

## Two new species of Manaosbiidae (Opiliones: Laniatores) from Panama, with comments on interspecific variation in penis morphology

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**Abstract.** In Central America, the family Manaosbiidae is recorded only from Panama and Costa Rica. Four species occur in this region: *Barrona williamsi* Goodnight & Goodnight 1942, *Bugabittia triacantha* Roewer 1915, *Poassa limbata* Roewer 1943, and *Zygopachylus albomarginis* Chamberlin 1925. In this paper, we describe *Barrona felgenhaueri* new species (Coclé Province, Panama) and *Bugabittia akini* new species (Coclé Province, Panama) and report a new record for *B. williamsi* (Coclé Province, Panama). We used SEM to examine the penis morphology of *Barrona* Goodnight & Goodnight 1942 and the Caribbean species *Cranellus montgomeryi* Goodnight & Goodnight 1947 and *Rhopalocranaus albilineatus* Roewer 1932. We compared genital morphology of these species with published descriptions for Manaosbiidae from South America. With respect to genital morphology, we found that the most variable characters were the number and relative sizes of the setae that occur on the lateral margins of the ventral plate. Other features that exhibited interspecific variation included the shape of the ventral plate, the shape of the distal border of the ventral plate, and the shape and armature of the apex of the stylus.

**Keywords:** Central America, morphology, Neotropics, taxonomy

The Manaosbiidae is a member of the suborder Laniatores. It belongs to the superfamily Gonyleptoidea, a lineage that also includes the Cosmetidae, Cranidae, and Gonyleptidae (Kury 2007). Recently, a phylogenetic analysis using molecular data (Giribet et al. 2009) supported the membership of Manaosbiidae within this clade. However, this study also indicated that Manaosbiidae is polyphyletic, at least with respect to the inclusion of the genus *Zygopachylus* Chamberlin. Manaosbiidae was initially recognized as the subfamily Manaosbiinae within the Gonyleptidae (Roewer 1943). Kury (1997) elevated the group to family status, refined the characters distinguishing the Manaosbiidae from the Cranidae and Gonyleptidae, and provided diagnostic characters for the family.

Of the 47 species and 27 genera currently placed in the Manaosbiidae (Kury 2007), 12 species are known only from female holotypes (Kury 2003). The morphology of the penis, an important structure in modern taxonomic descriptions for Opiliones (Acosta et al. 2007), has only been described for seven species, all from South America (Šilhavý 1979; Kury 1997, 2007).

Currently, the Manaosbiidae has a geographic distribution that includes the Caribbean islands of Trinidad and St. Vincent, northern South America, and Central America (Kury 2003). Most species are small (3.5–10 mm in scutal length) and known from only relatively few records. This is due, at least in part, to undersampling or lack of sampling the leaf litter, a microhabitat in which they can be relatively abundant (Kury 2007). Little is known about the natural history of these harvestmen, although Townsend et al. (2008a) provided observations concerning activity, habitat use and geographic distribution for *Cranellus montgomeryi* Goodnight & Goodnight 1947a and *Rhopalocranaus albilineatus* Roewer 1932 on the Caribbean island of Trinidad. The two basal segments on

tarsus I of males in most species are generally enlarged and frequently fused (Kury 2007). Observations of these segments with the aid of scanning electron microscopy (SEM) have revealed that these tarsal segments have numerous pore openings, which are hypothesized to be connected to packed clusters of exocrine glands that may function in intraspecific communication (Willemart et al. 2010). The only known species within the family from Central America that lacks the enlarged segments of tarsus I is *Zygopachylus albomarginis*. In this species, males construct and defend mud nests and mate with visiting females (Rodríguez & Guerrero 1976; Mora 1990). Following oviposition, the males remain in the nests and actively defend the eggs against ants and conspecifics (Mora 1990). Currently, four manaosbiid species are known from Central America, namely *Barrona williamsi* Goodnight & Goodnight 1942a (Panama), *Bugabittia triacantha* Roewer 1915 (Panama), *Zygopachylus albomarginis* Chamberlin 1925 (Panama) and *Poassa limbata* Roewer 1943 (Costa Rica). Each of these monotypic genera is endemic to Central America (Kury 2003). In this study, we describe two new species, *Barrona felgenhaueri* and *Bugabittia akini*. To provide greater insights into the phylogenetic relationships of manaosbiids, we used SEM to examine the penis morphology of *Barrona* and two Caribbean species (*Cranellus montgomeryi* and *Rhopalocranaus albilineatus*). We compared these observations to published descriptions of penis morphology for seven species from South America (Šilhavý 1979; Kury 1997, 2007).

### METHODS

The specimens examined in this study are deposited in the American Museum of Natural History, New York, USA (AMNH); Senckenberg Museum, Frankfurt, Germany (SMF)

and the Museo de Invertebrados G.B. Fairchild de la Universidad de Panama, Panama City, Panama (MIUP). Specimens were examined and photographed with a Leica Zoom stereomicroscope. Digital images of specimens were processed and the body and leg segments were measured with the aid of a Leica image capturing system.

Adult males of *Barrona williamsi* were collected in the field by R. Miranda from Parque Summit, Panama Province, Panama in September 2009. We collected specimens of *Cranellus montgomeryi* and *Rhopalocranaus albilineatus* from the Central and Northern Ranges of Trinidad, West Indies in July 2006 and 2008. Penises were dissected and prepared for scanning electron microscopy (SEM). Specimens were dehydrated in a graded ethanol series, dried with hexamethyldisilazane, mounted on an aluminum stub with double stick tape, and sputter-coated with gold. Penises were examined and photographed with a Hitachi S-3000N SEM at an accelerating voltage of 15 kV in the Microscopy Center at the University of Louisiana at Lafayette, USA. In addition, the penis of an AMNH paratype of *B. felgenhaueri* was dissected and examined with a compound light microscope. This penis was placed into a genitalia vial in 70% ethanol and stored with the male. For diagnoses and descriptions, we employed terminology for morphological features of harvestmen used by Goodnight & Goodnight (1947), Kury (1997), Kury & Pinto-da-Rocha (2002), and Acosta et al. (2007).

#### SYSTEMATICS

##### Manaosbiidae Roewer 1943

- Mitobatinae [part]: Simon 1879:226.  
 Prostyginae [part]: Roewer 1913:140; 1923:449; Mello-Leitão 1932:103; Goodnight & Goodnight 1942a:11.  
 Cranaina [part]: Roewer 1913:349; 1923:536; Mello-Leitão 1931:118; 1932:111; 1941:440; Roewer 1938:6; Goodnight & Goodnight 1942b:7; Soares & Soares 1948:583.  
 Hernandariinae [part]: Roewer 1913:460; 1923:582; Mello-Leitão 1932:129; Soares & Soares 1949:221.  
 Heterocraninae [part]: Roewer 1913:417; 1923:567.

Manaosbiinae: Roewer 1943:14, 56; Soares & Soares 1949:224.  
 Manausbiinae [misspelling]: Mello-Leitão 1949:12.  
 Stygnoleptinae [part]: H. Soares 1972:68.  
 Manaosbiidae: Kury 1997:3; Kury 2003:206; Kury 2007:209.

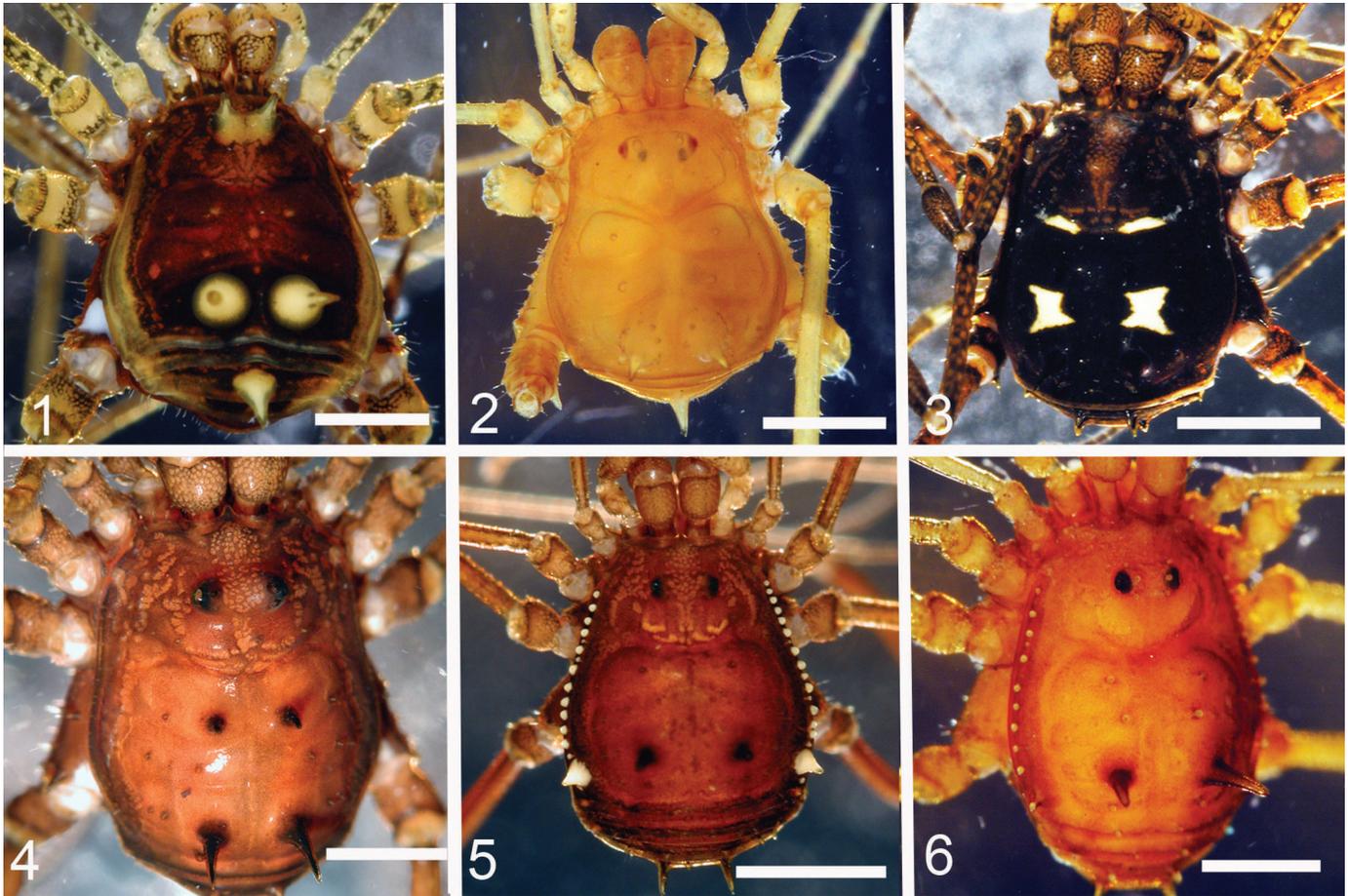
**Emended diagnosis.**—Gonyleptoidea with abdominal scute only slightly wider than carapace, ocularium small, without depression, unarmed or with 1–3 small or large spiniform tubercles; abdominal scutum unarmed or with paired tubercles, granular tubercles on area I generally smaller than the spiniform tubercles on area III; pedipalpus smooth, without strong armature on any segments; pedipalpal femur cylindrical; coxa IV barely visible above scute, dorsally covered with spiniform tubercles and armed with spiniform apical tubercle; trochanters I–III may have ectal tubercles; only basal segments of basitarsus I spindle-like in male; tarsi III–IV with a pair of smooth claws and occasionally sparse scapulae; ventral plate of penis rectangular elongate, with distal border substraight, concave, or with parabolic cleft, basal setae stout, slightly bent, median two pairs of setae of ventral plate dorsally located, distal setae flattened or strongly curved, but not helycoidal; stylus straight apex folded or papillate, glans exposed, without dorsal or ventral processes.

**Distribution.**—Brazil, Colombia, Costa Rica, Ecuador, Guyana, Panama, Peru, Suriname, Trinidad & Tobago, Venezuela, Windward Islands (St. Vincent and the Grenadines, Grenada).

**Included genera.**—*Azulamus* Roewer 1957, *Barrona* Goodnight and Goodnight 1942, *Belemnodes* Strand 1942, *Belemulus* Roewer 1932, *Bugabittia* Roewer 1915, *Camelianus* Roewer 1912, *Clavicranaus* Roewer 1915, *Cranellus* Roewer 1932, *Cucutacola* Mello-Leitão 1940, *Dibunostra* Roewer 1943, *Gonogotus* Roewer 1943, *Manaosbia* Roewer 1943, *Mazarunius* Roewer 1943, *Meridia* Roewer 1913, *Paramicrocranaus* Soares 1970, *Pentacranaus* Roewer 1963, *Poecilocranaus* Roewer 1943, *Rhopalocranaus* Roewer 1913, *Rhopalocranellus* Roewer 1925, *Sanvicentia* Roewer 1943, *Saramacia* Roewer 1913, *Semostrus* Roewer 1943, *Syncranaus* Roewer 1913, *Tegyra* Sørensen 1932 and *Zygopachylus* Chamberlin 1925.

#### KEY TO THE MANAOSBIIDAE OF CENTRAL AMERICA

1. Second free tergite with single spiniform tubercle ..... (*Bugabittia*)...2  
 Second free tergite with paired granular tubercles ..... 3
2. Ocularium with paired spiniform tubercles; paired spiniform tubercles on abdominal scutal area III without smaller encircling granular tubercles; tarsal formula 6:15:6:8 ..... *Bugabittia akini* new species (Fig. 1)  
 Ocularium with paired granular tubercles; paired spiniform tubercles on abdominal scutal area III encircled by smaller tubercles; tarsal formula 6:12:6:? ..... *Bugabittia triacantha* Roewer 1915 (Fig. 2)
3. Margins of abdominal scutum unarmed ..... (*Barrona*)...4  
 Margins of abdominal scutum with single row of granular tubercles with terminal tubercle (adjacent to areas III or IV) enlarged ..... 5
4. Scutum with 4 white patches; smaller patches on abdominal scutal area I, larger patches on area II; tarsal formula 6:12:6:6 ..... *Barrona felgenhaueri* new species (Fig. 3)  
 Scutum without white patches; carapace black with lighter mottling; tarsal formula 6:16:6:7 .....  
 ..... *Barrona williamsi* Goodnight & Goodnight 1942 (Fig. 4)
5. Terminal conical tubercle on margin of scutum much larger than other tubercles on scutal margin; anterior region of carapace with lighter mottling; more than 12 small tubercles on margins of abdominal scutum .....  
 ..... *Zygopachylus albomarginis* 1925 Chamberlin (Fig. 5)  
 Terminal tubercle on scutal margin only slightly larger than other tubercles on margin; anterior region of carapace without lighter mottling; less than 12 small tubercles on margins of abdominal scutum ..... *Poassa limbata* Roewer 1943 (Fig. 6)



Figures 1–6.—The Manaosbiidae of Central America: 1. *Bugabittia akini*, new species, holotype, female; 2. *B. triacantha*, Roewer 1915, holotype, female; 3. *Barrona felgenhaueri*, new species, holotype, female; 4. *B. williamsi*, male from Colón Province, Panama; 5. *Zygopachylus albomarginis*, female from Barro Colorado Island, Panama; 6. *Poassa limbata*, (Roewer 1943), holotype, female. Scale bars = 2 mm.

*Barrona* Goodnight & Goodnight 1942

*Barrona* Goodnight & Goodnight 1942:11; Goodnight & Goodnight 1947:11; Soares et al. 1992:4; Kury 1997:4; Kury 2003:207.

**Type species.**—*Barrona williamsi* Goodnight & Goodnight 1942, by original designation.

**Emended diagnosis.**—Anterior margin of carapace with 4–5 granular tubercles on each side. Eye mound with 2 granular tubercles on each side, anterior tubercle smaller. Abdominal scutal areas I and III with paired tubercles; spiniform tubercles on scutal area III much larger than granular tubercles on area I; area II unarmed, except for a few granular tubercles; areas IV–V unarmed and indistinct, margins of scutum unarmed. Lateral margins of scutum unarmed. Free tergites with paired granular tubercles, lateral edges with or without single tubercle on each side. Anal operculum with scattered granular tubercles. Pedipalpal femur and patella unarmed; tibia with 4 ectal (IiIi) and 4 or 5 mesal (IiIi or IiiIi) spines; tarsus with 4 ectal (IiIi) and 5 mesal (IiIi) spines. Coxa IV with 2 dorsal tubercles; posterior spiniform tubercle larger than anterior granular tubercle; femora III–IV with paired, dorsal apical tubercles; tarsal formula: 6:12–16:6:6–7; tarsal claws unpectinate. Color of scutum black to dark brown with or without white patches. Ventral plate of penis rectangular, elongate

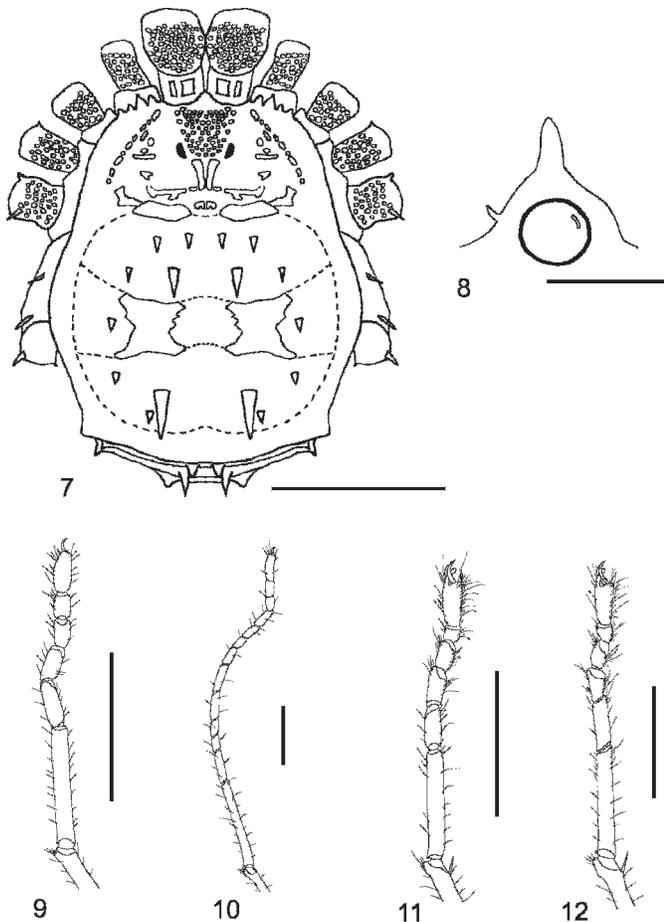
with concave distal margin; stylus unarmed, bent with a folded apex. Basitarsus I of male spindle-like; 2 basal segments enlarged.

*Barrona felgenhaueri*, new species  
(Figs. 3, 7–15)

**Material examined.**—PANAMA: *Coclé Province*: Holotype female, Parque Nacional General Division Omar Torrijos H., El Cope (08°49.2'80"N, 80°05'45.7"W), 23–28 February 2007, V. Townsend, A. Savitzky and J. Ray, collected by hand along hiking trails at night in montane rainforest (AMNH). Paratypes: 1 female, collected with holotype (AMNH); 1 male, same location, 1–4 November 1980, D. Mosley (MIUP).

**Etymology.**—This species is a patronym in honor of Bruce Felgenhauer who has made many contributions to the study of the morphology and natural history of tropical arthropods.

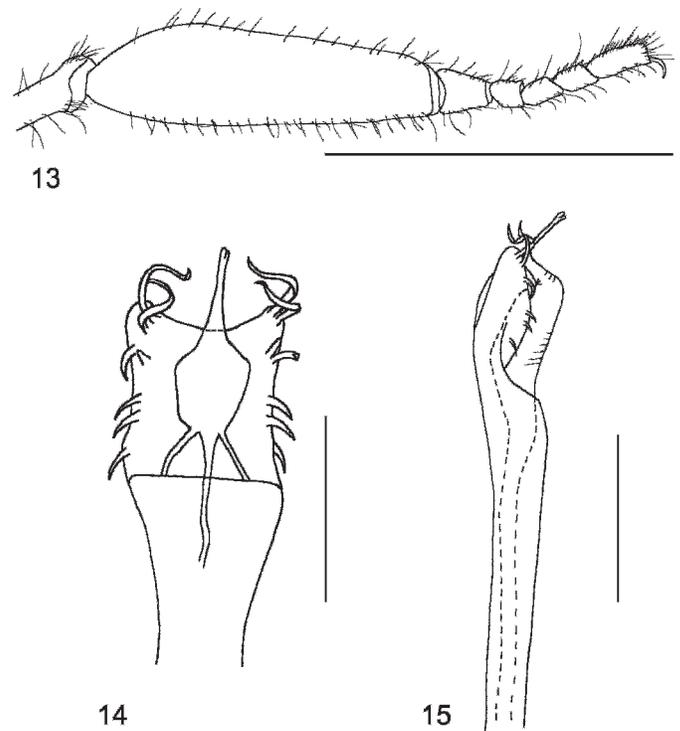
**Diagnosis.**—Dorsal scutum attenuate pyriform with scutal areas poorly defined, area I with 3 granular and 1 spiniform tubercle each side, area II with 1 granular tubercle and a large white patch each side, area III with 2 granular and 1 large spiniform tubercle each side, areas IV–V indistinct and unarmed (Fig. 7). Ocularium with large spiniform tubercle and a smaller anterior granular tubercle each side (Fig. 8). Anterior margin of carapace with 4 small granular tubercles



Figures 7–12.—*Barrona felgenhaueri*, new species, female, holotype: 7. Habitus, dorsal view; 8. Ocularium, lateral view; 9. Tarsus I, lateral view; 10. Tarsus II, lateral view; 11. Tarsus III, lateral view; 12. Tarsus IV, lateral view. Scale bars = 2 mm (Fig. 7); 0.3 mm (Fig. 8); 1 mm (Figs. 9–12).

on each side (Fig. 7). Cheliceral sockets of carapace shallow (Fig. 7). Cheliceral bulla smooth. Basal tarsal segments I of the male swollen and spindle-like (Fig. 13). Free tergite I with paired granular tubercles; II with paired spiniform tubercles and 1 granular tubercle on the margin each side; III with paired granular tubercles and 1 granular tubercle on margin of each side (Fig. 7). Femur and tibia IV straight. Tarsal formula 6:13:6:6. Tarsal claws III–IV unpectinate (Figs. 9–12). Penis: ventral plate with lateral borders straight and parallel, distal border slightly concave, unclenched; with third and fourth distal curved spines flattened; glans without dorsal or ventral process; stylus bent with folded apex (Figs. 14, 15).

**Description.**—*Female*: Measurements (paratype, in mm): dorsal scute length 4.17; cephalothorax length 1.35; mesotergum width 3.73; cephalothorax width 2.64; leg segments (length): trochanter I: 0.48; femur I: 2.88; patella I: 0.83; tibia I: 1.59; metatarsus I: 2.95; tarsus I: 2.38; total leg I: 11.11; trochanter II: 0.57; femur II: 6.15; patella II: 1.28; tibia II: 4.25; metatarsus II: 5.46; tarsus II: 5.26; total leg II: 22.97; trochanter III: 0.61; femur III: 4.58; patella III: 1.24; tibia III: 2.30; metatarsus III: 4.54; tarsus III: 2.35; total leg III: 15.62; trochanter IV: 0.61; femur IV: 6.12; patella IV: 1.39; tibia IV: 3.06; metatarsus IV: 6.61; tarsus IV: 3.14; total leg IV: 20.93.



Figures 13–15.—*Barrona felgenhaueri*, new species, male, paratype: 13. Tarsus I, lateral view; 14. Penis, dorsal view; 15. Penis, lateral view. Scale bars = 2 mm (Fig. 13); 250  $\mu$ m (Figs. 14, 15).

Dorsum (Fig. 7): anterior margin of carapace with 4 granular tubercles on each side; eye mound with a spiniform tubercle and an anterior granular tubercle on each side (Fig. 8); abdominal scutum with 4 distinct areas; area I with paired larger granular tubercles and 6 smaller granular tubercles; area II with 2 granular tubercles; area III with paired spiniform tubercles and 4 granular tubercles; areas IV–V indistinct and smooth; granular tubercles in areas I–V bearing small spines; lateral margins of abdominal scutum without tubercles. Free tergite I with pair of granular tubercles; II with pair of median granular tubercles and 1 granular tubercle on the margin each side; III with pair of median granular tubercles and 1 granular tubercle on the margin each side; tubercles on free tergites similar in size and shape and bearing spines. Anal operculum with 8 granular tubercles bearing spines.

Venter: coxae I–III with 1–2 rows of granular tubercles bearing spines, IV with scattered granular tubercles bearing spines.

Chelicera: smooth with sparse setae.

Pedipalp: trochanter length: 0.51 mm; femur length: 1.47 mm; patella length: 0.93 mm; tibia length: 1.21 mm; tarsus length: 1.22; total length: 5.34; coxa with one ventral tubercle bearing a spine; trochanter with one mesal tubercle bearing a spine; femur and patella smooth; tibia ectal IiIi, mesal IiIi; tarsus ectal IiIi, mesal IiIi.

Legs (Figs. 9–12): coxa IV with 2 spiniform tubercles; trochanters with a retrolateral granular tubercle; femora I–II smooth, femora III–IV with dorsal, apical spine on retrolateral surface, patellae-tarsi I–IV smooth with sparse spines; tarsal formula: 6:12:6:6.

Color: dorsum dark brown-black, with paired white patches on scutal groove and paired white patches on scutal area II, posterior patches larger than anterior ones; trochanters, patellae and chelicerae darker than pedipalps and femora; metatarsi annulate.

**Male:** Measurements (in mm): dorsal scute length 4.39; cephalothorax length 1.57; mesotergum width 3.78; cephalothorax width 2.85; total length pedipalp: 5.65; total length leg I: 12.49; total length leg II: 24.34; total length leg III: 16.58; total length leg IV: 21.84. Leg I: similar to female with the exception that the 2 most basal segments are swollen (Fig. 13). Legs II–IV similar to female. Tarsal formula: 6:13:6:6.

Color: similar to female.

**Genitalia** (Figs. 14, 15): truncus long and slender; ventral plate elongate subrectangular, tapering towards distal margin, with a distal border entire, slightly concave (Figs. 14); lateral borders with 5 straight + 2 recurved setae (Figs. 14, 15). Stylus straight with apex folded and unarmed (Fig. 14).

**Habitat.**—Specimens were collected from vegetation and spaces beneath logs from hiking trails in montane rainforest on a moderate slope. They were found after dark between 2100–2300 hr in the dry season during light to moderate periods of rainfall.

*Barrona williamsi* Goodnight & Goodnight 1942  
(Figs. 4, 16–19)

*Barrona williamsi* Goodnight & Goodnight 1942:11, fig. 26; Goodnight & Goodnight 1947:11, figs. 1, 2; Soares et al. 1992:4; Kury 2003:207.

**Material examined.**—PANAMA: *Coclé Province*: Male, Parque Nacional General Division Omar Torrijos H., El Cope (08°49.2'80"N, 80°05'45.7"W), 23–28 February 2007, V. Townsend, A. Savitzky and J. Ray, captured by hand along trails at night in montane rainforest (AMNH); *Colón Province*: male, Parque Nacional Soberania (09°07'55.3"N, 79°43'14.2"W), 1983, L. Sorkin (AMNH); *Panama Province*: male, Parque Nacional Summit (09°03'41.08"N, 79°38'55.75"W), September 2009, R. Miranda, captured by hand beneath logs and rocks during the morning (AMNH).

**Description.**—*Male genitalia* (Figs. 16–19): Truncus long and slender; ventral plate defined as an elongate subrectangle, tapering towards distal margin, with a distal border entire, slightly concave (Figs. 16, 17); lateral borders with 4 straight + 3 recurved setae (Fig. 18). Stylus straight with apex folded and unarmed (Fig. 19).

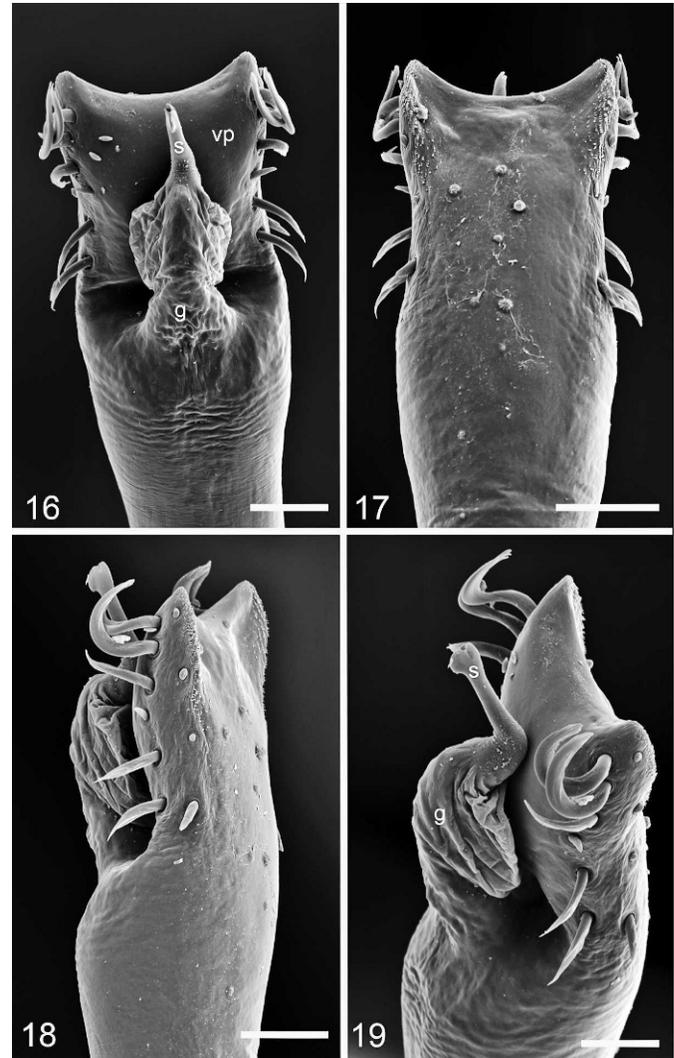
**Remarks.**—This species was previously known only from three specimens (female holotype, two male paratypes) collected at Barro Colorado Island, Canal Zone, Panama (Goodnight & Goodnight 1942, Goodnight & Goodnight 1947).

*Bugabittia* Roewer 1915

*Bugabittia* Roewer 1915:109; Roewer 1923:518; Mello-Leitão 1926:357; Roewer 1931:107; Mello-Leitão 1932:404; Soares & Soares 1949:231; Kury 1997:4; Kury 2003:207.

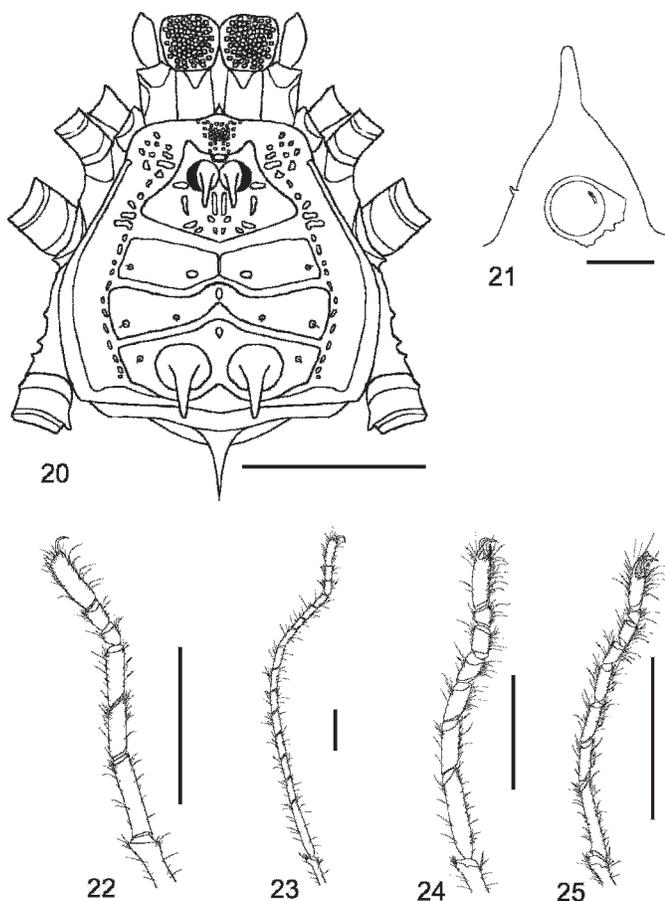
**Type species.**—*Bugabittia triacantha* Roewer 1915, by original designation.

**Emended diagnosis.**—Anterior margin of carapace with or without median spiniform tubercle. Ocularium with 2 or more tubercles each side, anterior granular tubercle smaller or with



Figures 16–19.—*Barrona williamsi* Goodnight & Goodnight 1942, penis, SEM: 16. Dorsal view of the distal portion of the penis; 17. Lateral view of distal portion of the penis; 18. Ventral view of the distal portion of the penis; 19. Lateral view of the distal tip of the stylus. Scale bars = 50  $\mu$ m. Abbreviations: g = glans penis, s = stylus, vp = ventral plate.

3 small granular tubercles, similar in size. Abdominal scutum with 4 distinct areas; areas I and II unarmed or armed with paired granular tubercles; area III with paired spiniform tubercles that may or may not be encircled by a ring of smaller granular tubercles; area IV–V unarmed; anterior margin with a single median process. Lateral margins of scutum unarmed. First and third free tergites unarmed; second free tergite with a median spiniform tubercle. Anal operculum smooth. Pedipalpal femur and patella unarmed; tibia with 4 ectal (IiIi) and 5 mesal (IiiIi) spines; tarsus with 4 ectal (IiIi) and 4 mesal (IiIi) spines. Coxa IV with 5 or more small tubercles, similar in size; femora III–IV with paired, dorsal apical granular tubercles; tarsal formula: 6:14–16:7:8; tarsal claws unpectinate. Color of scutum dark brown, with yellow legs mottled with black; spiniform tubercles on abdominal scutal area III and second free tergite yellow or white, contrasting strongly with dorsum. Metatarsus I with distal expansion near joint with tarsus.



Figures 20–25.—*Bugabittia akini*, new species, female, holotype: 20. Habitus, dorsal view; 21. Ocularium, lateral view; 22. Tarsus I, lateral view; 23. Tarsus II, lateral view; 24. Tarsus III, lateral view; 25. Tarsus IV, lateral view. Scale bars = 2 mm (Fig. 20); 0.2 mm (Fig. 21); 1 mm (Figs. 22–25).

Basitarsus I of male spindle-like; basal 3 segments swollen. Male genitalia unknown.

*Bugabittia akini*, new species  
(Figs. 1, 20–25)

**Material examined.**—PANAMA: *Coclé Province*: Holotype female, Parque Nacional General Division Omar Torrijos H., El Cope (08°49.2'80"N, 80°05'45.7"W), 23–28 February 2007, V. Townsend, A. Savitzky and J. Ray, collected by hand along hiking trails at night in montane rainforest (AMNH). Paratype: 1 female, collected with holotype (AMNH).

**Etymology.**—This species is a patronym in honor of Jonathan Akin who has made many contributions to the study of natural history and for his invaluable assistance on prior field trips.

**Diagnosis.**—Dorsal scutum pyriform with scutal areas poorly defined, areas I–II unarmed, area III with 1 spiniform tubercle each side not encircled by ring of smaller tubercles, areas IV–V indistinct and unarmed (Fig. 20). Ocularium with a spiniform tubercle and a smaller anterior granular tubercle each side (Fig. 21). Anterior margin of carapace unarmed (Fig. 20). Cheliceral sockets of carapace very shallow (Fig. 20). Cheliceral bulla smooth. Basal tarsal segments I of

male swollen and spindle-like. Free tergites I and III unarmed; II with 1 median spiniform tubercle (Fig. 20). Femur and tibia IV straight. Tarsal formula 6:14–16:7:8. Tarsal claws III–IV unpectinate (Figs. 22–25). Penis: unknown.

**Description.**—*Female*: Measurements (holotype, in mm): dorsal scute length 3.53; cephalothorax length 1.32; mesotergum width 3.59; cephalothorax width 2.36; leg segments (length): trochanter I: 0.50; femur I: 4.43; patella I: 0.89; tibia I: 2.84; metatarsus I: 5.30; tarsus I: 2.00; total leg I: 15.96; trochanter II: 0.72; femur II: 11.41; patella II: 1.17; tibia II: 8.81; metatarsus II: 10.67; tarsus II: 5.67; total leg II: 38.45; trochanter III: 0.80; femur III: 7.59; patella III: 1.38; tibia III: 3.69; metatarsus III: 6.98; tarsus III: 3.34; total leg III: 23.78; trochanter IV: 0.90; femur IV: 10.36; patella IV: 1.59; tibia IV: 5.16; metatarsus IV: 9.99; tarsus IV: 4.23; total leg IV: 32.23.

Dorsum (Fig. 20): anterior margin of carapace with median spiniform tubercle; eye mound with a larger spiniform tubercle and a smaller, anterior granular tubercle each side (Fig. 21); abdominal scutum with 4 distinct areas; area I smooth with a few sparse spines; area II smooth with a few sparse spines; area III with paired spiniform tubercles not encircled by smaller tubercles at the base; areas IV–V smooth; lateral margins of abdominal scutum without tubercles. Free tergite I smooth; II with a median spiniform tubercle; III smooth. Anal operculum smooth.

Venter: coxae I–III with rows of granular tubercles bearing spines, IV with scattered granular tubercles bearing spines.

Chelicera: smooth with many setae.

Pedipalp: trochanter length: 0.37 mm; femur length: 1.55 mm; patella length: 0.70 mm; tibia length: 0.96 mm; tarsus length: 1.03 mm; total length: 4.61 mm; coxa, trochanter, femur, and patella smooth; tibia ectal liii, mesal liiii; tarsus ectal liii, mesal liii.

Legs (Figs. 22–25): coxa IV with 5 granular tubercles bearing spines; trochanters with few, small granular tubercles bearing spines; femora I–II smooth, femora III–IV with a pair of dorsal, apical granular tubercles; patellae-tarsi I–IV smooth with sparse spines; tarsal formula: 6:14–16:7:8.

Color: dorsum dark brown, with lighter, yellowish margins on abdominal scutum and free tergites; ocularium, paired tubercles on area III, and single tubercle on free tergite II yellow, contrasting strongly with dorsum; legs, chelicerae and pedipalps yellow mottled with black.

*Male*: Unknown.

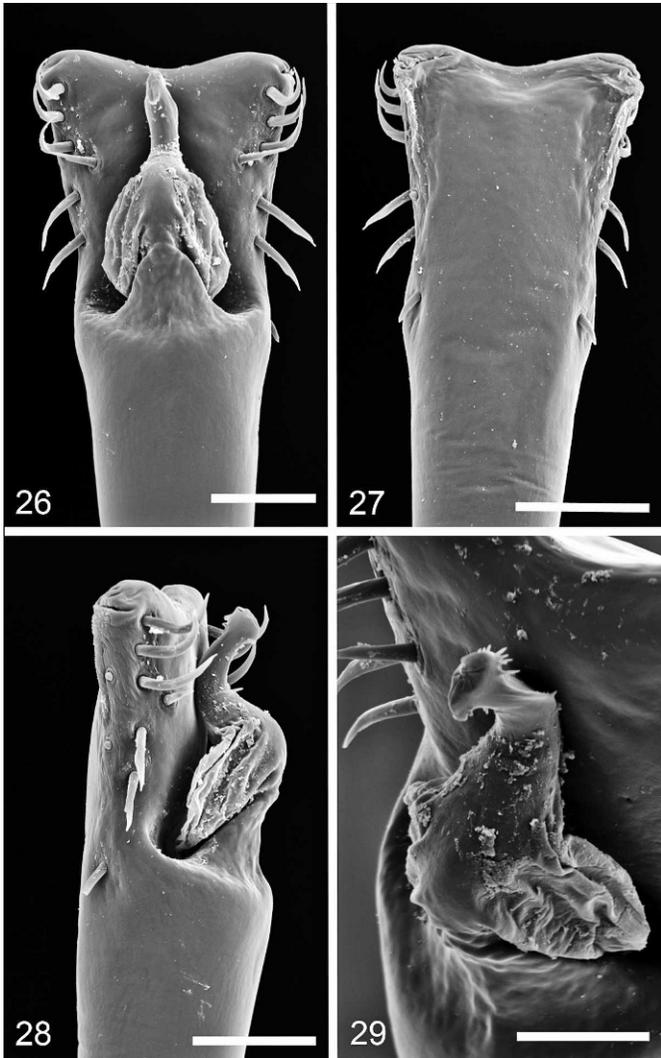
**Habitat.**—Same as *Barrona felgenhaueri*.

**Remarks.**—The holotype and paratype differ slightly in size and with respect to the morphology of metatarsus I. In the holotype, the distal region of this leg segment is noticeably expanded in comparison with that of the paratype. This morphology resembles that of the male holotype of *B. triacantha*, which also has a spindled basitarsus. The basitarsus of the female holotype of *B. akini* is not expanded.

*Cranellus montgomeryi* Goodnight & Goodnight 1947a  
(Figs. 26–29)

*Cranellus montgomeryi* Goodnight & Goodnight 1947a:6, figs. 11, 12; Kury 2003:207; Townsend et al. 2008a:59–60, figs. 2h, j; Townsend et al. 2008b:1027.

**Material examined.**—TRINIDAD, W.I.: 6 males, 6 females, Lalaja Trace (10°44'28.3"N, 61°16'17.3"W), July 2007, D.



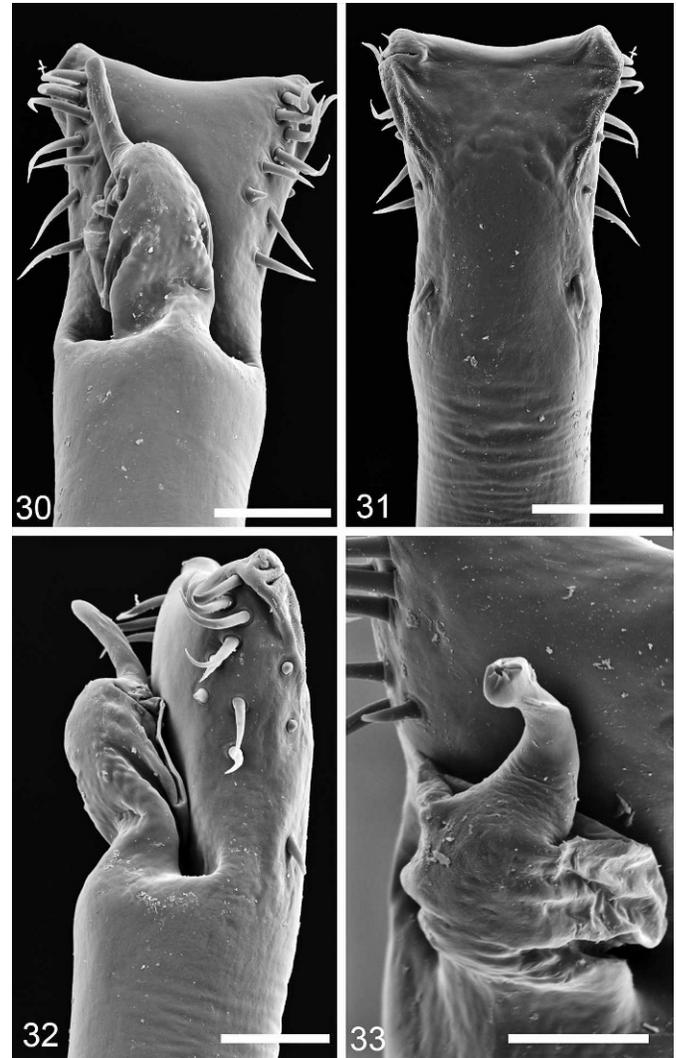
Figures 26–29.—*Cranellus montgomeryi* Roewer 1932, penis, SEM: 26. Dorsal view of the distal portion of the penis; 27. Lateral view of distal portion of the penis; 28. Ventral view of the distal portion of the penis; 29. Lateral view of the distal tip of the stylus. Scale bars = 50  $\mu$ m (Figs. 26–28); 25  $\mu$ m (Fig. 29).

Proud, captured by hand during the day in leaf litter along hiking trails in elfin woodland (AMNH); 3 males, 5 females, Morne Bleu Ridge, Northern Range (10°43'52.5"N, 61°15.7'0.7"W), July 2006, D. Proud and P. Ressler, captured by hand in leaf litter along hiking trail in montane rainforest (AMNH).

**Description.**—*Male genitalia* (Figs. 26–29): Truncus long and slender; ventral plate defined as an elongate rectangle, tapering towards distal margin, with a distal border entire, slightly concave (Figs. 26, 27); lateral borders with 3 straight + 3 recurved setae (Fig. 28). Stylus straight with apex folded and unarmed (Fig. 29).

*Rhopalocranaus albilineatus* Roewer 1932  
(Figs. 30–33)

*Rhopalocranaus albilineatus* Roewer 1932:285, fig. 3; Goodnight & Goodnight 1947a:8; González-Sponga 1991:205, figs. 29–36; Burns et al. 2007:140; Townsend et al.



Figures 30–33.—*Rhopalocranaus albilineatus* Goodnight & Goodnight 1947, penis, SEM: 30. Dorsal view of the distal portion of the penis; 31. Lateral view of distal portion of the penis; 32. Ventral view of the distal portion of the penis; 33. Lateral view of the distal tip of the stylus. Scale bars = 50  $\mu$ m (Figs. 30–32); 25  $\mu$ m (Fig. 33).

2008a:59–60, figs. 2f, g; Townsend et al. 2008b:1027–1029, figs. 1e, f; Giribet et al. 2009:18.

**Material examined.**—TRINIDAD, W.I.: 10 males, 10 females, Mt. Tamana, Central Range (10°28'15.5"N, 61°11'50.5"W), July 2008, M. Moore and J. Toraya, captured by hand late in the afternoon in leaf litter from tropical seasonal forest (AMNH).

**Description.**—*Male genitalia*: Truncus long and slender; ventral plate defined as an elongate rectangle, tapering towards distal margin, with a distal border entire, slightly concave (Figs. 30, 31); lateral borders with 4 straight + 3 recurved setae (Fig. 32). Stylus straight with apex folded and unarmed (Fig. 33).

**Remarks.**—This species is very common in the leaf litter in most forested habitats island-wide. Individuals have been captured from leaf litter, tree buttresses and from beneath logs and rocks.

Table 1.—Interspecific variation in penis morphology among Manaosbiidae. Data for the South American species are based upon examinations of published figures, micrographs or descriptions (Šilhavý 1979, Kury 1997, 2007).

| Species                                | Shape of the ventral plate | Shape of the distal border of the ventral plate | Setae on lateral border of ventral plate | Shape of the apex of stylus |
|--|----------------------------|---|--|-----------------------------|
| <i>Barrona felgenhaueri</i>            | Elongate, rectangular      | Slightly concave                                | 5 straight + 2 recurved                  | Folded                      |
| <i>Barrona williamsi</i>               | Elongate, rectangular      | Slightly concave                                | 4 straight + 3 recurved                  | Folded                      |
| <i>Cranellus montgomeryi</i>           | Elongate, rectangular      | Slightly concave                                | 3 straight + 3 recurved                  | Folded                      |
| " <i>Isocranaus</i> " <i>strinatii</i> | Elongate, rectangular      | Substraight                                     | 6 straight                               | Folded                      |
| <i>Manaosbia scopulata</i>             | Very elongate, rectangular | Parabolic cleft                                 | 4 straight + 3 recurved                  | Folded                      |
| <i>Rhopalocranaus albilineatus</i>     | Elongate, rectangular      | Slightly concave                                | 4 straight + 3 recurved                  | Folded                      |
| <i>Rhopalocranaus bordoni</i>          | Elongate, rectangular      | Slightly concave                                | 4 straight + 3 recurved                  | Folded                      |
| <i>Saramacia alvarengai</i>            | Elongate, rectangular      | Parabolic cleft                                 | 9 straight                               | Folded                      |
| <i>Saramacia annulata</i>              | Elongate, rectangular      | Parabolic cleft                                 | 8 straight                               | Folded                      |
| <i>Saramacia lucasae</i>               | Elongate, rectangular      | Parabolic cleft                                 | 8 straight                               | Folded                      |
| <i>Syncranaus cribrum</i>              | Elongate, rectangular      | Substraight                                     | 4 straight + 3 recurved                  | Papillate                   |

**Natural history.**—Little is known about the natural history of harvestmen from the family Manaosbiidae. In Trinidad, Townsend et al. (2008a) reported that *Rhopalocranaus albilineatus* is a habitat generalist and exhibits an island-wide distribution. In contrast, *Cranellus montgomeryi* is a habitat specialist, with a distribution limited to montane rainforest and elfin woodland in the Northern Range. In montane rainforest, *R. albilineatus* was present, but not as common as *C. montgomeryi*. In Panama, only the natural history of *Zygopachylus albomarginis* has been examined (Rodríguez & Guerrero 1976; Mora 1990). During the course of this study, we had opportunities to observe manaosbiids from two sites: Parque Summit, a lowland seasonal forest near the Canal Zone; and Parque General Division Omar Torrijos, a montane rainforest near El Cope. At Parque Summit, *Barrona williamsi* is syntopic with *Z. albomarginis*. Individuals of both sexes from each species were observed occupying refugia beneath logs during the day. During a brief one-day survey, two adult male *Z. albomarginis* were observed residing within mud nests, but no eggs, nymphs or females were observed in these arenas. Male *B. williamsi* were found nearby, beneath adjacent logs or in spaces between the bark and wood of fallen trees. At Parque General Division Omar Torrijos, sampling occurred over a period of several days, mostly at night between 2000–2400 h. Individuals of four species, including *Barrona felgenhaueri*, *B. williamsi*, *Bugabotia akini*, and an undescribed species of *Zygopachylus* were collected from the litter and from beneath logs and small rocks. No individuals were observed occupying mud nests; however, a male-female pair of *B. felgenhaueri* was collected from beneath the same log. We did not observe any instances of feeding, reproductive behavior, or ectoparasites for the manaosbiids at Parque GD Omar Torrijos. All four species were found in the same microhabitat along either walking trails or forest edges.

**Genital morphology.**—With respect to penis morphology, harvestmen of the family Manaosbiidae possess a moderately long truncus, which is distally divided into a rectangular ventral plate and a dorsal distal-oriented glans that lacks dorsal or ventral processes and terminates in a stylus with a folded or papillate apex (Table 1). In this study, we described the penis morphology of *Barrona felgenhaueri* and *B. williamsi* from Central America and *Cranellus montgomeryi* and *Rhopalocranaus albilineatus* from the Caribbean and com-

pared our observations with published descriptions of genital morphology for seven species from South America (Šilhavý 1979; Kury 1997, 2007). With respect to overall appearance, the penis morphology exhibited by *Barrona* spp. was most similar to that of *Rhopalocranaus* spp. and *Cranellus montgomeryi*.

However, we observed relatively little intrageneric variation (Table 1) in penis morphology. The only features that varied within the genera *Barrona*, *Rhopalocranaus* and *Saramacia* were the number and shape of setae on the lateral border of the ventral plate. Other characters associated with the penis including the shape of the ventral plate, the shape of the distal border of the ventral plate, and the shape of the apex of the stylus were conservative within a genus, but varied among the genera that we compared (Table 1). Most taxa possess an elongate, rectangular ventral plate, with the exception of *Manaosbia scopulata*, which has a very elongate ventral plate (Kury 2007). Most species also have a stylus with a folded apex, with the exception of *Syncranaus cribrum*, which has a papillate stylar tip (Kury 1997). The penises of *Manaosbia scopulata* and *Saramacia* spp. have a parabolic cleft in the distal margin of the ventral plate, in contrast to other taxa, in which the margin may be slightly concave or even substraight (Table 1). With respect to other families of harvestmen within the Laniatores, variation in penis morphology within the Manaosbiidae appears to be relatively conservative, similar to levels reported for the Cosmetidae (Kury et al. 2007; Townsend et al. 2010), and considerably less diverse than that observed for the Gonyleptidae (Kury & Pinto-da-Rocha 2007) or Oncopodidae (Schwendinger & Martens 2002).

The functional significance of genital morphology has received relatively little attention within the Gonyleptoidea or the suborder Laniatores. Currently, the functional aspects of genital morphology have only been explored in the Oncopodidae (Schwendinger & Martens 2002).

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