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Ethiopian oribatid mites of the family Scheloribatidae (Acari: Oribatida)

Sergey G. Ermilov[1*], Leonid B. Rybalov[2] and **Kerstin Franke[3]**

[1]Laboratory of Entomology, Phytosanitary Department, Nizhniy Novgorod Referral Center of the Federal Service for Veterinary and Phytosanitary Inspection, prospekt Gagarina 97, Nizhniy Novgorod, 603107 Russia; ErmilovAcari@yandex.ru

[2]Laboratory for Soil Zoology and General Entomology, Institute of Ecological and Evolutionary Problems, Russian Academy of Sciences, Leninskiy prospekt 33, Moscow, 117071 Russia; lrybalov52@mail.ru

[3]Section Arachnida, Senckenberg Museum of Natural History Goerlitz, Am Museum 1, Goerlitz, 02826 Germany; Kerstin.Franke@senckenberg.de

[*]Corresponding author

ABSTRACT

We have registered eight species and three genera (*Scheloribates* Berlese, 1908, *Similobates* Mahunka, 1982, *Perscheloribates* Hammer, 1973) of Scheloribatidae from southern Ethiopia. Two species of *Scheloribates*—*S. discifer* and *S. latipes*—and the genus *Perscheloribates* are reported from Ethiopia for the first time. Two new species, *Scheloribates acutirostrum* sp. n. and *Perscheloribates crassisetosus* sp. n. from Cholomu and Harenna forests, are described. The first is from soil, litter and mosses on trees, while the second is from litter. Identification keys to Ethiopian species of *Scheloribates* and African species of *Perscheloribates* are presented.

KEY WORDS: Oribatida, *Scheloribates*, *Perscheloribates*, mites, new species, new records, identification keys, Afrotropical, Ethiopia.

INTRODUCTION

Until recently, the oribatid mites of Ethiopia have been poorly studied (Berlese 1916; Aoki 1971; Mahunka 1982, 1983, 1984; Bernini 1988). However, investigations of these oribatids have increased, e.g. with the works of Niedbała (2008), Ermilov *et al.* (2010*a–h*, 2011, in press), and Niedbała & Ermilov (2011). The present work is part of a continuing study of the Ethiopian oribatid mite fauna, and focuses on species in the family Scheloribatidae. Worldwide, this family comprises 20 genera and 338 species that collectively have a cosmopolitan distribution (Subías 2004, online version 2011).

Only two species and two genera of Scheloribatidae have been reported previously from Ethiopia: *Scheloribates aethiopicus* Mahunka, 1982 and *Similobates demetororum* Mahunka, 1982. In the course of our taxonomic studies we have registered eight species and three genera (*Scheloribates* Berlese, 1908, *Similobates* Mahunka, 1982 and *Perscheloribates* Hammer, 1973) of Scheloribatidae from southern Ethiopia. We found representatives of two new species, one belonging to *Scheloribates* and another to *Perscheloribates*. The other identified scheloribatid taxa are presented below.

Scheloribates was proposed by Berlese (1908) with *Zetes latipes* Koch, 1844 as the type species. Currently, it comprises 221 species and is distributed worldwide (Subías 2004, online version 2011). The diagnostic characters of the genus *Scheloribates* are as following: lamellae well developed; prolamellae present, absent or partially developed; translamellar lines usually absent, but rarely incompletely present; sensilli with dilated head; pteromorphs immovable; notogaster with 10 pairs of setae or their alveoli; four or five pairs of sacculi on notogaster; four pairs of genital setae; legs tridactylous (e.g., Coetzer 1967–1968; Corpuz-Raros 1980; Lee & Pajak 1990).

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Perscheloribates was proposed by Hammer (1973) with *Perscheloribates clavatus* Hammer, 1973 as the type species. Currently, it comprises 41 species and have pantropical and subtropical distribution (Subías 2004, online version 2011). The diagnostic characters of *Perscheloribates* are as following: rostrum rounded; lamellae well developed; prolamellae present, absent or partially developed; translamellar lines usually absent, but rarely incompletely present; interlamellar setae long; sensilli with dilated head; pteromorphs immovable; notogaster with 10 pairs of setae or their alveoli; four pairs of sacculi on notogaster; four pairs of genital setae; lyrifissures *iad* adanal; legs monodactylous (e.g., Hammer 1973; Corpuz-Raros 1980).

MATERIAL AND METHODS

Samples (soil, mosses, lichens *etc*.) were processed in Tullgren funnels if another method is not specified.

Specimens of new species were studied in lactic acid, mounted on temporary cavity slides for the duration of the study, then were stored in 70% alcohol. All body measurements are presented in micrometres. Body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate, to avoid discrepancies caused by different degrees of notogastral distension. Notogastral width refers to the maximum width in dorsal aspect. Length of body setae was measured in lateral aspect.

Formulae of leg setation are given according to the sequence trochanter–femur–genu–tibia–tarsus (famulus included). Formulae of leg solenidia are given (in square brackets) according to the sequence genu–tibia–tarsus.

The holotype material is deposited at the Zoological Institute of the Russian Academy of Sciences, St Petersburg, Russia (ZISP). The paratype material is deposited at the Siberian Zoological Museum, Novosibirsk, Russia (SZMN) and is in the personal collection of the first author (PC).

List of collecting sites

S-1: 8°53'N:38°09'E, 2900 m, 10 km south of Ginchi city, Cholomu Forest (woody species, in particular *Hagenia abissinica* and *Podocarpus* forming the canopy; undergrowth of ferns), in mosses on trees, 15.xi.2009, L.B. Rybalov.

S-2: 6°42'N:39°43'E, 2249 m, Bale Mountains National Park, Harenna Forest (woody species, *H. abissinica* forming the canopy), in mosses on trees, 23.xi.2009, L.B. Rybalov.

S-3: 6°49'N:39°49'E, 4367 m, Bale Mountains National Park, Sanetti plateau, Batu mountain peak, plants *Artemisia* spp. and *Oxytriops* spp., 23.xi.2009, L.B. Rybalov.

S-4: 6°42'N:39°43'E, 4050 m, Bale Mountains National Park, Sanetti plateau, Afro-Alpine tundra, mosses and soil near a bog, 23.xi.2009, L.B. Rybalov.

S-5: 6°38'N:39°43'E, 1883 m, Bale Mountains National Park, Harenna Forest (woody species, in particular *H. abissinica* forming the canopy), in soil, 23.xi.2009, L.B. Rybalov.

S-6: 6°42'N:39°43'E, 2249 m, Bale Mountains National Park, Harenna Forest (woody species, in particular *H. abissinica* forming the canopy), in soil, 23.xi.2009, L.B. Rybalov.

S-7: 8°53'N:38°09'E, 2920 m, 10 km south of Ginchi city, Wenchi crater, Cholomu Forest (*H. abissinica* forming the canopy), plants on rock, 20.xi.2010, L.B. Rybalov & A.I. Bastrakov.

S-8: 8°53'N:38°09'E, 2810 m, 10 km south of Ginchi city, Cholomu Forest (*H. abissinica* forming the canopy), in litter, 28.xi.2010, L.B. Rybalov & A.I. Bastrakov.

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S-9: 8°53'N:38°09'E, 3300 m, 10 km south of Ginchi city, Wenchi crater, Cholomu Forest (*Erica* forming the canopy), plant mosses, 20.xi.2010, L.B. Rybalov & A.I. Bastrakov.
S-10: 8°53'N:38°09'E, 2810 m, 10 km south of Ginchi city, Cholomu Forest (*H. abissinica* forming the canopy), sifting filter, 04.xi.2010, L.B. Rybalov & A.I. Bastrakov.
S-11: same as S-10, but lichens on trees.
S-12: same as S-10, but leaf litter.
S-13: same as S-10, but mosses on trees.
S-14: same as S-10, but in soil.
S-15: same as S-10, but mosses and orchids on trees.

TAXONOMY

Family Scheloribatidae Grandjean, 1933

We found representatives of three genera and eight species of the family, as follow:
Scheloribates acutirostrum sp. n. Localities: S-1, S-5, S-12.
S. aethiopicus Mahunka, 1982. Localities: S-1, S-2, S-3, S-4, S-5, S-6, S-9, S-10, S-13, S-14, S-15.
S. discifer Balogh, 1959. Localities: S-3, S-4, S-5, S-6, S-8, S-10. First record for Ethiopia.
S. latipes (Koch, 1844). Localities: S-1, S-5, S-6, S-7, S-8, S-9, S-10, S-11, S-12. First record for Ethiopia.
Similobates demetororum Mahunka, 1982. Localities: S-5, S-8, S-10.
Perscheloribates crassisetosus sp. n. Localities: S-8, S-10.
P. ? *luminosus* (Hammer, 1961). Locality: S-10. First record for Ethiopia. Our specimens are similar to the description of *P. luminosus* in all characters. However Hammer (1961) does not give information about the prolamella, therefore we cannot make a definitive identification (our specimens lack a prolamella). We also have no identified material of *P. luminosus* for comparison. Thus, we tentatively name our species *P. luminosus*.
P. minutus (Pletzen, 1965). Localities: S-1, S-5. First record for Ethiopia.

Genus *Scheloribates* Berlese, 1908

Scheloribates acutirostrum sp. n.

Figs 1–3

Etymology: From Latin *acutus* (point) and rostrum, referring to the pointed rostrum.

Diagnosis: This species is distinguished by the following combination of character states: body size 614–697 × 448–481; dorsal and ventral surfaces of body smooth; rostrum pointed; translamellar line present, thin, interrupted medially; sensilli spindle-form, barbed, with short apical part; one pair of notogastral setae and nine pairs of notogastral alveoli; prolamellae absent; tarsi I each with 19 setae.

Description:

Measurements. Body length 647 (holotype ♂), 614–697 (paratypes: 3♂, 1♀); body width 481 (holotype ♂), 448–481 (paratypes: 3♂, 1♀).
Integument. Body brown. Dorsal and ventral surfaces of body smooth. Lateral surfaces of body weakly granulate.
Prodorsum (Figs 1A; 2A–C). Rostrum pointed in dorsoventral view. Lamellae more than half of prodorsum. Translamellar line present; thin, interrupted medially. Rostral (*ro*,

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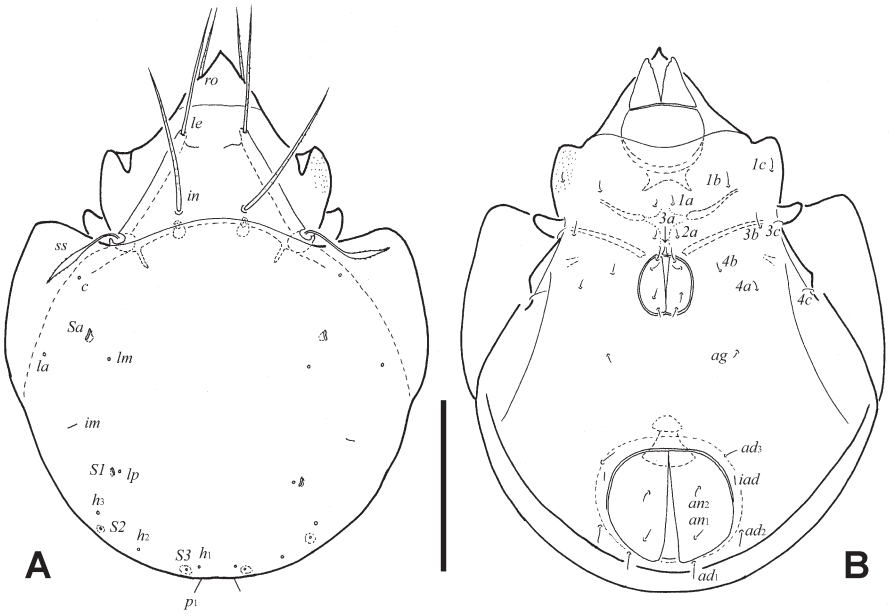

Fig. 1. *Scheloribates acutirostrum* sp. n.: (A) dorsal view, legs not shown; (B) ventral view, legs, palps and subcapitular setae not shown. Scale bar = 200 μm.

94–102), lamellar (*le*, 155–172) and interlamellar (*in*, 196–229) setae setiform, barbed. Sensilli (*ss*, 102–116) spindle-form, barbed; apical part short. Lateral region (Fig. 2B) with prolamella absent but sublamellar line present. Sublamellar areae porosae oblong or oval (*Al*, 12–16 × 4–8). Exobothridial setae (*ex*, 12) thin, slightly barbed.

Notogaster (Fig. 1A). Dorsosejugal suture weakly convex medially. Only one pair of thin, smooth notogastral setae (p_1, 12) present; other nine pairs represented only by alveoli. Sacculi *Sa* and *S1* oblong, distinct; *S2* and *S3* very small, inconspicuous. Opisthonotal gland opening and lyrifissures inconspicuous (except *im*) but present in typical arrangement for genus.

Anogenital region (Figs 1B; 2D–F). Two pairs anal (an_1, an_2, 20–24), three pairs adanal (ad_1–ad_3, 24), one pair aggenital (*ag*, 12–16) and four pairs of genital (g_1, 24–28; g_2–g_4, 16–20) setae setiform, smooth. Lyrifissures *iad* in typical position for genus. Ovipositor: length of lobes 86–90, length of cylindrical distal part (bDp) 98–110, width of cylindrical distal part 41–49. All setae of ovipositor setiform, smooth. Lobe setae $\psi_1 \approx \tau_1$ (36–41) longer than $\psi_2 \approx \tau_a \approx \tau_b \approx \tau_c$ (16–20). Coronal setae absent.

Epimeral region (Fig. 1B). Apodemes 1, 2, sejugal and circumpedal carina well-developed. Apodemes 3 present, but weakly visible. All epimeral setae (16–24) setiform, smooth.

Gnathosoma (Figs 3A–C). Subcapitulum longer than wide: 118–127 × 106–123. Hypostomal setae setiform, weakly and indistinctly barbed; *h* (41) longer than *m* (32) and *a* (24). Lateral lips with two pairs of adoral setae (or_1, or_2, 12–16), setiform, barbed. Palps (length 82–102) with setation 0–2–1–3–9(+1ω). All setae (except some on tarsi) weakly and indistinctly barbed. Chelicerae (length 151–164) chelate-dentate; cheliceral setae setiform, barbed, *cha* (57–65) longer than *chb* (32–41).

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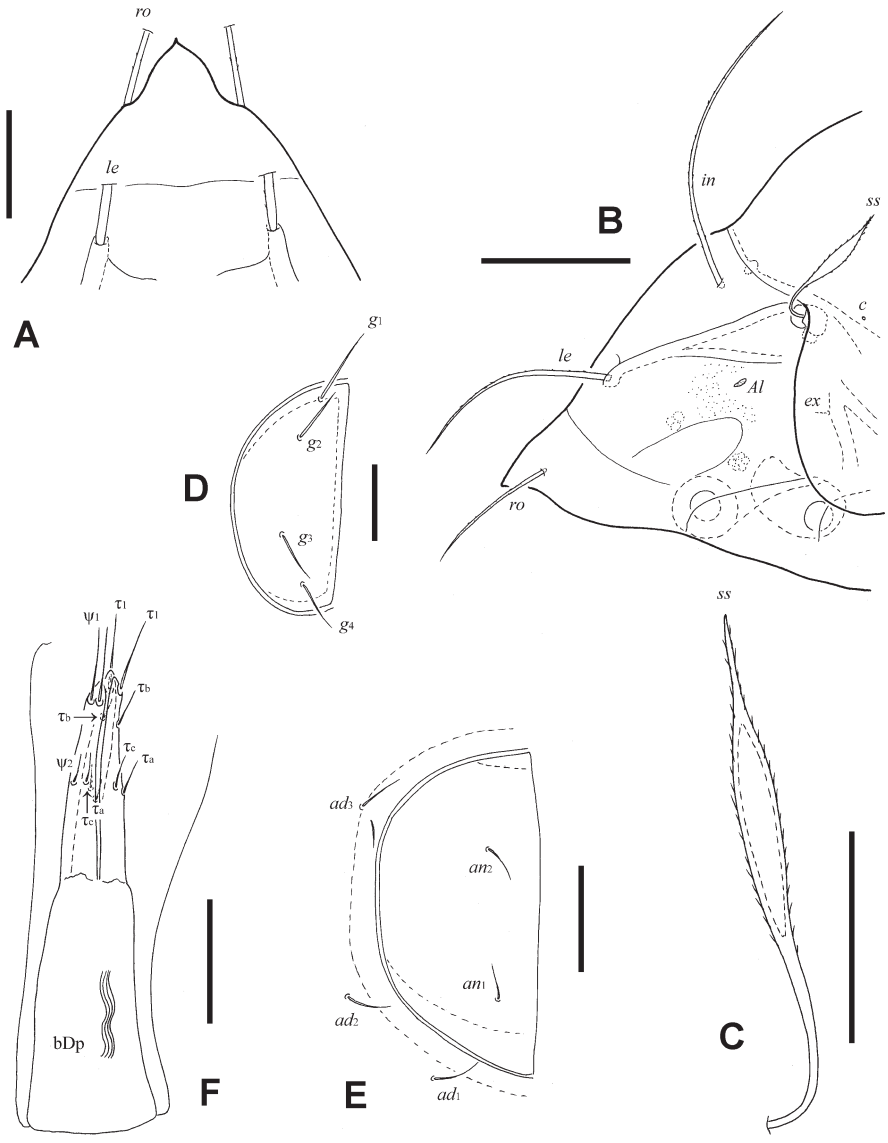

Fig. 2. *Scheloribates acutirostrum* sp. n.: (A) rostrum; (B) lateral view of prodorsum, gnathosoma and legs not shown; (C) sensillus; (D) genital plate, right; (E) anal plate, right, and adanal setae; (F) ovipositor. Scale bars A, C, E, F = 50 µm; B = 100 µm; D = 20 µm.

Legs (Figs 3D, 3E). Morphology of segments similar to other species of *Scheloribates* (e.g., Bayartogtokh 2000). Formulae of leg setation and solenidia: I (1–5–3–4–19) [1–2–2], II (1–5–2–4–15) [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. Almost all setae barbed. Famulus short, straight, blunt-ended. Solenidia ω_1 on tarsi I, ω_1 and ω_2 on tarsi II, rod-shaped; other solenidia setiform.

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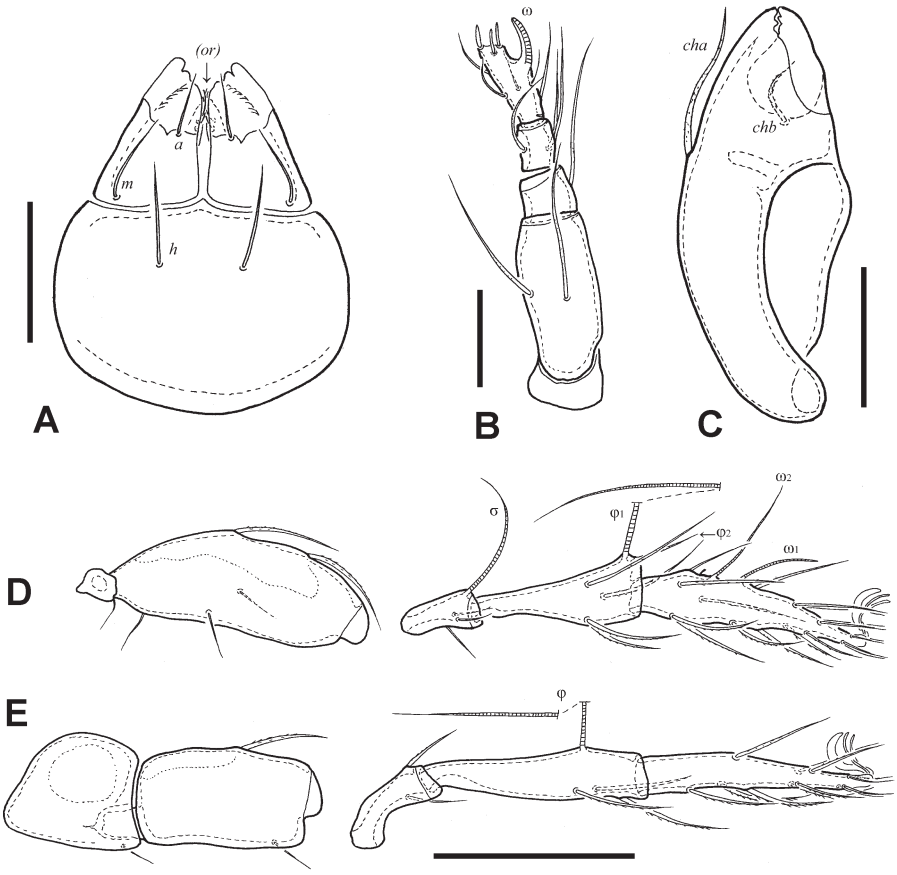

Fig. 3. *Scheloribates acutirostrum* sp. n.: (A) subcapitulum; (B) palp; (C) chelicera; (D) leg I, right, paraxial view; (E) leg IV, right, paraxial view. Scale bars A, C = 50 µm; B = 20 µm; D, E = 100 µm.

Holotype: ♂ ETHIOPIA: Locality S-1 (ZISP).

Paratypes: ETHIOPIA: Localities S-1 (1♀ PC), S-5 (2♂ SZMN), S-12 (1♂ SZMN).

Distribution: At present, this species is known only from Ethiopia.

Remarks: In having the combination of a pointed rostrum, spindle-form sensilli and prolamella absent *S. acutirostrum* sp. n. is similar to *S. sphaeroides* Hammer, 1973 from Polynesia and the Galapagos Islands (Hammer 1973). It differs from the latter in the relative length of interlamellar and lamellar setae (*in* longer than *le* in *S. acutirostrum*; *in* not longer than *le* in *S. sphaeroides*), the shape of the sensilli (head well developed, barbed and with short apical part in *S. acutirostrum*; head weakly developed, smooth and with long apical part in *S. sphaeroides*) and the presence of only notogastral setae p_1 (p_1, h_1–h_3 present in *S. sphaeroides*). In having the combination of a pointed rostrum and spindle-form sensilli, *S. acutirostrum* sp. n. is similar to *S. rostrodentatus* Hammer, 1977 from Pakistan (Hammer 1977), but differs from the latter by having smaller body (614–697 *vs* 980 in *S. rostrodentatus*) and in the absence of a prolamella (present in *S. rostrodentatus*).

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TABLE 1

Leg setation and solenidia of *Scheloribates acutirostrum* sp. n. Roman letters refer to normal setae (*e* – famulus), Greek letters refer to solenidia. One apostrophe (') marks setae on anterior, double apostrophe (") setae on posterior, side of the given leg segment. Parentheses refer to a pair of setae.

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	v'	d, (l), bv'', v''	(l), v', σ	(l), (v), φ_1, φ_2	(ft), (tc), (it), (p), (u), (a), s, (pv), v', (pl), e, ω_1, ω_2
II	v'	d, l'_1, l'_2, bv'', v''	(l), σ	(l), (v), φ	(ft), (tc), (it), (p), (u), (a), s, (pv), ω_1, ω_2
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)

Key to Ethiopian species of *Scheloribates*

1 Rostrum pointed; sensilli spindle-form ..... **acutirostrum** sp. n.
– Rostrum with rounded apex; sensilli with rounded head distally 2
2 Translamellar line present, interrupted medially; all notogastral setae developed ..... **aethiopicus** Mahunka, 1982
– Translamellar line absent; some notogastral setae presented by alveoli 3
3 Sensilli very short (length of head slightly longer than diameter of bothridia), with oval head ..... **discifer** Balogh, 1959
– Sensilli long (length of head considerably longer than diameter of bothridia), with noticeably oblong head ..... **latipes** Koch, 1844

Genus *Perscheloribates* Hammer, 1973
Perscheloribates crassisetosus sp. n.

Figs 4–6

Etymology: From Latin *crassus* (thick) and seta, referring to the thickened lamellar setae.

Diagnosis: This species is distinguished by the following combination of character states: body size 481–514 × 348–365; translamellar line present, interrupted medially; lamellar setae thickened; sensilli long, with asymmetrically dilated, barbed head; one pair of muscle sigilla present posterior to each saccule *Sa*, three pairs of muscle sigilla present posterior to each saccule *S1*; prolamella present; coronal setae of ovipositor present; hypostomal setae *a* thicker than others, setae *m* very short; tarsi I with 18 setae.

Description:

Measurements. Body length 481 (holotype ♂), 514 (paratype ♀); body width 348 (holotype ♂), 365 (paratype ♀).
Integument. Body brown. Dorsal and ventral surfaces of body smooth. Lateral surfaces of body weakly granulate.
Prodorsum (Figs 4A; 5A–C). Rostrum rounded in dorsal view. Lamellae more than half length of prodorsum. Translamellar line present; thin, interrupted medially. Rostral (57–65) and interlamellar (151–159) setae setiform, barbed. Lamellar setae (155–172) unusually thickened in basal half, ciliate. Sensilli long (94), with asymmetrically dilated head; head shorter than stalk, slightly barbed. Lateral region (Fig. 5A) with prolamella present and sublamellar line long. Sublamellar areae porosae oblong or oval (8–12 ×

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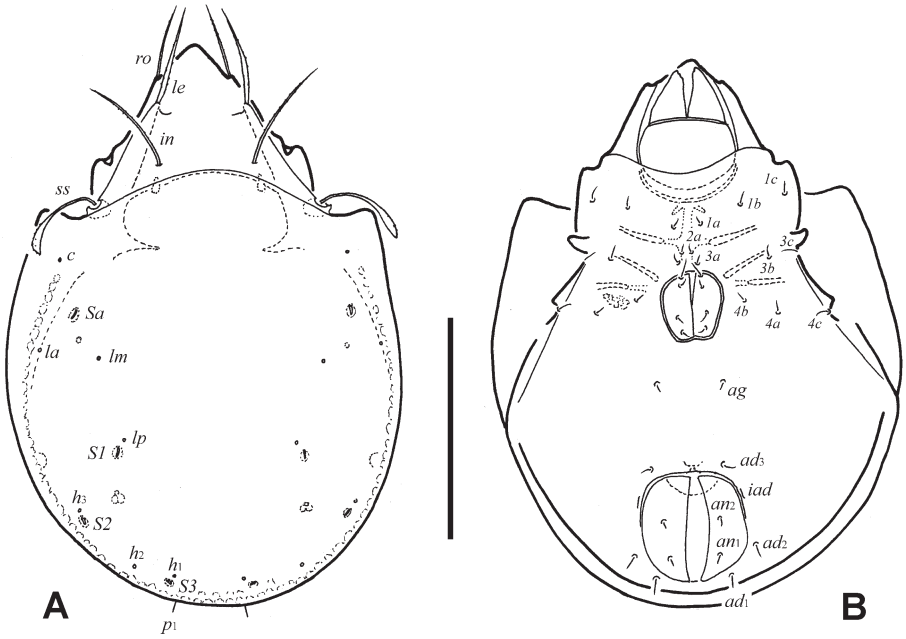

Fig. 4. *Perscheloribates crassisetosus* sp. n.: (A) dorsal view, legs not shown; (B) ventral view, legs, palps and subcapitular setae not shown. Scale bar = 200 µm.

4–6). Lateral carina (*kf*) as typical for many Scheloribatidae species, but part parallel to sublamellar line longer, more prominent. Exobothridial setae (*ex*, 8) thin, slightly barbed.

Notogaster (Fig. 4A). Dorsosejugal suture weakly convex medially. Only one pair of thin, smooth notogastral setae present (p_1, 16); nine other pairs presented by alveoli. All sacculi oblong, distinct. One pair of muscle sigilla (not sacculi) present posterior to each saccule *Sa*. Three pairs of muscle sigilla present posterior to each saccule *S1*. Circumgastric band of muscle sigilla distinct. Opisthonotal gland opening and lyrifissures indistinct, but developed in typical arrangement for genus.

Anogenital region (Figs 4B; 5D–F). Two pairs anal (8–12), three pairs adanal (20), one pair aggenital (8–12) and four pairs of genital (g_1, 20; g_2–g_4, 8–12) setae setiform, smooth. Lyrifissures *iad* in typical position for genus. Ovipositor: length of lobes 86, length of cylindrical distal part 96, width of cylindrical distal part 32. All setae of ovipositor setiform, smooth. Lobe setae $\psi_1 \approx \tau_1$ (24) longer than $\psi_2 \approx \tau_a \approx \tau_b \approx \tau_c$ (14). Coronal setae present (*k*, 8).

Epimeral region (Fig. 4B). Apodemes 1, 2, sejugal, 3 and circumpedal carina well-developed. All epimeral setae (12–20) setiform, smooth.

Gnathosoma (Figs 6A–C). Subcapitulum longer than wide: 118 × 102. Hypostomal setae setiform; *a* (26) slightly longer and thicker than *h* (24), both hardly barbed, setae *m* very short (8), smooth. Lateral lips with two pairs of adoral setae (12), setiform, barbed. Palps (length 73) with setation 0–2–1–3–9(+1ω). All setae (except some on tarsi) weakly and indistinctly barbed. Chelicerae (length 131) chelate-dentate; cheliceral setae setiform, barbed, *cha* (61) longer than *chb* (32).

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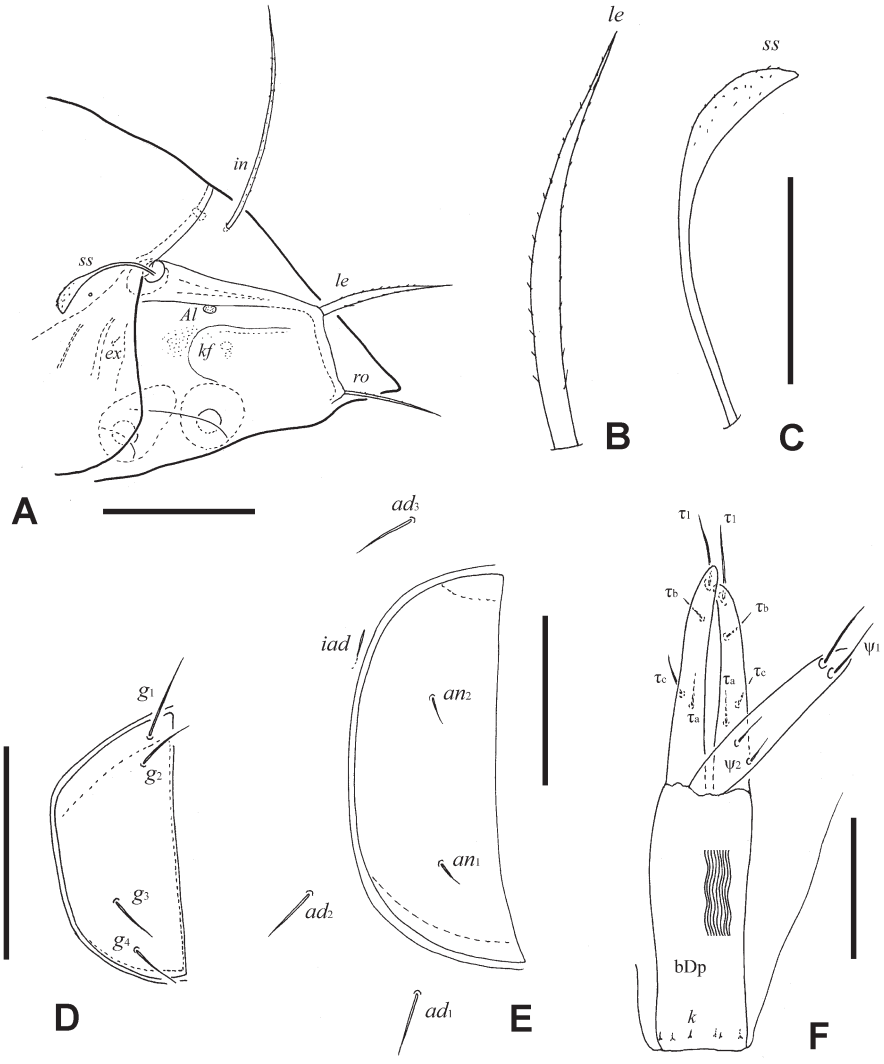

Fig. 5. *Perscheloribates crassisetosus* sp. n.: (A) lateral view of prodorsum, gnathosoma and legs not shown; (B) lamellar seta; (C) sensillus; (D) genital plate, right; (E) anal plate, right, and adanal setae; (F) ovipositor. Scale bars A = 100 µm; B–F = 50 µm.

Legs (Figs 6D, 6E). Formulae of leg setation and solenidia: I (1–5–3–4–18) [1–2–2], II (1–5–2–4–15) [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 2. Almost all setae barbed. Famulus short, straight, blunt-ended. Solenidia ω_1 on tarsi I, ω_1 and ω_2 on tarsi II, rod-shaped; other solenidia setiform.

Holotype: ♂ ETHIOPIA: Locality S-8 (ZISP).

Paratype: ETHIOPIA: ♀ Locality S-10 (PC).

Distribution: At present, this species is known only from Ethiopia.

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TABLE 2

Leg setation and solenidia of *Perscheloribates crassisetosus* sp. n. For explanation see Table 1.

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	*v′*	*d*, (*l*), *bv″*, *v″*	(*l*), *v′*, σ	(*l*), (*v*), φ_1, φ_2	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), (*pl*), *e*, ω_1, ω_2
II	*v′*	*d*, l'_1, l'_2, *bv″*, *v″*	(*l*), σ	(*l*), (*v*), φ	(*ft*), (*tc*), (*it*), (*p*), (*u*), (*a*), *s*, (*pv*), ω_1, ω_2
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*)

Remarks: In having the combination of long sensilli, with asymmetrically dilated and slightly barbed head, and the presence of translamellar line (interrupted medially), *P. crassisetosus* sp. n. is very similar to *P. luminosus* from the tropics (Hammer 1961); however, it clearly differs from the latter by having a larger body (481–514 *vs* 420 in *P. luminosus*) and thicker lamellar setae (thin in *P. luminosus*).

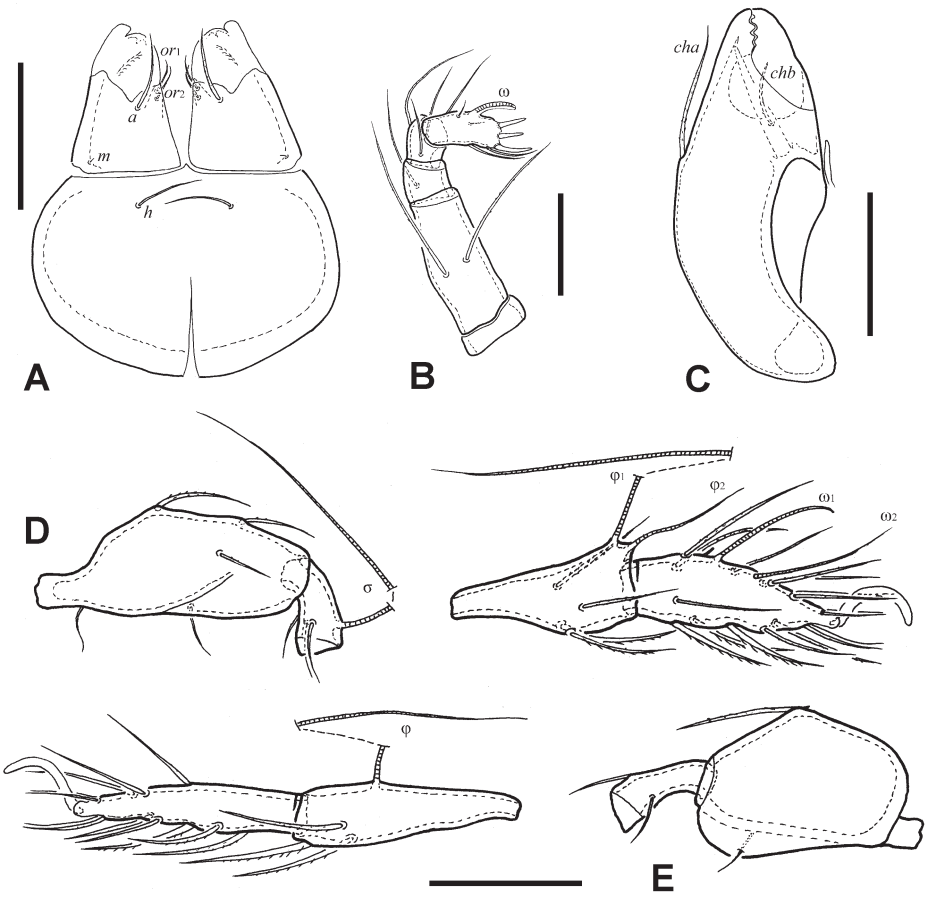

Fig. 6. *Perscheloribates crassisetosus* sp. n.: (A) subcapitulum; (B) palp; (C) chelicera; (D) leg I, right, antiaxial view; (E) leg IV, right, antiaxial view. Scale bars A, C–E = 50 µm; B = 20 µm.

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Key to African species of *Perscheloribates*

1 Translamellar line absent 2
– Translamellar line always present (interrupted medially) 4

2 Aggenital setae absent ..... **ethiopicus** (Mahunka, 1986)
– Aggenital setae present 3

3 All notogatral setae present, considerably longer than diameter of bothridia ..... **shiraensis** (Evans, 1953)
– Dorsal notogatral setae absent (only alveoli present), caudal setae not longer than diameter of bothridia ..... **rustenburgensis** (Pletzen, 1963)

4 Prolamella short, not reaching insertion of rostral setae ..... **minimus** Mahunka, 1992
– Prolamella long, reaching insertion of rostral setae or absent 5

5 Sensilli spindle-form 6
– Sensilli lanceolate 7

6 Sensillar head barbed; notogastral setae p_1–p_3 present .... **minutus** (Pletzen, 1965)
– Sensillar head smooth; only notogastral setae p_1 present ..... **tzitzikamaensis** (Pletzen, 1963)

7 Lamellar setae clear thicker than rostral and interlamellar setae ..... **crassisetosus** sp. n.
– Lamellar setae not thickened ..... **luminosus** (Hammer, 1961)

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