

Taxonomy

Taxonomy of the genus *Adebrotus* Lugo-Ortiz & McCafferty (Ephemeroptera: Baetidae)

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Abstract – The taxonomy of the enigmatic genus *Adebrotus* Lugo-Ortiz & McCafferty is reviewed in the present paper. The type-species, *A. amazonicus* Lugo-Ortiz & McCafferty, is redescribed based on nymphs from Northern Brazil. *Adebrotus lugo*, new species, is described based on nymphs from Southeastern Brazil, significantly extending the distributional range of the genus. In the light of these new evidences, the generic concept of *Adebrotus* is improved.

Key words: Mayfly / taxonomy / Neotropics / South America / new species

Introduction

The genus *Adebrotus* Lugo-Ortiz & McCafferty (Ephemeroptera: Baetidae) can be considered one of the less known member of the family in South America. Since its original description, which was based on a single species, *A. amazonicus* Lugo-Ortiz & McCafferty (Lugo-Ortiz and McCafferty, 1995), practically nothing was added to its knowledge. The only data available after that are the record of an undetermined species from French Guiana (Orth *et al.*, 2001), and the record of the type species from Mato Grosso State (Salles *et al.*, 2004). Surprisingly, both records, as well as the original description, were based on a single nymph, and consequently, only three specimens of the genus have been found since its discovery in 1995. The presence of *A. amazonicus* in Colombia, as stated by Domínguez *et al.* (2006), is not correct. Their statement was based on Domínguez *et al.* (2002), but these authors reported the species from the Brazilian Amazonian Region, not from Colombia.

According to Lugo-Ortiz and McCafferty (1995), the unique characteristics of the nymph, and the possibility that the species is rare and threatened in South America, were the main reasons that justified its description based on a single nymph. However, given the insufficiency of material, it was difficult for them to ascertain the generic and specific limits of the taxon.

Recently, during surveys of aquatic insects in Northern and Southeastern Brazil, a few specimens of *Adebrotus* have been found. Whereas those from Northern Brazil

were identified as *A. amazonicus*, those from Southeastern proved to be a distinct new species, which significantly extends to south the known distributional range of the genus. Besides the description of this new species, the objective of this paper is to redescribe *A. amazonicus* and, in the light of these new evidences, improve the generic concept of *Adebrotus*.

Material and methods

The taxonomic descriptions presented herein were generated from a DELTA (Dallwitz, 1980; Dallwitz *et al.*, 1993) database of South American baetid genera and species under development in order to propose a standard description for members of the family.

Pictures were taken using an OPTON Q719K-AC microscope with a T-0124S digital camera, or a Leica (M165C) stereomicroscope with a DFC420 digital camera. In the case of pictures taken at the stereomicroscope, a series of partially focused images were processed with the program Leica Application Suite V3.4.1. (Version 2009) to produce final images with enhanced quality. Line drawings were made with the aid of a camera lucida, photographs, or both. In either ways, final illustrations were prepared according to Coleman (2003, 2006).

The material examined is housed in the following institutions: Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Brazil, and Entomological Collection of the Universidade Federal do Espírito Santo (UFES), Vitória, Brazil.

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Taxonomy

***Adebrotus* Lugo-Ortiz & McCafferty, 1995**

Lugo-Ortiz & McCafferty, 1995: 234; Orth *et al.*, 2001: 34; Domínguez *et al.*, 2006: 64.

Description

Head

Lateral branch of epicranial suture curved.

Antenna with scape and pedicel subcylindrical.

Labrum (Figs. 5 and 17). Rectangular, broader than long. Dorsal surface flat. Distal margin straight or with barely discernible medial emargination and small process. Dorsal submarginal row of setae absent.

Right mandible (Figs. 7, 8, 19 and 21). Somewhat narrow. Incisors cleft, inner set perpendicular to outer set. Molar area reduced. Denticles of mola not constricted.

Left mandible (Figs. 9, 10, 20 and 22). Somewhat narrow. Incisors cleft, inner set perpendicular to outer set. Subtriangular process wide, above level of area between prosthema and mola, and with one sharp denticle at base. Molar area reduced. Denticles of mola not constricted.

Hypopharynx (Figs. 6 and 18). Lingua basally broad; subequal or little shorter than superlingua.

Maxilla (Figs. 11 and 23). Elongate, tapering distally. Crown of galea-lacinia with four sharp denticles. Inner dorsal row of setae reduced to two bifid and pectinate denti-setae. Inner ventral row of setae reduced to four robust pectinate setae. Maxillary palp very long, ca. $1/2 \times$ longer than length of galea-lacinia; two segmented.

Labium (Figs. 12 and 24). Glossa broad and little longer than paraglossa; outer margin with spine-like setae. Paraglossa curved inward. Outer margin with spine-like setae. Labial palp with segment II without distomedial protuberance, inner and outer margins curved; outer margin with several long, fine, simple setae. Segment III conical.

Thorax

Hind wing pads absent.

Legs (Figs. 13 and 25). Femur dorsally with one row of blunt setae. Tibia and tarsi elongate. Tarsal claw elongate, with one or two rows of denticles increasing in size distally.

Abdomen

Tergal surface creased (Figs. 15 and 27).

Gills on segments I–VII (Figs. 1–4). Margin with broad spines intercalating short, fine, simple setae.

Terminal filament as long as cerci (Fig. 3).

Diagnoses

Nymphs of *Adebrotus* are distinguished from other Baetidae by the following combination of characteristics: (1) Mandibles with incisors cleft, inner set perpendicular

to outer set, and with molar area reduced (Figs. 7–10 and 19–22); (2) Subtriangular process of left mandible with one sharp denticle at base (Figs. 10 and 22); (3) Maxilla elongate, tapering distally (Figs. 11 and 23); (4) Maxillary palp very long, ca. $1/2 \times$ longer than length of galea-lacinia (Figs. 11 and 23); (5) Labial palp with segment II without distomedial protuberance and with curved margins; outer margin with several long, fine, simple setae; segment III conical (Figs. 12 and 24); (6) Hind wing pads absent; (7) Legs elongate (Figs. 13 and 25); (8) Tergal surface creased (Figs. 15 and 27); (9) Gills on segments I–VII.

Distribution

Brazil (Northern and Southeastern) and French Guyana.

Composition

Adebrotus amazonicus Lugo-Ortiz & McCafferty, *Adebrotus lugo*, sp. nov.

Biology

The nymphs of *A. amazonicus* were collected on Igarapé do Samaúma, a black water tributary of the Rio Demeni (a tributary of the Rio Negro). The two nymphs were found over a block of clay that eroded from the river bank, in an area of moderate current. Nymphs of *A. lugo*, sp. nov., in turn, were collected on leaf litter packs retained among rocks in areas with moderate current, exclusively at the Córrego Rodrigues, a stream partially located at the Sooretama Biological Reserve (Rebio Sooretama). The stream, despite its location, comes from an unprotected and deforested area, and is somewhat disturbed, especially due to the presence of fine sediments over the substrates. Besides collections made at other streams in the Rebio Sooretama, four collecting trips were performed specifically in order to collect more nymphs at the Córrego Rodrigues, but only two specimens have been found. These data, in addition to the difficulty in finding nymphs of *A. amazonicus* in Central Amazonia, regardless of several collections that have been constantly performed there, are in agreement with the statement made by Lugo-Ortiz & McCafferty (1995) concerning the rarity and consequent threat of the genus.

***Adebrotus amazonicus* Lugo-Ortiz & McCafferty, 1995 (Figs. 1–2 and 5–16)**

Lugo-Ortiz & McCafferty, 1995: 235; Domínguez *et al.*, 2002: 462; Salles *et al.*, 2004: 2; Domínguez *et al.*, 2006: 64.

Description

Nymph

Length of body: 4.0–4.2 mm; cerci: unknown; terminal filament: unknown; antennae: unknown.



Figs. 1–4. *Adebrotus* spp., nymphs. 1. *Adebrotus amazonicus* (dorsal view). 2. *Adebrotus amazonicus* (lateral view). 3. *Adebrotus lugoi*, sp. nov. (dorsal view). 4. *Adebrotus lugoi*, sp. nov. (lateral view).

Head

Coloration: yellowish, gena washed with brown. Antenna yellowish.

Frontal keel absent.

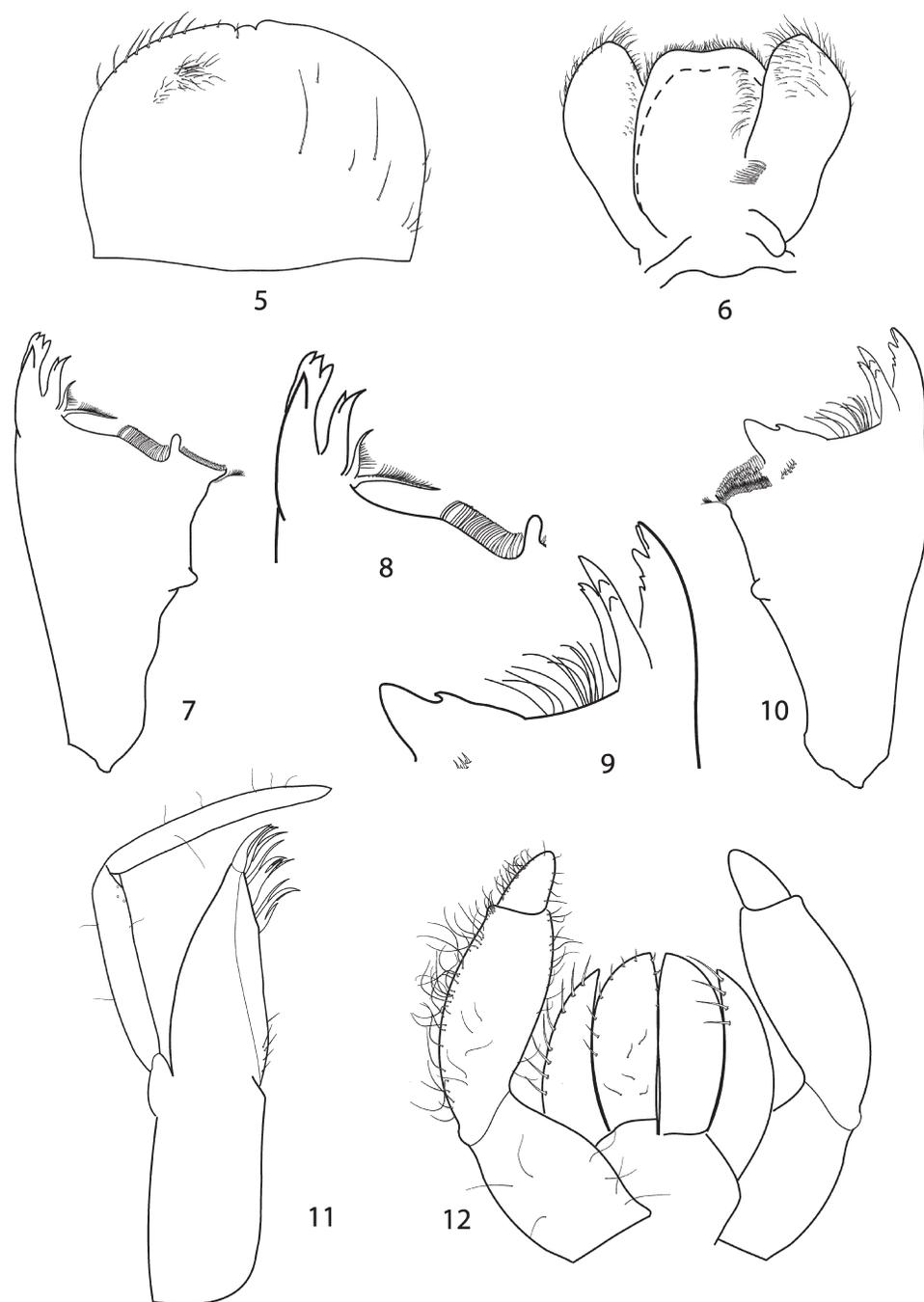
Antenna with scape and pedicel subcylindrical; flagellum with short spines on every segment.

Labrum (Fig. 5). Rectangular, longer than broad; width $1.4 \times$ length. Dorsal surface flat. Distal margin with barely discernible medial emargination and small process. Dorsally with long, fine, simple setae scattered over surface; arc of setae restricted to a single medial seta.

Ventrally with submarginal row of setae composed of row of spine-like setae; ventral surface without setae.

Hypopharynx (Fig. 6). Lingua subequal in length to superlingua. Apex slightly concave; with short, fine, simple setae; distal half not expanded. Superlingua not expanded; fine, simple setae scattered over lateral and distal margin.

Right mandible (Figs. 7 and 8). Incisors cleft, inner set perpendicular to outer set. Inner and outer set of incisors respectively with $5 + 2$ denticles. Prostheca robust, apically pointed and with frayed and slender process at base. Margin between prostheca and mola slightly concave; tuft



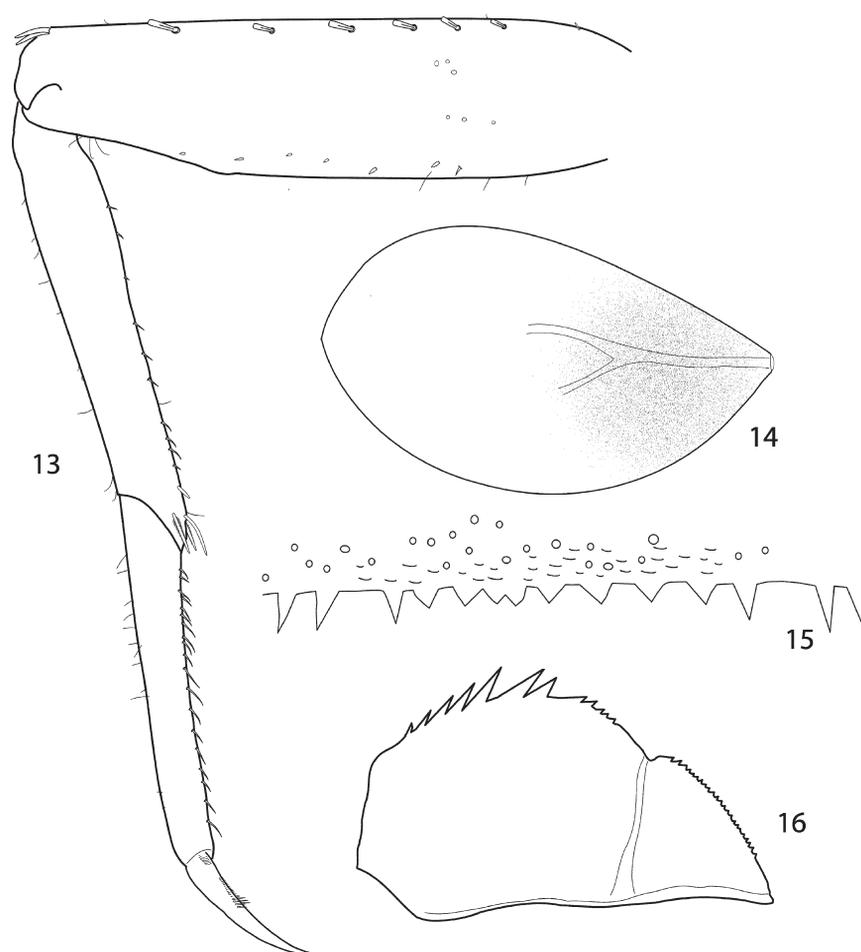
Figs. 5–12. *Adebrotus amazonicus*, nymph. 5. Labrum (left d.v., right v.v.); 6. Hypopharynx (left d.v., right v.v.); 7. Right mandible (d.v.); 8. Right mandible, detail of incisors and prosthema; 9. Left mandible, detail of incisors and prosthema; 10. Left mandible (d.v.); 11. Maxilla (v.v.); 12. Labium (left d.v., right v.v.).

of setae absent; tuft of spine-like setae at base of mola present, wider than mola; tuft of setae at apex of mola present, reduced to a single frayed setae. Lateral margins slightly convex.

Left mandible (Figs. 9 and 10). Incisors cleft, inner set perpendicular to outer set. Inner and outer set of incisors respectively with 5 + 3 denticles. Prosthema robust, apically with two denticles. Margin between prosthema and mola straight; tuft of long and robust setae present; tuft of spine-like setae at base of mola present, but reduced to

few setae; subtriangular process wide, above level of area between prosthema and mola and with a sharp denticle at base; denticles of mola not constricted; tuft of setae at apex of mola present, reduced to a single frayed setae.

Maxilla (Fig. 11). Crown of galea-lacinia with four slender denticles. Inner dorsal row of setae with two bifid and pectinate denti-setae. Medial protuberance of galea with one spine-like seta + four short setae. Maxillary palp long, 1.7 × length of galea-lacinia; setae on maxillary palp long, fine and simple, scattered over surface; palp



Figs. 13–16. *Adebrotus amazonicus*, nymph. 13. Fore leg; 14. Gill IV; 15. Posterior margin of terga IV; 16. Paraproct (d.v.).

segment II $1.2 \times$ length of segment I; apex of last segment pointed.

Labium (Fig. 12). Glossa with regular width along entire length, broader and little longer than paraglossa; $1.1 \times$ length of paraglossa; inner margin with four spine-like setae increasing in length distally; outer margin with seven spine-like setae decreasing in length distally; ventral surface scattered with short, fine, simple setae. Paraglossa curved inward; outer margin with row of eight long, spine-like setae; dorsally without setae; ventrally with four long, fine and simple setae near inner margin. Labial palp with segment I $0.6 \times$ length of segments II and III combined; segment I with scattered few, long, simple setae; segment II without distomedial protuberance; inner margin with scattered long, simple setae; outer margin with many, long, simple setae; dorsally with row of many long, fine and simple setae; segment III conical; length $1.6 \times$ width; covered with many simple setae, specially on outer margin.

Thorax

Yellowish, with brown marks as in Figures 1 and 2.

Hind wing pads absent.

Foreleg (Fig. 13). Yellowish; femur with subapical brown band; tibia and tarsus with median brown band. Ratio of foreleg $1.4:1.0:0.8:0.4$.

Forefemur. Length about $3.4 \times$ maximum width; dorsally with row of 7–8 blunt setae; (length of setae about $0.15 \times$ width of femur); apex rounded with two blunt setae; ventrally with few, short, spine-like setae near margin.

Tibia. Dorsally with row of scarce, short, fine, simple setae; ventrally with row of 11 short, spine-like setae and three long, pectinate setae at apex; tibio-patellar suture present, reaching basal third of tibial length.

Tarsus. Dorsally with scarce short simple setae; ventrally with one row of about 20 spine-like setae; tarsal claw with two rows of denticles, distal ones distinctly longer and increasing in length toward apex.

Mid and hind legs similar to foreleg.

Abdomen

Yellowish with brown marks, segments II, III, V–VII almost entirely washed with brown as in Figures 1 and 2.

Gills (Fig. 14). On segments I–VII. Pigmented at base. Tracheae extending from main trunk to inner margin. Gill I as long as length of segments II to half of III combined; oval. Gill IV subequal in length to segment V; oval. Gill VII as long as length of segment VIII; oval.

Terga (Fig. 15). Surface creased; posterior margin with irregular spines; spines present in posterior margin of segments II–X.

Paraproct (Fig. 16). With 12 marginal spines; postero-lateral extension with minute marginal spines.

Caudal filaments. Yellowish-brown with subapical whitish band. Terminal filament as long as cerci; inner margin of cercus and inner and outer margin of terminal filament with tufts of long, simple setae.

Adults

Unknown.

Distribution

Brazil, Amazonas and Mato Grosso States.

Material examined

Two nymphs, Brazil, Amazonas State, Barcelos, Igarapé do Samaúma, afluente do Rio Demeni, barranco, 09/viii/2009, F.F. Salles col. (one at INPA, one mounted on slides at UFES).

Adebrotus lugoi Salles, sp. nov. (Figs. 3, 4 and 17–28)

Description

Nymph

Length of body: 2.9 mm; cerci: 1.3 mm; terminal filament: 1.3 mm; antennae: 2.6 mm.

Head

Coloration: brownish, except for area around compound eyes, between lateral ocellus and base of antenna, and bellow median ocellus. Antenna whitish.

Frontal keel absent.

Labrum (Fig. 17). Rectangular, broader than long; width $1.9 \times$ length. Dorsal surface flat. Distal margin straight, with small process. Dorsally with long, fine, simple setae scattered over surface; arc of setae restricted to a single medial seta. Ventrally with submarginal row of setae composed of row of spine-like setae; ventral surface without setae.

Hypopharynx (Fig. 18). Lingua shorter than superlingua. Apex convex; with short, fine, simple setae; distal half not expanded. Superlingua not expanded; fine, simple setae scattered over distal margin.

Right mandible (Figs. 19 and 21). Incisors cleft, inner set perpendicular to outer set. Inner and outer set of incisors respectively with $5 + 2$ denticles. Prosthema robust, apically denticulate. Margin between prosthema and mola concave; tuft of setae absent; tuft of spine-like setae at base of mola present, as wide as mola; tuft of setae at apex of mola present, reduced to a single setae. Lateral margins almost straight.

Left mandible (Figs. 20 and 22). Incisors cleft, inner set perpendicular to outer set. Inner and outer set of incisors

respectively with $5 + 3$ denticles. Prosthema robust, apically with two denticles. Margin between prosthema and mola straight; tuft of setae absent; tuft of spine-like setae at base of mola present, but reduced to few setae; subtriangular process wide, above level of area between prosthema and mola and with a sharp denticle at base; denticles of mola not constricted; tuft of setae at apex of mola absent.

Maxilla (Fig. 23). Crown of galea-lacinia with four slender denticles. Inner dorsal row of setae with two dentisetae. Medial protuberance of galea with one spine-like seta + 1 short setae. Maxillary palp long, $1.42 \times$ length of galea-lacinia; two segmented; setae on maxillary palp long, fine and simple, scattered over surface; palp segment II $1.1 \times$ length of segment I; apex of last segment rounded.

Labium (Fig. 24). Glossa with regular width along entire length, as broad as and little longer than paraglossa; $1.1 \times$ length of paraglossa; inner margin with four spine-like setae increasing in length distally, apex with two short, blunt setae; outer margin with five spine-like setae; ventral surface scattered with short, fine, simple setae. Paraglossa curved inward; outer margin with row of 10 long, spine-like setae; dorsally without setae; ventrally with six long, fine, simple setae near inner margin. Labial palp with segment I $0.5 \times$ length of segments II and III combined; segment I with scattered few, long, simple setae; segment II without distomedial protuberance; inner margin with scattered long, simple setae; outer margin with many, long, simple setae; dorsally without row of setae; segment III conical; length 1.0 width; covered with many simple setae, specially on outer margin.

Thorax

Pro- and mesonotum brown with yellowish marks as in Figures 3–4, metanotum entirely brown.

Hind wing pads absent.

Foreleg (Fig. 25). Yellowish; femur with subapical brown band; tibia and tarsus with median brown band. Ratio of foreleg 1.2:1.0:0.7:0.3.

Forefemur. Length about $3.7 \times$ maximum width; dorsally with row of 7–8 blunt setae (length of setae about $0.19 \times$ width of femur); apex rounded; with two blunt setae; ventrally with few, short, spine-like setae near margin.

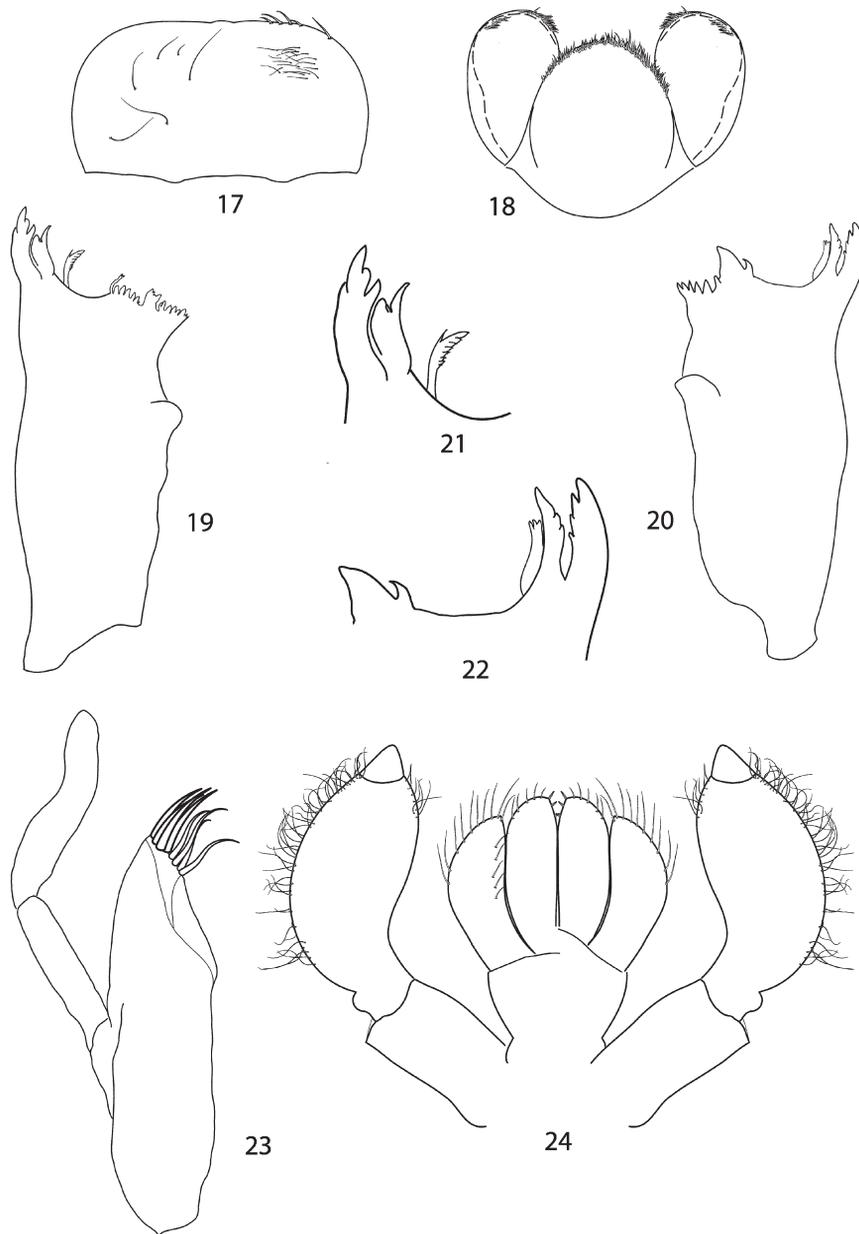
Tibia. Dorsally with row of scarce, short, fine, simple setae; ventrally with row of five short, spine-like setae plus three long, pectinate setae at apex; tibio-patellar suture present, reaching basal third of tibial length.

Tarsus. Dorsally with scarce short simple setae; ventrally with row of 10 short, pectinate, spine-like setae; tarsal claw with one row of 15–17 denticles increasing in size distally.

Mid and hind legs similar to foreleg.

Abdomen

Yellowish with brown marks, distal half of segments I and II, segments III, V–VII almost entirely washed with brown as in Figures 3–4.



Figs. 17–24. *Adebrotus lugoii*, sp. nov., nymph. 17. Labrum (left d.v., right v.v.); 18. Hypopharynx (d.v.); 19. Right mandible (d.v.); 20. Left mandible (d.v.); 21. Right mandible, detail of incisors and prosthema; 22. Left mandible, detail of incisors and prosthema; 23. Maxilla (v.v.); 24. Labium (left d.v., right v.v.).

Gills (Fig. 26). On segments I–VII. Entirely pigmented and creased. Tracheae restricted to main trunk. Gill I reaching half of length of segment III; oval. Gill IV subequal in length to segment V; oval. Gill VII little longer than length of segment VIII; oval.

Terga (Fig. 27). Surface creased; posterior margin with irregular spines; spines present in posterior margin of segments II–X.

Paraproct (Fig. 28). With eight marginal spines; posterolateral extension with minute marginal spines.

Caudal filaments. Brown, with submedian and subapical yellowish band. Terminal filament as long as cerci; inner margin of cercus and inner and outer margin of terminal filament with tufts of long, simple setae.

Adults

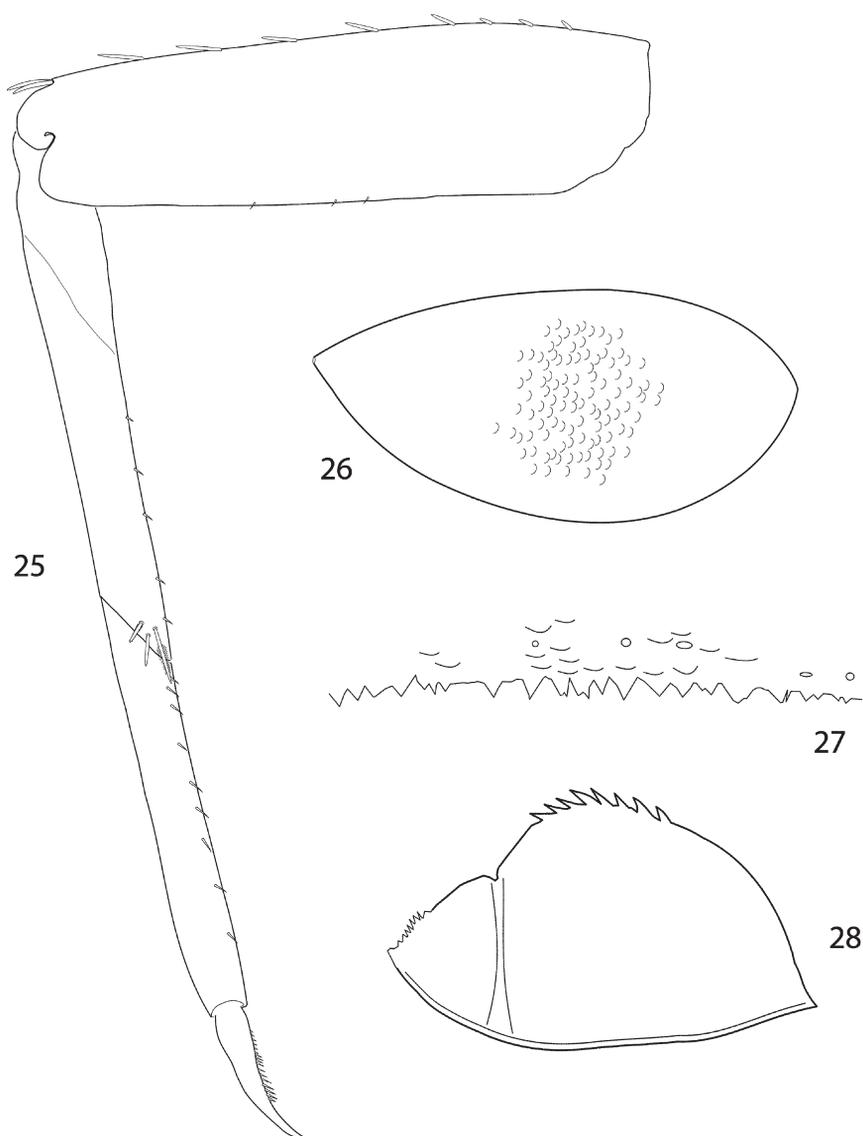
Unknown.

Etymology

I am honored in dedicating this species after Dr. C.R. Lugo-Ortiz, for his constant and pleasant instruction while I was starting to study baetid taxonomy and for his extensive contribution to the knowledge of the family in South America.

Distribution

Brazil, Espírito Santo State.



Figs. 25–28. *Adebrotus lugoi*, sp. nov., nymph. 25. Fore leg; 26. Gill IV; 27. Posterior margin of terga IV; 28. Paraproct (d.v.).

Material examined

Holotype: Nymph in alcohol, Brazil, Espírito Santo State, Sooretama, Reserva Biológica de Sooretama, Córrego Rodrigues, leaf litter, 02/vi/2009, F.F. Salles col. (UFES).

Paratype: Nymph mounted on four slides (medium Euparal), same data as holotype, except for 29/iv/2009 (INPA).

Discussion

Nymphs of *A. amazonicus* and *A. lugoi* can be distinguished by the following characteristics: (1) in *A. amazonicus* the prostheca of right mandible is robust at base, apically pointed and with frayed and slender process at base (Figs. 7 and 8), while in *A. lugoi* the prostheca is more robust, apically denticulate and without any process (Figs. 19 and 21); (2) the margin between

prostheca and mola of left mandible of *A. amazonicus* has long and robust setae (Figs. 9 and 10), these setae are absent in *A. lugoi* (Figs. 20 and 22); (3) the mola is somewhat more reduced in *A. lugoi*, and their denticles are sharp (Figs. 19 and 20), in *A. amazonicus* the denticles are blunt and more numerous (Figs. 7 and 10); (4) gills are pigmented only at base and their surface are not creased in *A. amazonicus* (Fig. 14), whereas in *A. lugoi* they are entirely pigmented and creased (Figs. 3, 4 and 26); (5) tarsal claws may have one (*A. amazonicus*, Fig. 13) or two (*A. lugoi*, Fig. 25) rows of denticles; (6) body color pattern (Figs. 1 and 2). The antenna of *A. lugoi* is very long, almost as long as body. Unfortunately, the antenna of *A. amazonicus* is broken and it is impossible to state if it is a generic or specific characteristic.

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