

A new genus and species of Ceratocanthidae from Tanzania (Coleoptera: Scarabaeoidea)

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Cryptophilharmostes mahunkai n.gen., n.sp., a remarkable Ceratocanthidae (Coleoptera: Scarabaeoidea) from the Usambara Mountains (Tanzania), is described. The morphology of the clypeus and mesoepisternum is discussed, also with reference to other Ceratocanthidae. The affinities of the genus are discussed, and within the Afrotropical fauna a group of genera formed by *Philharmostes* Kolbe and its allies is recognized.

Key words: Morphology, systematics, *Cryptophilharmostes*, Afrotropical Region.

INTRODUCTION

The Eastern Arc rainforests of Tanzania and Kenya (*sensu* Lovett & Wasser 1993) host an interesting fauna of Ceratocanthidae, with the endemic genus *Afrocloeotus* Petrovitz, 1968 (known only from the holotype of the type species *A. gibbosus* Petrovitz, 1968) and three endemic species of *Philharmostes* Kolbe, 1895 (Paulian 1977). Our knowledge of the faunal composition is, however, far from complete, as many forest patches still await exploration using modern collecting techniques. It was therefore not surprising to find further new species while examining the unidentified material from East Usambaras collected by a team from the Hungarian Natural History Museum (Budapest). Three specimens were found, representing two new taxa: a single male of a new *Philharmostes* and two individuals of remarkable new ceratocanthid. The latter is here described and assigned to a new genus, while the other taxon will remain undescribed until the examination of further specimens.

METHODS & ACRONYMS

Mouthpart terminology follows Nel & De Villiers (1988) and that of the male genitalia D'Hotman & Scholtz (1990), so that the dorsal part of aedeagus is the concave side. Drawings of genitalia were made after clearing 10% KOH. Scanning electron micrographs were taken with an Environmental Chamber SEM.

L = length; W = width; EL = maximum elytral length; EW = maximum elytral width; HL = maximum head length; HW = maximum head width; PL = maximum pronotal length; PW = maximum

pronotal width; HNHM = Hungarian Natural History Museum, Budapest.

DESCRIPTIONS

Cryptophilharmostes n.gen.

Type species: *Cryptophilharmostes mahunkai* n.sp.

Diagnosis

Small, flightless Ceratocanthidae; body very convex; head short and subrectangular; genal canthus indistinct and eyes not visible from above; antennae ten-jointed, scape slightly curved proximally then subconical; apical extremity of clypeus (see morphological remarks below) very developed; labial palpi short, weakly sclerotized, with joints two and three very short and joint four longer, egg-shaped and plump; mandibles distally slender and curved at a right angle, with acutely pointed apex; pronotum short and strongly embossed, anterior angles truncate; elytra convex, regularly rounded in transverse section, widely re-entering at apical third, strongly sculptured, without distinct pseudoepipleura and inferior sutural stria; meso- and metacoxae adjacent to each other; protibiae identical in both sexes, regularly and broadly curved outward with outer margin very finely serrate; aedeagus with parameres very short, subrectangular, slightly asymmetrical and weakly sclerotized; internal sac with a pseudosclerite; genital segment without distinct manubrium.

Etymology

From Greek '*kryptos*' (= hidden) and '*philhar-*

mostes' (the usual suffix for many genera of Ceratocanthidae), the name refers to life in leaf litter/soil and to the unusual external features that hide its affinities with the genus *Philharmostes*. The gender is masculine.

***Cryptophilharmostes mahunkai* n.sp.**, Figs 1–7

Type material. Holotype ♂ (HNHM): Tanzania, Tanga reg., Kwamkoro, Berlese s. n. 56, 7.II.1987, S. Mahunka & A. Zicsi. [hind left leg missing; aedeagus, genital segment and right antenna mounted in DMHF resin on a separate card, same pin]. Paratype (Allotype), ♀ (HNHM): Tanzania, Tanga reg., Kwamsambia For. Res., 10 km S. Kwamkoro, 1050 m / sifting litter, no. 105, 10.II.1987, S. Mahunka & A. Zicsi. [mouthparts mounted in DMHF resin on a separate card, same pin].

Description of holotype (Fig.1)

HL: 0.7 mm; HW: 1.2 mm; PL: 1.3 mm; PW: 2.1 mm; EL: 2.3 mm; EW: 2.1 mm.

Body short, strongly convex; shiny, uniformly dark brown with faint bronze sheen, underside and tarsi reddish-brown, antennae yellowish; no pubescence visible at low magnification ($\times 45$).

Head short, wider than long (W/L ratio = 1.7), subrectangular, distinctly narrower than pronotum, with labrum and tips of mandibles visible in anterodorsal view; anterior edge of head irregularly rectilinear, smooth, with a very small triangular protrusion in the middle and a small emargination just before genae; genae small, triangular, slightly protruding outward; genal canthus (= ocular canthus *sensu auctorum*) indistinct, eyes not visible from above, apart from a very small posterolateral portion; anterior edge of head slightly reflexed upward, reflexed area bearing a row of longitudinal narrow grooves on entire surface; two sharp, transverse, stout ridges just behind the grooved area; a large tubercle, behind these ridges, less protruding and sharp than ridges, ending with two other small tubercle-like ridges; another protruding, sharp, short longitudinal ridge at each side of head; vertex along its entire length with a transverse groove, sharply reflexed at right angle to surface; dorsal head surface completely areolate, each areole sub-circular and with surface plane with a pore in the middle, pore not impressed, very small, often bearing a very short and fine seta, areoles almost adjacent to each other; apical extremity of clypeus

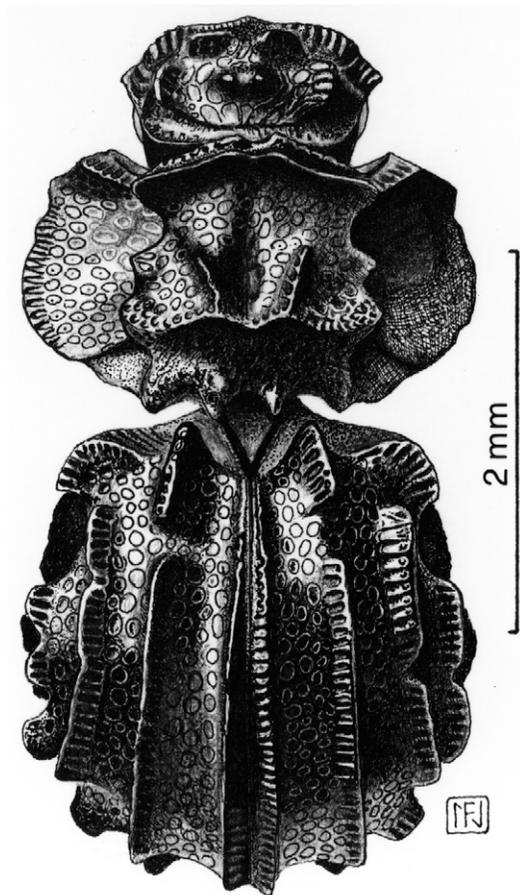


Fig. 1. *Cryptophilharmostes mahunkai* n.gen., n.sp., habitus of holotype (drawing by N. Falchi).

(see morphological remarks below) perpendicular to longitudinal axis of head and strongly developed (L = 0.6 mm), subrectangular (W/L ratio = 3), unevenly sculptured, slightly subcarinate centrally, with surface distinctly microreticulate.

Pronotum short (W/L ratio = 1.6), approximately as wide as elytra, anterior edge slightly bisinuate, strongly margined; margin thick and reflexed upwards, complete apart from a distinct, small emargination in the middle, covered by groove-like longitudinal areoles, each one bearing a short and fine seta distally; anterior angles truncate, truncature large and concave, visible in anterodorsal view; sides of pronotum irregularly rounded, margin not visible from above, well developed and thick in lateral view; base narrow, in the middle with four distally carinate tips directed backward; at each side of base margin not visible and edge finely serrate; pronotal surface



Fig. 2. *Cryptophilharmostes mahunkai* allotype, pronotum and head.

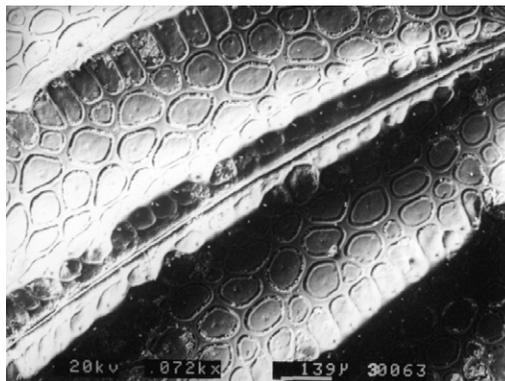


Fig. 3. *Cryptophilharmostes mahunkai* allotype, detail of microsculpture near elytral suture.

embossed, disc raised, with a raised tectiform transverse ridge just behind the anterior margin, two longitudinal tectiform ridges starting from middle of disc and joining a further transverse tectiform ridge near base; sides of disc deeply excavated inward, two excavations on each side, separated by a small tubercle-like ridge, second excavation smaller than first, more impressed and near base of pronotum; entire pronotal surface areolate as on head but areoles slightly larger (diameter about 0.05–0.06 mm), areoles at sides of pronotum slightly further apart, lateral margins with a row of transverse, narrow, very short, groove-like areoles; vertical surface of ridges comprising vertical groove-like areoles.

Scutellum a little wider than long (W/L ratio = 1.1), apex sharp and acute, with distal third narrow, each side slightly curved inwards, sides of base notched by articular process of elytron, apical portion of mesepisternum not visible from above, surface covered by small areoles as on head, but slightly smaller and further apart.

Elytra slightly longer than broad (W/L ratio = 0.9), convex, maximum width and convexity just beyond middle; apical third re-entering at apex, i.e. apical declivity flexed in under body and not visible from above; elytra fused, covered by a pattern of five (including sutural ridge) asymmetrical, sharp (tectiform), distinctly raised, longitudinal ridges, in profile irregularly shaped; ridges of variable length, often interrupted (apart from the sutural ridge) and sometimes reduced to large tubercles; vertical surface of ridges covered by vertical groove-like areoles; humeral callus indistinct apart from a large tubercle; pseudoepipleura indistinct (elytra almost regularly rounded in transverse section); marginal elytral area (*sensu*

Paulian 1977) narrow, enlarged outward near proximal third; sutural stria replaced by sutural ridge; inferior sutural stria (*sensu* Paulian 1977) replaced by a wide and feeble groove; striated articular area very narrow, made of only about three striae and visible only laterally; entire elytral surface uniformly areolate as on head, but areoles distinctly larger (diameter about 0.1 mm). Wings absent.

Antennae short, ten-jointed, scape relatively short, slightly curved proximally then subconical, funicle short, joints distinctly wider than long, club as long and almost as wide as funicle, three-jointed, joints small and hairy; mentum (Fig. 4) with flat ventral surface, subrectangular, relatively short, distinctly emarginated in the middle of anterior edge; labial palpi (including palpiger) four-jointed, very weakly sclerotized, second and third joints very short and subequal, fourth plump, egg-shaped, slightly longer than the former two joints together, outer ligular lobes short and weakly developed; maxillae with galea and lacinia membranous fringed with dense and very long fine hairs, mainly distributed along edges; maxillary palpi four-jointed, joints slender, the first two joints subequal in length, apical joint longer than the others, slightly wider at apical third; labrum subrectangular, not sinuate at middle; mandibles (Fig. 5) extending beyond labrum, basally stout, distally slender and curved at right angle, with acutely pointed apex, mesal brush well developed.

Procoxae subcontiguous; anterior trochanter small and narrow, anterior tip with a small patch of long hairs; profemora smooth, without emarginations; protibiae with inner emargination at apical third which is in turn also emarginated near apex

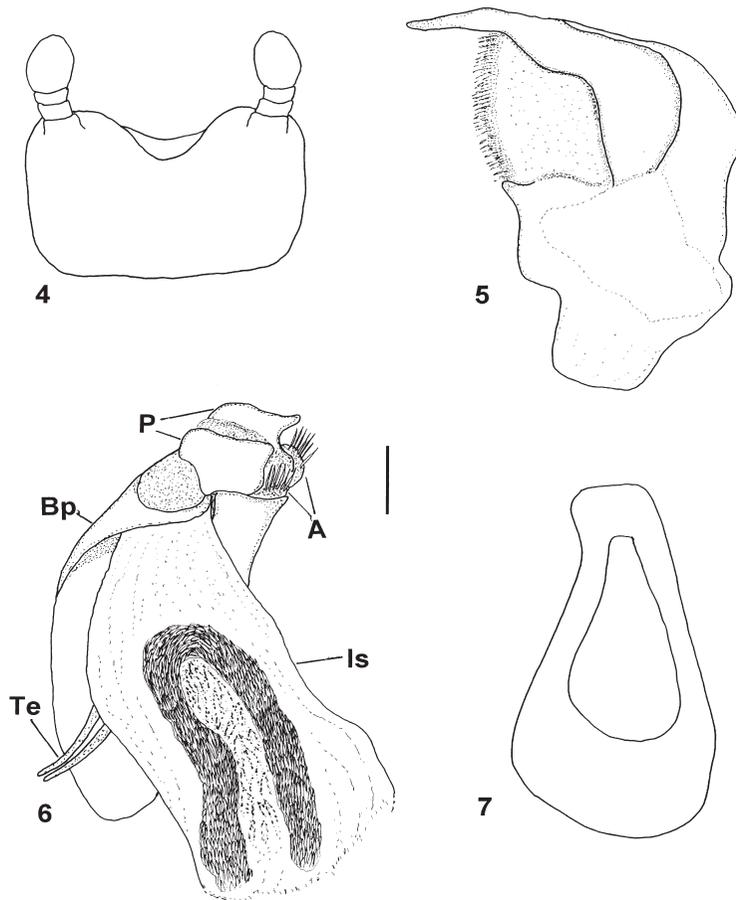


Fig. 4–7. 4, *Cryptophilharmostes mahunkai*, outline of mentum and labial palpi (scale bar = 0.1 mm); 5, *C. mahunkai*, right mandible (scale bar = 0.1 mm); 6, *C. mahunkai*, aedeagus and internal sac in dorsolateral view: P = parameres; Bp = basal piece; A = apophysis of parameres; Te = temones; Is = internal sac with pseudosclerite (scale bar = 0.1 mm); 7, *C. mahunkai*, outline of genital segment in dorsal view. Scale bar = 0.1 mm.

of tibia, outer edge very finely serrate with a slightly more distinct denticle at apex, apical spur slender, short with tip acute, starting at the beginning of second small emargination; protarsus attached near apical third on lateroventral surface of tibia, with basal segment as long as the other four together, following three segments short and subequal in length, fifth slightly longer, bearing two small, regularly curved claws, tarsomeres, excluding ultimate, with tufts of setae on ventral surface; mesosternum short, narrow and plump, with microreticulation and at sides some simple, impressed punctures; meso- and metacoxae almost adjacent to each other; middle and hind trochanters narrow; mesofemora with slight emargination at distal third of hind edge; mesotibiae slightly curved inward near apex, slender

(W/L ratio = 0,2), bearing two short, fine, apical spurs near inner apical angle; mesotarsi longer than apical edge, first tarsomere slightly shorter than following three together, each tarsomere, apart from the last one, bearing a tuft of setae on ventral surface; metafemora slightly enlarged at proximal third, then distinctly emarginated; metatibiae triangular, slightly enlarged apically, with two callosities along inner edge, one near the proximal third, the other at middle; apex of tibiae with two short, fine, straight apical spurs; metatarsi with first tarsomere as long as the following three, tufts of setae as in mesotarsi; meso- and metatarsi inserted at inner apical angle of tibiae.

Male genitalia: aedeagus (Fig. 6) with parameres short and weakly sclerotized, subrectangular,

slightly asymmetrical, dorsobasally with a small apophysis lying along anchoring point with basal piece, attached to basal piece and directed forward (distally also slightly upward), fringed distally with some medium-sized, erect setae; temones present, basal piece slightly twisted and very long, about four times as long as parameres, internal sac armed with a large dark patch, inverted-U-shaped, made of coarse, small, scale-like spicules (pseudosclerite); genital segment (Fig. 7) short, with branches joining together without forming a distinct manubrium.

Description of the paratype (allotype) (Figs 2, 3)

HL: 0.7 mm; HW: 1.2 mm; PL: 1.3 mm; PW: 2.1 mm; EL: 2.3 mm; EW: 2.1 mm.

Both pronotal sculpture and elytral ridges slightly less raised; few differences in the position of right elytron ridges; outer edge of protibiae with small apical denticle blunt. According to the present knowledge of sexual dimorphism in the Ceratocanthidae, all the above features should be regarded as intraspecific variations rather than external sexually dimorphic characters. Female genitalia unknown owing to damaged abdomen.

Etymology

This species is named after its collector Dr Sándor Mahunka, Deputy Director of HNHM.

Distribution and habitat

Kwamkoro is a small village near Amani (05°06'S, 38°38'E) in the Eastern Usambaras (Northeastern Tanzania). According to Mahunka, Pócs & Zicsi (1987) the holotype was collected with a Berlese funnel from litter and soil in a secondary rainforest (yellow laterite soil) at 1000 m, while the allotype was collected from sifted material from litter of 4 × 0.5 m² of a primary rainforest. Kwamsambia Forest is an intermediate (submontane) rainforest with 40–60 m tall evergreen canopy and some patches of secondary forest. The soil is ferralitic, orange to red laterite with greyish brown A0 layer (groundstone: gneiss). The flora of this area is rich in both endemic species and western African, lowland rainforest elements.

DISCUSSION

Morphology

All typical Ceratocanthidae (no data for atypical Ceratocanthidae *sensu* Howden & Gill 1995) have

the apical extremity of clypeus, to which the labrum is attached, distinctly bent downwards, perpendicular to the roof of the preoral cavity, and usually more or less set back and recessed with respect to the anterior margin of the head. This apical portion varies in size and sculpture within the family, it is extremely reduced in *Acanthocerodes* Péringuey, 1901, while in *Cryptophilharmostes* n. gen. it reaches its maximum development. The first author to deal with this feature was Hesse (1948), who interpreted it as the true clypeus. All subsequent authors (e.g. Paulian 1977) did not take into consideration Hesse's statement and continued to indicate as clypeus the anterior part of the head visible from above. If the clypeus is defined as the lower part of the head to which the labrum is attached anteriorly (Nel & De Villiers 1988), there is little doubt that this structure belongs to the clypeus. However, in order to give a name to it, the use of the traditional distinction between postclypeus and anteclypeus (Snodgrass 1935), does not seem prudent (owing to the lack of precise knowledge), while the use of another available term such as clypeal process (Edmonds 1972) is not desirable, as this latter structure, being simply a produced transverse carina that lies between the anterior margin of clypeus and its ventral surface, seems to be non-homologous to our structure. To solve the problem an ontogenetic study is needed and therefore, temporarily, this structure will be termed the apical extremity of the clypeus.

Another distinctive feature occurring in typical Ceratocanthidae and unique within the Scarabaeoidea is the presence of a small sclerite that externally notches the articular process of the elytron, and sometimes also the sides of the scutellum near the base. It is visible from above, mainly when the beetle assumes a rolled-up posture. Germar (1843) stated that it was a simple suture, while Harold (1874) and many subsequent authors identified it as the mesothoracic epimeron. Dissection of specimens of *Ebbrittoniella* Martínez, 1962, *Cyphopisthes* Gestro, 1899, *Madrastos* Paulian, 1975, *Germarostes* Paulian, 1982, *Martinezostes* Paulian, 1982, and *Philharmostes* Kolbe, 1895, suggests that this structure could be the result of the fusion of the mesobasalar (*sensu* Edmonds 1972) with the apical portion of mesepisternum, or the modified apical portion of mesepisternum (the view followed herein). This sclerite is well-developed in volant species, while in flightless species, such as *Cryptophilharmostes mahunkai*, is

absent or very reduced and normally not visible from above. This suggests that it plays some role in the movements of the elytra.

Affinities

The phylogenetic relationships within the Ceratocanthidae are still unclear. A preliminary analysis of all the genera of typical Ceratocanthidae and based on all available morphological data of adults suggests, as regards *Cryptophilharmostes*, affinities within the Afrotropical fauna, in particular with a group of genera formed by *Philharmostes*, *Callophilharmostes* Paulian, 1968, *Carinophilharmostes* Paulian, 1968, *Chaetophilharmostes* Paulian, 1977, *Petrovitzostes* Paulian, 1977, and *Baloghianestes* Paulian, 1968. This group appears monophyletic and is defined by the following set of characters: a) male genitalia: aedeagus with parameres slightly asymmetrical and weakly sclerotized, b) female genitalia: genital segment elongate and with genital palpi elongate and narrow, fringed with long hairs, c) female genitalia: bursa copulatrix usually with two or more symmetrical, sclerotized, echinulate, subcircular plates, d) protibiae, at least in the male, regularly and broadly curved outwards, with outer margin smooth or finely serrate, e) wings: M-Cu loop absent, f) wings: apical detached vein very long and close to first complete anal vein; characters b), c), d) and f) are unique to this group of genera within the family; in addition to these characters there is a tendency toward a reduction of number of antennomeres (eight in *Petrovitzostes* and *Callophilharmostes*, nine in *Baloghianestes* and few species of *Philharmostes*, ten in *Cryptophilharmostes*, *Carinophilharmostes*, *Chaetophilharmostes* and in the remaining species of *Philharmostes*). Relationships within the group are still to be clarified with a re-definition of all genera (including *Holophilharmostes* Paulian, created in 1968 as a subgenus of *Philharmostes* and then omitted in the revision of 1977).

Cryptophilharmostes, for its unusual habitus (in particular because of its short subrectangular head, indistinct canthus, and extremely developed apical extremity of clypeus), cannot be mistaken for any other known genus of Ceratocanthidae. It represents a lineage highly adapted to life in leaf litter/soil microhabitat (canthus indistinct with eyes not visible from above and characters related to flightlessness, i.e. elytra fused, distal third of elytra deeply re-entering, meso- and metacoxae adjacent, humeral callus indistinct,

apical portion of mesepisternum not visible from above). Its closest affinities within the above group of genera are unknown. Superficially it could be likened to *Baloghianestes*, which it resembles by sharing all the features related to soil life and flightlessness, but all these adaptative characters could be regarded as homoplasies due to convergent evolution. Actually the two genera differ in much more relevant characters, in fact *Baloghianestes* has a) aedeagus with internal sac having a true small sclerite, b) genital segment more triangular, with relatively long manubrium, c) different mouthparts (labial palpi longer and slender, mandibles regularly curved, with a small tooth near apex), d) different shape of protibiae (with emargination that occupies only apical fourth), metafemora (more enlarged proximally) and metatibiae (with apex more enlarged), e) anterior margin of head slightly triangular, f) apical extremity of clypeus less developed and g) antennae nine-jointed.

The male genitalia (with internal sac with a pseudosclerite and genital segment without a manubrium) and ten-jointed antennae could possibly relate *Cryptophilharmostes* to *Philharmostes sensu lato*.

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