



Description of *Alloretochus sigillatus* new species with comments and new distributional records for *Alloretochus peruanicus* (Ephemeroptera, Caenidae, Brachycercinae)

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Abstract

Alloretochus sigillatus **sp. nov.** is described from adults of both sexes and eggs from Bolivia and Ecuador. Diagnostic characters of this species include: large body size, ratio pedicel/scape 1.75, presence of posteromedian projection on metanotum, characteristic blackish marks on abdominal terga, presence of vestiges of posterolateral projections on abdomen segments IV–VI, male subgenital plate broadly emarginated posteriorly, ratios forceps length/subbasal width 8.9, female sternum IX produced distally reaching apex of segment X, tapering distally with rounded apex, egg with 4 costae in lateral half. Additional characters for all stages and SEM photographs of eggs are provided for *Alloretochus peruanicus*, with new records of its presence in Argentina, Bolivia, Peru and Colombia.

Key words: *Alloretochus*, *Latineosus*, *Cercobrachys*, *A. peruanicus*, *A. sigillatus*

Introduction

Brachycercinae (Ephemeroptera: Caenidae) is a very distinct group of mayflies with specialized psammophilous nymphs and very short-lived adults that are rare in collections (Sun & McCafferty 2008). The subfamily is known around the world with Holarctic, Oriental, and Neotropical representatives, but in this last region the knowledge is limited to very few specimens from isolated collections, recently classified into two genera (Sun & McCafferty 2008): *Latineosus* Sun & McCafferty, 2008 and *Alloretochus* Sun & McCafferty, 2008. *Latineosus* is known from two Neotropical species (*L. cayo* Sun & McCafferty from Belize and *L. colombianus* (Soldán) from Colombia) and one SW Nearctic species (*L. cibola* Sun & McCafferty). *Alloretochus* is only known from its type species, *A. peruanicus* (Soldán) recorded from Peru (Soldán 1986) and Bolivia (Molineri & Goitía 2006). The two genera differ in details in larval mouthparts, antennae and abdominal projections (Sun & McCafferty 2008), while the adult stage of *Latineosus* is still unknown. Nevertheless, Sun & McCafferty (2008) diagnosed the adult stage of *Alloretochus* mainly by the concave posterior margin of the male styliger plate. Adults showing this unique feature from NW Argentina, Bolivia and Colombia were studied and proved to represent two species: the previously known *A. peruanicus* and a new species, which is described herein as *Alloretochus sigillatus* **sp. nov.** from adults of both sexes and eggs from Bolivia. Additional characters for adults, eggs and larvae of *A. peruanicus* which were newly collected in Argentina, Bolivia and Colombia are also reported in the present study.

Material and methods

The male imagos studied here were identified at the genus level with the characters provided by Sun & McCafferty (2008). Females and males are attributed to the same species because they were collected at the same time and locality and show a similar color pattern and body size. Illustrations were made with the aid of a stereomicroscope (Nikon 20154) coupled with a camera lucida. The reared specimens and immature larvae are preserved in ethanol.

96%. Dissected parts were permanently mounted on microscope slides with Canada Balsam or Euparal. The membranous condition of the apical portion of the styliger resulted in folding and shrinking at the final mounting, sometimes exaggerating the median emargination, characteristic of the genus. Scanning electron microscope (SEM) photographs were obtained with a JEOL 35CF. The studied structures were dehydrated in a graded ethanol series, dried by critical point-method (using CO₂ in a Bomar apparatus), mounted with double-sided tape on SEM stubs, and sputter coated with gold.

Specimen depositories: Universidad Mayor de San Simón (UMSS), Cochabamba, Bolivia; Instituto de Biodiversidad Neotropical (IBN), Tucumán, Argentina.

***Alloretochus peruanicus* (Soldán)**

Figs. (1A–I, 3A–B)

Cercobrachys peruanicus Soldán, 1986: 343; Molineri & Goitia, 2006: 64; Domínguez *et al.*, 2006: 223.

Alloretochus peruanicus (Soldán), Sun & McCafferty, 2008: 78.

Diagnosis. Adult size variable (body length 2–4 mm); body with gray shading widely extended mainly on abdomen (darker on terga I–II and VII–VIII in male) and thoracic sterna (Figs. 1B–C, E–F); male subgenital plate broadly emarginated posteriorly as in Figs. 1G–H; ratios forceps length/subbasal width 6.8–8.0; female sternum IX produced distally but not reaching apex of segment X, distally truncated with small median notch; egg with 7–8 costae in a lateral half (Figs. 2H–I).

Material. 7 male and 4 female imagos (parts of a male on slide IBN636CM) from Argentina, Jujuy, Ledesma, río San Francisco, puente a Aguas Calientes, S 23° 42' 42"—W 64° 32' 4", m, 17–18.I.2013, light trap, C. Molineri col.; 1 male imago from BOLIVIA, río Blanco, ca. de Once por Ciento, camino entre Sta. Cruz y Trinidad, S 15° 21' 39.7"—W 63° 17' 28.8", 250 m, 14/VI/2000, E. Domínguez col.; 1 male imago (parts on slide IBN621CM) from COLOMBIA, Dpto Amazonas, P.N. Amacayacu, Qda. Mata-Mata, S 3° 48' 28"—W 70° 15' 21", 2–5.II.1999, at light 4–6 h AM, E. Domínguez, M.C. Zúñiga & C. Molineri cols. All material deposited in IBN. Material listed in Molineri & Goitia (2006) also examined.

Male. Length (mm): body, 2.3–3.8; forewing, 2.0–2.7; caudal filaments, 5.8–9.0. Ratio pedicel/scape, 1.7–2.0. Metanotum with posteromedian finger-like tubercle (Fig. 1B). Foreleg with black dot on apex of tibia and tarsus segments 2–3 (Fig. 1D). Ratios of length of body: foreleg: midleg: hindleg - 1: 0.6–0.8: 0.4: 0.4–0.5. Ratios of length of forefemur: tibia: tarsus - 1: 1.8–2.3: 1.5–1.7. Ratios of length of foretarsus segment I: II: III: IV: V - 1: 3.6–8.4: 3.0–3.4: 2.6–2.8: 1.8–2.0. Wing length/max width 1.8–2.3. Abdomen with thin and long vestiges of posterolateral projections on segments IV–VI; gray shading darker on terga I–II and VII–VIII. Genitalia (Figs. 1G–H): ratios forceps length/subbasal width 6.8–8.0.

Female. Length (mm): body, 4.0–4.5; forewing, 3.4–3.7; caudal filaments, 1.5–1.7. Metanotum with dorsal finger-like tubercle (Fig. 1E). Wing length/max width 2.3. Abdomen with vestiges of posterolateral projections on segments IV–VI; abdominal sternum IX produced distally, surpassing half of length of segment X but not reaching its apex; apex of sternum IX truncated with small median notch. Abdominal terga and sterna yellowish, widely washed with gray (Figs. 1E–F).

Egg. Shape elongate-ovate (Figs. 2H–I), ratios total length/maximum width: 3.0–3.3. Polar cap 1/10–1/5 of whole egg in length, without tubercles. Chorion with 7–8 costae in lateral half. Costa asymmetrical in cross-section (overlapping adjacent inter-costal groove on one side only), costae covered with subcircular wart-like microsculpture (detail in Fig. 2I). A thin layer that covers the egg (probably not part of the egg, but part of female body cavity) appeared partially detached in most of them, but always presented small circular tubercles (arrow in Fig. 2H).

Discussion. Sun & McCafferty (2008) differentiated the larvae of *Alloretochus* from those of all other genera of Brachycercinae by "having a maxillary palp segment 2 that is as long as about 2.3 X the length of the segment 1" (vs. no longer than 2.0 X in the others). In the only larva studied here (Fig. 1A), a ready to molt male, maxillary palps roughly coincide with this ratio, with one having a longer segment 2 (2.56X the length of segment 1) than the other (2.25X the length of segment 1) (Fig. 1I). Other characters of this larva, including the diagnostic patch of setae on labial palp, are identical to those described by Sun & McCafferty (2008).

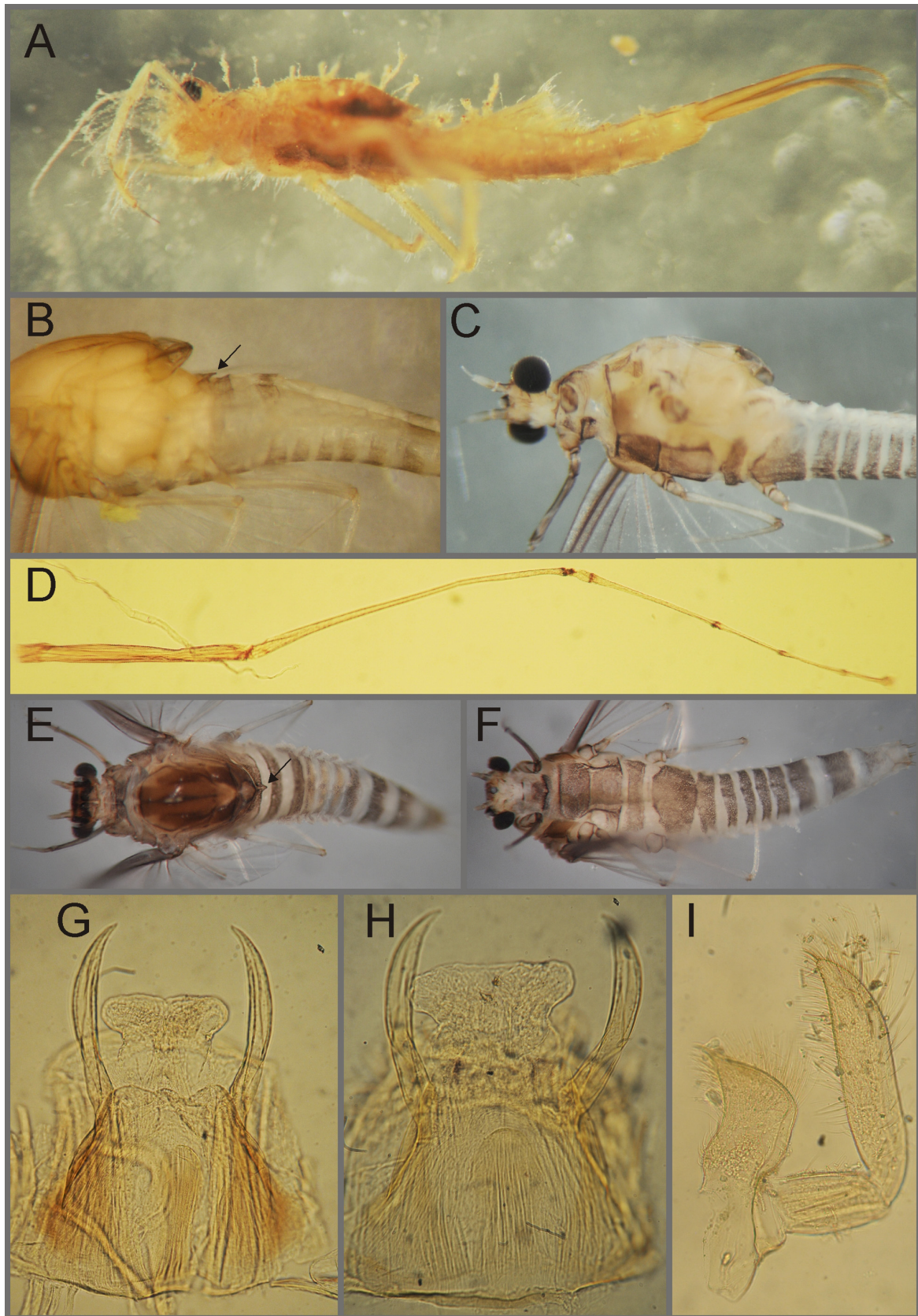


FIGURE 1. A–I. *Alloretochus peruanicus*: A, larva, ventrolateral view; B male from Blanco river in Bolivia, lateral view; C, male from San Francisco river, Argentina, ventrolateral view; D, foreleg of male from Colombia; E, female (S. Francisco river, Argentina) dorsal view; F, same, ventral; G, male genitalia (Colombian specimen); H, male genitalia (Argentinean specimen); I, larval maxilla.

Among the characters listed for *Alloretochus* adults (Sun & McCafferty 2008), the following were also present in the males studied here: prosternum conically produced ventrally (slightly marked in some specimens), pronotum with slightly convex to nearly straight lateral margin, vestiges of posterolateral projections on abdominal segments IV–VI (in segments I–III poorly developed, not projected), and subgenital plate broadly emarginate and distally membranous.

The small male (body, 2.3 mm, forewing, 2.0 mm; caudal filaments, 5.8 mm) collected in Colombian Amazonas and attributed here to *A. peruanicus* presents certain differences in relation to males of *A. peruanicus* from other localities, including the absence of gray shading or other marks on body (except the small black dots at apex of foretibia and tarsal segments, Fig. 1D), absence of posteromedian projection on metanotum and vestiges of posterolateral projections on abdominal segments. However, the morphology of male genitalia of this individual (Fig. 1G) is very similar to that of other specimens of *A. peruanicus* (Fig. 1H).

Alloretochus peruanicus shows a relatively wide range of variation in size and some ratios, as seen in the description above (for example the length of the second fore tarsal segment). This is not rare in the group; and other species may present similar intraspecific variations where specimens are abundant.

In general eggs of *A. peruanicus* are similar to *Cercobrachys fox* and *C. lilliei* (figures 570 and 572, respectively, in Sun & McCafferty 2008).

Distribution. Argentina (Jujuy), Bolivia (Tarija, Santa Cruz), Colombia (Amazonas), Peru (Loreto). *Alloretochus peruanicus* shows a wide distributional range including medium sized piedmont rivers as the Pilcomayo to larger ones as the Amazon.

Alloretochus sigillatus new species

(Figs. 2A–I, 3C)

Diagnosis. Adult size relatively large (male body ca. 4 mm, female ca. 5 mm); with characteristic blackish marks on abdominal terga (Figs. 2B–C, E); male subgenital plate broadly emarginated posteriorly as in Figs. 2D and 3C; ratios forceps length/subbasal width 8.9; female sternum IX produced distally reaching apex of segment X, tapering distally with rounded apex; egg with 4 costae in lateral half (Figs. 2F–G).

Type material. Holotype male imago (genitalia and legs on slide IBN421CM) from BOLIVIA, río Blanco, ca. de Once por Ciento, road between Sta. Cruz and Trinidad, S 15° 21' 39.7"—W 63° 17' 28.8", 250 m, 14/VI/2000, E. Domínguez col.; 2 male and 1 female imago paratypes same data as holotype. Holotype deposited in UMSS, remaining specimens in IBN.

Additional material. One male imago (IBN) from ECUADOR: Esmeralda Prov., Cantón Eloy Alfaro, Parroquia Telembí, Estero Arenales, N 00° 40' 05"—W 78° 59' 25", 80 m, 15/IV/2002, E. Domínguez col.

Male imago. Length (mm): body, 4.0–4.2; forewing, 3.0–3.2; caudal filaments, 9.0–10.0. General coloration yellowish white. Head (Fig. 2C) pale with diffuse gray shading between ocelli, and with paired sublateral black marks near hind margin; ratio pedicel/scape, 1.75. Thorax. Pronotum translucent white with medial, T-shaped black mark (Fig. 2C); mesonotum yellowish white with thin grayish medial line; metanotum yellowish white with whitish membranous posterior portion produced dorsally, forming gray-shaded, finger-like tubercle on hind margin (as pointed by arrow in Fig. 2A). Legs whitish except forefemur yellowish. Ratios of length of body: foreleg: midleg: hindleg - 1: 0.6: 0.4: 0.5. Ratios of length of forefemur: tibia: tarsus - 1: 2.2–2.4: 1.2–1.3. Ratios of length of foretarsus segment I: II: III: IV: V - 1: 3.0: 1.7: 1.4: 1.4. Wings with yellowish veins; length/max width 1.7. Abdomen (Fig. 2B) whitish turning yellowish white on segments IX–X; with blackish median marks of characteristic shape on terga I–II and VII–X; segments IV–VI with long, thin vestiges of posterolateral projections. Genitalia (Fig. 2D): subgenital plate and forceps yellowish, penes whitish. Ratios forceps length/subbasal width 8.9. Caudal filaments whitish.

Female imago. Length: body, 4.7; forewing, 3.7; caudal filaments, 1.5. Similar to male except: occiput with a large black macula between the sublateral spots; lateral ocelli much more produced dorsally (Fig. 2E). Thorax without gray shading; metanotum without finger-like dorsal tubercle. Ratios of length of body: foreleg: midleg: hindleg - 1: 0.2: 0.4: 0.4. Wing length/max width 1.9. Abdomen (Fig. 2E) with reduced dorsal markings, only present on terga I, III and X; sternum IX produced distally reaching apex of segment X, tapering distally with rounded apex.

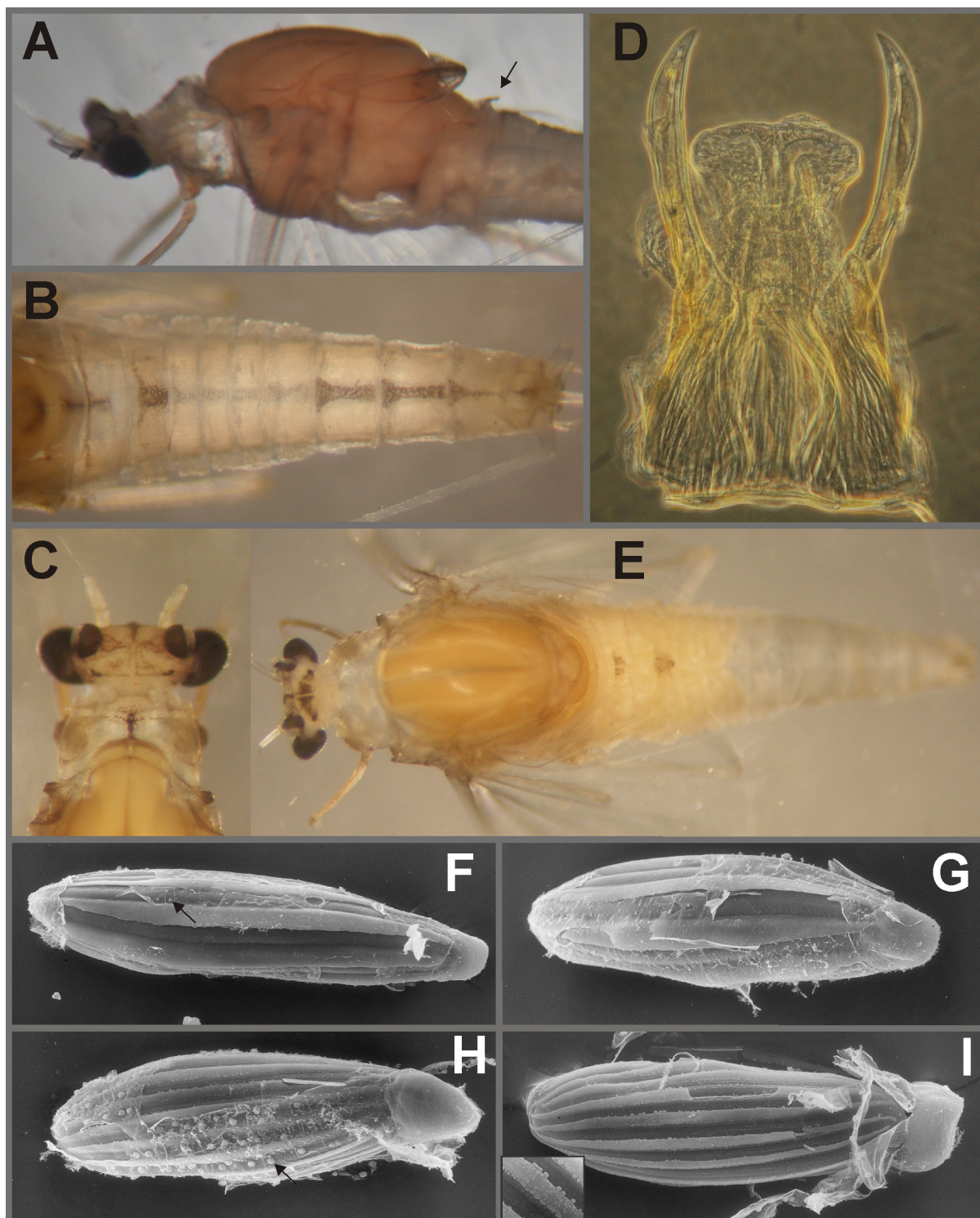


FIGURE 2. A–G: *Alloretochus sigillatus* **sp. nov.**: A, male imago, head and thorax, lateral view; B, same, dorsal view of abdomen; C, same, detail of head; D, male genitalia, ventral view; E, female imago, dorsal view; F–G, eggs. H–I, *A. peruanicus* eggs.

Egg (Figs. 2F–G). Shape elongate-ovate, ratios total length/maximum width: 3.1–4.3. Polar cap 1/10–1/5 of whole egg in length, without tubercles. Chorion with 4 costae in lateral half. Costae smooth, asymmetrical in cross-section (overlapping adjacent inter-costal groove on one side only). As described in the previous species, a thin layer covering the egg (probably not part of the egg) shows few small subcircular tubercles.

Etymology. From Latin "sigillatus" meaning "with small and distinct marks".

Discussion. The characteristic blackish marks on the abdomen steadily distinguish adults of *Alloretochus*

sigillatus sp. n. from *A. peruanicus* and also other brachycercines known from adult stage. The larval stage may be associated in the future by these marks, since generally adults carry body pigments from the larval stage (Sun & McCafferty 2008). The presence of posteromedian projection on metanotum and vestiges of abdominal projections on segment IV–VI is shared with *A. peruanicus* as redescribed above. The character proposed by Sun & McCafferty (2008) as autapomorphic for the genus *Alloretochus*, the broadly emarginated apex of the subgenital plate, is also present in this species. Male foretarsi are relatively shorter in *A. sigillatus* (1.2–1.3 times the length of forefemora), comparing to those of *A. peruanicus* (1.5–1.7 times the length of forefemora). Eggs of *A. sigillatus* differ from those of *A. peruanicus* by having only 4 wide costae in lateral half (7–8 costae in *A. peruanicus*), which are similar to eggs of *Cercobrachys etowah* (figure 569 in Sun & McCafferty 2008). A reduced number of costae is also present in *Latineosus colombianus* (figure 566 in Sun & McCafferty 2008), but in that species costae are much narrower.

Distribution. Bolivia (Santa Cruz) and Ecuador (Esmeralda). Biology unknown.

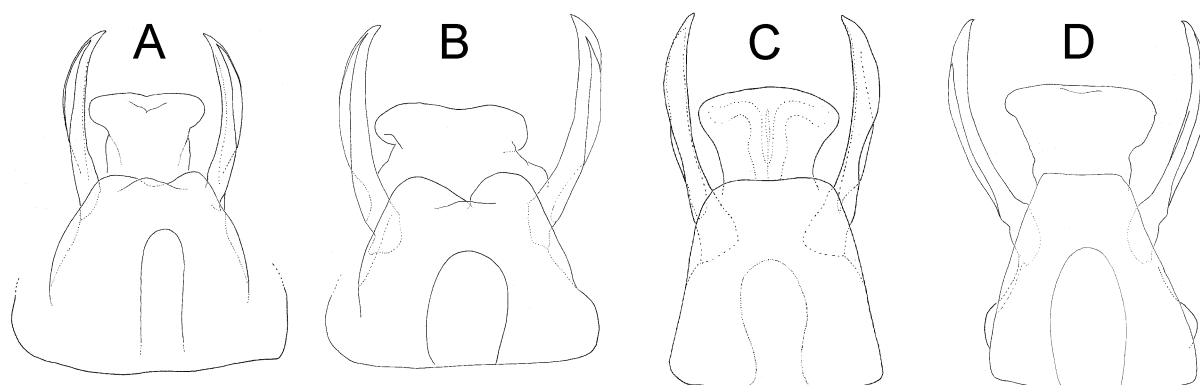


FIGURE 3. A–D. *Alloretochus* spp., male genitalia, line drawings: A, *A. peruanicus* from Colombia; B, *A. peruanicus* from Bolivia; C, *A. sigillatus* sp. nov.; D, *Alloretochus* undescribed species from Colombia.

Alloretochus sp.

(Fig. 3D)

Diagnosis. Adult medium sized (male body ca. 3.5 mm); with gray shading on terga I–II and VI–VIII; ratio pedicel/scape, 2.0; with posteromedian projection on metanotum and vestiges of posterolateral projections on abdominal segments IV–VI; male subgenital plate subtriangular and broadly truncated apically, hind margin very slightly concave; ratios forceps length/subbasal width 11.2.

Material. One male imago (slide IBN622CM, genitalia damaged while mounting) from COLOMBIA, Dpto Amazonas, P.N. Amacayacu, Qda. Mata-Mata, S 3° 48' 28"—W 70° 15' 21", 2–5.II.1999, at light 4–6 h AM, E. Domínguez, M.C. Zúñiga & C. Molineri cols.

Discussion. The single male imago may represent a different, unknown species of *Alloretochus*. However, it is not formally proposed here because of the bad condition of the material. This male imago is temporarily placed in *Alloretochus* because of the emarginated (although very slightly) hind margin of the styliger (Fig. 3D). Nevertheless, as the adult stage of *Latineosus* is yet not known, it is also possible that this individual belongs to *L. colombianus*, the only brachycercine previously known from Colombia. The main difference with other species is the much slender forceps (ratio L/W 11.2). This male was collected at the same light trap with a much smaller male here attributed to *A. peruanicus* (treated above).

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