

Redescription of the adults and description of the larvae and eggs of *Oligoneurioides amazonicus* Demoulin (Ephemeroptera: Oligoneuriidae)

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Abstract

The male adults of the genus *Oligoneurioides* and its type species, *O. amazonicus*, are redescribed. The female, larva, and egg are described for the first time and the distribution of the genus is extended. Notes on the biology of the larvae are also provided. The main characters that can be used to distinguish the genus and species from the other members of the family are: adults with (1) ventral portion of head concealed by a membranous extension of the frons; (2) vein IMP of forewings absent; (3) cross veins restricted to spaces between C and Sc, R₁ and R₃; and (4) penis lobes sclerotised, apically curved. Larvae with (1) head strongly projected anteriorly; (2) mid and hind episterna and epimera projected laterally; (3) prominent posterolateral projections on segments II–IX. Eggs polygonal in shape, polar caps absent and surface adorned with circular rugose protuberances.

Keywords: *Oligoneurioides*, redescription, Neotropics, Brazil

Introduction

Demoulin (1955), in a paper dealing with several mayflies (Ephemeroptera) from southern and northern Brazil, described *Oligoneurioides amazonicus* Demoulin, 1955, a new genus and species of Oligoneuriidae. The description was based on two male adults examined by him, and two additional specimens (one male and one female adult) formerly treated by Eaton (1883) erroneously as *Oligoneuria anomala* Pictet, 1843.

In the same work, Demoulin (1955) also described an enigmatic larva of Oligoneuriidae which possessed a long dome-shaped frons extending anteriorly. This larva, described for the first time by Spieth (1943) as the unknown immature stage of *Oligoneuria* Pictet, 1843, was assigned by Demoulin (1955) as *Spaniophlebia* Eaton, 1881, another genus with unknown larvae. Later, Koss and Edmunds (1970) suggested that these larvae could not belong to

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Spaniophlebia. Since then, no other works have treated this larva, and its identity remained unclear (e.g. Domínguez et al. 2006).

Recently, on collecting trips in several areas of Brazil's Amazon Region and southern Mato Grosso State, numerous Oligoneuriidae larvae of that type, with well projected dome-shaped frons, were found. We also rediscovered male and female adults of *O. amazonicus*. These adults, besides sharing the same abdominal colour pattern as these larvae, have a membranous frons extension so long that it covers entirely the ventral portion of their heads. One dissected male mature larva, with the genitalia of the subimago fully developed, leaves us in no doubt that they belong to the same genus and species. Therefore, the aim of the present paper is to redescribe the adults of *O. amazonicus*, formally describe the larvae of the genus and the species, and describe their eggs for the first time. As a result of this study, larvae of *Oligoneuria* and *Spaniophlebia* remain to be described.

Material and methods

Material was preserved in 80% ethanol. Body parts of larvae and adults were mounted on microscope slides in euparal or glycerin and drawn with a camera lucida attached to a stereomicroscope. Eggs were extracted from a mature larva, dehydrated in a graded ethanol series, dried by critical point-method, and mounted on SEM stubs and sputter coated with gold; then observed and photographed with Leo VP 1430 scanning electron microscope. Terms used in descriptions of thorax are from Kluge (1994). Material deposition is abbreviated as follows: Invertebrate Collection of the Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil (INPA), Instituto-Fundación Miguel Lillo, Tucúman, Argentina (IFML), Entomological Collection of the Museu Paraense Emílio Goeldi, Belém, Brazil (MPEG), and James Alexander Ratter Zoobotanic Collection of the Universidade do Estado do Mato Grosso, Nova Xavantina, Brazil (UNEMAT).

Taxonomy

Oligoneurioides Demoulin, 1955 (Figures 1–30)

Oligoneurioides Demoulin, 1955, p. 24.

Type species. *Oligoneurioides amazonicus* Demoulin, 1955 (original designation).

Included species. *Oligoneurioides amazonicus* Demoulin, 1955.

Distribution. Northern and Central Western Brazil (Figure 1).

Imago

Length of male: body 5.9–9 mm; forewing 6.5–9 mm. Length of female: body 7.5–8.8 mm; forewing 7.3–8.0 mm.

Head. Eyes of male widely separated on meson of head by a length approximately equal maximum width of an eye. Antennae broken-off. Ventral portion of head concealed by a membranous extension (Figure 5).

Thorax. Width of pronotum 0.3 times length. Mesoescutellum with short membranous filaments.

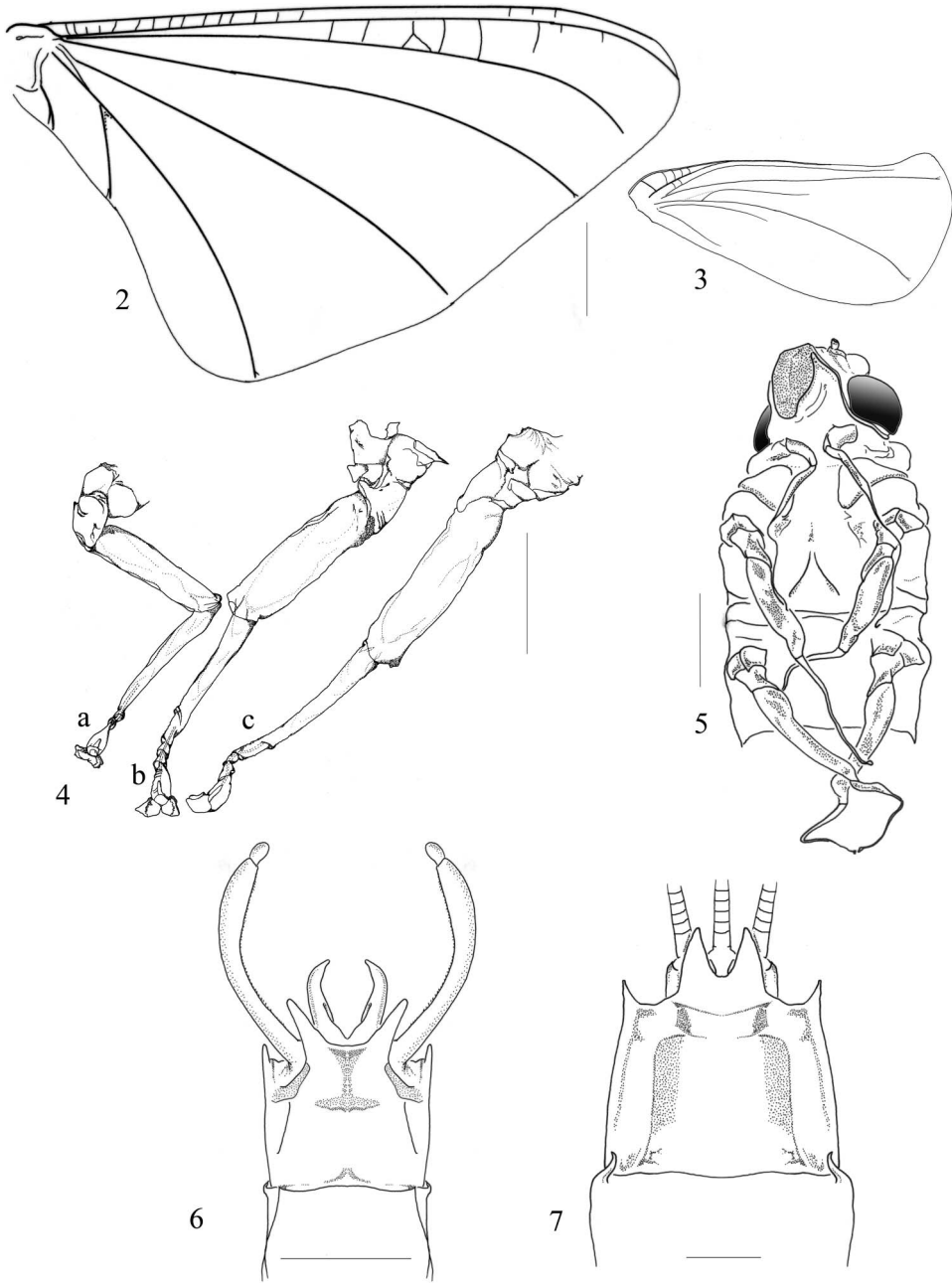


Figure 1. Geographic distribution of *O. amazonicus* in Brazil (differences in colouration indicate Brazilian States).

Wings. Membrane of fore and hind wings covered with microtrichia. Hind wings 0.5 times as long as forewings. Maximum width of forewings of female slightly more than 0.5 times maximum length. Forewings (Figure 2) with cross veins restricted to spaces between C and Sc, R₁ and R₃; hind wings (Figure 3) without cross veins; vein IMP of forewings absent; MA of hind wings unforked.

Legs. Ratios of segments in male forelegs: 0.98: 1.00 (1.0 mm): 0.17: 0.13: 0.20; forelegs 0.9 times the length of mid and hind legs (Figure 4); tibiae of mid and hind legs membranous; claws similar, blunt. Legs of females with tibiae and tarsi atrophied and twisted, femora well developed (Figure 5).

Abdomen. Posterolateral spines present on abdominal segments II–IX, twisted on segments II–VII, sometimes VIII; more developed on segment IX.



Figures 2–7. *Oligoneurioides amazonicus*, adult. (2) Forewing (female). (3) Hind wing (female). (4) Legs of male (a, foreleg; b, mid leg; c, hind leg). (5) Head and thorax of female (ventral). (6) Male genitalia (ventral). (7) Female sternum IX (ventral). Scales bars: 2–5, 1.0 mm; 6–7, 0.5 mm.

Male genitalia (Figure 6). Width of styliger plate 1.15 times maximal length; apex with long posterolateral projections inserted in a somewhat trapezoidal membranous base. Forceps with segment I 10 times length of segment II; 2/3 of segment I covered medially with setae.

Posterior margin of sternum VII of female shallowly concave; sternum IX posteromedially extended and broadly cleft (Figure 7).

Caudal filaments. Male: terminal filament and cerci subequal in length, apical 2/3 of caudal filaments with whorls of long setae on articulations. Female: caudal filaments broken-off and lost.

Mature larva (Figure 8)

Length of male body 11 mm. Length of female body 10.3–12 mm.

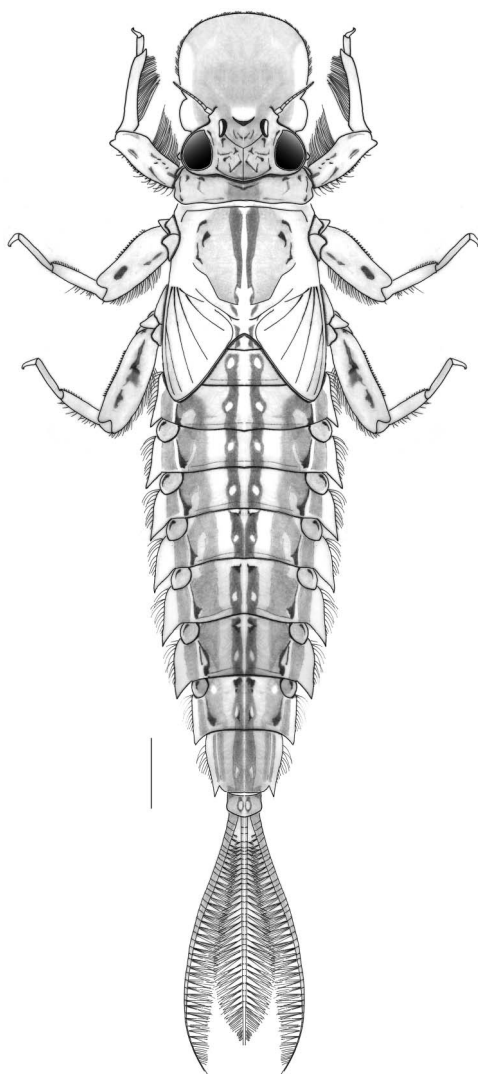
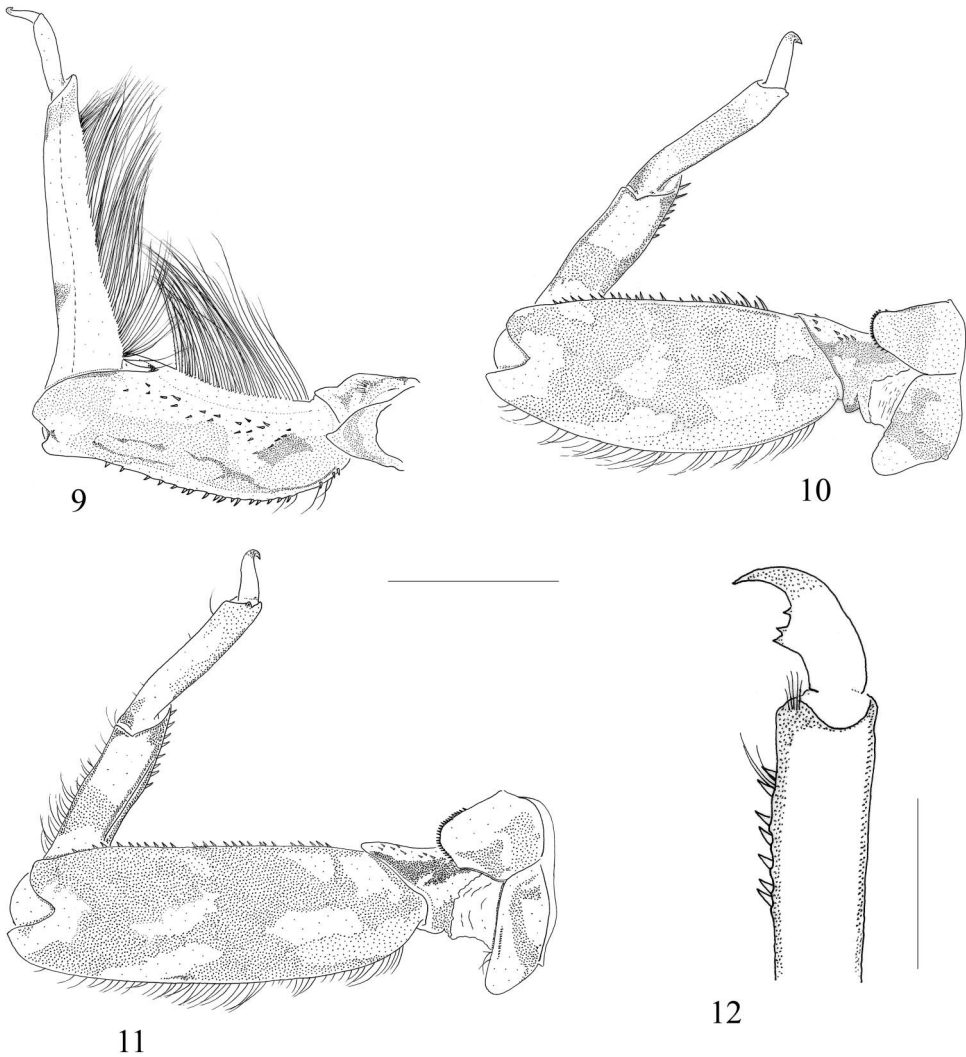


Figure 8. *Oligoneurioides amazonicus*. Dorsal view of larva. Scale bar: 1.0 mm.

Head. Prognathous, strongly extended anteriorly; anterior and lateral margins of extension covered ventrally with dense setae. Antennae inserted in front of eyes. Mouthparts typical of remaining oligoneuriid genera (Figures 15–20).

Thorax. Width of pronotum 4.2 times its length. Legs (Figures 9–11): foretarsi developed; forecoxae and foretrochanters subequal in length; trochanters and coxae on hind legs subequals; mid and hind tarsi 0.9 length of tibiae; tarsal claws hooked and denticulate, 1–2 subbasal denticles (Figures 12 and 23). Mid and hind episterna and epimera projected laterally. Coxae of mid and hind legs with a ventral patch of setae (Figure 24). Metasternum medially with two patches of dense setae.



Figures 9–12. *Oligoneurioides amazonicus*, larva. (9) Foreleg. (10) Mid leg. (11) Hind leg. (12) Hind tarsi. Scales bar: 9–11, 1.0 mm; 12, 0.5 mm.

Abdomen. Posterolateral spines on segments II–IX, all bordered externally with long setae. Terga and sterna with setae.

Gills. Gill I ventral, tufts multibranched, lamellae absent; gills II–VII dorsal, tufts present and branched, lamellae circular.

Sternum II–VI with posterior area of dense setae, this area may be separated medially on the last segments (Figures 25 and 26). Sternum IX posteromedially extended and broadly cleft (Figure 27). Terminal filament 5/6 as long as cerci, both with long setae throughout entire length, except for basal 1/5, bare.

Eggs (Figures 28–30)

Length: 200 μm . Maximum width: 176 μm . Polygonal, polar cap absent. Egg surface adorned with circular rugose protuberances.

Diagnosis

This genus can be distinguished from the other genera of the family by the following combination of characters.

In the adults: (1) ventral portion of head concealed by a membranous extension of the frons (Figure 5); (2) vein IMP of forewings absent (Figure 2); (3) cross veins restricted to spaces between C and Sc, R₁ and R₃ (Figure 2); (4) hind wings without cross veins (Figure 3); (5) genital forceps present (Figure 6); (6) penis sclerotised, apically curved (Figure 6); (7) apex of styliger plate with long posterolateral projections (Figure 6); and (8) sternum IX of female posteromedially extended and broadly cleft (Figure 7).

In the larvae: (1) head strongly projected anteriorly (Figures 8, 13 and 14); (2) mid and hind episterna and epimera projected laterally (Figure 8); (3) tarsal claws well developed, hooked and denticulate, 1–2 subbasal denticles (Figures 12 and 23); (4) gill lamellae on segments II–VII circular (Figure 8); (5) prominent posterolateral projections on segments II–IX (Figures 8 and 25); and (6) terminal filament about as long as cerci (Figure 8).

In the egg: polygonal in shape, polar caps absent. Egg surface adorned with circular rugose protuberances (Figures 28–30).

Comments

Eaton (1883) and Demoulin (1955) illustrate a 4th tarsal segment in the male foreleg. This is not visible in the specimens we studied, but the segmentation is more complex than indicated by these authors, and segments are twisted making more than one interpretation possible.

***Oligoneurioides amazonicus* Demoulin, 1955**

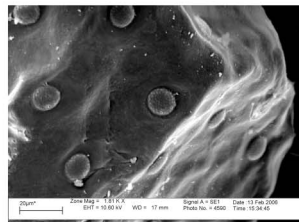
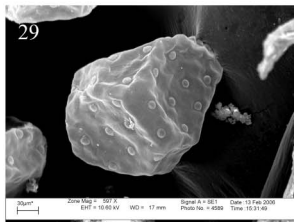
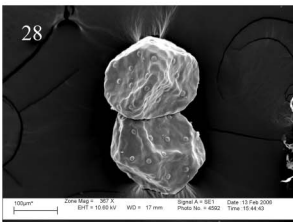
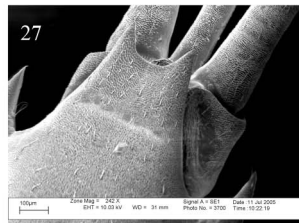
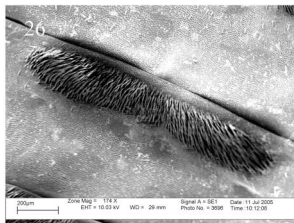
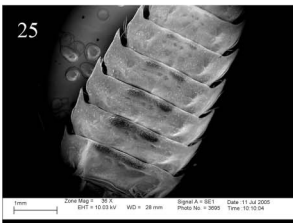
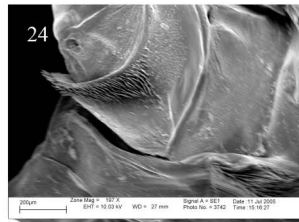
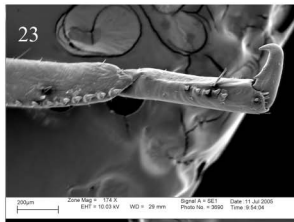
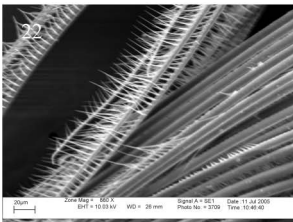
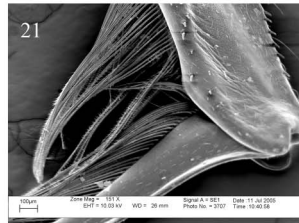
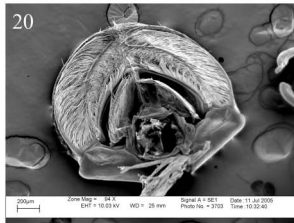
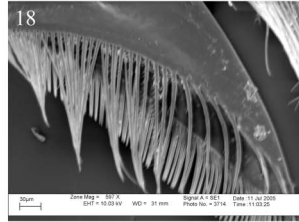
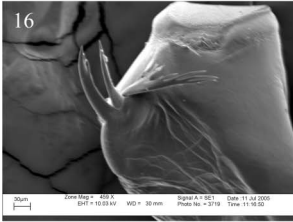
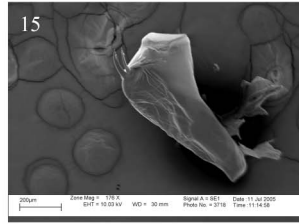
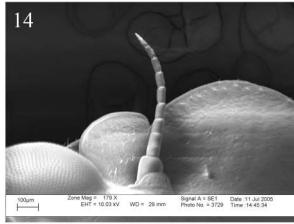
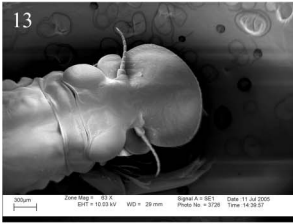
Oligoneurioides amazonicus Demoulin, 1955, p. 24; Hubbard, 1982, p. 269; Kluge, 2004, p. 146; Domínguez et al., 2006, p. 552.

Oligoneuria anomala; Eaton, 1883, p. 30 non Pictet.

Spaniophlebia larva; Demoulin, 1955, p. 27.

Material examined

Brazil, Mato Grosso state, Pontes e Lacerda County, Guaporé River (15°12'S, 59°21'W), N. Hamada, 20/vii/2004, 1 larva (INPA); **Nova Xavantina County**, Rio Taquaral, F.F. Salles &



H.S.R. Cabette, 10/i/2006, 10 larvae (UNEMAT); **Água Boa County**, Rio Forquilha, H.S.R. Cabette, 26/vi/2000, 2 ♀ (UNEMAT); **Água Boa County**, Rio Forquilha, H.S.R. Cabette, 17/x/2000, 2 ♂ (UNEMAT). **Pará state, Tucuruí County**, Chiqueirão Camp, B.M. Mascarenhas, 10/iv/1984, 10 ♂ (MPEG). **Roraima state, Bonfim County**, Raia stream (03°21'N, 59°54' W), N. Hamada & F.F. Salles, 20/x/2004, 6 larvae (INPA); **Caracarái County**, Rio Branco River, Cachoeira Bem-Querer (01°55' N, 61°00' W), N. Hamada, 15/xii/2000, 1 larva (IFML); **Boa Vista County**, Cauamé River (03°01'N, 61°08'W), N. Hamada, 24/x/2001, 1 larva. **Maranhão state, Carolina County**, Itapecuru River, above waterfall (07°24'S, 47°12'W), N. Hamada, 15/xi/2000, 4 larvae (INPA); Polme road, Barrolândia, Urupuxete River, N. Hamada, 12/viii/2001, 1 larva (INPA); São Brás (07°03'S, 47°16'W), N. Hamada, 16/xi/2000, 4 larvae (IFML); Marajá stream (07°11'S, 47°23'W), N. Hamada, 13/xi/2000, 4 larvae (INPA); Itapecuru River, above the bridge (07°24'S, 47°12'W), N. Hamada, 07/viii/2001, 1 larva (INPA). **Rondônia state, Porto Velho County**, Mutum River (above the bridge) (09°39'S, 64°56'W), N. Hamada, R.L.M. Ferreira, J.O. Silva, 08/vi/2004, 1 larva (IFML); Jaci-Paraná River (before the entrance of Branco River) (09°18'S, 64°25'W), N. Hamada, R.L.M. Ferreira, J.O. Silva, 10/vi/2004, 2 larvae (INPA); Jaci-Paraná River (after Branco River) (09°31'S, 64°21'W), N. Hamada, R.L.M. Ferreira, J.O. Silva, N. Rondônia, 10/vi/2004, 1 larva (INPA); Branco River (right bank tributary of Jaci-Paraná River) (09°26'S, 64°20'W), N. Hamada, R.L.M. Ferreira, J.O. Silva, 10/vi/2004, 4 larvae (INPA).

Male imago

General colouration yellowish brown and grey.

Head. General colouration yellowish brown, with blackish band along anterior and lateral margins, and with grayish marks on vertex; inner margin of pedicel brownish, remaining parts of antennae whitish. Eyes black. Ocelli transparent.

Thorax. Pronotum yellowish brown suffused with grey; mesonotum yellowish brown, anterior margin and basal 1/3 of mesoscutum, margins of submesoscutum and scutal posterior protuberance marked with grey; metanotum pale yellow suffused with grey; pro and metasterna transparent, mesosternum yellowish brown.

Wings. Wing membrane light grey; longitudinal and cross veins purplish gray.

Legs. Femora yellowish brown strongly suffused with gray. Tibiae and tarsi whitish.

Abdomen. Terga grayish brown, anterior and posterior margins of segments I–VII whitish; terga I–VIII with two pairs of submedian marks, anterior pair darker and surrounded with black, posterior pair light grey; terga VIII–X yellow brown suffused with grey; posterolateral projections darker. Sterna light gray. Sterna VIII–X yellow brown suffused with grey, posterolateral extensions of styliiger plate whitish. Forceps and caudal filaments whitish grey.

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Figures 13–30. *Oligoneurioides amazonicus*. SEMs of larvae and eggs. (13) Dorsal view of larval head. (14) Detail of dorsal view of larval head. (15) Left mandible. (16) Detail of left mandible, showing incisors and protheca. (17) Maxilla. (18) Detail of galea-lacinia. (19) Labium (ventral). (20) Labium (dorsal). (21) Detail of foreleg. (22) Detail of setae on the inner margin of foreleg. (23) Detail of hind tarsi and claw. (24) Detail of mid coxa, showing ventral patch of dense setae. (25) Abdominal sterna II–VII. (26) Detail of abdominal sternum IV showing ventral patch of dense setae. (27) Sternum IX of female. (28) Eggs. (29) Eggs. (30) Detail of egg surface.

Female imago

Similar to male imago, except for: general colouration darker; tibiae suffused with grey; wings with longitudinal and cross veins yellowish; and abdominal colouration. Terga yellowish, with two submedian longitudinal brown bands connected to each other by a transversal brown band.

Mature larva

General colouration brown (Figure 8).

Head. Brown, suffused with dark brown and with whitish and irregular dark brown marks. Ocelli whitish, inner margins blackish. Eyes black. Antennae pale yellow.

Thorax. Nota brown; pronotum with a median blackish mark and a pair of lateral brownish marks; mesonotum with a pair of median longitudinal brown band, and irregularly marked with dark brown. Sterna yellowish brown. Legs (Figures 9–11) yellowish, femora of all legs, especially mid and hind legs, washed with brown median marks as in Figures 8–11; tibiae of all legs yellowish, with subbasal and apical brown transverse band; mid and hind tibiae with inner margins brownish; tarsal claws yellowish, apically brown; inner margin of mid and hind tarsi with 5–7 and 7–8 heavy spines, respectively.

Abdomen. Colour pattern of terga similar to female imago, except general colouration brown and lateral margins of all segments yellowish white. Sterna yellowish brown. Gills brown. Caudal filaments light brown, apically whitish.

Diagnosis

As this genus remains monospecific, those characters used in the generic section should also be used for specific diagnosis.

Biology

This species was found in a wide range of habitats in the North (Roraima, Mato Grosso and Rondônia states) and Northeast (Maranhão state) region of Brazil. Larvae were collected in watercourses located in areas covered with rain forest (Mato Grosso and Rondônia states) and Savanna (Roraima, Mato Grosso, and Maranhão states) vegetation types. Specimens collected in Savanna were found in smaller streams, with width varying from 2 to 20 m, while those collected in the Rain forest were collected in larger rivers, with width varying from 20 m to more than 50 m. Water temperature varied from 20 to 30°C, pH from 5.8 to 7.8 and electrical conductivity below 10–30 $\mu\text{S}/\text{cm}$. Larvae used submerged leaves and roots from marginal vegetation as substrate, located in areas with high water velocity.

Acknowledgements

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