

Delouardus, a new *Centroptiloides* complex genus from Madagascar and its relationship with *Cheleocloeon* Wuillot & Gillies (Ephemeroptera: Baetidae)

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Delouardus djabala gen. n. and sp. n. (Ephemeroptera: Baetidae) is based on a distinctive larva from Madagascar. The new genus belongs to the *Centroptiloides* complex of Afrotropical genera based on its possession of two rows of small, bluntly pointed denticles on the tarsal claws. *Delouardus* is distinguished from other genera of the *Centroptiloides* complex by having the second segment of the labial palps deeply falcate apically, weakly pectinate setae on the legs, and elongate and weakly hooked tarsal claws. Character analysis revealed that *Delouardus* and *Cheleocloeon* are sister taxa, indicating that *Cheleocloeon* should also be included in the *Centroptiloides* complex, despite its derived claw characters.

Key words: Ephemeroptera, Baetidae, *Delouardus djabala*, new genus, new species, *Cheleocloeon*, *Centroptiloides* complex.

INTRODUCTION

The *Centroptiloides* complex of small minnow mayflies (Ephemeroptera: Baetidae) was proposed by Lugo-Ortiz & McCafferty (1998) as a monophyletic grouping of Afrotropical genera comprising *Acanthiops* Waltz & McCafferty, *Afroptilum* Gillies, *Barnumus* McCafferty & Lugo-Ortiz, *Centroptiloides* Lestage, *Dicentroptilum* Wuillot & Gillies, *Edmulmeatus* Lugo-Ortiz & McCafferty, *Herbrossus* McCafferty & Lugo-Ortiz, *Nesoptiloides* Demoulin, *Peuhlella* Lugo-Ortiz & McCafferty, *Susua* Lugo-Ortiz & McCafferty, and *Thraulobaetodes* Elouard & Hideux. Lugo-Ortiz & McCafferty (1998) characterized the *Centroptiloides* complex as having larvae with a double row of denticles on the tarsal claws (Lugo-Ortiz & McCafferty 1998: Figs 32, 42, 54, 66). Known adults of the *Centroptiloides* complex cannot, however, be adequately distinguished as an entire grouping from other Afrotropical baetids with single marginal intercalary veins in the forewings.

Here we describe a new genus and species of the *Centroptiloides* complex based on larvae from Madagascar. The discovery of the new taxon is of systematic importance because it is evidently closely related to *Cheleocloeon* Wuillot & Gillies, a genus previously hypothesized to belong to the *Bugilliesia* complex of Afrotropical and Madagascar genera (Lugo-Ortiz & McCafferty 1996) by Lugo-Ortiz & McCafferty (1997a). The material

examined is in the Purdue Entomological Research Collection, West Lafayette, Indiana, U.S.A.

Delouardus gen. n.

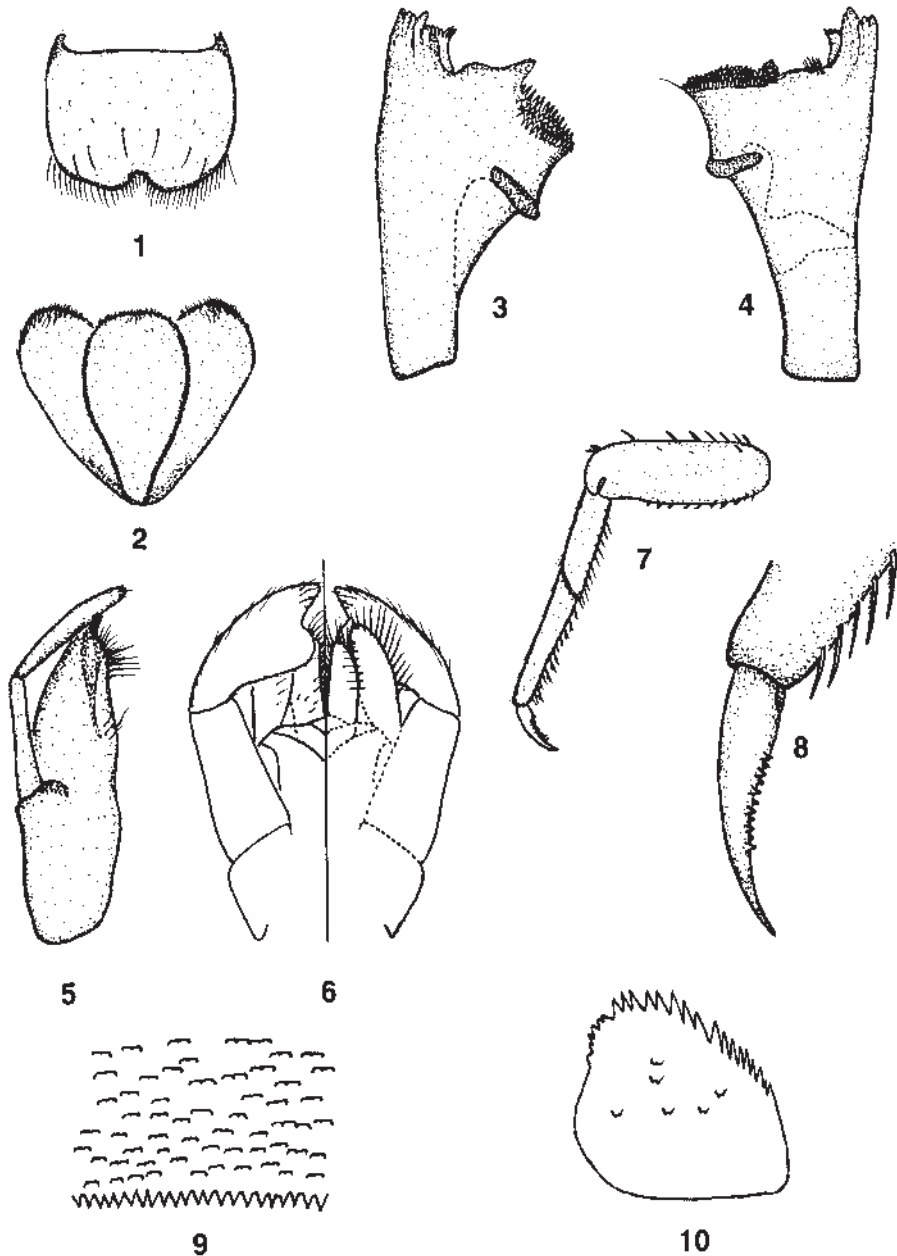
Type species *Delouardus djabala* sp. n.

Description of larva

Head. Labrum (Fig. 1) broadly rounded anteriorly, with deep anteromedial notch. Hypopharynx (Fig. 2) with broadly rounded lingua and superlinguae. Left mandible (Fig. 3) with incisors fused; prosthema apically denticulate; tuft of setae between prosthema and mola absent. Right mandible (Fig. 4) with incisors fused; prosthema apically denticulate; tuft of setae between prosthema and mola present. Maxillae (Fig. 5) with four blunt denticles on crown of galealaciniae; palps two-segmented, extending beyond galealaciniae. Labium (Fig. 6) with glossae slightly shorter than paraglossae, base broader than apex; paraglossae with base broader than apex; palps two-segmented; palp segment 1 with base slightly broader than apex; palp segment 2 deeply falcate apically, bluntly pointed apicolaterally, medio-apically rounded.

Thorax. Legs (Fig. 7) held close to body; femora with row of robust, simple setae dorsally and weakly pectinate setae ventrally; tibiae with long, fine, simple setae dorsally and long, robust, simple setae ventrally; tarsi with long, fine, simple setae dorsally and weakly pectinate setae ventrally;

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Figs 1–10. *Delouardus djabala*, larva. 1, labrum; 2, hypopharynx; 3, left mandible; 4, right mandible; 5, right maxilla; 6, labium (left = ventral; right = dorsal); 7, right foreleg; 8, tarsal claw; 9, tergum 4 (detail); 10, paraproct.

tarsal claws (Fig. 8) approximately 0.45 times length of respective tarsi, weakly hooked apically, with two rows of bluntly pointed denticles.

Abdomen. Terga (Fig. 9) with single and paired scale bases scattered over entire surface and posterior marginal spines. Gills on segments 1–7, held

dorsolaterally, somewhat narrow-elongate, well tracheated, approximately 2.0 times length of corresponding segments; gill 1 narrower than gills 2–7. Paraprocts (Fig. 10) with marginal spines.

Adult. Unknown.

Etymology. We name this genus after J.M.

Elouard for his contributions to the study of the mayflies of Madagascar. The name is a combination of a contraction of the Latin preposition *de* (for) and our colleague's last name. The gender is masculine.

Distribution. Madagascar.

Remarks. *Delouardus* clearly belongs to the *Centroptiloides* complex of genera because its larval stage has two distinctive rows of short, bluntly pointed denticles on the tarsal claws (Fig. 8). It is distinguished from other genera in the *Centroptiloides* complex by the following combination of characters: second segment of the labial palps deeply falcate apically and rounded medio-apically (Fig. 6); presence of pectinate setae on the legs (Fig. 7), and relatively elongate and apically weakly hooked tarsal claws (Figs 7, 8).

Analysis of characters indicates that *Delouardus* and *Cheleocloeon* share the following apomorphies: a narrow-elongate first pair of gills (Soldán & Thomas 1985: Fig. 15; Wuillot & Gillies 1993: Figs 9, 18; Lugo-Ortiz & McCafferty 1997a: Fig. 11), elongate and apically weakly hooked tarsal claws (Figs 7, 8; Soldán & Thomas 1985: Fig. 8; Wuillot & Gillies 1993: Figs 8, 17; Lugo-Ortiz & McCafferty 1997a: Fig. 9), and paired scale bases on the abdominal terga (Fig. 9; Soldán & Thomas 1985: Fig. 13; Lugo-Ortiz & McCafferty 1997a: Fig. 10). Recently, Lugo-Ortiz & McCafferty (1997a) hypothesized that *Cheleocloeon* belongs to the *Bugilliesia* complex of genera (see Lugo-Ortiz & McCafferty 1996) because the second segment of the male genital forceps is basally bulbous (Wuillot & Gillies 1993: Fig. 2). That analysis was tenuous, and the above larval data now show that *Cheleocloeon* has affinities and, evidently, its origin within the *Centroptiloides* complex. The basal bulb of the genitalia of *Cheleocloeon* differs in detail from any *Bugilliesia* complex genus and is apparently not derived from that complex.

The phylogenetic position of *Delouardus* and *Cheleocloeon* in relation to each other is suggested by larval claw morphology. *Delouardus* has tarsal claws with short, bluntly pointed denticles typical of other genera in the *Centroptiloides* complex (Fig. 8) (Lugo-Ortiz & McCafferty 1998: Figs 32, 42, 54, 66); *Cheleocloeon* has tarsal claws that grade from having two rows of minute, laterally compressed denticles to being edentate (Soldán & Thomas 1985: Fig. 8; Wuillot & Gillies 1993: Figs 8, 17; Lugo-Ortiz & McCafferty 1997a: Fig. 7). We hypothesize that the denticulation of the tarsal claws of

Delouardus represents the relatively plesiomorphic condition, and that the claws of *Cheleocloeon* are gradationally apomorphic and possibly related to the exploitation of different stream microhabitats.

The morphology of the second segment of the labial palps of *Delouardus* and *Cheleocloeon* is also of phylogenetic significance. In *Delouardus*, the second segment is deeply falcate, being bluntly pointed apicolaterally and rounded medio-apically (Fig. 6). The condition of the second segment of the labial palps of *Cheleocloeon* (Soldán & Thomas 1985: Fig. 5; Wuillot & Gillies 1993: Figs 6, 15; Lugo-Ortiz & McCafferty 1997a: Figs 6, 7; Lugo-Ortiz & McCafferty 1997b: Fig. 6), although appearing quite different, can be interpreted as representing an apically rounded modification of the homologous apicolateral region of the labial palps in *Delouardus*, along with the medial protrusion from the rounded medioapical area of the *Delouardus* palps.

Based on the assumption that *Delouardus* and *Cheleocloeon* are sister lineages and that *Delouardus* is plesiomorphic, we hypothesize that *Delouardus* and *Cheleocloeon* were present in Madagascar and Africa before Africa and Madagascar split, approximately 100 million years ago. After the separation of the two landmasses, representatives of *Cheleocloeon* spread northward in Africa, where the more specialized species with modified labial palps and tarsal claws occur. Isolated representatives of *Cheleocloeon* in Madagascar retained more plesiomorphic labial palps and tarsal claws. The *Delouardus* lineage evidently did not survive in Africa and is restricted to Madagascar.

Delouardus djabala sp. n., Figs 1–10

Description of larva

Lengths. Body: 3.7 mm; caudal filaments: 2.1 mm.

Head. Coloration dark yellow-brown, with no distinct markings. Antennal length unknown. Labrum (Fig. 1) with submedial pair of long, fine, simple setae and anterior submarginal row of two or three long, fine, simple setae. Hypopharynx as in Fig. 2. Left mandible (Fig. 3) with 3 + 3 denticles. Right mandible (Fig. 4) with 3 + 3 denticles. Maxillae (Fig. 5) with palp segment 1 approximately 0.83 times length of segment 2; row of two or three minute, fine, simple setae near medial hump. Labium (Fig. 6) with glossae with few minute, fine, simple setae ventrally near base, and

fine, simple setae marginally, increasing in length and girth apically; paraglossae with long, fine, simple setae marginally; palp segment 1 approximately 0.83 times length of segment 2, with short, fine, simple setae scattered over surface.

Thorax. Coloration dark yellow-brown, with no distinct markings. Hind wing pads present. Legs (Fig. 7) pale yellow-brown; femora with faint brown subrectangular marking anteriorly; tarsal claws (Fig. 8) with two rows of five or six denticles each.

Abdomen. Coloration medium-brown and dark yellow-brown. Tergum 1 dark yellow-brown; terga 2–8 medium-brown, with small submedial, round, dark yellow-brown markings anteriorly; tergum 2 with medium-sized medial, round, dark yellow-brown marking posteriorly; tergum 3 with large bell-shaped dark yellow-brown marking medially; terga 9 and 10 uniformly medium-brown. Sterna dark yellow-brown, with no distinct markings. Terga (Fig. 9) with posterior marginal spines approximately as long as basal width. Paraprocts (Fig. 10) with 20–25 somewhat irregular marginal spines and with scale bases scattered over surface. Caudal filaments cream to pale yellow-brown, with broad medium-brown band near middle; terminal filament subequal

in length to cerci.

Adult. Unknown.

Etymology. This species is named after the type locality, the Djabala River.

Material examined. Holotype: larva, MADAGASCAR, Antsiranana Province, Djabala R., 11 km NW of Hell-Ville, Nossi-Bé, 25.x.71, G.F. & C.H. Edmunds and F. Emmanuel.

Remarks. Although no other species of *Delouardus* are known, we expect that the setation of the labrum (Fig. 1), mandibular denticulation (Figs 3, 4), length ratio of the maxillary palps (Fig. 5), degree of development of the medial process of segment 2 of the labial palps (Fig. 6), leg setation and number of denticles on the tarsal claws (Figs 7, 8), abdominal coloration, tergal armature (Fig. 9), and arrangement and number of paraproctal spines (Fig. 10) may prove to be diagnostic of *D. djabala*.

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