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## Description of three new species of caddisflies from the Fianarantsoa Province, Madagascar

(Insecta, Trichoptera)

Kjell Arne Johanson & János Oláh

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Based on a collection of Trichoptera from the Fianarantsoa Province on Madagascar, the following three new species are described and illustrated: *Pseudoneureclipsis madagascariensis*, spec. nov. (Dipseudopsidae), *Madagocerum flinti*, spec. nov. (Odontoceridae), and *Cheimacheramus ranomafanensis*, spec. nov. (Sericostomatidae).

This report represents the first record of the genus *Pseudoneureclipsis* Ulmer from Madagascar, the fourth known species of the endemic Madagascan genus *Madagocerum* Oláh & Johanson, and the third known species in the Madagascan and South African genus *Cheimacheramus* Barnard.

Kjell Arne Johanson, Swedish Museum of Natural History, Entomology Department, Box 50007, S-10405 Stockholm, Sweden;  
e-mail: kjell.arne.johanson@nrm.se

János Oláh, Institute of Environmental Management, Tessedik College. Residence address: H-4032 Debrecen, Tarján 6, Hungary;  
e-mail: saker@szarvasnet.hu

### Introduction

The Madagascan Trichoptera fauna comprises 143 recorded species (Morse 2008), and more species are under description from the island (Oláh & Johanson submitted[a], Weaver et al. 2008). In total, 12 families are known from the country (Morse 2008, Oláh & Johanson submitted[a], Weaver et al. 2008), of which the Hydropsychidae are the most diverse in number of species (67 described species), followed by the Leptoceridae with 34 described species. The cosmopolitan family Dipseudopsidae are previously recorded and represented on Madagascar by 19 species, all within the genus *Dipseudopsis* Walker, 1852. A single male of *Pseudoneureclipsis* Ulmer, 1913 in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM) has been examined, representing the first record of the genus from Madagascar, and the sixth species

of the genus from the Afrotropical Region. Within the Afrotropical Region, the genus is otherwise recorded from the Democratic Republic of Congo, Ghana, Malawi and Angola (Tobias & Tobias 2006). The family Odontoceridae is divided into 12 genera, most of them that are represented by only one to few species and mainly restricted to the northern hemisphere. With the description of 3 species in the genus *Madagocerum* Oláh & Johanson (submitted [b]) the family was recorded for the first time in Africa. The single specimen available from USNM represents an undescribed species, and the genus now includes 4 species, all endemic to Madagascar. The Sericostomatidae genus *Cheimacheramus* Barnard, 1934 previously comprised 2 species and is restricted to South Africa and Madagascar (Johanson & Oláh 2006). At USNM unidentified specimens of the genus from Madagascar were identified as representing an undescribed species, and the second record of the

genus outside South Africa. The three species are described below in order to increase our knowledge of these rare genera.

### Material and methods

The material in this study were borrowed from the National Museum of Natural History, Smithsonian Institution, Entomology Department, Washington, D.C., U.S.A. as pinned specimens collected by E. Steiner at 1100 meter elevation about 7 km W Ranomafana in Province Fianarantsoa, on Madagascar in 1988. Previous to identification, the male abdomen of the holotypes was separated from the body and macerated in ProteinaseK at 56 °C for about 8 hours for DNA sampling. The nearly completely macerated abdomens were treated in hot KOH for a few minutes in order to complete the maceration. The abdomens were thereafter transferred to absolute ethanol for about 2 hours for dehydration before temporarily mounted on microscope slides in Euparal for illustration. The right wings of the holotypes were separated from the rest of the body, transferred to 80 % ethanol where most of the wing setae were removed. The wings were thereafter temporarily mounted on microscope slides in glycerol for examination and illustration.

The illustrations of the genitalia and wings produced by using a drawing tube mounted on a Leitz Ortholux II light microscope (Leica, Wetzlar, Germany). When the illustrations were completed the abdomens and wings were transferred to glycerol in micro vials mounted under the rest of the animals on their original pin. The left side of the whole animal was photographed by using an Olympus DP70 digital camera mounted on an Olympus compound microscope (SZX12; Olympus, Tokyo, Japan). Multiple layers of the animal were photographed and united into a single image using the analySIS 5.0 software (Soft Imaging System GmbH; Münster, Germany).

The terminology of the genitalic structures follows Oláh & Johanson (2008).

The depositories of the type materials are:

USNM National Museum of Natural History, Smithsonian Institution, Entomology Department, Washington, D.C., U.S.A.

NHRS Swedish Museum of Natural History, Entomology Department, Stockholm, Sweden.

## Descriptions

### Dipseudopsidae

#### *Pseudoneureclipsis madagascariensis*, spec. nov.

Figs 1, 4-9

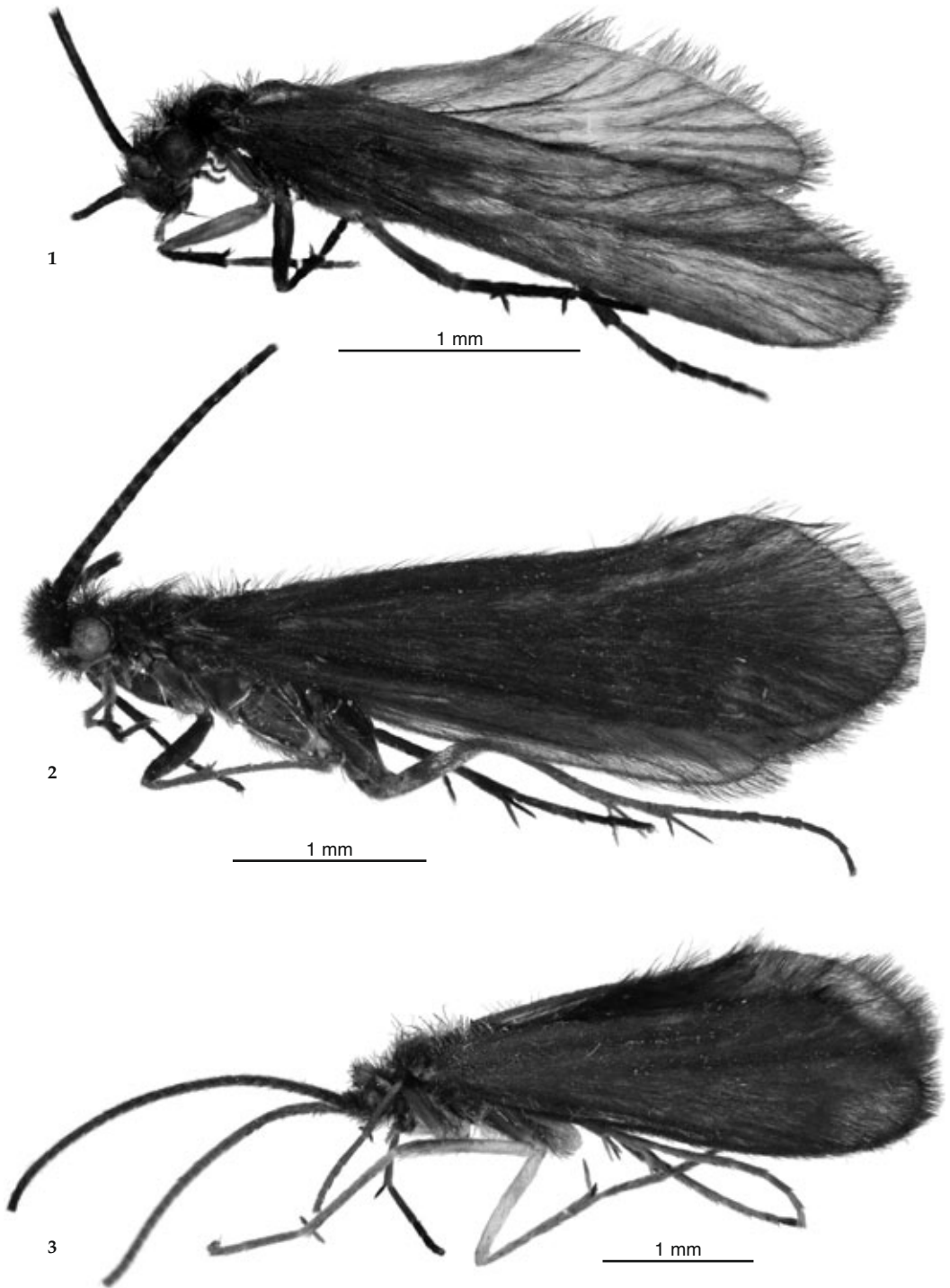
**Type.** Holotype ♂ Madagascar, Prov. Fianarantsoa, 7 km W Ranomafana, 1100 m, 1-7.xi.1988 [W. E. Steiner] (USNM, pinned, genitalia and right wings in glycerol in micro-vial).

**Diagnosis.** This species resembles *P. aculeata* Statzner, 1976 and *P. atewa* Gibbs, 1973 in the presence of long and slender coxopodites and harpagones. *Pseudoneureclipsis madagascariensis* is separated from the two species by having wider segment IX in lateral view and more weakly ventrad-curving harpagones. It has a small tergum X forming a central, spinose tongue between the preanal appendages.

### Description

**Holotype.** Wings: venation as in Fig. 10; forewing length 4.1 mm; hind wing length 3.2 mm.

Genitalia: In lateral view (Fig. 5) tergum IX strongly narrowing dorsad, without setae; dorsal apex slightly curving anterad; anterior margin slightly concave; posterior margin wide triangular. In dorsal view (Fig. 6) tergum IX forming transverse, narrow band located immediately behind preanal appendages. In lateral view (Fig. 5) sternum IX wide, oval; in ventral view (Fig. 7) lateral margins undulate; posterior margin concave; anterior margin triangularly incised. Preanal appendages small, tongue-shaped in lateral view; divided into plate-like lateral lobes and slightly dorsad hook-shaped mesal lobes; all lobes with short, stout setae (Fig. 6). Tergum X forming simple, central, tongue-like lobe between mesal lobes of preanal appendages (Fig. 6); covered by short, stout setae. Gonopods with well-developed coxopodite and harpago. In lateral view (Fig. 5) coxopodites oval, slender, apex bending posteroventrad; in dorsal view (Fig. 6) dorsal margins curving uniformly mesad along their length; in ventral view (Fig. 7) with rounded lateral margin; mesal margin strongly diverging along two-thirds their length. In lateral view (Fig. 5) harpagones tapering shortly after mid-length; apex tube-shaped, curving smoothly ventrad; in dorsal view (Fig. 6) short basal part orienting posterad before bending posteromesad. Pair of paraproctal processes located immediately below mesal lobes of preanal appendages; digitate, slightly curving mesad (Fig. 6). Phallic apparatus asymmetrically bottle-shaped in lateral view (Fig. 8); nearly parallel-sided from mid-length; in ventral view (Fig. 9) phallobase widely oval; pos-



**Figs 1-3.** Habitus photographs of the male holotypes. 1. *Pseudoneureclipsis madagascariensis* spec. nov. (Dipseudopsidae); 2. *Madagocerum flinti* spec. nov. (Odontoceridae); 3. *Cheimacheramus ranomafanensis* spec. nov. (Sericostomatidae).

terior apex truncate; pair of hooks present dorsally before posterior apex, seen in ventral view (Fig. 9); large, phallosomal process located centrally in phallus (Figs 8, 9); non-protruded endotheca apparently densely covered by microtrichia.

**Etymology.** *madagascariensis*, named after the type locality.

## Odontoceridae

### *Madagocerum flinti*, spec. nov.

Figs 2, 10-16

**Types.** Holotype ♂, Madagascar, Prov. Fianarantsoa, 7 km W Ranomafana, 1100 m, 8-21.x.1988 [W. E. Steiner] (USNM, pinned, genitalia and right wings in glycerol in micro-vial).

Paratypes: 2♂, same data as holotype, except one with dry abdomen in microvial; 1♂, same data, except NRM, pinned, dry abdomen in micro-vial, DNA extract EW4.

**Diagnosis.** This species is easily distinguished from the other species in the genus in the genitalia, particularly in the very broad dorsal part of tergum IX that is covered by microtrichia, the short and compact tergum X, and the long, ventrad produced harpagones. *Madagocerum thoderirk* Oláh & Johanson, submitted has also an anteriorly produced segment IX, but in that species the widest part is located at mid-height.

## Description

**Holotype.** Wings: venation as in Fig. 4; forewing length 6.1 mm; hind wing length 4.5 mm.

Abdominal segment V with small, pointed sternocross process located at posterior two-thirds its length (Fig. 11).

Genitalia: In lateral view (Fig. 12) tergum IX broad, oval, densely covered by large, dark microtrichia bordered by narrow line; posterior margin convex, with few long setae immediately below preanal appendages; anterior margin smooth. In dorsal view (Fig. 13) tergum IX with nearly parallel lateral margins; mesal part divided by long triangular membranous area pointing posterad; anterior division broadly triangular (Fig. 13). In lateral view, sternum IX with irregular anterior margin, ventrally with short anterad process; lateral faces without setae or large microtrichia. In ventral view (Fig. 14) sternite IX nearly rectangular, short, with well pigmented posterior margin and posterolateral corners. Preanal appendages small, rounded in lateral view (Fig. 12); in dorsal view (Fig. 13) rod-shaped, ori-

ented mesad; densely covered by long setae except smooth mesally. In lateral view (Fig. 12) tergum X originates from mid-height of segment IX; short, dorsal branches rounded; slightly longer, smooth, tapering, ventral branches with convex ventral margins. In dorsal view (Fig. 13) dorsal branches slightly exceeding preanal appendages; widely separated by mesal cleft, slightly converging mesally; ventral branches slightly exceeding dorsal branches, oriented posterad, each with slightly dilated apex. In lateral view (Fig. 12) gonopods with nearly parallel-sided and apically truncated coxopodite; harpago long, with rounded dorsal projection at base, tapering distad. In ventral view (Fig. 14) coxopodites nearly equally broad along their lengths, oriented laterad before curving posterad before harpagones; mesal margins parallel-sided at bases; harpagones slightly converge distad; slightly taper along their lengths. Phallic apparatus straight in lateral view (Fig. 15); ventral margin basally irregular; anterodorsal part broad, membranous; distal two-thirds membranous, straight, parallel-sided; in ventral view (Fig. 16) step-like narrowing distad.

**Etymology.** *flinti*, named after Dr. Oliver S. Flint, Jr. (USNM) acknowledging his great contribution in Trichoptera taxonomy and for making material available to us for study and description.

## Sericostomatidae

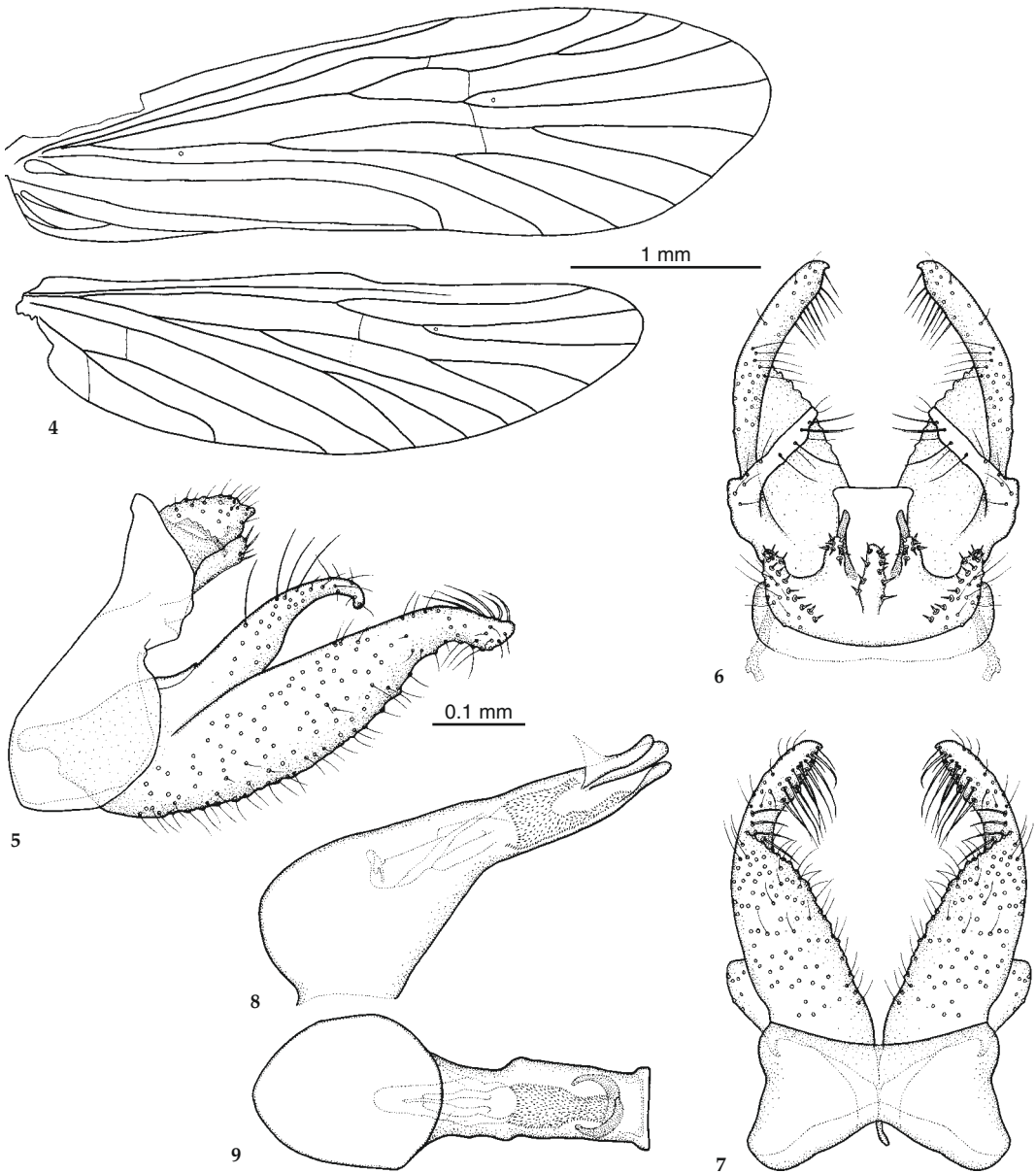
### *Cheimacheramus ranomafanensis*, spec. nov.

Figs 3, 17-24

**Types.** Holotype ♂, Madagascar, Prov. Fianarantsoa, 7 km W Ranomafana, 1100 m, 22-31.x.1988 [W. E. Steiner] (USNM, pinned, genitalia and right wings in glycerol in micro-vial).

Paratypes: 1♂, same data as holotype, except 1-7.xi.1988 (USNM, dry abdomen in microvial); 1♂, same data (NRM, pinned, dry abdomen in micro-vial, macerated head in glycerol, DNA extract EZ1).

**Diagnosis.** This species has unique genitalia that do not resemble those of other species in the genus *Cheimacheramus* or Sericostomatidae. The unique structure comprises the strongly anteriorly produced segment IX that is fused dorsally for most of its length. The two other species in the *Cheimacheramus* have a strongly dorsad-producing lobe on the coxopodites but in *C. ranomafanensis* the coxopodites are weakly produced dorsad. *Cheimacheramus ranomafanensis* has a pair of long, needle-shaped processes dorsally on tergum X that is also present in *Rhoizema spinosum* Barnard, 1934 from South Africa. Other species in *Rhoizema* have different processes dorsally



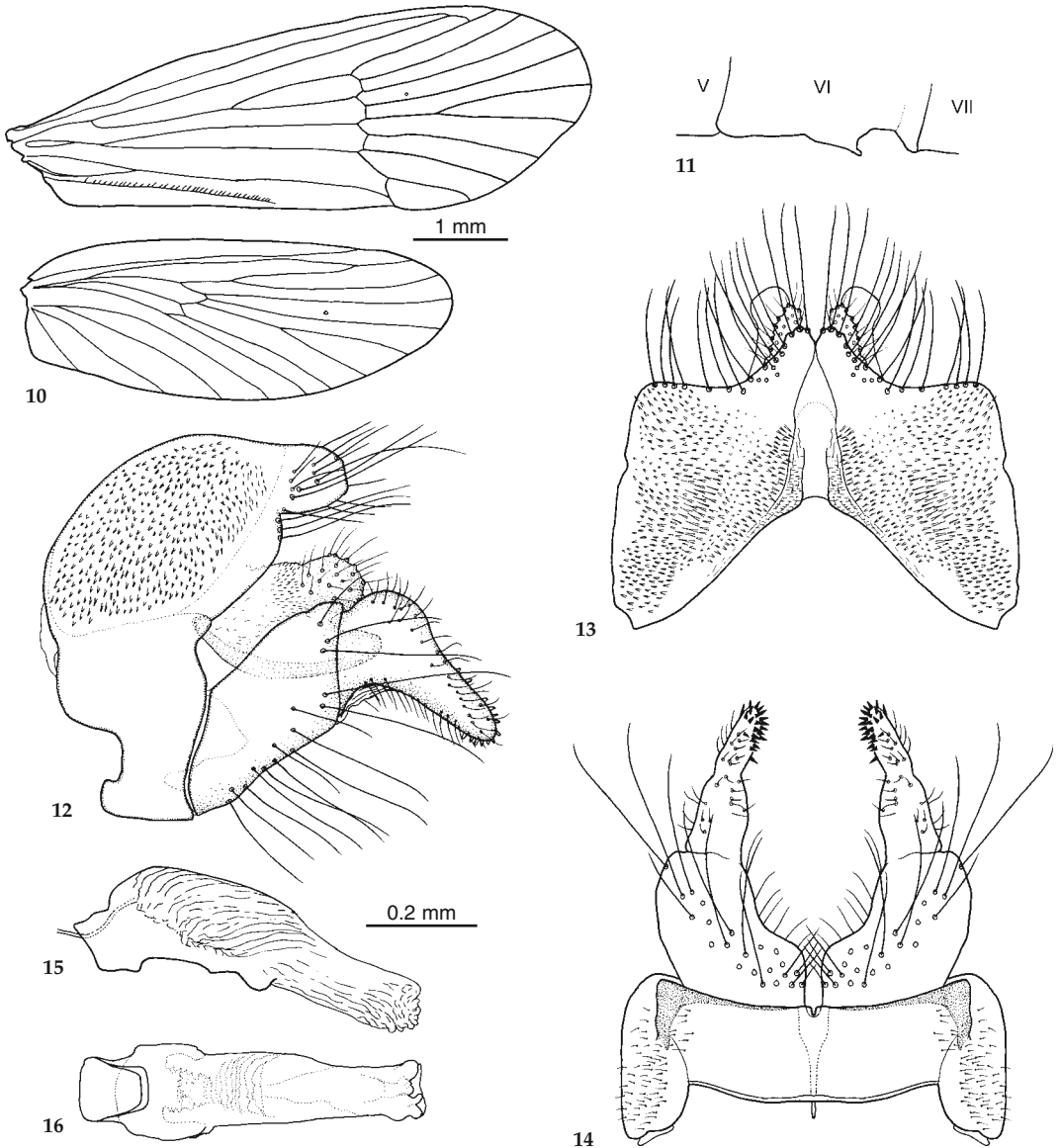
**Figs 4-9.** *Pseudoneureclipsis madagascariensis* spec. nov. (Dipseudopsidae), male holotype. 4. Right wings; 5. genitalia, lateral view; 6. genitalia, dorsal view; 7. genitalia, ventral view; 8. phallic apparatus, lateral view; 9. phallic apparatus, ventral view. The 1.0 mm scale bar refers to Fig. 4; the 0.1 mm scale bar refers to Figs 5-9.

on tergum X but not resembling those in *R. spinosum* or *C. ranomafanensis*. This new species is separated from *Rhoizema* species also by the shorter antennal pedicel, the shorter Tc in the forewings, the A1 in the forewings running into wing margin, and the absence of a closed Dc in the hind wings.

### Description

**Holotype.** Wings: venation as in Fig. 17; forewing length 6.2 mm; hind wing length 4.6 mm.

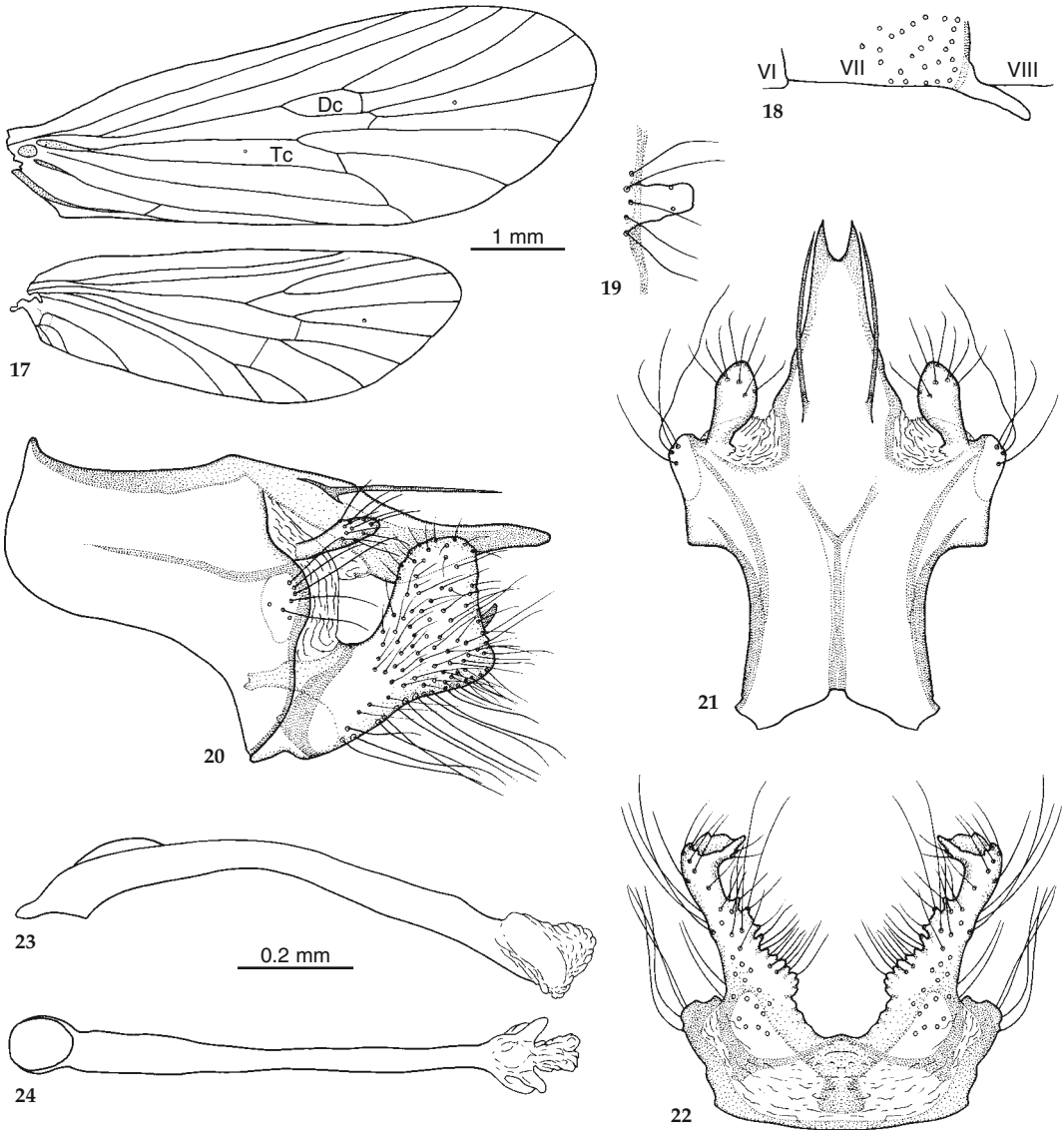
Abdominal segment VII with small, truncate sternal process located at posterior margin of segment (Figs 18-19).



**Figs 10-16.** *Madagocerum flinti* spec. nov. (Odontoceridae), male holotype. **10.** Right wings; **11.** abdominal sternites V-VII, lateral view; **12.** genitalia, lateral view; **13.** genitalia, dorsal view; **14.** genitalia, ventral view; **15.** phallic apparatus, lateral view; **16.** phallic apparatus, ventral view. The 1.0 mm scale bar refers to Fig. 10; the 0.2 mm scale bar refers to Figs 11-16.

**Genitalia:** In lateral view (Fig. 20) tergum IX strongly produced anterad; forming pair of broad lateral plates with concave dorsal margin and convex ventral margin; anterodorsal apices pointing dorsad; longitudinal apodeme separating tergum and sternum starting immediately below preanal appendages, straight, fading well before anterior

margin of segment. In dorsal view (Fig. 21) tergal plates IX fused mesally along most of their length; separated by longitudinal apodeme; apodeme bifurcate posterad probably forming border between tergum IX and tergum X. In lateral view (Fig. 20) sternum IX tapering ventrad; paler oval setose area present immediately anteriorly of posterior mar-



**Figs 17-24.** *Cheimacheramus ranomafanensis* spec. nov. (Sericostomatidae), male holotype. 17. Right wings; 18. abdominal sternites VI-VIII, lateral view; 19. ventral process on sternite VII, ventral view; 20. genitalia, lateral view; 21. genitalia, dorsal view; 22. genitalia, ventral view; 23. phallic apparatus, lateral view; 24. phallic apparatus, ventral view. The 1.0 mm scale bar refers to Fig. 17; the 0.2 mm scale bar refers to Figs 18-24.

gin below longitudinal apodeme. In ventral view (Fig. 22) sternum IX hidden by coxopodites. In dorsal view (Fig. 21) sternum IX broader than tergum IX. Broad membranous area forming band immediately posteriorly of segment IX (Figs 20, 21). Preanal appendages long, slightly dilate apically (Figs 20, 21), originating from membranous areas. In lateral view (Fig. 20) tergum X originates from tergum IX; long,

slightly curving ventrad before re-curving dorsad; tapering along its length; with pair of long, posterod oriented, needle-shaped processes originating near base of segment, above preanal appendages. In dorsal view (Fig. 21) base of tergum X about half as wide as tergum IX; uniformly narrowing toward apex; apex with U-shaped bifurcation. Gonopods without harpago; in lateral view (Fig. 20) coxopodites nar-

rowing slightly toward mid-length before strongly broadening dorsad into rounded dorsal apex; posterior margin weakly concave, with pointed median apex exceeding posterior margin. In ventral view (Fig. 22) coxopodites fused at base; separate from distal one-fourth; oriented posterolaterad; median apex oriented posteromesad; mesal margins strongly undulated due to presence of erect setal bases. Phallic apparatus long, slender along its length, slightly curving ventrad along anterior half (Fig. 23); distal half straight. In ventral view (Fig. 24) phallobase circular; narrowing to mid-length; endotheca divided into lateral and central branches; phallic sclerites not observed.

**Etymology.** *ranomafanensis*, named after the type locality, Ranomafana.

### Acknowledgements

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