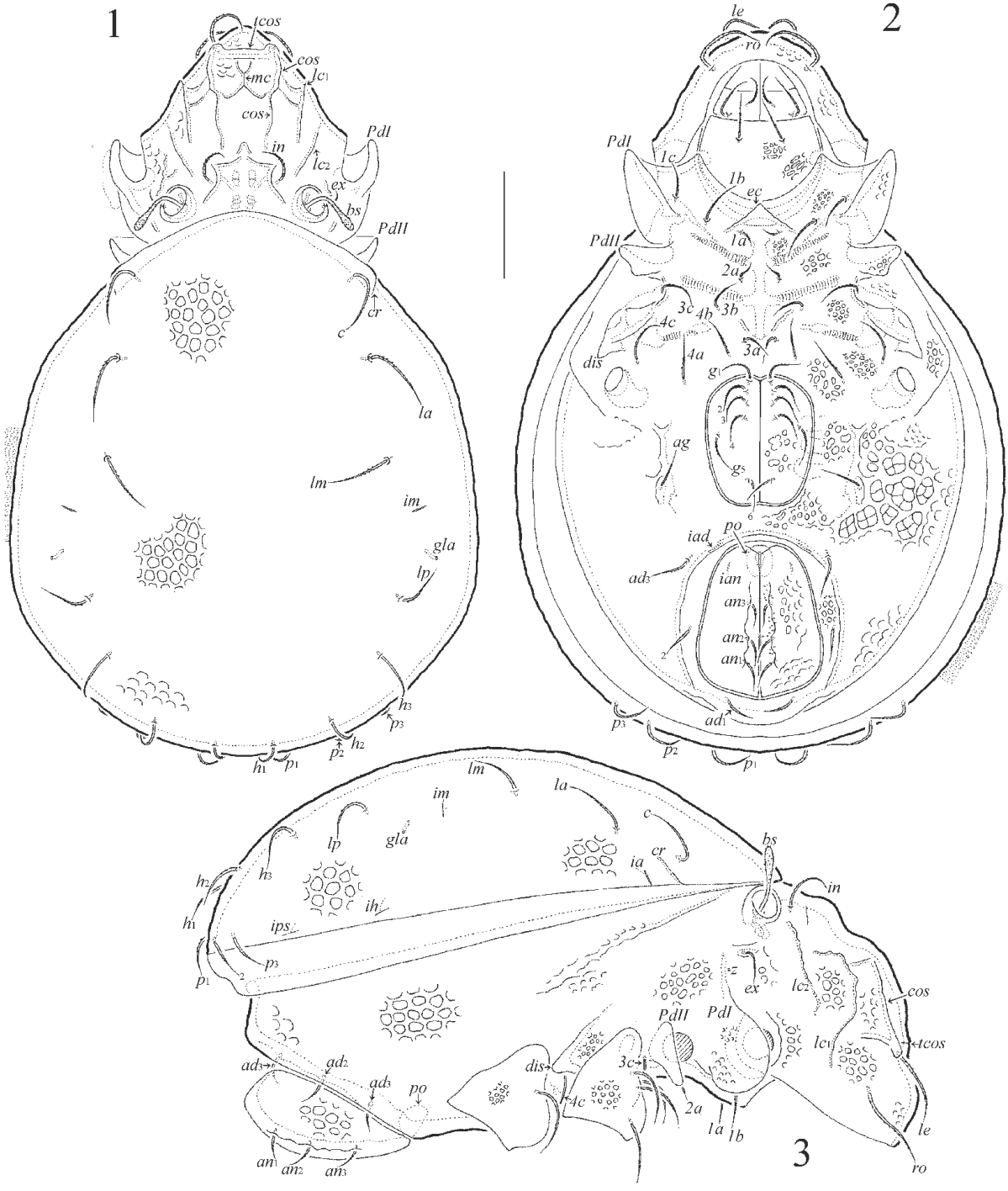
Redescription. *Measurements*. Body length: 690–780 (14 males, 10 females); notogaster width: 435–480 (14 males, 10 females). No distinct differences between males and females in body size, but males often smaller.

Integument. Body brown to dark brown. Surface microporose; additionally, dorsal (except intercostular and interbothridial regions) and ventral sides of body, subcapitular mentum, genital and anal plates, and partially leg segments (except genua I–IV and trochanters I, II) foveolate-reticulate. Body and legs covered by thick layer of cerotegument; its internal layer uniform, netlike reticulate (mostly hexagonal; Figs. 16–18), but the outer layer gel-like with microtubercular and bacillar structures.

Prodorsum. Rostrum broadly rounded. Costula medium-sized, lineate, sometimes shortly interrupted in the middle, with small quadrangular cusp; a pair is parallel; transcostula lineate; intercostular region with short medial carina bifurcate anteriorly and posteriorly, but this carina and branches modified (e.g., furcation absent, carina winding, position and length of branches asymmetric) in some specimens; interbothridial region with system of carinae forming unclear trapezoid structure; lateral side of prodorsum with two carinae, of these, lc_1 long, strong, lc_2 shorter, slight. Rostral (75–90), lamellar (60–71), interlamellar (45–49), and exobothridial (30–34) setae setiform, barbed; *le* inserted on cusp of the costula; bothridial seta (56–67) clavate (with rounded head distally) or fusiform (with narrowed head distally), barbed; head shorter than stalk.

Notogaster. Humeral region with short crista. Ten pairs of notogastral setae (p_1–p_3: 45–49; others: 60–67) setiform, barbed. Opisthonotal gland opening and all lyrifissures well visible.

Gnathosoma. Subcapitulum size: 150–154 × 112–120; subcapitular (*a*: 41–45; *m*, *h*: 52–56) and

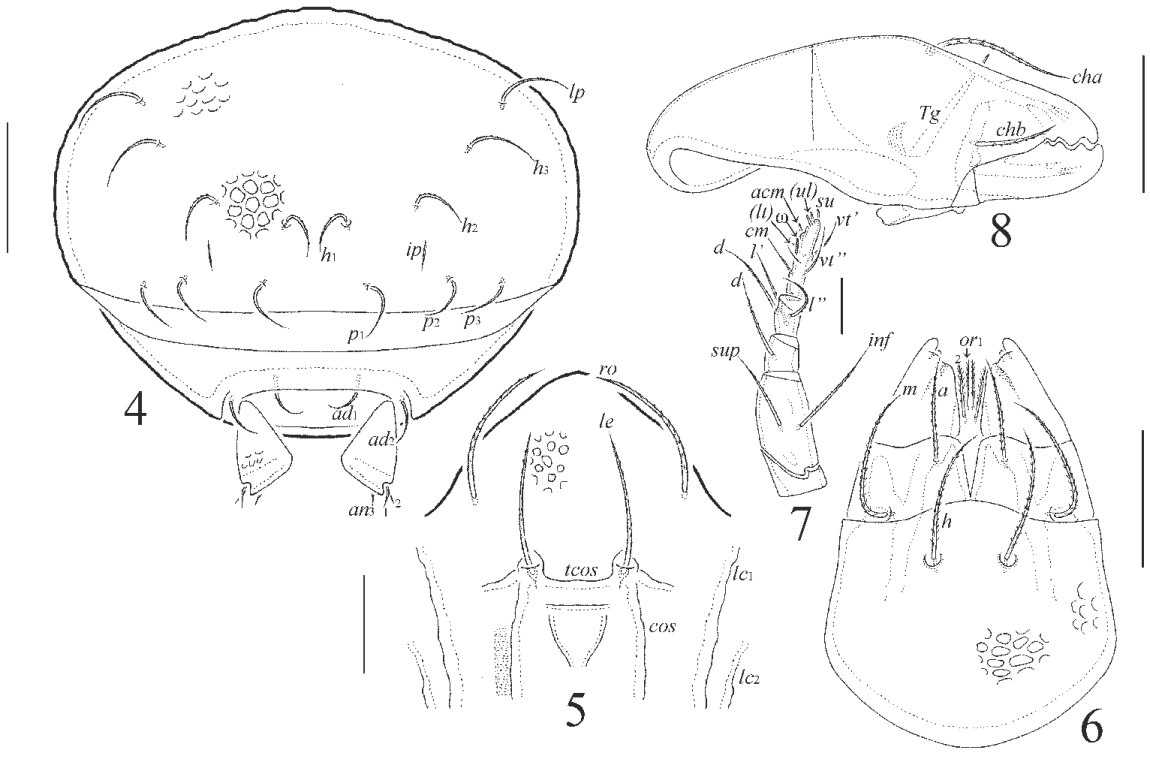


Figs. 1–3. *Caucaseremaeus krivolutskyi* Shtanchaeva and Subías, 2006, adult (legs omitted): 1—dorsal view; 2— ventral view; 3—right lateral view. Scale bar=100 μm.

adoral (19) setae setiform, barbed. Chelicera length: 169–180; both setae (*cha*: 49–56; *chb*: 26–30) setiform, barbed. Palp length: 101–109; postpalpal seta (7) spiniform.

Epimeral and lateral podosomal regions. Epimere I with medial triangular carina. All epimeral setae (*1a*, *2a*, *3a*: 34–37; others: 45–49) setiform, barbed. Discidium triangular, rounded distally.

Anogenital region. Genital (37–41), aggenital (37–41), anal (26–30), and adanal (26–30) setae setiform, barbed. Anal and adanal lyrifissures slightly observed.



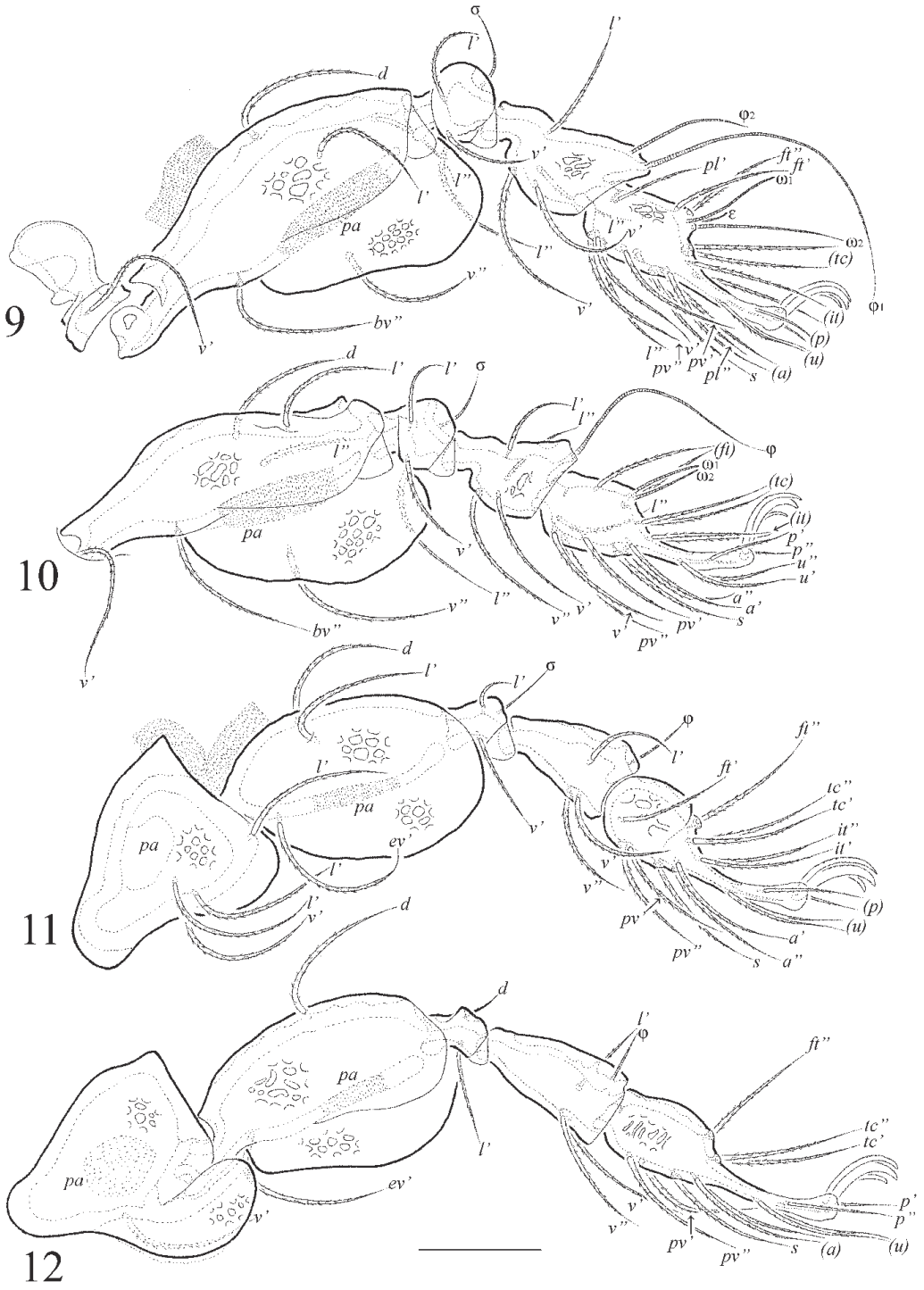
Figs. 4–8. *Caucaseremaeus krivolutskyi* Shtanchaeva and Subías, 2006, adult: 4—posterior view (gnathosoma and legs omitted); 5—anterior part of prodorsum, anterodorsal view; 6—subcapitulum, ventral view; 7—palp, right, antiaxial view; 8—chelicera, right, antiaxial view. Scale bars=100 μm (4), 50 μm (5, 6, 8), 20 μm (7).

Legs. All claws slightly barbed on dorsal side. Distal part of tarsi I–IV strongly elongate. Trochanters III, IV with small triangular process anterodorsally. Porose area on femora I–IV and on trochanters III, IV well visible. Formulas of leg setation and solenidia: I (1–5–3–4–20) [1–2–2], II (1–5–3–4–17) [1–1–2], III (4[5]–3–2–3–15) [1–1–0], IV (1–2–2–3–12) [0–1–0]; homology of setae and solenidia as indicated in Table 1. Famulus short, slightly swollen distally; seta *s* on tarsus I setiform, barbed (not eupathidial); solenidia ω_1 on tarsus I and ω_1, ω_2 slightly bacilliform, φ_1 on tibia I subflagellate, other solenidia rod-like.

GENERAL REMARKS

1. The original descritption of *C. krivolutskyi* (see Shtanchaeva and Subías 2006) contains several important inaccuracies including: the presence of prodorsal ridges (lamellae/costulae absent); presence of nine pairs of notogastral setae; prodorsal, notogastral and ventral setae smooth; rostral seta inserted distanced from the rostrum and posteriorly to lateral carina lc_1 (according to their Fig. 2.*1*). Based on the study of the paratype and the additional material from Abkhazia, we argue that, in fact, the species has: costulae connected by transcostula; 10 pairs of notogastral setae; the prodorsal, notogastral and ventral setae barbed; the rostral seta inserted distinctly anteriorly to lateral carina lc_1. Additionally, many body setae are longer than in the original description.

2. Shtanchaeva and Subías (2006) placed *Caucaseremaeus* in Eremaeidae. Later, Subías (2022, from the 2019 online version) changed this attribution and included the genus in Caleremaeidae. However, caleremaeid representatives are characterized by the presence of tubercles on the anterior notogastral margin, circular depressions between notogastral setae *c* and *la*, enantiophysis *A*, one solenidion on leg tarsus II, and the absence of pedotectum II (see Norton and Behan-Pelletier 2009). All characteristics listed above do not correspond to the diagnosis of *Caucaseremaeus*. If we compare the generic characteristics of *Caucaseremaeus* with those of Eremaeidae (Behan-Pelletier 1993) based on the adult, then they distinctly correspond to eremaeids (except for the absence of porose areas on leg tarsi and tibiae). Therefore, the original placement of *Caucaseremaeus* within Eremaeidae seems correct. Perhaps future genetic data on



Figs. 9–12. *Caucaseremaeus krivolutskyi* Shtanchaeva and Subías, 2006, adult: 9—leg I, left, paraxial view; 10—leg II (basal part omitted), left, paraxial view; 11—leg III, left, antiaxial view; 12—leg IV, right, paraxial view. Scale bar=50 μm.

C. krivolutskyi and the related species (e.g., from the families Eremaeidae, Caleremaeidae, Megeremaeidae) can more clearly indicate the position of the genus.

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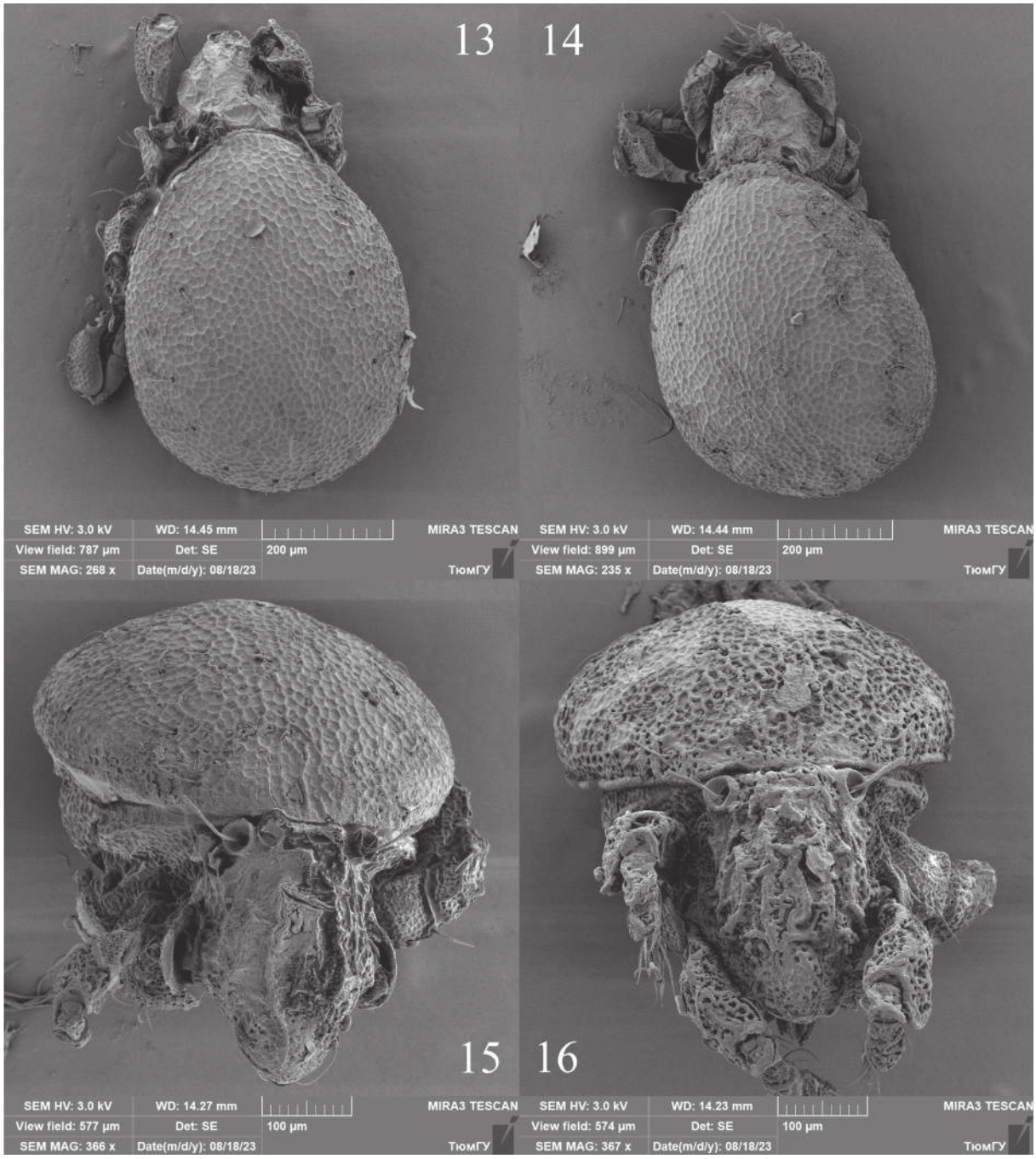

Figs. 13–16. *Caucaseremaeus krivolutskyi* Shtanchaeva and Subías, 2006, adult, SEM micrographs (cerotegument removed in 13–15; outer layer of cerotegument removed in 16): 13, 14—dorsal view; 15, 16—anterodorsal view.

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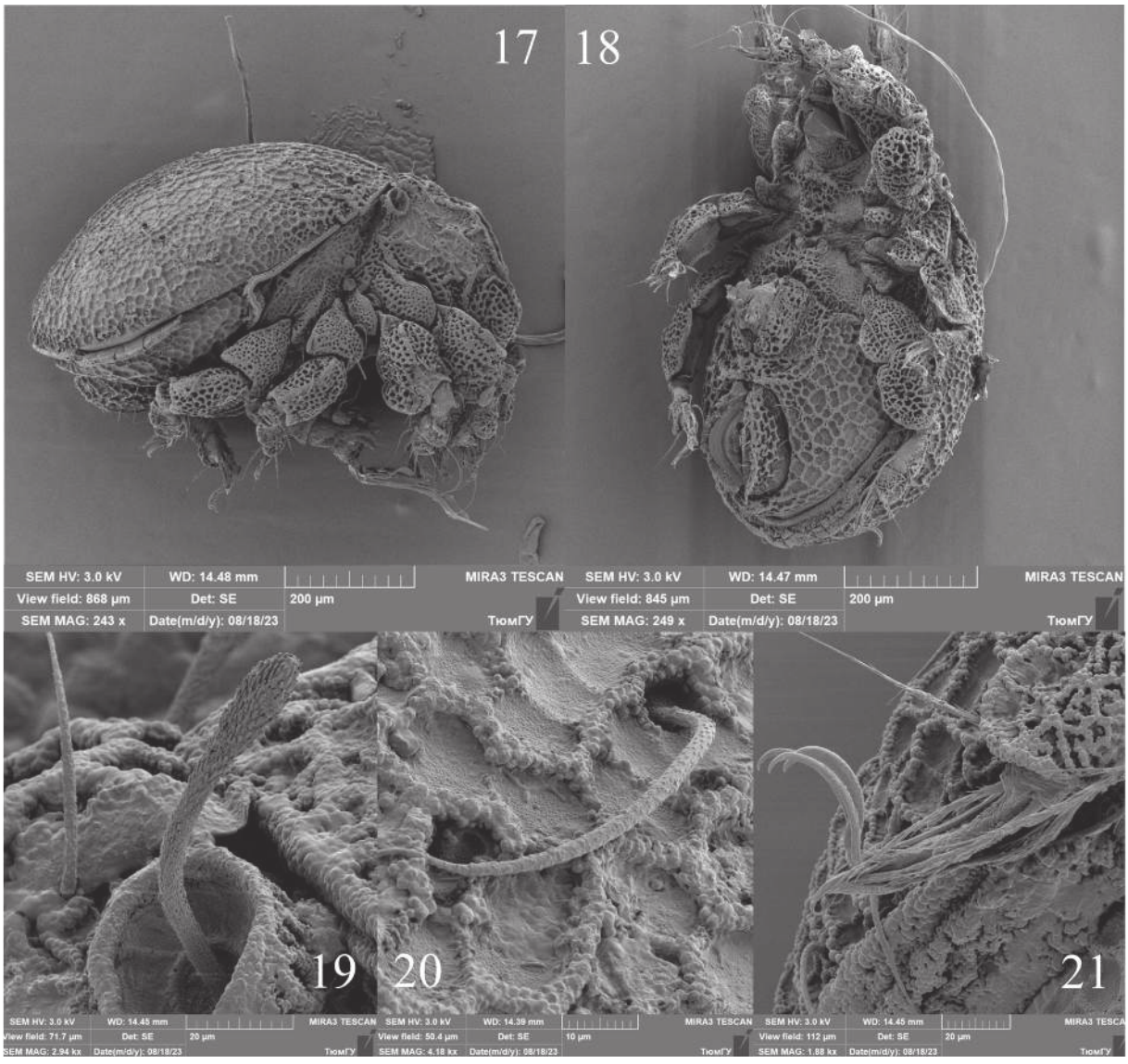

Figs. 17–21. *Caucaseremaeus krivolutskyi* Shtanchaeva and Subías, 2006, adult, SEM micrographs (outer layer of cerotegument removed): 17—right lateral view; 18—left ventrolateral view; 19—bothridial seta, bothridium and mediobasal part of interlaemllar seta; 20—notogastral seta *lp*; 21—distal part of leg IV, right, antiaxial view.

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Table 1

Leg setation and solenidia of adult *Caucaseremaeus krivolutskyi* Shtanchaeva and Subías, 2006

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', l",* 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), v', l",* ω_1, ω_2
III	*l', l', l', l'*, v'*	*d, l', ev'*	*l', v',* 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 mark (*'*) designates setae on the anterior and double quotation (*"*) setae on the posterior side of a given leg segment; parentheses refer to a pair of setae. *—seta *l'* on trochanter III present or absent.