



## Revision of the South American species of *Hagenulopsis* Ulmer and *Askola* Peters (Ephemeroptera: Leptophlebiidae) with description of six new species

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### Abstract

The South American species of the genera *Askola* and *Hagenulopsis* are revised. Three new species of *Askola* from Brazil are described based on male imagos. *Askola emmerichi* **sp. nov.** and *A. paprockii* **sp. nov.** present spotted wings, but differ in general coloration and details of genitalia; *Askola cipoensis* **sp. nov.** is easily distinguished because the male eyes being widely separated on meson of head. Three new species of *Hagenulopsis* are also described: *H. lipeo* (from Argentina and Bolivia) and *H. zunigae* (from Colombia), both described from imagos and nymphs, can be recognized by details of coloration and male genitalia. *H. esmeralda* **sp. nov.** from Ecuador, described from imagos, shows a distinct male genitalia and translucent male abdomen. A key to species for the the male and female imagos of *Askola* and *Hagenulopsis* species is provided.

**Key words:** Atalophlebiinae, Neotropics, taxonomy, new species, mayflies

### Introduction

*Askola* Peters and *Hagenulopsis* Ulmer are two of the four dipterous (with no hind wings) leptophlebiids known to South America. The monotypic *Bessierus* Thomas & Orth and *Perissophlebioides* Savage, are the two other dipterous genera, but are not closely related to the sister taxa *Askola* and *Hagenulopsis* (Domínguez, 2009).

The genus *Askola* was established by Peters (1969) from male and female imagos and nymphs for *A. froehlichii*, and no other species was described since then. We are describing here three new species, based on male imagos.

The genus *Hagenulopsis* was established by Ulmer (1920) and is currently known from all the stages. Five species have been described, three from adults and nymphs: *H. diptera* Ulmer, *H. minuta* Spieth and *H. traversae* (Peters), and two only from nymphs: *H. ingens* and *H. ramosa* Lugo-Ortiz & McCafferty.

We are describing three new species of *Hagenulopsis*, two based on male and female imagos and nymphs, and the third from male and female imagos.

We are also including a key to separate the male and female imagos of all the known species of *Askola* and *Hagenulopsis*. The aspect and coloration of the nymphs of *Hagenulopsis* is very similar, and we found it very difficult to separate them. As we did not have specimens of all the species, we prefer not to include a key to separate them.

## Material and methods

The material used in this study is preserved in ethyl alcohol 75%. Male legs and genitalia and nymphal parts were dissected and mounted in Canada Balsam. Wings were mounted dry. Female descriptions only list those characters that differ from male (excluding those related to sexual dimorphism). The material is deposited in the following institutions: Instituto-Fundación Miguel Lillo, Tucumán, Argentina (IFML); Museu de Zoologia, Universidad de São Paulo, Brazil (MZSP); Museo de Entomología, Universidad del Valle, Cali-Colombia (MUSENUV), Museo Ecuatoriano de Ciencias Naturales, Quito, Ecuador (MECN).

## Key to separate the imagos of *Askola* and *Hagenulopsis*

### Males

1. Vein ICu<sub>1</sub> of fore wings joined at base to CuA (Figs. 25–27); penis lobes without ventral spines (Figs. 28, 31, 34) ..... 2 (*Askola*)
- 1'. Vein ICu<sub>1</sub> of fore wings joined at base to CuP (Figs. 37–39); each penis lobe with a ventral spine (Figs. 40, 42–44) ..... 5 (*Hagenulopsis*)
- 2(1). Cross veins of fore wings not surrounded with dark clouds (Fig 27)..... 3
- 2'. Cross veins of fore wings surrounded with dark clouds (Figs. 25–26) ..... 4
- 3(2). Fore wing length approximately 7 mm; eyes meeting on meson of head (Figs. 11–12); penes not extending beyond posterior margin of styliger plate (similar to Fig. 31); basal 1/3 of forceps brown, remainder paler; general coloration as in Fig. 10 ..... *A. froehlichii*
- 3'. Fore wing length 4.5–5.3 mm; eyes separated on meson of head (Figs. 8–9); penes extending beyond posterior margin of styliger plate (Figs. 34–35); forceps light yellow washed with gray, lighter toward apex; general coloration as in Fig. 7..... *A. cipoensis* **sp. nov.**
- 4(2). Forceps yellowish-brown, except inner margins whitish; penes extending well beyond the posterior margin of styliger plate (Figs. 28–29); general coloration as in Figs. 1–3..... *A. emmerichi* **sp. nov.**
- 4'. Forceps whitish, except basal articulation orangeish; penes not extending beyond posterior margin of styliger plate (Figs. 31–32); general coloration as in Figs. 4–6 ..... *A. paprockii* **sp. nov.**
- 5(1). Cross veins of fore wings blackish brown surrounded with dark clouds; dorsal portion of eyes yellowish white (Figs. 23–24); general coloration as in Fig. 22 ..... *H. diptera*
- 5'. Cross veins of fore wings not surrounded with dark clouds (Figs. 37–39); dorsal portion of eyes darker (Figs. 14–15, 17–18, 20–21); general coloration not as above ..... 6
- 6(5). Well developed bridge between stalks of upper portion of male eyes (Fig. 47) ..... *H. minuta*
- 6'. Without well developed bridge between stalks of upper portion of male eyes ..... 7
- 7(6). Upper portion of male eyes separated on meson of head by a length equal to maximum width of lateral ocellus (distribution: Dominica and St. Lucia) ..... *H. traverae*
- 7'. Upper portion of male eyes meeting on meson of head (Figs. 14, 17, 20, 23) ..... 8
- 8(7). Light colored species, with abdominal segments II–VI translucent white, with black posterolateral spot (Figs. 16–18); first forceps segment long, three times length of styliger plate and straight (Fig. 41) ..... *H. esmeralda* **sp. nov.**
- 8'. Dark colored species, with abdominal segments II–VI heavily washed with black or blackish brown (Figs. 13, 19); first forceps segment short—not more than 2.3 times length of styliger plate, and curved medially (Figs. 41–42, 44) ..... 9
- 9(8). Hind femora yellowish washed with black, heavier on apical 1/4, with a longitudinal lighter line; cerci dark brown ..... *H. lipeo* **sp. nov.**
- 9'. Hind femora yellowish with black shading restricted to apical ¼; cerci yellowish ..... *H. zunigae* **sp. nov.**

### Females<sup>1</sup>

1. Cross veins of fore wings blackish brown surrounded with dark clouds; general coloration similar to Fig. 22 .....  

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  1. *Askola froehlichii*, the only species known from females for the genus, can be separated from the species of *Hagenulopsis* by the wing characters included in the male key.

	..... <i>H. diptera</i>	
1'.	Cross veins of fore wings not surrounded with dark clouds (Figs. 37–39); general coloration not as above .....	2
2(1).	Small species, body length 4.0 mm or less; cerci with darker annulations at articulation of three most basal segments .....	<i>H. minuta</i>
2'.	Larger species, body length 5 mm or more; cerci without annulations as above .....	3
3(2).	Abdominal sterna much paler than terga .....	4
3'.	Abdominal sterna concolorous with terga .....	5
4(3).	Abdominal terga II–VII with a paler, medial line (only subimago known, distribution: Dominica and St. Lucia) ..	
	..... <i>H. traverae</i>	
4'.	Abdominal terga II–VII with a pair of paler submedial dots on anterior margin (similar to Fig. 16) .....	
	..... <i>H. esmeralda</i> <b>sp. nov.</b>	
5(3).	Hind femora yellowish washed with black, heavier on apical ¼, with a longitudinal lighter line .....	
	..... <i>H. lipeo</i> <b>sp. nov.</b>	
5'.	Hind femora yellowish with black shading restricted to apical ¼ .....	<i>H. zunigae</i> <b>sp. nov.</b>

### **Askola Peters**

*Askola* Peters, 1969: 253. (Type-species: *Askola froehlichii* Peters).

**Discussion:** *Askola* can be distinguished from the other genera of Leptophlebiidae by the following combination of characters, in the imago: 1) hind wings absent; 2) MA fork slightly asymmetrical, MP fork symmetrical; 3) vein ICu1 of fore wings joined at base to vein CuA; 4) claws of a pair dissimilar, one apically hooked and the other blunt; 5) penes divided, tubular, slender, apically pointed, and without appendages or spines (Figs. 28–36); and 6) female with egg guide prolonged to middle of abdominal sternum IX and 7) female sternum IX deeply cleft apically. In the nymph: 1) hind wing pads absent; 2) anteromedian emargination of labrum with two small denticles; 3) denticles of tarsal claws progressively larger apically; 4) dorsal and ventral portions of abdominal gills I–VII equal and plate-like, with the apical half of each plate bordered with finger-like processes; 5) posterolateral spines present on abdominal segments V–IX or VI–IX. The generic description of the male imago needs to be emended with the following characters to include the variations reported for the new species: 1) eyes separated (Fig 8) or meeting (Figs. 2, 6 and 11) on meson of head; 2) wings hyaline (Fig 27) or spotted (Figs. 1, 25, 26), costal cross veins basad to bullae absent (Fig. 27) or present (Figs. 25–26); 3) penes extending (Figs. 28, 34) or not (Fig 31) beyond posterior margin of styliger plate.

### ***Askola emmerichi* sp. nov. Domínguez, Molineri & Mariano**

Male imago. Length: body, 5.0–5.2 mm; fore wing, 4.8–5.0 mm. General coloration (Fig. 1) thorax yellowish orange, abdomen translucent, blackish marks on thorax and abdomen forming a pair of sublateral longitudinal lines; wings with blackish marks. Head (Figs. 2–3). Dorsal portion of eyes grayish, lower portion black; eyes widely meeting dorsally on meson of head; head yellowish with black stripes between eyes and ocelli. Antennae whitish. Thorax. Pronotum yellowish white with blackish lateral third. Mesonotum orange yellow with lateral margin of scutum, scutellum and central line on scutellum blackish. Metanotum yellowish with lateral and posterior margins blackish. Pleurae and sterna yellowish white except sclerites close to base of legs II and III darker. Legs. Leg I yellowish white except tarsi whitish, black bands on apex of femur, subapex of tibia and base of tarsal segments III and IV; tarsal bands occupying ¾ of respective segment; claws grayish [legs II and III broken off and lost]. Wings (Figs. 1, 25). Membrane hyaline except base of C area yellowish and grayish spots mainly around cross veins as in Figs. 1, 25; longitudinal veins yellowish, cross veins blackish bordered with grayish; 4 costal cross veins from bulla to costal brace. Abdomen translucent white except segments VIII–X yellowish white. Terga with characteristic black pattern of marks and dots (Fig.1), sterna without marks. Genitalia (Figs. 28–30): styliger plate yellowish white darker on margins, forceps and

penes light gray, paler towards apex. Terminal filament whitish with a black band on the base of each segment [cerci broken off and lost].

**Material:** 1 male imago from Colombia-Brazil, Amazonas, Reserva Natural Palmarí, quebrada Natividad, cuenca rio Yabará, 150 m, N 04° 17' 28"- W 70° 17' 42", 28-V-2002, light trap, M.C. Zúñiga, D. Emmerich, A.J. Cardozo & R.J. Cardozo cols.; 1 male imago from Colombia-Brazil, Amazonas, Reserva Natural Palmarí, rio Yabará, muelle Centro Administrativo, 120 m, N 04° 17' 10"- W 70° 17' 49", 29-V-2002, light trap, same collectors. Holotype deposited at MUSENUV, paratype at IFML.

**Etymology:** We dedicate this species to our friend and colleague Daniel Emmerich, one of the collectors of the type material.

**Discussion:** *Askola emmerichi* can be separated from the other species of the genus by the following combination of characters. Imago: 1) blackish marks on thorax and abdomen forming a pair of sublateral longitudinal lines (Fig. 1), wings with blackish marks (Figs. 1, 25); 2) dorsal portion of eyes grayish and widely meeting dorsally on meson of head (Figs. 2–3); 3) forceps yellowish-brown, except inner margins whitish; 4) penes extending well beyond posterior margin of styliger plate (Figs. 28–29).

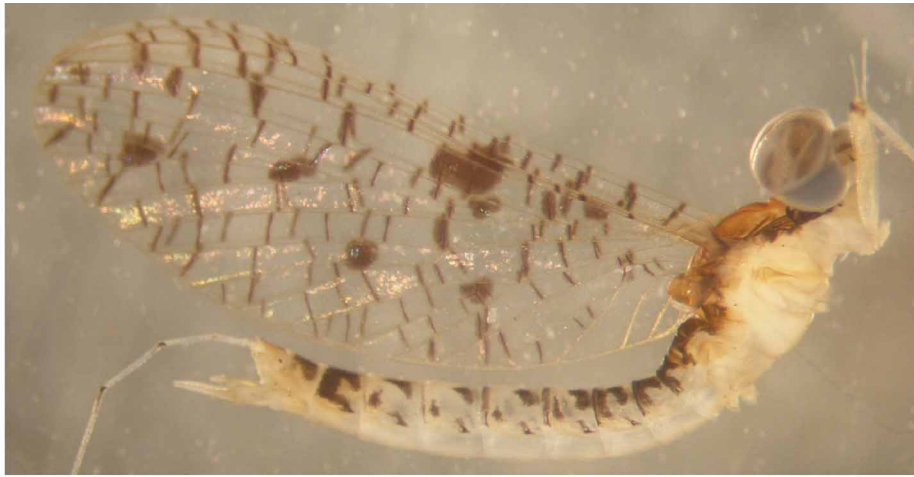
### *Askola paprockii* sp. nov. Domínguez, Molineri & Mariano

Male imago. Length: body, 6.5–6.8 mm; fore wing, 6.5–6.7 mm. General coloration (Figs. 4–5) thorax yellowish white, wings and abdomen hyaline, with grayish marks. Head (Fig. 6). Dorsal portion of eyes grayish black, lower portion black; eyes widely meeting dorsally on meson of head; head yellowish white with two black stripes from eyes and ocelli to fore margin. Antennae whitish. Thorax yellowish white darker on meso and metanotum. Pronotum with blackish marks on lateral margins and two pairs of black sublateral spots. Mesonotum with a small black spot at base of wings and diffuse black marks from wing base to anterior margin. Metanotum with a pair of broad sublateral black marks. Pleurae with distinct black marks especially around coxae, sterna with central area washed with black. Legs yellowish white with slightly darker femora; trochanters II–III with black spots; subapical black band on tibia I; black medial mark on femora II–III. Wings (Fig. 26). Membrane hyaline except base of C area yellowish and grayish spots mainly around cross veins as in Fig. 26; longitudinal veins yellowish gray lighter towards hind margin, cross veins blackish bordered with grayish; 4 costal cross veins from bulla to costal brace. Abdomen (Figs. 4–5) translucent white except segments IX–X yellowish heavily washed with black. Tergum I completely washed with black, terga II–VIII with a black band on lateral and hind margins, except medial line; terga VII–VIII with a pair of submedian blackish spots near fore margin. Abdominal sternum I with anteromedian black mark and a pair of blackish wide diagonal stripes, sterna II–VII with small anterolateral spot and thin and short oblique blackish stripe ending on spiracles, sterna VIII–IX with lateral margins blackish. Genitalia: styliger plate whitish uniformly washed with gray, forceps whitish except basal half washed with gray, penes yellowish washed with gray. [Caudal filaments broken off and lost].

**Material:** Holotype and 1 paratype male imagos from Brazil, Minas Gerais, rio Peixe/rio Itambé confluence, S 19° 17.525'- W 43° 15.457', 500 m, 4-II-1998, Holzenthal & Paprocki Cols. Holotype deposited at MZSP, paratype at IFML.

**Etymology:** We dedicate this species to H. Paprocki, Trichoptera specialist, one of the collectors of the type material.

**Discussion:** The male imago of *Askola paprockii* sp. nov. can be distinguished by the following combination of characters: 1) General coloration yellowish white with grayish marks (Figs. 4–5), wings with grayish spots (Fig. 26); 2) dorsal portion of eyes grayish black, eyes widely meeting dorsally on meson of head (Fig. 6); 3) 4 costal cross veins from bulla to costal brace (Fig. 26); 4) forceps whitish except basal half washed with gray (Fig. 5); 5) penes not extending beyond posterior margin of styliger plate (Figs. 31–32).



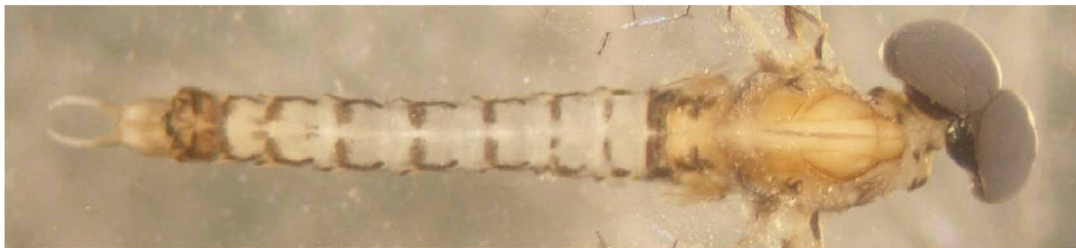
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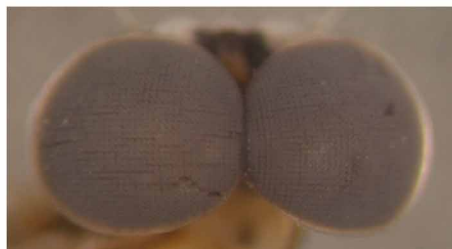
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**FIGURES 1–6.** *Askola*. Figs 1–3, *Askola emmerichi*, **sp. nov.**, male imago. 1, general aspect, lateral view; 2, head, dorsal view; 3, head, lateral view. Figs 4–6, *Askola paprockii* **sp. nov.**, male imago. 4, body, dorsal view; 5, idem, ventral view; 6, head, dorsal view.

### *Askola cipoensis* sp. nov. Domínguez, Molineri & Mariano

Male imago. Length: body and fore wing, 4.5–5.3 mm. General coloration (Fig. 7) yellowish, abdomen washed with gray. Head (Figs. 8–9). Dorsal portion of eyes yellowish brown, lower portion black; eyes widely separated dorsally on meson of head by ca. twice width of lateral ocelli; head yellowish washed with black between ocelli. Antennae: scape yellowish brown, pedicel yellowish white with a grayish band on apical half, flagellum whitish. Thorax yellowish with carinae and sutures slightly darker. Legs yellowish paler toward apex and with narrow subapical blackish band on tibiae, stronger on tibia I, and subapical blackish band on femora III. Wings (Fig. 27). Membrane hyaline with longitudinal and cross veins yellowish gray lighter towards hind margin; no costal cross veins basad to bulla. Abdomen (Fig. 7) translucent yellowish white except segments VIII–X whitish, segments I–II and VIII–X heavily washed with black; segments III–VII with a transversal blackish band, narrower at center. Terga I–IX with a transparent medial line. Genitalia (Figs. 34–36): styliger plate yellowish with hind margin orangeish; forceps light yellow washed with gray lighter toward apex, penes yellowish orange washed with gray. Caudal filaments yellowish white with every other intersegmental union with a narrow black band.

**Material:** Holotype male imago and 14 paratypes male imagos from Brazil, Minas Gerais, Serra do Cipó, km 126, II-1973, P. Montouchet & I. Sazima. Holotype and 6 paratypes deposited at MZSP, 7 paratypes at IFML.

**Etymology:** cipoensis, from the type locality, Serra do Cipó.

**Discussion:** male imago of *Askola cipoensis* sp. nov. can be distinguished by the following combination of characters: 1) General coloration yellowish, abdomen washed with gray (Fig. 7); 2) dorsal portion of eyes yellowish brown, eyes widely separated dorsally on meson of head (Figs. 8–9); 3) no costal cross veins basad to bulla (Fig. 27); 4) forceps light yellow washed with gray; 5) penes extending slightly beyond posterior margin of styliger plate (Figs. 34–35).

### *Askola froehlich* Peters

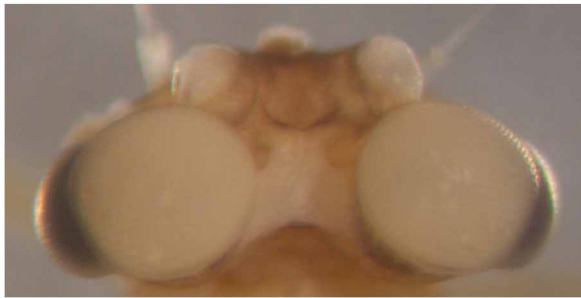
*Askola froehlich* Peters, 1969: 255 (male, female, nymph); Da-Silva, 2002: 1.

**Material:** 1 male imago from Brazil, SP, Casa Grande, Rib. Coruja, 11-IV-1983, light, C. G. Froehlich col.; 1 male imago from Brazil, SP, Campos do Jordão, Parque Estadual Campos do Jordão, córrego Galharada, 16-X-1998, C. G. Froehlich & H. Paprocki cols.; 1 male imago from Brazil, SP, Campos do Jordão, Parque Estadual Campos do Jordão, rio Sapucaí e córrego Galharada, 7–8/I/1986, C. G. Froehlich & L. G. Oliveira cols.; 1 male imago, 6 male subimagos and 3 female subimagos from Brazil, SP, Campos do Jordão, Parque Estadual Campos do Jordão, 16-XII-1987, C. G. Froehlich & L. G. Oliveira cols.; 2 mature male nymphs from Brazil, SP, Campos do Jordão, Parque Estadual Campos do Jordão, 18-XI-1987, C. G. Froehlich & L. G. Oliveira cols.; 1 male and 1 female from Brazil, SP, Jundiaí, Serra do Japi, Trilha da cachoeira do Paraíso, riacho paraíso, S23°14 W46°57", 1050 m, 18–20-XII-2007, Puçá, L. S. Lecci; R. A. Moretto & E. A. Nascimento cols.; 1 male and 1 female from Brazil, SP, Jundiaí, Serra do Japi, córrego Paraíso, 20-II-2008, Malaise trap, L. S. Lecci, R. A. Moretto & E. A. Nascimento cols. All material deposited at MZSP, except 1 male imago from Rib. Corujá, 1 male imago and one nymph from Campos do Jordão, 1 male and 1 female imagos from Serra do Japi.

**Discussion:** male imago of *Askola froehlich* can be distinguished by the following combination of characters: 1) General coloration yellowish, abdomen washed with gray (Fig. 10), wings hyaline; 2) dorsal portion of eyes blackish (Figs. 11–12); 3) 4 weak costal cross veins basad to and 1 on bulla; 4) basal 1/3 of forceps brown, remainder paler; 5) penes not extending beyond posterior margin of styliger plate.



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**FIGURES 7–12.** *Askola*. Figs 7–9, *Askola cipoensis* sp. nov., male imago. 7, general aspect, lateral view; 8, head, dorsal view; 9, head, lateral view. Figs 10–12, *A. froehlichii*, male imago. 10, general aspect, lateral view; 11, head, dorsal view; 12, head, lateral view.

## *Hagenulopsis* Ulmer

*Hagenulopsis* Ulmer, 1920: 34; Needham & Murphy, 1924: 43; Traver, 1946: 427; Peters, 1969: 258; Edmunds, Jensen & Berner, 1976: 221; Peters & Domínguez, 2001: 353. (Type-species: *Hagenulopsis diptera* Ulmer).

**Discussion:** *Hagenulopsis* Ulmer can be separated from the other genera of the family by the following combination of characters, in the adult: 1) hind wings absent; 2) MA fork symmetrical or asymmetrical, MP fork symmetrical; 3) vein ICu1 of fore wings attached at base to vein CuP (Figs. 37–39); 4) tarsal claws of a pair dissimilar, one apically pointed, other blunt; 5) penes divided, tubular, apically acute, with two small ventral spines located between 1/5–1/3 distance from apex; 6) inner angle of forceps segment I located about 1/2–1/3 distance from base; 7) female with well developed egg guide, which is prolonged to middle of abdominal sternum IX; and 8) female sternum IX deeply cleft apically. In the nymph: 1) labrum with rounded margins, and anteromedian emargination with 3–5 denticles; 2) mandible with few or no setae on apical third of outer margin; 3) apical 1/2 of segment III of labial palpi constricted; 4) denticles of tarsal claws progressively larger toward apex, except apical denticle much larger; 5) gills on abdominal segments I–VII lanceolate, narrow, dorsal and ventral portions similar; 6) posterolateral spines on abdominal segments VI–IX, larger posteriorly, only slightly developed in IV and V.

The generic description needs to be amended with the following characters to include the variations reported for the new species: In the imago, 1) penes divided, tubular, apically acute, with two small ventral spines located between 1/5–1/3 distance from apex; 2) inner angle of forceps segment I located about 1/2–1/3 distance from base. In the nymph, 1) labrum with rounded margins, and anteromedian emargination with 3–5 denticles.

Lugo-Ortiz & McCafferty (1996) separated one of the two species they described from nymphs, mainly on the presence of branched setae on the distal end of hind tibiae. The nymphs we are describing and *H. diptera* we studied (from Sao Paulo) have only simple setae on hind tibiae.

### *Hagenulopsis lipo* sp. nov. Domínguez, Molineri and Mariano

Male imago (Fig. 19). Length: body, 5.0–5.8 mm; fore wings, 5.0–5.6 mm. Eyes: upper portion grayish brown meeting dorsally, basally contiguous; facets small and numerous (Figs. 20–21). Facets of lower portion black, small. Head yellowish brown with black markings close to base of eyes. Ocelli whitish, lateral ocelli twice the size of the median one. Antennae: scape yellowish white, pedicel brownish [flagellum broken off and lost]. Thorax. Notae and pleurae reddish brown with carinae darker and whitish membranes; sterna yellowish brown with whitish membranes. Leg I yellowish heavily washed with black specially on femora, tarsi lighter; legs II–III with coxae and trochanter yellowish white, remainder segments yellowish washed with black specially at apex of femora; longitudinal lighter line on femora II–III; claws in all legs yellowish washed with black. Wings membrane hyaline uniformly tinted with light brown, veins brownish lighter toward apex, pterostigma clouded white (Fig. 37); no costal cross veins basad to bulla. Abdomen. Terga yellowish heavily washed with black except on two submedial and two sublateral paler areas close to anterior margin on each terga II to VI; sterna yellowish white washed with black except anterior margin and ganglia; posterior margin of sterna VII–VIII translucent. Genitalia (Figs. 43–46): styliger plate and forceps yellowish brown except inner margins of forceps whitish, penes yellowish white; short styliger plate (ratio maximum width/medial length: 1.95–2.17) with a similar width along its entire length, hind margin straight to slightly concave; first forceps segment curved medially (ratio length F1/styliger: 2.0–2.3) (Figs. 43–44). Caudal filaments, basal half of first segment yellowish brown; rest of filaments yellowish black basally, turning yellowish gradually toward apex.

Female imago. Length: body, 4.4–5.6 mm; fore wings, 5.0–5.8 mm. Head yellowish brown except base of ocelli blackish, and area between ocelli and eyes whitish. Eyes black. Thorax yellowish brown, sterna yellowish white except darker medially. Some females have lighter wing membranes than the males.



Abdomen ventrally with lighter areas covering anterior  $\frac{3}{4}$  of segments II–V; egg guide yellowish black lighter toward apex, apically acute.



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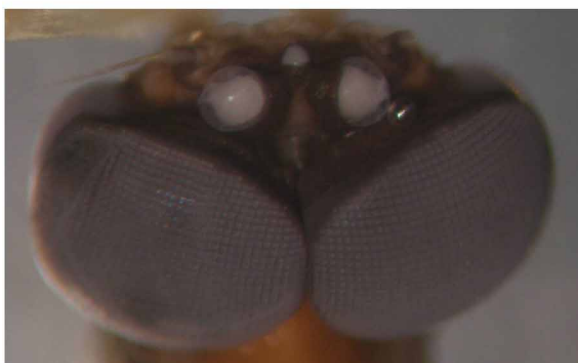
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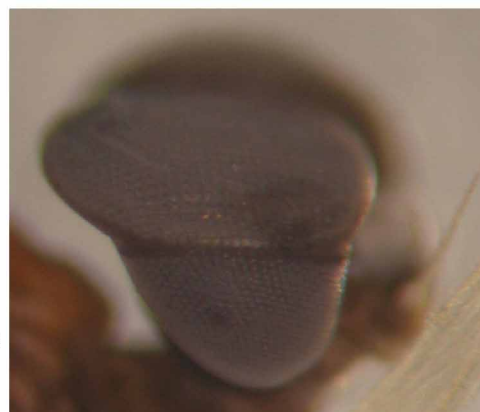
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**FIGURES 13–18.** *Hagenulopsis*. Figs 13–15, *H. zunigae* sp. nov. 13, male imago, general aspect, lateral view; 14, head, dorsal view; 15, head, lateral view. Figs 16–18, *H. esmeralda* sp. nov. 16, male imago, general aspect, lateral view; 17, head, dorsal view; 18, head, lateral view.



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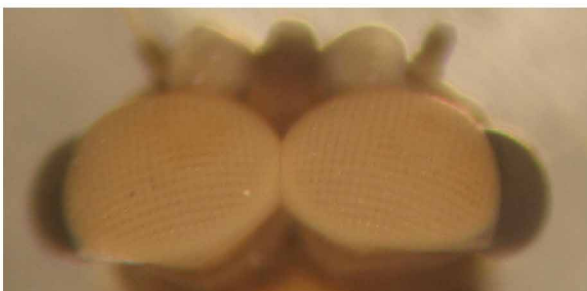
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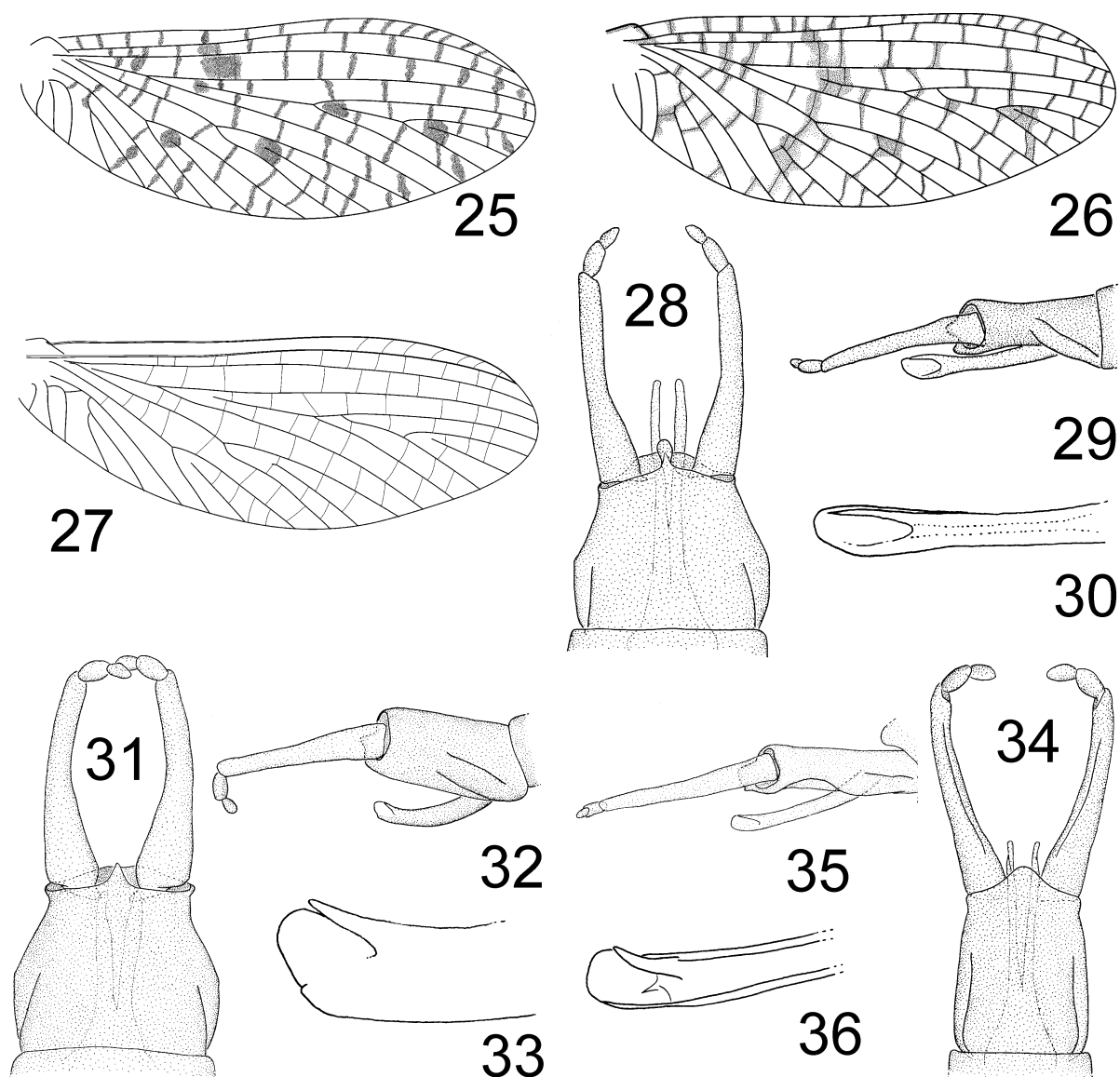


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**FIGURES 19–24.** *Hagenulopsis*. Figs 19–21, *H. lipeo*. 19, male imago, general aspect, lateral view; 20, head, dorsal view; 21, head, lateral view. Figs 22–24, *H. diptera*. 22, male imago, general aspect, lateral view; 23, head, dorsal view; 24, head, lateral view.

Mature nymphs. Female length: body, 5.4–5.6 mm, cerci 3.7–3.9 mm, terminal filament, 4.8–5.0 mm. Male length: body 5.3–5.6 mm, cerci 5.3 mm, terminal filament, 3.6 mm. Head. Eyes of male with reddish black upper portion and blackish lower portion; eyes of female black; ocelli whitish with inner half margin blackish. Antennae: scape yellowish, pedicel blackish, flagellum yellowish lighter toward apex. Dorsum of

head yellowish brown stained with black in central area. Mouthparts yellowish stained with black at: base of labrum, basal half of mandibles, outer margin and palpi segment I of maxilla, posterior margin of superlinguae, and submentum; molae of mandible and apical row of setae of maxilla orange brown; anteromedian emargination of labrum with 3 denticles, the median smaller than lateral ones. Thorax. nota yellowish white with latero-medial and latero-posterior areas washed with black; pro- and mesosternum yellowish white with ganglia and margins stained with black, metasternum yellowish white almost completely washed with black except inner margin of articulation of coxae. Leg I light orange yellow with coxa and margins of trochanters washed with black, femur almost completely washed with black except lighter oblique line. Legs II and III yellowish with coxa and two longitudinal lateromedial areas on femora, and longitudinal stripe on tibiae blackish; tibiae and tarsi darker than femora, claws orange brown. Tarsal claws with 8–9 denticles. Abdomen dorsally yellowish orange washed heavily with black especially on latero-posterior areas of terga; sterna yellowish with central area tinged with black, lighter in central area. [Posterolateral projection as in *minuta* description]. Gills whitish with blackish tracheae. Cerci yellowish orange, few setae on each intersegmental union.



**FIGURES 25–36.** *Askola*. Figs 25–27, male fore wing: 25, *Askola emmerichi* sp. nov.; 26, *Askola paprockii* sp. nov.; 27, *Askola cipoensis* sp. nov. Figs 28–30, *Askola emmerichi* sp. nov.: 28, genitalia, ventral view; 29, genitalia, lateral view; 30, penes, detail. Figs 31–33, *Askola paprockii* sp. nov.: 31, genitalia, ventral view; 32, genitalia, lateral view; 33, penes, detail. Figs 34–36, *Askola cipoensis* sp. nov.: 34, genitalia, ventral view; 35, genitalia, lateral view; 36, penes, detail.

**Material:** Holotype male imago from ARGENTINA: Salta, PN Baritu, Lipeo, estación 5, 13-XI-2004; 98 male and 8 female imagos same data as holotype. Paratypes: 18 nymphs from ARGENTINA: Salta, Parque Nacional Baritu, Lipeo, A° Los Naranjos, 13-XI-2004, E. Domínguez col.; 2 nymphs, same data as holotype, except A° Baritu, 17-XI-2004. Other material: Jujuy, El Carmen, A° Las Lanzas, 3-III-2000, Domínguez & Molineri cols. BOLIVIA: Dpto. Santa Cruz, Ichilo Prov., 10 km NE Hierba Buena Militar, Quebrada El Bronce, 1100 m, 19-IV-1993, E. Domínguez & M. Paco cols. All material deposited at IFML, except 5 male imagos at MZSP and 5 male imagos at MUSENUV.

**Etymology:** Lipeo, name of the type locality.

**Biology:** *Hagenulopsis lipeo* sp. nov. was collected in a small effluent of the Lipeo river, in Salta Province, NW Argentina. The stream was about 3 m wide and between 20 cm to 60 cm deep. The bottom was covered with rocks, with some sandy areas. A mating flight was observed during the morning hours, 1 m above the water course, performing the typical up and down pattern of most leptophlebiid species. It is interesting to note that the pattern does not seem, at least on the main features, to be affected by the dipterous conditions of the specimens. The size of the swarm was approximately 5 m long and 1 m width, and extended for about an hour. A few females were caught among the flying males.

**Discussion:** This species seems to have a rather extended distribution from NW Argentina to central Bolivia. It has been observed certain variation in the shape of the apex of the male styliger plate (Figs. 45–46), that is due to the angle of observation. It can be separated from the other- species of the genus by the following combination of characters. Imago: 1) general coloration dark (yellowish, heavily washed with black), pattern as in Fig. 19; 2) eyes of male meeting on -meson of head (Figs. 20–21); 3) first forceps segment not more than 2.3 times length of styliger plate, and curved medially (Fig. 43); 4) hind femora yellowish washed with black, heavier on apical 1/4, with a longitudinal lighter line; 5) cerci dark brown.

### ***Hagenulopsis esmeralda* sp. nov. Domínguez, Molineri & Bersosa**

Male imago (Fig. 16). Length: body, 4.8–5.2 mm; fore wings, 4.8–5.0 mm. Eyes: upper and lower portions black, meeting dorsally, in frontal view the eyes are contiguous except small basal and medio-apical openings; facets small and numerous. Head yellowish washed with black diffusely. Ocelli whitish, lateral ocelli twice the size of the median one. Antennae: scape yellowish white, pedicel brownish, flagellum yellowish lighter toward apex. Thorax. Pronotum yellowish white heavily washed with black except central area and two C-shaped submdian marks on posterior margin lighter; mesonotum orangish yellow with sutures and carinae darker, metanotum yellowish white with posterior and lateral margins washed with black; pleurae sclerites yellowish orange, membranes whitish heavily washed with black; sterna yellowish orange except central portions whitish. Legs yellowish white with brownish spot at apex of femora, hooked claw of a pair orange blunt claw grayish. Wings membrane hyaline except basal to costal brace brownish, veins yellowish brown, crossveins whitish, pterostigma clouded white (Fig. 38); bullae (better distinguishable in alcohol specimens) present on Sc, R<sub>1</sub>, R<sub>4+5</sub> and MP<sub>1</sub> about ½ from base; 4 costal cross veins from bulla to costal brace. Abdomen. Terga II–VI translucent white with black posterolateral angles; tergum VII whitish with sublateral circular areas and posterolateral angles washed with black; terga VIII–IX whitish heavily washed with black except narrow medial line; tergum X whitish with blackish anterolateral corners; abdominal sterna whitish. Genitalia (Figs. 41–42): whitish except basal articulation of forceps and posterior margin of styliger plate orangeish and penes light orange; long styliger plate (ratio maximum width/medial length: 1.66–1.95) wider at base becoming thinner toward apex, hind margin markedly concave; first forceps segment long and straight (ratio length forceps I/styliger plate: 3) (Fig. 41). Caudal filaments translucent white with black annulations, narrow near base of filaments and widening towards apex.

Female imago. Length: body, 5.0–5.5 mm; fore wings, 5.3–5.5 mm. Eyes black. Head yellowish white with two dark stripes between lateral ocelli and posterior margin. Antennae scape and pedicel yellowish washed with black, flagellum grayish lighter towards apex. Thorax. Pronotum whitish heavily washed with

black; mesonotum yellowish orange margins darker; pleurael sclerites yellowish orange slightly washed with black, membranes whitish heavily washed with black; sterna yellowish except central parts whitish. Legs coxae and trochanter yellowish orange washed with black on coxae, femora whitish with black subapical band, tibiae and tarsi yellowish white, claws grayish. Wings. Membrane hyaline basally brown as in male, longitudinal and crossveins brownish, bullae as in male. Abdomen. Terga whitish, heavily washed with black from I to IX, except median area of tergum VII, and a pair of submedial dots on anterior margin of terga II–VII paler; sterna whitish except posterior margin of sternum VI and egg guide brownish, egg guide apically acute. Caudal filaments light yellowish brown with annulations as in male.

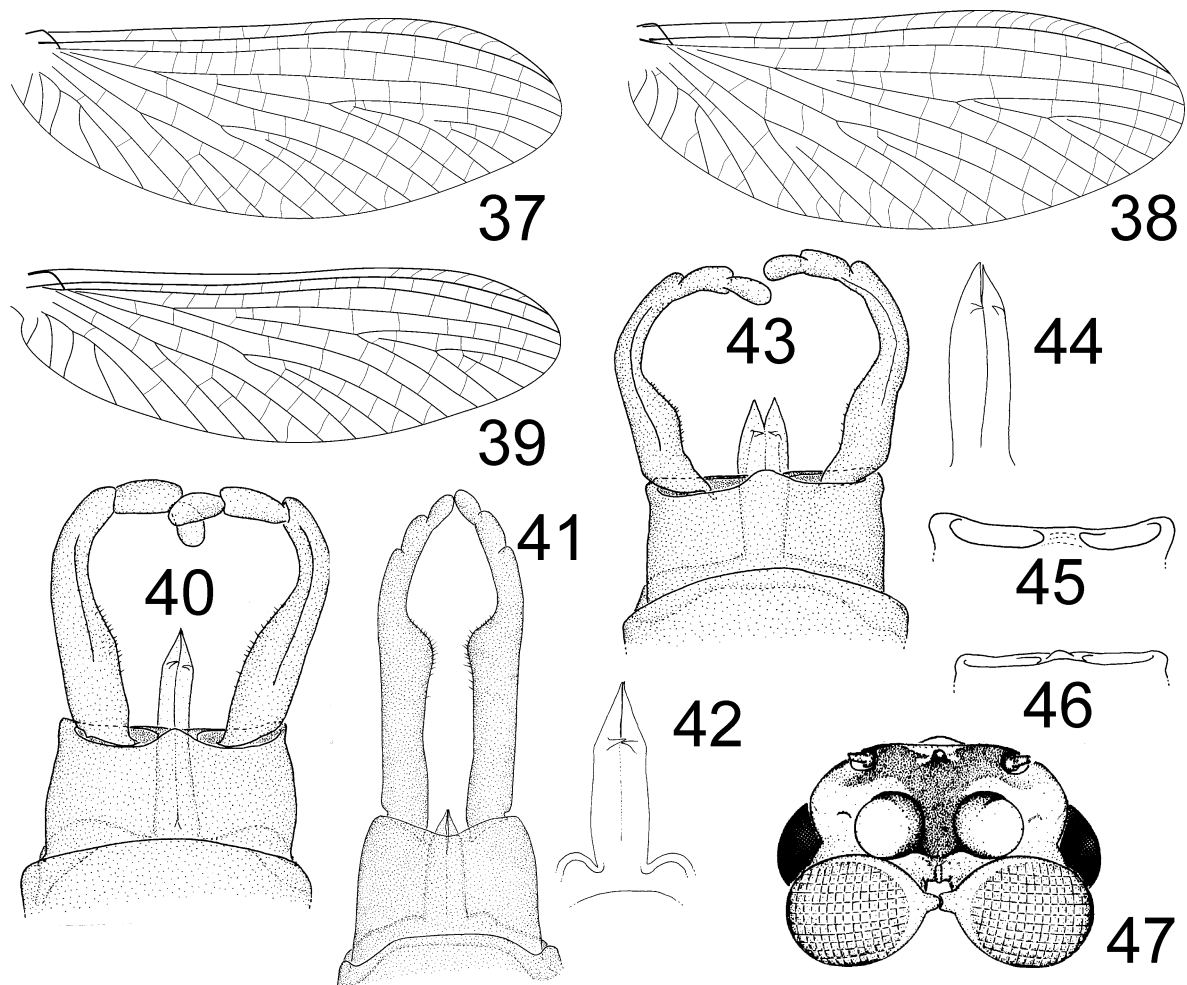
**Material.** Holotype male from ECUADOR: Esmeralda Prov., Canton Eloy Alfaro, Parroquia Telembí, Estero Arenales, N 0° 40' 06", W 78° 69' 26", 40 m, 15-IV-2002, E. Domínguez, F. Bersosa, M.C. Zuñiga coll. Allotype, and paratypes (42 males, 5 females) same data as Holotype; 6 male and 1 female imagos (paratypes) from ECUADOR: Esmeralda Prov., Canton Eloy Alfaro, Parroquia Telembí, Comunidad San Miguel, Estero Charco Vicente, N 0° 41' 36", W 78° 54' 33", 80 m, 14-IV-2002, E. Domínguez, F. Bersosa, M.C. Zuñiga coll. Imagos of both sexes were captured in the same nuptial flight. Holotype, Allotype and half of the paratypes deposited in MECN, rest of paratypes divided equally between IFML and MUSENUV.

**Etymology:** Esmeralda, from the name of the Ecuadorean province where the species was collected.

**Discussion:** *Hagenulopsis esmeralda* sp. nov. can be separated from the other species of the genus by the following combination of characters. Imago: 1) general coloration light, with abdominal segments II–VI translucent white, with black posterolateral angles (Figs. 16–18); 2) eyes of male meeting on dorsum of head (Figs. 17–18); 3) first forceps segment long (3 times length of styliger plate), and straight (Fig. 42); 4) hind femora yellowish white with brownish spot at apex; 5) cerci translucent white with black annulations, narrow near base of filaments and widening towards apex.

### ***Hagenulopsis zunigae* sp. nov. Domínguez, Molineri and Mariano**

Male imago (Fig. 13). Length: body, 6.0–6.8 mm; fore wings, 6.0–6.5 mm. Eyes: upper portion dark reddish brown, lower portion black, meeting dorsally, in frontal view the eyes are contiguous; facets small and numerous. Head yellowish washed with black in median area delimited by eyes and ocelli. Ocelli whitish, median ocelli very small, lateral ocelli 4 times the size of the median one. Antennae: scape yellowish and pedicel yellowish brown, flagellum grayish, lighter towards apex. Thorax. Pronotum yellowish with margins and paramedian lines blackish; mesonotum yellowish orange with sutures and carinae darker, metanotum yellowish orange diffusely washed with black darker along margins; pleural sclerites yellowish orange, membranes whitish heavily washed with black; sterna yellowish orange except central portions whitish and margins of sclerites blackish. Legs. Leg I: coxa, trochanter and femur yellowish heavily washed with black, tibia light yellowish black, tarsi whitish except apical tarsomere washed with black, hooked claw grayish, blunt claw translucent white. Legs II and III similar to leg I, except femora shading restricted to apical ¼. Wings membrane hyaline tenuously tinged with brown; except basal to costal brace brownish, veins grayish brown, crossveins lighter, pterostigma clouded white; bullae (better distinguishable in alcohol specimens) present on Sc, R<sub>1</sub>, R<sub>4+5</sub> and MP<sub>1</sub> about ½ from base (Fig. 37); 4 costal cross veins from bulla to costal brace. Abdomen. Terga yellowish white heavily washed with blackish brown except terga III–VII with anterior margins with central area and corners not tinged; sterna yellowish white shaded with brownish black except ganglia and semicircular area close to posterior margin on sterna III–VIII, lighter. Genitalia (Fig. 40): styliger plate yellowish white with basal half and posterior margins washed with black; forceps yellowish white with segment I heavily washed with black; penes yellowish white; short styliger plate (ratio maximum width/medial length: 1.95–2.16) with a similar width along its entire length, hind margin straight to slightly concave; first forceps segment curved medially (ratio length F1/styliger: 2.2) (Fig. 40). Caudal filaments yellowish gray lighter towards apex.



**FIGURES 37–47.** *Hagenulopsis*. Figs 37–39, male fore wing: 37, *H. zunigae* sp. nov.; 38, *H. esmeralda* sp. nov.; 39, *H. lipeo*. Fig. 40, *H. zunigae* sp. nov., genitalia, ventral view. Figs 41–42, *H. esmeralda* sp. nov.: 41, genitalia, ventral view; 42, penes, detail. Figs 43–46, *H. lipeo*: 43, genitalia, ventral view; 44, penes, detail; 45, apex of styliger plate, ventral view; 46, idem, variation. Fig. 47, *H. diptera*, male head, dorsal view.

Female imago. Length: body, 6.1–6.3 mm; fore wings, 6.5 mm. Head yellowish gray, with whitish area between eyes and center of head. Eyes black. Thorax yellowish brown, with pleural sclerites washed with black. Abdomen lighter than male; egg guide yellowish washed with black, apically acute. [Caudal filaments broken off and lost].

Mature male nymphs. Length: body 5.2–6.7 mm, cerci 3.5–4.0 mm, terminal filament, 5.0 mm. Head. Eyes of male with yellowish brown upper portion and blackish lower portion; eyes of female black; ocelli whitish with inner half margin blackish. Antennae whitish with blackish band occupying 2/3 of pedicel. Dorsum of head yellowish washed with black in central area. Mouthparts yellowish white with clypeus, labrum, base of mandibles, stipes of maxillae and postmentum of labium washed with black; molae of mandibles and crown of setae on maxillae orangeish; anteromedian emargination of labrum with 3 denticles of similar size. Thorax. Thoracic nota light yellow orange, pronotum and metanotum heavily washed with black, mesonotum with outer margin and base of wingbuds blackish; thoracic sterna yellowish heavily washed with black except basal part of prosternum and area between legs in mesosternum. Leg I yellowish with two subapical black spots on femora, tibiae and tarsi darker. Legs II and III with coxae, trochanters and femora yellowish white, trochanters washed with black, femora with subapical black band, tibiae and tarsi yellowish especially on leg III. Tarsal claws yellowish white, with 9–10 denticles. Abdomen light yellow orange, darker dorsally and with a blackish pattern similar to male imago but more diffuse. [Posterolateral

projection as in *minuta* description]. Gills whitish with blackish tracheae. Caudal filaments yellowish orange lighter towards apex, with setae on each intersegmental union.

**Material.** Holotype male imago from COLOMBIA: P. N. Farallones de Cali, Peñas Blancas, río Pichinde, N 3° 25' 45", W 76° 39' 27", 2.000 m, 17-18-III-1999, E. Domínguez, M.C. Zuñiga & C. Molineri; allotype female imago, 7 male imagos and 1 male nymph paratypes, same data as holotype; 7 male and 1 female imagos and 2 male nymphs paratypes from COLOMBIA: Boyacá, Municipio de Arcabuco, Santuario de Flora y Fauna de Iguaque, quebrada Carrizal, N 5° 42' 37", W 73° 27' 43", 2720 m, 6-II-1997, E. Domínguez, M. Pescador & L. Baena cols. All material deposited at MUSENUV, except 4 male imagos from río Pichinde, 3 male, 1 female imago and 2 nymphs from quebrada Carrizal, deposited at IFML.

**Etymology:** The species is dedicated to Maria del Carmen Zuñiga, friend and colleague for her enthusiasm and contributions to the knowledge of Colombian aquatic insects.

**Discussion:** *H. zunigae* sp. nov. can be separated from the other species of the genus by the following combination of characters. Imago: 1) General coloration dark (yellowish white heavily washed with blackish brown except terga III–VII with anterior margins with central area and corners not tinged), pattern as in Fig. 13; 2) eyes of male meeting on dorsum of head (Figs. 14–15); 3) first forceps segment around 2.2 times length of styliger plate, and curved medially (Figs. 41–42); 4) hind femora yellowish with black shading restricted to apical ¼; 5) cerci yellowish.

### *Hagenulopsis diptera* Ulmer

*Hagenulopsis diptera* Ulmer, 1920: 34; Lestage, 1922: 33; Edmunds, Jensen & Berner, 1976: 221; Peters & Domínguez, 2001: 356.

**Material studied:** One male imago from BRAZIL, São Paulo, Campos do Jordão, Parque Estadual, 16/XII/1987. C. G. Froehlich & L. G. Oliveira cols. Six nymphs, same data, except date: 18/XI/1987. Three nymphs deposited at MZSP, remainder at IFML.

**Discussion:** This species was recently redescribed (Peters & Domínguez, 2001), it can be separated from the other species of the genus by the following combination of characters. Imago: 1) general coloration yellowish brown, pattern as in Fig. 22, 2) cross veins surrounded with dark clouds; 3) dorsal portion of male eyes yellowish white, meeting on dorsum of head (Figs. 23–24); 4) first forceps segment around 1.5 times length of styliger plate, and curved medially (Figs. 41–42); 5) hind femora yellowish-white, with wide medial and narrower apical grayish black bands; 6) cerci yellowish-white, with basal 1/3 of each segment grayish.

### *Hagenulopsis minuta* Spieth

*Hagenulopsis minutus* Spieth, 1943: 10; Traver, 1946: 427.

*Hagenulopsis minuta*; Peters & Domínguez, 2001: 354.

**Discussion:** This is a very small species (body size 3–4 mm) as noted by Spieth (1943), in the species description. It is known from Surinam, Brazil and Venezuela. Peters & Dominguez (2001) detailed variations in size, and coloration. The Venezuelan specimens are larger and the color pattern is more pronounced than the others. *H. minuta* can be separated from the other species of the genus by the following combination of characters. Imago: 1) general coloration reddish brown, heavily washed with blackish brown; 2) upper portion of male eyes separated basally, meeting medially with well developed eye bridge on inner margin of upper portion; 3) first forceps segment around 2 times length of styliger plate, and curved medially; 4) hind femora yellowish, with wide subbasal and apical dark bands; 5) cerci pale, articulations of basal 3 segments darker.

## Acknowledgments

We are grateful to María del Carmen Zúñiga, Daniel Emmerich, Lucas Lecci and Claudio Froehlich for material donation. Partial support was obtained from ANCYPT (PICT 528 and PICT 351) and CONICET (PIP 1484). The two first authors are member of the CONICET, which support is acknowledged.

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