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Revision of the Malagasy genus *Nesoptiloides* (Ephemeroptera, Baetidae)

JEAN-LUC GATTOLLIAT[1] & MICHEL SARTORI[2]

[1]ORSTOM, Laboratoire de Recherche sur les Systèmes Aquatiques et leur Environnement (LRSAE)
BP 434, Androhibe, Antananarivo 101, Madagascar
Present address: Museum of Zoology, P.O. Box 448, CH-1000 Lausanne 17, Switzerland
Jean-Luc.Gattolliat@ie-zea.unil.ch
[2]Museum of Zoology, P.O. Box 448, CH-1000 Lausanne 17, Switzerland
Michel.Sartori@ie-zea.unil.ch

The examination of reared mayflies from different basins of North-East Madagascar established that the imago of *Centroptilum electropterum* Demoulin, 1966, and the larva of *Nesoptiloides intermedia* Demoulin, 1973, are conspecific. Consequently, *N. intermedia* is placed in the synonymy of *C. electropterum*. Thus, the type species of *Nesoptiloides* is *N. electroptera* (Demoulin) comb. nov. Characters supporting *Nesoptiloides* are given and the imago of *N. electroptera* is redescribed. Distribution and ecology of the species are discussed.

Keywords: Baetidae, *Nesoptiloides*, taxonomy, ecology, Madagascar

INTRODUCTION

The genus *Nesoptiloides* was erected by DEMOULIN (1973) to accommodate the new species *N. intermedia,* which was known so far by a few larvae from the Eastern coast of Madagascar. He noticed that the larvae share a lot of common features with the genus *Centroptilum* (also referred as *Afroptilum* (GILLIES, 1990)), but also reminds the genus *Centroptiloides* by the large size and the strong tracheation of the gills.

DEMOULIN (1966) had already described a baetid imago of large size, *Centroptilum electropterum,* possessing intermediate features between the genera *Centroptilum* and *Centroptiloides*.

Reared material from the North-East of Madagascar indicates that *C. electropterum* and *N. intermedia* correspond respectively to the imaginal and larval stages of the same species. Consequently, *N. intermedia* is placed in the synonymy of *C. electropterum.* The species differs from other members of *Centroptilum*, from *Afroptilum* and from other genera of the *Centroptiloides* complex by several notable and probably apomorphic characters. For this reason, we propose to maintain the genus *Nesoptiloides* with *C. electropterum* recombined into *N. electroptera* as the type species.

The imago of the species is redescribed. The study of several populations of *Nesoptiloides* from different basins of Madagascar indicates variation in relative size and setation of the individuals, but these characters are probably irrelevant for taxonomy within the genus.

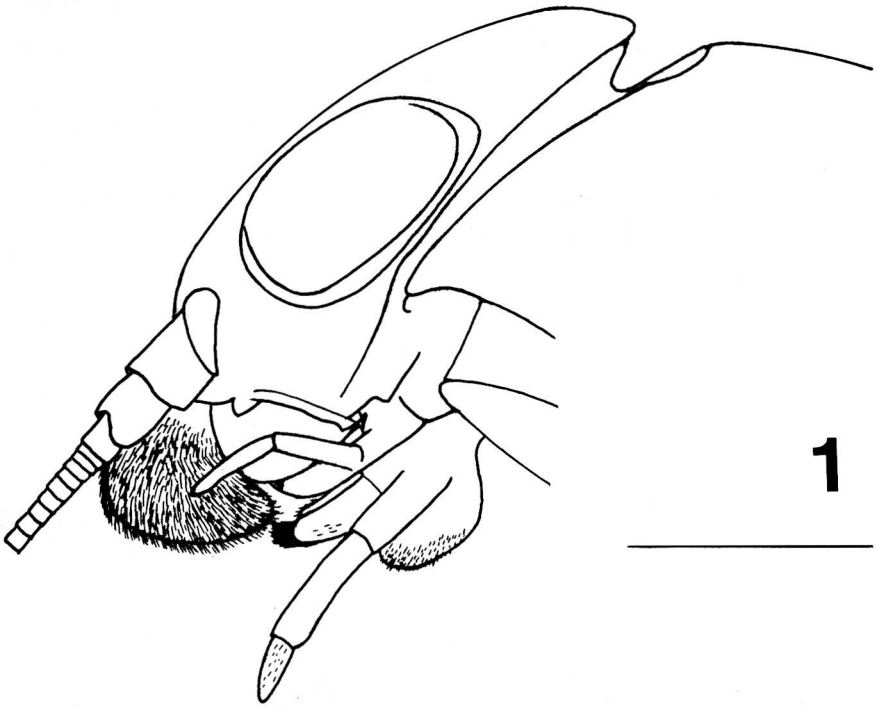


Fig. 1. *Nesoptiloides electroptera*, head of larva, lateral view. Scale: 1 mm.

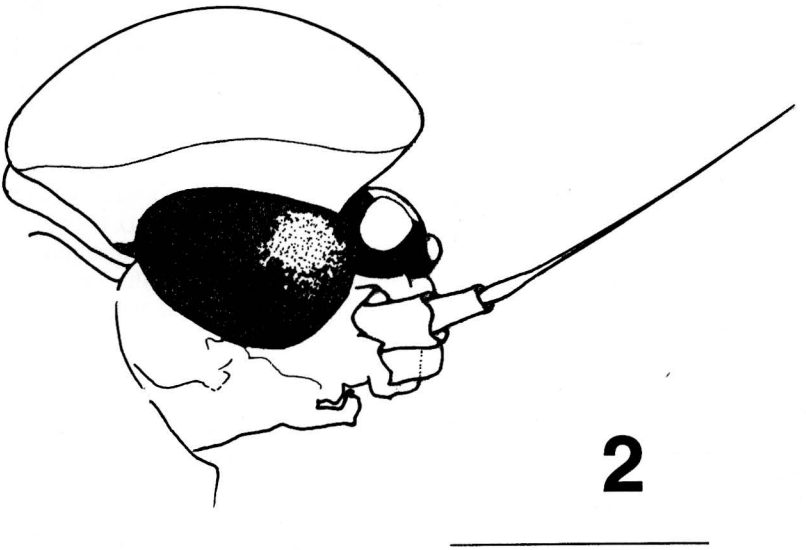
TAXONOMY

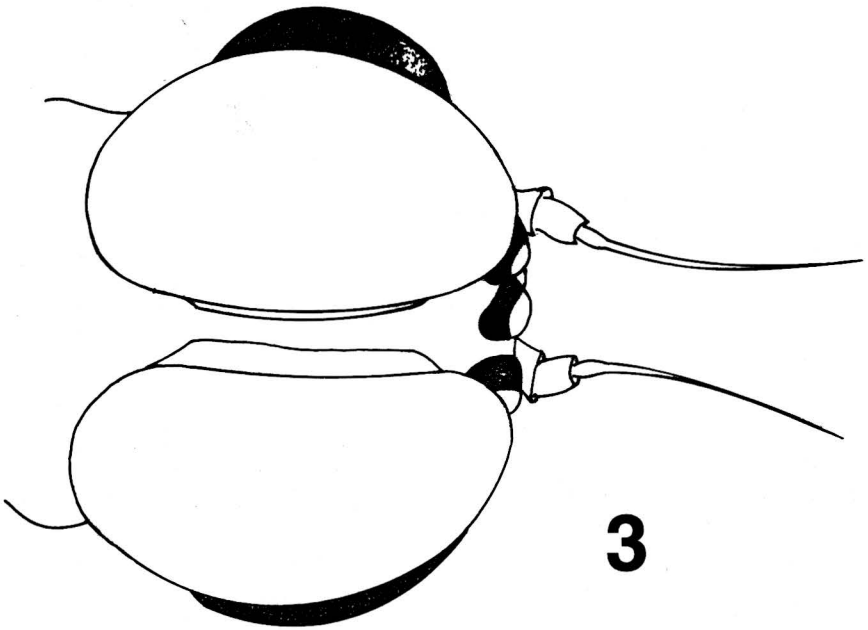
Nesoptiloides DEMOULIN, 1973

Larva. Head as in Fig. 1; additional characters in LUGO-ORTIZ & MCCAFFERTY (1998).

Male imago. Turbinated eyes, quite low, strongly curved and widened towards apex (Figs 2, 3). Forewing (Fig. 4) with a single intercalary vein between the longitudinal veins; costal margin straight, or slightly sinuate subapically, amber coloured to the Sc vein at least. Hindwing (Fig. 5) with 2 well-marked longitudinal veins and bearing a conspicuous spur on the costal margin. Genitalia possessing a sclerite between the 3-segmented gonopods (Fig. 6).

Comments. According to LUGO-ORTIZ & MCCAFFERTY (1998), *Nesoptiloides* belongs to the *Centroptiloides* complex, which is characterized by the presence of one intercalary veins on the forewing and two subparallel rows of teeth on the tarsal claws of the larva. It differs from the other genera of the complex by a markedly convex ventral margin of the forefemur, the presence of a ventrodistal process on





Figs 2 and 3. *Nesoptiloides electroptera*, head of imago: (2) lateral, (3) dorsal view. Scale: 1 mm.

the foretibia (DEMOULIN, 1973; LUGO-ORTIZ & MCCAFFERTY, 1998), a labrum incrassate and the presence of a basal bulge on the labium (Fig. 1).

Nesoptiloides also resembles most of the other Afrotropical mayflies of the *Bugilliesia* complex of genera in having one intercalary vein on the forewing (LUGO-ORTIZ & MCCAFFERTY, 1996a), but it lacks a large protuberance on the segment 2 of the genital forceps.

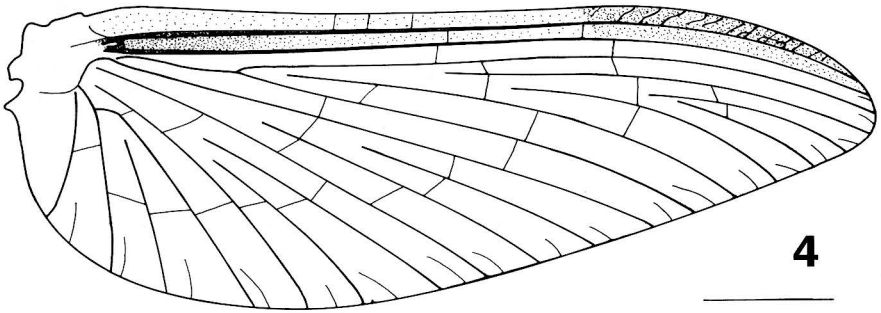
Within the *Centroptiloides* complex, *Nesoptiloides* is characterized by the hindwing possessing two veins in combination with a stout marginal process. It resembles that of *Dabulamanzia* (WUILLOT & GILLIES, 1993; GATTOLLIAT *et al.*, in press), but the absence in *Nesoptiloides* of an acute mediobasal projection on the segment 2 of the male genitalia and of the apomorphic features of the larva of *Dabulamanzia* (LUGO-ORTIZ & MCCAFFERTY, 1996b) suggest that the hindwing resemblance between these two genera is homoplasic.

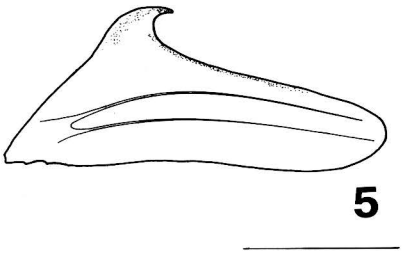
The unusual shape and high variation in colouration of the forewing might represent synapomorphies supporting the association of *Nesoptiloides* with *Centroptiloides*. The presence of a conspicuous spur on the costal margin of the hindwing and of a sclerite between the gonopods are apparently autapomorphic for *Nesoptiloides*.

Nesoptiloides electroptera (DEMOULIN, 1966), **n. comb.**

Centroptilum electropterum DEMOULIN, 1966
Nesoptiloides intermedia DEMOULIN, 1973, **n. syn.**

Holotype (male imago): Madagascar, Rianila Basin, Rogez town (Andekaleka), 4.1931, 550 m, leg. A. Seyrig.
Additional material examined (collected by J.-M. Elouard, F.-M. Gibon, M. Sartori and J.-L. Gattolliat): ANTONGOMBATO basin: Makis river, Camp base WWF <49°10'09"E; 12°31'40"S> 27.3.1994, 1075 m, P0189, 1 reared male imago; same data, but 29.3.1994, P0194, 1 larva; same data, but 1.4.1994, P0198, 1 larva; same data, but 9.3.1995, P0357, 1 larva; same data, but 30.3.1995, P0360, 10 larvae; same data, but 31.3.1995, P0364, 3 larvae; same data, but 3.4.1995, P0371, 5 larvae; Makis river, 100 m above Great Fall <49°10'14"E; 12°29'17"S> 29.3.1995, 1075 m, P0358, 1 larva. LOKOHO basin: Marojejy Camp I <49°46'18"E; 14°25'50"S> 5.10.1996 500 m, P0607, 1 larva; Marojejy Camp II; <49°45'37"E; 14°26'10"S> 14.10.1996, 750 m, P0620, 3 larvae; same data, but <49°45'33"E; 14°26'05"S> 15.10.1996, 750 m, P0621, 1 larva; same data, but 18.10.1996, P0624, 1 larva; same data, but <49°45'57"E; 14°25'57"S> 20.10.1996, 730 m, P0628, 1 larva; Manantenina river <49°45'37"E; 14°25'57"S> 17.10.1996, 720 m, P0623, 6 larvae. BETSIBOKA basin: Vanjainanitra river, Amboasary <47°56'40"E; 18°26'03"S> 31.10.1996, 1300 m, P0631, 1 larva; Ambatomisana river, 'Géranium-usine' <47°57'07"E; 18°27'15"S> 8.11.1995, 1300 m, P0534, 1 male imago; Sahavilana river <47°57'20"E; 18°28'47"S> 14.12.1996, 1375 m, P0675, 1 larva. MANGORO basin: Mangoro river, bridge over the Mangoro <48°06'32"E; 18°52'32"S> 18.10.1995, 840 m, P0508, 1 larva; Manjakatompo Ankaratra Reserve <47°19'59"E; 19°20'23"S> 9.3.1995, 1675 m, P0281, 6 larvae; Manjakatompo Ankaratra Reserve, tributary of Ankeniheny river <47°18'46"E; 19°21'23"S> 6.3.1995, 1700 m, P0269, 9 larvae; Mandraka <47°55'18"E; 18°54'55"S> 10.5.1995, 1220 m, P0383, 1 larva; Mandraka, Manambolo river <47°56'10"E; 18°55'23"S> 18.10.1995, 1025 m, P0509, 4 larvae. RIANILA basin: road to Lakato <48°21'38"E; 19°03'07"S> 21.3.1995, 1050 m, P0298, 3 larvae; same data, but 29.4.1998, P0722, 1 larva; same data, but <48°21'48"E; 19°02'40"S> 19.10.1995, 1050 m, P0514, 1 larva; same data, but 22.4.1997, P0693, 3 larvae; same data, but <48°21'50"E; 19°03'30"S> 19.10.1995, 1075 m, P0507, 13 larvae; same data, but 26.11.1996, P0657, 1 larva; same data, but <48°21'51"E; 19°02'22"S> 22.4.1997, 1050 m, P0692, 2 larvae; Périnet-Mantady Reserve, Sahatany river <48°25'57"E; 18°49'41"S> 14.4.1995, 950 m, P0452, 1 larva; Ambalafary <48°21'03"E; 19°02'10"S> 31.3.1997, 1127 m, P0683, 1 larva. SAKANILA basin: road to Lakato, Vakoho river <48°23'57"E; 19°07'13"S> 20.3.1995, 820 m, P0293, 2 larvae. MANGOKY basin: 24 km from Amborompotsy, Manambaroa river <46°23'55"E; 20°37'10"S> 24.5.1996, 1475 m, P0600, 4 larvae. NAMORONA basin: Namorona river, Ranomafana <47°27'18"E; 21°15'37"S> 16.4.1994, 725 m, P0209, 2 larvae. MANAMPATRANA basin: Andringitra Camp I, Iantara river <47°01'50"E; 22°13'28"S> 17.11.1993, 1350 m, P0165, 7 larvae; Andringitra Camp II, Sahavatoy river <47°00'50"E;





Figs 4 and 5. *Nesoptiloides electroptera*, wings of imago: (4) forewing (scale: 2 mm), and (5) hindwing (scale: 0.5 mm).

22°13'33"S> 20.11.1993, 1390 m, P0168, 1 larva. MANAMPANIHY basin: Camp II Andohahela, tributary of Andohahela river <46°44'09"E; 24°35'40"S> 26.11.1995, 925 m, P0544, 1 reared female subimago.

Male imago. Maximal length: body 13.5 mm, forewing 14.5 mm, hindwing 1.4 mm, cerci 27 mm. Turbinated eyes (Figs 2, 3) brown, darkened basally, quite short and widened apically. Antennae amber coloured, with flagellum basally bulbous. Presence of a marked medial carina between the antennae. Forewing (Fig. 4) variable in colour pattern, uniformly amber coloured, or hyaline with amber coloured area extended from the costal margin to the Sc vein; veins amber coloured, but the Sc and the C veins brown; pterostigma with about 15 cross veins usually reaching the C vein and occasionally forked. Hindwing (Fig. 5) usually hyaline, occasionally amber coloured; pair of subparallel longitudinal veins almost reaching the apex of the wing; micropores covering the costal margin and the spur, the latter stout and hooked. Legs (DEMOULIN, 1966: Figs 2c-e) amber coloured, except foretarsi and apical portion of foretibia dark brown. Abdomen with terga 1-6 brown and terga 9-10 ochre, dark brown pattern on lateral portion of terga 1-6 and lateroapical portion of terga 7-9; sterna uniformly yellow.

Genitalia (Fig. 6) with first and second segment well delimited; first segment stout, wider than long and apically narrowed; second segment with inner margin slightly curved basally; third segment 2.5 x as long as wide and with a small callosity in the middle of the inner side. Gonopods very scarcely covered with setae. Sclerotised plate between the gonopods well developed, more or less exposed with regard to the position of the gonopods.

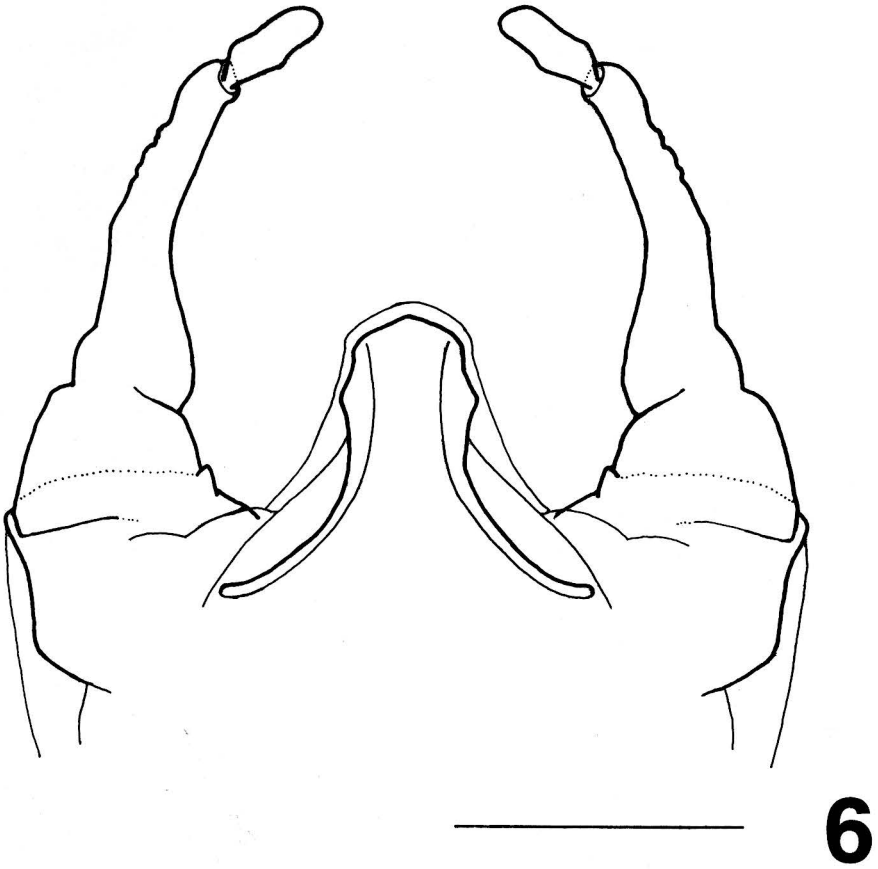


Fig. 6. *Nesoptiloides electroptera*, male genitalia. Scale: 0.5 mm.

Female imago. Unknown.

Comments. The female subimagoes resemble the male imagoes, in particular with respect to body and wings colouration. The size of the female larvae and subimagoes suggests that the female imagoes might exceed by 2-3 mm the length of the male imagoes.

The *Nesoptiloides* larvae from different basins appear to differ slighty with respect to the relative length of the third segment of the labial palpi compared to that of the second, the shape of the apex of the maxillary palpi and the number of setae on the ventral surface of the paraglossae. The male imagoes appear to vary in their body length (the holotype is relatively small) and forewing colouration. However, these characters vary inconsistently within the studied populations and have been credited to infraspecific variation. The unusual variability of *N. electroptera* suggests that the species is a compound of isolated populations in a speciation process.

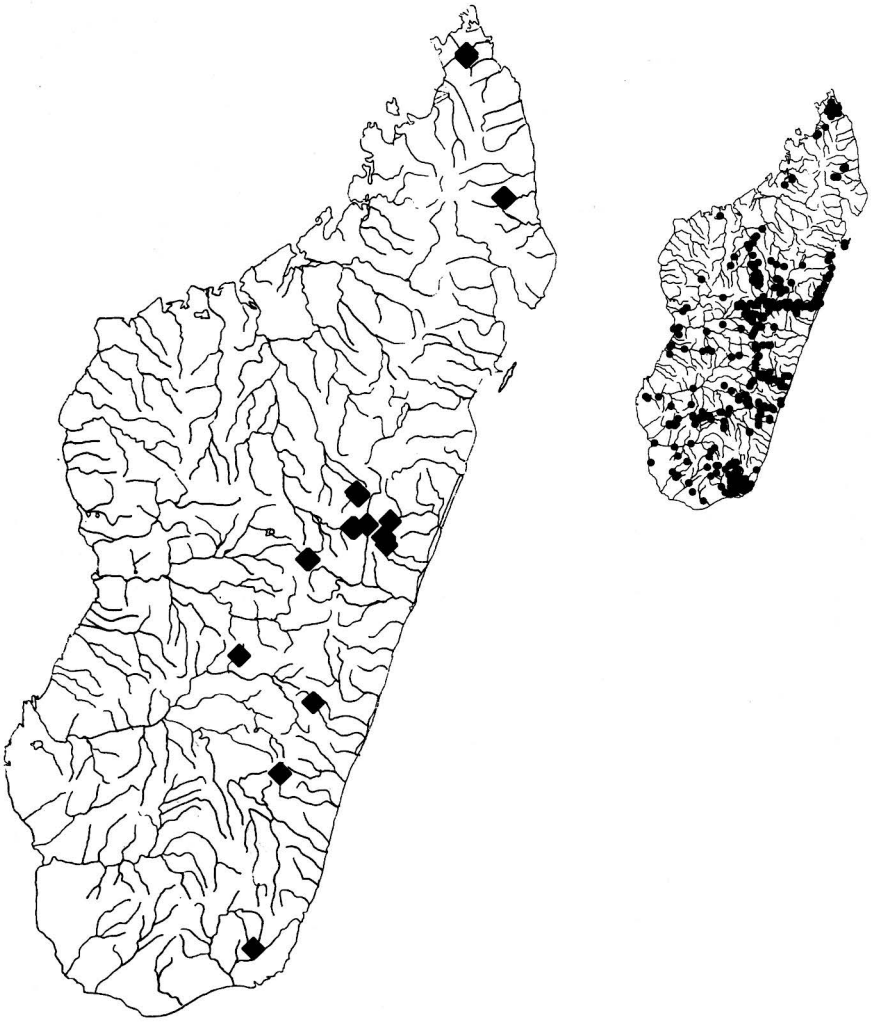


Fig. 7. Distribution of *N. electroptera* (diamonds) and sampled stations (circles)

DISTRIBUTION AND ECOLOGY

Nesoptiloides electroptera has been found in all the main basins of the Eastern coast and in two basins of the Western coast of Madagascar (Fig. 7). This distribution appears exceptional compared to that of other Malagasy mayflies, such as the members of *Proboscidoplocia* (ELOUARD & SARTORI, 1997), which have strongly restricted areals. The species appears relatively abundant in small to medium rivers flowing in intact humid forests to degraded forests at altitudes ranging from 500 to 1700 m above sea level.

Examination of gut content of various stages revealed almost exclusively dismembered invertebrates, indicating that *N. electroptera* is carnivorous. At first stages, the species feeds mostly on Diptera larvae (Chironomidae, Simuliidae and Blephariceridae). The part of baetids within the prey increases together with the size of the predator and consisted in *Afroptilum*, *Dicentroptilum* and, in a lower proportion, *Xyrodromeus*. From the antepenultimate stage of *N. electroptera,* only small debris of cuticula are found in the guts (instead of large debris such as legs, heads and abdomens found in the guts at the previous stages) suggesting that the prey is chewed. A robust labrum, tibiae with a stout ventrodistal process and femora with a markedly convex ventral margin are important adaptations to predation (GATTOLLIAT & SARTORI, in press). *Nesoptiloides electroptera* is thus the largest predaceous mayfly of Madagascar.

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REFERENCES

DEMOULIN, G. 1966. Quelques Ephéméroptères nouveaux de Madagascar. *Ann. Soc. Ent. Fr. (N.S.) 2(3)*: 711-717.

DEMOULIN, G. 1970. Ephemeroptera des faunes éthiopiennes et malgaches. *S. Afr. Anim. Life 14*: 24-170.

DEMOULIN, G. 1973. Ephéméroptères de Madagascar. *Bull. Inst. R. Sci. Nat. Belg. 49*: 1-20.

ELOUARD, J.M. & SARTORI, M. 1997. *Proboscidoplocia* a singular plural (Ephemeroptera : Polymitarcyidae : Euthyplociinae). *In*: P. LANDOLT & M. SARTORI (eds), *Ephemeroptera & Plecoptera. Biology-Ecology-Systematics*: pp. 439-448. MAURON, TINGUELY & LACHAT, Fribourg (Switzerland).

GATTOLLIAT, J.-L. & SARTORI, M., in press. Predaceous Baetidae in Madagascar: an uncommon and unsuspected high diversity. *Proceedings of the IX Conference on Ephemeroptera. Acta Zool. Lilloana.*

GATTOLLIAT, J.-L., SARTORI, M. & ELOUARD, J.-M., in press. Aquatic Biodiversity from Madagascar: three new species of Baetidae (Ephemeroptera) from the Réserve Naturelle Intégrale d'Andohahela. *Fieldiana.*

GILLIES, M.T. 1990. A revision of the African species of *Centroptilum* EATON (Baetidae, Ephemeroptera. *Aquatic Insects 12(2)*: 97-128.

LUGO-ORTIZ, C.R. & MCCAFFERTY, W.P. 1996a. The *Bugilliesia* complex of African Baetidae (Ephemeroptera). *Trans. Am. Entomol. Soc. 122(4)*: 175-197.

LUGO-ORTIZ, C.R. & MCCAFFERTY, W.P. 1996b. The composition of *Dabulamanzia*, a new genus of Afrotropical Baetidae (Ephemeroptera), with descriptions of two new species. *Bull. Soc. Hist. Nat., Toulouse 132*: 7-13.

LUGO-ORTIZ, C.R. & MCCAFFERTY, W.P. 1998. The *Centroptiloides* Complex of Afrotropical small minnow mayflies (Ephemeroptera: Baetidae). *Ann. Entomol. Soc. Am. 91(1)*: 1-26.

WUILLOT, J. & GILLIES, M.T. 1993. New species of *Afroptilum* (Baetidae, Ephemeroptera) from West Africa. *Rev. Hydrobiol. Trop. 26*: 269-277.

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