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Research article

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Revision of the genus *Attemsostreptus* Verhoeff, 1941 with description of a new species from Tanzania and notes on the tribe Trachystreptini Cook, 1896 (Spirostreptida, Diplopoda)

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Abstract. We revise the genus *Attemsostreptus* Verhoeff, 1941 based on type material of the type species, *A. costatus* Verhoeff, 1941, synonymise *A. orobius* (Kraus 1958) with *A. costatus* and describe a second species of the genus, *A. reflexus* sp. nov., collected from Kimboza Forest Reserve in Tanzania, and discuss the dubious tribe Trachystreptini.

Keywords. Millipedes, new species, synonymy, Tanzania, Trachystreptini.

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Introduction

The genus *Attemsostreptus* was first erected by Verhoeff in 1941 to accommodate the species he then described from the mountains in Tanzania's Morogoro Region, *Attemsostreptus costatus* Verhoeff, 1941. The genus remained monotypic for over forty years until Krabbe (1982) assigned to it a second species *Attemsostreptus orobius* (Kraus, 1958) described in the genus *Lophostreptus* (Kraus 1958). In her work on the systematics of Spirostreptida, Krabbe (1982) provided a diagnosis for the genus based on the gonopod structures and speculated that *A. orobius* might be a junior synonym to *A. costatus*, which would bring the genus back to the monotypic status.

A few spirostreptids collected during the 1990s by the NGO 'Frontier Tanzania' and kept in the Natural History Museum of Denmark were recently studied and turned out to represent a new species that we describe here and assign to *Attemsostreptus*. We formally synonymise *A. orobius* (Kraus, 1958) with *A. costatus* Verhoeff, 1941, based on Krabbe (1982) and on the study of type material of *A. costatus* kept in the Zoologische Staatssammlung München in Germany.

Material and methods

All studied specimens are preserved in 75% ethanol. Measurements and photographs were obtained with a Nikon DS-F2.5 camera mounted on a Nikon SMZ25 stereo microscope, using NIS-Elements Microscope Imaging Software with an Extended Depth of Focus (EDF) patch. Images were processed with Adobe Photoshop CS6 and assembled in Adobe InDesign CS6.

Terminology follows Hoffman (2008) and Enghoff (2017).

Institutional abbreviations

HNHM = Hungarian Natural History Museum

NHMW = Naturhistorisches Museum Wien

NHMD = Natural History Museum of Denmark (Zoological Museum), University of Copenhagen

ZSM = Zoologische Staatssammlung München

Morphological abbreviations

atp = antetorsal process

bs = basomere

H = vertical diameter

in = incision

L = body length

lap = lateroapical metaplical process

map = mesapical metaplical process

mp = metaplica

mcs = mesal coxal spines

pp = proplica

PR = podous rings

px = paracoxite

st = sternum

Results

Order Spirostreptida Brandt, 1833
Family Spirostreptidae Pocock, 1894
Tribe Trachystreptini Cook, 1896

Genus *Attemsostreptus* Verhoeff, 1941

Diagnosis

Readily distinguishable from other genera of Spirostreptidae by the extremely long, slender lateral metaplical processes, in combination with the ‘trachystreptinine’ habitus, i.e., with marked longitudinal striae/keels over the entire body ring circumference. Krabbe (1982) presented a more detailed diagnosis, based mainly on male secondary sexual characters, as follows (translated from German and slightly modified): collum without longitudinal keels. First pair of legs with strong ‘shoulders’; the outer margin of the coxosternum smooth with 4 lateral small setae; prefemoral processes divergent, short, triangular with gently rounded margins, prefemora and prefemoral processes with pores. Gonopod sternum low and small; coxae slender, proplica (pp) simple, straight, bearing a few setae distally; metaplicae (mp) apically round to angular with extremely elongated lateral processes (lap) tapering into a claw-like apex, distally round to subrectangular; telopodite slender with a long, thin antetorsal process (atp), distal

to (atp) becoming even slenderer, apex bifurcate with a thin serrated lamella and an acuminate apical process.

Included species

Attemsostreptus costatus Verhoeff, 1941, *Attemsostreptus reflexus* sp. nov.

Attemsostreptus costatus Verhoeff, 1941

Fig. 1

Attemsostreptus costatus Verhoeff, 1941: 262–263, plate 12, figs 35–36.

Lophostreptus orobius Kraus, 1958: 11–12, plate 3, figs 30–34. **syn. nov.**

Attemsostreptus orobius Krabbe 1982: 252–253, fig. 185.

Material examined

Attemsostreptus costatus Verhoeff, 1941 types (ZSM), 4 micro-preparations of 2 ♂♂ and 1 juvenile ♂.

TANZANIA • 1 ♂, juvenile, gonopods, 3 sections of a tergite; ZSM A20042783 • ♂ legs 1–7, gnathochilarium, labrum; ZSM A20042784 • ♂, gonopod in one block; ZSM A200427814 • 1 ♂, gonopods separated in left and right, left and right telopodites, two leg-pairs attached to a portion of sternite; ZSM A20042785.

Descriptive notes on gonopods

STERNUM (st). Small and simple, lower than paracoxite (px).

COXA. Proplica (pp) simple, straight and broad, distally with scattered bristles. Metaplica (mp) with a deep mesoapical incision, a rounded mesoapical metapical process (map) and a long twisted and downturned lateroapical metapical process (lap). The latter (lap) pointing proximolaterad and ending in claw-like pointed apex.

TELOPODITE. With a thin and curved antetorsal process (atp) ending in a pointed apex, post-torsal part forming a loop at mid-length, narrowing towards apex, apex bifurcate with a thin serrated lamella (sl) and an acuminate apical process.

Comments

Verhoeff (1941: 263, pl. 12, fig. 36) described serrations on the margins of the ‘solenomere’ and three projections at the apex of the ‘telomere’. The descriptions and drawings of Krabbe (1982: 252 fig. 185) and Kraus (1985: 1–12, figs 30–34) match our observations.

Attemsostreptus reflexus sp. nov.

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Figs 2–5

Diagnosis

A species of genus *Attemsostreptus* that differs from *A. costatus* in the shape of the coxal apical and lateral processes, and in the presence of coxal distomesal spines.

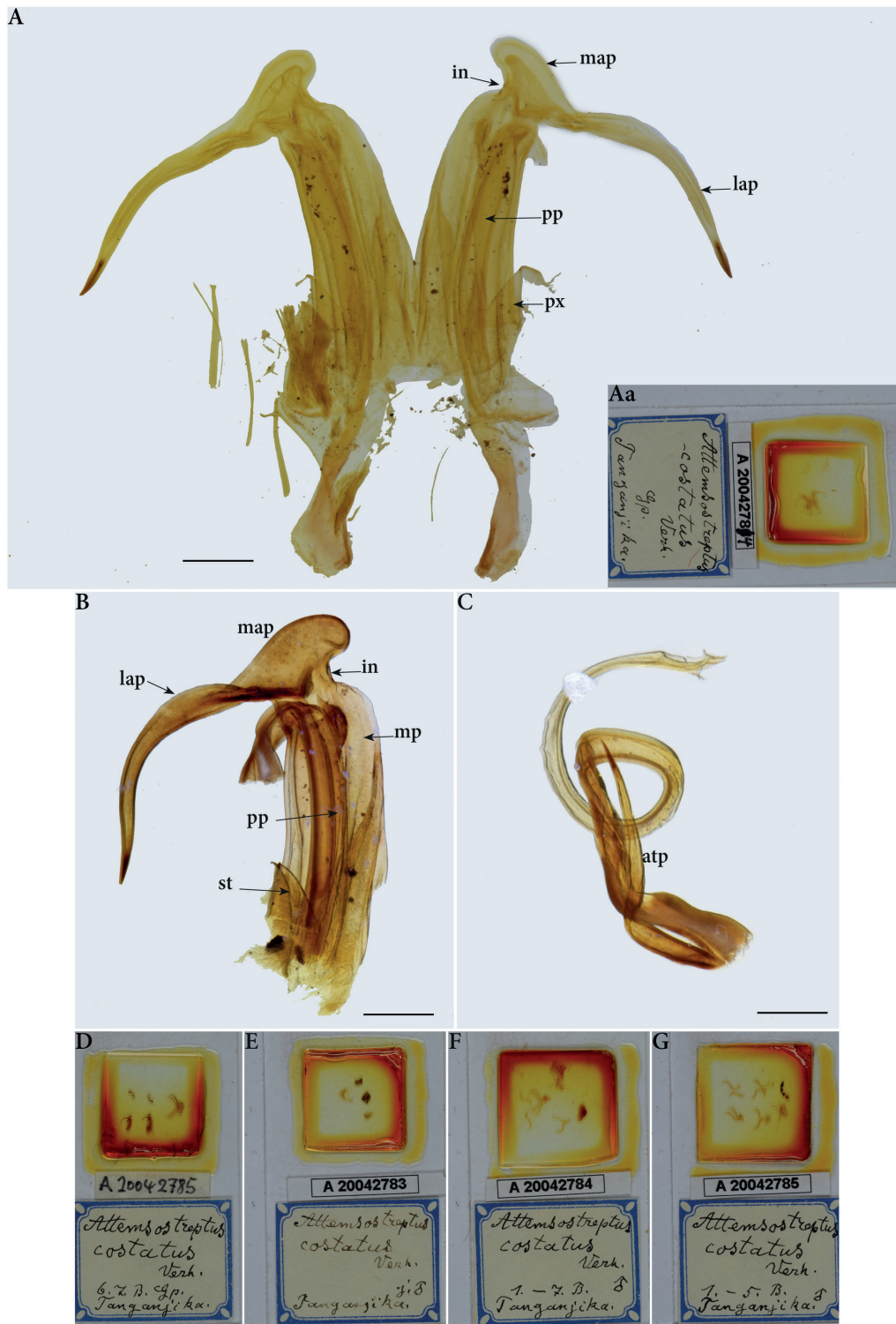


Fig. 1. *Attemsostreptus costatus* Verhoeff, 1941, type material ZSM. **A.** Gonopods, anterior view. **Aa.** Overview of slide A 200427814, containing the gonopods. **B.** Slide A20042785, left gonopod, anterior view. **C.** Telopodite. **D–G.** Overview of Verhoeff's slides (ZSM) A20042785, A20042783, A20042784, A20042785. For abbreviations, see Material and methods. Aa, D–G photo credit J. Spelda. Scale bars: A–C = 0.5 mm; Aa, D–G: images not to scale.



Fig. 2. *Attemsostreptus reflexus* sp. nov., male holotype (NHMD607065), head and anteriormost body rings. **A.** Ventral view. **B.** Lateral view. Scale bar: 1 mm.

Etymology

The species epithet is a Latin adjective meaning ‘turned back’ and referring to the shape of the lateroapical metaplical process of the gonopod.

Material examined

Holotype

TANZANIA • 1 ♂, missing posterior part, dissected; Morogoro Reg., Morogoro Distr., Kimboza Forest Reserve; 37°48' E, 07°01' S; Jan.–Mar. 1994; Frontier Tanzania leg.; NHMD607065.

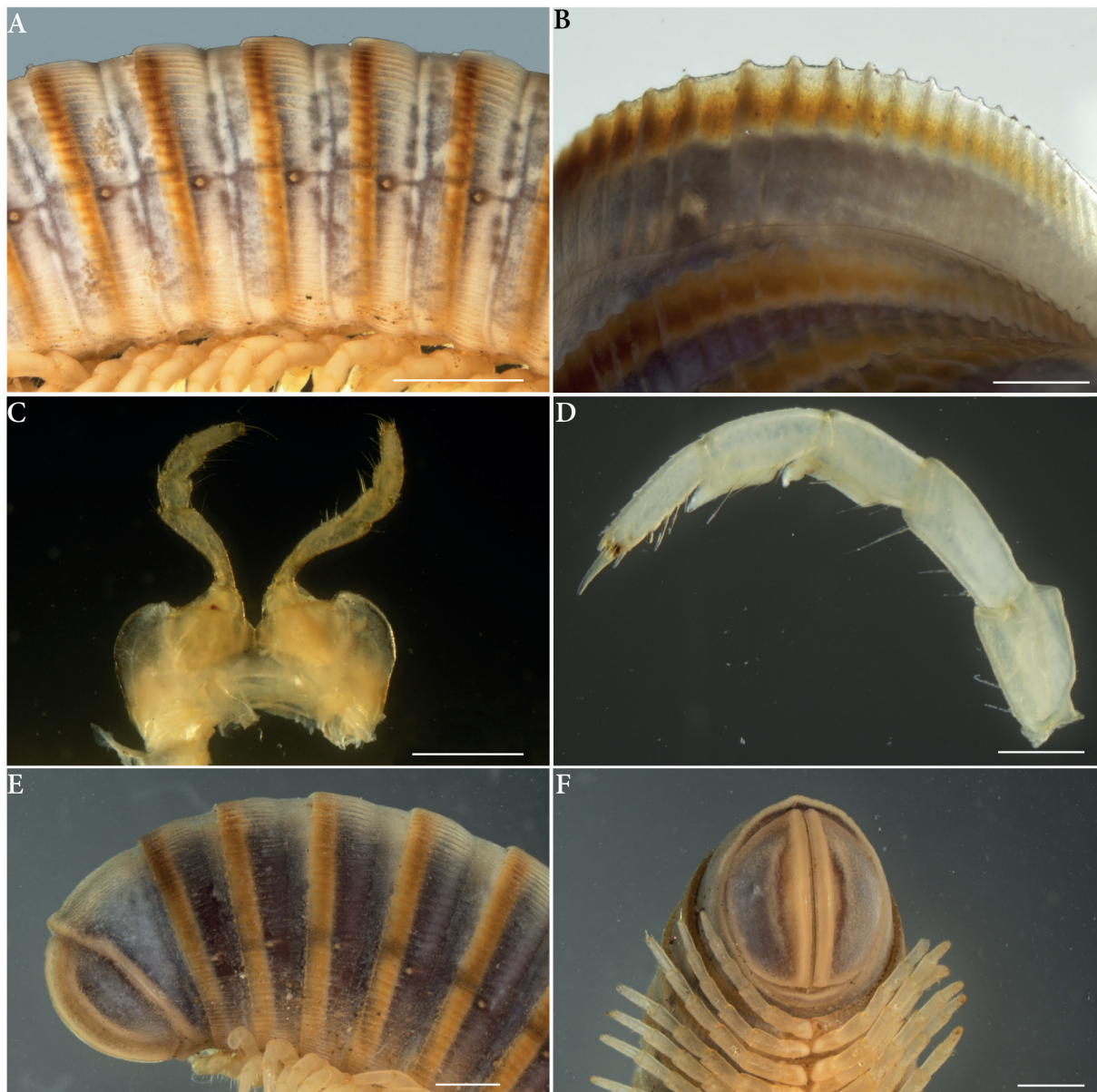


Fig. 3. *Attemsostreptus reflexus* sp. nov., external structures. **A.** Midbody rings in lateral view, telson towards the left, female paratype. **B.** Limbus, male holotype (NHMD607065). **C.** First pair of legs, male holotype (NHMD607065). **D.** Midbody leg with soft pads, male holotype (NHMD607065). **E.** Posteriormost body rings and telson in lateral view, female paratype. **F.** Posteriormost body rings and telson in ventral view, female paratype. Scale bar: 1 mm.



Fig. 4. *Attemsostreptus reflexus* sp. nov., male holotype (NHMD607065), gonopods. **A.** Gonopods, anterior view. **B.** Right gonopod, antero-apical view. **C.** Telopodite. **D.** Tip of telopodite. For abbreviations, see Material and methods. Scale bars: A = 1 mm; B–D = 0.5 mm.

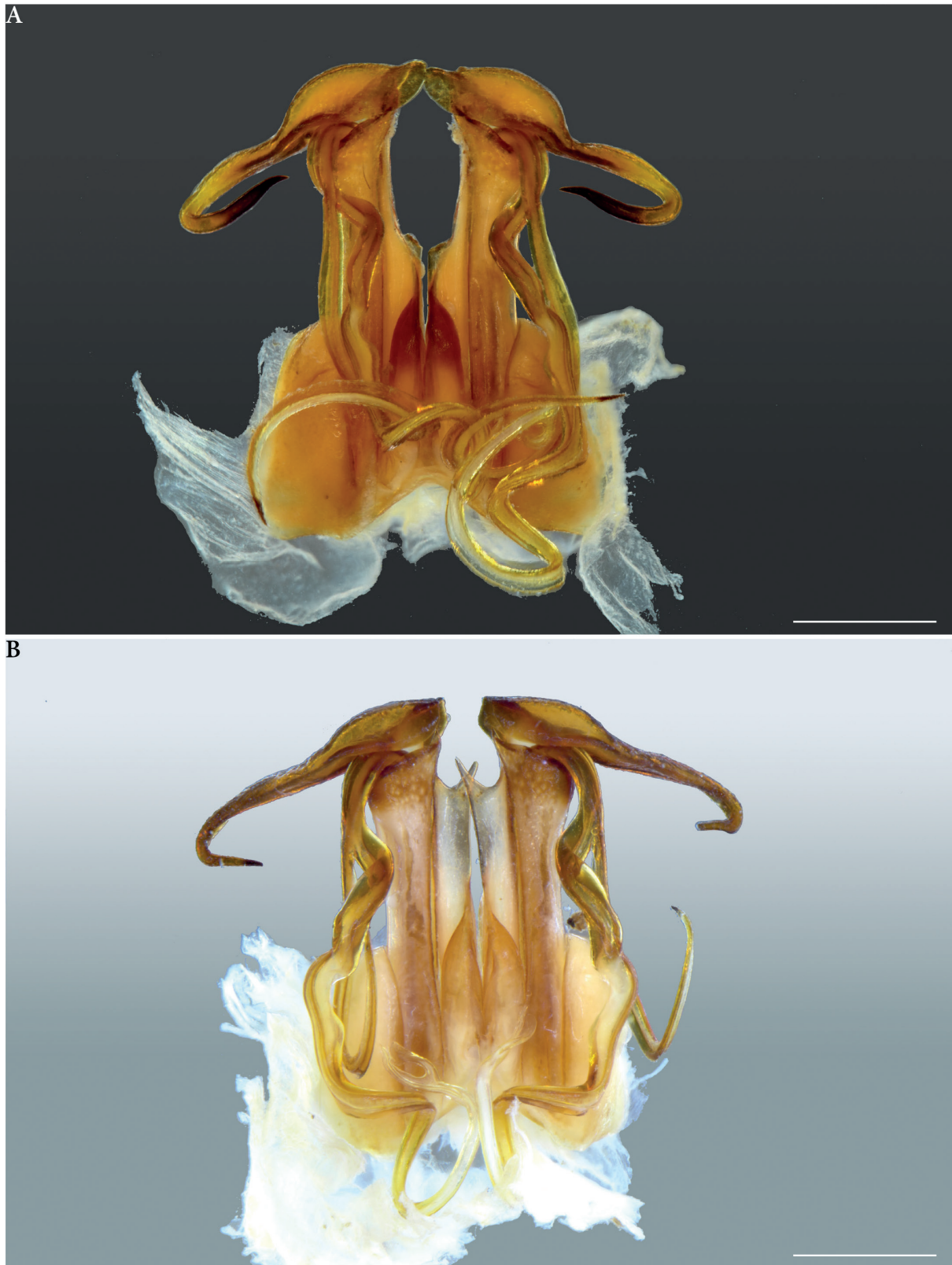


Fig. 5. *Attemsostreptus reflexus*, males without locality data. **A.** ♂, (NHMD621669). **B.** ♂, deviating gonopods (HNHM diplo-1697). Scale bar: 1 mm.

Paratypes

TANZANIA • 1 ♂, missing posterior part; same collection data and repository as for the holotype; NHMD607073 • 4 ♀♀, three of which broken in half and one missing posterior part; same collection data and repository as for the holotype; NHMD607073.

Other material examined

TANZANIA • 1 ♂, without data, mesal coxal spines (mcs) short, originating more distally than in the type specimens, mesoapical metaplical process (map) more truncate than round, distolateral spine maybe not quite so extraordinarily long, only 51 PR vs 56 PR in females from type series, body length (L) 65 mm, vertical diameter (H) 4.0 mm; NHMD621669 • 1 ♂, HNHM diplo-1697, without data, exactly like type specimens except that (mcs) are broken, 53 PR, L 70 mm, H 4.3 mm.

Description

MEASUREMENTS. Holotype ♂: H = 4.3 mm, broken in three parts, missing posterior end. Paratypes ♂: H = 4 mm; broken, missing posterior end. Females: L = 78.5–81.2 mm; H = 4.8–5.2 mm; 56 PR.

COLOUR (Figs 2–3). After several years in ethanol, orange-reddish-brown, colour more intense at margin of the posterior half of metazonites, prozonites lighter with a hint of chestnut at the lateral margins. Head dark brown in occipital area, sputtered with yellowish on frons and reddish to yellowish brown on labrum and gnathochilarium. Antenna and legs yellowish.

HEAD (Fig. 2). Four supralabral setae. Antennae reaching back to body ring 6. Eyes reaching slightly beyond mesal margin of antennal socket, each with ca 10 vertical rows of ommatidia, ca 5 horizontal rows, ca 35 ommatidia. Mandible as in *Tropostreptus* (Enghoff 2017): stipes in males with a small apico-ventral lobe; odontomere long, moveable; sectile edge of psectromere with ca 5 lobes; ca 12 pectinate lamellae; one wide molar furrow. Gnathochilarium: prementum simple, not depressed; mentum with deep depression basally delimited by sharp ridge, as in *Pseudotibiozus* (Enghoff & Larsson 2018: fig. 3); stipites with basal row of setae adjacent to mentum, apicolaterally with field of many setae, distally with swelling harbouring one modified seta, as in *Pseudotibiozus* (Enghoff & Larsson 2018: fig. 3).

COLLUM (Fig. 2). With protruding antero-ventral lobes in males. Three or four lateral furrows. No antennal groove.

BODY RINGS (Figs 2B, 3A, E). Prozonae with non-conspicuous furrows. Metazonae with regular longitudinal striae on entire body ring circumference, areas between striae elevated as ridges, ridges projecting beyond posterior margin of ring (Fig. 3B). Ozopore round, visible as bright spot rimmed with grey at the middle of metazona, behind suture (Fig. 3A), latter thin and sometimes curving at level of ozopore. Pleurotergal lobes meeting behind posterior pair of legs on each body ring.

LEGS (Figs 2–3C–D). Length ca 4 mm, slightly shorter in females. Males with postfemoral and tibial pads from third pair until beyond midbody (Fig. 2A), pads decreasing in size posteriorly, absent from posteriormost legs. First pair of legs in male (Fig. 3D) similar to those of *A. costatus* as described by Krabbe (1982).

TELSON (Fig. 3E–F). Preanal ring with straight dorsal margin. Anal valves with raised median margins forming blunt lips, flanked by distinct grooves, i.e., of the “fossate” type *sensu* Hoffman (2011).

GONOPODS. (Figs 4–5). Sternum (st) small and simple, lower than paracoxite (px).

COXA. Proplica (pp) simple, straight and broad, distomesal corner sharp, distal margin almost straight, oblique, surface in distal part with scattered bristles. Metaplica (mp) broad and stout; mesal margin

straight, in basal part folded laterad as broad duplicature, subapically with large distad spine (mcs); in some specimens, (mcs) smaller and inserted more distally than in the holotype; metaplica apically gently rounded, mesoapical metaplical process (map) protruding as narrow ovoid mesal lobe, truncate in a few specimens (Fig 5B), meeting medially and totally lacking the meso-apical incision observed in *A. costatus*, laterally showing a strong constriction and protruding as lateroapical metaplical process (lap). This process (lap) very long, and strongly curved, first directed laterad, then making a U-turn and pointing distomesad to mesad in most specimens, ending in claw-like pointed apex.

TELOPODITE. With a thin and curved antetorsal process (atp) ending in a pointed apex, post-torsal part long, with several torsions and an incomplete loop, thereafter narrowing towards apex and bifurcating into a thin serrated lamella (sl) and an acuminate apical process.

Distribution

Kimboza Forest Reserve, Morogoro.

Discussion

Attemsostreptus was placed in “Trachystreptini” by Verhoeff (1941) who, however, questioned this assignment because although the body ring sculpture of *Attemsostreptus* suggested Trachystreptini, the gonopods of *A. costatus* in Verhoeff’s view are more similar to those of *Spirostreptus* (in the then prevalent sense, cf. Hoffman *et al.* 2001) than to those of the then best known trachystreptinine genus, *Lophostreptus* Cook, 1895. Demange & Mauriès (1975) analysed the trachystreptinine spirostreptids in great detail and provided a revised classification. They discussed the problems with delimiting Trachystreptini because the ‘diagnostic’ metazonital keels are developed to very different degrees. Demange & Mauriès (1975) mentioned another character which they regarded as a valid character for Trachystreptini, viz the shape of the lateral lobes of the collum. According to these authors, a part of the anterior surface of the collar lobes is flexed towards the head capsule, thereby forming a cavity for accommodating the antennae. Hoffman (1980: 85) expressed general skepticism towards the internal division of Spirostreptidae into subfamilies/tribes, and Krabbe (1982) like Verhoeff (1941) placed the name Trachystreptini in quotes, referred to it as a “Formengruppe” (morpho-group) and implicitly argued against its monophyly. Based on personal scrutiny of original literature as well as specimens from NHMW and NHMD, we can confirm that the collum character emphasized by Demange & Mauriès (1975) is not present in all “trachystreptinine” genera. Whereas in some species, e.g., *Furcillogonus frigidus* Demange & Mauriès, 1975, and *Calostreptus chelys* Cook, 1895, the antennal grooves are very prominent, grooves are completely absent in the genus *Attemsostreptus*, as they are in *Lophostreptus ptilostreptoides* Carl, 1909, *L. armatus* Pocock, 1896, *Anastreptus scalatus* (Karsch, 1881) and *Bucinogonus kandti* (Carl, 1909). An antennal groove is present in *Humilistreptus* Demange, 1958 (= *Guviogonus* Demange & Mauriès, 1975), a genus which includes a species with a “trachystreptinine” habitus as well as some without (Krabbe 1982).

If the relationships of *Attemsostreptus* to other spirostreptids thus remain unclear, the genus as such is well characterised and may be regarded as monophyletic based on the remarkable, very long and clearly apomorphic lateroapical metaplical processes.

The type locality of *Attemsostreptus reflexus* sp. nov., Kimboza Forest Reserve, is situated in the foothills of the Uluguru Mts, see Daggart *et al.* (2004) for further information. Several millipede species have previously been recorded from Kimboza F.R., viz *Hyperbolus morogoroensis* (Kraus, 1958) (Pachybolidae), *Xystopyge proplicatus* Frederiksen & Enghoff, 2012 (Odontopygidae), *Lophostreptus ptilostreptoides* Carl, 1909, *Obelostreptus proximospinosus* Krabbe, 1982, and *Tropostreptus sigmatospinus* Enghoff, 2017 (Spirostreptidae), *Lyodesmus kimboza* Hoffman, 1990,

L. rubidopsis (Kraus, 1958), and *Rhododesmus planus* (Kraus, 1958) (Oxydesmidae) (Enghoff *et al.* 2016; Enghoff 2017).

The only known congener of *A. reflexus*, viz *A. costatus*, is also known only from the Uluguru Mts, suggesting a very restricted distribution area of the genus *Attemsostreptus*.

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