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Guloptiloides: an Extraordinary New Carnivorous Genus of Baetidae (Ephemeroptera)

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ABSTRACT

Guloptiloides (Ephemeroptera, Baetidae), gen.n., is described to accomodate the species *G. gargantua* (larvae) and *G. spA* (female imagoes) based on specimens from the Eastern coast of Madagascar. Larvae of *Guloptiloides* are remarkable by the adaptation of the mouthparts to a predatory diet. It is also distinct from other genera in that adults have hindwings with 3 well-marked longitudinal veins and a single extremely developed spur on the costal margin. Affinities and ecology are discussed.

KEYWORDS: Ephemeroptera, Baetidae, new genus, Madagascar, carnivorous genus.

INTRODUCTION

The knowledge of the faunal composition of the baetid family in Madagascar has conspicuously increased recently (Lugo-Ortiz & McCafferty, 1997, 1998; Gattolliat & Sartori, 1998; Gattolliat et al., 1999; Lugo-Ortiz & McCafferty, in press). Among the twelve genera known to occur in Madagascar, two are strictly or predominantly carnivorous: *Nesoptiloides* Demoulin and *Herbrossus* Lugo-Ortiz and McCafferty. The here described genus is consequently the third one. The high specialisation of its mouthparts, its very contrasted coloration and its big size make this genus very remarkable and easily distinguishable.

Guloptiloides Gattolliat & Sartori gen. n.

Description

Larva
Head. Labrum (Fig. 1) three-lobed, conspicuously wider than long, dorsally covered by setae. Hypopharynx unknown.

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Left mandible (Fig. 4) highly transformed, long and very narrow; one set of sharp incisors; lateral margin with conspicuous convex angulation; prostheca little developed. Mola (Fig. 5) completely transformed into an incisor; distance between incisors and mola quite reduced; tuft of setae between prostheca and mola absent. Right mandible (Fig. 2) almost symmetrical to the left one except the prostheca poorly developed.

Maxillae (Fig. 6) with 4 long and acute teeth; row of setae under the teeth reduced to only 2 normal setae and 2 teeth-like setae; palp thin, two-segmented.

Labium (Fig. 7) with glossae stout and short, ventral face covered with setae; paraglossae subequal to the glossae, crescent shape, covered with thin setae at the apex; palp three segmented, segment 1 and 2 long and thin, segment 3 short, subconical.

Thorax. Hind wing present.

Legs (Fig. 14) with forefemora without pronounced ventral marginal convexity. Femora without villopore. Femoral patch reduced to a single stout seta at the apex of the femora. Foretibiae without ventrodistal process. Small proximal arc on the tibiae absent. Tarsal claw (Fig. 15) with 2 rows of teeth.

Abdomen. Terga (Fig. 12) with scale bases, posterior marginal with acute spines. Three caudal filaments relatively short. Two pyramidal sclerites at the basis of the filament extremely developed.

Adult.

Thorax. Forewing (Fig. 16) hyaline; with only one intercalary vein between the longitudinal veins. Hindwing (Fig. 17) with 3 well-marked longitudinal veins and a well-developed single spur on the costal margin.

Eggs. Elongated (Figs. 18, 19) with rounded apices. Chorionic structure with longitudinal ridges. Interridge spaces constituted with small lense-shaped concavities. No polar cap.

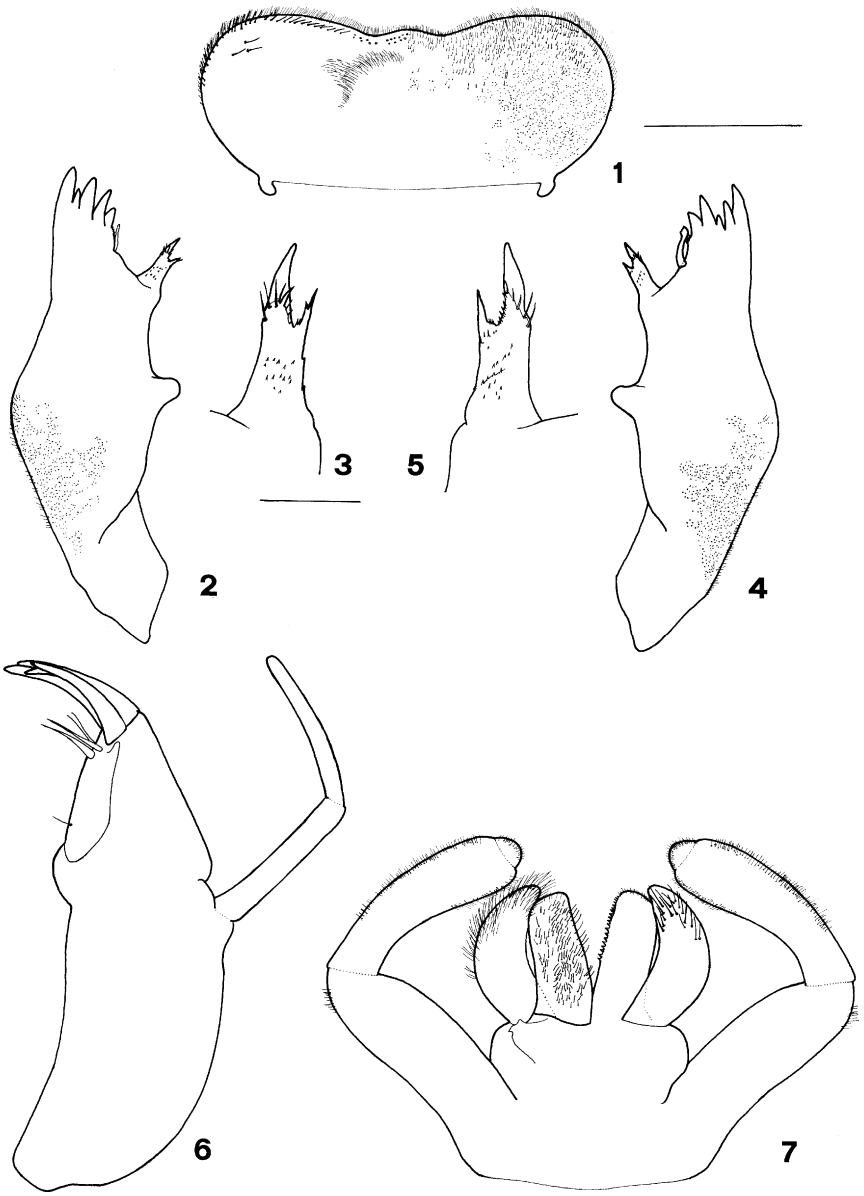
Etymology. The generic name is constructed from *Gulo*, latin name of the wolverine (*Gulo gulo*), in reference to its voracious habits; it is also an anagram of the first surname letters of the ephemeropterist C.R. Lugo-Ortiz (West Lafayette), with an apposition of *-ptiloides* in reference to the close genera *Nesoptiloides* and *Centroptiloides*.

Type species. Guloptiloides gargantua Gattolliat & Sartori sp. n.
Species included. Guloptiloides gargantua Gattolliat & Sartori sp. n., *Guloptiloides* sp. A

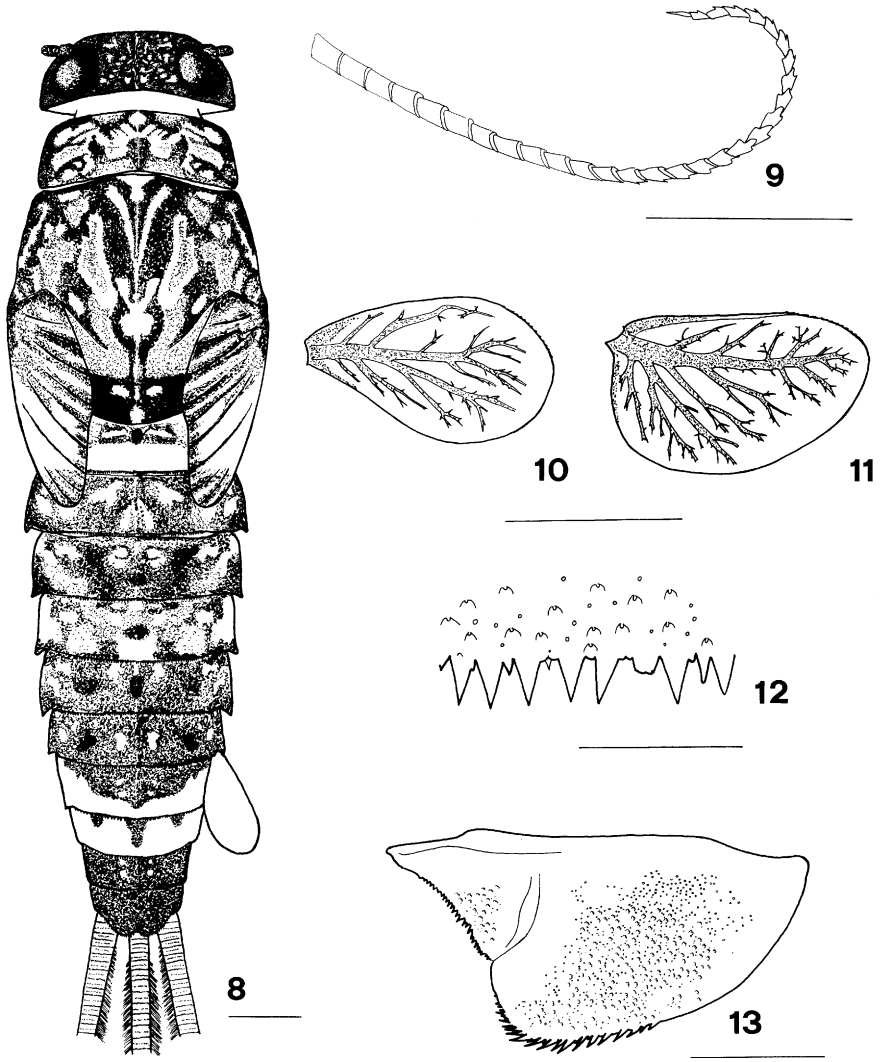
Distribution. This genus is restricted to two basins of the Eastern coast of Madagascar. The larvae live in shallow streams, with relatively fast current.

DISCUSSION

Larvae of *Guloptiloides* are readily distinguished from other genera of Baetidae by the combination of a three-lobed labrum (Fig. 1), long and narrow mandibles

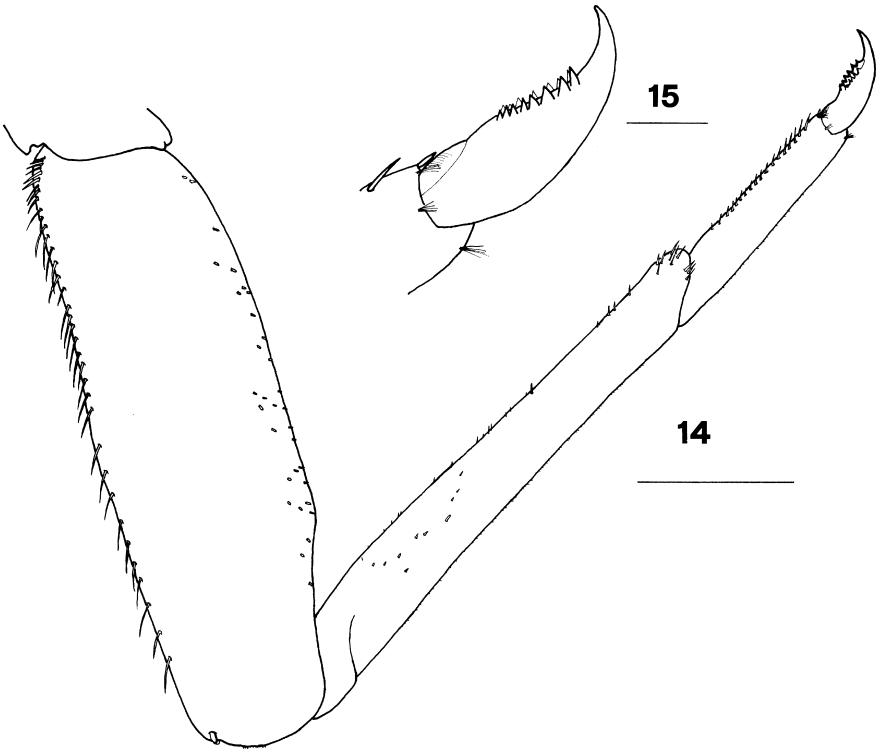


Figs. 1–7. *Guloptiloides gargantua* sp. n., larval mouthparts: Fig. 1, labrum; Fig. 2, right mandible; Fig. 3, right mola; Fig. 4, left mandible; Fig. 5, left mola; Fig. 6, right maxilla; Fig. 7, labium (left: ventral; right: dorsal). Scale: 0.5 mm, except Figs. 3 and 5 for which it is 0.1 mm.



Figs. 8–13. *Guloptiloides gargantua* sp. n., larval structures: Fig. 8, habitus (dorsal view), scale 1 mm; Fig. 9, flagellum of antenna, scale 0.5 mm; Figs. 10, 11, first and third gill, respectively, scale 1 mm; Fig. 12, distal margin of tergite, scale 0.1 mm; Fig. 13, paraproct, scale 0.25 mm.

(Figs. 2,4) almost symmetrical, with the mola (Figs. 3, 5) transformed into an incisor, the absence of setae between prostheca and mola, the maxillae (Fig. 6) with the apical setation strongly reduced, the labium (Fig. 7) with glossae and paraglossae short and stout, labial palps more than twice longer than glossae and

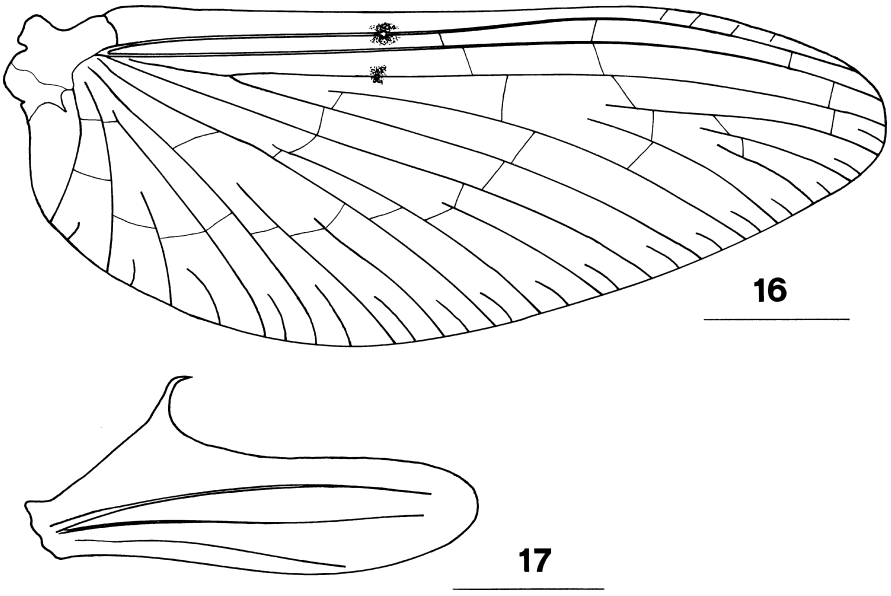


Figs. 14–15. *Guloptiloides gargantua* sp. n., larval structures: Fig. 14, left foreleg, scale 0.5 mm; Fig. 15, tarsal claw, scale 0.1 mm.

paraglossae, tarsal claws (Fig. 15) with two rows of teeth, and two extremely developed sclerified pyramidal structures at the basis of the filaments.

Adults of *Guloptiloides* are also easily distinguished from other genera by a hindwing (Fig. 17) with an extremely developed single spur on the costal margin and three well-marked longitudinal veins, forewing with a single intercalary vein (Fig. 16) between the longitudinal veins and the eggs (Figs. 18, 19) with a chorionic structure with longitudinal ridges.

Phylogenetic relationships are difficult to establish because of the many convergences observed between the main lineages of Baetidae. The modifications of the mouthparts, especially the mandibles (Figs. 2–4), for carnivorous diet are very similar among the Baetidae family (*Centroptiloides, Echinobaetis, Harpagobaetis, Nesoptiloides, Raptobaetopus*) (Demoulin, 1973; Müller-Liebenau, 1978; Mol, 1986, 1989; Lugo-Ortiz & McCafferty, 1996b; Gattolliat & Sartori, 1998). It results that even if the unusual mouthparts of *Guloptiloides* are morphologically related to those of other carnivorous genera, it does not mean that they are phylogenetically close.



Figs. 16–17. *Guloptiloides* sp. A, adult structures: Fig. 16, forewing, scale 2 mm; Fig. 17, hindwing, scale 0.5 mm.

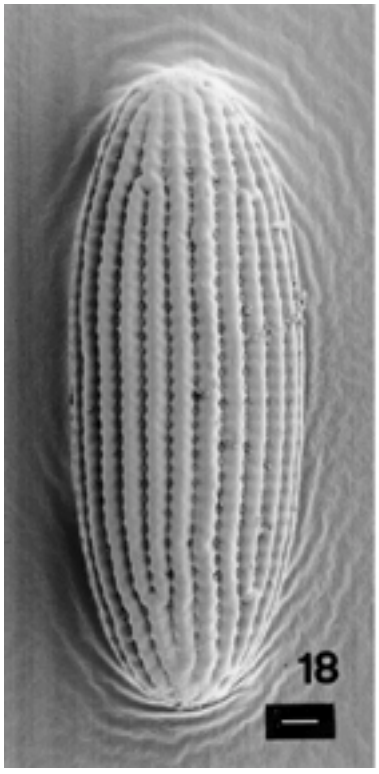
Nevertheless, the larval claws (Fig. 15) with a double rows of teeth, the absence of femoral villopores (Fig. 14) and the forewing (Fig. 16) with a single intercalary vein seem to exclude the belonging of *Guloptiloides* to the *Baetis* complex (Waltz & McCafferty, 1987).

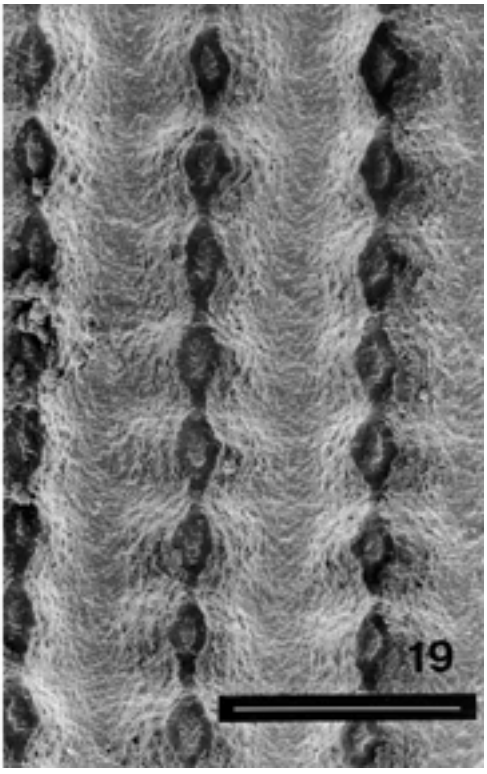
The *Buggiliesia* complex is mainly erected with characters based on the male genital forceps (Lugo-Ortiz & McCafferty, 1996a). Although the male imago of *Guloptiloides* remains unknown, the larval claws (Fig. 15) with a double rows of teeth also exclude its membership in the *Buggiliesia* complex.

Considering the larval claws with a double rows of teeth and the forewing (Fig. 16) with a single intercalary vein, *Guloptiloides* presents the characteristics of the *Centroptiloides* complex (Lugo-Ortiz & McCafferty, 1998). But both those characters must be considered as plesiomorphies, and do not imply the membership of *Guloptiloides* in this complex.

The hindwing (Fig. 17), with 3 well-marked longitudinal veins and a well-developed single spur, has characters similar to those of the genus *Dabulamanzia* (Lugo-Ortiz & McCafferty, 1996b). With regard to the differences at the larval stage between the two genera, we must certainly consider them as convergence rather than apomorphic features.

The knowledge of the male genitalia will certainly give new information, and allow us to establish the phylogenetic position of this genus more precisely.





Figs. 18–19. *Guloptiloides* sp. A, structures of eggs dissected from adult: Fig. 18, habitus, Fig. 19, detail of chorionic structure. Scales 10 µm.

Guloptiloides gargantua Gattolliat & Sartori sp. n.

Description

Larva

Maximal length (full grown specimen): Body 12 mm. Cerci 5.2 mm. Terminal filament subequal to the cerci.

Head. Coloration (Fig. 8) dark brown with light brown vermiform markings on vertex and frons. Antennae dark brown, about 4 mm long; scapus longer than wide; pedicellus subcylindrical, longer than wide. Distal part of the flagellum serrated (Fig. 9), segments of exceptional shape.

Labrum (Fig. 1) dorsally covered with abundant, small setae especially at the apex; margin laterally and apically with long setae; ventrally with a row of stouter setae parallel to the lateral and distal margin; 3 independant setae in the latero-distal part; median lobe with traces of insertion of setae.

Hypopharynx unknown.

Left mandible (Fig. 4) with a conspicuous convex angulation on the external margin; incisors fused to a group of 5 sharp teeth, the tooth nearer the prostheca with internal margin jagged; prostheca reduced, shorter than the incisors, with small teeth at the apex; tuft of setae between prostheca and mola absent; mola (Fig. 5) transformed in a two-pointed tooth, acute setae subparallel to the apex of the principal point, spines covering the basis of the mola; tuft of long setae at the apex of the mola absent; basal half with short thin setae dorsally, longer near the lateral margin. Right mandible (Fig. 2) symmetrical to the right except the prostheca slender, without teeth at the apex.

Maxillae (Fig. 6) with 4 long and acute teeth, apex of the galea with only two stout and not pectinated setae and two normal setae instead of the usual baetid row of setae; a single seta perpendicular to the margin of the galea; usual row of 5 to 6 setae at the basis of the galea absent; two setae at the external basis of the teeth absent; palp 2-segmented glabrous and slender.

Labium (Fig. 7) with glossae subequal to paraglossae; inner margin of the glossae with small stout denticules, ventrally covered all over with numerous setae; paraglossae of crescent shape, ventral face laterally and apically covered with long, thin setae, dorsal face with few stout setae at the apex. Labial palp 3-segmented; first segment subcylindric, not covered with micropores, with only few thin setae at the apex of the lateral margin; second segment moderately produced apicolaterally, with thin setae on the lateral margins, usual row of 7 to 9 setae near the outer margin absent; third segment subconical, covered with thin setae.

Thorax. Characteristic scale bases cover the whole thorax including the legs. Coloration (Fig. 8) dark brown with light brown markings. Forewing pad (Fig .8) dark brown with light brown markings and a transversal yellow band at the level of the first abdominal segment, major veins well-marked with dark brown lines; hindwing pad present.

Forelegs (Fig. 14) with coxa slender covered with scale bases, very scarce setae. Femora dorsally with a single row of long setae, ending with two short, stout setae; apex with small denticles; stout setae subparallel to the dorsal margin absent; sparse apically blunt setae on the ventral margin. Tibiae dorsally with only a row of very small setae; ventral margin with few stout setae, apex with acute setae; posterior face with very scarce setae. Tarsi dorsally with only a row of very small setae; ventrally, with a row of stout, apically pointed setae becoming longer toward the apex; three tufts of setae at the apex; tarsal claws (Fig. 15) stout with 2 rows of 5 to 8 teeth, subapical pair of thin setae absent.

Middle and hind legs similar to foreleg.

Abdomen. Characteristic scale bases covering the whole abdomen. Coloration (Fig. 8) dark brown with light brown markings. Terga (Fig. 12) with abundant scale bases and traces of insertion of setae; posterior marginal spines regular, triangular, twice longer than wide; small spines irregulary present between the

main spines. Sterna yellow, with abundant scale bases and traces of insertions of setae; posterior margin of sterna 1 to 7 without spines; posterior margin of segments 8 and 9 with irregular spines which are slighty broader than long.

Gills on abdominal segments 1 to 7, tracheation black, well-developed; serrated at the apex; gill 1 smaller than the others, shape as in figure 10; gills 2 to 7 identical in shape (Fig. 11).

Paraproct (Fig. 13) with about 20 irregular marginal spines, blunt laterally and sharper and more slender at the apex; surface covered with micropores and scale bases; no setae visible; postero-lateral extension with about 20 well-developed spines along the margin; surface covered with micropores and scale bases.

Cerci and median caudal filament light brown with a large dark brown band, each segment covered with scale bases, and apical margin with a row of triangular, acute teeth. The two pyramidal sclerified structure at the basis of the filament nearly reaching the distal part of tergite 10.

Male and female imagines. Unknown

Material: Holotype: One female larva (n°697a), 26.4.1997, Madagascar, Rianila basin, Sandrakatrana river, loc. Ambodiaviavy (48°39'45"E; 18°57'31"S), altitude 350m. *Paratypes:* One larva (n°697b), same locality and same data as holotype. One female larva, 7.04.99, Rianila basin, Sahatandra River, loc. Ambodiriana, near Ambalafary (48°20′19″ E; 19°01′30″ S), altitude 980m. Eleven female larvae, 11.04.99, Mangoro basin, unnamed river, loc. Road to Anosibe an'ala (21km from Moramanga) (48°14′13″ E; 19°05′57″ S), altitude 940m. One female larva, 12.04.99, Mangoro basin, Mangoro river, loc. bridge over the Mangoro (48°06′32″ E; 18°52′32″ S), altitude 840m. *Additional material:* One larva (n°243a), 6.5.1994, Mangoro basin, Mangoro river, loc. bridge over the Mangoro (as before). One female larva, 24.03.99, Antongombato Basin, Makis river, loc. 100m from Grande Cascade, Montagne d'Ambre Nature Reserve (49°10′14″ E; 12°29′17″ S), altitude 675m.

Etymology: The specific epithet is the name to the principal character from the story, "Vie inestimable du grand Gargantua" from the French middle-age writer Rabelais.

DISCUSSION

Although *Guloptiloides gargantua* is the only species known at the larval stage, the following characters are expected to distinguish it from other species: the shape of the mola (Figs. 3, 5), the setation on the glossae and paraglossae (Fig. 7), the shape of the labial palps (Fig. 7), the setation on the foreleg (Fig. 14) especially on the ventral and dorsal margin of the femur and the paraproctal spination (Fig. 13). The characteric scale bases covering the thorax and the abdomen could also be specific characters.

Guloptiloides sp. A

Description

Larva. Unknown.

Male imago. Unknown.

Female imago. Maximal length: Body 12.5 mm. Cerci 21.0 mm. Forewing 11.8 mm. Hindwing 1.4 mm.

Head. Light brown without marking. Carina well-developed between the antennae. Antennae light brown.

Thorax. Light brown without marking, only the pronotum darker; some specimens appear to be darker.

Forewing (Fig. 16) hyaline, except two black marks on veins Sc and R_2 with significant widening of the veins; with only one relatively long intercalary vein between the longitudinal veins except between subcostal and first radial veins; pterostigma with 4 to 6 generally incomplete vertical cross-veins.

Hindwing (Fig. 17) hyaline, costal part of the wing of some specimens middle brown; 3 well-marked longitudinal veins, first and second joined at the basis, one very developed spur on the costal margin. Legs light brown.

Abdomen. Coloration of the terga uniformly light brown, some specimens sligthy darker. Sterna yellowish brown. Cerci yellowish brown, black at the apex of each segment; surface covered with setae. Subgenital area with distal part of the sternite 7 convex and the distal margin with small spines, sternite 8 depressed in the proximal part.

Eggs. Elongated (Figs. 18, 19) shape with rounded apices. Chorionic structure with longitudinal ridges. Interridge spaces constituted of small lense-shaped concavities. No polar cap.

Material examined. One female imago (n°213d), 17.4.1994; Madagascar; Namorona basin; Tamara river; loc. 4 km from Ranomafana; long. 47°25′37″ E; lat. 21°14′45″ S; altitude 850 m. One female imago (n°214a), 17.4.1994; Madagascar; Namorona basin; Ambatandrano river; loc. Ambatandrano; long. 47°26′32″ E; lat. 21°14′45″ S; altitude 775m. Two female imagines (n°223a), 20.4.1994; Madagascar; Namorona basin; tributary of Namorona river; loc. 1.8km from Vohiparara; long. 47°23′00″ E; lat. 21°14′52″ S; altitude 1125m.

DISCUSSION

Similarities in egg structures (Figs. 18, 19) between the larvae and the female imagines allow us to assign them to the genus *Guloptiloides*. However, as long as the specificity of the chorionic structure has not been confirmed, we refrain naming the female imagines.

DISTRIBUTION AND ECOLOGY

The genus *Guloptiloides* is distributed only in four different basins on the Eastern and Northern coasts of Madagascar. The genus has been caught in small to medium rivers (2 to 9 m width and 0.2 to 1.5 m depth) flowing in intact humid forest to degraded forest at altitudes between 350 and 1125 m above sea level. Despite very frequent sampling, we only found few specimens of this genus, which appears to be very rare.

The morphology of the mouthparts clearly indicated a carnivorous diet. The analysis of the gut content established that *Guloptiloides* is a strictly carnivorous genus at least since the middle larval stages, feeding mostly on Baetidae (*Xyrodromeus* spp., *Afroptilum* spp.). *Guloptiloides* is the third carnivorous genus of Malagasy Baetidae. In all the stations, it is sympatric with the other two carnivorous genera *Nesoptiloides* and *Herbrossus* (Gattolliat, unpublished data).

The two sclerified pyramidal structures at the basis of the filaments appear to be apomorphic structures the aim of which is difficult to interpret. One hypothesis is that they contribute to move or establish the rigidity of the short filaments. They could also be related to the ecological niche exploited by *Guloptiloides*, but as long as its habitat is still poorly known, the function of the structure will remain uncertain.

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