 Zootaxa 452: 1–10 (2004)
www.mapress.com/zootaxa/
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ISSN 1175-5326 (print edition)

ZOOTAXA

ISSN 1175-5334 (online edition)

452

A distinctive new species of *Xyrodromeus* Lugo-Ortiz & McCafferty (Ephemeroptera: Baetidae) from Madagascar

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Abstract

The genus *Xyrodromeus* Lugo-Ortiz & McCafferty was established for Afrotropical species of Baetidae (Ephemeroptera) possessing bladelike mandibles. Recently, three new species were described from Madagascar. *Xyrodromeus ambiguus* n. sp. is established for larvae collected in the North and North-East of Madagascar. It possesses most of the generic features of *Xyrodromeus*, but differs significantly from all the previously known species by possessing two rows of denticles on the tarsal claws. This species has an intermediate position between *Xyrodromeus* and *Dicentropilum* Wuillot & Gillies. While it may confirm the strong relationship between the two genera, it also opens the question of their validity and could suggest that all these species belong to a single variable and graded genus.

Key words: Ephemeroptera, Baetidae, *Xyrodromeus ambiguus* sp. n., systematics, Madagascar

Introduction

The genus *Xyrodromeus* Lugo-Ortiz & McCafferty was established for Afrotropical species possessing highly specialised mouthparts for scraping stones (Lugo-Ortiz & McCafferty, 1997). This genus now encompasses five species: one in East Africa (the type species *X. africanus* Lugo-Ortiz & McCafferty) and four in Madagascar (Lugo-Ortiz & McCafferty, 1997; Gattolliat, 2002). The phylogenetic position remained unclear until the description of the imago and accurate observations on the mouthparts allowed one to recognise affinities with *Afroptilum* Gillies and *Dicentropilum* Wuillot & Gillies (Gattolliat, 2002; McCafferty, 2002).

Larvae possessing bladelike mandibles were collected in great numbers in the North and North-East of Madagascar (Montagne d'Ambre and Marojejy areas). As they significantly differ from all the previously known species, a new species is described herein.

The holotypes and some of the paratypes are housed in the Museum of Zoology, Lausanne, Switzerland. Other paratypes are deposited in the Museum National d'Histoire Naturelle, Paris, France.

Taxonomy

Xyrodromeus ambiguus sp. n.

Larva

Maximum length: Body 7.7 mm. Cerci 10.3 mm and terminal filament 3.2 mm.

Head. Brown with vermiform marks on vertex and frons poorly visible. Antennae pale cream yellow, except scape and pedicel brown. Turbinate eyes purple.

Labrum (Fig. 1) trapezoid, broader apically; distal margin with numerous simple setae; dorsal surface with an arc of about 20 long and thin setae, submedial pair of setae present, abundant short setae; ventral surface with a row of 3 minute setae and a row of very thin setae parallel to distal margin.

Hypopharynx as in figure 2 with minute thin setae, lingua not trilobate.

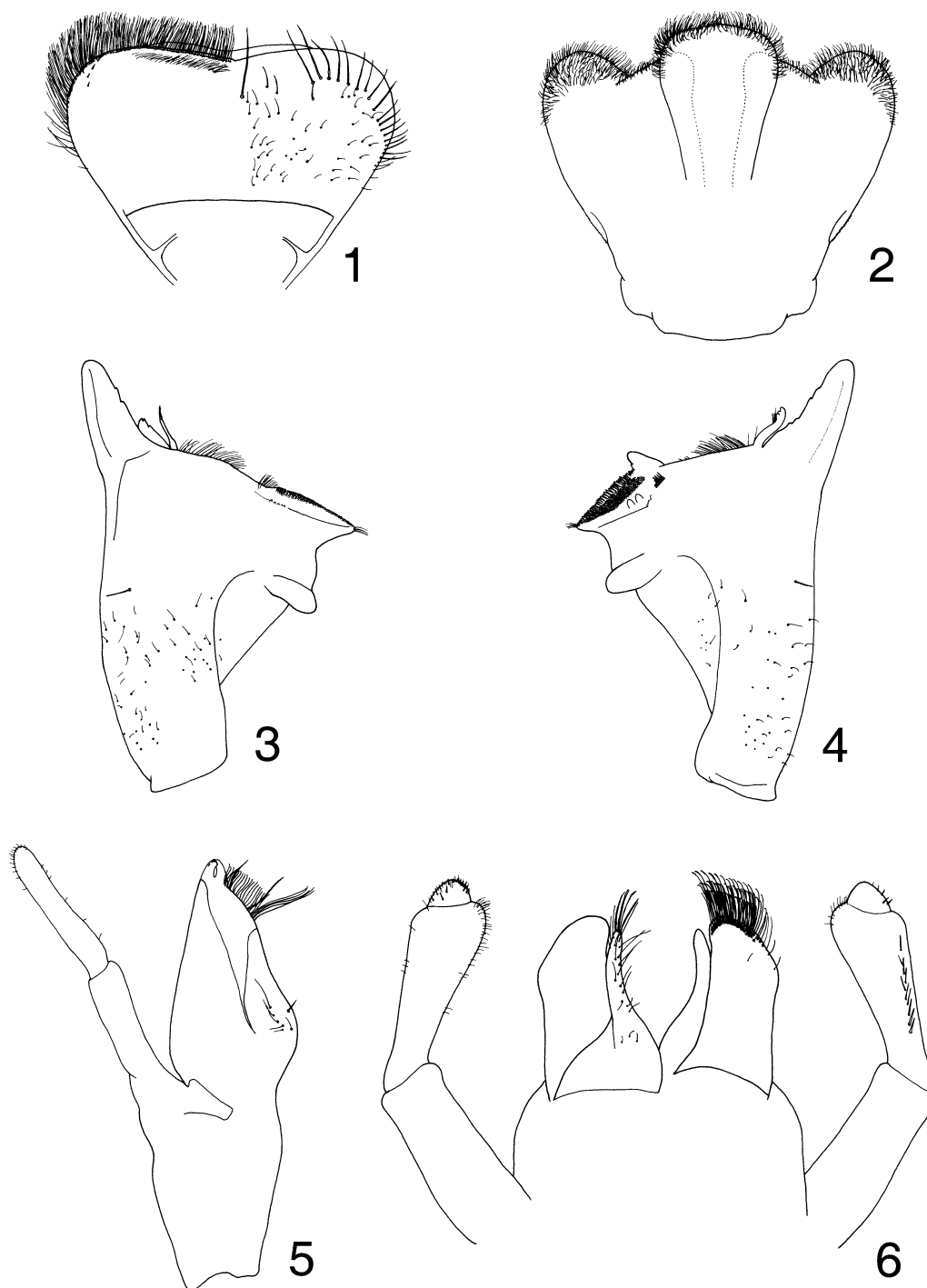
Right mandible (Fig. 3) with two sets of fused incisors, the inner one extremely reduced; prostheca reduced to a simple filament; a complete row of short setae between prostheca and mola; tuft of small setae near the mola; tuft of setae at the apex of the mola reduced to 3 setae; basal half with a stout seta perpendicular to the margin and abundant small setae dorsally.

Left mandible (Fig. 4) with completely fused incisors; prostheca with very reduced denticles and a comb-shape structure apically; abundant short setae between prostheca and mola; tuft of setae under the mola; tuft of setae at the apex of the mola reduced to 3 or 4 setae; basal half with a stout seta perpendicular to the margin and abundant small setae dorsally.

Maxillae (Fig. 5) with distal tooth opposed to the 3 others; 2 rows of setae, the first one formed by abundant small setae and the second by 2 long stout setae ending with 5 setae twice as long as the others; 6 setae at the base of the galea roughly arranged in a row; 1 single small seta perpendicular to the margin of the galea.

Labium (Fig. 6) with glossae slightly shorter than paraglossae; glossae with long setae, a few small setae on the dorsal margin; paraglossae apically with 3 rows of setae; first segment of the labial palp 0.9 x length of the second and third combined; second segment with a moderately rounded distomedial expansion, covered with numerous thin setae, row of about 10 thin setae; third segment cap-like, with small setae.

Thorax. Brown with attenuate darker flame-like marks.



Figs 1 to 6. Larval structures of *Xyrodromeus ambiguus* : 1 : labrum (left : ventral; right : dorsal). 2 : hypopharynx. 3 : right mandible. 4 : left mandible. 5 : right maxilla. 6 : labium.

Hind wing pads present.

Legs colouration: femora brown with yellow marks; tibiae yellow with inner margin darker; tarsi yellow apically brown.

Legs (Fig. 7). Ventral margin of coxae with small pointed setae.

Femora dorsally with a row of abundant long setae; submarginal row of numerous minute setae restricted to the proximal third; dorsoapical patch of several small blunt setae; numerous small setae on the ventral margin.

Tibiae with a row of minute blunt setae dorsally; apex with 1 medium seta dorsally; ventral margin with minute pointed setae; tibio-patellar suture absent.

Tarsi dorsally almost bare, ventrally with about 9 setae, apical ones longer; tarsal claws (Fig. 8) with two rows of 5 teeth increasing in length, subapical pair of setae present.

Second and third legs similar to foreleg, except tibio-patellar suture present.

Abdomen. Colouration of the terga brown, darker medially without pattern; terga 8–9 lighter.

Terga (Fig. 11) with scale bases, posterior margin with blunt spines.

Sterna yellow; with scale and setal bases, smooth posterior margin with a continuous row of setae without spines (Fig. 12).

Asymmetrical gills on abdominal segments 1 to 7; gill 1 (Fig. 9) reduced, without tracheation; gills 2–7 (Fig. 10) with dark tracheation, serrated with thin setae apically and posteriorly.

Paraproct (Fig. 13) expanded, surface with numerous scale and setal bases, about 10 well-developed pointed marginal spines and small spines; posterolateral extension with about 10 scale bases and with numerous small spines along the margin.

Male imago

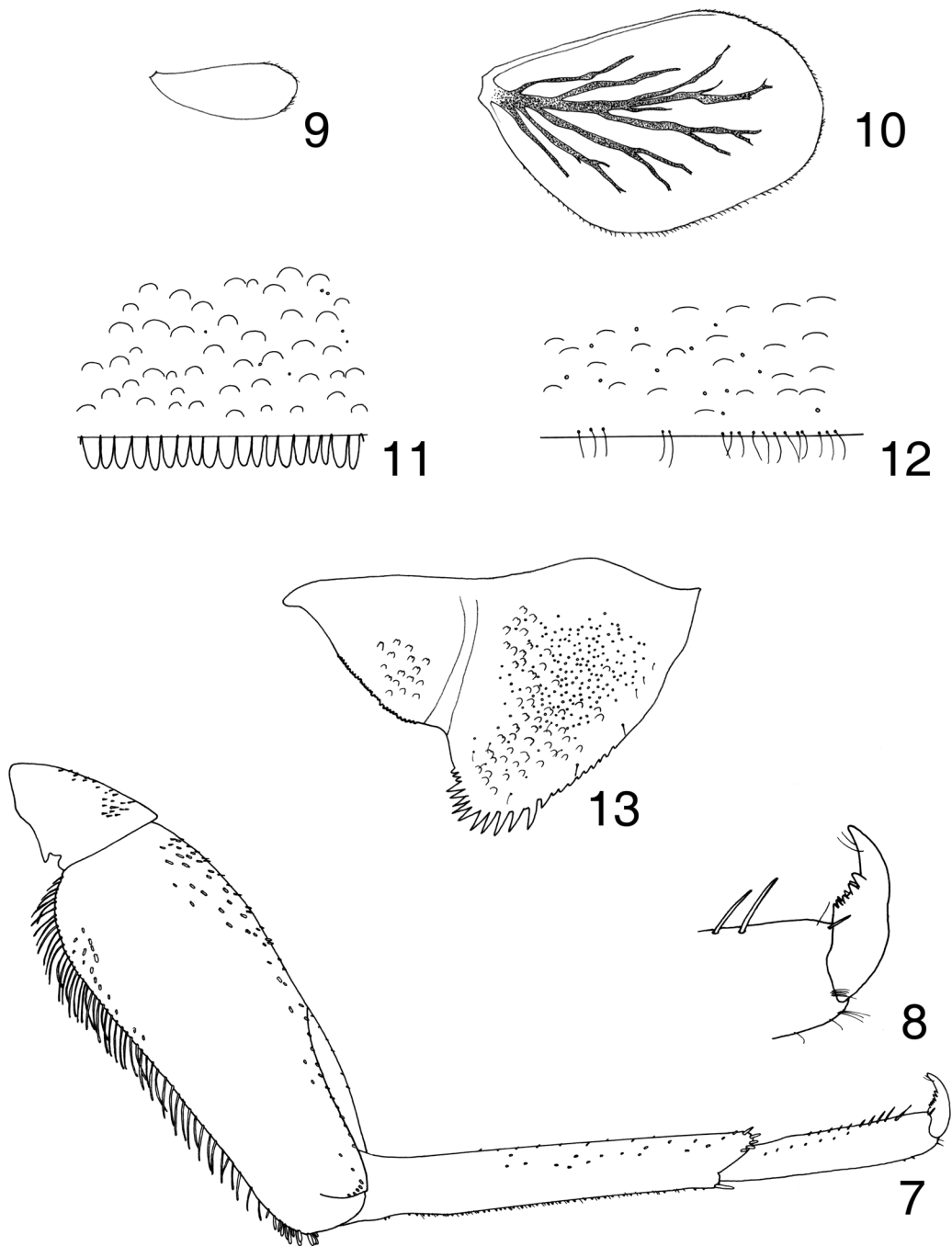
Maximum length: Body 7 mm. Forewing 7.5 mm. Hindwing 1.2 mm.

Head. Light brown without marking. Turbinate eyes purple, darker at the base.

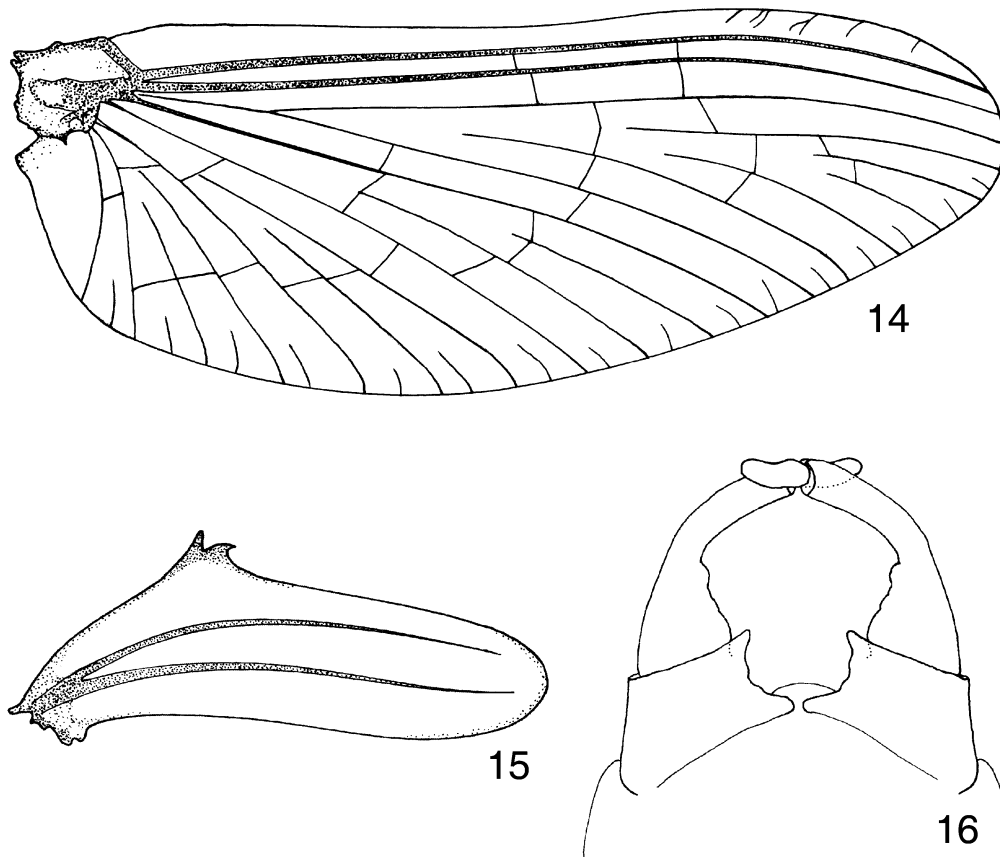
Thorax. Coppery brown. Forewing (Fig. 14) hyaline, with one intercalary vein between longitudinal veins; pterostigma with 5 to 7 cross-veins that do not reach the subcostal vein. Hindwing (Fig. 15) hyaline with 2 longitudinal veins, joined at the base; 2 distinct but not widely separated spurs on the costal margin.

Abdomen. Terga pale cream with a brown stripe near the distal margin; sterna pale cream.

Genitalia (Fig. 16) with 3-segmented gonopods, limit between the first and the second barely visible. Basal segment with a pointed apophysis at the apex of the inner margin; first segment stout, without setae; second segment with subparallel margins; third segment elongate, outer margin concave.



Figs 7 to 13. Larval structures of *Xyrodromeus ambiguus* : 7 : foreleg. 8 : tarsal claw. 9 : first gill. 10 : fourth gill. 11 : posterior margin of the fourth tergum. 12 : posterior margin of the fourth sternum. 13 : paraproct.



Figs 14 to 16. Male imaginal structures of *Xyrodromeus ambiguus* : 14 : forewing. 15 : hind wing. 16 : genitalia.

Etymology

This specific epithet is from the Latin, meaning ambiguous, because of the phylogenetic position of the species being intermediate between *Xyrodromeus* and *Dicentropitulum*.

Ecology

Xyrodromeus ambiguus was collected in small to medium streams (1.5 to 6 m wide, 0.2 to 0.6 m depth) with moderate to fast flow (0.5 to 1.3 m/s). All the localities are in tropical rain forest without human activity. This species has been found in a restricted number of localities, but when it is present, it is one of the dominant species. *Xyrodromeus ambiguus* co-occurs with the four other Malagasy species (with the four species in the Marojejy area, and with *X. namarona* and *X. sartorii* in La Montagne d'Ambre National Park for example).

Material examined

Holotype

1 male larva, (P0818), Madagascar, Antongombato bas., Makis riv., Loc. Roussette Station (Montagne d'Ambre National Park), Long. 49°10'09" E, Lat. 12°31'40" S, Alt. 1075 m, 23.03.1999. Gattolliat, J.-L. & Rabeantoandro, Z.

Paratypes

168 larvae (3 larvae on slide 818d, 818e, 818f), same data as holotype

8 larvae, (P0189), same locality as holotype, 27.03.1994. Elouard, J.-M. & Sartori, M.

14 larvae, (P0191), same locality as holotype, 28.03.1994. Elouard, J.-M. & Sartori, M.

1 male imago from rearing (on slide), (P0194), same locality as holotype, 29.03.1994. Elouard, J.-M. & Sartori, M.

12 larvae, (P0200), same locality as holotype, 02.04.1994. Elouard, J.-M. & Sartori, M.

3 larvae, (P0364), same locality as holotype, 31.03.1995. Ralaiteferana, A. & Blanc, L.

2 larvae, (P0371), same locality as holotype, 03.04.1995. Blanc, L. & Ralaiteferana, A.

3 larvae, (P0752), same locality as holotype, 17.03.1999. Gattolliat, J.-L. & Rabeantoandro, Z.

11 larvae, (P0806), same locality as holotype, 20.03.1999. Gattolliat, J.-L. & Rabeantoandro, Z.

59 larvae (1 female larva on slide 826c), (P0826), same locality as holotype, 25.03.1999. Gattolliat, J.-L. & Rabeantoandro, Z.

2 larvae (one male larva on slide 193b), (P0193), Madagascar, Antongombato bas., Makis riv., Loc. Roussette Station (Montagne d'Ambre National Park), Long. 49°10'21" E, Lat. 12°31'38" S, Alt. 1050 m, 29.03.1994. Elouard, J.-M. & Sartori, M.

1 larva, (P0196), same locality as P0193, 30.03.1994. Elouard, J.-M. & Sartori, M.

40 larvae (P0828), same locality as P0193, 25.03.1999. Gattolliat, J.-L. & Rabeantoandro, Z.

9 larvae, (P0814), Madagascar, Antongombato bas., Makis riv., Loc. 100m down the Great Waterfall (Montagne d'Ambre National Park), Long. 49°10'14" E, Lat. 12°29'17" S, Alt. 675 m, 22.03.1999. Gattolliat, J.-L. & Rabeantoandro, Z.

58 larvae, (P0822), same locality as P0814, 24.03.1999. Gattolliat, J.-L. & Rabeantoandro, Z.

41 larvae (P0819), Madagascar, Antongombato bas., Makis riv., Loc. Roussette Station (Montagne d'Ambre National Park), Long. 49°10'21" E, Lat. 12°31'27" S, Alt. 1030 m, 23.03.1999. Gattolliat, J.-L. & Rabeantoandro, Z.

Other material

3 larvae, (P0510), Madagascar, Mangoro bas., Manambolo riv., Loc. Mandraka, Long. 47°55'58" E, Lat. 18°55'17" S, Alt. 1050 m, 18.10.1995. Pilaka, T.

1 larva, (P0606), Madagascar, Lokoho bas., Manantenina riv., Loc. Marojejy Camp I, Long. 49°46'20" E, Lat. 14°26'02" S, Alt. 450 m, 04.10.1996. Legrand, J. & Randriamasi-

manana, D.

1 male and 1 female subimagos (form rearing), 2 larva, (P0613), Madagascar, Lokoho bas., Manantenina riv., Loc. Marojejy Camp I, Long. 49°46'07" E, Lat. 14°26'03" S, Alt. 480 m, 10.10.1996. Legrand, J. & Randriamasimanana, D.

4 larvae, (P0620), Madagascar, Lokoho bas., unnamed river, Loc. Marojejy Camp II, Long. 49°45'37" E, Lat. 14°26'10" S, Alt. 750 m, 14.10.1996. Legrand, J. & Randriamasimanana, D.

3 larvae, (P0621), Madagascar, Lokoho bas., unnamed river, Loc. Marojejy Camp II, Long. 49°45'33" E, Lat. 14°26'05" S, Alt. 750 m, 15.10.1996. Legrand, J. & Randriamasimanana, D.

7 larvae, (P0623), Madagascar, Lokoho bas., Manantenina riv., Loc. Marojejy Camp II, Long. 49°45'37" E, Lat. 14°25'57" S, Alt. 720 m, 17.10.1996. Legrand, J. & Randriamasimanana, D.

79 larvae, (P0872), Madagascar, Betaolana bas., Ambolokopatrika riv., Loc. Betaolana Camp 1, Long. 49°26'47" E, Lat. 14°32'25" S, Alt. 800 m, 08.10.1999. Doumenq, E.

66 larvae, (P0874), same locality as P0872, 09.10.1999. Doumenq, E.

12 larvae, (P0875), same locality as P0872, 10.10.1999. Doumenq, E.

8 larvae, (P0893), Madagascar, Ampary bas., Anlanbe riv., Loc. Anjanaharibe Sud-Ouest Camp1, Long. 49°26'53" E, Lat. 14°47'00" S, Alt. 1200 m, 26.10.1999. Doumenq, E.

18 larvae, (P0897), same locality as P0893, 27.10.1999. Doumenq, E.

35 larvae, (P0898), same locality as P0893, 30.10.1999. Doumenq, E.

6 larvae, (P0899), same locality as P0893, 31.10.1999. Doumenq, E.

112 larvae (3 larvae on slide 1009a, 1009c and 1009d), (P1009), Madagascar, Lokoho bas., Manantenina riv., Loc. Marojejy Camp2, Long. 49°45'58" E, Lat. 14°26'23" S, Alt. 800 m, 26.11.1999. Doumenq, E.

Discussion

Xyrodromeus ambiguus appears very closely related to the other species of *Xyrodromeus*. *Xyrodromeus ambiguus* and *X. namarona*, the only other species of *Xyrodromeus* known at the imaginal stage, can be separated only by the eye colour and the degree of development of the apophysis of the basal segment of the gonopods. Important larval characters such as the setation of the labrum (Fig. 1; Figs 14 and 27 in Gattolliat, 2002; Figs 1 and 13 in Lugo-Ortiz and McCafferty, 1997), setation of the dorsal and ventral margins of the legs (Fig. 7; Figs 12, 25 and 36 in Gattolliat, 2002; Fig. 7 in Lugo-Ortiz and McCafferty, 1997), the whole maxillae (Fig. 5; Figs 5, 19 and 31 in Gattolliat, 2002; Fig. 5 in Lugo-Ortiz and McCafferty, 1997) and the third segment of the labial palp (Fig. 6; Figs 6, 18 and 32 in Gattolliat, 2002; Figs 6 and 16 in Lugo-Ortiz and McCafferty, 1997) are extremely similar. *Xyrodromeus ambiguus* differs from all the other known species, except for *X. sartorii*, with the left mandible having a second very reduced set of incisors (Fig. 3; Fig. 29 in Gat-

tolliat, 2002) and the left prostheca having reduced denticles and a comb-shaped structure (Fig. 4; Fig. 30 in Gattolliat, 2002). The most peculiar character of *Xyrodromeus ambiguus* is definitely the tarsal claw with two rows of teeth (Fig. 8). All the previously known species of *Xyrodromeus* possess only one row. This character separates *Xyrodromeus* from most of the Afrotropical genera, especially those included by Lugo-Ortiz and McCafferty (1998) in the *Centroptiloides* complex. The single row was also the main reason for the difficulty in clarifying the relationships of *Xyrodromeus*.

The discovery of this new species indicates a need to revise the generic diagnosis of *Xyrodromeus*: larval claws with one or two rows of denticles, the right mandible with one set or two sets of completely fused incisors, left prostheca with or without very reduced denticles and comb-shaped structure.

Tarsal claws with two rows of teeth, right mandible with two sets of incisors and prostheca with denticles and a comb-shaped structure are assumed to be the plesiomorphic state of these characters. As *Xyrodromeus ambiguus* presents all these plesiomorphies, this species must be considered as having a basal position among the genus.

This redefinition of *Xyrodromeus* confirms its presumed affinities with genera of the *Centroptiloides* complex, especially *Dicentroptilum*, suggested independently by Gattolliat (2002) and McCafferty (2002). According to Lugo-Ortiz and McCafferty (1997, 1998 and 2001), *Dicentroptilum* and *Xyrodromeus* can be separated by the following characters: number of sets and degree of fusion of incisors of the right mandible, degree of reduction of the left prostheca, number of rows of teeth of the tarsal claw and setation of the dorsal margin of tibiae and tarsi. The gradation in the degree of adaptation for scraping appears in other Malagasy genera, such as *Cloeodes* and *Dabulamanzia* (Gattolliat & Sartori, 2000; Gattolliat, 2001). *Xyrodromeus ambiguus* has an intermediate position between *Dicentroptilum* and the rest of *Xyrodromeus*.

It corroborates the conclusion by McCafferty (2002) that the two genera are either closely related or represent a single variable and graded genus. It must be noted that some larval characters of the original description of *Dicentroptilum*, such as papillae at the base of forecoxae (Fig. 10 in Wuillot & Gillies, 1994, Fig. 7 in Lugo-Ortiz & McCafferty, 2001) and individual segments of the cerci set at an oblique angle with the sides (Fig. 13 in Wuillot & Gillies, 1994), were dismissed to include the Malagasy species *Dicentroptilum merina* Lugo-Ortiz & McCafferty (Lugo-Ortiz & McCafferty, 1998).

In the original description of *Dicentroptilum*, Wuillot and Gillies (1994) use the widely separated two spurs of the hind wings as a diagnostic character for the genus (Fig. 2 in Wuillot & Gillies, 1994). The two species of *Xyrodromeus* known at the imaginal stage possess a hind wing with two usually closely aligned spurs (Fig. 15, Fig. 40 in Gattolliat, 2002). The shape of the two spurs seems to be a reliable character to separate the two genera. Consequently, the knowledge of the imaginal stage of the different species is essential to determine the validity of the two genera and confirm the generic attribution.

Acknowledgements

I want to thank the whole team of the Laboratoire de Recherche sur les Systèmes Aquatiques et leur Environnement (LRSAE), especially its director Dr J.-M. Elouard for great help, logistical assistance and the gift of material. I also want to express my appreciation to Dr Michel Sartori (Museum of Zoology, Lausanne) and Helen M. Barber-James (Dept. Freshwater Invertebrates, Albany Museum, Grahamstown, South Africa) for useful comments on this paper. This paper is the contribution n° 52 to the series "Aquatic Biodiversity of Madagascar".

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