

The adult and redefinition of the genus *Prebaetodes* Lugo-Ortiz & McCafferty (Ephemeroptera: Baetidae), with description of a new species from Venezuela

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The adult stage of *Prebaetodes* Lugo-Ortiz & McCafferty is described for the first time based on reared specimens from Venezuela. The adults of the genus can be distinguished from other genera of South American Baetidae by the following combination of characters: paired marginal intercalaries of forewings, anal area rounded and relatively narrow; hind wings absent; male eyes turbinate, contiguous basally and slightly separated dorsally; segment I of forceps without distomedial projection, segment III elongated and uniformly slender. Additionally, a new species, *P. meridinensis* is described based on nymphs and imagines, and notes on its biology are included. The genus is herein redefined based on variations of characters observed in the new species and the adult generic description.

Keywords: *Prebaetodes*; new species; South America; Venezuela; Andean streams

Introduction

Prebaetodes Lugo-Ortiz & McCafferty, currently a monotypic genus, is known only from the nymphal stage, like some of the other South American baetid genera (Dominguez, Molineri, Pescador, Hubbard and Nieto 2006). The genus was established by Lugo-Ortiz and McCafferty (1996a) for *P. sitesi* Lugo-Ortiz & McCafferty, described from nymphs from Colombia and Ecuador. Dominguez et al. (2006) had indicated that the genus occurs in Venezuela, but we have not found published taxonomic papers of the taxon in the country until now. Its presence in Venezuelan rivers has been mentioned in a few ecological works (Pérez and Segnini 2005; Chacón and Segnini 2007), but without taxonomic confirmation. *Prebaetodes* belongs to the *Baetodes* complex which includes the genera *Baetodes* Needham & Murphy, *Mayobaetis* Waltz & McCafferty, *Moribaetis* Waltz & McCafferty (Lugo-Ortiz and McCafferty 1996a), and the most recently described genus *Lugoiops* McCafferty & Baumgardner (McCafferty and Baumgardner 2003). Like the other members of the *Baetodes* complex, *Prebaetodes* is South American in origin

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(McCafferty 1998), and is one of the 17 endemic genera recorded from the Neotropical Region (Lugo-Ortiz and McCafferty 1999).

Based on the variation of nymphal and adult characters we have observed on the new species and the first generic description of the alate forms, the genus is herein redefined.

Materials and methods

Adults of *P. meridinensis* were reared in the laboratory from mature nymphs collected from Río La Picón, 2200 m, 8°37'57" N, 71°02'12" W, Mérida, Venezuela. The nymphs were kept in artificial streams, with an average water temperature of 12°C and photoperiod of 12:12. Subimagines were kept in a dark room at approximately 17°C until emergence to imago, which generally occurred early in the morning. All measurements were made using a calibrated ocular micrometer and are given to the nearest 0.5 mm. Terminology for the adult thoracic morphology proposed by Tsui and Peters (1975) and Kluge (1994) is used in the description of the adults. Eyes of male imagines were measured as follows: length, distance between midposterior and midanterior margins of dorsal surface; width, distance between midlateral margins. Length of labrum was measured as distance between midposterior margin and anteromedial emargination. In descriptions of structures of the legs, we use the terms "spine-like setae" and "hair-like setae" as synonyms for "stout, simple setae" and "fine, simple setae" respectively, terms used by Lugo-Ortiz and McCafferty (1996a). For the margins of the femora, tibiae and tarsi, we use the terminology of Hubbard (1995).

Prebaetodes Lugo-Ortiz & McCafferty, 1996 (Figures 1–26)

Prebaetodes Lugo-Ortiz & McCafferty 1996: 371, figures 19–22 and 25–37; Dominguez et al. 2006: 172, figures 57A–K.

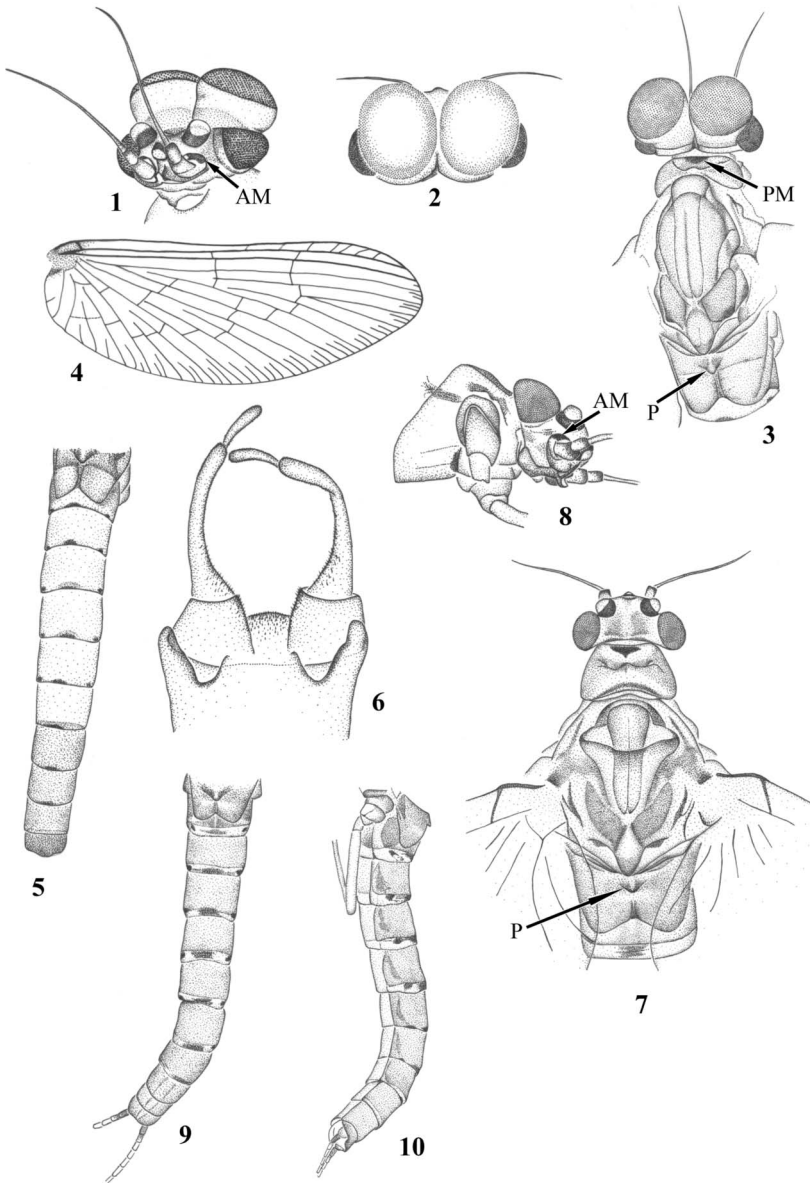
Type species: *Prebaetodes sitesi*

Other species: *Prebaetodes meridinensis* sp. n.

Imago

Head of ♂ (Figures 1–3, 7–8). Compound eyes turbinate, height of stalk approximately 0.5 times length of dorsal surface, stalks contiguous at the bases and slightly separated dorsally (Figures 2 and 3), dorsal surface (Figure 2) nearly round (length slightly longer than width); antennae (Figures 1 and 7) as long as width of cephalic capsule.

Thorax (Figures 3, 7). Forewings (Figure 4) with paired marginal intercalaries, anal region rounded and relatively narrow (not extended beyond the first abdominal segment); hind wings absent. Legs of ♂. Prothoracic legs with tibiae almost twice the length of femora and 1.5 times the length of tarsi, tarsi with four segments decreasing in length distally; mesothoracic and metathoracic legs with tibiae 1.5 times length of femora and almost 4 times length of tarsi, segments 1 and 4 of tarsi equal in length and approximately twice longer than segments 2 and 3. Legs of ♀. All legs of similar length, tibiae about 1.4 times length of femora and three times length of tarsi, tarsal segments same as in mesothoracic and metathoracic legs of ♂. Metanotum with posteriorly directed medial protuberance (Figures 3 and 7).



Figures 1–10. *Prebaetodes meridinensis*, male and female adult. (1) Male head (frontal); (2) male head (dorsal); (3) head, thorax and first abdominal segment of male (dorsal); (4) forewing; (5) male abdomen (dorsal); (6) genitalia; (7) head, thorax and first abdominal segment of female (dorsal); (8) head and prothorax of female (lateral); (9) female abdomen (dorsal); (10) female abdomen (lateral). AM = antennal macula, PM = pronotal macula, P = protuberance

Abdomen (Figures 5, 6, 9, 10). Male genitalia (Figure 6), forceps three-segmented; segment I short, nearly as long as wide, slightly wider at base, without distomedial projection; segment II elongated and gradually widened in its basal fourth, segment III elongated and uniformly slender.

Nymph

Head (Figure 11). Antennae (Figure 12) long, 3–4 times the width of cephalic capsule; scape 1.5 times the length of pedicel; only pedicels with a dorsolateral row of long, simple setae and with scale-like tubercles. Lateral margins of frons broadly connected to clypeus.

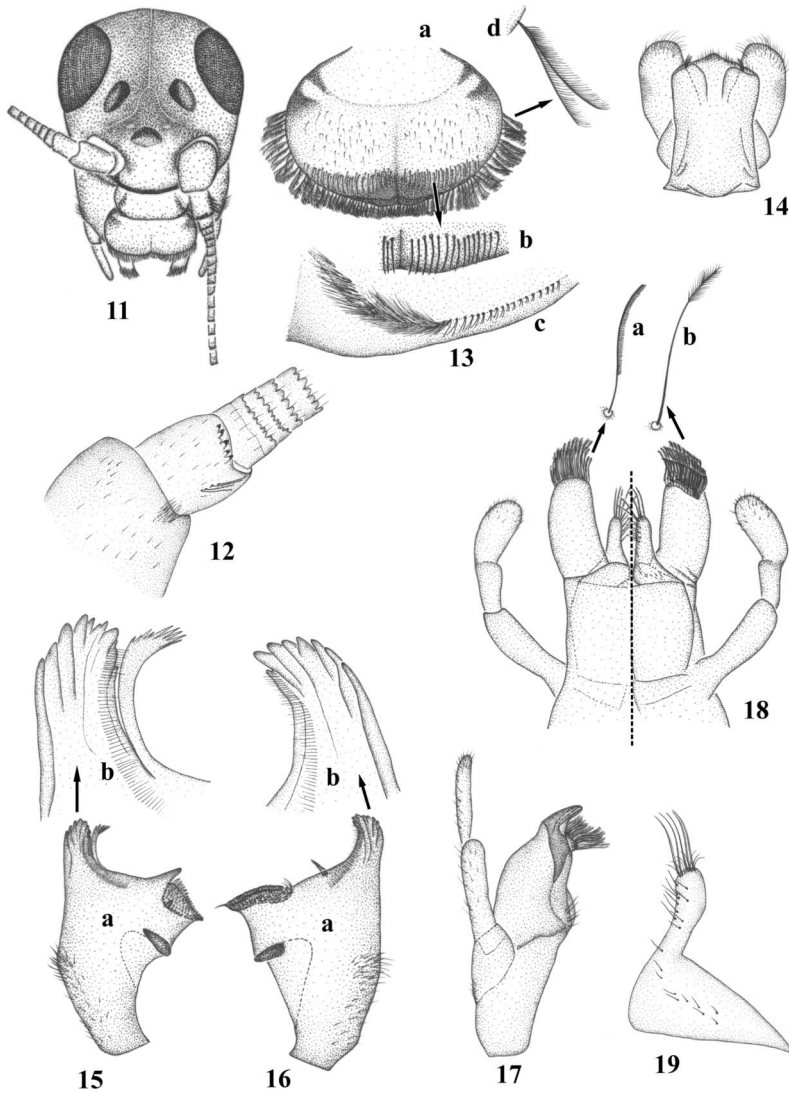
Mouthparts (Figures 13–19). *Labrum* rounded, basally narrow, laterally expanded, with lateral margins curved from the base; anteromedial emargination shallow; width 2.2–3.0 times length; dorsally with two rows of setae, a submarginal transverse row of long and slender setae and a marginal row of long bifid and pectinate setae (Figures 13a, b, d); ventrally with a row of branched setae (Figure 13c). *Hypopharynx* (Figure 14), lingua broad, somewhat rectangular, shorter than superlinguae, with a distomedial projection and a pair of tuft of setae anterolaterally; superlinguae narrow and elongate. *Mandibles* (Figures 15 and 16), incisors fused apically; lateral margins somewhat curved, with long, simple dorsal setae not extending beyond basal half; left prosthema very close to incisors, with setae or denticles distally; right mandible with prosthema spine-like and serrate medially, and tuft of setae at base of mola. *Maxillae* (Figure 17), four elongate denticles on galealaciniae; a inner hump near midregion; a row of long, simple setae on inner hump; palpi two-segmented, slightly longer than galealacinia. *Labium* (Figures 18 and 19), palpi three-segmented, segment I as long as segments II and III combined; segment II nearly 0.5 times length of segment III, slender and without projection; segment III ellipsoidal; glossae basally broad and apically narrow and round, with scattered short, simple setae ventrally, and long pectinate setae distally (Figure 19); paraglossae, 1.3–1.4 times longer than glossae, 2.5–3.9 times wider and subequal width to glossae (distally and basally, respectively), medial margin slightly or strongly concave, with three ventrodistal rows of long setae (two most proximal rows have pectinate setae, the most distal row has pectinate or plumose setae).

Thorax. Legs (Figure 20) without villopore; femora elongate, apically round, ventral and dorsal edges subparallel, dorsal edge with a row of long, hair-like setae interrupted with long spine-like setae (the last two are contiguous), ventral edge with short spine-like setae; tibiae elongate and slender, nearly as long as femora, dorsal edge with long spine-like or blunt setae and long hair-like setae, ventral edge with short spine-like setae; tarsi slender, 0.33–0.48 times the length of tibiae, dorsal edge with long hair-like setae, ventral edge with spine-like setae gradually increasing in size toward distal edge; tarsal claws elongate, with a row of denticles, apical denticle enlarged, and a lateral subapical strong seta (Figure 21).

Abdomen (Figures 22, 24, 26). Terga with scales, posterior margins with irregular triangular spination (Figure 22). Gills (Figure 23) on segments I–VII, oval, marginally serrate and with fine, simple setae, gill I highly reduced. Paraprocts (Figure 25) with posterior margins smooth and submarginal spines. Terminal filament 0.16–0.30 times length of cerci, with rudimentary setation. Cerci with long setae on inner side.

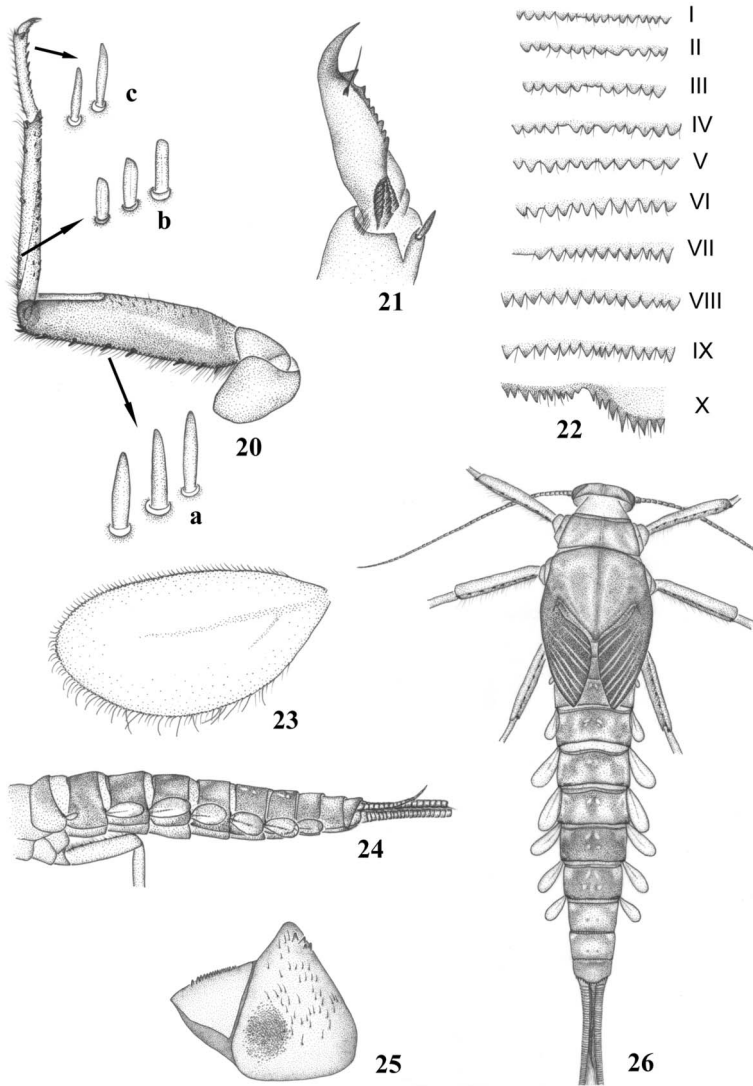
Discussion

Adults of *Prebaetodes* are herein described for the first time but can be distinguished from the other genera of Baetidae from South America by the following combination of characters: (1) forewings with paired marginal intercalaries, anal area rounded and relatively narrow (not extended beyond the first abdominal segment); (2) hind



Figures 11–19. *Prebaetodes meridinensis*, nymph. (11) Head (frontal); (12) antennal scape and pedicel; (13a) labrum, dorsal (complete), (13b) detail of dorsal submarginal row of setae of labrum, (13c) labrum, ventral (right distal portion), (13d) detail of the marginal setae of labrum; (14) hypopharynx (ventral); (15a) left mandible (dorsal); (15b) left mandible, detail of incisors; (16a) right mandible (dorsal); (16b) right mandible, detail of incisors; (17) maxilla (ventral); (18) labium, left (dorsal), right (ventral), with details of the (a) pectinated and (b) plumose setae of paraglossae; (19) detail of glossae (ventral).

wings absent; (3) male eyes turbinate, contiguous basally and slightly separated dorsally, dorsal surfaces nearly round; (4) forceps, segment I without distomedial projection, segment III elongated and uniformly slender. In Dominguez et al. (2006), the adults of *Prebaetodes* would key to *Americabaetis* Kluge, because both genera have segment III of forceps elongated. Based on the comparison of our material of *Prebaetodes* with some adults (males and females) of *Americabaetis* spp. from Venezuela, reared from nymph, and with the original descriptions of South



Figures 20–26. *Prebaetodes meridinensis*, nymph. (20) Leg I, with (a) details of the long spine-like setae on posterior edge of femur, (b) blunt setae on posterior edge of tibia, and (c) spine-like setae on anterior edge of tarsus; (21) tarsal claw I; (22) posterior margin of terga I–X; (23) gill IV; (24) abdomen (lateral); (25) left paraproct (ventral); (26) habitus.

American species of *Americabaetis* known from nymphs and adults [*A. alphus* Lugo-Ortiz & McCafferty, *A. longetron* Lugo-Ortiz & McCafferty, *A. robacki* (Lugo-Ortiz & McCafferty), *A. titthion* Lugo-Ortiz & McCafferty (Lugo-Ortiz and McCafferty 1996b; Salles, Lugo-Ortiz and Da Silva 2004; Salles and Boldrini 2008)], we found that the male adults of *Prebaetodes* can be distinguished from *Americabaetis* by: (1) shape of segment III of forceps, uniformly slender in *Prebaetodes*, distally expanded in *Americabaetis*; and (2) male compound eyes: turbinate portions, contiguous at base and slightly separated dorsally in *Prebaetodes*, entirely separated in *Americabaetis*;

dorsal surfaces, nearly round (width > 0.80 times the length) in *Prebaetodes*, ellipsoidal (width about 0.5 times the length) in *Americabetis*. The female adults of both genera are less distinctive and morphologically difficult to distinguish.

The additional nymphal characters that we have observed in our material but were not mentioned in the original description of the genus by Lugo-Ortiz and McCafferty (1996a) are included herein. Some questionable generic characters which were listed by Lugo-Ortiz and McCafferty (1996a) and Dominguez et al. (2006) are also discussed.

Based on the series of nymphs that we have studied, the nymphs of *Prebaetodes* can be distinguished from the other genera of South American Baetidae by the following combination of characters. (1) Antennae 3–4 times the width of cephalic capsule, scape 1.5 times the length of pedicel, only pedicels with a dorsolateral row of long, simple setae and with scale-like tubercles. (2) Labrum rounded, basally narrow, laterally expanded, with lateral margins curved from the base, width 2.2–3.0 times length; dorsally with two rows of setae, a submarginal transverse row of long and slender setae and a marginal row of long bifid and pectinate setae. (3) Hypopharynx with lingua shorter than superlinguae, with a distomedial projection and a pair of tuft of setae antero-laterally. (4) Mandibles with incisors fused apically; right prosthema spine-like. (5) Maxillae with four elongate denticles on galealaciniae; a inner hump near midregion; a row of long, simple setae on inner hump; palpi two-segmented, slightly longer than galealacinia. (6) Labium: palpi with segment II nearly 0.5 times length of segment III, slender and without projection; segment III ellipsoidal; glossae with scattered short, simple setae ventrally, and long pectinate setae distally; paraglossae, 1.3–1.4 times longer than glossae, 2.5–3.9 times wider and subequal width to glossae (distally and basally respectively), with three ventrodorsal rows of long setae (two most proximal rows have pectinate setae, the most distal row has pectinate or plumose setae). (7) Legs: dorsal edge of femora with a row of long, hair-like setae interrupted with long spine-like setae (last two contiguous); tarsi with ventral edge with spine-like setae gradually increasing in size toward distal edge; tarsal claws with a row of denticles, apical denticle enlarged, and a lateral subapical strong seta. (8) Posterior margins of abdominal terga with irregular triangular spination. (9) Gills on segments I–VII, marginally serrate and with fine, simple setae, gill I highly reduced. (10) Paraprocts with posterior margins smooth and submarginal spines. (11) Terminal filament 0.16–0.30 times length of cerci.

Some of the generic characters that Lugo-Ortiz and McCafferty (1996a) have listed for original description of *Prebaetodes* differ from what was observed in our specimens. These characters are: (1) a dorsolateral row of long, fine, simple setae on scapes; (2) segment II of labial palpi medially concave; (3) tibiae somewhat twisted; (4) tarsi 0.33 times the length of tibiae; and (5) terminal filament < 0.25 but \geq 0.20 times the length of cerci. In our material, these characters are as follows: (1) absence of dorso-lateral row of long, fine, simple setae on antennal scapes; (2) segment II of labial palpi somewhat straight medially; (3) tibiae straight; (4) tarsi approximately 0.45 times the length of tibiae; and (5) terminal filament 0.16–0.23 times the length of cerci. The variations found between our material and the description given by these authors suggest that those characters are not generic and hence would be exclusive for *P. sitesi*.

Likewise, our material differs with some of the characters that were added later by Dominguez et al. (2006) for description of the genus, such as: (1) length of antennae: 3–4 times the width of cephalic capsule in our specimens, three times

the width of cephalic capsule according to Dominguez et al. (2006). (2) Width of labrum: twice the length (on midregion) in our material, three times the length in Dominguez et al. (2006). (3) Shape of marginal setae of labrum: in our material, these setae are bifid basally and pectinate; Dominguez et al. (2006) described these setae as bipectinate with basally bifid setae near midline and apically bifid setae at lateral margin, although, as illustrated in their figure 57C, all of those setae seem basally bifid and pectinate, as described above for our specimens (Figure 13d). (4) Length and width of paraglossae: in our material, paraglossae, 1.3–1.4 times longer than glossae, 2.7–3.9 times wider and 0.8–1 times as wide as glossae (distally and basally, respectively); in Dominguez et al. (2006) paraglossae are 1.3 times longer and 2.5 times wider than glossae. (5) Shape of ventral–distal rows of long setae on paraglossae: in our specimens, the two most proximal rows of setae are pectinate, the distal row has plumose setae; according to Dominguez et al. (2006) all three rows of setae are pectinate. (6) Length of terminal filament: 0.16–0.23 length of cerci in our specimens, 0.25–0.30 length of cerci in Dominguez et al. (2006).

On the other hand, some of the characteristics given for *P. sitiesi* (Lugo-Ortiz and McCafferty 1996a) were also observed in our specimens; these are: (1) labrum with a submarginal cluster of long, simple setae dorsally; (2) maxillae with four sharp denticles on galealaciniae and long, simple setae on medial hump; (3) glossae with scattered short, simple setae ventrally; (4) femora and tibiae: dorsal edge with long, robust, simple setae (in femora, last two contiguous) and long, fine, simple setae; ventral edge with short, stout, simple setae; (5) tarsi with robust, simple setae of increasing size on ventral edge; (6) tarsal claws with distal denticle largest; (7) posterior margin of abdominal terga with irregular triangular spination; (8) gills marginally serrate and with fine, simple setae; (9) paraprocts with submarginal spines. Consequently, we conclude that these characteristics are not exclusive for *P. sitiesi* and therefore should be diagnostic of the genus.

***Prebaetodes meridinensis* sp. n.** (Figures 1–26)

Material examined. Holotype, ♂ imago (reared), VENEZUELA, Edo. Mérida, Sector La Mucuy, Río La Picón, 2,200 m, 8°37'57" N, 71°02'12" W, 7/X/2005. M. M. Chacón and S. Segnini. Allotype, ♀ imago (reared), same data as holotype except date of collection, 22/IX/2005. Paratypes: two ♀ imagines (reared), same data as holotype; one ♂ imago (reared, with portions of wings, legs and genitalia still encased with subimaginal cuticle), one ♀ imago (reared), two nymphs (one with mouthparts, right legs and right antenna, mounted on slides), same data as allotype; one ♂ imago (reared, nymphal exuviae lost), and two ♀ imagines (reared), same data as holotype except date of collection and collectors, 14/V/2008, M. M. Chacón and D. Briceño; one ♀ imago (reared), same data as holotype except date of collection and collectors, 2/V/2008, M. M. Chacón and D. Briceño; one ♀ imago (reared) and three nymphs (one with mouthparts, right legs and abdominal segment X, mounted on slides), same data as holotype except date of collection, 23/IX/1999; six nymphs (one with mouthparts, right legs and right antenna, mounted on slides; one with only mouthparts mounted on slides), same data as holotype except date of collection, 10/III/2000; one nymph, Edo. Mérida, Río Nuestra Señora, 870 m, 8°30'31" N, 71°17'12" W, 3/IV/2000, M.M. Chacón and S. Segnini; six nymphs (one with mouthparts, and right legs mounted on slides), Edo. Mérida, Río La Astillera, Sector San Jacinto, 1260 m, 8°33'05" N, 71°13'36" W, 4/IV/2000, M. M. Chacón and S. Segnini; one nymph, Edo. Mérida, Río San Jacinto, 1525 m, 8° 34'00" N, 71°08'00" W, 4/IV/2000, M. M. Chacón and S. Segnini; one nymph, Edo. Mérida, Río Chama, 1750 m, 8°38'02" N, 71°03'41" W, 16/III/2000, M. M. Chacón and S. Segnini; 14 nymphs (1 with mouthparts, and right legs and antennae, mounted on slides), Edo. Mérida, Río La Fría, 1930

m, 8°38'58" N, 71°03'09" W, 9/III/2000, M. M. Chacón and S. Segnini; five nymphs, Edo. Mérida, Río La Sucia, 8°39'14" N, 71°02'33" W, 1935 m, 9/III/2000, M.M. Chacón and S. Segnini; two nymphs, Edo. Mérida, Río El Cardenillo, 8°41'08" N, 70°59'49" W, 2175 m, 18/III/2000, M. M. Chacón and S. Segnini; two nymphs, Edo. Mérida, Río La Cuesta, 2210 m, 8°39'48" N, 71°08'12" W, 17/III/2000, M. M. Chacón and S. Segnini; six nymphs (one with mouthparts, and right legs and antennae, mounted on slides), Edo. Mérida, Río La Carbonera, Sector El Valle, 2315 m, 8°40'15" N, 71°06'45" W, 24/III/2000, M. M. Chacón and Segnini. Holotype, Allotype, five ♀ imago paratypes and 45 nymphs in Universidad de Los Andes, Mérida, Venezuela; one ♂ imago, one ♀ imago and two nymphs paratypes in FAMU, Florida A&M University, Tallahassee, Florida, USA; one ♂ imago, one ♀ imago and two nymphs paratypes in Instituto Miguel Lillo, Tucumán, Argentina.

Male imago (in alcohol, right wing and genitalia on slide)

Body length 6.5–7.2 mm; forewing length 7.4–8.4 mm.

Head. Whiteish-yellow; lightly shaded with brown on anterior margin, dorsal and lateral regions; with two reddish-brown maculae on antennal sockets, behind scapes (Figure 1). Turbinate eyes: stalks with basal half whiteish-yellow anteriorly and yellow-brown diffuse posteriorly, distal half pale-yellow, dorsal surface ochre-yellow; ventral portions of eyes yellowish-black. Ocelli hyaline-whiteish, with base blackish. Antennae with scapes and pedicels whiteish-yellow, tinged with brown distally, flagella whiteish slightly washed with yellow-brown.

Thorax (Figure 3). General colouration yellowish-brown. Pronotum whiteish anteriorly, with a triangular, blackish-brown macula anteromedially; posteriorly whiteish-yellow, with a brown shaded area extended laterally, in a triangular shape, from the medial region; posterior margin widely tinged of brown. Mesonotum yellowish-brown with some lighter areas; anteronotal protuberance and medioscutum darker laterally; posterolateral angles of posterior scutal protuberances and lateral areas of parascutellum tinged with reddish-brown; scutellum slightly darker distally; scuto-scutellar impression whiteish-yellow. Basal half of metanotum whiteish-yellow with shaded areas of reddish-brown laterally and medially; distal half yellowish-brown, somewhat translucent; medial protuberance whiteish centrally and tinged of reddish-brown laterally. Sternum yellowish-brown, with furcasternum 1 slightly clearer; basisternum 2 strongly shaded with brown marginally and posterior margin rounded; and metasternum darker medially. Pleura yellowish-brown, membranous areas whiteish-yellow. *Legs* with coxae whiteish-yellow ventrally and yellowish-brown dorsally; femora, tibiae and tarsi uniformly whiteish slightly washed with yellow. *Wings* (Figure 4) hyaline, yellowish-amber, with basal area slightly shaded with brown, longitudinal and cross-veins brownish to yellowish-brown, majority of marginal intercalaries relatively long (length > distance between two contiguous longitudinal veins), a single marginal intercalary between veins R₁ and R₂, stigmatic area hyaline and with 4–5 cross-veins.

Abdomen (Figure 5). Terga I–VI whiteish-translucent, tergum I shaded with brown; terga I–V with two blackish lateral spots and a blackish medial stripe on posterior margin, the medial stripe is slightly thicker on tergum II; tergum VI with posterior margin broadly tinged with blackish-brown; terga VII–X ochre-yellowish, with tergum VII tinged with blackish-brown on posterior margin as tergum VI; tergum X slightly darker. Sterna I–VI whiteish-translucent, sterna VII–IX whiteish-yellow. *Genitalia* (Figure 6), styliger plate and segment I of forceps slightly washed with ochre-yellow, segments II and III of forceps uniformly whiteish; distal region of styliger plate with numerous short spine-like setae; forceps with segment III 0.32

times length of segment II, longer spine-like setae on inner side of segment I and basal third of segment II, and numerous short spine-like setae on segment III and distal half of segment II.

Female imago (in alcohol)

Body length 7.1–8.1 mm; forewing length 7.3–8.9 mm. Similar to male imago, except for the following:

Head (Figures 7–8). Yellowish shaded with brown dorsally, lateral to midline; posterior margin lightly tinged with brown. Eyes yellowish–black.

Thorax (Figure 7). Pleura with some membranous parts tinged with blackish-brown, subalar sclerites darker than in male, and a thick blackish stripe on the membranous area between propleura and mesopleura. Prosternum whiteish-yellow, with basisternum tinged with dark brown anteriorly and posteriorly, and furcasternum broad and diffusely washed with brown. Legs whiteish lightly shaded with brown. Wings with stigmatic area whiteish-opaque, bases of veins C, Sc and R₁ reddish-brown to yellowish-brown.

Abdomen (Figures 9 and 10). Terga I–X ochre-yellow with diffuse blackish-brown lateral stripes; tergum I paler posterolaterally; terga I–VI with two blackish-brown lateral spots and a blackish-brown medial stripe on posterior margin, both are slightly thicker on terga II–IV; tergum VII with a thinner blackish-brown medial stripe on posterior margin and without lateral spots; tergum X shaded with dark brown on posterior margin. Pleural regions whiteish-yellow. Sternum whiteish-yellow to whiteish-brown, somewhat translucent. Cerci whiteish-yellow with the two basal segments tinged with yellowish-brown.

Mature nymph (Figures 11–26)

Length: male body 6.0–7.1 mm, female body 6.8–8.6 mm.

Head (Figure 11). Generally, slightly darker than rest of body, reddish-brown on vertex and upper half of frons, lower half whiteish-yellow (between frontoclypeal suture and upper margin of median ocellus). Antennae (Figure 12) yellowish-brown; length 3–4 times width of cephalic capsule; scape and pedicel with scattered small simple setae; pedicel with a dorsolateral row of 5–8 long simple setae, and a dorsal submarginal row of 4–5 fingernail-like scales.

Mouthparts (Figures 13–19). Labrum (Figure 13) whiteish-yellow; margins diffusely tinged with yellowish-brown, and with two C-shaped blackish basal maculae as in Figure 13a; width 2.2–2.5 times medial length; marginal setae, basally bifid (each branch pectinate, Figure 13a, d), extended up to nearly half of labrum, and decreasing in length from lateral regions to midline; ventrally with two submarginal rows of basally bifid setae at lateral regions of the row of branched setae (Figure 13c). *Hypopharynx* (Figure 14), lingua 0.54 times as wide as long, distomedial projection rounded; superlinguae diffusely tinged with brown laterally. *Mandibles* (Figures 15 and 16), ventrally with a semicircular row of hair-like setae, extended submarginally from inner region of incisors up to near midline (Figures 15b and 16b). Left mandible (Figure 15a) with approximately 10 denticles on incisors, the four most outer denticles are distinguishable from each other, the others are irregular and difficultly distinguished (Figure 15b); prostheca yellowish, paler at basal half, with spine-like denticles apically; mola with a central denticle

larger than the others. Right mandible (Figure 16a) with eight denticles on incisors, the most inner denticles of irregular shape and much smaller than the others (Figure 16b); mola with a tuft of robust basal setae and a robust distal seta; prostheca somewhat serrate medially and with a few short hair-like setae. *Maxillae* (Figure 17), galealacinae with a ventral row of 4–5 long simple setae on medial hump; two rows of pectinate setae at base of denticles. *Labium* (Figure 18 and 19), glossae, distally with 4–5 long, pectinate sword-like setae and shorter curved hair-like setae (about 1/3 length of previous setae) ventrally oriented, medially with two longitudinal rows of long simple setae (Figure 19); paraglossae 1.3–1.4 times longer, 2.7–3.9 times wider and 0.8–1.0 times as wide as glossae (distally and basally, respectively), rounded and somewhat constricted apically, slightly concave at inner margin, ventrodistally with three rows of two kinds of setae: pectinate in the two most proximal rows (Figure 18a) and plumose (in apical third) in the most distal row (Figure 18b); palpi with segment II somewhat straight medially.

Thorax (Figures 20–21, 26). Nota yellowish-brown, with some areas slightly darker, as in Figure 26. Pleura yellowish-brown, darker on margins. Sterna whiteish-yellow. Legs (Figure 20). Coxae and trochanters yellowish-brown at dorsal surface and whiteish-yellow at ventral surface. Femora whiteish-yellow on posterior face, shaded with brown on anterior face, with basal half paler medially; with long spine-like setae on dorsal edge (Figure 20a) varying in number (8–14 on femur I, 9–15 on femur II and 9–12 on femur III). Tibiae whiteish-yellow, ventral half diagonally shaded with brown; slender and straight; 0.83–0.98 times length of femora; with long blunt setae on dorsal edge (Figure 20b), varying in number (5–7 on tibia I, 7–8 on tibiae II and 6–8 on tibiae III). Tarsi whiteish-yellow shaded with brown; 0.38–0.48 times length of tibiae; with long hair-like setae on dorsal edge, scattered in groups of 2–5 setae; spine-like setae on ventral edge (Figure 20c) vary in number (8 on tarsus I, 8–9 on tarsus II and 8–10 on tarsus III), with apical spine slightly shorter than subapical spine. Tarsal claws (Figure 21) with 6–9 denticles, subapical seta more basal to enlarged apical denticle.

Abdomen. Sterna whiteish shaded with yellowish-brown. Terga yellowish variably tinged with brown to reddish-brown, pattern as in Figure 26: tergum I darker on mid-region, paler on anterolateral areas; terga II, VI and VII with a darker and more extensive tinged area than terga I, III–V and VIII–IX, only paler on anterolateral areas; terga III–V diffusely paler on central and anterolateral areas; terga VIII–IX diffusely paler on central area and anterolaterally, but with a different tinged pattern from that of terga III–V; tergum X uniformly darker than anterior segments. Terga II–VII can have 2–4 whiteish medial spots as in Figure 26. The spines on posterior margin of abdominal terga are smaller and rounded on the basal segments, and progressively increase in size and more triangular towards distal segments (Figure 22); generally a hair-like seta arises between two spines. Gills yellowish marginally; tracheae blackish with few or no lateral branches; slightly more serrate at distal half of outer margin; with marginal setae of different size: uniformly short along outer margin, and long setae nestled between several shorter setae along inner margin (Figure 23); gills II–IV increasing in size and gills IV–VII decreasing in size, with gill III almost as large as gill IV, and gills II and VII similar in size (Figure 24). Paraproct (Figure 25) with 4–5 submarginal spines, scattered simple setae and small scales grouped near the outer laterobasal area. Terminal filament and cerci uniformly whiteish slightly shaded with brown; terminal filament 0.16–0.23 times length of cerci.

Associations

Adults and nymphs were associated by rearing. Additionally, male and female adults generally have similar colour patterns, most notably the presence of a triangular anteromedial blackish macula on pronotum (Figures 3 and 7) and two blackish-brown maculae on antennal sockets (Figures 1 and 8). Mature nymphs generally have similar colour patterns.

Observations

One of the male paratypes has dorsal portions of eyes, thorax and abdominal segments VII–X, darker than holotype. The other male imago paratype has thorax and abdominal segments VII–X paler (somewhat orange-yellowish) than holotype. Female imago paratypes show two distinct colour patterns: one specimen collected in October 2005 and three specimens collected in May 2008 have a similar colour pattern as in allotype, particularly the blackish-brown medial stripes of different thickness on posterior margin of abdominal terga I–VII. Other specimens (one collected in September 1999, one in September 2005, one in October 2005) have a paler colour pattern, and stripes on posterior margin of abdominal terga I–VII are reddish and less extended laterally than in allotype. In nymphs, the whiteish medial spots as in Figure 26 are consistent in the nymphal exuviae of female adults reared and in mature female nymphs. In mature male nymphs, nymphal exuviae of male adults and nymphs not mature, such spots are somewhat diffuse and observed more easily on terga VI–VII.

Biology and locality

La Picón River, from where the adults of *P. meridinensis* were obtained, is a cold, turbulent, clear, first-order stream, with daily average water temperature and air temperature of 11.5°C (range 9.8–15°C) and 12.4°C (range: 7.6–19.6°C), respectively (Briceño and Chacón, unpublished data). The river bed has a width of about 4.5 m, water depth of 0.21 m, current velocity of 0.70 m/s, slope of 13.3%, and high riparian canopy cover (92.5%). The bottom substrates are composed mainly of stones of varied sizes, gravel and sand, and with high storage of detritus. This stream and other localities where the remainder of examined nymphs were collected are located on the upper watershed of Río Chama (Mérida State, Venezuela, 8°30'18" – 8°48'26" N, 70°50'28"–71°19'14" W), with altitude ranging from 870 to 2315 m. All streams flow across two ecological entities (Cloud Forest and Montane Forest). Detailed information about the environmental characteristics of each site can be found in Segnini and Chacón (2005). At the time of sampling, the values of water temperature of these sites were between 10.5 and 22°C. In La Picón River, the emergence of *P. meridinensis*, recorded for the December–February period, was observed between 13:00–19:00 hours, with a slight increase during the first hours of night (17:00–19:00 hours); furthermore, emergence flight was more numerous in riffles than in pools (Briceño and Chacón, unpublished data). In general, the nymphs of *P. meridinensis* were collected in low abundances in these streams, where they represented only 1.5% of the total number of ephemeropterans collected (Chacón 2003). The other genera (unidentified species) found together with *P. meridinensis* were, in order of abundance: *Baetodes* (53.4%), *Leptohyphes* (23.9%), *Thraulodes*

(7.5%), *Andesiops* (4.8%), *Camelobaetidius* (3.7%), *Nanomis* (2.8%), *Americabaetis* (1.6%); and *Tricorythodes*, *Lachlania*, *Haplohyphes*, *Farrodes*, *Mayobaetis* and *Fallceon* with < 0.5%. Particularly for the La Picón River, Perez and Segnini (2005) showed that, among ephemeropterans, the nymphs of *Prebaetodes* (probably all *P. meridinesis*) represent the fifth most abundant taxon (9%) after *Baetodes* (29.5%), *Leptohyphes* (20%), *Thraulodes* (19%) and *Andesiops* (16%). In regard to environmental tolerances, Chacón and Segnini (2007) found that, in these Andean rivers, the nymphs of *Prebaetodes* (all identified by us as *P. meridinesis*) are associated with low levels and narrow tolerance ranges for temperature and water mineralization (alkalinity, conductivity, hardness) in comparison to other genera of Ephemeroptera. Hence, *P. meridinesis* could be considered a potential indicator species of water quality in this region.

Etymology

The species is named for Mérida, State and city of Venezuela, where the type specimens were collected.

Discussion

Attempts to borrow the nymphal type specimens of *P. sitesi* for comparative study were unsuccessful; hence, no direct observations were made, and our comparison was based on the original description of the species by Lugo-Ortiz and McCafferty (1996a) including the species diagnosis given by Dominguez et al. (2006). Based on our study, we have no doubt that *P. meridinesis* represents a new species and can be easily distinguished from *P. sitesi* by the following characters. (1) Dorsolateral row of long setae on scapes: absent in *P. meridinesis*, present in *P. sitesi*. (2) Number of denticles on mandibular incisors: in *P. meridinesis*, right incisors with eight denticles (the most inner of irregular shape and smaller than others) and left incisors with approximately 10 denticles (only the four most outer are distinguishable from each other); *P. sitesi* has seven and nine denticles on right and left incisors, respectively. (3) Shape of the ventrodiscal rows of long setae on paraglossae: in *P. meridinesis*, the two most proximal rows have pectinate setae, the distal row has plumose setae; in *P. sitesi*, all of these setae are pectinate. (4) Shape of segment II of labial palpi: straight medially in *P. meridinesis*, concave medially in *P. sitesi*. (5) Shape of tibiae: straight in *P. meridinesis*, somewhat twisted in *P. sitesi*. (6) Number of spines on dorsal edge of tibiae: 5–8 (variable among the legs as described above) in *P. meridinesis*; 9–10 in *P. sitesi*. (7) Colour pattern of abdominal terga: in *P. meridinesis*, terga II–X as described above; in *P. sitesi*, terga II–X with a distinct colour pattern (terga IX–X paler than I–VIII and terga II–VIII with pale anteromedial areas).

Shape of spines on posterior margin of abdominal terga could be distinctive of *P. meridinesis*, but it was not included to discriminate between the two species because in *P. sitesi*, this character seems variable. Lugo-Ortiz and McCafferty (1996a) described such spines as triangular, but according to Dominguez et al. (2006) they are rounded.

Moreover, in our specimens (including nymphal exuviae), the presence of another group of noticeable characteristics was consistent, which were not mentioned for *P.*

sitesi; these are: (1) mandibles with a semicircular row of hair-like setae, extended submarginally from the inner region of incisors up to near midline; (2) left mola with a larger central denticle; (3) submarginal row of fingernail-like scales on antennal pedicels; (4) labrum with two C-shaped blackish laterobasal maculae; (5) blunt setae on dorsal edge of tibiae; and (6) abdominal gills with marginal setae of different sizes, variably arranged along the inner and outer margins as described above. Therefore, we conclude that these characteristics, in addition to the seven listed above, should be diagnostic for *P. meridinensis*.

The description of *P. meridinensis* represents the first taxonomic report of the genus from Venezuela. Additionally, it provides new information regarding the diagnostic characters for the genus, known so far only from *P. sitesi*. Likewise, the description, for the first time, of the genitalia of the male of *Prebaetodes*, can also help to define the diagnosis for the adult stages of the *Baetodes* complex. Lugo-Ortiz and McCafferty (1996a) hypothesised about the presence of a distinct small distomedial projection on the basal segment of genital forceps of the male adults of this generic complex, based on what they observed in male adults of the genera *Baetodes*, *Mayobaetis* and *Moribaetis*. However, in the male genitalia of *P. meridinensis*, this character is not present, and hence cannot be considered diagnostic for this generic complex.

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References

- Chacón, M.M. (2003), 'Comunidades de Ephemeroptera (Insecta) en la Cuenca del Río Chama y su relación con la variabilidad ambiental', unpublished Doctoral thesis, Universidad de Los Andes, Merida.
- Chacón, M.M., and Segnini, S. (2007), 'Óptimos y tolerancias ambientales para las ninfas de Ephemeroptera en un gradiente altitudinal en la Cordillera de Mérida, Venezuela', in *Entomología Mexicana* (Vol. 6, No. 1), eds. E.G. Estrada, A. Equihua, C. Luna and J.L. Acevedo; México, Sociedad Mexicana de Entomología, pp. 225–230.
- Domínguez, E., Molineri, C., Pescador, M.L., Hubbard, M.D., and Nieto, C. (2006), 'Ephemeroptera of South America', in *Aquatic Biodiversity of Latin America (ALBA)* (Vol 2), eds. J. Adia, J.R. Arias, G. Ru-Delgado and K.M. Wantzen, Sofia-Moscow: Pensoft, p. 646.
- Hubbard, M.D. (1995), 'Toward a standard methodology for the description of mayflies (Ephemeroptera)', in *Current Directions in Research on Ephemeroptera*, eds. L.D. Corkum and J.J.H. Ciborowski, Toronto: Canadian Scholars' Press, Inc., pp. 361–369.

- Kluge, N. Ju. (1994), 'Pterothorax structure of mayflies (Ephemeroptera) and its use in systematics', *Bulletin de la Société Entomologique de France*, 99, 41–61.
- McCafferty, W.P. (1998), 'Ephemeroptera and the great American interchange', *Journal of the North American Benthological Society*, 17, 1–20.
- McCafferty, W.P., and Baumgardner, D.E. (2003), '*Lugoiops maya*, a new genus and species of Ephemeroptera (Baetidae) from Central America', *Proceedings of the Entomological Society of Washington*, 105, 397–406.
- Lugo-Ortiz, C.R., and McCafferty, W.P. (1996a), 'Phylogeny and classification of the *Baetodes* complex (Ephemeroptera: Baetidae), with description of a new genus', *Journal of the North American Benthological Society*, 15, 367–380.
- Lugo-Ortiz, C.R., and McCafferty, W.P. (1996b), 'Taxonomy of the Neotropical genus *Americabaetis*, new status (Insecta: Ephemeroptera: Baetidae)', *Studies on Neotropical Fauna and Environment*, 31, 156–169.
- Lugo-Ortiz, C.R., and McCafferty, W.P. (1999), 'Global Biodiversity of the mayfly Family Baetidae (Ephemeroptera): A generic perspective', *Trends in Entomology*, 2, 45–54.
- Pérez, B., and Segnini, S. (2005), 'Variación espacial de la composición y diversidad de géneros de Ephemeroptera (Insecta) en un río tropical altiandino', *Entomotropica*, 20, 49–57.
- Salles, F.F., and Boldrini, R. (2008), 'Male imago description of *Americabaetis longetron* Lugo-Ortiz & McCafferty (Ephemeroptera: Baetidae), and first key to adults of the genus', *Neotropical Entomology*, 37, 564–566.
- Salles, F.F., Lugo-Ortiz, C.R., and Da Silva, E.R. (2004), 'Descrição da fêmea adulta de *Americabaetis tithion* (Ephemeroptera: Baetidae)', *Acta Zoológica Mexicana (n.s.)*, 20, 23–26.
- Segnini, S., and Chacón, M. (2005), 'Caracterización fisicoquímica del habitat interno y ribereño de ríos andinos en la Cordillera de Mérida, Venezuela', *Ecotropicos*, 18, 38–61.
- Tsui, P.T.P., and Peters, W.L. (1975), 'The comparative morphology and phylogeny of certain Gondwanian Leptophlebiidae based on the thorax, tentorium, and abdominal terga (Ephemeroptera)', *Transactions of the American Entomological Society*, 101, 505–595.