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NEW FAUNISTIC AND TAXONOMIC DATA ON ORIBATID MITES (ACARI, ORIBATIDA) OF ETHIOPIA

© 2022 S. G. Ermilov^{a, *}, U. Ya. Shtanchaeva^{b, **}, L. S. Subías^{b, ***}

^aTyumen State University, Tyumen, 625003 Russia

^bComplutense University, Madrid, 28040 Spain

*e-mail: ermilovacari@yandex.ru

**e-mail: umukusum@mail.ru

***e-mail: subias@bio.ucm.es

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The present study is based on the oribatid mite material collected from the Borena-Sayint National Park in Ethiopia. We present a list of identified taxa, which includes 41 species from 34 genera and 24 families; this list contains some mite records that are new to the Ethiopian fauna and the Afrotropical Region. One new species of the genus *Ramusella* is described; *R. rybalovi* sp. n. differs from *R. paraarcuata* Ermilov et Starý 2018 in its smaller body size, the presence of prodorsal costulae and epimeral tubercles, and in having longer notogastral setae.

Keywords: acarofauna, *Ramusella*, taxonomy, morphology, Afrotropical Region

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The Ethiopian oribatid mite (Acari, Oribatida) fauna has been studied insufficiently (e.g., Ermilov et al., 2012; Ermilov, 2014; Ermilov, Rybalov, 2019). Our work is based on material collected in the Borena-Sayint National Park (southern part of Ethiopia) during 2018. The primary goal of our paper is to present a list of the identified taxa, with notes on the new mite findings. A secondary goal of our paper is to describe and illustrate a newly discovered species. In particular, during the taxonomic identification, we found one new species belonging to the genus *Ramusella* Hammer 1962 (family Oppiidae Sellnick 1937). This genus comprises six subgenera and 86 species, all of which have a cosmopolitan distribution (Subías, 2020). Prior to this work, only two *Ramusella* species have been recorded from Ethiopia (Ermilov, Rybalov, 2013, 2018): *Ramusella (Insculptoppia) fusiformis* (Wallwork 1961) and *Ramusella (Rectoppia) ginchiensis* Ermilov et Rybalov 2013.

MATERIAL AND METHODS

S p e c i m e n s. Substrate samples (litter) containing oribatid mites were collected using a stainless-steel frame (50 × 50 cm) with a sieve (mesh size 2 × 2 cm) from two localities in the Ethiopian Borena-Sayint National Park: 1) BSNP-1, 20 km WNW of Mega, deciduous woodland with *Aloe* sp., on a valley slope, 04°08'37.6" N, 038°04'59.0" E, 1766 m a.s.l.,

28.11.2018 (collected by L.B. Rybalov); 2) BSNP-2, same location as BSNP-1, except the woodland was dominated by *Ficus sycomorus* trees. The mites were extracted from the litter samples into 75% ethanol using Berlese's funnels with the help of electric lamps in laboratory conditions in the course of seven days. Presently, the specimens are distributed among two institutions: the Senckenberg Museum of Natural History, Görlitz, Germany (SMNH); and the Tyumen State University Museum of Zoology, Tyumen, Russia (TSUMZ).

Observation and documentation. Specimens were mounted in lactic acid on temporary cavity slides for measurement and illustration. The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the notogaster. Notogastral width refers to the maximum in dorsal aspect. 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 and conventions. 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 and notations. Prodorsum: *cos* = costula; *tcos* = transcostula; *ro*, *le*, *in*, *bs*, *ex* = rostral, lamellar, interlamellar, bothridial, and exobothridial seta, respectively; *exv* = vestige of second exobothridial seta; *pt* = postbothridial tubercle; *lc* = lateral carina. Notogaster: *c*, *la*, *lm*, *lp*, *h*, *p* = notogastral setae; *ia*, *im*, *ip*, *ih*, *ips* = notogastral lyrifissures; *gla* = opisthotal 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-c*, *2a*, *3a-c*, *4a-c* = epimeral setae; *vt* = epimeral (ventrosejugal) tubercle; *lt* = lateral tubercle; *lr* = lateral ridge; *PdI* = pedotectum I; *dis* = discidium. Anogenital region: *g*, *ag*, *an*, *ad* = genital, aggenital, anal, and adanal seta, respectively; *iad* = adanal lyrifissure; *po* = preanal organ. Legs: *Tr*, *Fe*, *Ge*, *Ti*, *Ta* = leg trochanter, femur, genu, tibia, tarsus, respectively; ω , ϕ , σ = leg solenidia; ε = leg famulus; *d*, *l*, *v*, *bv*, *ev*, *ft*, *tc*, *it*, *p*, *u*, *a*, *s*, *pv*, *pl* = leg setae.

LIST OF IDENTIFIED TAXA

Ptyctimous mites (not identified). Localities: BSNP-1 (1 ex.), BSNP-2 (6 ex.).

Brachychthoniidae

Brachychthonius impressus Moritz 1976. Locality: BSNP-2 (>20 ex.). Distribution: Palaeartic Region. New record of the species in the Afrotropical Region.

Brachychthonius pauliani Balogh et Mahunka 1966. Locality: BSNP-2 (1 ex.). Distribution: Congo. New record of the species in Ethiopia.

Liochthonius latus Mahunka 1982. Locality: BSNP-2 (>20 ex.). Distribution: Afrotropical Region.

Cosmochthoniidae

Cosmochthonius lanatus (Michael 1885). Locality: BSNP-2 (19 ex.). Distribution: Cosmopolitan.

Cosmochthonius sp. Locality: BSNP-2 (1 ex.).

Sphaerochthoniidae

Sphaerochthonius splendidus (Berlese 1904). Localities: BSNP-1 (4 ex.), BSNP-2 (>20 ex.). Distribution: Tropical and Subtropical Regions.

Trhypochthoniidae

Trhypochthonius tectorum (Berlese 1896). Locality: BSNP-1 (1 ex.). Distribution: Semicosmopolitan.

Malaconothridae

Tyrphonothrurus ensifer (Mahunka 1982). Locality: BSNP-2 (2 ex.). Distribution: Afrotropical Region.

Nothridae

Nothrus crassisetus Mahunka 1982. Locality: BSNP-2 (3 ex.). Distribution: Ethiopia.

Hermanniellidae

Hermanniella spiniseta Mahunka et Mahunka-Papp 2007. Locality: BSNP-2 (6 ex.). Distribution: Afrotropical Region. New record of the species in Ethiopia.

Gymnodamaeidae

Jacotella frondeus (Kulijev 1979). Locality: BSNP-2 (2 ex.). Distribution: southern Palaeartic Region. New record of the species in the Afrotropical Region.

Aleurodamaeidae

Aleurodamaeus recenfesevpi Ermilov et Rybalov 2012. Localities: BSNP-1 (2 ex.), BSNP-2 (2 ex.). Distribution: Ethiopia.

Damaeidae

Belba sp. Locality: BSNP-2 (1 ex.). New record of the genus in the Afrotropical Region.

Metabelba glabriseta Mahunka 1982. Locality: BSNP-2 (5 ex.). Distribution: Afrotropical Region.

Eremulidae

Eremulus arabicus Mahunka 2009. Locality: BSNP-2 (1 ex.). Distribution: Yemen. New record of the species in Ethiopia.

Eremulus sp. Locality: BSNP-2 (1 ex.).

Dameolidae

Fosseremus laciniatus (Berlese 1904). Locality: BSNP-2 (10 ex.). Distribution: Cosmopolitan.

Opiidae

Arcoppia cf. *rugosa* (Mahunka 1974). Locality: BSNP-2 (4 ex.). Distribution: Afrotropical Region.

Helioppia sol (Balogh 1959). Locality: BSNP-2 (>20 ex.). Distribution: Afrotropical Region, Vietnam. New record of the species in Ethiopia.

Lasiobelba (Antennoppia) heterosa (Wallwork 1964). Locality: BSNP-2 (10 ex.). Distribution: Afrotropical and southern Palaeartic Regions.

Neoamerioppia csabai Mahunka et Mahunka-Papp 2007. Locality: BSNP-2 (1 ex.). Distribution: Afrotropical Region. New record of the species in Ethiopia.

Neoamerioppia extrusa (Mahunka 1983). Locality: BSNP-2 (14 ex.). Distribution: Afrotropical Region.

Oxyoppia complicata Mahunka 1986. Locality: BSNP-2 (1 ex.). Distribution: Afrotropical Region.

Ramusella rybalovi sp. n. Locality: BSNP-2 (7 ex.). New record of the nominate subgenus in Ethiopia.

Teratoppiidae

Teratoppia ciliata Wallwork 1961. Locality: BSNP-2 (1 ex.). Distribution: Afrotropical Region.

Suctobelbidae

Suctobelbella (Flagrosuctobelba) kotschani (Mahunka et Mahunka-Papp 2007). Locality: BSNP-2 (4 ex.). Distribution: Afrotropical Region.

Suctobelbella (Flagrosuctobelba) sp. Locality: BSNP-2 (1 ex.).

Suctobelbella (Ussuribata) spirochaeta Mahunka 1983. Locality: BSNP-2 (2 ex.). Distribution: Afro-tropical Region, Japan.

Tectocephidae

Tectocephus velatus (Michael 1880). Locality: BSNP-2 (1 ex.). Distribution: Cosmopolitan.

Eremaeozetidae

Eremaeozetes costulatus Mahunka 1977. Locality: BSNP-2 (1 ex.). Distribution: Oriental Region. New record of the family and genus in Ethiopia; new record of the species in the Afrotropical Region.

Microzetidae

Berlesezetes glaber Mahunka 1982. Locality: BSNP-2 (>20 ex.). Distribution: Ethiopia.

Phenopelopidae

Eupelops cf. acromios (Hermann 1804). Locality: BSNP-2 (1 ex.). Distribution: Semicosmopolitan.

Punctoribatidae

Afroleius valerieae Coetzee 2014. BSNP-2 (2 ex.). Distribution: South Africa. New record of the genus and species in Ethiopia.

Caloppiidae

Zetorchella nortoni Ermilov, Sidorchuk et Rybalov 2010. Localities: BSNP-1 (8 ex.), BSNP-2 (>20 ex.). Distribution: Ethiopia.

Oribatulidae

Zygoribatula contracta Grobler 1994. Locality: BSNP-2 (1 ex.). Distribution: South Africa. New record of the species in Ethiopia.

Scheloribatidae

Scheloribates pallidulus (Koch 1841). Locality: BSNP-2 (2 ex.). Distribution: Cosmopolitan. New record of the species in Ethiopia.

Scheloribates sp. Locality: BSNP-2 (1 ex.).

Perscheloribates ethiopicus (Mahunka 1986). Locality: BSNP-2 (1 ex.). Distribution: Tanzania. New record of the species in Ethiopia.

Haplozetidae

Haplozetes vindobonensis (Willmann 1935). Locality: BSNP-2 (>20 ex.). Distribution: Afrotropical and Palaearctic Regions, Mexico, Vietnam.

Vilhenabates cf. reductus Mahunka et Mahunka-Papp 2008. Locality: BSNP-2 (2 ex.). Distribution: Kenya. New record of the species in Ethiopia.

Galumnidae

Galumna breviseta Mahunka et Mahunka-Papp 2009. Localities: BSNP-1 (19 ex.), BSNP-2 (>20 ex.). Distribution: Afrotropical Region. New record of the species in Ethiopia.

The list includes 41 species (of these, five are unidentified) from 34 genera and 24 families. Eleven species (*Sellnickochthonius pauliani*, *Hermanniella spiniseta*, *Eremulus arabicus*, *Helioppia sol*, *Neoamerioppia csabai*, *Afroleius valerieae*, *Zygoribatula contracta*, *Scheloribates pallidulus*, *Perscheloribates ethiopicus*,

Vilhenabates cf. reductus, *Galumna breviseta*), one subgenus (*Ramusella (Ramusella)*), two genera (*Eremaeozetes*, *Afroleius*) and one family (Eremaeozetidae) are recorded for the first time in Ethiopia. Three species (*Brachychthonius impressus*, *Jacotella frondeus*, *Eremaeozetes costulatus*) and one genus (*Belba*) are recorded for the first time in the Afrotropical Region.

TAXONOMY

Ramusella (Ramusella) rybalovi

Ermilov, Shtanchaeva et Subías sp. n.

(Figs 1–3)

Material. Holotype (♂) and four paratypes (3♂♂, 1♀): Ethiopia, Borena-Sayint National Park, 20 km WNW of Mega, deciduous woodland with *Ficus sycamoros*, on a valley slope, 04°08'37.6" N, 038°04'59.0" E, 1766 m a.s.l., litter, 28.11.2018 (collected by L.B. Rybalov).

The holotype is deposited in the SMHM; four paratypes are deposited in the TSUMZ. Additional material (two adults): personal collection of S.G. Ermilov. All specimens are preserved in ethanol with a drop of glycerol.

Diagnosis. Body size: 223–257 × 116–140. Costulae and transcostulae present, separated. Prodorsal setae well developed, setiform, barbed; *le* short-est. Bothridial setae long, pectinate, unilaterally with three long, barbed branches. Notogastral setae long, setiform, sparsely barbed (except *c* represented by alveoli). Ventrosejugal region with one pair of epimeral tubercles. Epimeral and anogenital setae short, setiform, roughened to sparsely barbed.

Description. Measurements. Body length: 232 (holotype), 223–257 (paratypes); notogaster width: 124 (holotype), 116–140 (paratypes). Female larger than males: 257 × 140 versus 223–232 × 116–132.

Integument. Body color light brown. Body surface microporose (visible only under high magnification in dissected specimens, × 1500). Lateral parts of body between bothridia and acetabula I–III densely tuberculate (diameter of tubercles up to 2).

Prodorsum (Figs 1a, 1c). Rostrum rounded. Costulae and transcostula present, separated; costulae very thin, transcostula thickened. Rostral (24–28), lamellar (10), interlamellar (22–26), and exobothridial (12–16) setae setiform, barbed, inserted on micro-tubercles. Lamellar setae located behind transcostula. Bothridial setae (53–57) pectinate, unilaterally with three long, barbed branches. Interbothridial region with three pairs of muscle sigillae. Interlamellar tubercles absent. Postbothridial tubercles present. Longitudinal rows, comprising several muscle sigillae, present in front of the bothridia. Lateral prodorsal carinae slightly developed, arch-like.

Notogaster (Figs 1a, 1c). Anterior border convex medially. Nine pairs of notogastral setae (*la*, *lm*, *lp*, h_1-h_3 , 32–36; p_1-p_3 , 20–24) setiform, sparsely



Fig. 1. *Ramusella rybalovi* sp. n., adult: *a* – dorsal view, *b* – ventral view (gnathosoma and legs not shown), *c* – lateral view (gnathosoma and legs not shown). Scale bar 50 μ m.



Fig. 2. *Ramusella rybalovi* sp. n., adult: *a* – subcapitulum, ventral view; *b* – palp, right, antiaxial view; *c* – chelicera, left, paraxial view; *d* – leg I, right, antiaxial view. Scale bar (μm): *a*–*c* – 10; *d* – 20.



Fig. 3. *Ramusella rybalovi* sp. n., adult: *a* – leg II, without tarsus, right, antiaxial view; *b* – leg III, without tarsus, left, antiaxial view; *c* – leg IV, left, antiaxial view. Scale bar 20 μ m.

barbed; setae *c* represented by alveoli. Notogastral lyrifissures, opisthonotal gland openings, circumgastric scissure, and circumgastric sigillar band slightly visible.

Gnathosoma (Figs 2a–2c). Subcapitulum longer than wide (53–57 \times 41). Subcapitular setae setiform, *a* (8) and *h* (12) slightly barbed, *m* (12) shortly ciliate. Adoral setae (4) setiform, thin, smooth. Palps (32)

with setation 0-2-1-3-8(+1 ω). Solenidion of palptarsi short, bacilliform, located in distal part. Postpalpal setae (4) spiniform, smooth. Chelicerae (53–57) with two setiform setae, *cha* (16) shortly ciliate dorsally, *chb* (10) barbed.

Epimeral and lateral podosomal regions (Figs 1b, 1c). Ventrosejugal region with one pair of epimeral tu-

Table 1. Leg setation and solenidia of adult *Ramusella rybalovi* sp. n.

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

Roman letters refer to normal setae, Greek letters – to solenidia (except ε = famulus). Single prime (') marks setae on the anterior and double prime (") – setae on the posterior side of a given leg segment. Parentheses refer to a pair of setae.

bercles. Epimeral borders IV well developed, semi-oval. Epimeral setal formula: 3-1-3-3; setae setiform, *1a*, *2a*, *3a* (8) and *1b*, *1c*, *4a*, *4b* (12) sparsely roughened, others (16) sparsely barbed. Lateral ridge between bothridia and acetabula IV slightly developed, distally expanded to form a tubercle, which is located posteriorly to bothridia. Discidia triangularly pointed.

Anogenital region (Figs 1b, 1c). Five pairs of genital (6), one pair of aggenital (8), three pairs of adanal (8), and two pairs of anal (8) setae setiform, sparsely roughened. Adanal setae *ad*₁ inserted on semi-oval ridge. Adanal lyrifissures distinct.

Legs (Figs 2d, 3a–2c). Leg claws smooth. Trochanters III with two or three posterior teeth. Formulas of leg setation and solenidia: I (1-5-2-4-20) [1-2-2], II (1-5-2-4-16) [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. Solenidia ω₁ on tarsi I, ω₂ and σ on tarsi II and σ on genua III slightly bacilliform, other solenidia setiform.

Remarks. *Ramusella rybalovi* sp. n. is morphologically most similar to *Ramusella paraarcuata* Ermilov et Starý 2018 from Vietnam (Ermilov, Starý, 2018) in having pectinate bothridial setae with a few (about three) distinctly barbed branches. However, the new species differs from *R. paraarcuata* in: 1) smaller body size (223–257 × 116–140 versus 415–464 × 232–249 in *R. paraarcuata*), 2) presence of prodorsal costulae (versus costulae absent in *R. paraarcuata*), 3) presence of epimeral tubercles (versus tubercles absent in *R. paraarcuata*), and 4) having comparatively long notogastral setae (longer than exobothridial setae) (versus notogastral setae short, similar in length to exobothridial setae in *R. paraarcuata*).

Etymology. The species name is dedicated to our friend and colleague, soil zoologist Dr. Leonid B. Rybalov (A.N. Severtsov Institute of Ecology and Evolution, Moscow, Russia).

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НОВЫЕ ФАУНИСТИЧЕСКИЕ И ТАКСОНОМИЧЕСКИЕ ДАННЫЕ О ПАНЦИРНЫХ КЛЕЩАХ (ACARI, ORIBATIDA) ЭФИОПИИ

С. Г. Ермилов^{1, *}, У. Я. Штанчаева^{2, **}, Л. С. Субиас^{2, ***}

¹Тюменский государственный университет, Тюмень, 625003 Россия

²Университет Комплутенсе, Мадрид, 28040 Испания

*e-mail: ermilovacari@yandex.ru

**e-mail: umikusum@mail.ru

***e-mail: subias@bio.ucm.es

Настоящее исследование базируется на материале, собранном в национальном парке Борена-Сайнт в Эфиопии. Представлены перечень идентифицированных таксонов, включающий 41 вид из 34 родов и 24 семейств, и новые находки для фауны Эфиопии и Афротропической области. Описан один новый вид рода; *R. rybalovi* sp. n. отличается от *R. paraarcuata* Ermilov et Starý 2018 меньшими размерами тела, а также наличием продорсальных костул, эпимеральных туберкул и более длинных ногогастральных щетинок.

Ключевые слова: акарофауна, *Ramusella*, таксономия, морфология, Афротропическая область