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Magadacerina, a new genus of Leptoceridae (Trichoptera) from Madagascar

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Abstract

Magadacerina forcipata, new genus, new species (Trichoptera: Leptoceridae), is described from Madagascar. The monotypic genus is characterised by having the tibial spur formula 2,2,2; wings with sessile bifurcation of M; genitalia with preanal appendages fused with segment IX and greatly produced posterad, and a tergum X with an anteriorly extended ventral base articulating with a sclerotised spine-like process of the phallic shield. The new genus is most closely related to *Blyzophilus* in the tribe Blyzophilini.

Key words: Leptocerinae, Blyzophilini, *Magadacerina*, *forcipata*, new genus, new species

Introduction

The long-horned caddisflies (Leptoceridae) are 1 of the 3 largest families within the Trichoptera, as well as one of the most widespread. The highest species diversity of the family is recorded from the tropics (Holzenthal *et al.* 2007). The Leptoceridae have until recently been grouped into 2 subfamilies: Triplectidinae Ulmer and Leptocerinae Leach, a classification mainly supported by wing venation characters and characteristics in leg and phallic morphology (Morse 1981; Morse & Holzenthal 1987). Based on recent evidence from analyses of molecular data, it has been suggested that Leptoceridae should hold 4 subfamilies, by the removal of *Leptorussa* Mosely from the Leptocerinae to form Leptorussinae Morse, and removal of Grumichellini Morse from Triplectidinae to form Grumichellinae Morse (Malm & Johanson 2011). Malm & Johanson (2011) recognized 45 genera within the family, after the synonymisation of *Ptochoecetis* Ulmer with *Oecetis* McLachlan, and *Condocerus* Neboiss with *Hudsonema* Mosely.

The subfamily Leptocerinae currently includes 28 genera, and contains the most species-diverse genera of the family, *Oecetis* (with about 400 species), *Triaenodes* McLachlan and *Setodes* Rambur (each with more than 200 described species), as well as 5 monotypic genera, *Achoropsyche* Holzenthal, *Blyzophilus* Andersen & Kjærandsen, *Leptoceriella* Schmid, *Neoathripsodes* Holzenthal, and *Russobex* StClair (Holzenthal *et al.* 2007; Malm & Johanson 2011). Eighteen genera of Leptocerinae have been recorded from the Afrotropical Biogeographic Region, of which 6 are endemic to the region: *Axiocerina* Ross (2 species), *Leptecho* Barnard (3 species), *Hemileptocerus* Ulmer (2 species), *Sericodes* Schmid (2 species) and *Blyzophilus* (1 species). The Madagascan Leptoceridae fauna consists of the seven previously recorded genera *Athripsodes* Billberg, *Homilia* McLachlan, *Leptocerina* Mosely, *Leptocerus* Leach, *Oecetis*, *Setodes* and *Triaenodes* (Johanson 2010).

Morse (1981) presented a phylogenetic hypothesis of the Leptoceridae, and an outline of the classification used up to date for the subfamily, with 4 new tribes. Later, Holzenthal (1984) erected the genus *Achoropsyche* and tribe Achoropsychini, a sister group of the clade proposed by Morse (1981) that included Triaenodini, Oecetini, Setodini, Mystacidini. Morse's (1981) classification was also followed by Andersen *et al.* (1999) when describing the Afrotropical monotypic genus *Blyzophilus* and tribe Blyzophilini, and placing it in a trichotomy with Leptocerini and the remaining "higher" leptocerines (Triaenodini, Oecetini, Setodini, Mystacidini). According to Andersen *et al.* (1999), *Blyzophilus* is characterised by 4 unique synapomorphies: the presence of a pair of

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dorsolateral sclerotised strips on the phallic shield that articulates with basoventral projections of tergum X; poor sclerotisation of the basal plate of the inferior appendages; an unusually long and slanted crossvein *r-m*; and the sigmoid shape of the forewing *Cu2*.

Here we describe a new monotypic genus based on a two male specimens collected on Madagascar. This new genus appear to be closest related to *Blyzophilus*, both regarding the morphological traits listed herein and in light of the molecularly based phylogenetic hypothesis performed by Malm & Johanson (2011) where it as *Genus novum* was recovered as sister to *Blyzophilus*. It is also included as 'New genus' in a key to caddisfly genera on Madagascar presented by Johanson *et al*. (2010).

Material and methods

The holotype specimen used in this study was collected by Mike E. Irwin (Illinois Natural History Survey (INHS), Institute of Natural Resource Stability, Urbana-Champaign, USA), and Evert I. Schlinger (World Spider-Endoparasitoid Laboratory, Santa Ynez, California, USA) in a Malaise trap near a tropical forest river. The unsorted Trichoptera material was stored in bulk at about 80% ethanol before being sorted to species. The abdomen was cleared in 8% KOH before being washed in absolute ethanol and temporarily mounted in Euparal, and the right wing was temporarily mounted in glycerol. The genitalia and wings were drawn using a drawing tube mounted on a Leitz Ortholux light microscope. Final illustrations were drawn in the GNU freeware Inkscape v.0.46 (www.inkscape.org). After being illustrated, the genitalia were transferred into a micro-vial together with the right wings and rest of the body.

DNA was extracted from the right hind leg using ProteinaseK and DNA sequences were submitted to EMBL (accession numbers FN601138 and FN601035) with the submission of the Leptoceridae phylogeny by Malm & Johanson (2011). The holotype specimen will be deposited at the Illinois Natural History Survey (INHS), and the paratype specimen at the Swedish Museum of Natural History (NHRS).

The terminology applied on the genitalia and wings follow those of Holzenthal *et al.* (2007) and Andersen *et al.* (1999).

Taxonomy

Magadacerina, new genus

Figures 1–8

Type species. *Magadacerina forcipata*, Malm & Johanson, new species; by present designation.

Placed in tribe Blyzophilini Andersen, Kjærandsen & Morse 1999, for reasons stated in the Discussion section.

By having the tibial spur formula 2,2,2, the new genus is easily distinguished from most other Leptocerinae genera. It is distinguished from *Poecilopsyche* by having hind wings with stem of *R1* fully developed, from *Leptocerina* by having hind wings without an expanded anal region and male genitalia with a narrow ventral part of segment IX, from *Athripsodes* and *Ceraclea* by having each forewing with a sessile fork of *M*, from *Leptecho* by having fork I present in the hind wing, from *Axiocerina* by having the forewing crossveins *r-m* and *m-cu* almost parallel and male genitalia without lateral bulbs on the inferior appendages, and from *Blyzophilus* by having male genitalia with the preanal appendages greatly produced posterad and forewings with the crossvein *r-m* not oblique.

Description. Male body. Colour yellowish brown (in alcohol). Head with prominent dorsolateral sulci, midcranial sulcus absent, anteromesal setal wart subtriangular with small circular mediolateral setal wart at each posterior corner (Fig. 1). Tibial spur formula 2,2,2.

Male wings. Forewings narrow; *R1* indistinct along the length of *Sc*; discoidal cell nearly as long as thyridial cell; forks I and V present, fork I petiolate; crossvein *r-m* and crossvein *m-cu* almost aligned; bifurcation of *M* sessile; *Cu2* slightly sigmoid (Fig. 2). Hind wings narrow, discoidal cell absent, forks I and V present, bifurcation of *M* sessile. Nygma in both wings located close to *M1+2* (Fig. 3).

Male genitalia. Segment IX short ventrally, slightly longer dorsally. Preanal appendages wide basally and fused with segment IX, posterodorsally produced into pair of long, digitate extensions, apically curving ventrad (Figs 4–5). Tergum X directed posteroventrad before extending posterad into pair of dorsally curving lobes; fused

basoventrally, greatly produced anterad into segment IX (Fig. 6). Inferior appendages each with 2 dorsal lobes: medial lobe club-shaped, lateral lobe tapering to acute apex (Fig. 4); basal plates merged with ventral ridge; curved anteroventrad (Fig. 4; IA.b.p). Phallus sinuous in lateral view, with pair of stout paramere spines; phallobase 1/5th of total length; phallic shield covering basal part, apparently articulating with basal plate of inferior appendage, dorsal apex produced into spine-like process articulating with basoventral extension of tergum X (Figs 7–8).

Etymology. *Magada-*, derived from Madagascar, the type country, and *-cerina*, from the Greek "keros" meaning "horn" (here "antenna"), following the suffix tradition of other leptocerine genera. Gender is feminine.

Magadacerina forcipata, new species

Figures 1–8

Male body. Colour yellowish brown (in alcohol). Head with two prominent dorsolateral sulci, midcranial sulcus absent; anteromedian setal wart subtriangular, with one small, almost circular mediolateral setal wart at each posterior corner; oblong dorsolateral setal warts following eye margin, almost merging with posterolateral setal warts (Fig. 1); maxillary palps missing (broken), labial palps each with 3 segments. Pronotum with pair of lateral setal warts; mesonotum with pair of dorsolateral lines consisting of setiferous punctures, nearly in continuation with punctures on mesoscutellum. Tibial spur formula 2,2,2.

Male wings. Forewing length 6–7 mm (broken), light straw colour, narrow. *R1* basally indistinct, reaching wing margin closer to *R2* than to *Sc*; discoidal cell almost as long as thyridial cell; forks I and V present; fork I petiolate, stalk almost as long as *R2*; crossvein *r-m* emerging slightly more than its length basad of crossvein *s*, directed posterad, joining *M1+2* shortly after split from *M3+4*, bifurcation of *M* sessile; nygma located close to *M1+2*, almost in line with bifurcation of fork I; crossvein *m-cu* emerging at about 1/4th its length into *M3+4*, slightly slanted; *Cu2* slightly sigmoid (Fig. 2).

Hind wing 5 mm long (broken), narrow, more than 3 times longer than wide, *R1* meeting wing margin close to *R2*, forks I and V present; fork I petiolate, with stalk longer than fork; discoidal cell absent; bifurcation of *M* sessile, crossvein *r-m* emerging at about half its length into *R4+5*, meeting *M* at about twice its length into *M1+2*; nygma located close to *M1+2*; *Cu1* dividing shortly basad of bifurcation of *M* (Fig. 3).

Male genitalia. Segment IX (IX) slightly wider dorsally, somewhat produced posterad at mid-ventral part (Fig. 4), excised at anterior margin mid-ventrally (Fig. 6) and mid-dorsally (Fig. 5). Preanal appendages (PA) setose, fused with segment IX, expanded anteroventrally, almost reaching mid-height of segment IX; well developed posterad, forming pair of digitate extensions, apices curving ventrad, each apex with dense patch of setae present anteroventrally (Fig. 4). Tergum X (X) long, directed posteroventrad at dorsobasal 1/3rd before turning posterad (Fig. 4); apical half divided into 2 distinct lateral lobes (Fig. 6), each lobe dorsally setose, excised laterally before ending in dorsally curving, slightly thickened knob without setae; ventrolateral bases fused, produced anterad into segment IX, sclerotised (Fig. 4); fused base almost parallel-sided in lateral view (Fig. 4), anterior apex produced dorsad and somewhat "human foot"-like, fused to thin, sclerotised structures originating mesally of preanal appendages; fused base almost parallel-sided in ventral view (Fig. 6), slightly narrowing apically, apex blunt, somewhat concave. Inferior appendages (IA) wide basally, almost flat in ventral view (Fig. 6); each with short basoventral bulge in lateral view (Fig. 4), narrowing dorsoapically; posteromedially with small, posterad-directed protuberance (IA.pr); each appendage apicodorsally with medial and lateral lobes; medial lobe (IA.dm) tapering at base before widening to slightly knobbly, club-shaped apex; lateral lobe (IA.dl) tapering into acute apex, with right-angled lateral bend at mid-length (Fig. 6); basal plate (IA.b.p) curving ventrad, forming semicircle in lateral view (Fig. 4), fused medially to ventral ridge; apex concave in ventral view (Fig. 6). Phallus sinuous, basal part directed anterodorsally, bending sharply at basal 2/5th, apical half tubular; paramere spines (p.s.) strong, tapering, originating about at mid-length (Fig. 7); phallothremal sclerite (p.sc.) oval, hollowed, indistinct; phallobase (Ph.b.) covering basal 1/5th; phallic shield (Ph.sh.) almost enveloping phallobase, posterobasally apparently articulating with basal plate of inferior appendages, in ventral view widening anteriorly, almost rectangular (Fig. 8), dorsal apex forming stout, spine-like process in lateral view, articulating with anteriorly produced ventral base of tergum X (Figs 3, 7).

Holotype male: Madagascar: Finarantsoa Prov., Ranomafana, Malaise trap near river in tropical forest, 12–20.xii.1999, 1150 m, 21.2554°S, 47.4552°E [M.E. Irwin & E.I. Schlinger]

1 male paratype: Madagascar: Fianarantsoa, Matsiatra Ambony, Ranomafana NP, Namorona river, 1.8 km from Vohiparara, -21.24032°S, 47.39186°E, 1130 m, 30.x.2011, 22W black light, stony river bank, Field# MAD11-

61, Leg. J. Bergsten, R. Bukontaite, T. Ranarilalatiana, & J.H. Randriamihaja. Collecting Permit: No 250/11/MEF/SG/DGF/DCB.SAP/SCB. Export Permit: No 143N-EA11/MG11

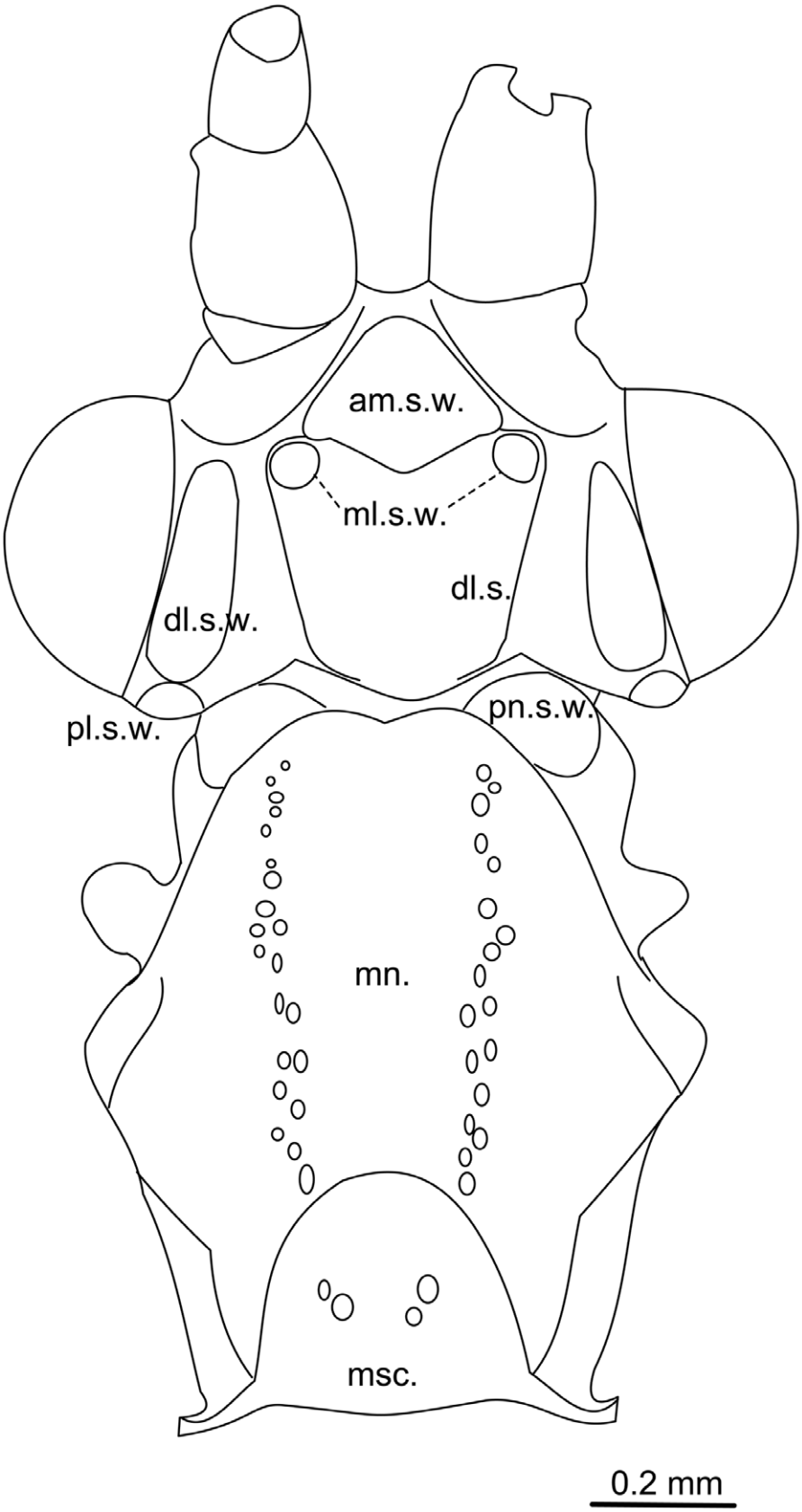
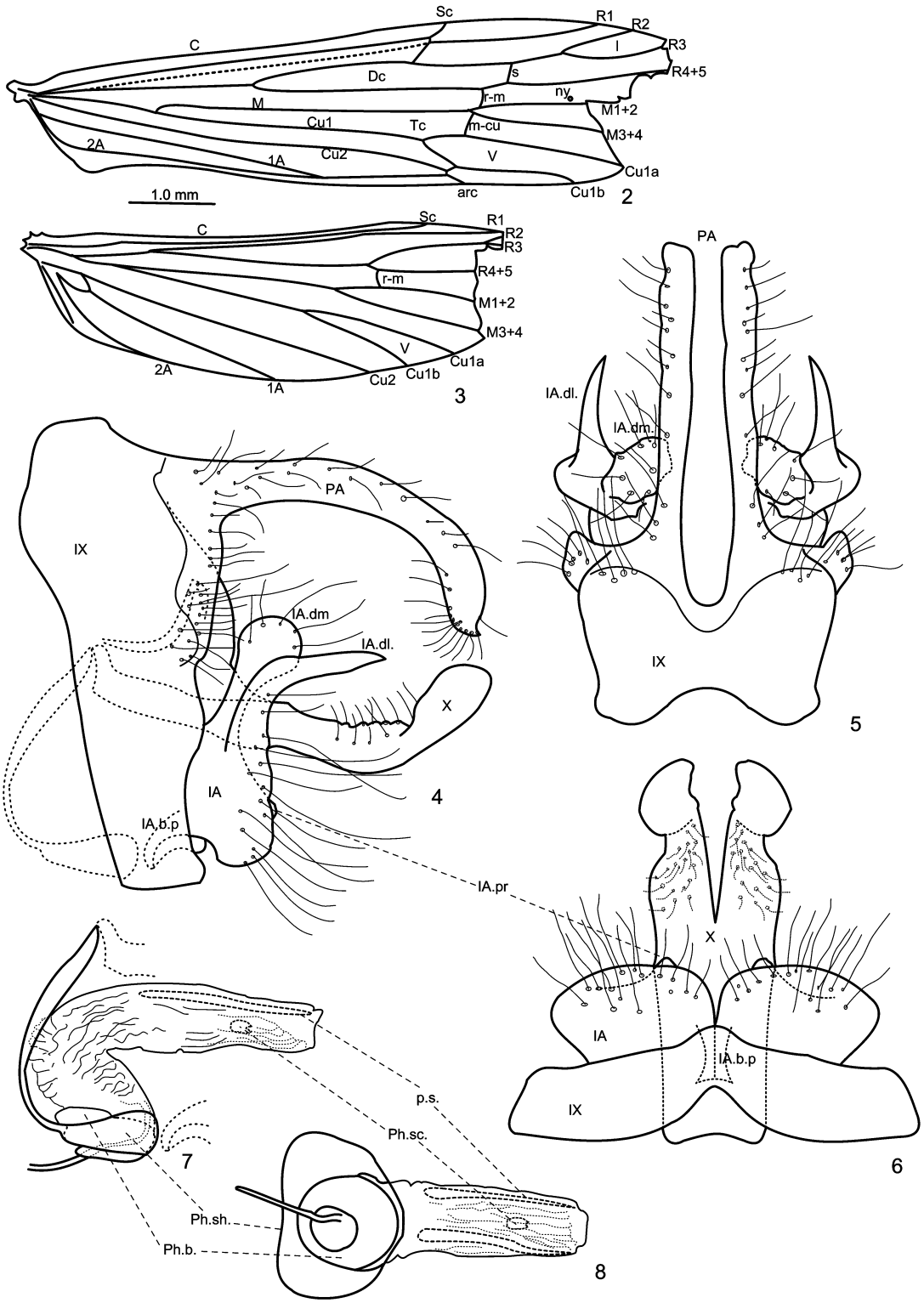


FIGURE 1. *Magadacerina forcipata* new genus, new species, male holotype. Head, pro- and mesothorax in dorsal view. Abbreviations: am.s.w.—anteromesal setal wart; d.l.s.w.—dorsolateral setal wart; l.s.—lateral sulcus; ml.s.w.—mesolateral setal wart; mn.—mesonutum; msc.—mesoscutellum; p.l.s.w.—posterolateral setal wart; pn.s.w.—pronotal setal wart.



FIGURES 2–8. *Magadacerina forcipata* new genus, new species, male holotype. **2–3.** Right forewing (2) and hind wing (3). Abbreviations: *C*—costal vein, *Sc*—subcostal vein, *R1–5*—radial veins 1–5, *M*—media, *M1+2*—anterior median vein, *MP*—posterior median vein, *Cu1–2*—cubital veins (1–2), *1–2A*—first and second anal veins, I—apical fork 1, V—apical fork 5, *Dc*—discoidal cell, *Tc*—thyridial cell, ny—nygma, *s*—sectoral crossvein connecting *R2+3* with *R4+5*, *r–m*—crossvein connecting *R* and *M*, *m-cu*—crossvein connecting *M* and *Cu*. **4–6.** Genitalia in left lateral (4), dorsal (5) and ventral (6) views. Abbreviations: IX—segment IX, X—tergum X, IA—inferior appendage, IA.dl.—inferior appendage dorsolateral lobe, IA.dm.—inferior appendage median lobe, IA.b.p.—inferior appendage basal plates, IA.pr.—protuberance on inferior appendage, PA—pre-anal appendages. **7–8.** Phallus in left lateral (7) and ventral (8) views. Abbreviations: Ph.b.—phallobase, Ph.sc.—phallothremal sclerite, Ph.sh.—phallic shield, p.s.—paramere spine.

Etymology. *Forcipata*, from Latin "*forceps*", named after the pincer-like appearance of the preanal appendages together with tergum X.

Discussion

The species is known from two male specimens, collected on Madagascar in 1999 and 2011, and is unique compared to other Leptocerinae genera. Some genitalic characters, *i.e.* inferior appendages and tergum X, somewhat resemble some of the *Leptocerina* species reviewed by Gibon & Randriamasimanana (2007). However, other characters, such as head (lateral sulci instead of medial sulcus) and wing morphology (no expanded anal region) and shape of segment IX (ventrally short) do not agree with *Leptocerina* characteristics. *Magadacerina* appears to be more closely related to *Blyzophilus* from Ghana, with a similar wing venation, spur formula 2,2,2; preanal appendages fused to segment IX; anterior extension of the basoventral portion of tergum X; and phallus with a phallic shield articulating with the anteriorly expanded basoventral portion of tergum X and the basal plate of the inferior appendages. The shape of the genitalia, such as the preanal appendages (well developed in *Magadacerina*), inferior appendages (*Magadacerina* lacks the prominent recurved spine of *Blyzophilus*) and phallic apparatus (differently shaped phallic shield), are quite dissimilar to those of *Blyzophilus*, making us hesitate to include this new species into that genus and instead propose a new genus for it. The phylogenetic relationship between these two genera is corroborated by the molecular phylogenetic analysis of the family Leptoceridae presented by Malm & Johanson (2011), where the new genus was recovered as sister to *Blyzophilus*. However, the phylogenetic placement of the Blyzophilini tribe within the Leptocerinae is as yet not completely resolved. This record from Madagascar, which now holds 8 leptocerid genera (Johanson 2010), leaves the tribe with a disjunct Madagascar-Ghana distribution, but with the hopes that more extensive collection on the African continent may shed more light on the systematics and morphology of this tribe, and of the subfamily Leptocerinae as a whole.

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