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Two new species of oribatid mites of the family Carabodidae from Ethiopia (Acari: Oribatida)

SERGEY G. ERMILOV¹, EKATERINA A. SIDORCHUK² & LEONID B. RYBALOV³

¹Center of Independent Examinations-NN, Nizhniy Novgorod 603107, Russia,
e-mail: ErmilovAcari@yandex.ru

²Paleontological Institute, Russian Academy of Sciences, Moscow 117997, Russia

³Institute of Ecological and Evolutionary Problems, Russian Academy of Sciences, Moscow 117071, Russia

ABSTRACT. Two new species of oribatid mites of the family Carabodidae, *Carabodes (Klapperiches) dilatatus* sp. n. and *Austrocarabodes (Austrocarabodes) heterosetosus* sp. n., are described from Ethiopia. *Carabodes (Klapperiches) dilatatus* sp. n. belongs to the species group with clavate sensilli, interlamellar and notogastral setae dilated apically, surface of body with tubercles and is most similar to *Carabodes (Klapperiches) samoensis* (collected from Samoa Islands, Polynesia), but the latter has rather large head of sensilli; rostral and lamellar setae smooth; adanal setae *ad*₁ and *ad*₂ dilated apically. Among African species *Carabodes (Klapperiches) dilatatus* sp. n. is most similar in morphology of notogaster and ventral body side to *Carabodes (Klapperiches) pocsi* (collected from Tanzania), but the latter has short sensilli with large head; notogastral setae phylliform and approximately identical length. *Austrocarabodes (Austrocarabodes) heterosetosus* sp. n. is most similar in morphology of sensilli, lamellar and notogastral setae, and prodorsal transversal lath to *Austrocarabodes (Austrocarabodes) rugosus* (collected from Tanzania), but the latter has more widely body, spatulate lamellar setae and surface of notogaster without foveolae. List of all collected and identified Carabodidae species from Ethiopia is presented.

Key words: acarology, taxonomy, oribatid mites, new species, Carabodidae, Ethiopia.

INTRODUCTION

In the course of faunistic studies of Carabodidae mite fauna (Acari: Oribatida) of Ethiopia (African region) we have found six species. This family comprises more than 20 genera and 300 species, that cosmopolitan distributed. Earlier only one carabodid

species has been found and described from Ethiopia, *Austrocarabodes* (*Austrocarabodes*) *glabrus* MAHUNKA, 1982. In the present work, we propose and describe a new species from subgenus *Carabodes* (*Klapperiches*) MAHUNKA, 1978 and new species from subgenus *Austrocarabodes* (*Austrocarabodes*) HAMMER, 1966. List of four other identified Carabodidae species is presented further.

Carabodes (*Klapperiches*) comprises more than 40 species with cosmopolitan (except Antarctic region) distributions; only seven species of which are known from African region (SUBÍAS 2004). *Austrocarabodes* (*Austrocarabodes*) comprises more than 70 species with cosmopolitan (except Boreal region) distributions; about half species of which are known from African region (SUBÍAS 2004). Distinctive morphological characters of African species of *Carabodes* (*Klapperiches*) and *Austrocarabodes* (*Austrocarabodes*) were given in the keys of BALOGH and BALOGH (2002).

MATERIAL AND METHODS

Locality and habitat of the new species are characterized in the “Material examined” sections.

Specimens were studied and illustrated in lactic acid, mounted on temporary cavity slides for the duration of the study. All body measurements are presented in micrometers. 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. Some specimens of each species were dissected for detailed studies (gnathosoma, ovipositor, legs).

Formulas for leg setation are given according to the sequence trochanter–femur–genu–tibia–tarsus (famulus included). Formulas for leg solenidia are given according to the sequence genu–tibia–tarsus, for each leg.

DESCRIPTIONS OF NEW SPECIES

Family Carabodidae KOCH, 1837

Genus *Carabodes* KOCH, 1835

Subgenus *Carabodes* (*Klapperiches*) MAHUNKA, 1978

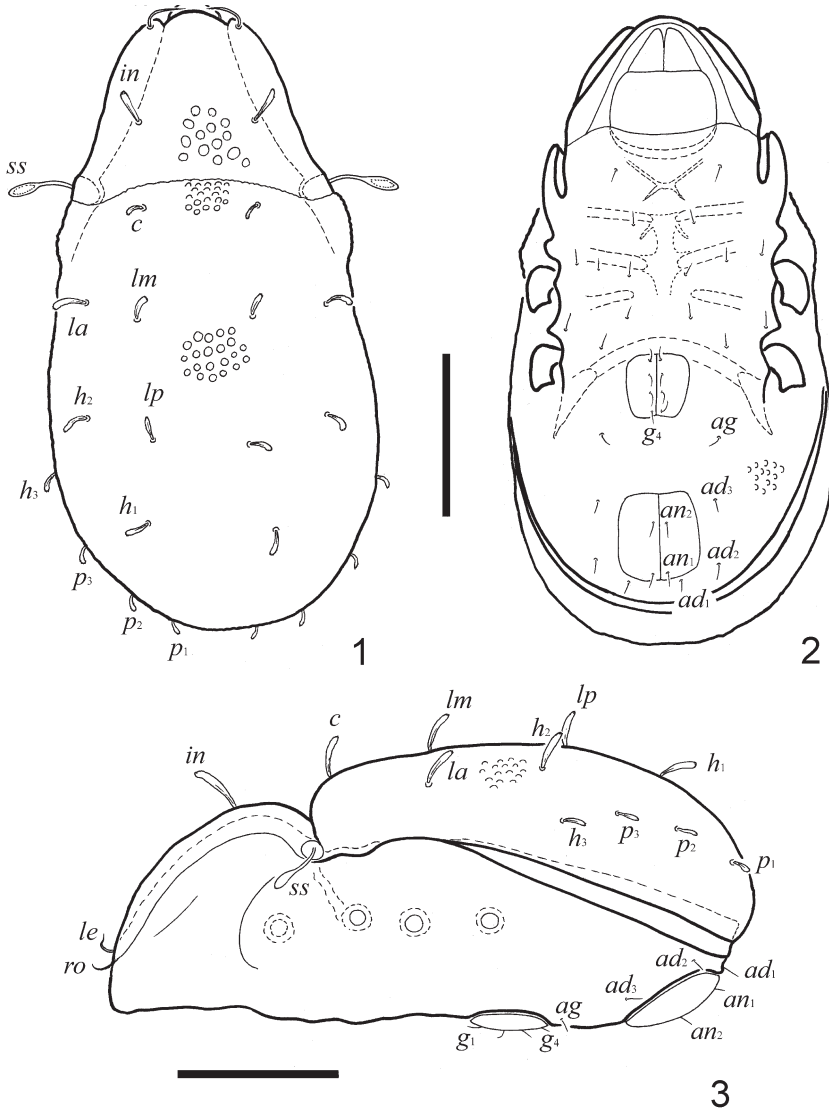
Carabodes (*K.*) *dilatatus* ERMILOV, SIDORCHUK & RYBALOV sp. n.

(Figs. 1-18)

DIAGNOSIS

With character states of *Carabodes* (*Klapperiches*) that were proposed by MAHUNKA (1978), and summarized by MAHUNKA (1986), by BALOGH and BALOGH (1992). New species is recognized by the size of body, 365-464 × 182-249; surface of body with tubercles; rostral setae (*ro*, 28-36) setiform, curved mediad, slightly barbed; lamellar setae (*le*, 36-45) setiform, thickened in median part, curved mediad, barbed; interlamel-

lar (*in*, 36-45) and notogastral (16-41) setae dilated apically, with serrated margins, slightly barbed; sensilli (*ss*, 45-53) with rather long stalk and smooth head; adanal, anal, aggenital and epimeral setae setiform, slightly barbed, approximately identical length (16-20); palps with setal formula 0-2-1-2-6(+1 ω).

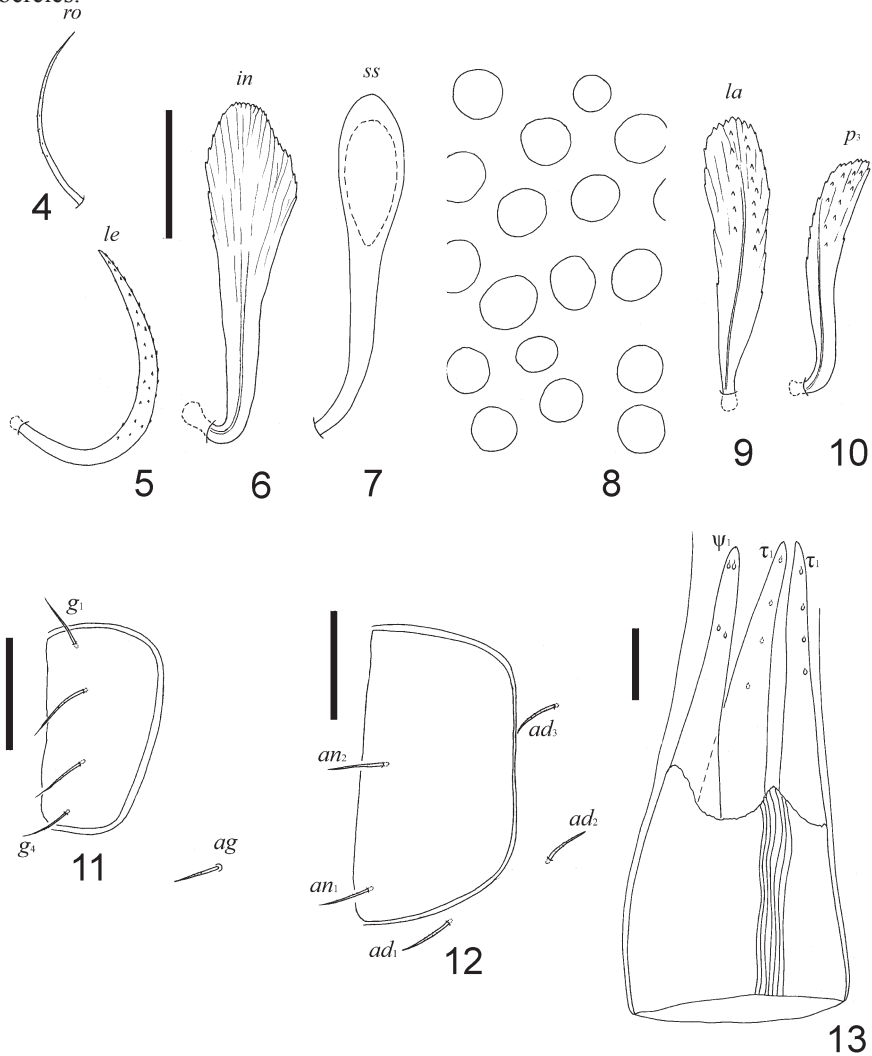


1-3. *Carabodes (K.) dilatatus* sp. n.: 1 – dorsal view, legs removed, 2 – ventral view, legs partly removed, 3 – lateral view, legs removed. Scale bar 100 μ m

DESCRIPTION

Measurements. Body length 365 (holotype, female), 431-464 (four paratypes, females), 381-431 (four paratypes, males); body width 182 (holotype, female), 215-249 (four paratypes, females), 182-215 (four paratypes, males).

Integument. Body color grey-yellow. Surface of body with tubercles. Tubercles hemispherical (maximum 8); distance between tubercles less than diameter of these tubercles.



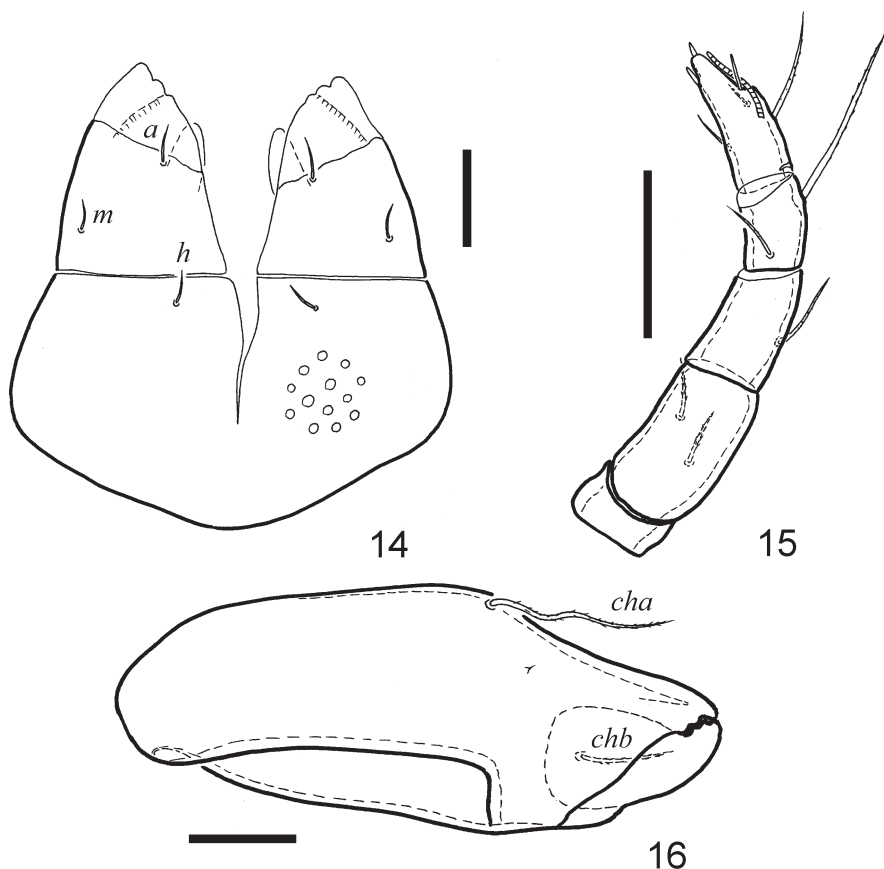
4-13. *Carabodes (K.) dilatatus* sp. n.: 4 – rostral seta, 5 – lamellar seta, 6 – interlamellar seta, 7 – sensillus, 8 – median part of notogaster with tubercles, 9 – notogastral seta *la*, 10 – notogastral seta *p*₃. Scale bar 20 μm; 11 – genital plate, left, and aggenital seta, 12 – anal plate, left, and adanal setae, 13 – ovipositor.

Scale bar 20 μm

Prodorsum (Figs. 3, 4-7). Rostral setae (28-36) setiform, curved mediad, slightly barbed. Lamellar setae (36-45) setiform, thickened in median part, curved mediad, barbed. Interlamellar setae (36-45) dilated apically, with serrated margins, slightly barbed. Sensilli (45-53) with rather long stalk and smooth head.

Notogaster (Figs. 3, 8-10). Ten pairs of notogastral setae (16-20 caudal setae and 28-41 others setae) dilated apically, with serrated margins, slightly barbed.

Anogenital region (Figs. 11-13). Two pairs of anal setae, three pairs of adanal setae, one pair of aggenital setae, four pairs of genital setae setiform, slightly barbed, approximately identical length (16-20); aggenital setae slightly shorter than others. Ovipositor typical for Carabodidae (ERMILOV 2010). Elongate, narrow (110-122 × 36-41), length of lobes 69-77, length of cylindrical distal part 41-45. Setae weakly developed, minute (1). Setae *k* and their alveoli not observed.



14-16. *Carabodes (K.) dilatatus* sp. n.: 14 – subcapitulum, 15 – palp, 16 – chelicera. Scale bar 20 μ m

Epimeral region (Figs. 2). Epimeral setal formula: 1–1–3–3; setae *1a*, *1c* and their alveoli absent. All setae setiform, straight or slightly curved, slightly barbed, approximately identical length (16–20).

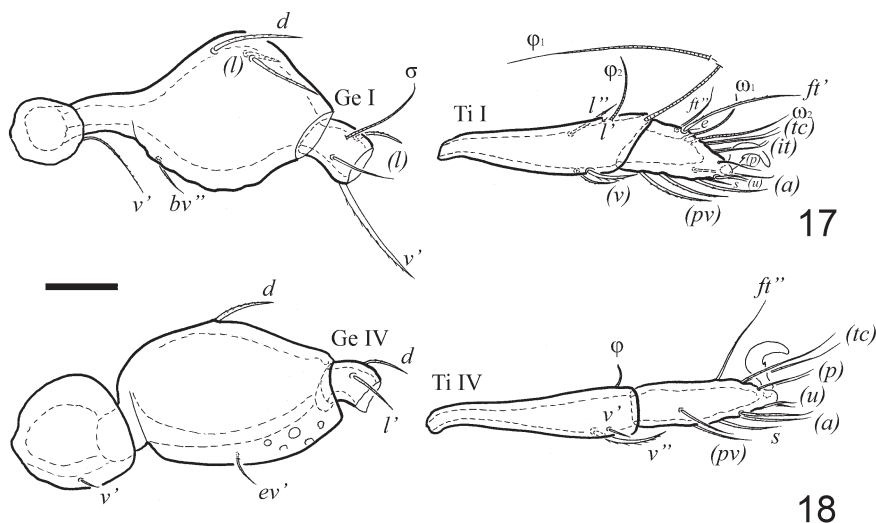
Gnathosoma (Figs. 14–16). Subcapitulum longer than wide: 86–98 × 73–77. Hypostomal setae *a*, *m*, *h* approximately equal length (10–12), setiform, slightly barbed. Adoral setae absent. Palp (49–57) with specific setation 0–2–1–2–6(+1 ω). Solenidion (ω) long, thick. Chelicera (length 106–114) with few blunt teeth on fixed and movable digits. Cheliceral setae setiform, barbed; *cha* (32–41) longer, than *chb* (16–20).

Legs (Figs. 17, 18). Claws with small thorn ventrally. Formulas of leg setation and solenidia: I (1–4–3–4–16) [1–2–2], II (1–4–3–3–15) [1–1–2], III (2–3–1–2–15) [1–1–0], IV (1–2–2–2–12) [0–1–0]; homology of setae and solenidia indicated in Table 1. Setae setiform, with barbs or ciliae. Solenidia ϕ_1 on tibiae I very long, setiform; other solenidia rod-like, straight or curved.

MATERIAL EXAMINED

Holotype and ten paratypes were obtained from: African region, Ethiopia, 6°38'N, 39°43'E, 1883 m above sea level, Bale Mountains National Park, Harena Forest, in soil, collected by L.B. Rybalov, 23.11.2009. Additional material: 1) five specimens ibid; 2) 15 specimens were obtained from: African region, Ethiopia, 6°42'N, 39°43'E, 2249 m above sea level, Bale Mountains National Park, Harena Forest (wood species, in particular, *Hagenia abissinica* forming the canopy), in soil, collected by L.B. Rybalov, 23.11.2009.

The holotype is deposited in the collection of Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia; eight paratypes ibid; two paratypes (dissected) are in the personal collection of the first author.



17–18. *Carabodes* (*K.*) *dilatatus* sp. n.: 17 – leg I, left, paraxial view, 18 – leg IV, left, anti-axial view; Ti, Ge – tibiae, genera, accordingly. Scale bar 20 μ m

Table 1. Leg setation and solenidia of *Carabodes (Klapperiches) dilatatus* sp. n.*

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	v'	d, (l), bv''	(l), v', σ	(l), (v), φ ₁ , φ ₂	(ft), (tc), (it), (p), (u), (a), s, (pv), e, ω ₁ , ω ₂
II	v'	d, (l), bv''	(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	(v), φ	(ft), (tc), (it), (p), (u), (a), s, (pv)
IV	v'	d, ev'	d, l'	(v), φ	ft'', (tc), (p), (u), (a), s, (pv)

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

REMARKS

Carabodes (Klapperiches) dilatatus sp. n. belongs to the *Carabodes (Klapperiches)* species group with clavate sensilli, interlamellar and notogastral setae dilated apically, surface of body with tubercles. New species is most similar to *Carabodes (Klapperiches) samoensis* BALOGH and BALOGH, 1986 collected from Polynesia, Samoa Islands (BALOGH and BALOGH 1986), but the latter has rather large head of sensilli; rostral and lamellar setae smooth; adanal setae ad_1 and ad_2 dilated apically. Among African species *Carabodes (Klapperiches) dilatatus* sp. n. is most similar in morphology of notogaster and ventral body side to *Carabodes (Klapperiches) pocsi* MAHUNKA, 1983 collected from Tanzania (MAHUNKA 1983a), but the latter has short sensilli with large head; notogastral setae phylliform and approximately identical length.

ETYMOLOGY

The specific name “*dilatatus*” refers to the shape of notogastral setae.

DISTRIBUTION

At present, this species is only known from Ethiopia.

Genus *Austrocarabodes* HAMMER, 1966**Subgenus *Austrocarabodes (Austrocarabodes)* HAMMER, 1966*****Austrocarabodes (A.) heterosetosus* ERMILOV, SIDORCHUK & RYBALOV sp. n.**

(Figs. 19-40)

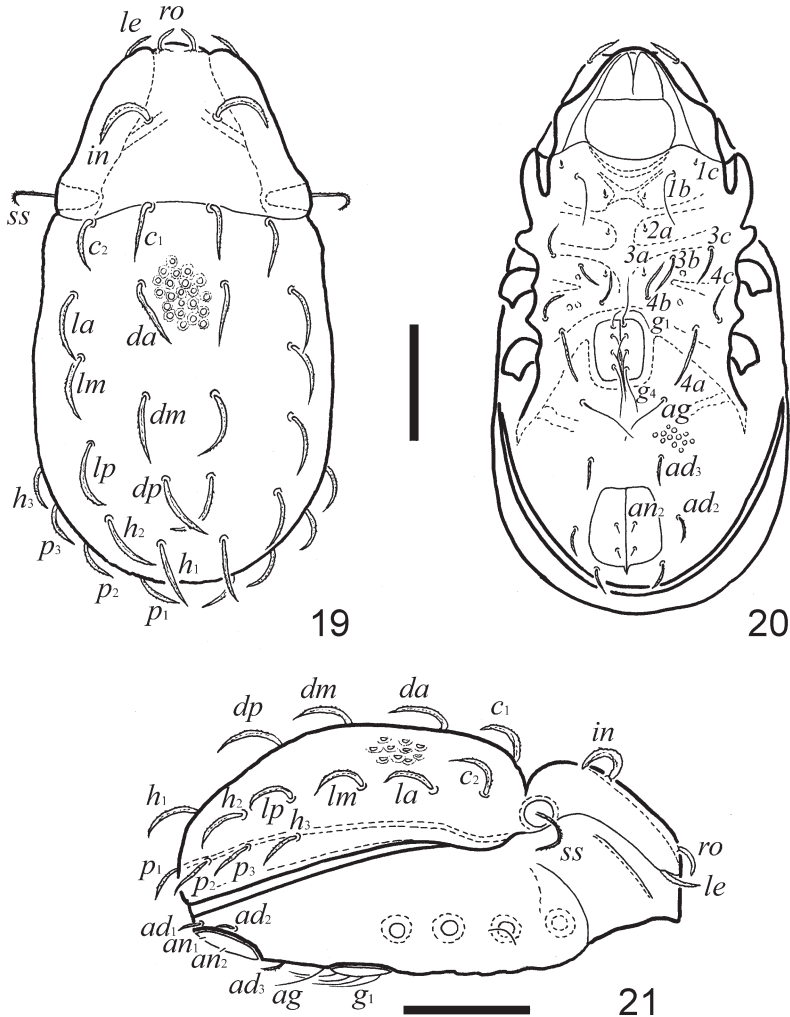
DIAGNOSIS

With character states of *Austrocarabodes (Klapperiches)* that were proposed by HAMMER (1966), and summarized by MAHUNKA (1986), by BALOGH and BALOGH (1992). New species is recognized by the size of body, 415-514 × 215-265; prodorsal transversal lath interrupted medially; surface of notogaster foveolate, foveolae with thickened margins; rostral (41-49), interlamellar (86-98) and notogastral (49-77) setae phylliform, with serrated margins, barbed; lamellar setae (53-65) phylliform, curved mediad, well

barbed; sensilli (65-73) thin, curved, ciliate; adanal setae phylliform; anal and aggenital setae long, setiform; epimeral setae *1a*, *1c*, *2a*, *3a* very short, lanceolate, barbed, epimeral setae *1b* longest, setiform, slightly barbed, other epimeral setae thickened, barbed; hypostomal setae *h* dilated apically, setae *m* dilated basally, with thin tips.

DESCRIPTION

Measurements. Body length 448 (holotype, male), 415-514 (two paratypes, males), 481-514 (two paratypes, females); body width 215 (holotype, male), 215-265 (two paratypes, males), 265 (two paratypes, females).



19-21. *Austrocarabodes (A.) heterosetosus* sp. n.: 19 – dorsal view, legs removed, 20 – ventral view, legs partly removed, 21 – lateral view, legs removed. Scale bar 100 μ m

Integument. Body color brown to dark brown. Surface of body with foveolae. Foveolae (maximum 12) with thickened margins; distance between foveolae subequal to their diameters.

Prodorsum (Figs. 19, 21-25). Prodorsal transversal lath interrupted medially; rostral (41-49) and interlamellar (86-98) setae phylliform, with serrated margins, barbed; lamellar setae (53-65) phylliform, curved mediad, well barbed. Sensilli (65-73) thin, curved, ciliate.

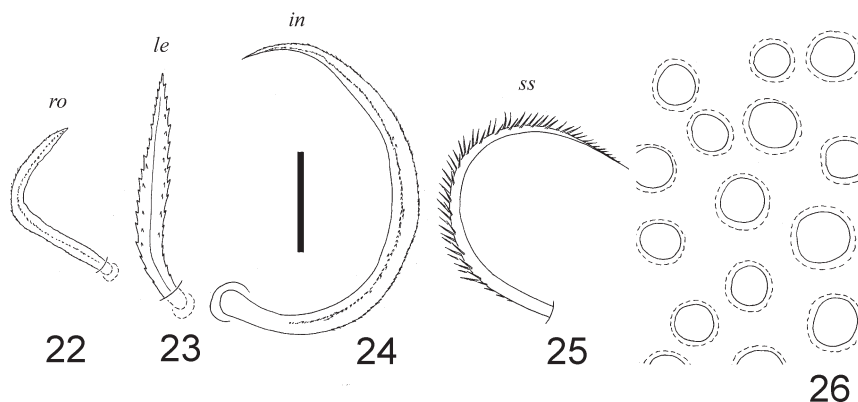
Notogaster (Figs. 19, 21, 26). Fourteen pairs of notogastral setae (49-61 caudal setae and 61-77 others setae) phylliform, with serrated margins, barbed.

Anogenital region (Figs. 27-31). Two pairs of anal setae (an_1 , an_2 , 12) simple, straight, smooth. One anal plate in two specimens with three anal setae. Adanal setae (24-32) slightly phylliform, barbed. One pair of aggenital and four pairs of genital setae long, approximately identical in length (45-57), setiform, thin, smooth. Ovipositor typical for Carabodidae (ERMILOV 2010). Elongate, narrow (155-171 × 53-61), length of blades 94-102, length of cylindrical distal part 61-69. Setae very short, $\psi_1 \approx \tau_1$ (2-3) longer than other setae (1). Setae k and their alveoli not observed.

Epimeral region (Figs. 32-35). Epimeral setal formula: 3-1-3-3. Epimeral setae with different length, 12-90. Setae $1a$, $1c$, $2a$, $3a$ very short, lanceolate, barbed; setae $1b$ longest, setiform, slightly barbed; other setae thickened, barbed.

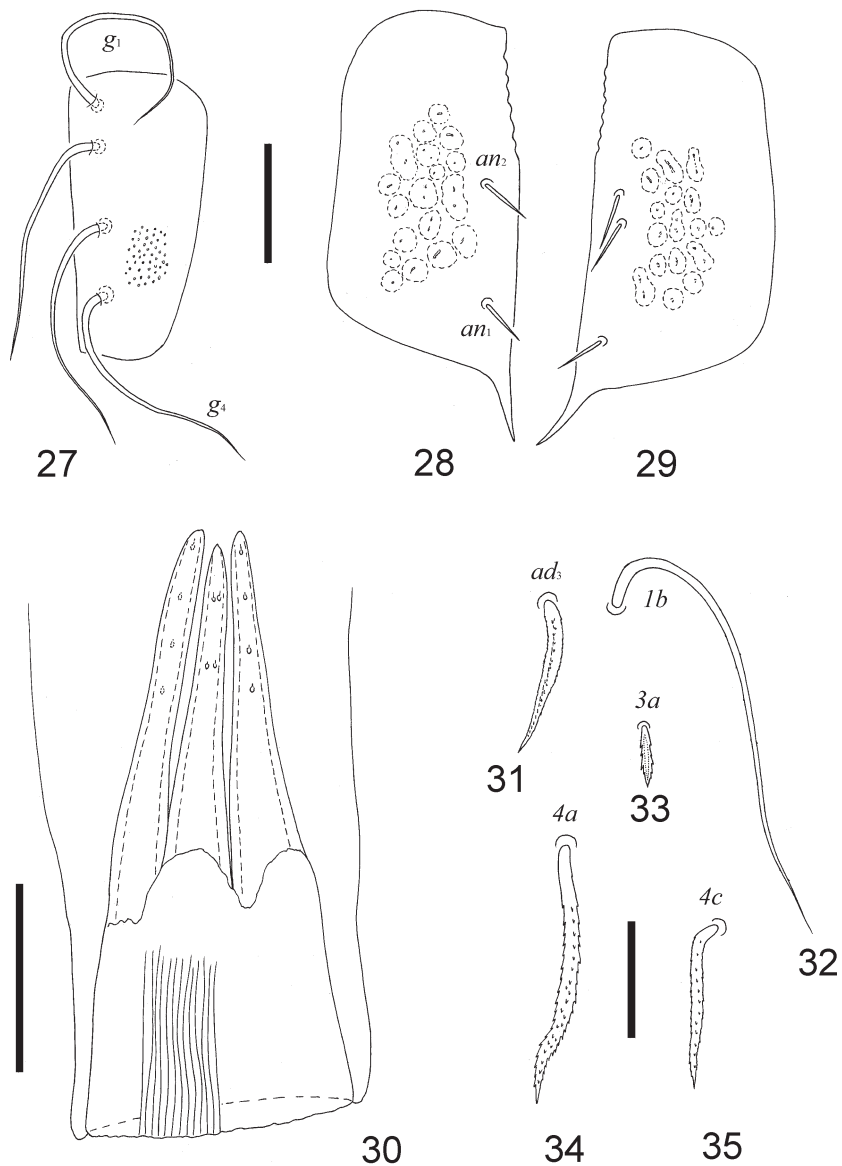
Gnathosoma (Figs. 36-38). Subcapitulum longer than wide: 110 × 82. Hypostomal setae h , 8-10, dilated apically, well barbed; setae m , 12-16, dilated basally, with thin tips, slightly barbed; setae a , 12-16, setiform, slightly barbed. Adoral setae absent. Palp (61) with setation 0-2-1-3-8(+1 ω). Solenidion (ω) long, thick. Chelicera (length 123) with few blunt teeth on fixed and movable digits. Cheliceral setae setiform, barbed; cha (45) longer, than chb (20).

Legs (Figs. 39, 40). Claws with small thorn ventrally. Formulas of leg setation and solenidia: I (1-4-3-4-16) [1-2-2], II (1-4-3-3-15) [1-1-2], III (2-3-1-2-15) [1-1-0], IV (1-2-2-2-11) [0-1-0]; homology of setae and solenidia indicated in Table 2. Setae setiform or fusiform, or dilated apically (except thorn-like u), with barbs



22-26. *Austrocarabodes (A.) heterosetosus* sp. n.: 22 – rostral seta, 23 – lamellar seta, 24 – interlamellar seta, 25 – sensillus, 26 – median part of notogaster with foveolae. Scale bar 20 μ m

or long ciliae. Solenidion ϕ_1 on tibia I very long, setiform; other solenidia rod-like, straight or curved.



27-35. *Austrocarabodes (A.) heterosetosus* sp. n.: 27 – genital plate, left, 28 – anal plate, left, 29 – anal plate with abnormal number of setae, right, 30 – ovipositor, 31 – adanal seta ad_3 , 32 – epimeral seta 1b, 33 – epimeral seta 3a, 34 – epimeral seta 4a, 35 – epimeral seta 4c. Scale bar (27-30, 31-35) 20 μm , scale bar (30) 50 μm

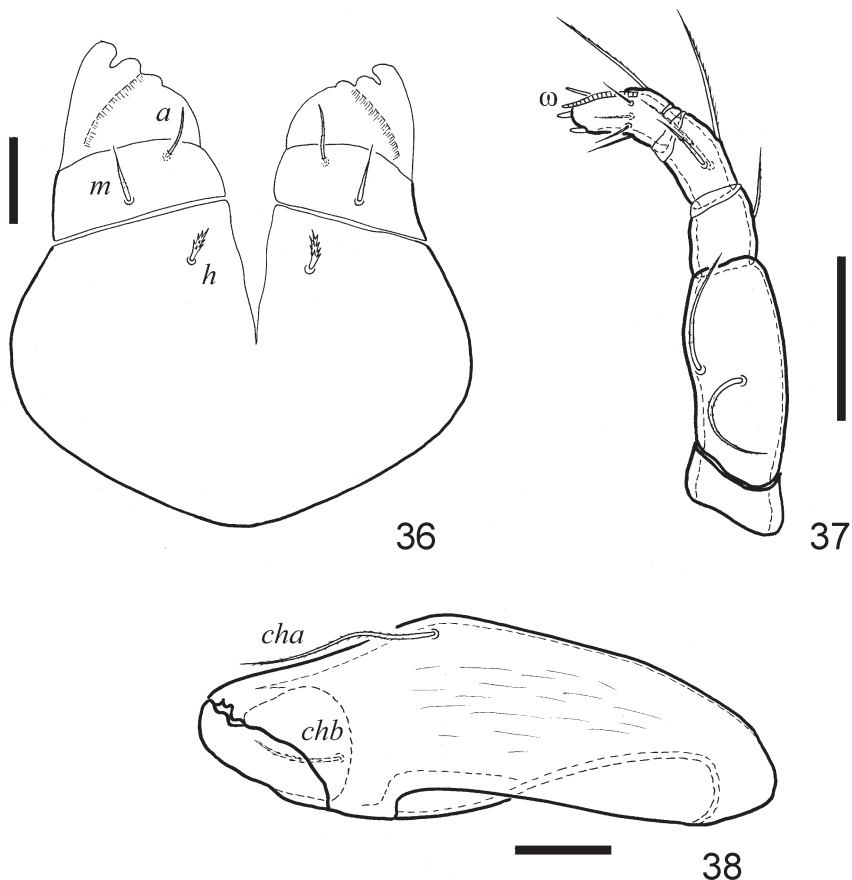
MATERIAL EXAMINED

Holotype and five paratypes were obtained from: African region, Ethiopia, 6°38'N, 39°43'E, 1883 m above sea level, Bale Mountains National Park, Harena Forest, in soil, collected by L.B. Rybalov, 23.11.2009. Additional material: 1) seven specimens *ibid*; 2) more than 20 specimens were obtained from: African region, Ethiopia, 6°42'N, 39°43'E, 2249 m above sea level, Bale Mountains National Park, Harena Forest (wood species, in particular, *Hagenia abissinica* forming the canopy), in soil, collected by L.B. Rybalov, 23.11.2009.

The holotype is deposited in the collection of Zoological Institute of Russian Academy of Sciences, St. Petersburg, Russia; paratypes *ibid*.

REMARKS

Austrocarabodes (Austrocarabodes) heterosetosus sp. n. is most similar in morphology of sensilli, lamellar and notogastral setae, and prodorsal transversal lath



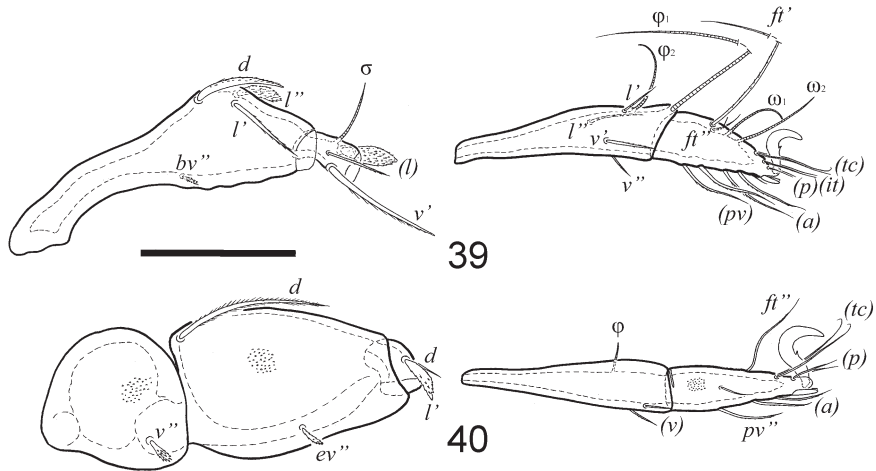
36-38. *Austrocarabodes (A.) heterosetosus* sp. n.: 36 – subcapitulum, 37 – palp, 38 – chelicera. Scale bar 20 μ m

Table 2. Leg setation and solenidia of *Austrocarabodes (Austrocarabodes) heterosetosus* sp. n.*

Leg	Trochanter	Femur	Genu	Tibia	Tarsus
I	v'	d, (l), bv''	(l), v', σ	(l), (v), φ ₁ , φ ₂	(ft), (tc), (it), (p), (u), (a), s, (pv), e, ω ₁ , ω ₂
II	v'	d, (l), bv''	(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	(v), φ	(ft), (tc), (it), (p), (u), (a), s, (pv)
IV	v'	d, ev'	d, l'	(v), φ	ft'', (tc), (p), (u), (a), s, pv''

*See Table 1 for explanation.

to *Austrocarabodes (A.) rugosus* MAHUNKA, 1969 collected from Tanzania (MAHUNKA 1969), but the latter has more widely body (294-313), spatulate lamellar setae and surface of notogaster without foveolae.



39-40. *Austrocarabodes (A.) heterosetosus* sp. n.: 39 – leg I, without trochanters, left, paraxial view, 40 – leg IV, left, antiaxial view; Ti, Ge – tibiae, genua, accordingly. Scale bar 50 μm

ETYMOLOGY

The specific name “*heterosetosus*” refers to the different shape of the epimeral setae.

DISTRIBUTION

At present, this species is only known from Ethiopia.

LIST OF OTHER COLLECTED AND IDENTIFIED CARABODIDAE SPECIES FROM ETHIOPIA

1. *Congocephus ornatus* MAHUNKA, 1983 (described from Tanzania; Mahunka 1983a). Earlier, this species has only been known from the type locality in Tanzania.

Material examined: one specimen was obtained from Bale Mountains National Park, Harena Forest, in soil, 6°38'N, 39°43'E, 1883 m above sea level, collected by L.B. Rybalov, 23.11.2009.

2. *Austrocarabodes (Austrocarabodes) sinuosociliatus* MAHUNKA, 1983 (described from Tanzania; MAHUNKA 1983b). Earlier, this species has only been known from the type locality in Tanzania. **Material examined:** 1) one specimens was obtained from Bale Mountains National Park, Harena Forest, in soil, 6°38'N, 39°43'E, 1883 m above sea level, collected by L.B. Rybalov, 23.11.2009; 2) two specimens were obtained from Bale Mountains National Park, Harena Forest (wood species, in particular, *Hagenia abissinica* forming the canopy), in soil, 6°42'N, 39°43'E, 2249 m above sea level, collected by L.B. Rybalov, 23.11.2009.

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