



## ***Parakari* a New Genus of the Family Baetidae (Insecta: Ephemeroptera) from Guyana Highlands**

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### **Abstract**

Baetidae is one of the most diverse families of Ephemeroptera. In South America this family now encompasses 27 genera and more than 130 species. The Guyana region is known for its extraordinary diversity and high level of endemism, which is, above all, remarkable at the tops of the isolated flat-topped table mountains – tepuis. Recently various international speleological expeditions to Churí-tepui explored the cave systems of this mountain. Here we describe a new genus of Baetidae recently found during the mentioned expeditions to Churí-tepui and Auyán-tepui. *Parakari* n. gen. can be distinguish from the other genera of this family, among other characters, in the nymphs by the absence of abdominal gills I, tarsal claws with subapical denticle larger than the others, right mandible with prostheca bifid and pectinate and with incisors positioned in obtuse angle to mola area, lingua with a tuft of setae, segment II of maxillary palpi with a concavity and a hole apically and segment II of labial palpi with a strong distomedial projection. In the adults the hind wings are absent and genitalia with segment II of forceps with a constriction, segment III elongate and long. Two new species are included in this genus; each one was collected at different tepui. A key and illustrations are included.

**Key words:** Venezuela, Tepui, Pantepui, taxonomy, systematic

### **Resumen**

Baetidae es una de las familias más diversas de Ephemeroptera. En América del Sur esta familia cuenta con 27 géneros y más de 130 especies. La región de las Guayanas es conocida por su extraordinaria diversidad y su alto nivel de endemismo, muy notable sobre todo en las cimas aplanadas de las mesetas localmente llamadas Tepuyes. Recientemente varias expediciones espeleológicas internacionales al Churí-tepui exploraron los sistemas de cuevas de estas montañas. En este trabajo se describe un nuevo género de Baetidae recientemente encontrado durante las expediciones anteriormente mencionadas a los tepuyes Churí y Auyán. *Parakari* gen. n. puede ser distinguido de los restantes géneros de esta familia, entre otros caracteres, en la ninfa por la ausencia de la branquia abdominal I, uñas tarsales con el denticulo subapical más grande que los otros, mandíbula derecha con la prosteca bífida y pectinada y los incisivos ubicados en ángulo obtuso respecto al área de la mola, lingua con un penacho de setas, segmento II del palpo maxilar con una concavidad y un agujero apicalmente y segmento II del palpo labial con una fuerte proyección distomedial. En los adultos, las alas posteriores están ausentes y la genitalia con el segmento II de los fórceps con una constricción y el segmento III largo y alargado. Dos especies nuevas son incluidas en este género, cada una de ellas fue colectada en diferentes tepuyes. Se incluyen una clave e ilustraciones.

**Palabras claves:** Venezuela, Tepui, Pantepui, taxonomía, sistemática

### **Introduction**

Baetidae is one of the most diverse families of Ephemeroptera. The nymphs of this family inhabit a variety of lotic and lenitic habitats with sandy or rocky substrate. Some nymphs live at high altitude (between 3000–4000 m a.s.l.) while others live at low altitude (100–400 m a.s.l.). In South America this family now encompassed 27 genera and

more than 130 species (Nieto, 2010). Most of these genera were described in the last decade of the 20<sup>th</sup> century, being *Corinnella* Thomas & Dominique (2006) the last genus described from this region.

The Guyana region is known for its extraordinary diversity and high level of endemism, which is, above all, remarkable at the tops of the isolated flat-topped table mountains – tepuis (Huber 2005, Rull 2005, Rull & Nogué 2007, Breure & Schlögl 2010). It is true also for many aquatic species with an endemic geographical distribution (e.g. Čiampor & Kodada 1999, Issa & Jaffe 1999, Kodada & Jäch 1999, Derka 2002, DeMarmels 2007, Derka *et al.* 2009, Derka & Fedor 2010). Tepuis are remains of a gigantic eroded surface that has been dissected by the Amazon and Orinoco basins. They are composed of quartzites and sandstones of the Precambrian Roraima Group, overlaying the igneous metamorphic Guyana Shield (Gibbs & Barron 1993). The ecological community of their summits, separated from surrounding wide lowlands and uplands by the sheer cliffs, is considered a distinct and discontinuous biogeographical province called Pantepui. Pantepui includes about 50 mountains (topographic islands) in southern Venezuela, northwestern Guyana and northern Brazil. They range from 1500 to 3000 m a.s.l., cover an area of about 5000 km<sup>2</sup> and their surface area ranges between 0.2 and 1096.3 km<sup>2</sup> (Berry *et al.* 1995, Huber 1995, McDiarmid & Donnelly 2005). Owing to its extremely difficult access, the area remains, however, poorly explored. Aquatic fauna of the tepui summits has been only poorly explored. Entire insect orders are practically unknown, e. g. the first mayfly and stonefly records were published only recently (Derka *et al.* 2009, 2010). Nowadays, various international speleological expeditions to Churí-tepui explored the cave systems of this mountain (Šmída *et al.* 2010). Here we describe a new genus of Baetidae found during mentioned expeditions to Churí-tepui and Auyán-tepui. Two new species are included in this genus; each one was collected at a different tepui.

## Material and methods

Nymphs were collected from all submerged substrates or microhabitats by manually picking the specimens or using a hydrobiological net. Adults were collected by entomological hand net. Some subimagines were captured and reared. Material was preserved in ethyl alcohol 96°.

Dissected parts of the specimens studied were mounted on microscope slides using Canada balsam as mounting media. All the material is preserved in ethyl alcohol 96°. Line drawings were done using a camera lucida attached to a microscope. The pictures of nymphs were taken using a digital camera Leica DFC 425 attached to a stereomicroscope Leica M205 C and Auto-Montage Pro version 5.0 software. The pictures of adults were taken using a NIKON SMZ-10 stereomicroscope or an OLYMPUS BX-51 microscope, with a Nikon D5000 digital camera. The holotypes are deposited in Instituto Miguel Lillo, Tucumán, Argentina (IML), paratypes are housed at IML; Museo del Instituto de Zoología Agrícola, Facultad de Agronomía, Universidad Central de Venezuela, Maracay, Venezuela (MIZA); and Department of Ecology, Faculty of Natural Sciences, Comenius University, Mlynská dolina, Bratislava, Slovakia (FNS).

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**Male Imago** (Figs. 15–18). Length: body: 6.4–6.5 mm; fore wings: 6.9–7.0 mm. Turbinate eyes oval, height of stalk  $\frac{1}{2}$  eye diameter (Fig. 16). Legs I–II broken-off, leg III with tibia 1.6 times the length of femur, tarsi  $\frac{1}{3}$  times the length of tibia; tarsi with 4 segments decreasing in length distally. Fore wings (Fig. 17) with paired long marginal intercalary veins; hind wings lacking. Genitalia with forceps three segmented, segment II with a constriction segment III elongate and long (Fig. 18).

**Female Imago.** Length: body: 5.7–6.0 mm; fore wings: 6.7–6.8 mm. Fore wings with paired marginal intercalary veins; hind wings lacking.

**Nymph.** Length of body: 4.5–5.5 mm. Cerci  $\frac{1}{2}$  the length of body, terminal filament subequal in length to cerci. Antennae partially broken-off and lost. Mouthparts: Labrum with setae dorsally, anterior margin with 6–7 spine-like setae near midline and a row of bipectinate setae laterally (Fig. 19b). Mandibles (Figs. 5–6, 20–21) with incisors fused apically and without setae between prostheca and mola. Left mandible (Figs. 5, 20) with prostheca robust with 12–13 denticles. Right mandible (Figs. 6, 21a–b) with incisors positioned in obtuse angle to mola area; prostheca bifid and pectinate. Hypopharynx (Figs. 7, 22) with lingua with a tuft of setae. Maxillae with four denti-

cles, first and fourth denticles with a pointed projection apically (Figs. 23b–c), palpi with two segments, segment II with a concavity and a hole apically (Fig. 23d). Labium (Figs. 9, 24) with glossae shorter than paraglossae and with a row of setae, paraglossae rectangular, with three rows of long robust and pectinate setae; palpi three segmented, segment II with a strong distomedial projection, segment III rounded.

Legs (Figs. 10, 25). Femora with a row of spines on dorsal edge and a pair of spines apically. Tarsal claws (Figs. 11, 26) with a row of denticles, subapical denticle larger than the others. Hind wing pads absent. Abdomen with gills on segments II–VII. Paraprocts with spines apically (Figs. 14, 29). Caudal filaments with spines every two segments. Terminal filament subequal in length to cerci; internal margin of cerci and lateral margins of terminal filament with long setae.

**Etymology.** Parakari is a local indian name of a fermented alcoholic beverage manufactured from cassava by Pemon Indians. This ethnic group inhabits the Gran Sabana region in SE Venezuela, where this genus was collected. We proposed this genus name in order to acknowledge the cultural heritage of Pemon people. The gender is masculine.

**Type species.** *Parakari churiensis* n. sp.

**Diagnosis.** This genus can be distinguished from the other genera of the family by the following combination of characters: In the male imago: 1) hind wings absent; 2) fore wings (Fig. 17) with paired long marginal intercalary veins; 3) genitalia with segment II of forceps with a constriction, segment III elongated (Fig. 18). In the nymph: 1) gills on abdominal segments I absent; 2) hind wing pads absent; 3) tarsal claws (Figs. 11, 26) with a row of denticles, subapical denticle larger than the others; 4) labrum with anterior margin with 6–7 spine-like setae near midline and a row of bipectinate setae laterally (Fig. 19b); 5) mandibles (Figs. 5–6) with incisors fused apically and without setae between prostheca and mola; 6) right mandible (Figs. 6, 21a–b) with incisors positioned in obtuse angle to mola area; prostheca bifid and pectinate; 7) hypopharynx (Figs. 7, 22) with lingua with a tuft of setae; 8) maxillae with four denticles, first and fourth denticles with a pointed projection apically (Figs. 23b–c), segment II of palpi with a concavity and a hole apically (Fig. 23d); 9) labium (Figs. 9, 24) with paraglossae rectangular and with three rows of long robust and pectinate setae, segment II of palpi with a strong distomedial projection.

In the key of nymphs of South American genera of Baetidae (Domínguez *et al.* 2006, pag. 58) the couplets 19–21 are modified to include *Parakari* n. g. as follow:

19 (17) Gills present on abdominal segments II–VII. ....	20
- Gills present on abdominal segments I–VII. ....	22
20 (19) Segment II of labial palpi with distomedial projection (Domínguez <i>et al.</i> 2006, Fig. 9F). ....	21
- Segment II of labial palpi without lateral projection (Domínguez <i>et al.</i> 2006, Fig. 69F). ....	<i>Zelus</i>
21 (20) Mandibles without setae between prostheca and mola (Figs. 5–6); right prostheca bifid (Fig. 6); segment II of maxillary palpi with a concavity and a hole apically (Fig. 23d). ....	<i>Parakari</i> n. g.
- Mandibles with setae between prostheca and mola; right prostheca robust with denticles apically; segment II of maxillary palpi not as above. ....	<i>Americabaetis</i>

Regarding phylogenetic relationship of *Parakari*, we included this genus into the matrix proposed by Nieto (2010). The analysis recovered *Parakari* in the Node R (Fig. 73, Nieto 2010), within *Tupiara* + *Acerpenna* + *Americabaetis* supported by two synapomorphies: paraglossae with three rows of setae and segment III of forceps elongated. *Americabaetis* and *Parakari* were recovered as sister groups by gill I and hind wings absent.

### Key to nymphs of *Parakari* n. g.

- 1 Posterior margin of abdominal terga with pointed spines (Fig. 12); labrum (Fig. 4) dorsally with one subapical setae near midline; labium (Fig. 9) with segment II of palpi with a thin distomedial projection ..... *P. auyanensis* n. sp.  
Posterior margin of abdominal terga with rounded spines (Fig. 27); labrum (Fig. 19a) dorsally with two subapical setae near midline, one short and one long; labium (Fig. 24a) with segment II of palpi with a broad distomedial projection .....  
..... *P. churiensis* n. sp.

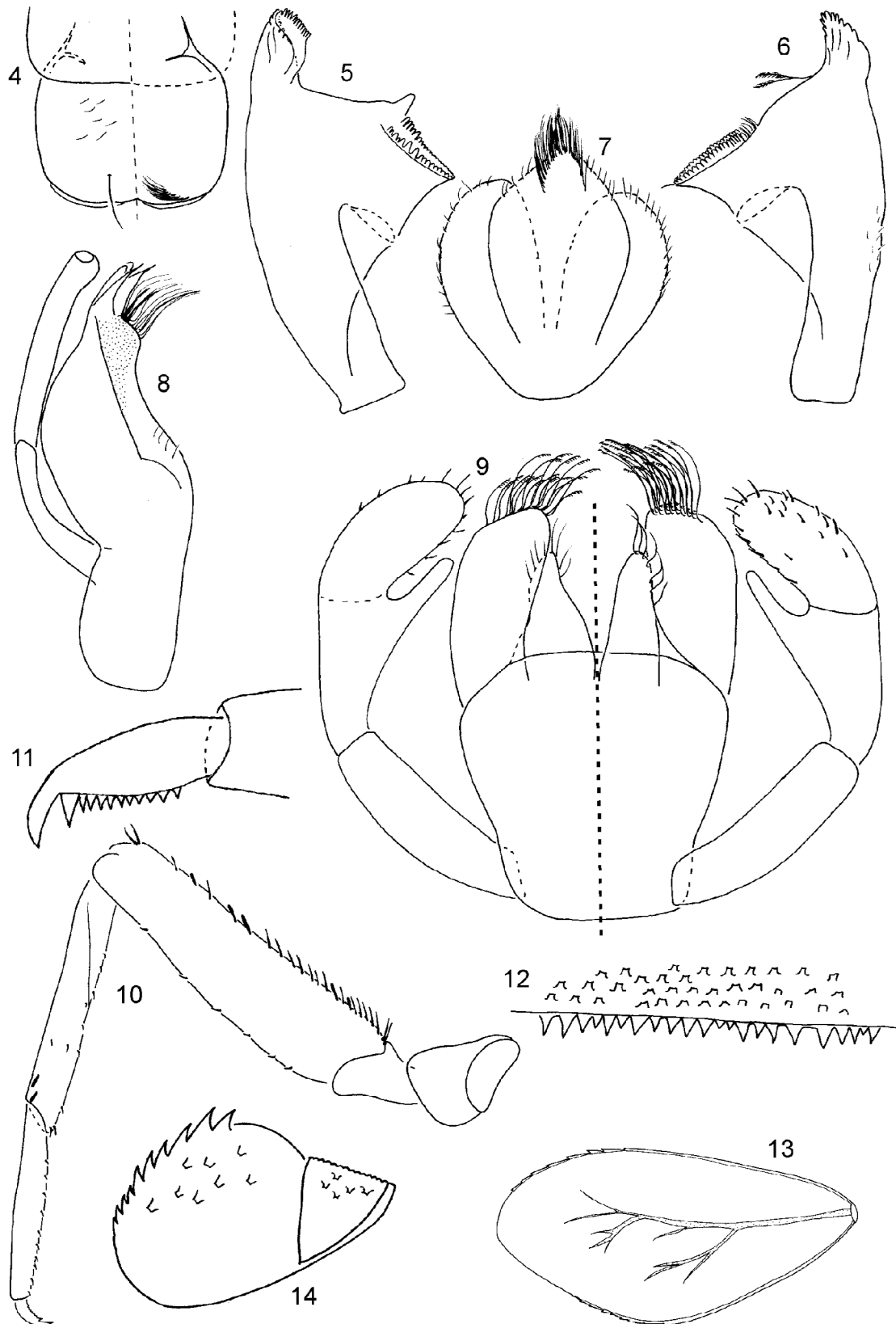
*Parakari auyanensis* new species Nieto & Derka

(Figs. 1, 4–14)

Adult. Unknown.



**FIGURES 1–3.** Nymphs, dorsal habitus. 1, *Parakari auyanensis* **sp. nov.** 2, *Parakari churiensis* **sp. nov.** 3, *Parakari churiensis* **sp. nov.**



**FIGURES 4–14.** *Parakari auyanensis* sp. nov. Nymph. Mouthparts (Figs. 4–9): 4, labrum, left d.v., right v.v.; 5, left mandible v.v.; 6, right mandible v.v.; 7, hypopharynx v.v.; 8, maxilla v.v.; 9, labium, left d.v., right v.v. 10, leg I; 11, tarsal claw I. 12, posterior margin of tergum IV. 13, gill IV. 14, paraproct.

**Nymph** (Fig. 1). Length: body: 4.5–4.7 mm; cerci: 2.5–2.6 mm; terminal filament: 2.3–2.4 mm. Antennae partially broken, scape and pedicel yellowish. Head yellowish brown. Eyes: compound eyes brownish, ocelli black. Antennae, yellowish brown. Mouthparts (Figs. 4–9): Labrum (Fig. 4) wider than long, dorsally with one subapical setae near midline. Left mandible (Fig. 5) with incisors positioned at right angle to mola area, thumb of mola area transverse to anterior margin. Right mandible (Fig. 6) with prosthema bifid apically. Hypopharynx (Fig. 7) with lingua longer than superlinguae. Maxillae (Fig. 8) with palpi subequal in length to galea-lacinia, segment I shorter than segment II. Labium (Fig. 9) with paraglossae with two nonpectinate blade-like setae (as in Fig. 24b), palpi with segment II with a thin distomedial projection, segment III twice longer than wide.

Thorax yellowish brown, fore wing pads brownish. Pleurae yellowish brown. Sterna pale yellow. Legs (Fig. 10): coxae and trochanter yellowish brown, femora, tibiae, tarsi and claws yellowish. Tarsal claw (Fig. 11) with 11–12 denticles. Abdomen segments I–X (Fig. 1) reddish brown. Posterior margin of terga with pointed spines (Fig. 12). Sterna pale yellow. Gills (Fig. 13) whitish, elongated, 1.5 times the length of each tergum, main and a few secondary tracheae pigmented. Paraprocts as in Fig. 14. Caudal filaments yellowish brown.

**Etymology.** Auyán-tepui is the name of the tepui where this species was collected.

**Diagnosis.** *Parakari auyanensis* n. sp. can be distinguished from the other species of the genus by the following combination of characters: 1) labrum (Fig. 4) dorsally with one subapical seta near midline; 2) left mandible (Fig. 5) with incisors positioned at right angle to mola; 3) prosthema of right mandible bifid apically (Fig. 6); 4) hypopharynx with lingua longer than superlinguae (Fig. 7); 5) maxillary palpi subequal in length to galea-lacinia (Fig. 8); 6) labial palpi with segment II with a thin distomedial projection (Fig. 9); 7) posterior margin of abdominal terga with pointed spines (Fig. 12).

**Material.** Holotype male nymph: VENEZUELA, Bolívar Province, NP Canaima, **Auyán Tepui Plateau**, Río Churún near to El Lecho camp; N 5° 49'34.6'', W 62° 32'27.9'', 1740 m.a.s.l., Loc. 9; 10/ I/ 2010, T. Derka & M. Svitok cols. Paratypes: 30 nymphs the same locality and collectors. 17 nymphs: head waters of Río Churún, ca. 30 min from El Oso camp, Loc. 8, 9/ I/ 2010, T. Derka & M. Svitok cols. 3 nymphs: stream below Salto Angel, 21.3°C, 24/ XI/ 2008, T. Derka & M. Svitok cols. 21 nymphs: Río Oso in El Oso camp, N 5° 47'1.4'', W 62° 32'12.5'', 1733 m.a.s.l., Loc. 7, 9/ I/ 2010, T. Derka & M. Svitok. 6 nymphs: Quebrada El Peñón in camp El Peñón, Auyán tepui massif, N 5° 44'40.4'', W 62° 32'29.7'', 1832 m.a.s.l., Loc. 5, 8/ I/ 2010, T. Derka & M. Svitok cols. Holotype and 20 paratypes are housed at IML; 10 paratypes are housed at MIZA; other paratypes are housed at FNS.

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(Figs. 2–3, 15–30)

**Male imago** (Figs. 15–16). Length: body: 6.4–6.5 mm; fore wings: 6.9–7.0 mm. Head yellowish brown, antennae yellowish brown. Eyes (Fig. 16): dorsal portion of turbinate eyes orange brown, stalk brownish, ventral portion black, bases of ocelli black. Thorax brownish (Fig. 15), mesoscutum (MS) pale brown, submesoscutum (SMS) brownish. Metascutellum brownish, medial projection pale brown. Pleurae yellowish brown. Prosternum pale yellow, meso and metasterna yellowish brown. Legs pale yellow. Wings hyaline (Fig. 17), costal and subcostal spaces of fore wings translucent. Abdomen pale yellow except segments VII–VIII brownish. Genitalia (Fig. 18) yellowish. Cerci broken-off and lost.

**Female Imago.** Length: body: 5.7–6.0 mm; fore wings: 6.7–6.8 mm. Head reddish brown, antennae reddish brown; compound eyes blackish. Thorax: pronotum reddish brown, mesoscutum yellowish, submesoscutum brownish, metascutellum yellowish brown. Pleurae and sterna yellowish. Legs yellowish. Wings hyaline, costal and subcostal space of fore wings translucent. Abdomen: segments I–VIII reddish brown, segments IX–X pale yellow, sterna pale yellow. Cerci broken off and lost.

**Nymph** (Figs. 2–3). Length: body: 5.2–5.5 mm; cerci: 2.5–2.6 mm; terminal filament: 2.3–2.4 mm. Head yellowish brown. Eyes: compound eyes orange brown, ocelli black. Antennae yellowish brown.

Mouthparts (Figs. 19–24): Labrum (Fig. 19a) subquadrangulate, dorsally with two subapical setae near midline, one short and one long. Left mandible (Fig. 20) with incisor positioned at obtuse angle to mola area, thumb of mola area transverse to anterior margin. Right mandible (Figs. 21a–b) with incisors elongated, prosthema bifid basally. Hypopharynx (Fig. 22) with lingua subequal in length to superlinguae. Maxillae (Fig. 23a) with crown

with two long pectinated setae, palpi longer than galea-lacinia, segment I longer than segment II. Labium (Fig. 24a) with paraglossae with two nonpectinated blade-like setae (Fig. 24b), segment II of palpi with a broad distomedial projection, segment III slightly longer than wide.

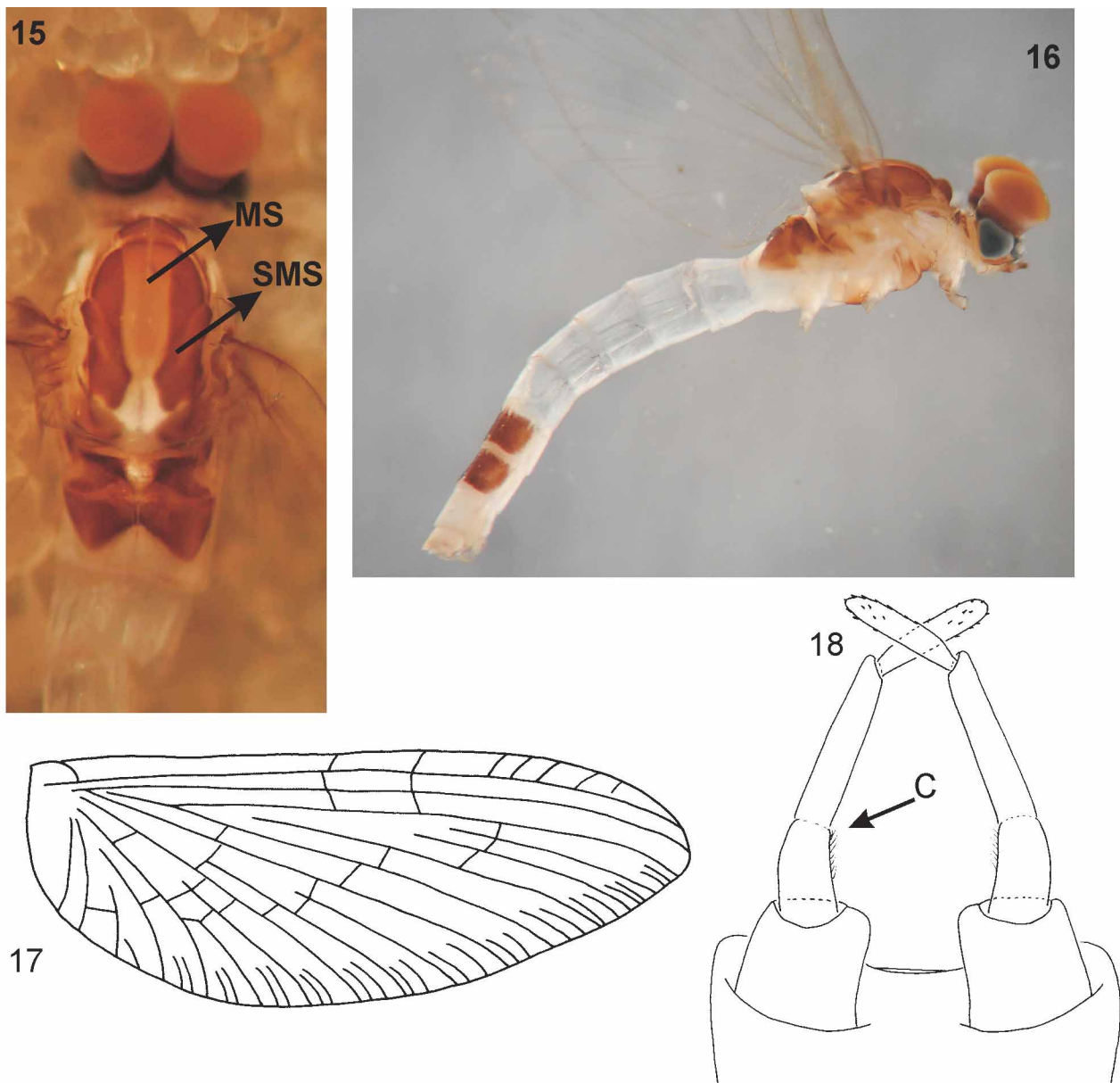
Thorax yellowish brown, fore wing pads yellowish. Metanotum brownish. Legs (Fig. 25): femora yellowish, tibiae, tarsi and claws yellowish brown. Tarsal claws (Fig. 26) with 10–11 denticles. Pleurae yellowish brown, sterna pale yellow.

Abdomen segments I–VI, IX–X (Fig. 2) yellowish, segments VII–VIII brownish. Posterior margin of terga with rounded spines (Fig. 27). Sterna pale yellow. Gills whitish (Fig. 28), rounded, subequal in length of each tergum, main trachea pigmented. Paraprocts as in Fig. 29. Caudal filaments yellowish (Fig. 30).

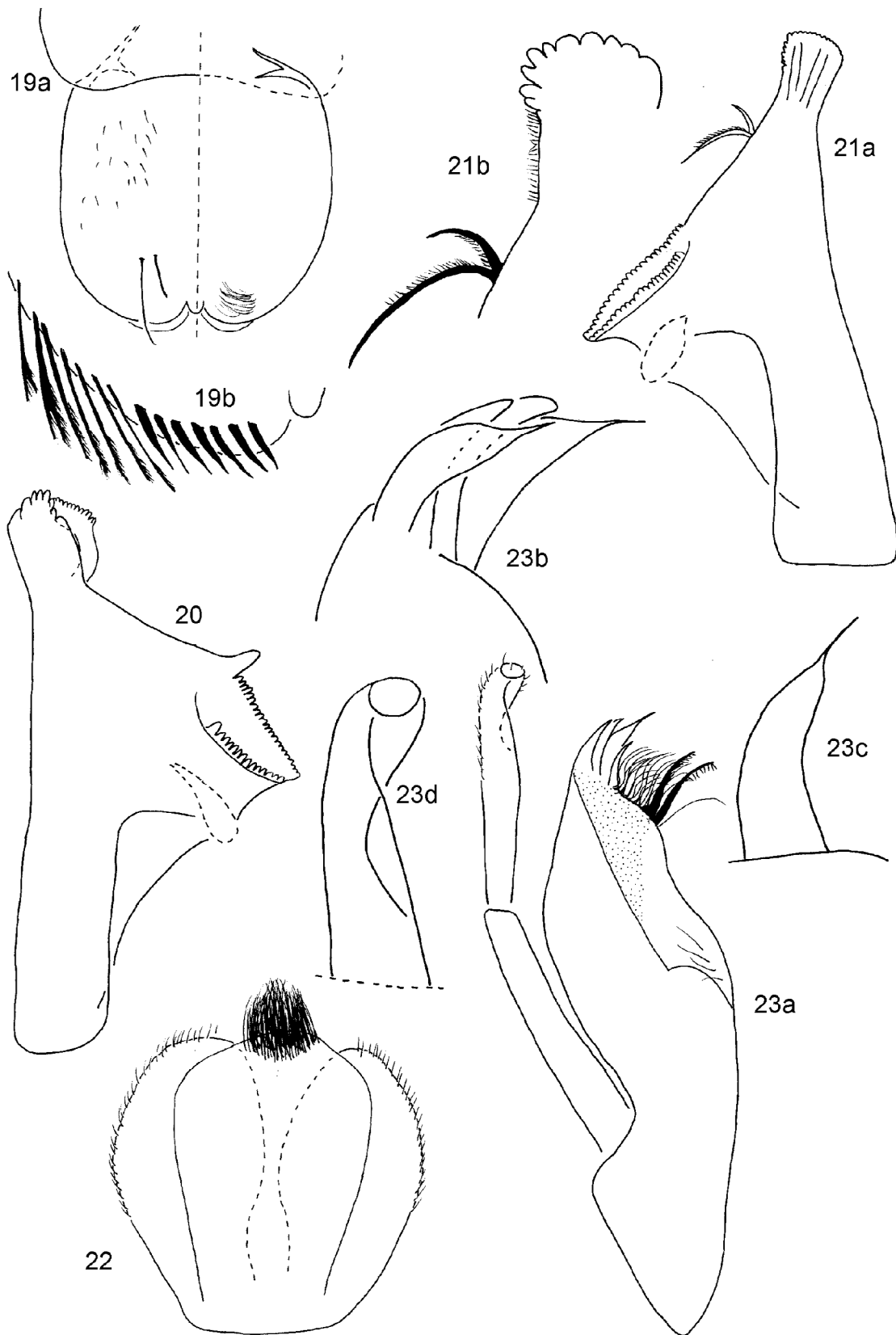
**Variation.** some nymphs present the abdominal segments I–X yellowish (Fig. 3).

**Etymology.** Churí-tepui is the name of the tepui from the Chimantá Massif where this species was collected.

**Diagnosis.** *Parakari churiensis* n. sp. can be distinguished from the other species of the genus by the following combination of characters. In the nymph: 1) labrum (Fig. 19a) dorsally with two subapical setae near midline, one

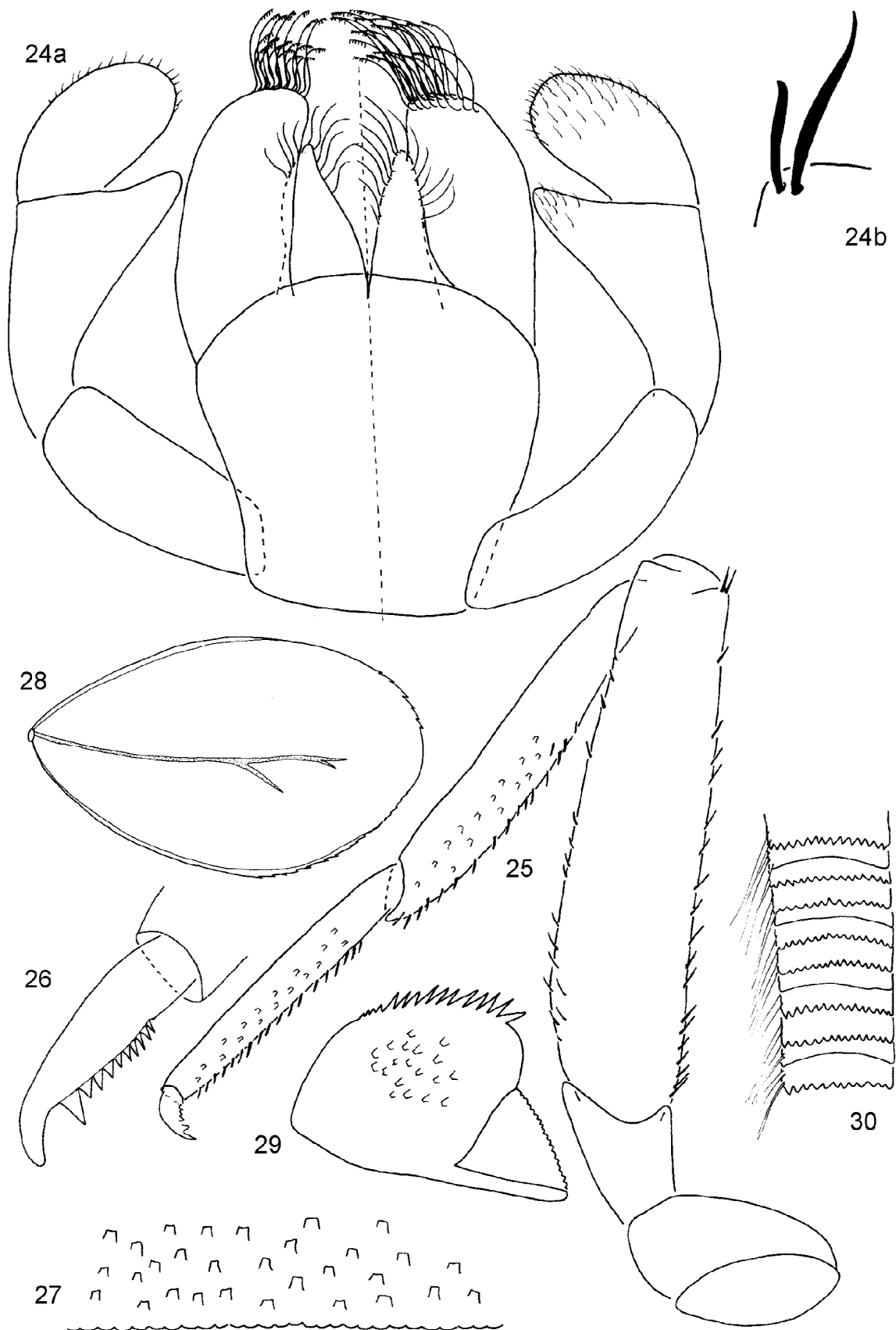


**FIGURES 15–18.** *Parakari churiensis* sp. nov. Male imago. 15, dorsal view (MS: mesoscutum, SMS: submesoscutum). 16, lateral view. 17, fore wing. 18, genitalia, C: constriction.



**FIGURES 19–23.** *Parakari churiensis* sp. nov. Nymph. Mouthparts (Figs. 19–23): 19a, labrum, left d.v., right v.v.; 19b, labrum: apical setae; 20, left mandible v.v.; 21a, right mandible v.v.; 21b, right mandible: prostheca detail; 22, hypopharynx v.v.; 23a, maxilla v.v.; 23b, denticles detail; 23c, denticule I detail; 23d, maxillary palpi, segment II detail.

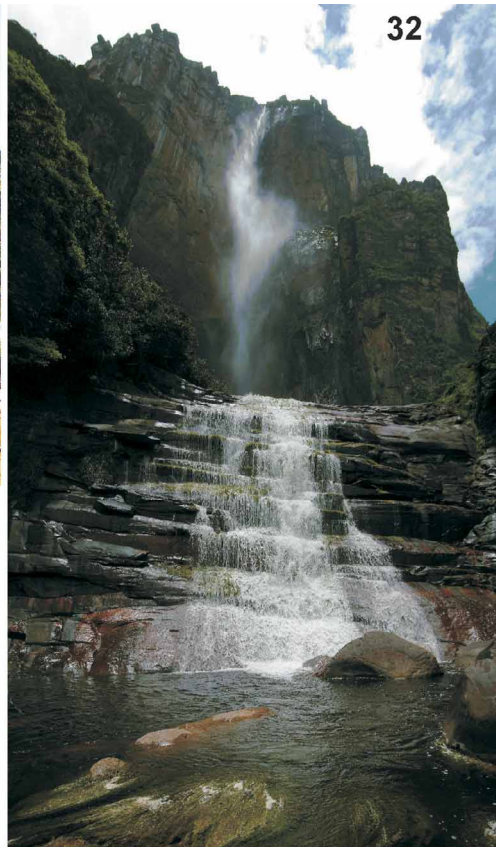
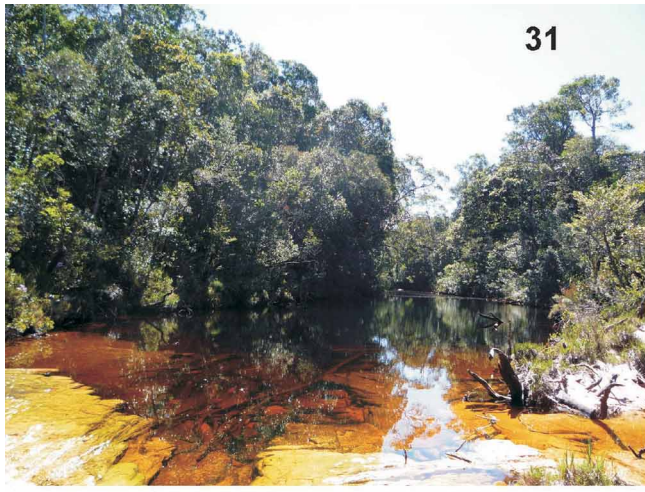




**FIGURES 24–30.** *Parakari churiensis* sp. nov. Nymph. 24a, labium, left d.v., right v.v.; 24b, paraglossae: two nonpectinate blade-like setae detail. 25, leg I; 26, tarsal claw I. 27, posterior margin of tergum IV. 28, gill IV. 29, paraproct. 30, cercus.

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**FIGURES 31–33.** Sampling sites. 31, Auyán Tepui, Río Churún (Loc. 9); 32, stream below Salto Angel; 33, Churí Tepui, stream at the Plateau above Cueva Charles Brewer (Loc. 6); 34, Churí Tepui, spring stream below waterfall at Río Olinka (Loc. 8); 35, Churí Tepui, Río Olinka (Loc. 11).

TABLE 1. Sampling sites and ambient variables.

Locality	pH	Conductivity ( $\mu\text{S}\cdot\text{cm}^{-2}$ )	Temperature ( $^{\circ}\text{C}$ )	Stream width (m)	Stream depth (m)	Bottom substrate
<b>Churí Loc. 6</b>	4.35	14.0	14.0	1.0–3.0	0.03–1.5	bedrock, locally small depositions of gravel and stones, tree roots
<b>Churí Loc. 7</b>	4.5	9.0	13.6	<4	-	bedrock, locally small depositions of gravel
<b>Churí - Cueva Charles Brewer-the end</b>	4.58	9.0	14.0	-	-	bedrock, sand, rarely stones and plant detritus
<b>Churí Loc. 8</b>	4.38	18	14.3	0.3–1	0.01–0.3	bedrock, coarse sand, moss, tree roots
<b>Churí Loc. 9</b>	3.3	25	17.5	0.7–4	0.01–1.5	sand, stones, woody debris, tree roots
<b>Churí Loc. 11</b>	4.48	9	13.6	5–10	0.2–1	bedrock, locally small depositions of gravel, moss
<b>Churí Loc. 13</b>	3,75	17	16.8	0.2–1.5	0.1–0.7	vascular plants, filamentous algae, rarely stones
<b>Auyán Loc. 5</b>	-	-	14.6	2–5	0.1–1	bedrock, gravel, leaves, woody debris, tree roots
<b>Auyán Loc. 7</b>	-	-	14.9	2–4	0.1–1	bedrock, stones, woody debris, tree roots
<b>Auyán Loc. 8</b>	-	-	21.1	18	0.02–0.3	bedrock, only locally small depositions of gravel and stones
<b>Auyán Loc. 9</b>	-	-	19,7	6–15	0.5–2	bedrock, locally depositions of sand, woody debris
<b>Stream below Salto Angel</b>	-	-	21.3	10–15	0.5–2	stones, gravel

short and one long; 2) left mandible (Fig. 20) with incisors positioned at obtuse angle to mola area; 3) right mandible with incisors elongated (Fig. 21a), prosthema bifid basally (Fig. 21b); 4) hypopharynx (Fig. 22) with lingua subequal in length to superlinguae; 5) maxillary palpi (Fig. 23a) longer than galea-lacinia; 6) labial palpi (Fig. 24a) with segment II with a broad distomedial projection; 7) posterior margin of abdominal terga with rounded spines (Fig. 27). In the adult, 1) thorax with medioscutum pale brown, submedioscutum brownish.

**Material.** Holotype: male nymph: VENEZUELA, Bolívar Province, Chimantá Massif, **Churí-tepui**, Cueva Charles Brewer (the end), 17/ I/ 2009. T. Derka col. Paratypes: 34 nymphs the same locality and collector. 15 nymphs: spring stream below waterfall at Río Olinka originating in Cueva Juliana, 2300 m.a.s.l., Loc.8, 20/ I/ 2009, T. Derka col. 91 nymphs, 3 male and 12 female imagos (dried and damaged from spider web) and 2 male and 3 female subimagos: Quebrada Lila, a stream at the Plateau above Cueva Charles Brewer, 2400 m.a.s.l., Loc. 6, 26/ I/ 2009, T. Derka col. 132 nymphs, 10 female and 8 male subimagos (reared), 1 male imago (reared): Cueva Charles Brewer (entrance), 2300 m.a.s.l., 15/ I/ 2009, T. Derka col. 62 nymphs and 2 male imagos (reared): Quebrada Lila, a stream at the Plateau above Cueva Charles Brewer, 2400 m.a.s.l., Loc. 6, 21/ I/ 2009, T. Derka col. 52 nymphs: stream above Pozo Capuchino, 2300 m.a.s.l., Loc. 7, 16/ I/ 2009, T. Derka. 1 nymph: Río Olinka, stream above waterfall above Cueva Juliana, 2300 m.a.s.l., Loc. 11, 19/ I/ 2009, T. Derka col. 3 female imagos (dried and damaged from spider web), 7 male and 7 female subimagos: Canyon below Cueva Charles Brewer, 28/ I/ 2009, T. Derka col. 1 nymph: springs of Western river, Loc. 13, 23/ I/ 2009, T. Derka col. 55 nymphs: river below Cueva Juliana, ca. 2300 m.a.s.l., Loc. 9, 20/ I/ 2009, T. Derka col. 1 nymph: Cueva Colibrí, 26/ I/ 2009. Holotype and 63 paratypes are housed at IML; 20 paratypes housed at MIZA; other paratypes are housed at FNS.

**Biology.** All material was collected in streams at tepuis plateaus (Figs. 31, 33–35). The only exception was material from the stream below Salto Angel (Fig. 32), the highest waterfall on the Earth (979 m), which drops down directly from the plateau of Auyán tepui. The material was collected from different types of streams, from spring streams to bigger mountain rivers. All streams are typically oligotrophic, with low conductivity from 9 to 18  $\mu\text{S}\cdot\text{cm}^{-2}$  and acid water with pH ranging between 3.75 and 4.58 (Table 1). Streams have mostly bedrock bottom with only minor accumulations of sands, gravels, stones and detritus. Due to geological conditions, nymphs must be able to withstand high current velocities and fluctuations without possibility to hide into hyporheal. Nymphs inhabit environments with wide range of temperatures from oligostenothermal cave streams with stable temperatures around 13–14 °C to wide and shallow streams with high daily thermal fluctuations with maximum temperatures exceeding more than 21 °C during sunny days. Subimagos were observed flying one hour before sunset. Potential predators of nymphs are dragonfly and dobsonfly larvae. Curiously, some nymphs of *P. churiensis* were found in bladder tramps of *Utricularia humboldtii* (T.D. pers. observ.).

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