



A new species of *Asthenopus* (Ephemeroptera: Polymitarcyidae: Asthenopodinae) from Brazil and Colombia

CARLOS MOLINERI¹, PAULO VILELA CRUZ² & DANIEL EMMERICH³

¹CONICET, Instituto de Biodiversidad Neotropical, Facultad de Ciencias Naturales e IML, M. Lillo 205, San Miguel de Tucumán, 4000, Tucumán, Argentina, UNASUR. E-mail: cmolineri@csnat.unt.edu.ar

²Universidade Federal do Amazonas - UFAM, Av. General Rodrigo Octávio Jordão Ramos, 3000, Campus Universitário, Coroado I, Manaus, Amazonas, Brasil. Programa de Pós-graduação em Entomologia, Instituto Nacional de Pesquisas da Amazônia (INPA), CEP 69060-001, Manaus, Amazonas, Brazil. E-mail: pvilelacruz@gmail.com

³Sección Entomología, Facultad de Ciencias, PEDECIBA, Universidad de la República, Montevideo, Uruguay. E-mail: danielommerich07@gmail.com

Abstract

A new species of *Asthenopus*, *A. crenulatus* sp. nov. is described from adults of both sexes from Brazil and Colombia. The new species is diagnosed by: male foreleg length 0.7–0.9 times the length of fore wing, marginal intercalary veins on the entire margin of fore and hind wings generally shorter than distance between longitudinal veins, forceps and penes long and slender, penes with many subapical spines. This new species is closely related with *A. picteti* (Hubbard). A key to the male adults of *Asthenopus* is included.

Key words: burrowing mayfly, Ephemeroidea, *Asthenopus picteti*, taxonomy

Introduction

Asthenopus is the only Neotropical member of Asthenopodinae (Polymitarcyidae), and currently three species are known in this genus (Domínguez *et al.* 2006): *A. curtus* (Hagen) known from adults of both sexes and nymphs from Brazil, *A. gilliesi* Domínguez and *A. picteti* (Hubbard) both known from male imagos from Uruguay. Before 1988, species in *Asthenopus* were included in two genera: *Asthenopus*, established by Eaton and *Asthenopodes*, established by Ulmer. Both genera were distinguished by length of legs, wing venation and shape of the male genitalia (Ulmer, 1924; Traver, 1956). In 1988, Domínguez described *A. gilliesi*, with intermediate characters between *Asthenopus* and *Asthenopodes*, raising questions about their taxonomic status. Hubbard & Domínguez (1988) synonymized these genera since no clear generic distinction could be observed in the adults and all the Neotropical nymphs known at this moment presented a very similar morphology.

The nymphs of Asthenopodinae are characterized by their stout mandibular tusks, used to burrow in submersed wood and other plant tissues. *Asthenopus* nymphs had been reported in rotten wood and in soft tissues of live *Thypha* and *Eichornia* (Sattler 1967, Berner 1978).

The aim of the present contribution is to describe a very distinctive new species, from adults of both sexes, collected in the Amazonas state in Brazil and Colombia.

Material and methods

Morphological terms and descriptions follow standard methodology for the group (Domínguez *et al.* 2006). Material is preserved in 96° alcohol, dissected parts are mounted on Canada Balsam except wings, mounted dried. Pictures were taken with an Axion Vision Camera (AxioCamICc1) coupled to a Zeiss stereomicroscope (Discovery V12) and Olympus DP72 Camera coupled to a Olympus microscope BX51, the pictures were combined by free

software CombineZP. Measures used for the calculation of the ratios of forceps and wings are indicated in the figures. The material is housed in IML (Instituto Miguel Lillo, Tucumán, Argentina), INPA (Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil) and MUSENUV (Museo de la Universidad del Valle, Cali, Colombia).

Results

Asthenopus crenulatus sp. nov.

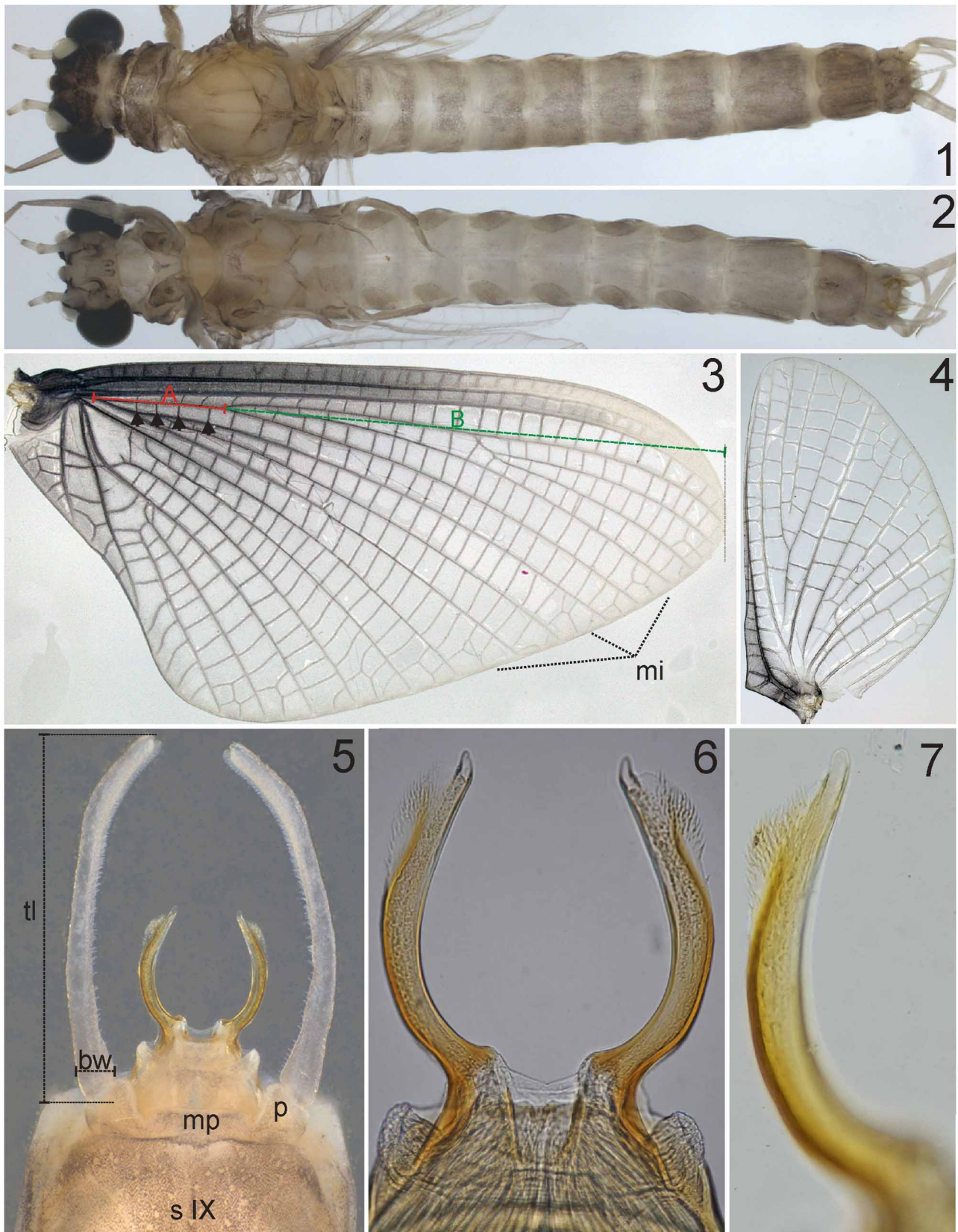
Male imago (Figs. 1–7). Length (mm): body, 7.0–7.8; fore wing, 7.5–8.6; hind wing, 3.1–3.7; fore leg (from coxa to apex of claw), 6.2–6.9; cerci, 21.6. General coloration yellowish white. Head (Figs. 1–2) brownish dorsally except small pale median mark on hind margin, tinged black at base of antennae and on a triangle between ocelli; ventrally much paler, with blackish markings. Antennae yellowish shaded slightly with gray on apex of scape and pedicel, flagellum hyaline; scape and pedicel long and slender, scape (0.23 mm) slightly longer than pedicel (0.18 mm), flagellum long, reaching hind margin of pronotum. Thorax (Figs. 1–2). Pronotum and propleurae translucent yellowish completely shaded with brown, darker on anterior ring, and lateral and hind margins of posterior ring; a narrow pale sinuous strip separates anterior and posterior rings; presternum pale. Mesonotum yellowish shaded gray on sutures mainly between posteroscutal protuberances; mesopleurae and sternum slightly paler with gray shading on anterior half. Metanotum yellowish shaded gray medially, pleurae and sternum paler, translucent. Legs. Forelegs similar in length to body, 0.7–0.9 times the length of the forewing; coxa, trochanter and femur yellowish brown, rest translucent yellowish, shaded gray almost completely but lighter apically. Length (mm) of foreleg segments (mean of two males): femur (0.79), tibia (1.59), tarsite 1 (0.1), tarsite 2 (1.22), tarsite 3 (0.92), tarsite 4 (0.81), tarsite 5 (0.66), longer claw (0.38), shorter claw (0.22). Middle and hind legs with long coxae and trochanters; femora, tibiae and tarsi very reduced and membranous; both legs yellowish, shaded with gray mainly on a basal spot of hind coxa and distal mark on hind femur. Wings (Figs. 3–4). Membrane hyaline except on costal and subcostal sector of fore and hind wings, grayish, sometimes whitish apical half; all veins yellowish brown; short marginal intercalaries (mi in Fig. 3) attached along entire hind margin of both wings. Three to four crossveins between R and M sectors basally to R stem (arrows in Fig. 3). Ratio Rs length from fork to margin (B in Fig. 3)/stem length (A in Fig. 3) = 4. Ratio MA length from fork to margin/stem length, range 9 to 11. Abdomen (Figs. 1–2) whitish translucent shaded very slightly with brownish gray on dorsum, sterna paler; tergum X shaded stronger on three longitudinal marks (one median, two sublateral) and margins. Genitalia (Figs. 5–7): forceps whitish translucent, penes yellowish; pedestals (p in Fig. 5) relatively short, well separated from each other by a subrectangular median plate (mp in Fig. 5); forceps relatively long and slender, with setae on inner margin increasing in number distally, apex curved medially (Fig. 5); base of penes well developed, penean arms cylindrical, curved medially, and with many spines subapically on outer margin (Figs. 6–7). Cerci whitish; terminal filament very reduced, straight, with 6 thin annuli.

Female subimago (Figs. 8–13). Length (mm): body, 10.2–10.8; fore wing, 11.1; hind wing, 4.3. General coloration yellowish light brown. Head (Figs. 8–9) dorsally blackish except on median zone, paler; venter of head yellowish white. Antennae light yellowish, shaded gray on apex of scape and pedicel. Thorax (Figs. 8–9) yellowish brown with blackish membranes, shaded with brownish gray on pronotum and with black on posteromedian marks on meso- and metanotum. Legs whitish yellow shaded brownish on dorsum. Wings (Figs. 10–11), membrane slightly tinged with light brown, veins brownish; costal and subcostal sector of fore and hind wings, grayish, sometimes apical half of costal and subcostal sector of forewing whitish; forewing with four longitudinal intercalary veins between R₂ and R₃. Abdomen (Figs. 8–9). Terga yellowish shaded with brownish gray; sterna whitish yellow with anteromedial longitudinal brownish line and two reddish brown spots medially; sternum VIII (Fig. 12) with paired anteromedial sockets, sockets small, shallow and contiguous (so in Fig. 13). Terminal filament whitish, shorter than tergum VIII, with 6 thin annuli; cerci yellowish brown paler apically, 0.5–0.6 times the length of the abdomen.

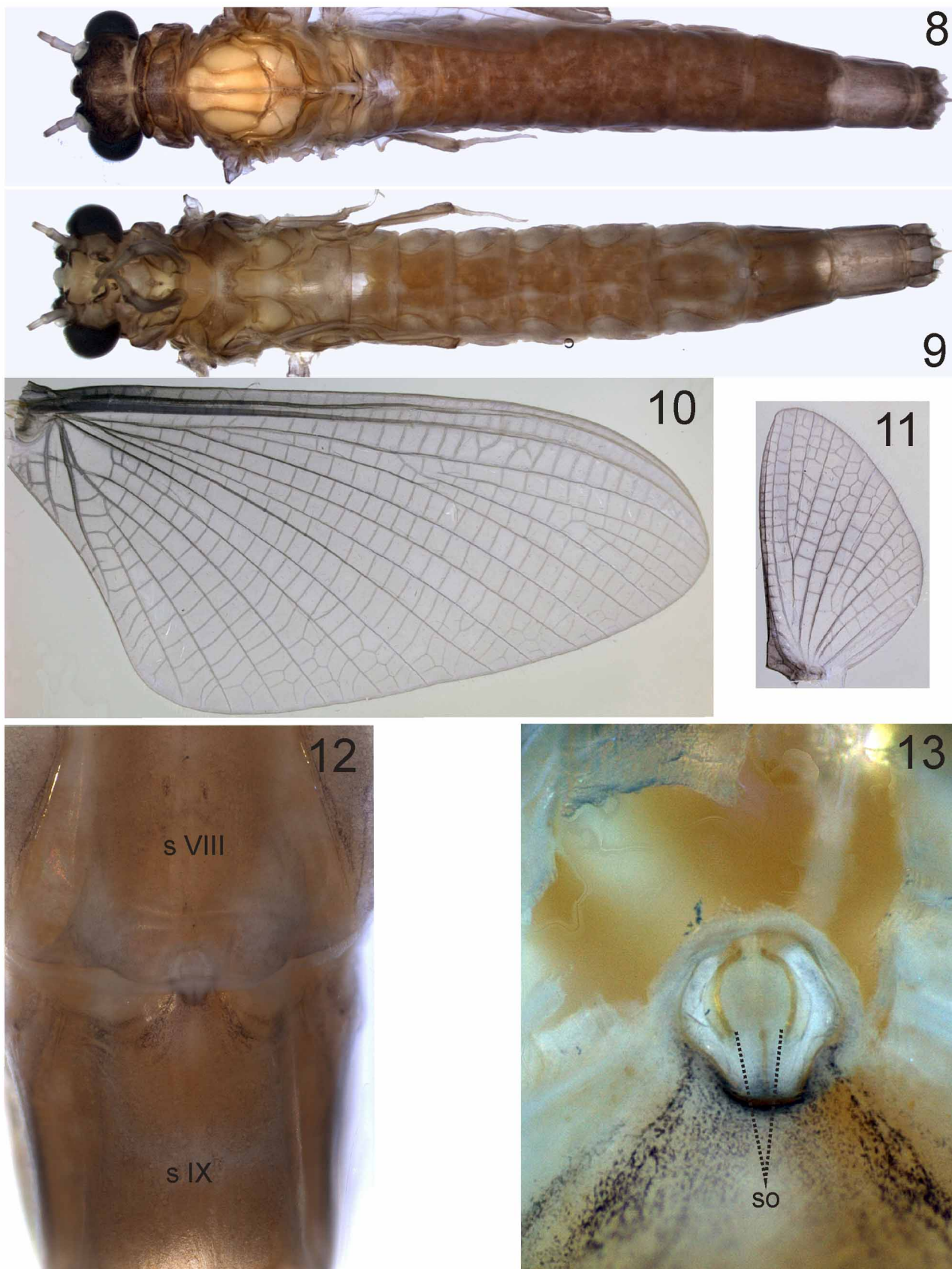
Eggs. Length, 221–266 µm; width, 143–152 µm. Slightly oval; yellow with two polar caps on apices, each formed by a long coiled filament; no chorion microsculptures visible at 100X.

Nymphs. Unknown.

Remarks. The differences between male imago and subimago are limited to length of forelegs, forceps and cerci. The penes of imago and subimago are similar, allowing the identification in both stages.



FIGURES 1–7. *Asthenopus crenulatus* sp. nov. Male imago. 1, body, d.v. (= dorsal view); 2, body, v.v. (= ventral view); 3, forewing; 4, hind wing; 5, genitalia, v.v.; 6, penes; 7, detail of penes. Abbreviations: bw = basal width; mi = marginal intercalaries; mp = median plate of styliger; p = pedestal; s IX = sternum IX; tl = total length.



FIGURES 8–13. *Asthenopus crenulatus* sp. nov. Female subimago. 8, body, d.v. (= dorsal view); 9, body, v.v. (= ventral view); 10, forewing; 11, hind wing; 12, abdominal sterna VIII–IX; 13, detail of sockets. Abbreviations: so = sockets; s VIII, s IX = sterna VIII and IX. d.v.

Etymology. From Latin *crenulatus* meaning "minutely crenated", because of the remarkable penile structure (Figs. 5–7).

Diagnosis and discussion. *Asthenopus crenulatus* sp. nov. can be distinguished from the other species of the genus by the following combination of characters: 1) male foreleg with large and apically widening tibia, first tarsite partially fused to second tarsite, foreleg length 0.7–0.9 times the length of forewing; 2) marginal intercalary veins present on the entire margin of fore and hind wings (Figs. 3–4, 10–11), generally shorter than distance between longitudinal veins in male (Figs. 3–4), but longer and anastomosed in female (Figs. 10–11); 3) basal relation of forewing veins IMP-MP₁ variable (IMP joined to MP₁, or basally free); 4) forewing with 3 to 4 crossveins between Rs and MA basal to Rs fork; 5) ratio total length/basal width of forceps 8.5–9.0 (tl/bw in Fig. 5); 6) penes long and slender, outer apical margin with many small spines (Figs. 6–7).

Asthenopus crenulatus is more closely related with *A. picteti* (Hubbard) than to other species of the genus. The characters shared by both species include the relatively slender forceps and penes and the relatively long male forelegs. Both species can be easily distinguished by the larger size (forewing length, 12 mm), and absence of subapical penile spines in *A. picteti*. Furthermore, the extremely specialized foretibial-tarsal joint and apically enlarged foretarsal claws of *A. picteti* (Traver 1956) are absent in the new species, that shows the common states for these characters (tarsite 1 not fused with tibia, and claws widening slightly on the apex).

Female adults are only known for *A. curtus* (Berner 1978) and an undetermined species from Uruguay ("*Asthenopodes* sp." in Traver 1956) but sockets on the VIII sternum were not known to occur in the genus until now. These structures were studied by McCafferty and Bloodgood (1989) in a species of *Tortopsis* and recently described for females of *Tortopus* (Molineri 2010). They are supposed to function as part of the coupling apparatus during copula.

Material. Holotype male from BRAZIL: AM 240, Ramal Paulo Freire, Sitio os Pioneiros, Km-05, Presidente Figueiredo, Amazonas, 94 m, 24.iv.2008, S 2° 4' 5" – W 59° 54' 28.8", light trap, N. Hamada col.. Paratypes: 1 male imago and 3 male subimagos same data as holotype; 1 male imago (wings and genitalia on slide), 9 male subimagos, and 4 female subimagos from BRAZIL: AM 240 - Km 21: Sitio da Corredeira Santo Amaro, Presidente Figueiredo, Amazonas, 112 m, 21.iv.2008, S 2° 2' 21.4" – W 59° 50' 43.9", light trap, N. Hamada col.; and 1 male imago (wings and legs on slide) from COLOMBIA-BRAZIL: Reserva Natural Palmarí, río Yavarí, Muelle Centro Administrativo, 120 m, 29.v.2002, S 4° 17' 10" – W 70° 17' 49", light trap, M. C. Zúñiga, D. Emmerich, R. Zúñiga and A. Zúñiga col. The paratype male imago from river Yavarí is deposited in MUSENUV, one male imago and one female subimago (paratypes) from Brazil are deposited in IML, the remaining material (holotype and paratypes) in INPA.

Key to the male imagos of *Asthenopus*

- | | | |
|------|---|------------------------------|
| 1 | Fore legs 0.73 × or less the length of forewings; penes broad at base, sometimes narrowing apically | 2 |
| - | Fore legs 0.8 × or more the length of forewings; penes slender from base to apex | 3 |
| 2(1) | Fore legs of male 0.50–0.55 × the length of forewings; marginal intercalary veins of fore wings usually as long as or longer than distance between longitudinal veins | <i>Asthenopus gilliesi</i> |
| - | Fore legs of male 0.60–0.73 × the length of forewings; marginal intercalary veins of fore wings usually shorter than distance between longitudinal veins | <i>Asthenopus curtus</i> |
| 3(1) | Medium sized species (forewing 12 mm); penes without apical crenulations | <i>Asthenopus picteti</i> |
| - | Small species (forewing 7.5–8.6 mm); penes with subapical crenulations. | <i>Asthenopus crenulatus</i> |

Acknowledgements

We wish to thank M. C. Zúñiga for the loan of the Colombian specimen, and to Eduardo Domínguez and an anonymous reviewer for comments on the manuscript. PVC thanks financial support provided by research projects "Insetos aquáticos: biodiversidade, ferramentas ambientais e a popularização da ciência para melhoria da qualidade de vida humana no Estado do Amazonas" PRONEX-CNPq-FAPEAM and INPA (MCT). CM thanks financial support from CONICET (PIP 1484).

References

- Berner, L. (1978) The status of *Asthenopus curtus* (Hagen) (Ephemeroptera: Polymitarcyidae). *Acta Amazonica*, 8, 103–105.
- Domínguez, E. (1988) *Asthenopus gilliesi* sp. n. y su importancia en la taxonomía de la subfamilia Asthenopodinae (Ephemeroptera: Polymitarcyidae). *Anales Del Museo de Historia Natural de Valparaíso*, 19, 21–26.
- Domínguez, E., Molineri, C., Pescador, M., Hubbard, M.D. & Nieto, C. (2006) *Ephemeroptera of South America in Aquatic Biodiversity in Latin America (ABLA, Vol. 2)*, eds. Adis, J., Arias, J.R., Rueda-Delgado, G. and Wantzen, K.M. Sofia-Moscow, Pensoft.
- Hubbard, M.D. & Domínguez, E. (1988) Synonymy of the Neotropical mayfly genera *Asthenopus* and *Asthenopodes* (Ephemeroptera: Polymitarcyidae: Asthenopodinae). *Florida Entomologist*, 71, 207–210.
- McCafferty, W.P. & Bloodgood, D.W. (1989) The female and male coupling apparatus in *Tortopus* mayflies. *Aquatic Insects*, 11, 141–146.
- Molineri, C. (2010) A cladistic revision of *Tortopus* Needham & Murphy with description of the new genus *Tortopsis* (Ephemeroptera: Polymitarcyidae). *Zootaxa*, 2481, 1–36.
- Sattler, W. (1967) Über die Lebensweise, insbesondere das bauverhalten, neotropischer Eintagsfliegen-Larven (Ephemeroptera, Polymitarcyidae). *Beiträge zur Neotropischen Fauna*, 5, 89–110.
- Traver, J.R. (1956) The genus *Asthenopodes* (Ephemeroptera). *Comunicaciones Zoologicas del Museo de Historia Natural de Montevideo*, 75, 1–15.
- Ulmer, G. (1924) Einige alte und neue Ephemeropteren. *Konowia* 3, 23–37.