

Three new species of *Afroptiloides* (Insecta: Ephemeroptera) and first report of this genus from Madagascar

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The validity of the genus *Afroptiloides* GILLIES, 1990, has been recently subject to controversy. The description of three new species from Madagascar greatly improves the knowledge about the variability within the genus and also reinforces its validity. *Afroptiloides spinosum* n. sp., *Afroptiloides delphinae* n. sp. and *Afroptiloides namorona* n. sp. represent the first report of the genus from Madagascar and out of Africa. They form a lineage distinct from the African species. They present important variations in the degree of development of the median dorsal processes and in the mouthparts. Their affinities and ecology are discussed.

Keywords: Ephemeroptera, Baetidae, *Afroptiloides*, new species, Madagascar

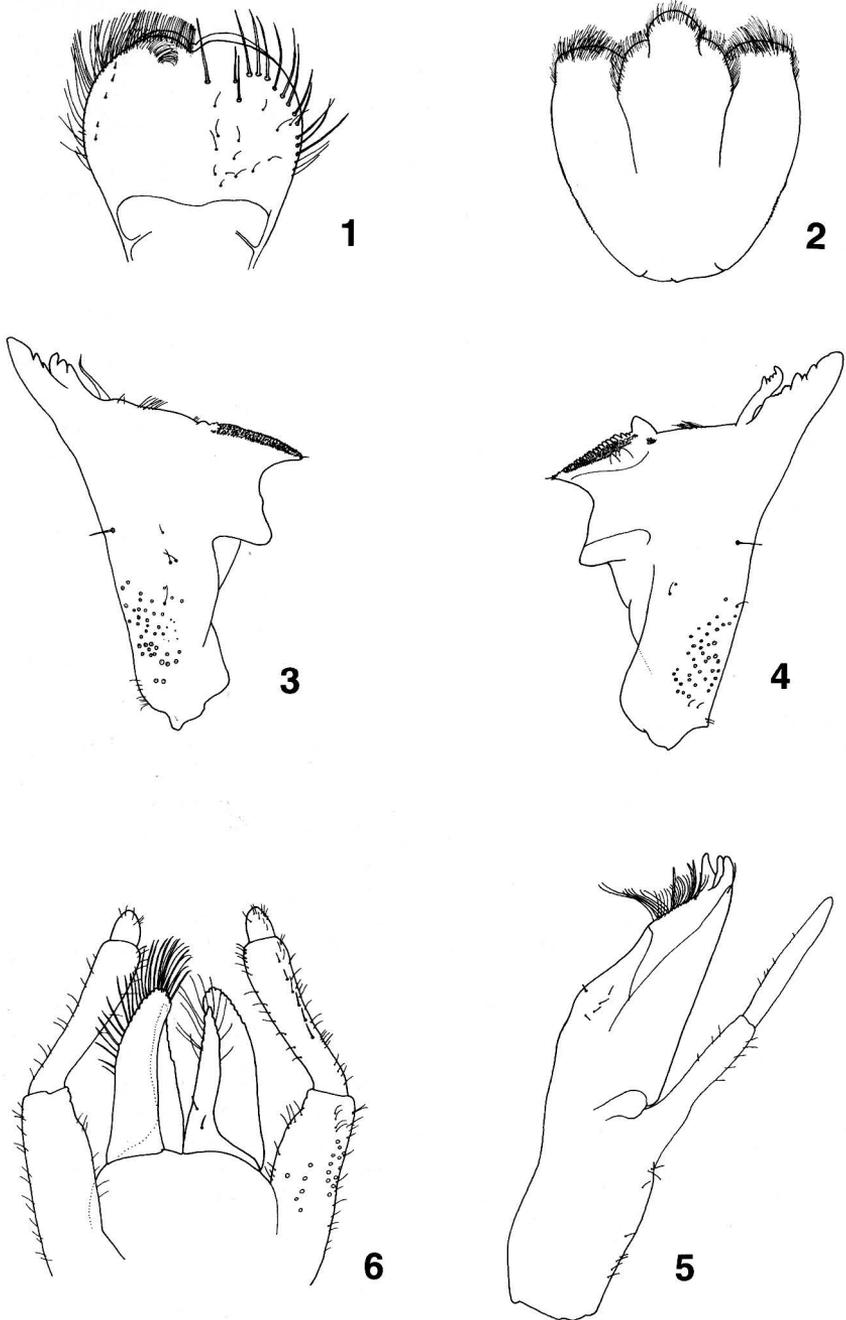
INTRODUCTION

The genus *Afroptiloides* has been erected by GILLIES (1990) for species previously assigned to the polyphyletic genus *Centroptilum* EATON. It comprises very small two-tailed species with a particular median dorsal line of processes. McCAFFERTY & DE MOOR (1995) synonymized *Afroptiloides* with *Acanthiops* WALTZ & McCAFFERTY, which has been erected for a very specialized species (WALTZ & McCAFFERTY, 1987a). This synonymy was justified by the following synapomorphies shared by *Acanthiops* and *Afroptiloides*: symmetrical, reduced, rounded terminal labial palp segment, double row of denticles on claws and distinctive medial armature of the abdominal terga (BARBER-JAMES & McCAFFERTY, 1997). Afterwards, GILLIES reinstated the genus *Afroptiloides*, justified by the polyphyletic origin of *Acanthiops* sensu BARBER-JAMES & McCAFFERTY, even if *Acanthiops* and *Afroptiloides* certainly share a recent common ancestor (GILLIES, 1999).

Afroptiloides appears to be represented in Madagascar by three very distinctive species. Two of them can be easily distinguished from other African species by the elongate shape of the mouthparts, especially of the labium and the maxillae. On the other hand, two of the three species do not possess a median dorsal line of processes. Other features especially on legs clearly indicate that these three species are closely related and belong to *Afroptiloides*.

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

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

TAXONOMY

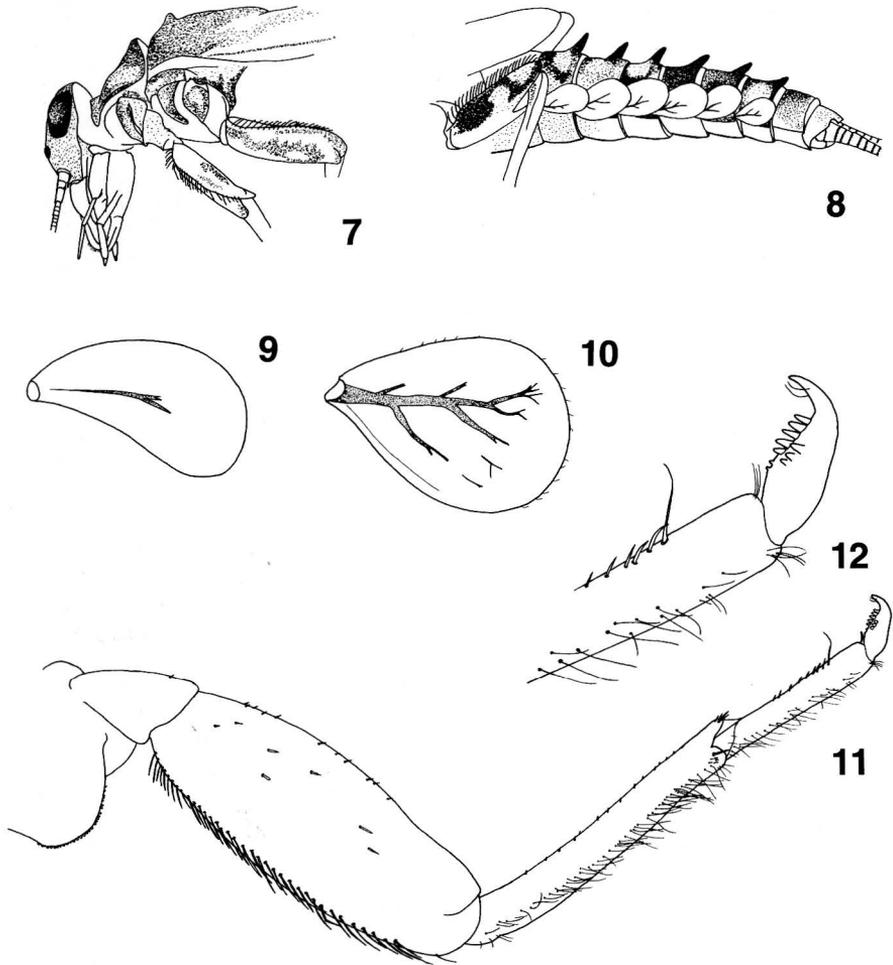
Afroptiloides spinosum n. sp.

Larva. Maximal length (full grown female specimen): body 5.1 mm; cerci 3.9 mm. Terminal filament reduced to a single segment.

HEAD almost uniformly brown. Antennae brown with scapus and pedicellus darker. Eyes black; turbinate eyes brown; ocelli grey. Labrum (Fig. 1) small and rounded, with an anteromedial emargination, dorsally with an arc of about 14 long setae and few thin setae in proximal half; distal margin bordered with thin setae, the disto-lateral ones much longer; ventrally with a row of about five spines and a disto-medial arc of very thin setae. Hypopharynx as in Fig. 2, superlingua well-developed. Right mandible (Fig. 3) with two sets of incisors, the external one turned backwards; thin prosthema without teeth or process; tuft of setae between prosthema and mola present; tuft of setae at apex of mola reduced to a single seta; basal half with short thin setae dorsally, one stout seta perpendicularly to the external margin. Left mandible (Fig. 4) with incisors fused; prosthema well-developed, with 4 teeth together with a comb-shaped structure; tuft of setae between prosthema and mola present; tuft of setae at the apex of the mola reduced to 3 setae; basal half dorsally with few short thin setae, one stout seta perpendicular to the external margin. Maxillae (Fig. 5) slender with 4 teeth, the distal one opposed to the three others; row of setae ending with two or three long setae, two spine-like setae in the middle of the row; row of 4 small setae at the basis of the galea; 1 single small seta perpendicular to the margin of galea; palp 2-segmented, slender, longer than galealacinia, bordered with thin setae. Labium (Fig. 6) with glossae shorter than paraglossae; glossae slender, apex with long setae on both margins; paraglossae slender, apically rounded, with simple stout setae apically and on the outer margin. Labial palp 3-segmented, slender, longer than glossae and paraglossae; first segment elongated with thin setae on both margins, 1.3 shorter than second and third combined; second segment slightly produced apicomediaally, outer margin slightly incurved, row of 6 setae, covered with small setae on both margins; third segment subconical, longer than broad, covered apically with short setae.

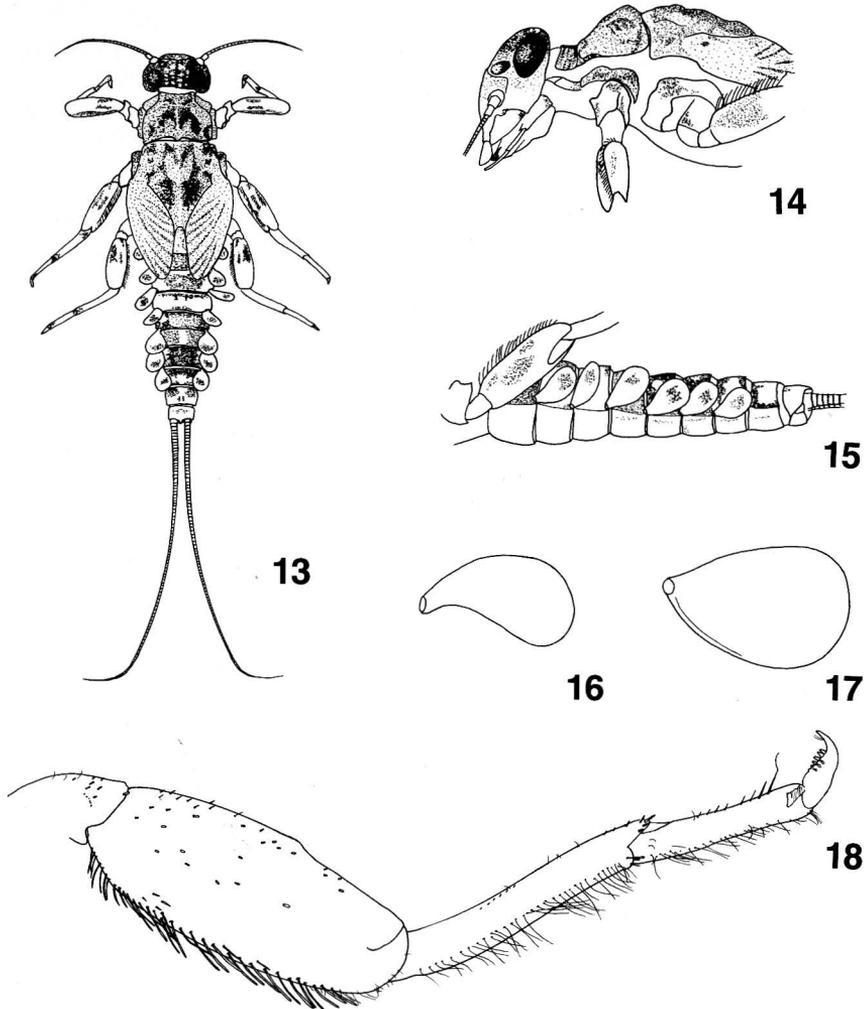
THORAX almost uniformly brown. Pronotum strongly narrowed proximally, with two distal processes. Mesonotum with a proximal process (Fig. 7). Hindwing pad present. Femora brown, with yellowish pattern; tibiae and tarsi medium brown. Forelegs as in Fig. 11, coxa almost without setae. Femora dorsally with a row of long and pointed setae, apical patch of stout setae absent; lateral margin with few small setae; ventral margin with only few minute acute setae. Tibiae dorsally with a row of long and thin setae; apically with a single stout pointed seta and a patch of minute pointed setae; ventrally with minute setae and apically with a patch of about 4 acute setae. Tarsi with a row of long and thin setae dorsally; ventral margin with a row of small and pointed setae ending with an extremely developed seta; tarsal claws (Fig. 16) with 2 rows of teeth, the first one formed by about 8 teeth, the two proximal ones poorly developed, the second row reduced to 3 teeth in a lateral position; two subapical, long and thin setae. Middle and posterior legs similar to foreleg.

ABDOMEN medium to dark brown (Fig. 8), without pattern, segments 4 and 5 lighter. Line of median well-developed processes on terga 1 to 8, decreasing in length toward the apex. Terga covered with traces of insertion of setae, without scale bases. Posterior margin of segments 1 to 5 smooth without spines; number of



Figs 7–12: Larval structures of *A. spinosum*. 7: head and thorax (lateral view); 8: abdomen (lateral view); 9: first gill; 10: fourth gill; 11: left foreleg; 12: tarsal claw.

spines of the posterior margin increasing from segment 6 to the apex, margin of segment 9 completely bordered by pointed spines twice longer than broad. Sterna yellowish brown; covered with traces of insertion of setae, without scale bases; smooth posterior margin without spines. Gills present on abdominal segments 1 to 7, main tracheal branches brown, broad, limited in number, sparse thin setae apically, not serrated (Fig. 10); gill 1 paddle-shaped (Fig. 9). Paraproct covered with micro-pores, without scale bases; postero-lateral extension with about 15 well-developed pointed spines along the margin. Cerci brown dorsally and yellowish brown ventrally, with swimming setae on the whole inner margin; median caudal filament reduced to a single segment.



Figs 13–18: Larval structures of *A. delphinae*. 13: in toto (dorsal view); 14: head and thorax (lateral view); 15: abdomen (lateral view); 16: first gill; 17: fourth gill; 18: left foreleg.

Male and female imagoes. Unknown.

Holotype (larva ♀): Madagascar, Rianila Bas., Sahatandra Riv., Ambodiriana, near Ambalafary road to Lakato, 48°20'19" E, 19°01'30" S, 980 m, 7.4.1999, n°860a, leg. J.-L. Gattolliat and N. Raberiaka.

Paratypes: Same data as holotype, 16 larvae; same data as holotype, but 19.10.1995, leg. J.-M. Elouard and T. Pilaka, P0514, 1 larva; Rianila Bas., unnamed riv., road to Lakato, 48°21'48" E, 19°02'40" S, 1050 m, 8.4.1999, P0861, leg. J.-L. Gattolliat and N. Raberiaka, 8 larvae; Rianila Bas., tributary riv. to Sahatandra Riv., near Ambalafotsy, road to Lakato, 48°21'51" E, 19°02'22" S, 1050 m, 8.4.1999, P0862, leg. J.-L. Gattolliat and N. Raberiaka, 1 larva.

Etymology. The specific epithet is Latin expressing the strong development of the median dorsal processes.

***Afrotiloides delphinae* n. sp.**

Larva. Maximal length (full grown specimen): body 3.7 mm; cerci 2.9 mm. Terminal filament reduced to a single segment.

HEAD brown with darker pattern. Antennae yellowish brown, except scapus and pedicel brown. Eyes black; turbinate eyes brown; ocelli grey. Mouthparts similar to those of the previous species.

THORAX. Brown with lighter and darker brown patterns on the pronotum. Pronotum strongly narrowed proximally, with two weakly developed distal processes. Mesonotum (Fig. 14) with a weakly developed proximal process. Hindwing pad present. Legs brown with apex of tibiae yellowish brown. Forelegs as in Fig. 18, coxa with small setae. Femora dorsally with a row of long and blunt setae, apical patch of stout setae absent; long and thin setae on the apical margin; lateral margin with few small setae; ventral margin with small acute setae. Tibiae dorsally with a row of long and thin setae, apically with a stout blunt seta; ventrally with few small setae and apically with a patch of about 4 acute setae. Tarsi with a row of long and thin setae dorsally; ventral margin with a row of small and pointed setae ending with an extremely developed seta; tarsal claws with 2 rows of teeth, the first one formed by about 7 teeth, the two proximal ones poorly developed, the second row reduced to 3 teeth in a lateral position; two subapical, long and thin setae. Middle and posterior legs similar to foreleg.

ABDOMEN brown, with segments 4, 5, 9 and 10 lighter (Fig. 13). Line of median process on terga 1 to 8 absent (Fig. 15). Terga covered with traces of insertion of setae, without scale bases. Posterior margin of segments 1 to 8 smooth without spines; segments 9 and 10 laterally with a few spines as long as broad, blunt. Sterna yellowish brown; covered with traces of insertion of setae and few setae, without scale bases; smooth posterior margin without spines. Gills present on abdominal segments 1 to 7, without visible tracheation, not serrated (Fig. 17); gill 1 paddle-shaped (Fig. 16). Paraproct covered with micropores, without scale bases or setae; margin of the paraproct and postero-lateral extension with about 12 pointed spines. Cerci yellowish brown, with swimming setae on the distal half of the inner margin; median caudal filament reduced to a single segment.

Male and female imagoes. Unknown.

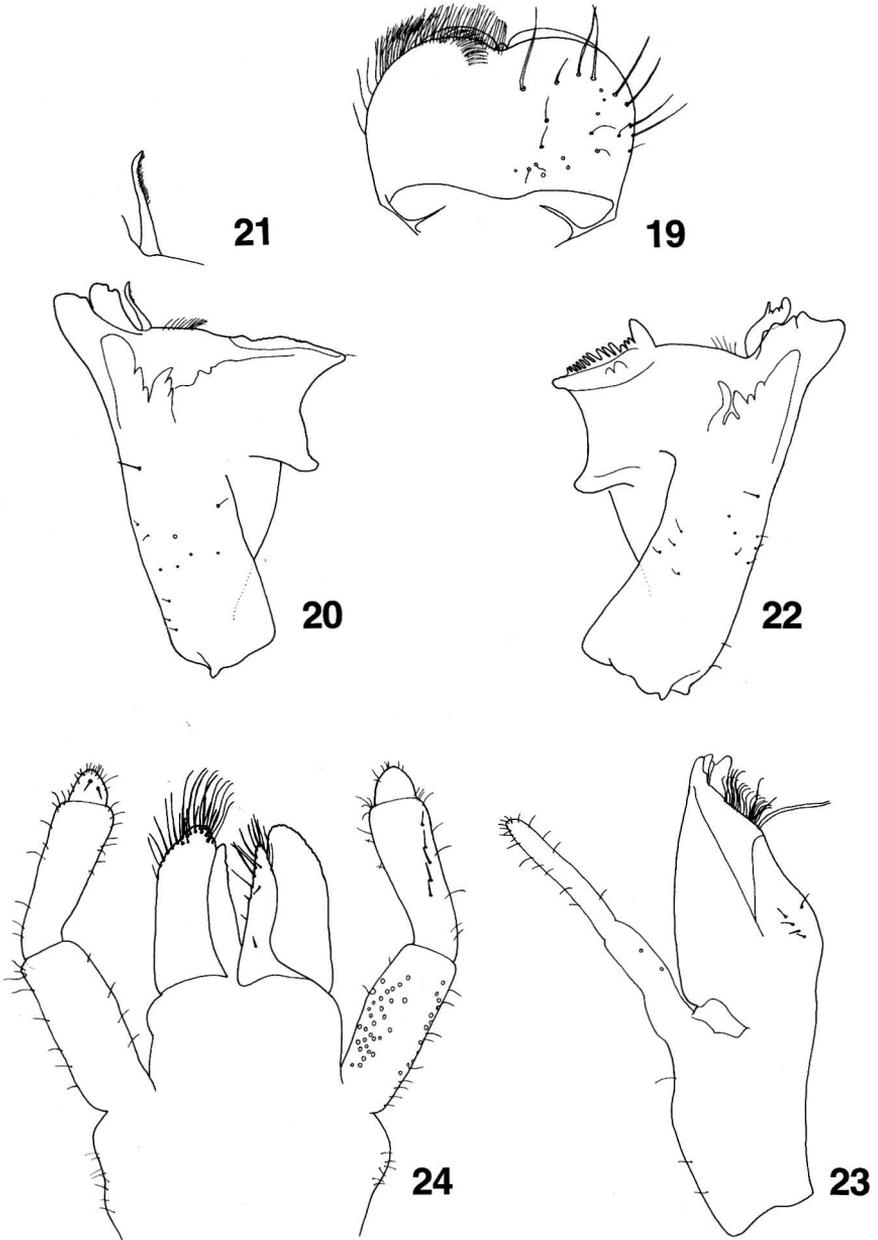
Holotype (larva ♀): Madagascar, Rianila Bas., Sahatandra Riv., Ambodiriana, near Ambalafary road to Lakato, 48°20'19" E, 19°01'30" S, 980m, 7.4.1999, P0860, leg. J.-L. Gattolliat and N. Raberiaka. *Paratypes*: Same data as holotype, 6 larvae; Rianila Bas., unnamed riv., road to Lakato, 48°21'48" E, 19°02'40" S, 1050 m, 8.4.1999, P0861, leg. J.-L. Gattolliat and N. Raberiaka, 8 larvae; Rianila Bas., Sandrakatrana Riv., Ambodiaviavy, near Beforona, 48°39'45" E, 18°57'31" S, 350 m, 9.4.1999, P0863, leg. J.-L. Gattolliat and N. Raberiaka, 5 larvae; same data, but 863a, 1 larva.

Etymology. This species is dedicated to Delphine Magnenat Braillard.

***Afrotiloides namorona* n. sp.**

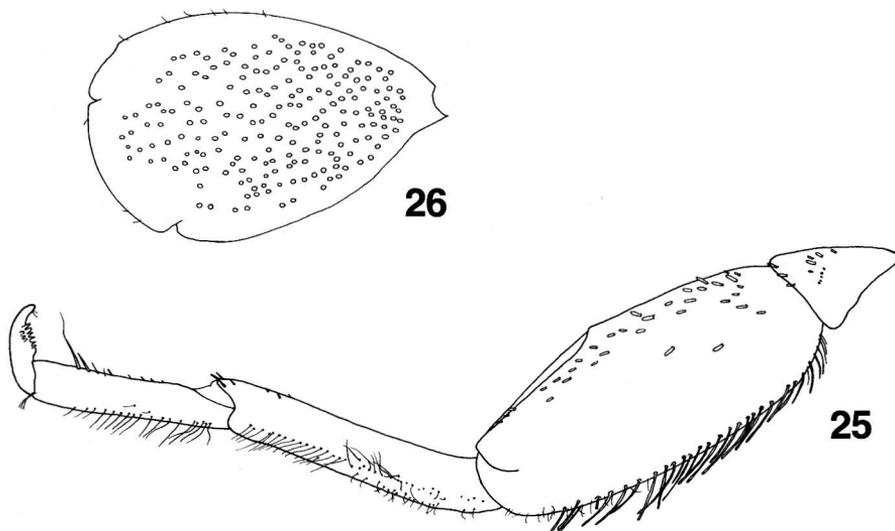
Larva. Maximal length (full grown specimen): body 3.7 mm; cerci 3.4 mm. Terminal filament reduced to a single segment.

HEAD uniformly yellowish brown with darker pattern. Antennae yellowish brown. Eyes black; turbinate eyes brown, ocelli grey. Labrum (Fig. 19) rounded, with an anteromedial emargination, dorsally with an arc of about 8 long setae and few thin setae in the proximal half; distal margin bordered with thin setae, apico-



Figs 19–24: Larval structures of *A. namorona*: 19: labrum (left: ventral; right: dorsal); 20: right mandible; 21: right prostheca; 22: left mandible; 23: right maxilla; 24: labium.

laterally feathered; ventrally with a disto-medial arc of very thin setae. Hypopharynx unknown. Right mandible (Fig. 20) with two sets of incisors; prostheca thin,



Figs 25–26: Larval structures of *A. namorona*: 25: left foreleg; 26: fourth gill.

covered with thin setae on the apical half of the inner margin; prostheca slender with thin setae on the inner margin (Fig. 21); tuft of setae between prostheca and mola present; basal half dorsally with few short thin setae, one stout seta perpendicular to the external margin. Left mandible (Fig. 22) with incisors fused; prostheca well-developed, with 4 teeth together with a comb-shaped structure; tuft of setae between prostheca and mola reduced; basal half dorsally with few short thin setae, one stout seta perpendicular to the external margin. Maxillae (Fig. 23) with 4 teeth, the distal one opposed to the three others; row of setae ending with two long setae, stout setae in the middle of the row; row of 4 small setae at the basis of the galea; 1 single small seta perpendicular to the margin of galea; palp 2-segmented, slightly longer than galealacinia, second segment with thin setae, especially toward the apex. Labium (Fig. 24) with glossae shorter than paraglossae; apex of glossae and inner margin with stout setae; paraglossae, apically rounded, with two rows of simple stout setae. Labial palp 3-segmented; first segment sub-rectangular with thin setae especially on the outer margin, 1.1 shorter than second and third combined; second segment with outer margin almost straight, row of 5 setae, with few small setae on both margins; third segment subconical, slightly broader than large, covered apically with short setae and stout pointed setae.

THORAX almost uniformly brown with yellowish brown pattern. Pronotum strongly narrowed proximally, without distal processes. One process on the proximal part of the mesonotum. Hindwing pad present. Legs yellowish brown, except apex of femora, tibiae and tarsi darker. Forelegs as in Fig. 25, coxa with small setae. Femora dorsally with a row of long and blunt setae, apical patch of stout setae absent; few long and thin apico-dorsal setae; lateral margin with few small setae; ventral margin with blunt setae. Tibiae with two rows of setae dorsally, the first one on the whole length, formed by long and thin setae, the second one, only in the proximal half, formed by short and thin setae; ventrally only with few setae apically. Tarsi with a row of long and thin setae dorsally; ventral margin with a row of small

and pointed setae ending with an extremely developed seta; tarsal claws (Fig. 16) with 2 rows of teeth, the first one formed by 6 subequal teeth, the second row reduced to 3 teeth in a lateral position; two subapical, long and thin setae.

ABDOMEN yellowish brown, darker in the middle of each segment, especially the second and the third. Median dorsal line of processes on terga 1 to 8 absent. Terga covered with traces of insertion of setae, without scale bases. Posterior margin of segments 4 and 5 smooth without spines. Sterna yellowish brown; covered with traces of insertion of setae, without scale bases; smooth posterior margin of segments 4 and 5 without spines. Gills present on abdominal segments 1 to 7, with micropores, without visible tracheation, not serrated (Fig. 26); gill 1 paddle-shaped. Paraproct unknown. Cerci yellowish brown, with few swimming setae on the distal half of the inner margin; median caudal filament reduced to a single segment.

Male and female imagoes. Unknown.

Holotype (larva): Madagascar, Namorona Bas., Ambatoaranana Riv., Ranomafana village, 47°27'26" E, 21°15'23" S, 780m, 8.11.1996, P0642, leg. J.-L. Gattolliat and C. Rochat.

Paratypes: same data as holotype, 2 larvae.

Etymology. This species is named after the river where the specimens were collected.

DISCUSSION

The genus *Afroptiloides* has been recently reinstated and redescribed (GILLIES, 1999). Important features allow to distinguish *Afroptiloides* from *Acanthiops*: *Acanthiops* presents a squat form of the body with abdominal segments telescoping, luxuriant armature of the terga especially on segment IX, overlapping and strongly asymmetrical gills with numerous tracheations (DEMOULIN, 1967; GILLIES, 1999), whereas *Afroptiloides* presents a common body shape with variously developed median dorsal spurs decreasing in size toward the apex. Moreover, *Afroptiloides* possesses tibiae with a dorsal row of fine hairs and cerci with swimming hairs (GILLIES, 1999).

The three new Malagasy species possess all the apomorphies of the genus *Afroptiloides* such as reduced median caudal filament, tarsal claw with two row of teeth the second one reduced, tibiae with dorsal row of thin setae, mandibles with setae between prosthema and mola, except the median dorsal spur in *A. namorona* and *A. delphinae* (WALTZ & MCCAFFERTY, 1987a; GILLIES, 1990, 1991).

The three species also present new features: tarsi with an extremely developed ventral subapical seta, tarsi with a ventral row of long and thin setae, process on the proximal part of the mesothorax and pronotum strongly narrowed proximally. These features clearly indicate that these three Malagasy species have evolved separately from the African ones and form a distinct lineage. However, these characters are not sufficient to erect a new genus for them.

Afroptiloides delphinae and *A. namorona* do not possess an abdominal median dorsal line of processes. However, they appear to be closely related to *A. spinosum*, which possesses a well-developed line of processes. This character is consequently not sufficient to remove *A. delphinae* and *A. namorona* from *Afroptiloides*. The three species probably originally possess a median dorsal line of processes and that has

been subsequently reduced in *A. delphinae* and *A. namorona*. The same case can be observed in *Afrobaetodes* (GILLIES, 1991; GATTOLLIAT & SARTORI, 1999).

The extremely developed ventral subapical setae and long and thin setae on the dorsal margin of tibiae and tarsi distinguish the three Malagasy species as original characters of *Libebrella* (WALTZ & McCAFFERTY, 1987b) also presents such features, however *Libebrella* possesses all the apomorphies of the *Baetis* complex such as tarsal claw with a single row of teeth, ventral femoral patch on the foreleg, which are not present in the species treated here.

Afroptiloides spinosum differs from the two other species by the strong development of the median dorsal line of processes, the development of the thoracic process, the broad, reduced in number tracheal branches of the abdominal gills, the swimming setae on the whole inner margin of the caudal filament. *Afroptiloides delphinae* appears to be very closely related to *A. spinosum*, especially regarding mouthparts, which are very similar in both species. The slender maxillae and labium of the two species present similarities with those of *Afroptiloides griffithsi* LUGO-ORTIZ & McCAFFERTY (LUGO-ORTIZ & McCAFFERTY, 1998). However, *A. delphinae* does not possess processes on the abdomen and its gills are without tracheation. *Afroptiloides namorona* differs from the two other species by the non-slender maxillae and labium, the shape of the labrum and of the incisive of the mandibles.

DISTRIBUTION AND ECOLOGY

The three new species present a distribution restricted to two basins of the eastern coast. *Afroptiloides namorona* has been found only in one small tributary of the Namorona river at an altitude of 780 m in the degraded tropical forest. *Afroptiloides spinosum* and *A. delphinae* are sympatric: they were caught in three small streams of the same basin at altitudes between 350 and 1050 m in the degraded tropical forest.

All three species were caught in small streams (less than 3 meters broad), with little depth (5 to 20 cm), and fast running waters. They live mainly on the top of rocks and on the flagstones.

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