



A polychromatic new species of *Apiomerus* (Hemiptera: Reduviidae: Harpactorinae) from Central America

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Abstract

Apiomerus barrocoloradoi **sp. nov.** is described from Costa Rica and Panama. This new species is highly polychromatic, a judgment based on specimens of the same locality. Dorsal habitus images documenting the range of variation of the color pattern are provided. Male and female genitalia are documented in detail to provide unambiguous characters for species recognition. Color variation is discussed with regard to traditional species limits.

Key words: Heteroptera, Apiomerini, taxonomy, genitalia

Introduction

Apiomerus is the most diverse genus of the tribe Apiomerini (Harpactorinae) and one of the largest in the Reduviidae. They are commonly known as bee-assassins because of their frequent association with stingless and other bees (Weaver *et al.* 1975; Johnson & Wiemer 1982; Poinar 1992; Gonzales-Bustamante 1994; Marques *et al.* 2003; da Silva & Gil-Santana 2004).

There are 101 valid species of *Apiomerus* (Maldonado 1990; Gil-Santana & Milano 2007), but at least 114 names (including subspecies) and proposed synonymies to evaluate (Martinez 1981; Maldonado 1990; Gil-Santana *et al.* 2006). *Apiomerus* is restricted to the Western Hemisphere, the species distribution ranging from the United States to Argentina, with most of the diversity found in the tropical region of South America.

Apiomerus has never been fully revised taxonomically, but several publications have dealt with the description of new species, usually focusing on a geographically restricted fauna. In a pioneering work, Champion (1899) treated all species from Central America known at the time. Several new species have since been described, mostly from South America, and usually relying on color patterns for species recognition (Costa Lima *et al.* 1951, 1952; Costa Lima & Mendes 1952; Prosen & Martinez 1955; Buckup 1957; Prosen *et al.* 1959, 1962; Carcavallo *et al.* 1964; Gil-Santana & Milano, 2006). Szerlip (1980), in an unpublished dissertation, proposed several new species of *Apiomerus* from North and Central America, and provided a hypothesis of relationships for eight species groups that he had defined within *Apiomerus*.

In this paper, we describe a new species of *Apiomerus* from Costa Rica and Panama, and provide evidence for its highly variable coloration. Furthermore, we document in detail the male and female genitalia, in order to provide unambiguous morphological characters that 1) show that all color morphs treated in this paper are actually the same species, and 2) support the hypothesis of this taxon as being a new species.

Material and methods

Specimens: 146 specimens were examined for this project. They are deposited in the following entomological collections: American Museum of Natural History, New York, USA (AMNH); B. D. Gill collection, Ottawa,

Canada (BDGC); Cornell University, Ithaca, USA (CUIC); Florida State Collection of Arthropods, Gainesville, USA (FSCA); Hungarian Natural History Museum, Budapest, Hungary (HNHM); Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica (INBIO); University of Kansas, Lawrence, USA (KU); Natural History Museum of Los Angeles County, Los Angeles, USA (LACM); Texas A&M, College Station, USA (TAMU); Essig Museum, University of California, Berkeley, USA (UCB); Bohart Museum, University of California, Davis, USA (UCD); Natural History National Museum, D.C., USA (USNM).

In addition, four *Apiomerus* species were examined to make comparisons with the new species regarding coloration and external male and female genitalia (see below “Other Material Examined”).

Each examined specimen was associated with a Unique Specimen Identifier (USI). These USIs are machine-readable matrix labels. Each USI has a prefix (UCR_ENT), which identifies it as a Heteropteran Systematics Lab project, and a unique number. USIs were used to enter specimen label data into the Plant-Bug PBI locality database which was then used to output the list of examined material.

Label data of the holotype are copied verbatim. Interpolated data (secondary subdivisions and georeference) are in square brackets. Data from different labels are separated by a backslash. Interpolated data from other specimens are not indicated by square brackets.

Observations, dissections, imaging, and measurements: Observations were made with a Nikon SMZ-1500 dissecting scope. Male specimens were relaxed in a humid chamber for 12 hrs, after which the pygophore was removed with a pair of forceps. In female specimens the whole abdomen was removed applying a small drop of ethanol or water at the base, and gently moving the abdomen up and down with the aid of the forceps. Both the pygophore (males) and the whole abdomen (females) were placed in warm 10% KOH solution for about 5 to 7 minutes. The structures were then rinsed in distilled water, dehydrated in 100% ethanol, and placed in glycerol for their dissection. In males, the phallus was removed from the pygophore by severing the ligaments of each of the processus capitatus. The endosoma was extended by gently pulling the sclerotized parts with forceps until full extension was achieved. In females, tergites were removed, and the gonocoxae 8 were separated from sternite 7. The syntergite 9/10 was removed, as well as the gonocoxae 8 from the bursa copulatrix. The bursa copulatrix was stained with chlorazol black (Carayon 1964).

Dorsal habitus and genitalia images were taken with a Microoptics-USA system equipped with a K2 lens and CF-2 or CF-4 objectives. Scanning electron micrographs (SEM) were taken with an environmental SEM Zeiss Evo 60, after specimens were coated with gold-palladium. Details of tergite 9 of the males were documented on a Zeiss Axioscop 2 with Plan-Neofluar 10x and 20x objectives, and equipped with a MicroPublisher digital camera.

Measurements were taken on a dissecting scope equipped with a 2-axes movable stage (Mitutoyo Corp.), with the aid of two digital micrometers (Boeckeler®) which were connected to a Microcode II RS-232 digital readout (Boeckeler®). Measurements are otherwise indicated in millimeters.

Description: The new species was described using DELTA (Dallwitz *et al.* 1999). A template including characters suitable to describe *Apiomerus* species was generated using the DELTA editor. A layout template was produced for this character dataset. The templates for the description and the layout can be found on the Heteropteran Systematics Lab website (<http://heteroptera.ucr.edu/>) under the menu “Databases.”

Terminology: External morphology mostly follows Weirauch and Forero (2007), and Weirauch (2008a, b). Genitalic terms follow Wygodzinsky (1947), Scudder (1959), Davis (1966), Carrera and Osuna (1996), and Forero and Weirauch (in prep.).

Georeferencing and mapping: Most of the specimen label data lacked GPS geographic coordinates. We georeferenced unambiguous locality data with the aid of GEOLocate (Rios & Bart 2005), or by finding each of the localities in local maps, which were then georeferenced with the aid of Google Earth. A distribution map was generated with ArcMap 9.1 (ESRI 2005). The shaded-relief map of Central America was derived from a digital elevation model of the Shuttle Radar Topography Mission (SRTM) from NASA.

Apiomerus barrocoloradoi sp. nov.

Figures 1–7

Diagnosis. Recognized by the elongate forewing membrane, surpassing the abdomen by about 1/3 of its length (Fig. 1); the apex of metafemur and base of metatibia yellow (Fig. 1, arrows); the median process of the pygophore strongly bifid, with the rami nearly horizontal in posterior view, and a short, wide base (Figs. 4A, B); the parameres L-shaped, cylindrical, with a swollen base and enlarged apex (Figs. 5C, D); the lateral sclerotizations of the endosoma triangular and recurved (Figs. 5E, F, *lats*); the caudal margin of tergite 8 in females entire (Fig. 4C); the bursa copulatrix with lateral lobes (Figs. 6A, C); and the dorsal-most fold of the sclerotized transversal folds of the bursa copulatrix triangular and knob-shaped (Figs. 6A, B, *dmf*).

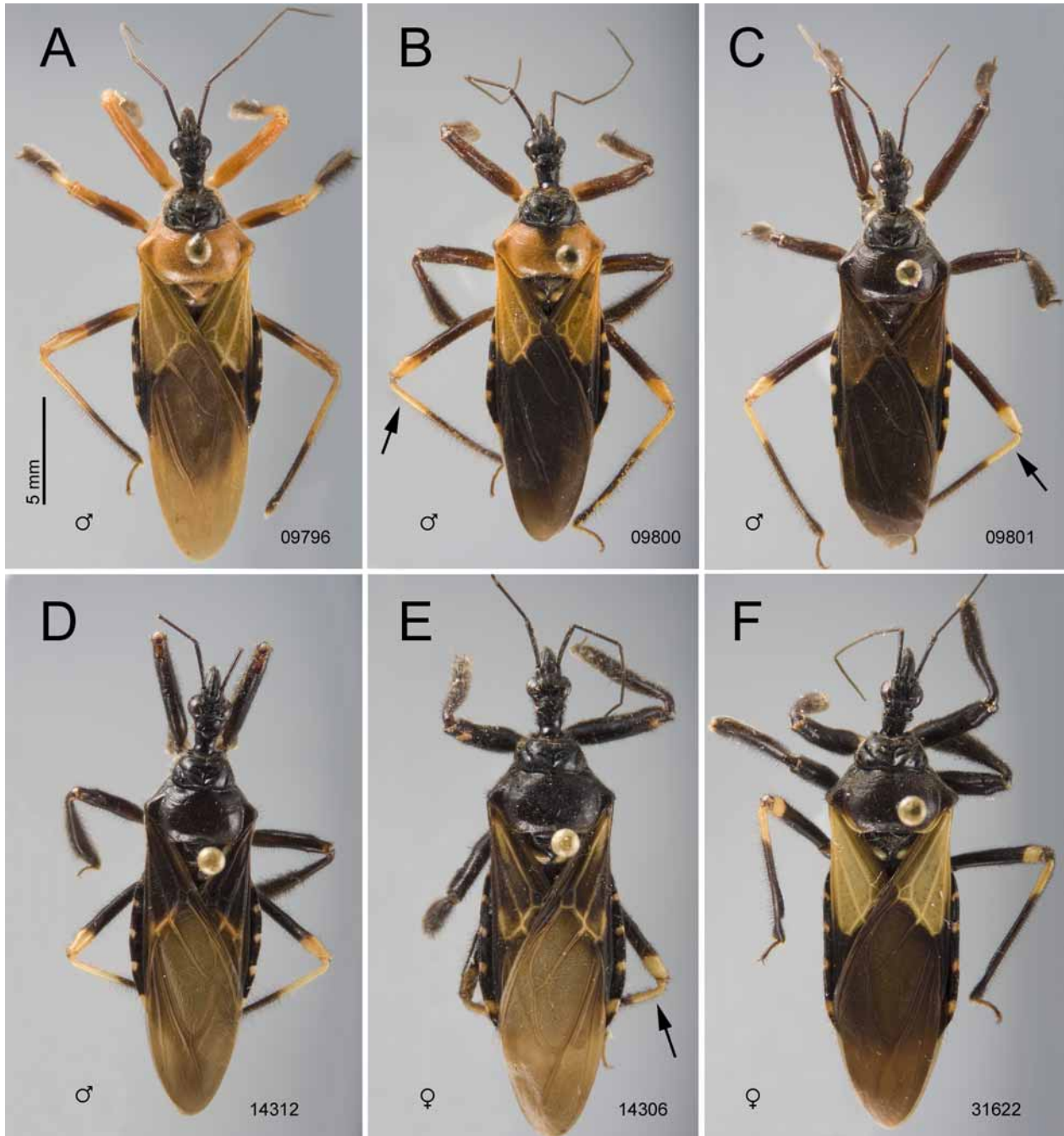


FIGURE 1. Dorsal habitus images of *A. barrocoloradoi*. Polychromatic morphs are present in both sexes. B and C are specimens from a single collection event. Arrows indicate the diagnostic chromatic character: yellow apex of the metafemur and base of the metatibia. Numbers indicate USI numbers with prefix UCR_ENT.

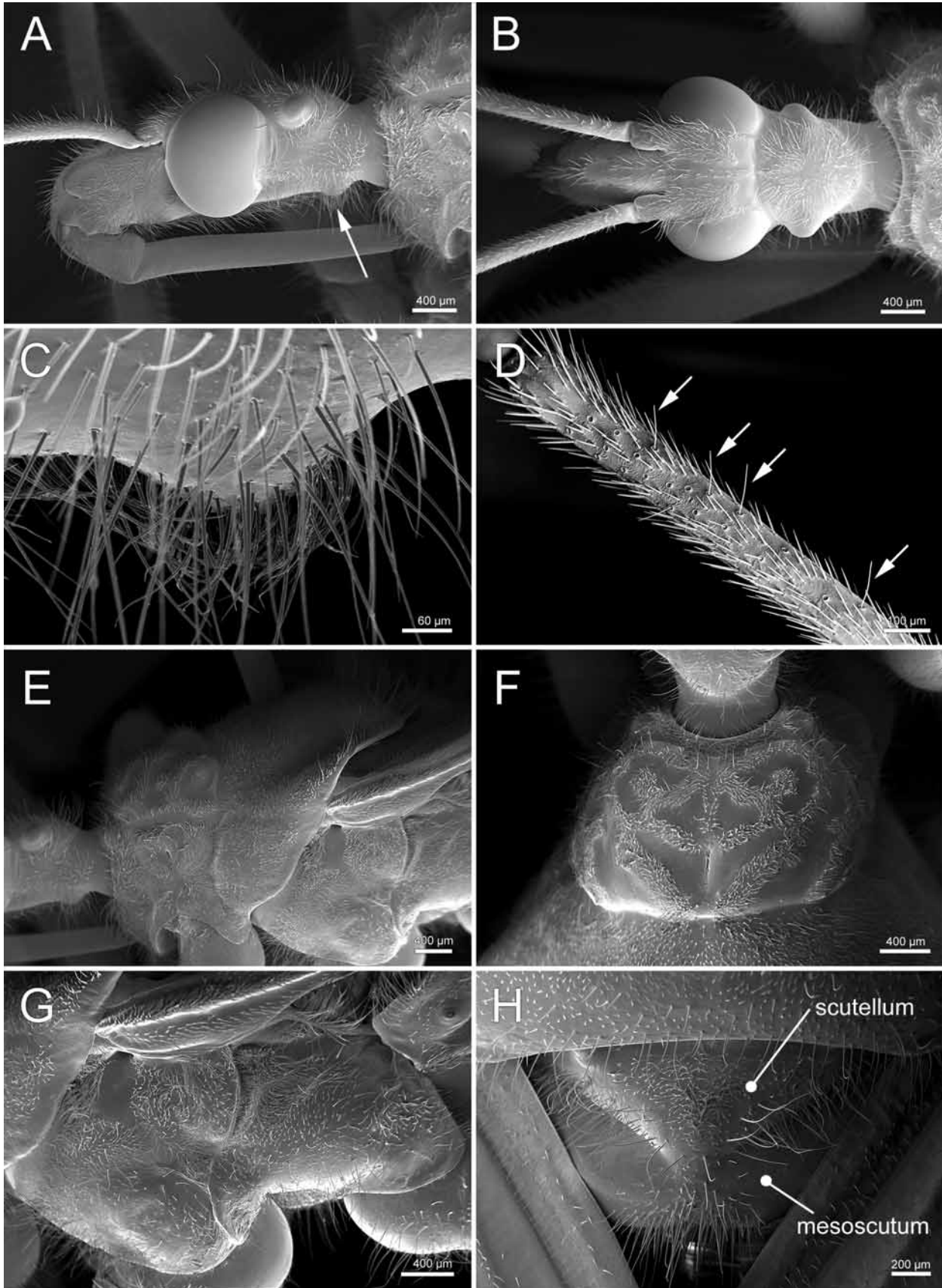


FIGURE 2. SEM of *A. barrocoloradoi*, male. **A.** Head, lateral view; arrow indicates gular tubercle. **B.** Head, dorsal view. **C.** Detail of gular tubercle. **D.** Antennal pedicel and trichobothria; arrows indicate some of the standing trichobothria. **E.** Prothorax, lateral view. **F.** Anterior lobe of pronotum showing vestiture on ridges. **G.** Thoracic pleura. **H.** Scutellum and mesoscutum.

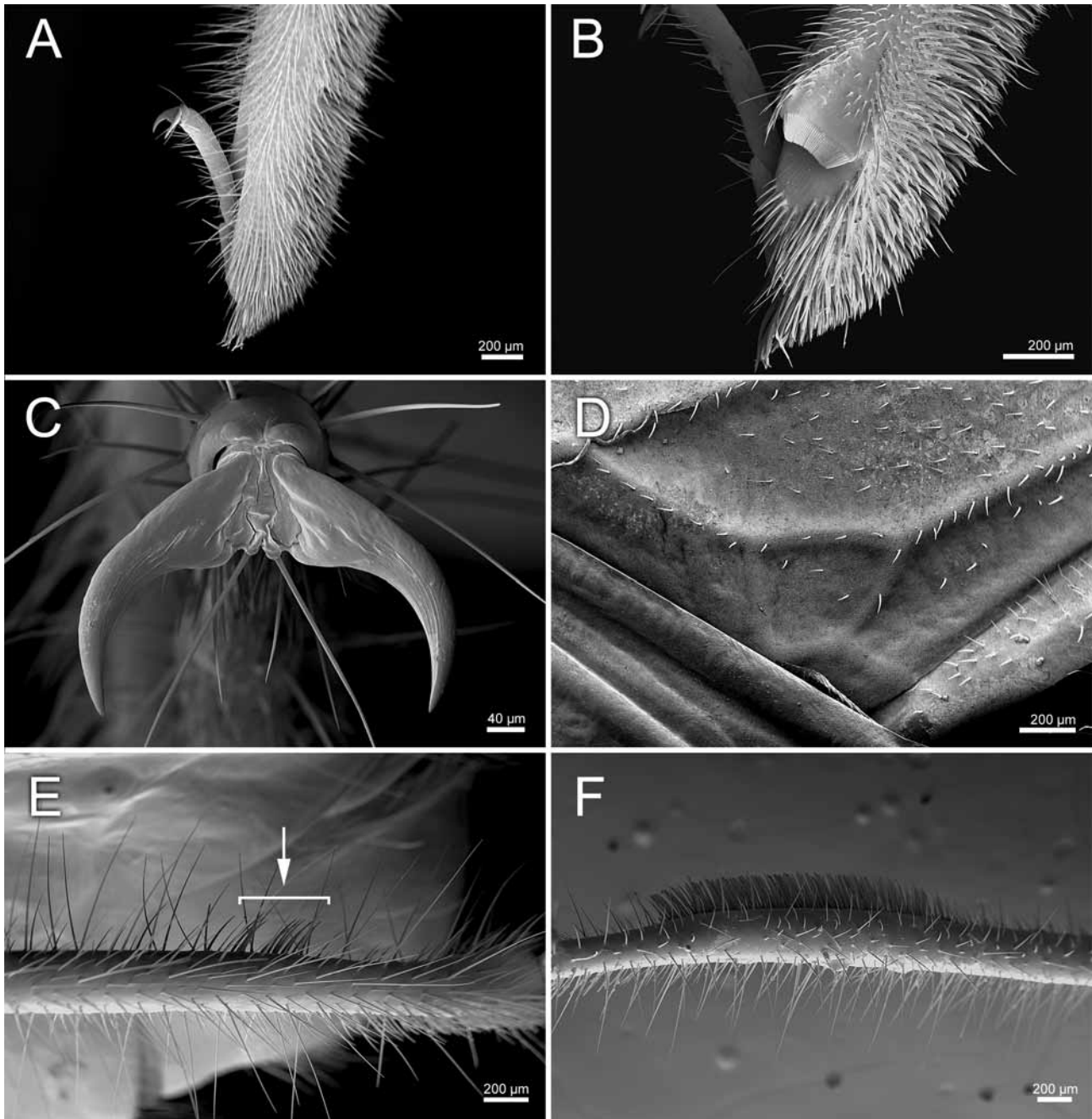


FIGURE 3. SEM of *A. barrocoloradoi*. **A.** Apex of protibia, lateral view. **B.** Apex of protibia with protibial comb, medial view. **C.** Pretarsus, frontal view. **D.** Quadrangular cell on corium. **E.** Metatibia and comb in male; arrow indicates the extent of the comb. **F.** Metatibia and comb in female.

Description. *MALE:* Medium-sized; total average length 21.36 (SD \pm 1.1) mm (Table 1). **COLORATION** (Fig. 1): **HEAD:** Dark brown. **THORAX:** Pronotum with anterior lobe always dark brown, posterior lobe from dark brown to yellow, sometimes forming patterns. Scutellum disc dark brown. Mesoscutum usually yellow, sometimes dark brown. Thoracic pleura from dark brown to pale yellow, sometimes pale yellow with dark areas. *Hemelytron:* Corium usually yellow with apex dark brown, but commonly highly variable, from completely dark brown with apical veins yellow, to pale brown medially and yellow at base and apex; membrane from dark brown to pale yellow. *Legs:* Foreleg either completely dark brown, or with femur partially or completely yellow, and tibia with apical 3/4 black, sometimes with base yellow; coxa and trochanter dark brown or partially yellow. Midleg similar to foreleg. Hindleg with basal 3/4 of femur dark brown, apex yellow; and tibia with base yellow and apical 3/4 dark brown. **ABDOMEN:** Dark brown;

connexival segments with a small, rounded, pale yellow spot on the anterior margin of each segment; sternite VII medially with an anterior broad band or two broad pale yellow spots, sometimes sternites V and VI with median pale yellow areas. Pygophore completely dark brown or with two small, rounded, pale yellow spots below the posterior margin. VESTITURE: Densely setose. HEAD: Gula with two longitudinal rows of dense, sericeous setae; gular tubercle with short and long, dense, sericeous setae (Fig. 2C). THORAX: Pronotum, anterior lobe with short dense setae on lateral ridges. Posterior lobe with short, sparse setae, intermixed with long very sparse setae. Scutellum with short, dense, sericeous setae on disc; lateral margins with simple, long setae. Mesoscutum with dense, simple, long setae medially on posterior margin. *Legs*: Fore and mid tibiae densely setose (Fig. 3A). Hind tibia sparsely setose. Metatibial comb highly variable, composed of 1 to 25 setae, but more commonly of 15–20 setae (Fig. 3E). ABDOMEN: Margin of connexivum with short, dense, decumbent setae; intermixed with sparse, mid-sized setae. Pygophore with posterior margin densely setose, setae very long. STRUCTURE: HEAD (Fig. 2A, B): Basal gular tubercle medium-sized, rounded (Fig. 2A, C). Scapus about two times anteocular length; pedicel as long as scapus, with numerous trichobothria (Fig. 2D). THORAX: Pronotum 1.3 times wider than long (Fig. 2E); anterolateral angle rounded; anterior pronotal lobe subquadrate, shorter than posterior lobe, about half as wide as posterior lobe, disc slightly convex, longitudinal groove as a deep ovate depression close to transverse sulcus, surface with conspicuous ridges (Fig. 2F); posterior pronotal lobe smooth, disc slightly convex, posterior margin straight, submedian sulcus obsolete, humeral angle rounded. Thoracic pleura as in figure 2G. Scutellum triangular, lateral margin rounded, disc elevated, posterior margin rounded, not produced (Fig. 2H). Mesoscutum visible dorsally, posterior margin gently rounded (Fig. 2H). *Legs*: Stout. Fore femur similar to mid and hind femora; femora subapically slightly protruding. Pretarsus with simple claws (Fig. 3C). *Hemelytron*: Exceeding tip of abdomen by about 1/3 of its length; quadrangular cell present (Fig. 3D); cubital cell slightly longer than postcubital cell, expanded in apical half with apex acute, base narrower than that of postcubital cell; postcubital cell nearly parallel sided, apex of postcubital cell triangular. ABDOMEN: Elongate ovoid, slightly convex ventrally. Connexiva expanded beyond margin of hemelytron. Abdominal sternites distinct; spiracles of 2nd to 7th sternites flat on sternite. Sclerotized portion of sternite VIII restricted to ventral half of segment, segment VIII about half the length of pygophore, posterior margin concave, 8th spiracle in membrane. GENITALIA: Pygophore elongate ovoid, about 1/4 length of abdomen (Figs. 4A; 5A, B), genital opening dorsally with distinct paired sclerites (tergite 9); inner margin of genital opening strongly elevated, rounded, proximal area flat (*imarg*, Fig. 5A, B). Pygophore bridge absent, only strong sclerotized protuberances present (*prt*, Fig. 5A, B); anterior opening of pygophore with smooth rim (*rim*, Fig. 5A). Median process of pygophore bifid (Figs. 4A, 5A), nearly vertical (Fig. 5B); rami inserted on base (Fig. 4B); base inserted on posterior margin; rami in caudal view gently concave, nearly horizontal, ramus shorter than base width, apical portion produced as a small, acute projection, directed downwards (Fig. 4B). Paramere insertion in apical 1/3 of pygophore (Fig. 5A, B); inverted L-shaped; cylindrical; apex expanded; base of paramere enlarged (Fig. 5C, D); distal portion of body of paramere smooth; distal portion of paramere socket not produced medially. Tergite 9 divided in proximal and distal sclerites (Fig. 5I); proximal portion rugose, with short, stout, simple setae on caudal margin; distal portion strongly convex, with short, delicate setae on whole distal portion; medial area of distal portion with a non-sclerotized, circular area (Fig. 5I, J, arrows). Aedeagus globular. Basal articulatory apparatus broad, trapezoidal, dorsal portion enlarged (*dpba*; Fig. 5H), arms wide (*aba*; Fig. 5H); plate bridge stout (*plbrg*; Fig. 5H), process absent; ductifer sclerotized, circular (*duc*; Fig. 5H); plate extension in lateral view about as long as basal plate, angled (*pext*; Fig. 5F), in ventral view with margins expanded distally (Fig. 5F). Dorsal phallosomal sclerite (DPS) heavily sclerotized, longer than wide, posterior margin rounded, carinated; apex wide, more than half the width of the DPS; each lateral margin with a small emargination subapically (*dps*; Fig. 5E); disc slightly convex (*dps*; Fig. 5F). Phallosoma slightly sclerotized laterally. Endosomal struts reaching midpoint of DPS, slender, fused at base and apex, but not medially; curved in proximal half; parallel in distal half (*str*; Fig. 5E). Endosoma with basal lateral lobe present, flap-like, shaped as 2 separate lobes; distal lobe lightly sclerotized, proximal lobe membranous (*latlb*; Fig. 5E, F). Dorso-lateral lobe subdivided in a proximal and distal portion; completely membranous (*dltlb*; Fig. 5E). Median, basal sclerotization divided in left and right portions, subdivided in proximal and distal portions; lobes highly sclerotized (*mbs*; Fig. 5E); proximal lobe ovoid with apex acute, distal lobe elongate-ovoid with rounded apex and shrivelled surface. Median dorsal lobe small, with nearly transverse, non-sclerotized rugosities (*mdlb*; Fig. 5F). Lateral sclerotizations with proximal portion nearly triangular in dorsal view; base of proximal portion twisted and extended medially; distal portion slightly sclerotized (*lats*; Fig. 5E, F). Distal dorsal lobe

with horseshoe-shaped field of strong denticles (*fdt*; Fig. 5E). Basal, ventral lobes small and triangular (*bvlb*; Fig. 5G). Median ventral area of endosoma with very small denticles. Distal, ventral paired lobes small (usually not inflated and difficult to see) (*vplb*; Fig. 5G).

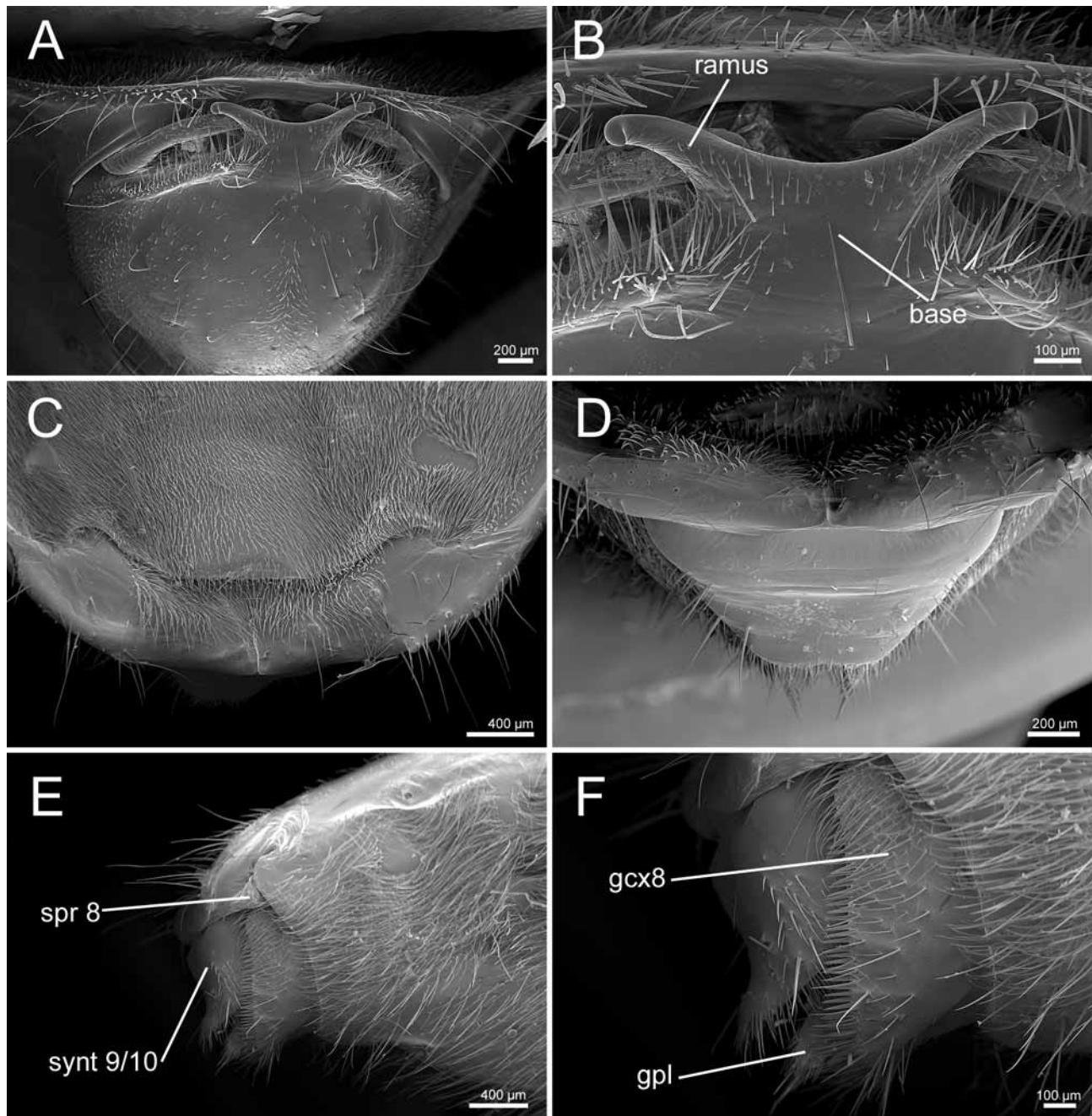


FIGURE 4. SEM of *A. barrocoloradoi*, external male and female genitalia. **A.** Pygophore, caudal view. **B.** Median process of pygophore, caudal view. **C.** Tergites VII and VIII of female, dorsal view. **D.** Syntergite 9/10, caudal view. **E–F.** Female external genitalic sclerites, lateral view. *spr8*=spiracle 8; *synt 9/10*=syntergite 9/10; *gcx8*=gonocoxa 8; *gpl*=gonoplac.

FEMALE: Larger than male (Table 1), similar to it except in the following. **COLORATION:** Pronotum usually completely dark brown; sometimes posterior margin with a narrow, pale yellow strip on areas next to scutellum. Abdomen usually completely dark brown. **VESTITURE:** *Legs:* Metatibial comb dense (Fig. 3F). **STRUCTURE:** **ABDOMEN:** Tergite 8 with margin entire (Fig. 4C). **GENITALIA:** Syntergite 9/10 (Figs. 4D–F; 6E) about two times wide as long; proximal half flat; lateral margins rounded, broadly produced (*lmarg*, Fig. 6E); distal margin slightly emarginate (*dmarg*, Fig. 6E). Gonocoxa 8 (Fig. 4F; 6D) about as wide as long, posterior margin straight; median, posterior angle with short, dense setae; apex of lateral prolongation broadly

rounded. Gonapophysis 8 with apical portion acute; cephalic portion prolonged into bursa, strongly sclerotized, apex knob-like, strongly protruding (*prgap8*, Fig. 6B, C). Gonocoxa 9 (*gcx9*, Fig. 6A, B) broad dorsally, narrowing on ventral portion. Gonapophysis 9 (*gap9*, Fig. 6A) long and tapering, reaching apex of gonapophysis 8. Gonoplac (*gpl*, Figs. 4F; 6A–C) not fused medially; dorsomedial projection short, reaching middle of apex of ventral projection; apex of dorsomedial projection with numerous (about 5–7), stout, short setae; ventral projection slightly flattened laterally and concave medially; apex of ventral projection with numerous, short (and a few long), dense setae. Bursa copulatrix membranous, without median dorsal sclerites (Fig. 6A); ovoid, with lateral lobes, small, located cephalad (*lbs*, Fig. 6A, C); anterior dorsal area of bursa sclerotized, with five, narrow, transversal folds (*dfl*, Fig. 6A, C), dorsal-most fold protruding over other folds, its apex triangular, knob-like, broadly rounded (*dmf*, Fig. 6A, B); anterior ventral area of bursa not sclerotized.

TABLE 1. Measurements of *Apiomerus barrocoloradoi* sp. nov. *Abd*=Abdomen; *AntOc*=Anteocular; *AntPron*=Anterior pronotal lobe; *Clyp-Abd*=Clypeus-Abdomen; *IntOcDist*=Interocular distance; *Ped*=Pedicel; *PostOc*=Postocular; *PostPron*=Posterior pronotal lobe; *Scut*=Scutellum; *Scap*=Scapus.

Species		Length									
		Total	Clyp-Abd	Head	AntOc	PostOc	AntPron	PostPron	Scut	Scap	Ped
<i>Apiomerus barrocoloradoi</i>											
males (N= 5)	Mean	21.36	17.59	4.20	1.35	1.73	1.66	2.50	1.00	2.23	2.23
	SD	1.10	0.73	0.13	0.11	0.14	0.09	0.18	0.14	0.07	0.16
	Range	2.89	2.01	0.33	0.28	0.36	0.21	0.48	0.37	0.21	0.39
	Min.	20.20	16.60	4.07	1.15	1.55	1.60	2.31	0.86	2.12	1.99
	Max.	23.09	18.61	4.40	1.43	1.91	1.81	2.79	1.23	2.33	2.38
females (N= 5)	Mean	23.99	20.33	4.54	1.57	1.86	1.78	3.05	1.15	2.21	2.16
	SD	0.46	0.75	0.08	0.06	0.16	0.07	0.07	0.15	0.09	0.08
	Range	1.29	2.00	0.19	0.17	0.35	0.18	0.17	0.35	0.23	0.22
	Min.	23.41	19.09	4.45	1.49	1.64	1.72	2.98	1.06	2.11	2.03
	Max.	24.70	21.09	4.64	1.66	1.99	1.89	3.15	1.41	2.33	2.25

continued.

Species		Width				
		Head	IntOcDist	AntPron	PostPron	Abd
<i>Apiomerus barrocoloradoi</i>						
males (N= 5)	Mean	2.10	0.91	3.15	5.59	6.23
	SD	0.09	0.08	0.17	0.33	0.46
	Range	0.24	0.19	0.42	0.85	1.15
	Min.	2.02	0.84	3.01	5.28	5.86
	Max.	2.25	1.04	3.43	6.13	7.02
females (N= 5)	Mean	2.23	1.03	3.55	6.65	7.48
	SD	0.09	0.04	0.13	0.10	0.37
	Range	0.22	0.10	0.34	0.25	0.87
	Min.	2.16	0.96	3.37	6.56	7.18
	Max.	2.38	1.07	3.71	6.80	8.05

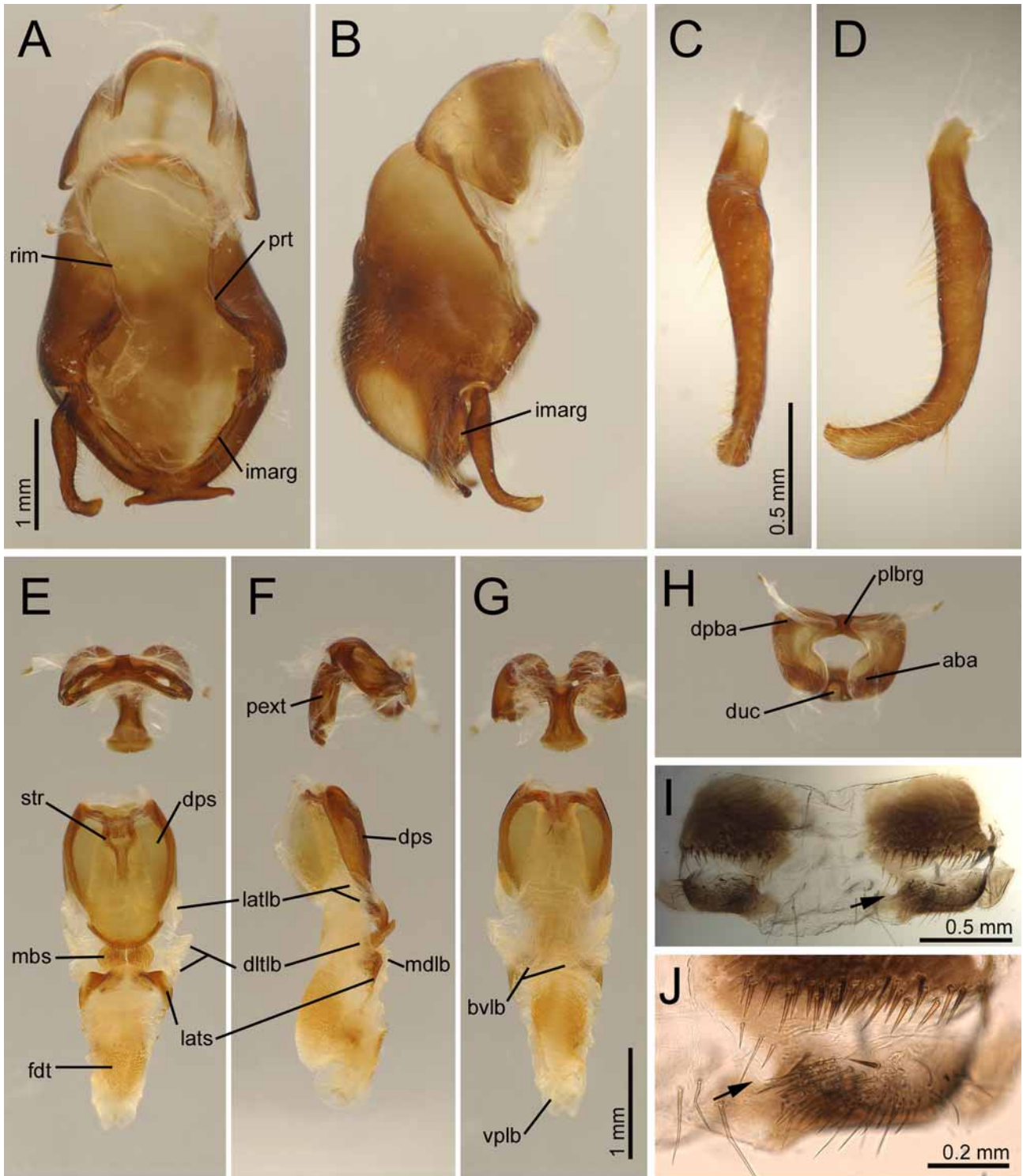


FIGURE 5. *Apiomerus barrocoloradoi*, male genitalia. **A.** Pygophore and sternite 8, dorsal view. **B.** Idem, lateral view. **C.** Right paramere, lateral view. **D.** Idem, dorsal view. **E.** Inflated phallus, dorsal view. **F.** Idem, lateral view. **G.** Idem, ventral view. **H.** Articular apparatus, cephalic view. **I.** Tergite 9, detail of right sclerites showing chaetotaxia; arrow indicates round, non-sclerotized area. **J.** Detail of non-sclerotized area between anterior and posterior sclerites of tergite 9. *aba*=arms of articular apparatus; *bvlb*=basal ventral lobes; *dltlb*=dorso-lateral lobe; *dpba*=dorsal portion of basal articular apparatus; *dps*=dorsal phallothecal sclerite; *duc*=ductifer; *fdt*=field of denticles; *imarg*=inner margin of pygophore; *latlb*=lateral lobe; *lats*=lateral sclerotizations; *mbs*=median basal sclerotization; *mdlb*=median dorsal lobe; *pext*=plate extension; *plbrg*=plate bridge; *prt*=protuberance of bridge; *rim*=rim of anterior opening; *str*=struts.

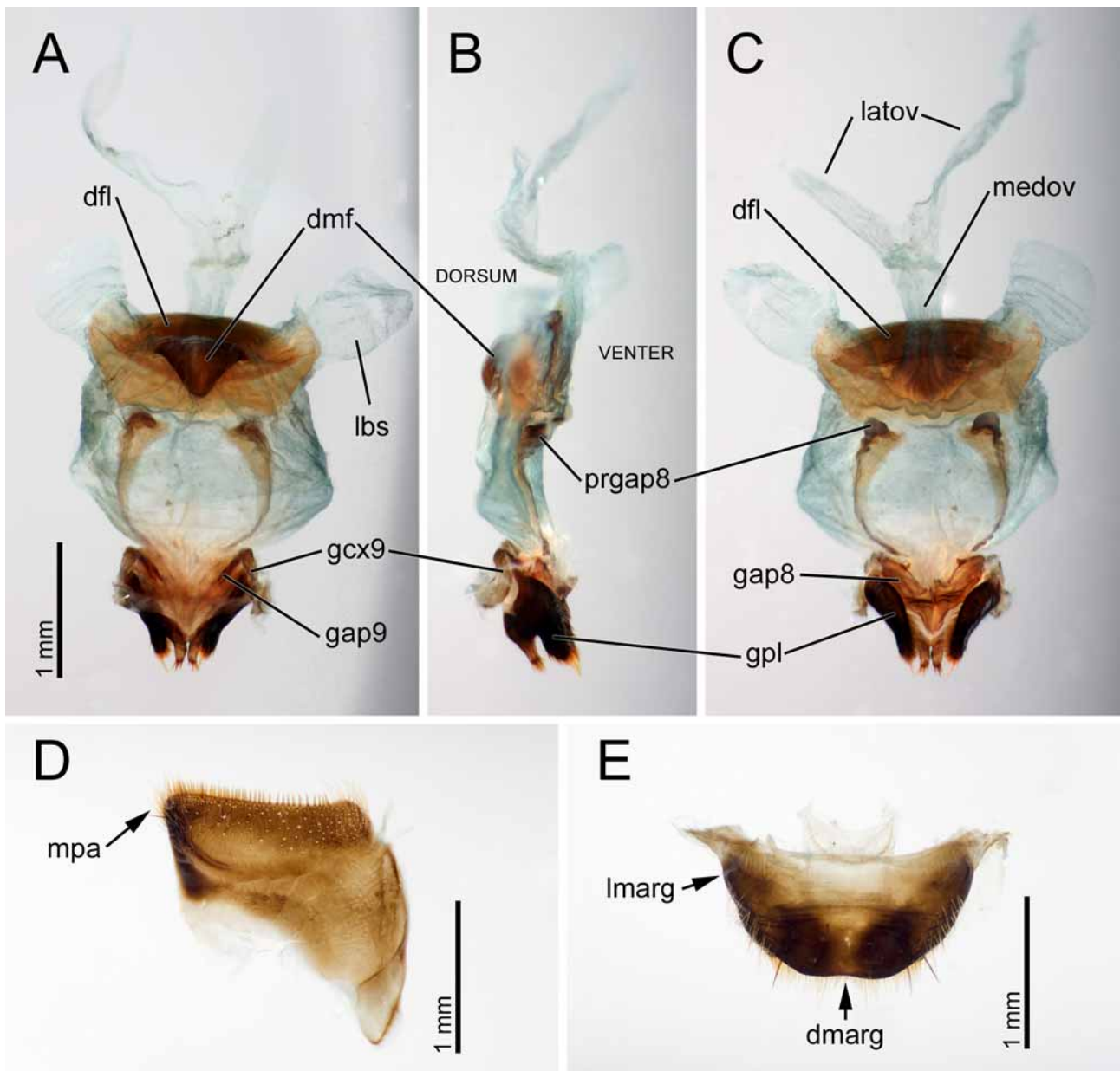


FIGURE 6. *Apiomerus barrocoloradoi*, female genitalia. **A.** Bursa copulatrix, dorsal view. **B.** Idem, lateral view. **C.** Idem, ventral view. **D.** Right gonocoxa 8, ventral view. **E.** Syntergite 9/10, caudal view. *dfl*=anterodorsal folds; *dmarg*=distal margin of syntergite 9/10; *dmf*=dorsalmost fold; *gap8*=gonapophysis 8; *gap9*=gonapophysis 9; *gcx9*=gonocoxa 9; *gpl*=gonoplac; *latov*=lateral oviducts; *lbs*=lateral lobes; *lmarg*=lateral margin of syntergite 9/10; *medov*=median oviduct; *mpa*=medial posterior angle of gonocoxa 8; *prgap8*=basal process of gonapophysis 8.

Etymology. The name is taken from Barro Colorado Island, Panama, one of the localities in which this species occurs and from which many specimens have been collected.

Biology. Unknown. Some specimens have been collected in interception traps or at lights, in particular UV light traps. The latter indicates that they fly at least occasionally at night.

Distribution. Known from the Darien region in Panama west to Costa Rica (Fig. 7).

Holotype male. [PANAMA: Canal Zone]: Barro Colorado Isl[and], Canal Zone, [9.15472°N 79.84806°W], 27 Mar 1962, H. Ruckes / collected on NSF grant G 9830 / California insect survey 181391 / Holotype *Apiomerus barrocoloradoi* **sp. nov.** Forero, Berniker, & Szerlip [red label]; 1 ♂ (UCR_ENT 00017710) (AMNH).

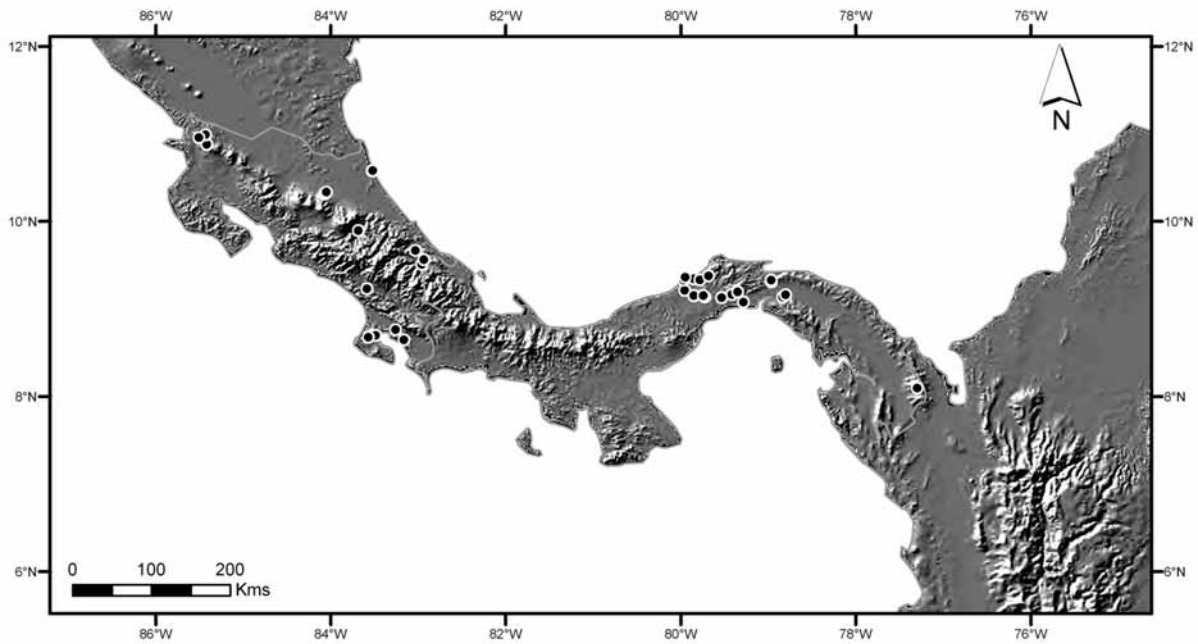


FIGURE 7. Distribution map of *A. barrocoloradoi* in Central America.

Paratypes. COSTA RICA: Alajuela: Est. San Ramon, 10.88327°N 85.41354°W, 620 m, 26 Apr 1994 – 24 May 1994, Hurtado Garcia, 1 ♀ (UCR_ENT 00014282) (INBIO). Est. San Ramon Oeste, 10.88327°N 85.41354°W, 620 m, 03 Apr 1994 – 19 Apr 1994, C. Cano, 1 ♂ (UCR_ENT 00014303) (INBIO); 03 Apr 1994–19 Apr 1994, F. Quesada, 1 ♀ (UCR_ENT 00014307) (INBIO). San Carlos, Schild and Burgdorf, 1 ♀ (UCR_ENT 00014924) (AMNH). San Carlos, 1902, Schild and Burgdorf, 4 ♀ (UCR_ENT 00010626, UCR_ENT 00015120 - UCR_ENT 00015122) (AMNH), 1 ♀ (UCR_ENT 00012340) (HNHM). **Cartago:** Turrialba, 9.9°N 83.683°W, 01 Jan 1750, K. Cooper, 1 ♀ (UCR_ENT 00009825) (AMNH). **Guanacaste:** Est. Pitilla, 9 km S. Santa Cecilia, P.N. Guanacaste, A.C. Guanacaste, 10.99261°N 85.42948°W, 700 m, Jun 1994, P.Rios, 1 ♀ (UCR_ENT 00014304) (INBIO). Est. Pitilla, 9 km S. Santa Cecilia Fila Orosilito, P.N. Guanacaste, 10.99261°N 85.42948°W, 700 m, Apr 1994, F. Pizarro, 1 ♀ (UCR_ENT 00014305) (INBIO). La Maritza, Hda. Orosi, 10.9589°N 85.50255°W, 550 m, 02 Jun 1986–05 Jun 1986, W. Hallwachs, D. H. Janzen, 1 ♀ (UCR_ENT 00014309) (INBIO). **Heredia:** P.N. Braulio Carrillo, Sarapiquí, La Virgen, Quebrada Cabalonga a Sardinalito, 10.31899°N 84.064°W, 600 m, 27 Apr 2005, M. Ballester, A. Peraza, Libre, 1 ♀ (UCR_ENT 00014308) (INBIO). P.N. Braulio Carrillo, Sarapiquí, Transecto Sardinalito, 10.33615°N 84.04663°W, 400 m, 13 Apr 2005, M. Ballester, A. Peraza, O. Fonesca, Libre, 1 ♀ (UCR_ENT 00014310) (INBIO). **Limón:** Amubri, Talamanca., A.C. Amistad, 9.51483°N 82.95537°W, 70 m, 06 Jun 1994–28 Jun 1994, G. Gallardo, 1 ♀ (UCR_ENT 00014286) (INBIO). Cerro Tortuguero, P.N. Tortuguero, 10.58374°N 83.52575°W, 100 m, May 1990, J. Solano, 1 ♂ (UCR_ENT 00014274) (INBIO). Estacion Hitoy Cerere, R. Cerere, Res. Biol. Hitoy Cerere, 9.67177°N 83.0277°W, 100 m, 19 Apr 1992–29 Apr 1992, E. Lopez, 1 ♀ (UCR_ENT 00014285) (INBIO); 06 May 1992–16 May 1992, G. Carballo, 2 ♂ (UCR_ENT 00014275, UCR_ENT 00014276), 1 ♀ (UCR_ENT 00014283) (INBIO); Jun 1992, G. Carballo, 1 ♀ (UCR_ENT 00014284) (INBIO); 20 May 1993 - 06 Jun 1993, G. Carballo, 10 ♂ (UCR_ENT 00014287 - UCR_ENT 00014296), 5 ♀ (UCR_ENT 00014297 - UCR_ENT 00014301) (INBIO). Suretka, 9.5667°N 82.9333°W, 19 May 1924, J. C. Bradley, 2 ♀ (UCR_ENT 00021241, UCR_ENT 00021242) (CUIC). Tortuguero, 10.5833°N 83.5167°W, 16 Jul 1971–24 Jul 1971, J. G. Ehrenfeld, 1 ♀ (UCR_ENT 00017677) (AMNH). Valle la Estrella, R.B. Hitoy Cerere, 9.67177°N 83.0277°W, 100 m, Jul 1994, F. Quesada, 1 ♀ (UCR_ENT 00014281) (INBIO). Valle la Estrella, R.B. Hitoy Cerere, A.C. Amistad, 9.67177°N 83.0277°W, 100 m, Jun 1994, G. Carballo, 4 ♂ (UCR_ENT 00014278 - UCR_ENT 00014280, UCR_ENT 00014302), 2 ♀ (UCR_ENT 00014277, UCR_ENT 00014311) (INBIO). **Puntarenas:** 1.8 mi W of Rincon, Osa Peninsula, 8.7075°N 83.51324°W, 06

Mar 1971–06 Mar 1971, J.P. Donahue, C.L. Hogue, 1 adult, sex unknown [abdomen missing] (UCR_ENT 00010912) (LACM). 2.5 mi SW of Rincon, Osa Peninsula, 8.7°N 83.48333°W, 14 Mar 1967, G. Schuster, 1 ♀ (UCR_ENT 00011348) (FSCA). Bosque Esquinas, A.C. Osa, 8.76885°N 83.25676°W, 200 m, May 1994, M. Segura, 1 ♀ (UCR_ENT 00014306) (INBIO). Bosque Esquinas, Peninsula Osa, A. C. Osa, 8.76885°N 83.25676°W, 200 m, May 1994, F. Quesada, 2 ♂ (UCR_ENT 00014318, UCR_ENT 00014319) (INBIO). Golfito, Camino a las Torres, 8.64982°N 83.16058°W, 500 m, 23 Apr 2004, Porras, Gamboa, Briceno, Moraga, Luz, 1 ♂ (UCR_ENT 00014320) (INBIO). Rancho Quemado, Pen. de Osa, 8.6791°N 83.56671°W, 200 m, Feb 1992, F. Quesada, 1 ♂ (UCR_ENT 00014314) (INBIO); Mar 1992, F. Quesada, 1 ♂ (UCR_ENT 00014317) (INBIO); Apr 1992, K. Flores, 3 ♂ (UCR_ENT 00014313, UCR_ENT 00014315 - UCR_ENT 00014316) (INBIO); Apr 1992, D. Brenes, 1 ♂ (UCR_ENT 00014312) (INBIO). **PANAMA: Canal Zone:** Alhajuelo, 28 May 1912, Unknown, 1 ♀ (UCR_ENT 00009819) (AMNH). Barro Colorado Isl[and], C[anal]. Z[one], 9.15472°N 79.84806°W, Jul 1942–Aug 1942, J. Zetek, 1 ♂ (UCR_ENT 00009349) (USNM); 19 May 1967, Delong & Triplehorn, 1 ♀ (UCR_ENT 00009350) (USNM); 19 May 1967, J. Maldonado C., 1 ♂ (UCR_ENT 00009348) (USNM). Barro Colorado Island, 9.15563°N 79.84895°W, 28 Apr 1964–30 Apr 1964, W.D. Duckworth & S.S. Duckworth, 1 ♂ (UCR_ENT 00009357), 1 ♀ (UCR_ENT 00009361) (USNM); 01 May 1964–09 May 1964, W.D. Duckworth & S.S. Duckworth, 5 ♂ (UCR_ENT 00009354 - UCR_ENT 00009356, UCR_ENT 00009358 - UCR_ENT 00009359), 7 ♀ (UCR_ENT 00009362 - UCR_ENT 00009368) (USNM); 10 May 1964–17 May 1964, W.D. Duckworth & S.S. Duckworth, 1 ♂ (UCR_ENT 00009360) (USNM). Barro Colorado Island, 9.15562°N 79.84895°W, 21 May 1966, M. G. Naumann, 1 ♀ (AMNH_PBI 00035828) (AMNH). Barro Colorado Island, 9.15472°N 79.84806°W, 20 Jun 1924, N. Banks, 1 ♀ (UCR_ENT 00009818) (AMNH); 22 Apr 1929, S. W. Frost, 1 ♂ (UCR_ENT 00009812) (AMNH); 27 Jun 1933, J.D. & H. Hood, 1 ♂ (UCR_ENT 00009815) (AMNH); 11 Jul 1934–11 Jul 1943, Otis E. Shattuck, 1 ♀ (UCR_ENT 00009817) (AMNH); 26 Apr 1956, C. W. & M. E. Rettenmeyer, 1 ♀ (UCR_ENT 00035990) (KU); 28 Apr 1956, Carl W. & Marian E. Rettenmeyer, 1 ♂ (UCR_ENT 00035982), 4 ♀ (UCR_ENT 00035991, UCR_ENT 00035993 - UCR_ENT 00035995) (KU); 02 May 1956, Carl W. & Marian E. Rettenmeyer, 1 ♂ (UCR_ENT 00035989) (KU); 09 May 1956, Carl W. & Marian E. Rettenmeyer, 2 ♂ (UCR_ENT 00035979, UCR_ENT 00035980) (KU); 09 May 1956, C. W. & M. E. Rettenmeyer, 1 ♀ (UCR_ENT 00035984) (KU); 10 May 1956, Carl W. & Marian E. Rettenmeyer, 1 ♀ (UCR_ENT 00035988) (KU); 11 May 1956, Carl W. & Marian E. Rettenmeyer, 1 ♂ (UCR_ENT 00035983) (KU); 15 Jun 1956, Carl W. & Marian E. Rettenmeyer, 1 ♀ (UCR_ENT 00035992) (KU); 23 Apr 1962, H. Ruckes, 1 ♀ (UCR_ENT 00009821) (AMNH); 24 Apr 1962, H. Buckes, 2 ♂ (UCR_ENT 00009809, UCR_ENT 00009810) (AMNH); 28 Apr 1962, H. Ruckes, 2 ♂ (UCR_ENT 00009813, UCR_ENT 00009816) (AMNH); 29 Apr 1962, H. Ruckes, 1 ♂ (UCR_ENT 00009814) (AMNH); 30 Apr 1962, H. Buckes, 1 ♂ (UCR_ENT 00009811) (AMNH); 08 May 1966, M. G. Naumann, 1 ♂ (UCR_ENT 00035981), 2 ♀ (UCR_ENT 00035985, UCR_ENT 00035986) (KU); 16 May 1967, R. E. Beer, 1 ♀ (UCR_ENT 00035987) (KU); 06 Jun 1972, D. Engleman, 1 ♀ (UCR_ENT 00032580) (UCB); 05 Jun 1978, Snyder-Molino, 2 ♂ (UCR_ENT 00009798, UCR_ENT 00009799) (AMNH); 21 Apr 1981, R.B. & L.S. Kimsey, 1 adult, sex unknown (UCR_ENT 00007297) (UCD); 22 Apr 1981, R.B. & L.S. Kimsey, 1 ♀ (UCR_ENT 00007296) (UCD); 31 May 1981, R.B. & L.S. Kimsey, 1 ♀ (UCR_ENT 00007298) (UCD); 13 May 1985–21 May 1985, H. Wolda, 2 ♀ (UCR_ENT 00007299, UCR_ENT 00007300), 1 ♀ (UCR_ENT 00007301) (UCD). Coco Solo Hospital, 9.35°N 79.85°W, 23 May 1972, Engleman, 1 ♀ (UCR_ENT 00008890) (USNM). Escobal Road, 9.21739°N 79.95576°W, 05 Jun 1978, D. Engleman, Light Trap, 1 ♀ (UCR_ENT 00009824) (AMNH). Fort Sherman, 9.33333°N 79.96666°W, 26 Jun 1976, A. Thurman, 1 ♂ (UCR_ENT 00009808) (AMNH). **Colon:** Fort Sherman, 9.36666°N 79.95°W, 13 Jun 1989–13 Jun 1989, J. R. White, 1 ♀ (UCR_ENT 00007295) (UCD). Gatun L., Barro Colorado I, 9.15563°N 79.84895°W, 28 Apr 1981, Bruce Gill, 1 ♂ (UCR_ENT 00018801) (BDGC). Santa Rita Arriba, 9.3378°N 79.78°W, 18 May 1976, D. Engleman, Light Trap, 2 ♂ (UCR_ENT 00009800, UCR_ENT 00009801) (AMNH); 21 May 1976, D. Engleman, Light Trap, 1 ♂ (UCR_ENT 00009822) (AMNH); 22 May 1976, D. Engleman, Light Trap, 1 ♂ (UCR_ENT 00009802) (AMNH). Santa Rita Ridge, 9.38084°N 79.68235°W, 07 May 1977, D. Engleman, Light Trap, 1 ♂ (UCR_ENT 00009803), 1 ♀ (UCR_ENT 00009823) (AMNH). **Darien:** Rio Tacarcuna, 8.09931°N 77.29622°W, 579 m, Jul 1963, W. P. Murdoch, 1 ♀ (UCR_ENT 00008891) (USNM). **Panama:** 10–13 km N of El Llano, 9.31264°N 78.96434°W, 29 May 1983–31 May

1983, E. Giesbert, 1♀ (UCR_ENT 00010911) (LACM). Altos de Maje, Chepo, 9.13796°N 78.83546°W, 14 May 1976–15 May 1976, D. Engleman, Light Trap, 4♂ (UCR_ENT 00009804 - UCR_ENT 00009807) (AMNH). Cabima, 9.1333°N 79.5333°W, 30 May 1911, A. Busck, 3♀ (UCR_ENT 00009351 - UCR_ENT 00009353) (USNM). Canal Area, Old Gamboa Rd. km 1–5, 9.14137°N 79.72564°W, 50 m, Jun 1993–Jul 1993, C. Snyder, 1♂ (UCR_ENT 00014923) (AMNH). Cerro Azul, 9.16927°N 79.41629°W, 29 Apr 1981, E. Giesbert, 2♂ (UCR_ENT 00009796, UCR_ENT 00009797) (AMNH). Cerro Jefe, 9.2°N 79.35°W, 700 m, 20 May 1972, Stockwell, 1♀ (UCR_ENT 00032581) (UCB). Km 7, pipeline road, Gamboa, 9.15825°N 79.7435°W, May 1996, S. Lingafelter, 1♀ (UCR_ENT 00035827) (AMNH). Maje Station, 9.16666°N 78.8°W, 18 May 1974, A. Ramirez, 1♀ (UCR_ENT 00009826) (AMNH). Nusagandi, 9.33333°N 78.96666°W, 18 May 1993–20 May 1993, E. Riley, 1♀ (UCR_ENT 00031622) (TAMU). Pacora, 9.0833°N 79.2833°W, 21 m, 21 May 1951, F. S. Blanton, 1♀ (UCR_ENT 00009820) (AMNH).

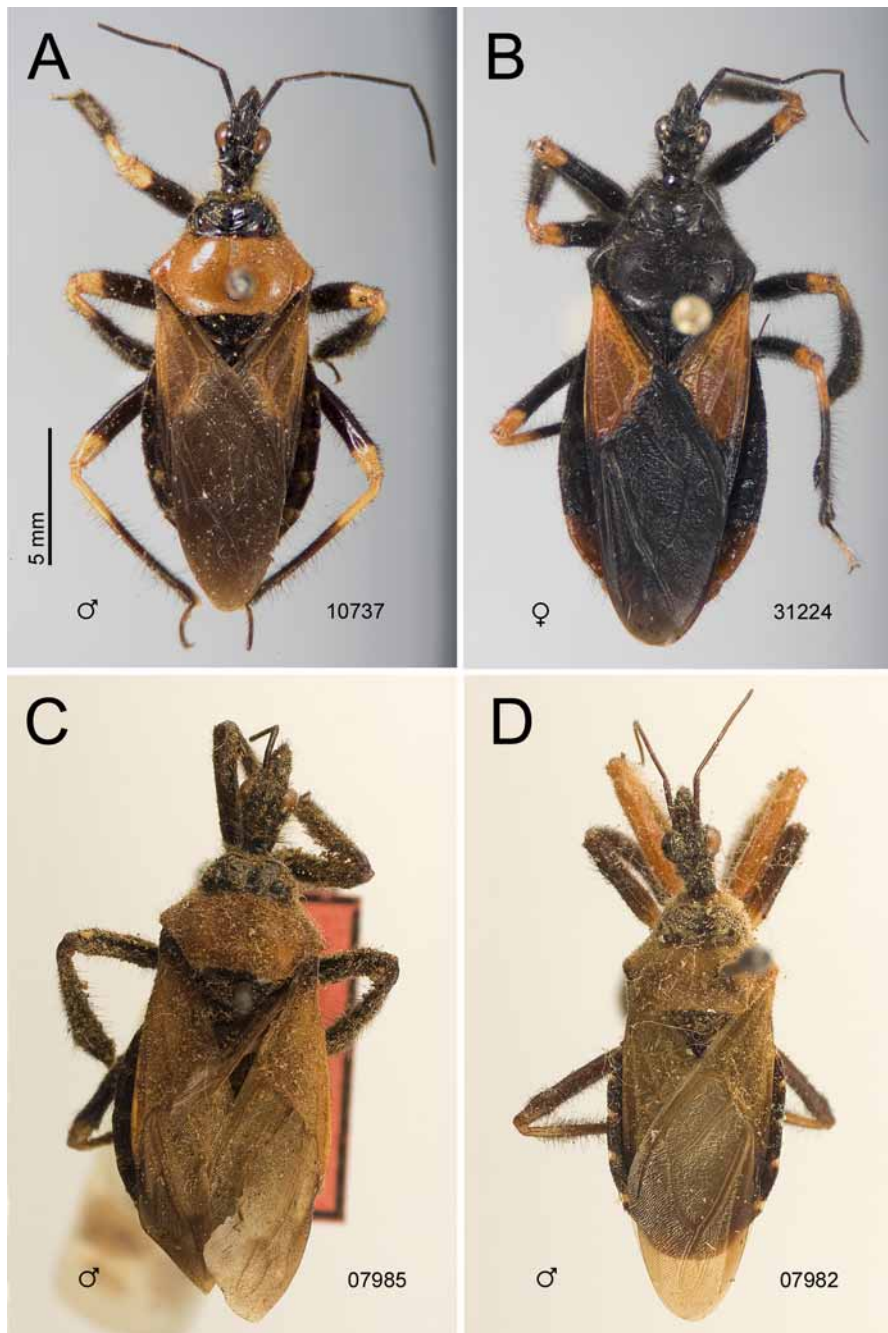


FIGURE 8. Dorsal habitus images of *Apiomerus* species similar in coloration to *A. barrocoloradoi*. See text for discussion. **A.** *A. nigricollis*. **B.** *A. saileri*. **C.** *A. venezuelensis*, holotype. **D.** *A. shannoni*, holotype. Numbers indicate USI numbers with prefix UCR_ENT.

Other material examined. *Apiomerus nigricollis* Stål, 1860. **BRAZIL: Amazonas:** Benjamin Constant, 11 Feb 1942–01 Mar 1942, August Rabaut, 1♂ (UCR_ENT 00010736) (AMNH). **Espirito Santo:** Santa Thereza, Dec 1946, R. Arle, 1♀ (UCR_ENT 00017672) (AMNH). **Parana:** Iguacu N. P., 20 Oct 1982–23 Oct 1982, Dr. L. Gomez, 2♀ (UCR_ENT 00017670 - UCR_ENT 00017671) (AMNH). **Santa Catarina:** Nova Teutonia, 10 Dec 1944, Fritz Plaumann, 1♂ (UCR_ENT 00010738). **Sao Paulo:** S. Bernardo; 15 Jan 1942, Spitz, 1♂ (UCR_ENT 00010737) (AMNH).

Apiomerus saileri Costa Lima, Campos Seabra, & Hathaway, 1951. **BOLIVIA: La Paz:** Guanay, Oct 1993–01 Nov 1993, L. Pena, 4♂ (UCR_ENT 00009394 - UCR_ENT 00009397), 2♀ (UCR_ENT 00031223, UCR_ENT 00031224) (USNM).

Apiomerus shannoni Costa Lima, Campos Seabra, & Hathaway, 1951. **PERU: Loreto:** Iquitos, 3.748°S 73.247°W, Mar 1931–Apr 1931, R. C. Shannon, 1♂ (UCR_ENT 00007982 [cat Type No. 61896 USNM]) (USNM).

Apiomerus venezuelensis Costa Lima, Campos Seabra, & Hathaway, 1951. **VENEZUELA:** Unknown locality, 1♂ (UCR_ENT 00007985 [cat Type No. 61885 USNM]) (USNM).

Discussion

Similar species: Champion (1899) treated 18 species of *Apiomerus* from Central America. None of these species resembles the color morphs here described for *A. barrocoloradoi* **sp. nov.**, which are all clearly distinguished by the yellow apex of the metafemur and the yellow base of the metatibia (Fig. 1, arrows). It is surprising that Champion did not encounter any specimens of *A. barrocoloradoi*, for this species seems to be very widespread in Costa Rica and Panama. None of the species described by Dispos (1971) from Central America resembles the color morphs of *A. barrocoloradoi*.

Based on coloration, in particular due to the coloration of the hind legs, some color morphs of *A. barrocoloradoi* might resemble a few South American species such as *A. nigricollis*, *A. saileri*, *A. shannoni*, and *A. venezuelensis* (Fig. 8). Beside obvious color differences, *A. nigricollis* and *A. barrocoloradoi* differ in that the rami of the median process of the pygophore are nearly horizontal in *A. barrocoloradoi*, whereas in *A. nigricollis* they are strongly directed dorsally. In the females of *A. barrocoloradoi*, the margin of tergite 8 is entire, not slightly produced as in *A. nigricollis* (Costa Lima *et al.* 1951). In *Apiomerus saileri* the rami are directed dorsally, forming a gentle curve and are inserted on the pygophore posterior margin (Costa Lima *et al.* 1951), not on a well defined base as in *A. barrocoloradoi*. Similarly, in *A. venezuelensis* the rami are directed upwards (Costa Lima *et al.* 1951). In *Apiomerus shannoni* the rami are inserted on the posterior margin of the pygophore not on a base as in *A. barrocoloradoi*. In both *A. shannoni* and *A. venezuelensis* the bodies are not as elongate as in *A. barrocoloradoi* and the forewing membranes are shorter relative to the caudal margin of tergite 7.

Character discussion and phylogenetic affinities: Szerlip (1980) proposed eight species groups within *Apiomerus*. He proposed the *pictipes* group [*A. pictipes* Herrich-Schaeffer, 1848, *A. flaviventris* Herrich-Schaeffer, 1848, *A. barrocoloradoi* (as a manuscript species), and two undescribed species], and the *crassipes* group [*A. crassipes* (Fabricius, 1803), *A. spissipes* (Say, 1825), and several undescribed species] as sister groups based on deflexed extensions of tergite 8 (paramedial lobes) in the female. He included *A. barrocoloradoi* in the *pictipes* group because of the slightly concave rami of the median process of the pygophore in the males (nearly T-shaped), the trapezoidal shape of syntergite 9/10, the deflexed paramedial lobes of tergite 8, and the presence of transverse sclerotizations with an enlarged dorsal projection on the anterior area of the bursa copulatrix in the females.

Although the rami of the median process of the pygophore are slightly concave in all members of the *pictipes* group, including *A. barrocoloradoi*, the orientation of the median process is distinct in this species. In lateral view, the process is nearly vertical (Fig. 5B), whereas in all other species of the *pictipes* group, it is almost horizontal. Having a vertical median process is a common occurrence in other *Apiomerus* species outside the *pictipes* group, such as *A. crassipes* (Fabricius, 1803), *A. lanipes* (Fabricius, 1803), *A. emarginatus* Stål, 1872, and *A. vexillarius* Champion, 1899.

A trapezoidal syntergite 9/10 is not restricted to the *pictipes* group. A similarly shaped syntergite 9/10 is found commonly in many South American *Apiomerus* species (Costa Lima *et al.* 1951).

Szerlip (1980) also stated that the paramedial lobes of tergite 8 are weakly defined and scarcely deflexed in *A. barrocoloradoi*. Our observations determined that tergite 8 is entire (Fig. 4C) and does not possess deflexed paramedial lobes, which are present in females of both the *pictipes* and *crassipes* groups. An entire tergite 8 without deflexed paramedial lobes are characters also found in other *Apiomerus* species outside the *pictipes* and *crassipes* groups, such as *A. colombianus* Costa Lima, Campos Seabra, & Hathaway, 1951, *A. lanipes* and many other species (Costa Lima *et al.* 1951).

Sclerotizations within the bursa copulatrix are a feature common in all species of *Apiomerus* so far examined (Forero, pers. obs.), not just those in the *pictipes* and *crassipes* groups. In *A. barrocoloradoi*, the dorsalmost sclerotized fold contains an apical knob-like projection. This is not seen in any other females of the *pictipes* group. Species of the latter group share a nearly identical, distinct configuration, in which the dorsalmost fold contains a median, inverted, Y-shaped projection.

Despite these differences, there are characters which suggest a close relationship between *A. barrocoloradoi*, and the *pictipes* and *crassipes* species groups. All three share characters of the male genitalia, such as C-shaped lateral sclerotizations, basal lateral lobes, and paired dorso-lateral sclerotizations of the endosoma, characters which do not occur in other *Apiomerus* species, indicating the possibility that *A. barrocoloradoi* is the sister taxon to the *crassipes* + *pictipes* groups. Alternatively, *A. barrocoloradoi* might be the sister taxon to the *pictipes* group, and they together might be sister to the *crassipes* group. Evidence in support of this might be the presence of a dorsal projection on the sclerotizations of the bursa copulatrix, (lacking in the *crassipes* species group), and the T-shaped configuration of the median process of the pygophore (compared to the U-shape in the *crassipes* group). These alternative hypotheses are currently being tested in a cladistic analysis of the two species groups (Berniker *et al.*, in prep.).

Chromatic variability: Color polymorphism is a frequent phenomenon in many insect groups (Nabours *et al.* 1933; Rowell 1971; Corbet 1980; Clarke *et al.* 1985; Castner & Nickle 1995). Some Heteroptera species also exhibit color polymorphism (Doesburg 1968; McIver & Stonedahl 1987; Blinn 1988; Vivian & Panizzi 2002; Forero 2008), including Reduviidae (Mason 1976). In fact, many Harpactorinae species are sexually dimorphic regarding color patterns (Champion 1899; Gil-Santana & Milano 2007), and some are even polychromatic (Champion 1899; Hart 1986), at least in one of the sexes (Gil-Santana 2008), a situation which is also found in other insects (Cordero & Andrés 1996). In *A. barrocoloradoi*, color polymorphism is not restricted to either sex, but instead both sexes have high degrees of color polymorphism. This color polymorphism is not correlated to the geographic range of *A. barrocoloradoi*. Similar color morphs are found in geographically widely separate areas and multiple morphs can even be found during the same collection event (e.g., Fig. 1A, B). Other species of *Apiomerus* also show high degree of color variation (Gil-Santana *et al.* 2006), but this is the first time that this variation is matched with detailed documentation of the internal genitalic morphological structures showing that color morphs are just intraspecific variation.

Polychromatism has been explained as a strategy to avoid predation (Bond 2007), or may be related to different mating strategies or to genetic drift (Andrés & Cordero 2001); and may be due to effects on different diets (Schwertner *et al.* 2002) or to abiotic environmental factors (Mason 1976). In the case of *A. barrocoloradoi* and of many other polychromatic Harpactorinae, it is unknown which factor is driving color polymorphism.

Because of the high chromatic variability present in many of the species of *Apiomerus*, including *A. barrocoloradoi*, it is necessary to avoid relying entirely on coloration patterns for species delimitation (Rowell 1971). Although coloration might provide useful characters for species identification, species limits might be better based on more unambiguous morphological characters. In *A. barrocoloradoi*, despite the highly variable coloration, the morphology of the male and female genitalia exhibited very little intraspecific variation and provided useful characters for species diagnosis.

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