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Andres David Murcia

Universidad Distrital Francisco José de Caldas
Grupo de Investigación en Artrópodos "Kumangui"
Carrera 3 # 26A – 40
Bogotá, DC, Colombia

Oscar J. Cadena-Castañeda

Universidad Distrital Francisco José de Caldas
Grupo de Investigación en Artrópodos "Kumangui"
Carrera 3 # 26A – 40
Bogotá, DC, Colombia

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The stick insects (Insecta: Phasmatodea) from the Cloud Forest of the Chicaque Natural Park, Colombia

Andres David Murcia
Universidad Distrital Francisco José de Caldas
Grupo de Investigación en Artrópodos "Kumangui"
Carrera 3 # 26A – 40
Bogotá, DC, Colombia
davidzoon.phasmas@gmail.com
https://orcid.org/0000-0002-7559-7468

Oscar J. Cadena-Castañeda
Universidad Distrital Francisco José de Caldas
Grupo de Investigación en Artrópodos "Kumangui"
Carrera 3 # 26A – 40
Bogotá, DC, Colombia
ojccorthoptera@gmail.com
https://orcid.org/0000-0001-5646-0602

Abstract. A faunal study for the order Phasmatodea of the Chicaque Natural Park is presented, including a list of species found, descriptions, redescriptions, and biological notes. A total of nine species were found and studied; two new genera: *Ramandeun* **new genus**, *Nubilophasma* **new genus**, and four new species: *Atratomorpha jorgei* **new species**, *Isagoras franciscoverai* **new species**, *Nubilophasma chicaquensis* **new genus** and **new species**, and *Ramandeum coronatum* **new genus** and **new species** are described. The description of the eggs of the new taxa, of the previously unknown eggs of *Paraceroys quadrispinosus* (Redtenbacher, 1906), and the redescription of the eggs of *Libethra rabdota* Stål, 1875, and *Libethra inchoata* Brunner von Wattenwyl, 1907 are provided. Additional comments on the ecology and morphological variation of the reviewed taxa are included. Finally, further studies on the stick insect fauna of the Colombian Andes are discussed and recommended to provide more information to broaden the understanding of the species that inhabit this complex mountain system.

Key words. High Andean forests, new genera, new species, taxonomy, ootaxonomy, morphological variation.

Resumen. Se presenta un estudio faunístico para el orden Phasmatodea del Parque Natural Chicaque, incluyendo un listado de especies halladas, descripciones, redescripciones, huevos y notas biológicas. Un total de nueve especies fueron halladas y estudiadas, dos géneros nuevos son descritos: *Ramandeun* **nuevo genero** y *Nubilophasma* **nuevo genero** y cuatro nuevas especies: *Atratomorpha jorgei* **nueva especie**, *Isagoras franciscoverai* **nueva especie**, *Nubilophasma chicaquensis* **nuevo genero** y **nueva especie** y *Ramandeun coronatum* **nuevo genero** y **nueva especie.** La descripción de los huevos de los nuevos taxones, y los huevos desconocidos de *Paraceroys quadrispinosus* (Redtenbacher, 1906), y la redescripción de los huevos de *Libethra rabdota* Stål, 1875, and *Libethra inchoata* Brunner von Wattenwyl, 1907 son proporcionados. Se incluyen comentarios adicionales sobre la ecología y variación morfológica de los taxones revisados. Finalmente, se discute y sugieren más estudios sobre la fauna de insectos palo de los Andes colombianos que proporcionen mayor información para ampliar la comprensión de las especies que habitan este complejo sistema montañoso.

Palabras clave. Bosques alto-andinos, nuevos géneros, nuevas especies, taxonomía, ootaxonomía, variación morfológica.

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Introduction

Phasmatodea is an order of insects with a stick-like or leaf-shaped body, resembling plant parts; therefore, they are known as stick and leaf insects. They can have ornamentations such as leafy structures, and spines, often resembling branches, mosses, lichens, and leaves. These insects are commonly known as 'mariapalitos' and

'insectos palo' in Spanish, or stick insects. The phasmids are mainly solitary insects with nocturnal habits and are exclusively phytophagous (Tilgner 2009). Their eggs are similar to plant seeds and exhibit species-specific variations. Additionally, the form of the eggs corresponds to oviposition techniques, such as buried eggs with a tapered posterior pole for easier burial (Robertson et al. 2018). Non-flying species are often polyphagous due to their limited ability to move, whereas flying species have a more restricted diet, often specializing in their food plants (Robertson et al. 2018).

Stick insects are widely distributed, with their most remarkable diversity in tropical regions, with fewer species in the subtropical areas (Zompro 2004). Currently, around 3400 species have been described globally (Brock et al. 2022). There are few and scattered studies on Colombian stick insects. Contributions like those of Morgan Hebard included the description of numerous species in his first two contributions to the orthopteroids of Colombia (Hebard 1919, 1921). In the most recent and comprehensive contribution published on Colombian phasmids, 74 species, and four genera were described, although the authors estimate there may be 300 species in Colombia (Conle et al. 2011). With the above and the recent works published so far by Murcia et al. (2019, 2020), 184 species of stick insects are known in the country. However, studies for this group of insects in Colombia are mainly taxonomic and have not been carried out in important ecosystems such as cloud forests.

Cloud forests are forests recognized as fragile ecosystems with tremendous pressure due to its sensitive to climate changes (Bubb et al. 2004). In general terms, cloud forests are considered wooded sites where the air, coming from low, humid, and warm regions, condenses to regularly produce cloudiness that remains most of the time (Ojeda 2001). Cloud forest should be priority for Colombia and worldwide conservation due to their species diversity and high level of endemism, especially epiphytic, vascular and non-vascular plants, some groups of birds, amphibian, invertebrates, and several threatened or vulnerable species (Armenteras et al. 2007). Thus, this study seeks to document the species and description of the phasmids present in the cloud forest of the Chicaque Natural Park.

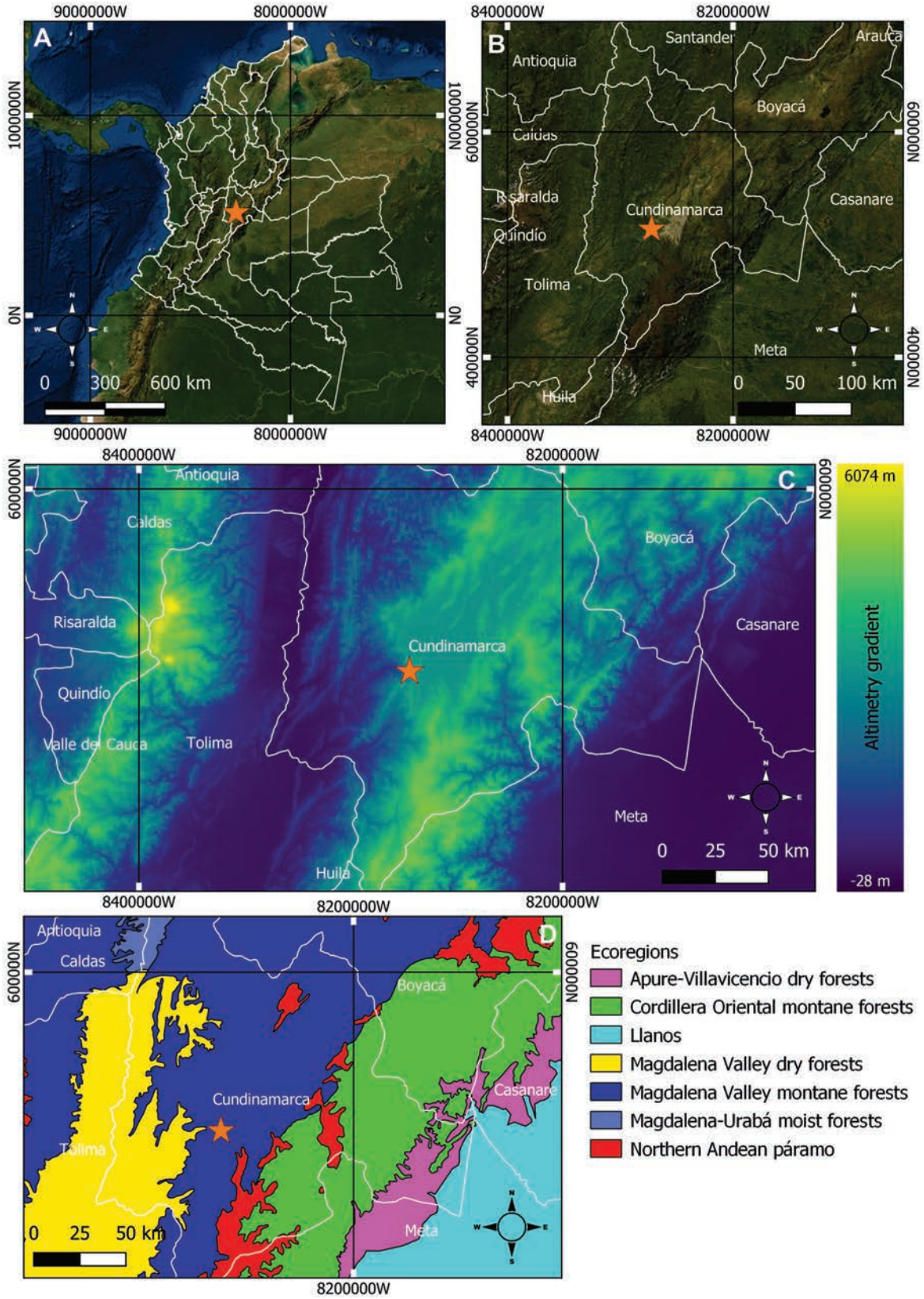
Materials and Methods

Study area. The Chicaque Natural Park (4.607441, −74.304860) is located on the southwestern edge of the Bogotá savanna, in the municipality of San Antonio del Tequendama. The upper limit of the park connects with the dry corridor of the Bogotá savannah between the municipalities of Soacha and Bojacá. The lower limit connects with the middle basin of the Bogotá River with the municipalities of Tena and El Colegio (Rivera and Córdoba 1998; Map 1).

The approximate area of the park is 300 ha of the sub-Andean Forest "cloud forest" with a gradient from 2000 to 2700 m (Rivera and Córdoba 1998). The precipitation is approximately 2000 mm per year (Armenteras et al. 2007). It is a cloud forest located on the slopes of the mountain range; the behavior of its rainfall depends on the rising humid air masses of the Magdalena Valley, which form large banks of fog in the higher areas of the park. Its relative humidity fluctuates between 75% and 86% (Armenteras et al. 2007). The average temperature is between 14.6°C and 15.3°C (Rivera and Córdoba 1998). The map was built using ArcGIS version 10.8.

Fieldwork and preservation. For the phasmids collection in the park, sampling was carried out in September and December 2020 and May and June 2021. The samplings were carried out on the park's main trails due to their easy access, and the stick insects are easily found on the sides of roads and highways. The collections were made between 19:00 and 24:00 hours, manually, accompanied by a photographic record of the insect's habit in the field.

The male specimens were collected and sacrificed in a lethal bottle with potassium cyanide (KCN), separated, and placed in paper envelopes to store in plastic bottles with 95% alcohol. The female samples were collected and kept alive to obtain their taxonomically important eggs. In the laboratory, the specimens were rehydrated by submerging them in warm water to facilitate dry mounting; then, they were labeled. The eggs were stored in Eppendorf tubes, labeled, and kept in the freezer at -10°C for 10 days. Finally, the collected specimens and their eggs were deposited in the Collection of Arthropods and other Invertebrates of the Francisco José de Caldas District University, Bogotá, Colombia (CAUD). Photos of the habitus of specimens and individuals in the field were taken with a Canon t5 (Tokyo, Japan) camera with a 60mm macro lens, and those of diagnostic structures and eggs with a Carl Zeiss Stemi 305 trino stereomicroscope (Jena, Germany).



Map 1. Study area and location of Chicaque National Park (as a star), Cundinamarca, Colombia. **A)** Location in Colombia. **B)** Cundinamarca (satellite images). **C)** Location in altitude. **D)** Ecoregions maps.

The specimens were measured in millimeters with a vernier as follows: *Total length* (TL), from the front of head to the edge of the last abdominal segment, excluding the antennae; *Pronotum* (Pr); *Mesonotum* (Ms), *Metanotum* (Mt) and *Median Segment* (MSeg), from the anterior to the posterior border. *Pro-* (Pf), *Meso-* (Mf), *Metafemur* (Hf), and *Pro-* (Pt), *Meso-* (Mt) and *Metatibia* (Ht) from the base to the apex; *Antennae* (Ant), scapus base to the tip of last antennal segment. The eggs were described and measured in millimeters based on Sellick's (1997) proposal, checking the sculpting of the capsule, the operculum shape, and the micropylar plate.

Results

Order Phasmida
Suborder Euphasmatodea
Family Diapheromeridae Kirby, 1904
Subfamily Diapheromerinae Kirby, 1904
Tribe Oreophoetini Zompro, 2001
Genus *Libethra* Stål, 1875

***Libethra rabdota* (Westwood, 1859)**
(Fig. 1–8)

Diagnosis. Species with marked sexual dimorphism. **Male.** Body yellow and thin (Fig. 1A–B). Head unarmed and flat vertex (Fig. 1C); antennae reaching the VI tergite. Pronotum and metanotum smooth (Fig. 1C), mesonotum with small lateral spines (Fig. 1B). Abdomen smooth (Fig. 1A). Legs ornamentations variable, from armed with small spines or unarmed (Fig. 1B). Tergite X divided into two lobes by a midline running through it; poculum firmly tectiform with the posterior margin elongated, convex, and slightly elevated (Fig. E–G).

Female. Body brown and more robust than the male (Fig. 2A–B). Head armed with two very prominent foliose structures (Fig. 2C), antennae reaching tergite IV (Fig. 2A–B). Thorax with variable ornamentations, with several granules or tubercles, and spines with tubercles varying in length, the mesonotal ones larger (Fig. 2B). Abdomen with tergites III–VIII with small posterolateral extensions. Tergite III with prominent foliose structure. Tergite IV–V with a smaller foliose structure located on the posterior margin. Tergite VII has a foliose structure larger than in tergites IV and V and less conspicuous than in tergite III (Fig. 2A–B). Legs armed with numerous foliose structures that vary in size (Fig. 2A–B). Subgenital plate does not project beyond the apex of the abdomen, becoming gradually narrower towards its apex, where it ends in two points and is centrally excavated (Fig. 2E–G).

Measurements (mm). ♂/♀ TL: 33–35 / 36–37, Pr: 2–2.5 / 3–3.2, Ms: 8–9 / 8–10, Mt: 4–4.2 / 4–4.5, Pf: 10–11 / 9–10, Mf: 8–8.2 / 7–8, Hf: 11–12 / 10–10.5, Pt: 11–11.2 / 10–10.5, Mt: 7–8.5 / 7.5–8, Ht: 11–12 / 11–12, Ant: 29–29.5 / 24–27.

Eggs. Dark brown and slightly shiny, with a cream-colored region surrounding the collar and extending dorsally around the micropylar plate. Rough capsule (Fig. 3), 1.8 times longer than wide and 1.6 times longer than tall, semi-ellipsoidal in shape, dorsal surface progressively narrowing towards the posterior polar zone, ovoid operculum with numerous hairs wholly surrounded by the collar, inserted in an angle of 35° (Fig. 3B–C). Micropylar plate anterior to the central region, ovoid with a prominent margin, slightly laterally compressed in the posterior region, inner part smooth (Fig. 3A). Micropylar cup small, extending beyond the posterior margin of the micropylar plate. The midline is faint and does not reach the polar zone (Fig. 3A).

Measurements (mm). Length: 3, capsule height: 1.5, capsule width: 1.2, operculum diameter: 1.

Coloration variation. Male. With variable coloration, as described below: 1. Body completely dark brown (Fig. 4A). 2. Light green body (Fig. 4B). 3. Ocher-colored body (Fig. 4C). 4. Light brown with yellow legs (Fig.5A). 5. Light brown with small irregular green spots on the integument (Fig. 5B). 6. Dark brown body with a longitudinal yellow dorsal line extending from the pronotum to the tergite X (Fig. 5C). **Female.** 1. Brown body with spines and green leafy extensions. (Fig.6). 2. Body with different shades of brown (Fig. 7A–B). 3. Gray body (Fig. 7C), some individuals may present combinations of these colors and exhibit different dorsal and longitudinal lines (Fig. 7A, D).

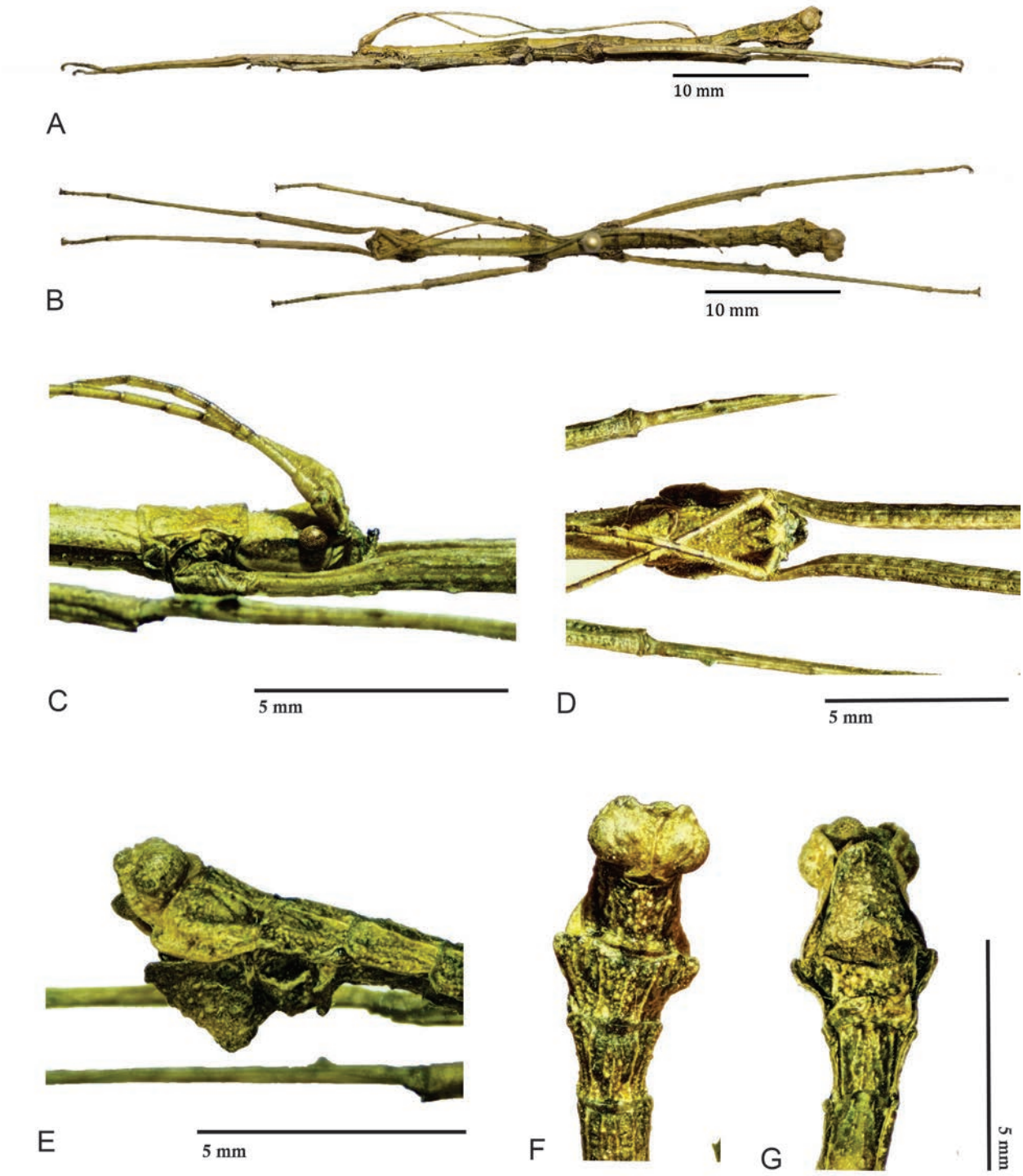


Figure 1. *Libethra rabdota* (Male). **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views, respectively.

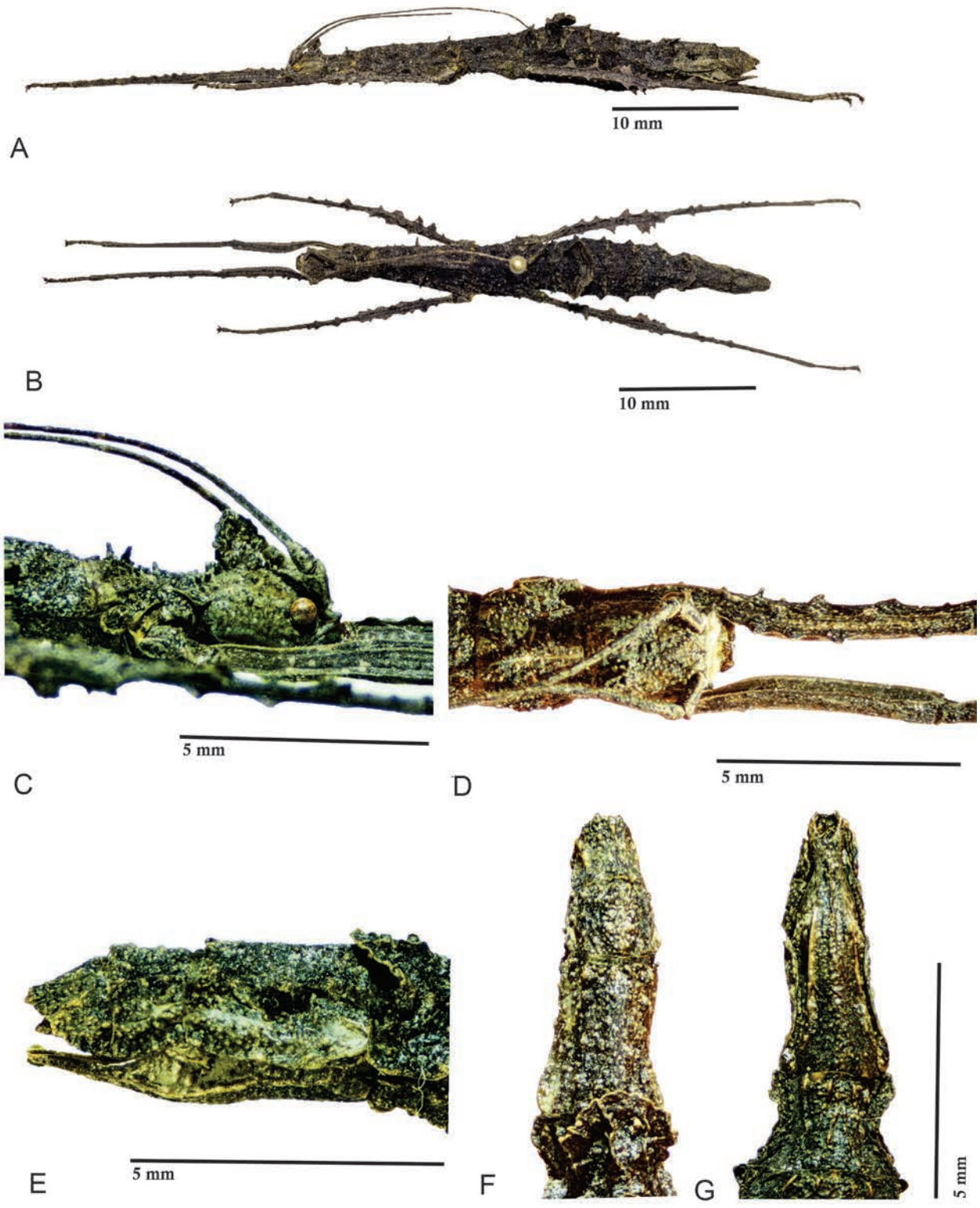


Figure 2. *Libethra rabdota* (Female). **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views, respectively.

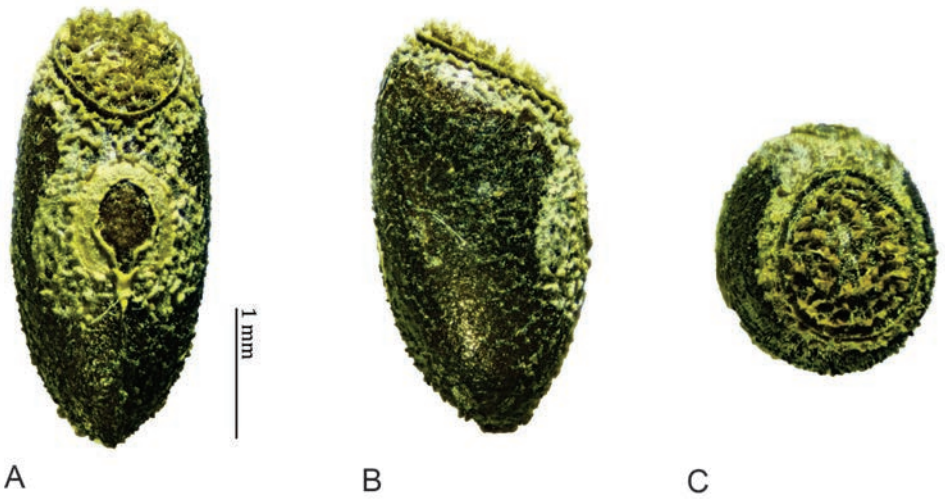


Figure 3. *Libethra rabdota*. Eggs. **A)** Dorsal view. **B)** Ventral view. **C)** Anterior pole.

Figure 4. *Libethra rabdota*. Live males, color variation. **A)** Entirely dark brown body. **B)** Light green. **C)** Ocher.

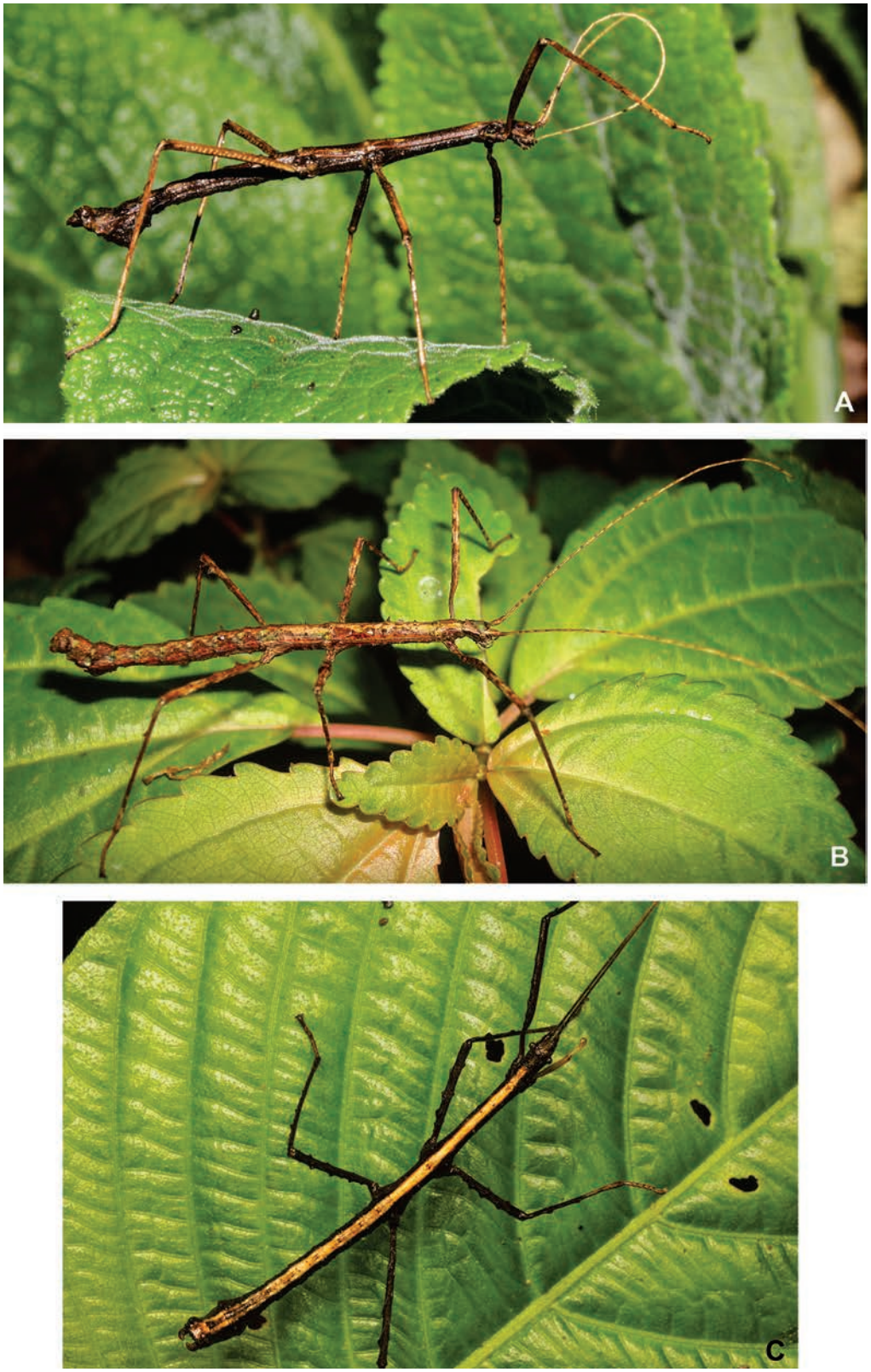


Figure 5. *Libethra rabdota*. Live males, color variation. **A)** Light brown with yellow legs. **B)** Light brown with slight irregular green spots on the tegument. **C)** Dark brown body with a longitudinal yellow dorsal line that extends from the pronotum to the X tergite.

Figure 6. *Libethra rabdota*. Live female. Brown coloration with spines and green leafy extensions.

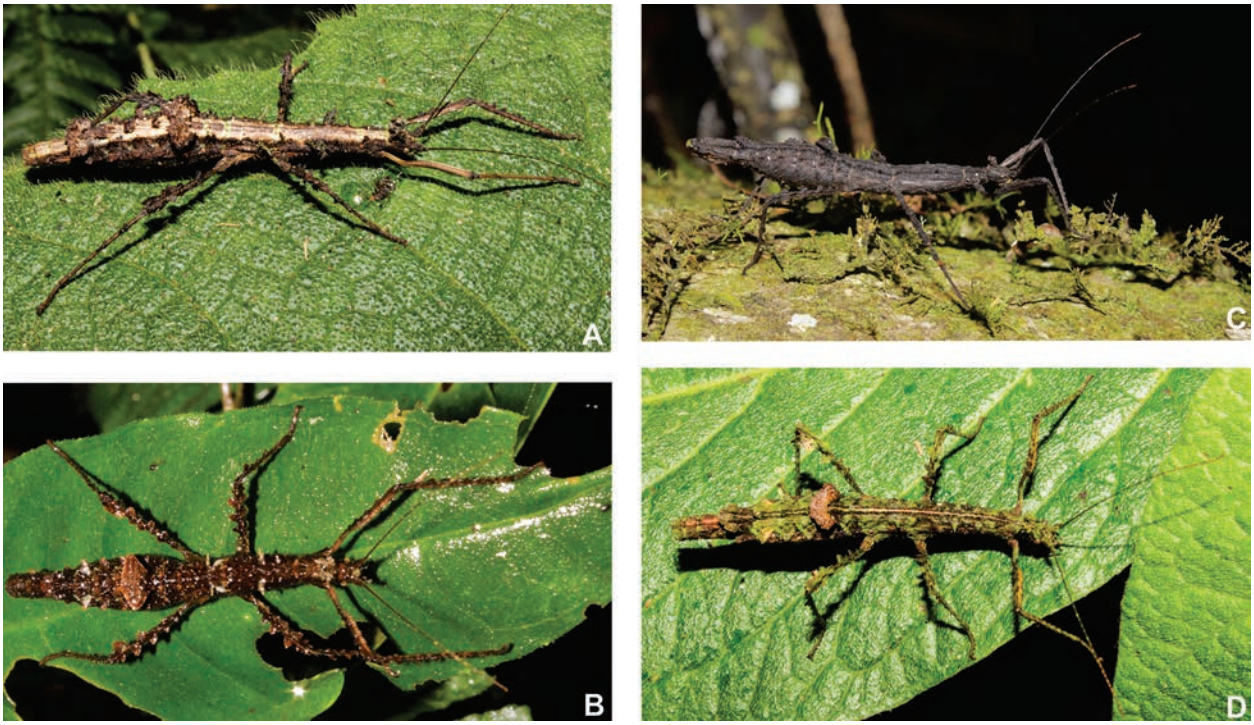


Figure 7. *Libethra rabdota*. Live females, color variation. **A–B)** Body with different shades of brown. **C)** Gray body. **D)** Some individuals may present combinations of these colors and exhibit different dorsal and longitudinal lines.

Distribution. Widely distributed, in Colombia has been recorded in the departments of Antioquia 1305–2269 m, Cundinamarca 1914 m, Quindío 1800 m, Risaralda (Pereira) and Caldas 1040–2592 m, Cauca, Risaralda, Chocó (Conle et al., 2011).

Comments. This species has a wide distribution from the Andean region to the Chocó Biogeographic region in Colombia. As it is a wingless species with little dispersal capacity, possibly the specimens from the different localities are not the same species. Additional studies of the individuals from the different mountain ranges as well as from Chocó are required to be able to delimit their taxonomic entities. A couple was seen copulating, and the male had the phallic complex completely exposed (Fig. 8).

Figure 8. *Libethra rabdota* in copulation.

Specimens and eggs examined. 5 males and 9 females: 3♂ 1 ♀ 4°36′31″N 74°18′25″W. 2496 m. 14 January 2017; 2♂3♀. 4°36′36″N 74°18′26″W. 2409 m. 15 January 2017; 2 ♀. 4°36′43″N 74°18′34″W. 2237 m. 28 January 2017; 3♀. 4°36′29″N 74°18′34″W. 2367 m. 12 September 2020. 15 eggs examined. (CAUD).

Libethra inchoata Brunner von Wattenwyl, 1907

(Fig. 9–12)

Diagnosis. Body medium-sized (50–57 mm.), in shades of brown, males slim and slender, females robust. Head longer than wide, flat in males or with two prominent irregular tubercles in females; medium-length filamentous antennae. Thorax smooth in males or rough and slightly granular in females. All femora transversely trapezoidal with smooth ventromedial carina, smooth or with small lobes; profemur strongly compressed basally; tibiae without area apicalis. Abdomen smooth or with tiny granules and small foliose structures on tergite VII in females. Poculum large and strongly convex with posterior margin lanceolate and flexed, extending from the middle of the anal segment. Subgenital plate three times wider than long and progressively constricted towards apex, convexly elevated, and carinate on the posterior section. Apex with two points and centrally excavated. Cerci short, flattened dorsoventrally, and curved in males.

Description. Male. Dull brown body coloration. Body smooth, without tubercles or granules (Fig. 9A–B, 12). **Head.** Smooth and unarmed, distinctively longer than wide, with flattened vertex; eyes spherical and prominent (Fig. 9C–D). Antennae reaching the tergite VII (Fig. 9A–B); scape wide and rectangular in dorsal view, flattened dorsoventrally; pedicel semi-cylindrical, transversely shorter than scape; third antennomere twice as long as the scape, the other 35 antennal segments variable in length. **Thorax.** Pronotum smooth, rectangular, longer than wide, but shorter than head, with a transverse suture in the middle (Fig. 9C–D). Mesonotum elongated, approximately six times longer than pronotum (Fig. 9A–B). Metanotum is as long as half of the length of the mesonotum (Fig. 9B). Prosternum compressed anteriorly by the prothoracic coxae. Mesosternum smooth, elongated, with parallel sides. Metasternum half the length the mesosternum, dilating progressively towards the posterior section; metafurcal groove Y-shaped, near the posterior margin. **Legs.** Pro and metathoracic legs equal in length but longer than mesothoracic legs. All femora transversely trapezoidal, with smooth ventromedial carina, profemora strongly compressed basally. All tibiae with four prominent borders and without area apicalis. Pro- and

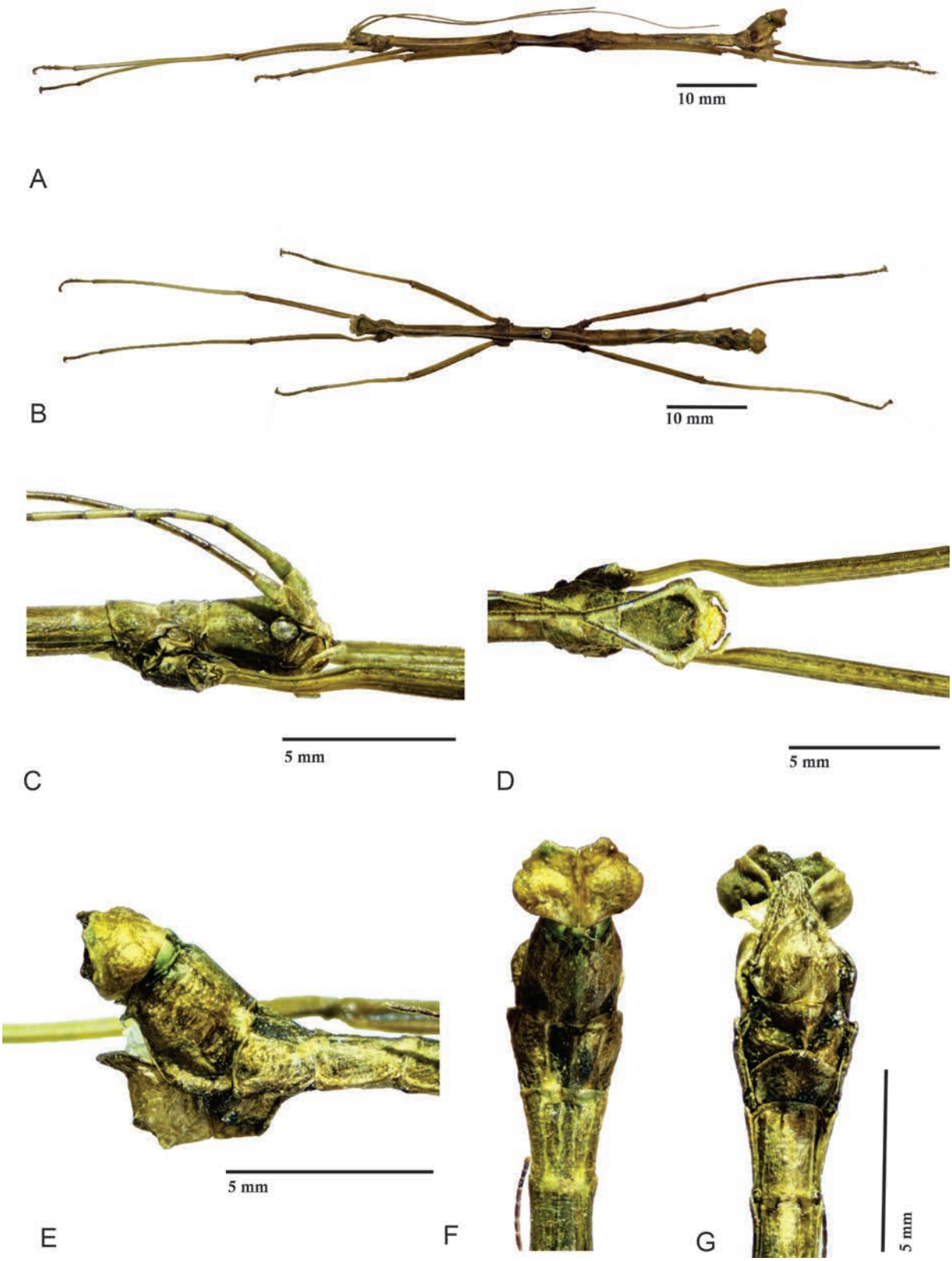


Figure 9. *Libethra inchoata* (Male). **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views, respectively.

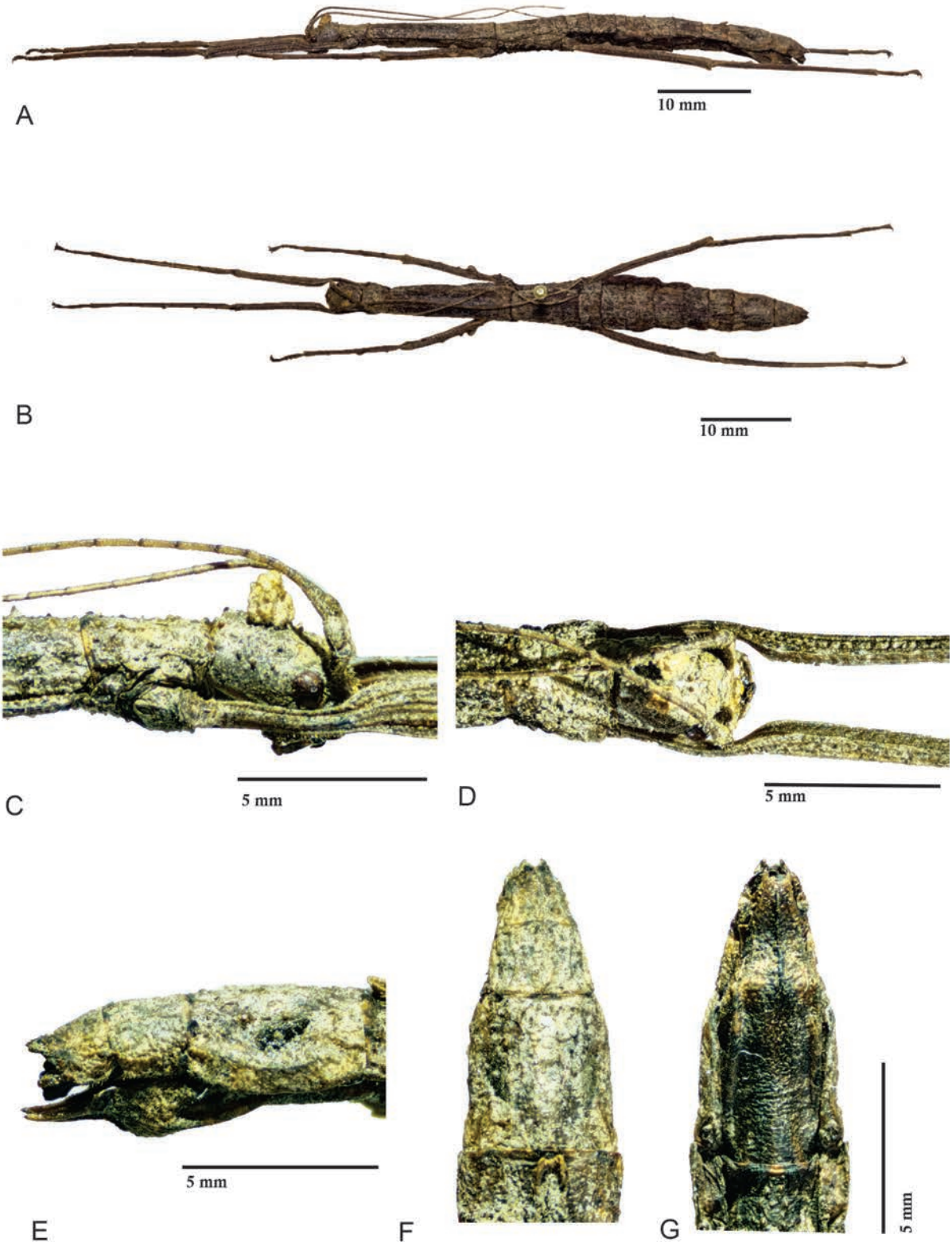


Figure 10. *Libethra inchoata* (Female). **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views, respectively.

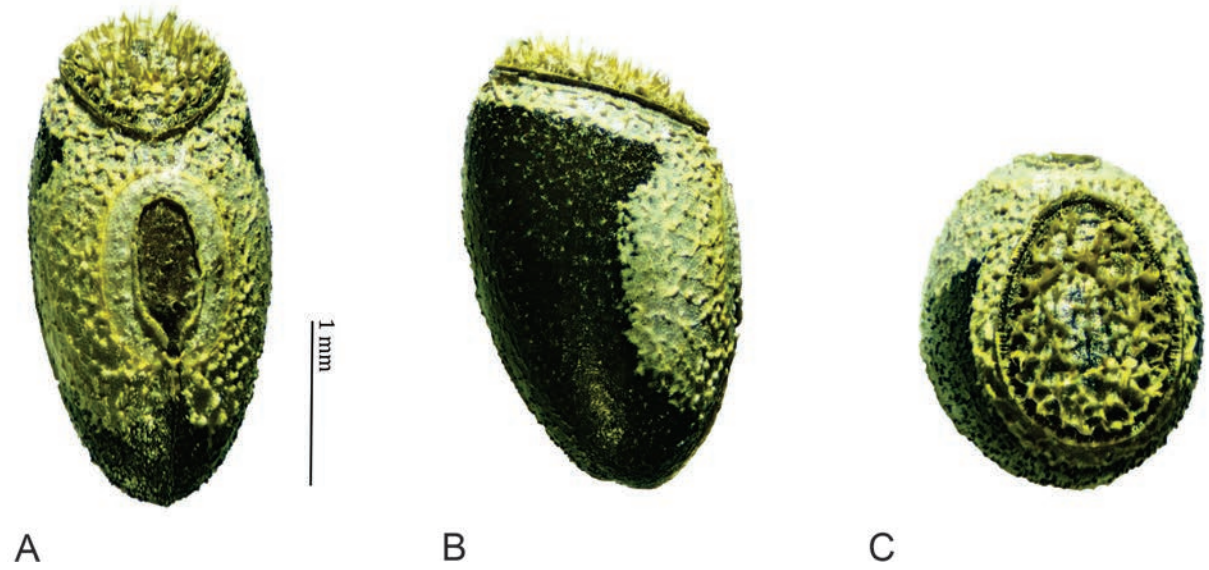


Figure 11. *Libethra inchoata*. Eggs**. A)** Dorsal view. **B)** Ventral view. **C)** Anterior pole.

Figure 12. *Libethra inchoata.* Live male.

mesotibiae longer than pro- and mesofemur, metatibia as long as metafemora. Basitarsi elongated as long as the rest of the tarsi combined. **Abdomen.** Segments smooth. Median segment as long as half of the second tergite, wider than long, anterior margin convex. Tergites II–VII longer than wide; tergites VIII-X with a longitudinal carina; tergite VIII wider than long, widening from anterior margin to posterior one; tergite IX longer than wide, compressing on posterior margin; tergite X wider than the rest of the tergites, divided into two lobes by a smooth carina that crosses it from anterior to the posterior margin, posterior margin is concave with emarginated apex. Sternites I-VI approximately equal in length, with two small closely spaced granules near the posterior margin; sternite VII wider than long, posterior margin convex and abruptly raised, sternite VIII twice as wide as long, traversed from the anterior to posterior margins by a carina and completely elevated above the other tergites. Poculum large and strongly cupuliform, posterior margin lanceolate and flexed, extending to the middle of the anal segment, cerci robust and curved (Fig. 9E–G).

Redescription of the female. Body dark brown, smoothly wrinkled, as long as male but more robust (Fig. 10A–B). Head longer than wide, with two very prominent irregularly shaped tubercles near the posterior portion of the head; genae granulated, vertex with small spines; eyes spherical (Fig. 10C–D). Antennae reach the median segment (Fig. 10–A); scape wide, compressed dorsoventrally; pedicel cylindrical in cross-section, and shorter than scape; the others flagellomeres variable in length. **Thorax.** Rough and slightly granular. Pronotum longer than wide, in dorsal view as wide as head but slightly shorter (Fig. 10–D). Mesonotum elongate, 4.5 times longer than pronotum, widening near posterior margin (Fig. 10–B). Metanotum gradually widened from its anterior to posterior margin, as long as half the length of mesonotum (Fig. 10–B). Prosternum as wide as long, compressed anteriorly by the prothoracic coxae. Mesosternum granular, 4.5 times longer than prosternum, with invaginated mesofurcal groove near posterior margin. Metasternum widened from anterior to posterior margin, with small tubercles and invaginated metafurcal groove near posterior margin. **Legs.** Long, shape and proportions similar to those in males; mesofemur ventrally smooth, dorsally slightly toothed and basally provided with a pair of lobes on its margins; metafemur dorsally toothed. Pro- and mesotibiae with small spines on their dorsal margins and smooth ventrally, metatibia with a dorsal tooth near its basal area, all tibiae similar in length. Pro and mesobasitarsi as long as the next three tarsomeres combined, metabasitarsus similar in length to following four tarsomeres combined. **Abdomen.** Robust in dorsal view and grainy textured. The median segment about half as long as tergite II, 2.5 times as wide as long. Tergites II-VII wider than long; tergite VII with a slight foliose prolongation; tergite VIII longer than wide, tapering towards the posterior margin; tergite IX wider than long, with half the length of tergite VIII, narrower and more compressed on posterior margin; tergite X in dorsal view completely covering the subgenital plate, as long as tergite IX but about half as wide, divided by a median suture running through it from anterior to posterior margin, the posterior margin is emarginated in a triangle shape. Cerci reduced, shorter than anal segment, slightly compressed dorsoventrally. All sternites granular, sternites II–VII wider than long; subgenital plate elongated, three times longer than wide, progressively constricting towards the apex and rising convexly from the tergite VIII–IX, posterior portion longitudinally carinate, apex ending in two points centrally excavated (Fig. 10E–G).

Measurements (mm). ♂/♀ TL: 50.2–50.4 / 55–57, Pr:2.5–3 / 3.5–3.8, Ms:14–15 / 14–16, Mt: 9–9.2 / 6–6.5, MSeg: 1.5–2 / 2–2.2, Pf: 16–17 / 14–15, Mf: 11–12 / 10–11, Hf: 14–16 / 15–17, Pt: 17–20 / 17–18, Mt: 11–13 / 12–12.5, Ht: 15–17 / 16–17, Ant: 38–45 / 30–31.

Eggs. Dark brown and slightly shiny, with a light-colored region surrounding the collar, extending on the dorsal part around the micropylar plate, near the posterior polar zone (Fig. 11). Capsule moderately rough, 1.5 times longer than wide and oval (Fig. 11B); dorsal surface progressively narrowing towards the polar zone, ovoid operculum with numerous hairs wholly surrounded by the collar, inserted at an angle of 22° (Fig. 11A–C). Micropylar plate on the central region of the dorsal capsule, elongated with conspicuous margin, slightly compressed laterally, inner part slightly rough. Micropylar cup small, extending beyond the posterior margin of the micropylar plate. A prominent midline is reaching the polar zone (Fig. 11A).

Measurements (mm). Length: 2.8, capsule height: 1.9, capsule width: 1.6, operculum diameter: 1.2.

Specimens and eggs examined. 7 males and 4 females: 2♂ and 2♀ 4°36′25″N 74°18′38″W. 2301 m. 22 May 2021. 3♂ 2♀ 4°36′22″N 74°18′30″W. 2404 m. 5 June 2021. 2♂ 4°36′43″N 74°18′31″W. 2284 m. 21 January 2017. 7 eggs examined. (CAUD).

Distribution. Only known from its type locality, Bogotá, Colombia.

Comments. A redescription of the female of *L. inchoata* is provided, comparing with the collected females, which fit the morphological characteristics of the lectotype female, differing in the shape of the leafy projection of the abdomen, which are more developed in the II–III tergites, these are inconspicuous in the female specimens examined here, this character has a variable development, especially in the *Libethra* species, and may be poorly developed, in an intermediate state, or conspicuous (Gutiérrez-Valencia et al. 2017). The prolongation of the tergite VII is similar both in the lectotype and in the females studied here. The description of the unknown male and the unknown eggs are also provided.

The association of the two sexes of this species was clarified, because the specimens were usually collected in copulation; morphologically both species differ as mentioned in the descriptions and redescriptions. Additionally, the species were not found together, but rather each species was in a different area and path of the park.

Tribe Diapheromerini Kirby, 1904

Comments. *Ramandeun* Murcia and Cadena-Castañeda, **new genus**, is included in the tribe Diapheromerini because it shares the following characters with the other members of the tribe: 1) tibia without area apicalis, 2) abdomen at least as long as or longer than the thorax, 3) femora trapezoidal, in section transverse, 4) profemur not serrated, meso and metafemora not evenly serrated ventrally, 5) antennae distinctly longer than the profemur 6) rarely winged, new genus wingless, 7) anal segment of male not divided or bilobed, 8) eggs without capitulum (Zompro 2001).

Ramandeun Murcia and Cadena-Castañeda, new genus

Description. Body large and thin; general coloration of the body yellow. Head longer than wide, wider towards the eyes and narrower at its posterior margin; vertex elevated and may have small tubercles or spines; eyes large and spherical; scape and pedicel unarmed, scape elongated 1.5 times longer than pedicel and ventrally compressed, antennae not exceeding the tergite III. Pronotum rectangular 1.5 times longer than wide; mesonotum elongated, seven times longer than pronotum; metanotum smooth, as long as half-length of mesonotum. All femora slightly trapezoidal with setouse edges and compressed basally. Abdomen smooth, longer than head and thorax combined, median segment indistinguishable from metanotum; all tergites longer than wide. Poculum as long as sternite VIII, slightly convex. Subgenital plate lanceolate, projects beyond the apex of the abdomen, three times the length of the anal segment. Cerci very small, dorsoventrally compressed, and slightly curved, hidden in dorsal view by the anal segment.

Type species. *Ramandeun coronatum* **new species** by original designation and monotypy.

Etymology. The name is the combination of the Latin words *ramus* (branch) and *Andean* (Andean). The name of this genus means "Andean branch", adding the ending *un*. The gender of the name is being established as neuter.

Comparison. The new genus differs from other Diapheromerini such as the Andean genera *Andeocalynda* Henneman and Conle, 2020 and *Clonistria* Stål, 1875 in having an indistinguishable median segment in both sexes; absence of a preopercular organ in the sternite VII of females (Fig. 16F). Both sexes' heads armed with small tubercles or spines; with large, spherical eyes, small and almost rounded in the genera mentioned above. Males also differ in having a poculum as long as the sternite VIII, is slightly convex and not bulging as in *Andeocalynda*. However, it shares with *Andeocalynda* the lanceolate subgenital plate projected beyond the last tergite. This character is helpful to differentiate from *Paracalynda* Zompro, 2001 easily, which has the subgenital plate short and does not project beyond the abdominal segment IX.

Ramandeun coronatum Murcia and Cadena-Castañeda, new species

(Fig. 13–17)

Holotype. ♂. Colombia, Cundinamarca, San Antonio de Tequendama, Chicaque Natural Park. 4°36′59″N, 74°18′46″W. 2216m. 23 May 2021 (CAUD).

Paratype. ♀. Same data as holotype (CAUD).

Description. Male. General coloration of the body pale yellow, surface completely smooth without tubercles or granules (Fig. 13A–B). **Head.** Longer than wide, slightly broader towards the eyes and narrowing near the posterior margin, vertex slightly elevated with two tiny parallel tubercles slightly protruding from the anterior region (Fig. 14A–B); eyes conspicuous, spherical, and prominent; antennae reaching the posterior margin of tergite III (Fig. 13A–B); scape elongated, 1.5 times longer than pedicel, dorsoventrally compressed and rectangular in dorsal view; pedicel round in cross-section; third antennomere narrower than the pedicel, the other 60 flagellomeres variables in length. **Thorax.** Pronotum slightly longer than the head, rectangular, 1.5 times longer than wide, with a longitudinal midline extending from anterior to posterior margin and with a transverse suture running through it, anterior margin concave and posterior convex and narrow (Fig. 14A–B). Mesonotum elongate, cylindrical, thinner than the pronotum, and approximately seven times longer (Fig. 13B). Metanotum as long as half the length of the mesonotum (Fig. 13B). **Legs.** Long, pro- and metathoracic legs equal in length, slightly longer than mesothoracic legs, all femora slightly trapezoidal, profemora compressed basally. All tibiae without area apicalis, with four prominent edges similar in size. Probasitarsus and metabasitarsus longer than the other tarsomeres

Figure 13. *Ramandeun coronatum* **new genus and new species.** (Male). **A–B**) Habitus in lateral and dorsal views, respectively.

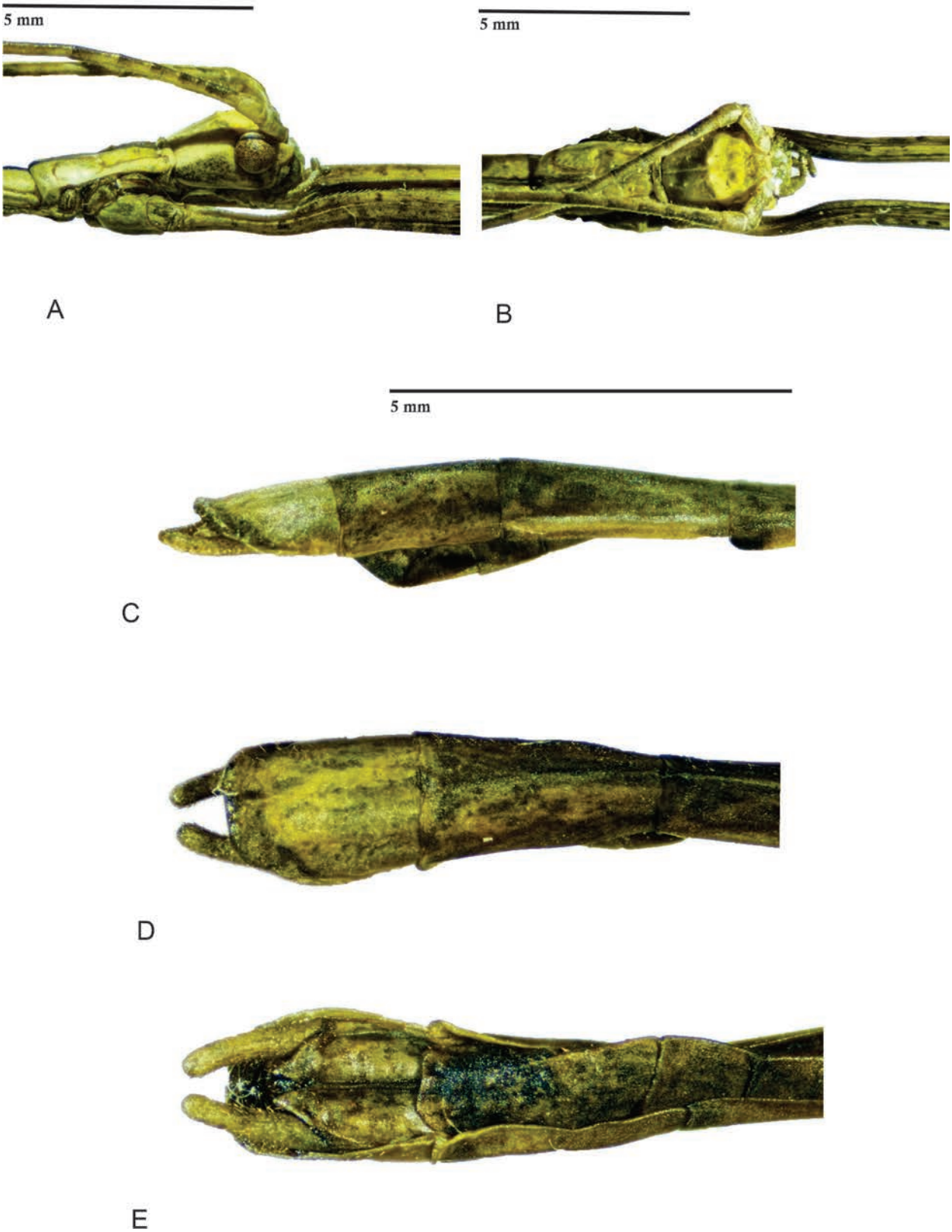


Figure 14. *Ramandeun coronatum* **new genus and new species.** (Male). **A–B)** Head and pronotum in lateral and dorsal views, respectively. **C–E)** Terminalia in lateral, dorsal, and ventral views, respectively.

Figure 15. *Ramandeun coronatum* **new genus and new species.** (Female). Habitus in lateral and dorsal views, respectively.

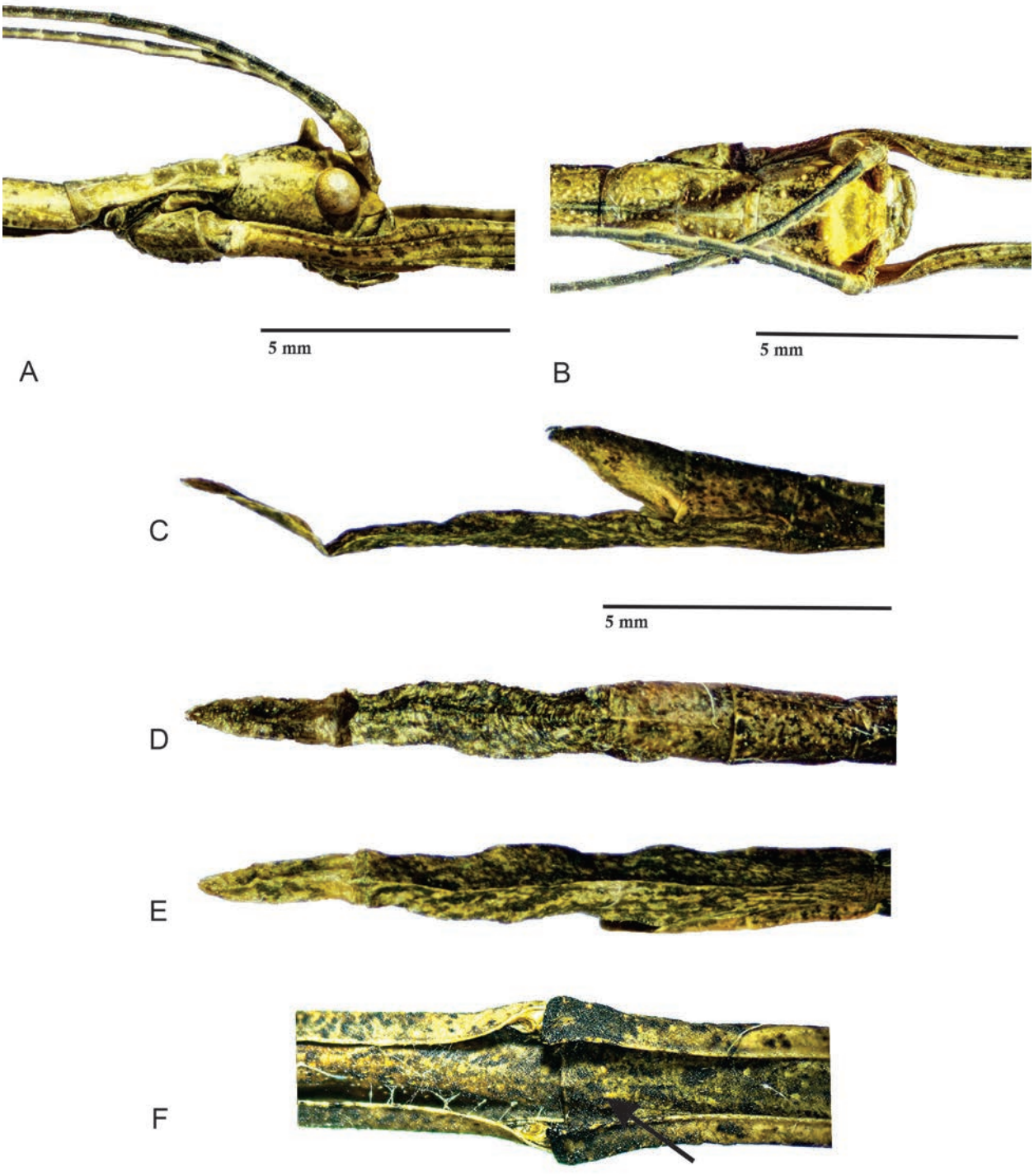


Figure 16. *Ramandeun coronatum* **new genus and new species.** (Female). **A–B)** Head and pronotum in lateral and dorsal views, respectively. **C–E)** Terminalia in lateral, dorsal, and ventral views, respectively. **F)** Sternum VII, the black arrow indicates the lack of preopercular organ.

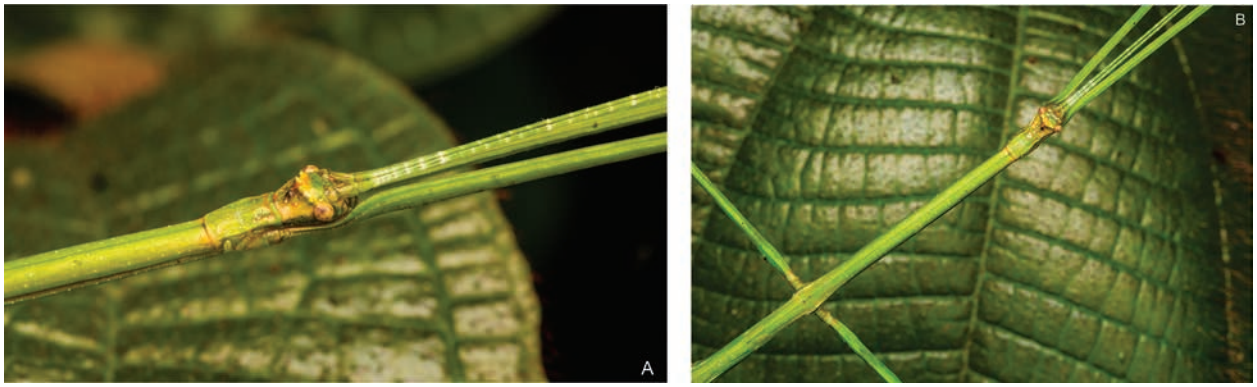


Figure 17. *Ramandeun coronatum* **new genus and new species. A**) Live female. **B)** See the crown details.

combined, mesobasitarsus as long as the other tarsomeres combined. **Abdomen.** Median segment indistinguishable from metanotum. Tergites II–VI elongated and 3.5 times longer than wide, tergite VII slightly shorter than tergite VI; tergite VIII narrower and shorter than tergite VII; tergite IX parallel-sided, shorter than tergite VIII; tergite X distinctly shorter than tergite IX, posterior margin slightly convex and elevated. Cerci shorter than tergite X, slightly curved, compressed towards its apex. Sternites II-VI with parallel sides and equal in length, sternites VII slightly shorter than sternite VI and elevated near the posterior margin, sternite VIII slightly shorter than sternite VII and elevated from its anterior to posterior margin; poculum as long as the sternite VIII, slightly convex (Fig. 14C–E).

Female. Similar to male. Body yellow, irregularly covered with small black spots; distinctly longer than male and slightly more robust with slightly granular thorax (Fig. 15A–B). **Head.** As in male. Vertex with a crown of spines crossing transversely just behind the eyes, the two central spines very conspicuous and the lateral ones less prominent (Fig. 16A–B). **Thorax.** Slightly granulose. Mesonotum very elongated, about 7.5 longer than the pronotum. **Legs.** Mesofemur with a small latero-ventral spine on its anterior part. **Abdomen.** Tergite X slightly elevated, as long as tergite IX, traversed by a longitudinal carina from its anterior to posterior margin, its posterior margin is abruptly depressed in the middle. Sternite VII flat. Subgenital plate lanceolate, laterally compressed, narrowing towards the apex, very elongated, projecting beyond the apex of the abdomen, three times longer than the anal segment. Cerci very small, dorsoventrally compressed, slightly curved, and hidden in dorsal view by the anal segment (Fig. 16C–E).

Eggs. Unknown.

Etymology. The name refers to the characteristic crown of thorns that crosses the vertex of the female.

Measurements (mm). ♂/♀ TL: 90 / 115, Pr: 3 / 4, Ms: 24 / 29, Mt:13 / 15, Pf: 23 / 30, Mf: 20 / 26, Hf: 26 / 39, Pt: 27 / 36, Mt: 22 / 28, Ht: 29 / 39, Ant: 55 / 70.

Comments. A live female with a green coloration was observed in the field, and the crown of thorns that cross the vertex transversely just behind the eyes can be seen (Fig. 17A–B). Both type specimens were collected in copulation.

Family Pseudophasmatidae Rehn, 1904
Subfamily Pseudophasmatinae Rehn, 1904
Tribe Anisomorphini Redtenbacher, 1906
Genus *Atratomorpha* Conle and Hennemann, 2002

Atratomorpha jorgei Murcia and Cadena-Castañeda, new species
(Fig. 18–22)

Holotype. ♂. Colombia, Cundinamarca, San Antonio de Tequendama, Chicaque Natural Park. 4°36′29″N 74°18′21″W. 2538 m. 7 March 2014 (CAUD).

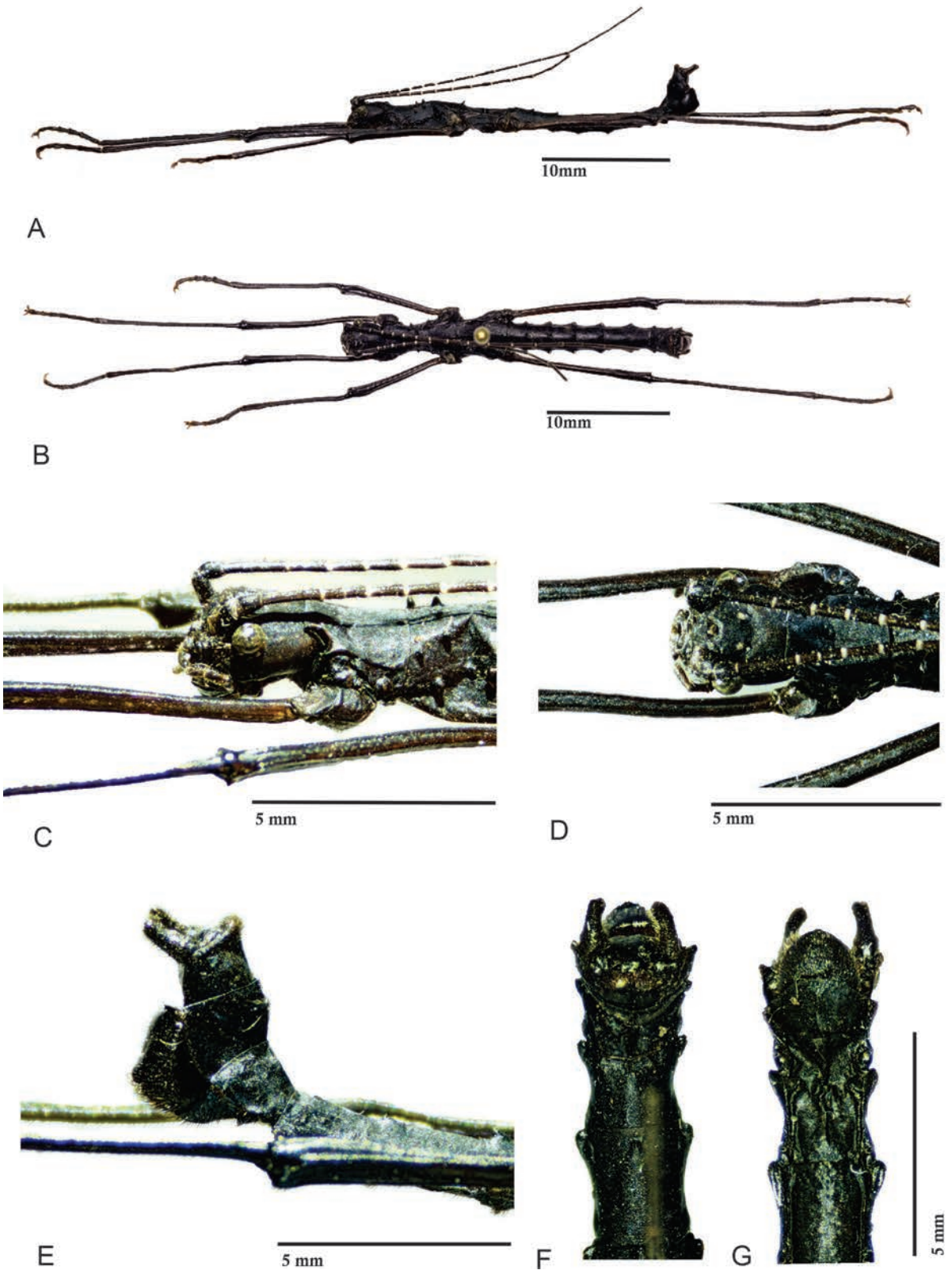


Figure 18. *Atratomorpha jorgei* **new species.** (Male). **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views, respectively.

Paratypes. 2♀. Same data as holotype. ♂. 4°37′05″N 74°18′43″W. 2229 m. 26 September 2020. 2♂ 4°36′32″N 74°18′26″W 2469 m. 26 June 2013. 2♂ y 1♀ 4°37′11″N 74°18′46″W 2247 m. 26 June 2013 (CAUD).

Description. Male. Body robust, general coloration dull black, antennomeres apically white, and tarsi brown (Fig. 18A–B.) **Head.** As long as wide, similar in length to the pronotum and with ocellar rudiments, vertex flattened and without spines; eyes rounded and mid-sized; antennal scape rectangular in dorsal view, slightly compressed dorsoventrally, pedicel as long as the scape and round in cross-section, third antennomere as long as the scape and pedicel together (Fig. 18C–D), the others 35 antennomeres progressively increasing in length, antennae slightly surpassing the abdomen (Fig. 18A–B). **Thorax.** Pronotum indistinctly longer than wide, with large rounded anterolateral angles for defensive glands, pronotal disc with a longitudinal furrow extending from anterior margin to near posterior region of pronotum (Fig. 18C–D). Mesonotum about 1.2 times longer than pronotum, progressively widened from its anterior to posterior margin, with a pair of dorsolateral spines located on the anterior part and a pair of posterior dorsal spines near the middle of the mesonotum, the lateral margins with a longitudinal row of spines varying in size; a conspicuous small spine protrudes from its posterior margin (Fig. 18A–D). Metanotum half as long as of mesonotum, posterior margin very smooth almost indistinguishable from the median segment. Prosternum half as long as mesosternum, with distinctly convex posterior margin. Mesosternum with conspicuously invaginated mesofurcal groove. Metasternum one-third of the length of mesosternum with conspicuously invaginated metafurcal groove. **Legs.** Long, smooth and unarmed, femur rectangular, with four setous edges, slightly widened apically. Profemur longer than head, pro-, and mesonotum combined. Mesofemur slightly curved. Metafemur reaching the posterior margin of tergite VII; tibiae smooth and unarmed, area apicalis present, pro- and metatibiae distinctly longer than second ones. Basitarsi at least as long as the sum of the II–III tarsomeres, the rest of the tarsomeres progressively reducing their length. **Abdomen.** Distinctly thinner than thorax, longer than head and thorax combined. Abdominal segments II–VII with small posterolateral projections and segments II–VI with a small spine on its posterior margin. Median segment inconspicuous as long as metanotum; tergite II and III as long as wide; tergite IV–VI progressively elongated, slightly longer than wide; tergite VII as long as wide but shorter than previous tergites; tergite VIII broader than long; tergite IX longer than tergite VIII and slightly wider than long, slightly raised above midpoint; tergite X twice as wide as long but narrower than other tergites, lateral margins parallel, posterior margin prominent with a small extension in the central area and a small notch. Cerci setose, as long as tergite X, round transversely, curved and thicker near their base. Abdominal sternites smooth but slightly raised on their posterior margin; sternites II–III as long as wide; sternites IV–VI slightly longer than wide; sternites VII wider than long; sternites VIII twice as wide as long with posterior margin slightly convex, poculum, prominent raised, and cup-shaped (Fig. 18E–G).

Female. Body robust (Fig. 19A–B). **Head.** As in male (Fig. 19C–D). **Pronotum.** Quadrangular with slightly compressed lateral margins; mesonotum longer than pronotum with straight lateral margins (Fig. 19A–B). **Abdomen.** As wide as thorax, narrowing posteriorly. Tergites II–VI wider than long; tergite VII narrower than tergite VI; tergite VIII slightly shorter than tergite VII; tergite IX with posterior margin abruptly raised medially, tergite X cupuliform, slightly keeled longitudinally, wider towards its anterior margin, posterior margin tapering slightly towards its apex. Cerci slightly shorter than tergite X. Abdominal sternites similar to those of male but uniformly smooth, sternites II–III wider than long; posterior margin of sternite VII narrow at its apex; subgenital plate elongated, with fine hairs, and a convex and rounded posterior margin (Fig. 19E–G).

Measurements (mm). ♂/♀ TL: 26–35 / 37–40, Pr: 2–4 / 3–4, Ms: 4–6 / 5–6, Mt: 2.5–5 / 3–5, MSeg:1–2 / 2–3, Pf: 11–11.5 / 13–12, Mf: 8–11 / 10–10.5, Hf: 11–13 / 13–14, Pt: 11–13 / 14–15, Mt: 9–10 / 10–11, Ht: 13–14 / 16–16.5, Ant: 24–36 / 39–43.

Eggs. Capsule rough, bright light brown (Fig. 20). Rectangular in shape with posterior pole rounded dorsally (Fig. 20A), capsule 1.3 times longer than wide and 1.2 times longer than tall, dorsal surface straight and narrowed abruptly over polar area (Fig. 20B), ventral surface almost straight narrowing over the polar area, operculum ovoid and flat with a small central cone (Fig. 20C). Micropylar plate ellipse-shaped, located in the central part of the egg, with raised inner part and, wide margins. Micropylar cup over posterior end of micropylar plate (Fig. 20A). 7 eggs examined.

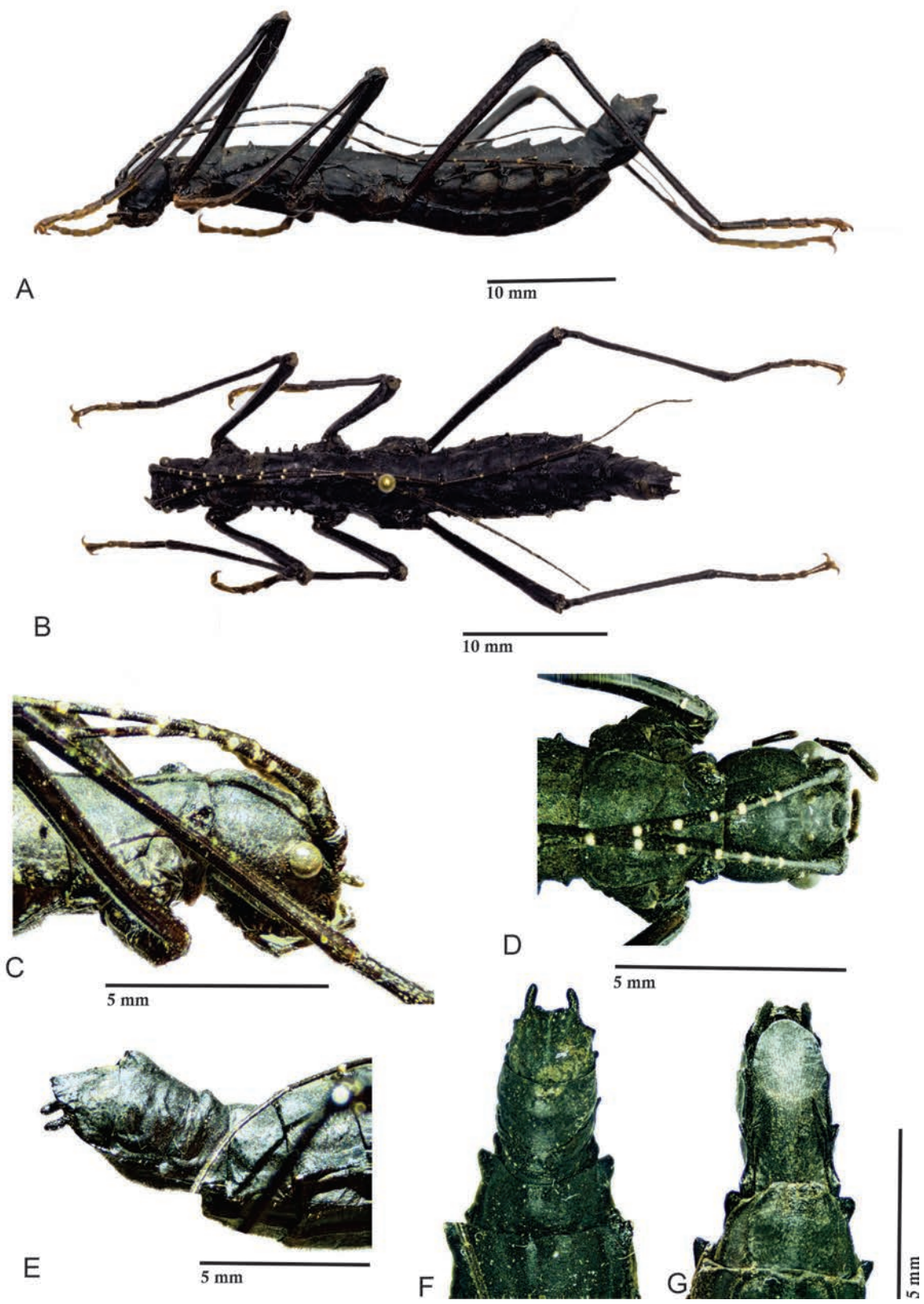


Figure 19. *Atratomorpha jorgei* **new species.** (Female). **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views, respectively.

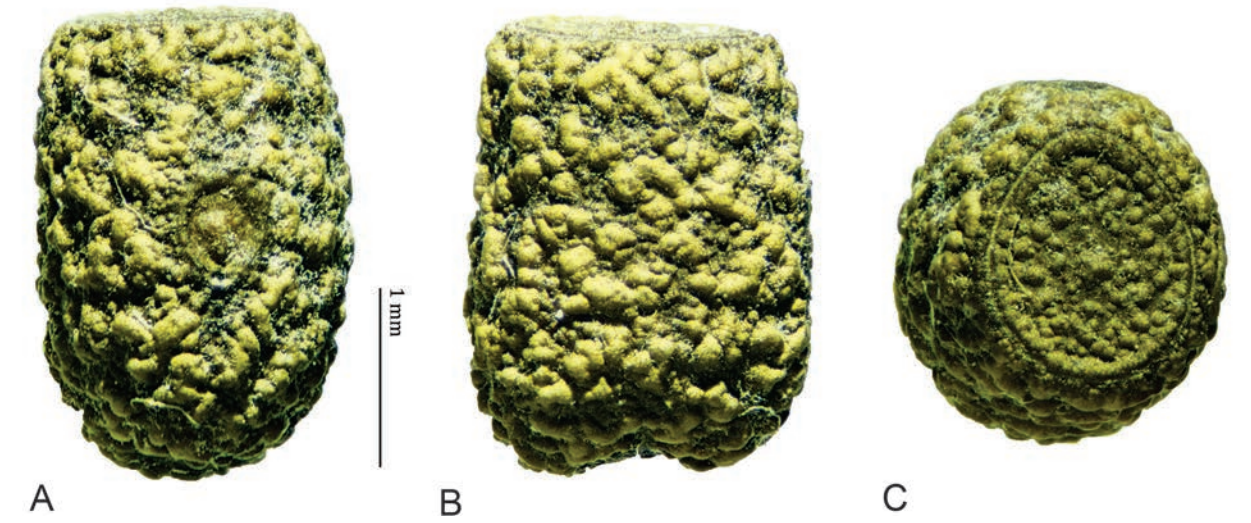


Figure 20. *Atratomorpha jorgei* **new species.** Eggs. **A)** Dorsal view. **B)** Ventral view. **C)** Anterior pole.

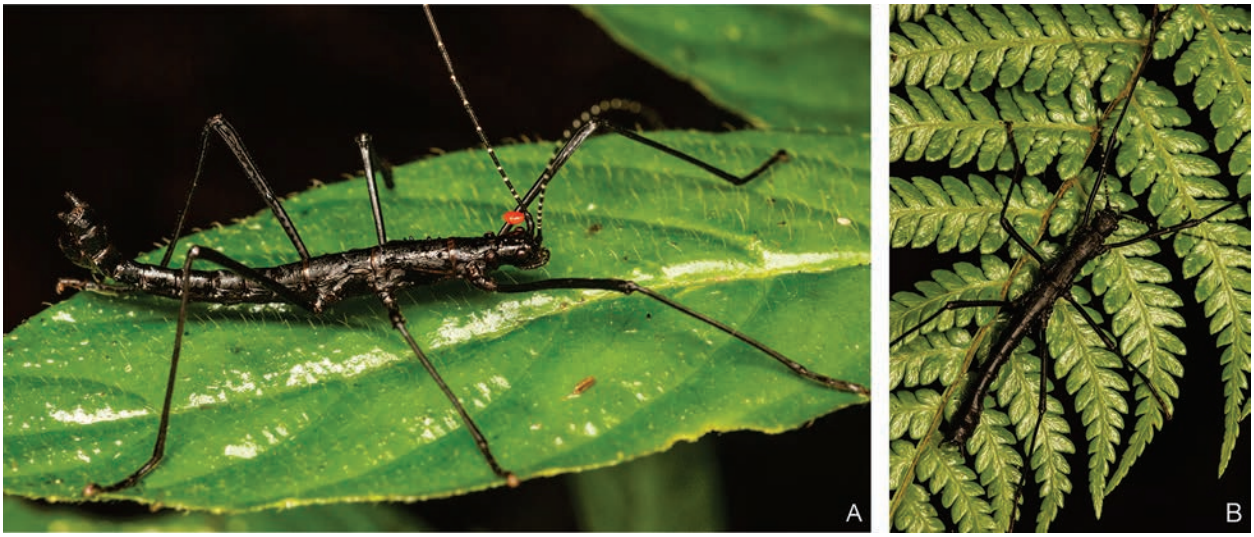


Figure 21. *Atratomorpha jorgei* **new species.** Live male. **A–B)** Lateral and dorsal view respectively.

Measurements (mm). Length 3, capsule height 2.4, capsule width 2, operculum diameter 1.2.

Etymology. This species is dedicated to the father of the first author, Jorge Murcia Romero, thanking him for his invaluable support and recognizing his impetus for persistence in the face of adversity.

Comparison. This new species is included within *Atratomorpha*, due to its matte black coloration, apterism, antennae slender and longer than the body, legs elongated and slender, profemur at least equal in length to the combination of the pro- and mesothorax. This new species is very similar to *Atratomorpha atrata* (Hebard, 1919), but differs in the shape of the scape being rectangular, not as square, the pronotum smooth and without granules. Female with the posterior margin of the tergite IX abruptly elevated medially, the tergite X is cupuliform; subgenital plate is elongated with a distinctly rounded margin and is not conical in shape as described for *A. atrata*. The tergite X of the male of *A. jorgei* **new species** has a prominent posterior margin and a small prolongation in the central area; very different from that seen in *A. atrata* which is distinctively rounded, smooth,

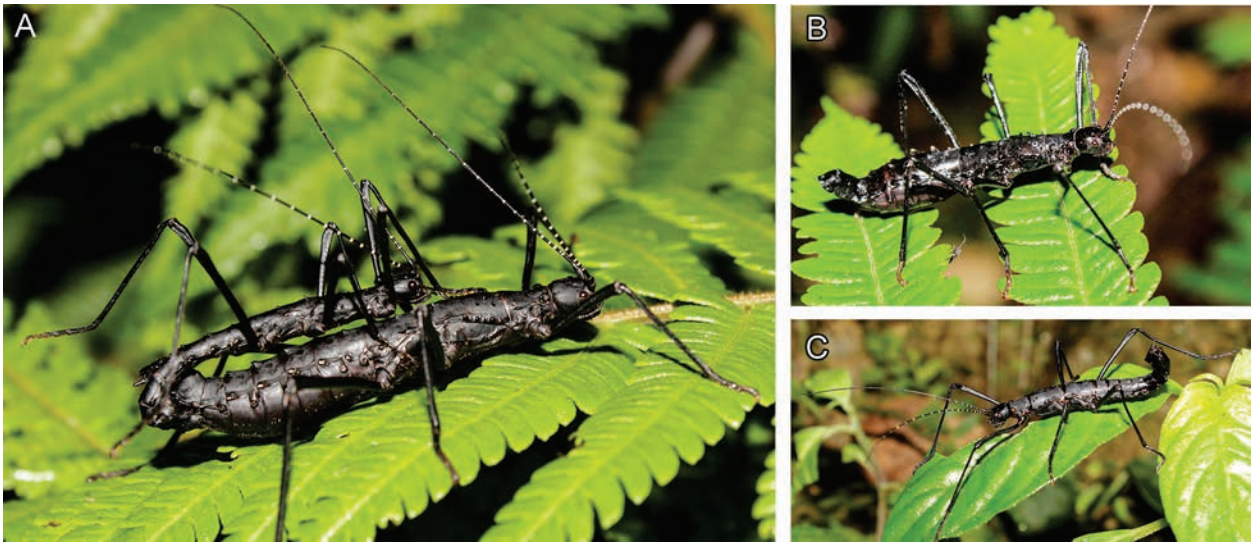


Figure 22. *Atratomorpha jorgei* **new species. A)** In copulation. **B)** Live female. **C)** Live male.

and not prominent. The cerci in both sexes are setose but differ in being curved and thicker near their base in the new species.

It also differs from *Atratomorpha coriacea* (Redtenbacher 1906), which has bright yellow eyes in the dorsal half and black in the ventral half, but in *Atratomorpha jorgei* **new species** the eyes are entirely black; also, the surface of the body of *A. coriacea* is densely grained.

Comments. Sometimes the males with Acari (Mesostigmata) ectoparasites on their antennae, were observed (Fig. 21A). Several individuals were seen perched or moving on ferns (Fig. 21B). Eventually, copulating individuals were found, and sexual dimorphism in this species can be noticed, with the females being distinctively more robust and slightly longer than the males (Fig. 22A). When handled and feeling threatened, they frequently release a white spray from their prothoracic glands that are fired from a distance, irritating the mucous membranes and leaving the insect's body covered with this liquid, giving a milky appearance on the integument (Fig. 22B).

The specimens examined are very similar and show no apparent intraspecific variation (Fig. 22C). However, the specimens found in the lower zone of the park at 2229 m have a larger body size, being noticeably more robust and longer than the individuals found in the upper zone of the park above 2530 m, showing an evident reduction in body size in the higher areas of the park.

Tribe Pseudophasmatini Kirby, 1904

Comments. *Nubilophasma* Murcia and Cadena-Castañeda**, new genus**, is included in Pseudophasmatini, due to the following characters: 1) body opaque, not shiny; 2) head clearly longer than wide; 3) ocelli present in at least one of the sexes; 4) mesonotum with a distinctive midline dorsally; 5) profemur longer than head prothorax and mesothorax combined, strongly curved and compressed basally (Zompro 2005). 6) Tegmina with projecting anterolateral borders and wings that do not project beyond the tip of the abdomen (Zompro 2004).

Nubilophasma Murcia and Cadena-Castañeda, new genus

Description. Body light brown with yellow stripes arranged on the legs. Tegmina with green veins, costal region of wings brown with discontinuous light green or yellow stripes, a longitudinal yellow line run along the dorsal surface of head and thorax. Head slightly longer than wide, wider towards eyes, tapering towards rear, males with ocelli and females without them, eyes prominent and spherical; antennae brown with irregularly arranged yellow bands, antennomeres club-shaped; antennae longer than the total length of the body. Pronotum rectangular with raised and rounded anterolateral angles for the defensive glands, with tiny granules along its lateral margins, and armed with four spines on the anterior half of the mesonotum, two smaller anteriorly and two

more conspicuous posteriorly. Tegmina short, extending to the middle of the metanotum, strongly convex with oval margins; costal margin constricted at the base, hind wings projecting to the middle of the tergite IX. Femora slightly widened apically; probasitarsus and metabasitarsus very elongated, as long as the sum of the other tarsomeres, mesobasitarsus twice as long as the second tarsomere. Abdominal segments with posterolateral projections in both sexes. Abdominal sternite V of male longer than wide with a very prominent projection that forks distally into two spines, located on its posterior margin; sternite VII with preopercular organ small and located near posterior margin. Poculum longer than wide, strongly convex with pronounced ventral prolongation, 2.5 times longer than sternite VIII, anterior margin convex, posterior margin extending to anterior margin of the anal segment. Cerci curved, as long as tergite X with numerous setae, and round and widened distally. Subgenital plate elongate, 2.5 times longer than wide, extending near the apex of tergite X, slightly convex with oval posterior margin.

Type species: *Nubilophasma chicaquensis* **new species** by original designation and monotypy.

Etymology. The name is the combination of the Latin words *nubilo* (referring to cloud forest habitat "From the cloud aggregations") and the typical termination for phasmid genera *phasma*. The name means "stick insect from the cloud". The gender of the name is being established as feminine.

Comparison. The genus *Ignacia* Rehn, 1904 (*sensu* Zompro, 2004), shares the club-shaped antennomeres; mesonotum with spines; femora wide apically, and abdomen with lateral expansions. In contrast, the new genus has the mesonotum distinctly longer than the pronotum. The wings do not exceed the tergite IX; tegmina do not have the prominent shoulder-shaped prolongation on the anterior border, as described by Zompro (2004), common to *Ignacia* species. Additionally, the abdominal expansions are most conspicuous in *Nubilophasma* **new genus**; the base of fore-femur is almost straight and not curved as seen to *Ignacia*.

Comments. The type species of *Ignacia* Rehn, 1904 is *Pseudophasma auriculatum* Bolívar [Y Urrutia] (= *Ignacia auriculata*), inherited from replaced name. Compared with the species currently included in *Ignacia*, the type species differs markedly from the other species of the genus. The spine-shaped prolongation of the costal edge of the tegmina is remarkable for *I. auriculata*, only comparable to *Ignacia atrophica* (Pallas, 1772), both Amazonian species. In addition, these two species do not have developed lobes on the lateral edges of the abdomen segments, as mentioned by Zompro (2004) and Gutiérrez and Bacca (2014), in the diagnosis of this genus. On the other hand, *I. amapaensis* Piza, 1978, does not have any of the diagnostic characters of *Ignacia*; apparently, it does not belong to that genus, its type specimen should be revised, and perhaps moved to *Pseudophasma* Kirby, 1896.

In contrast, *Nubilophasma* **new genus** can be confused with *Ignacia*, but the two genera can be easily distinguished with the comparison characters provided here. The confusion is caused by the diagnosis proposed by Zompro (2004), since he based his generic description on a specimen identified by him as *I. auriculata* from the locality Cachabi, Ecuador (Chocó Biogeographic). Still, the type locality of *I. auriculata* is the Atalapo River, Ecuador or Venezuela (Amazon).

Therefore, the specimen studied by Zompro (2004) is not a "true" *Ignacia*, and is most likely conspecific with *I. spinipes* Conle et al., 2011 (Colombia, Chocó) and *Ignacia* sp. (Colombia, Nariño; identified by Gutiérrez and Bacca (2014)). Apparently, only two species should be considered valid for *Ignacia* (*I. auriculata* and *I. atrophica*) with a distribution restricted to the Amazon. Later studies may confirm this opinion, and if so, *I. spinipes* should be moved into *Nubilophasma* **new genus**, a different genus from *Ignacia*.

Nubilophasma chicaquensis Murcia and Cadena-Castañeda, new species

(Fig. 23–27)

Holotype. ♂. Colombia, Cundinamarca, San Antonio de Tequendama, Chicaque Natural Park. 4°37′02″N, 74°18′46″W. 2.229 m. 26 September 2020 (CAUD).

Paratypes. 1♀1♂. Same data as holotype.

Description. Male. Body light brown with yellow stripes on legs (Fig. 23A–B). Tegmina with green veins, costal region of the wings brown with delicate pale brown veins, and discontinuous light green stripes (Fig. 23B). A longitudinal yellow line runs along the dorsal surface of the head and thorax. Head with yellow postocular lines

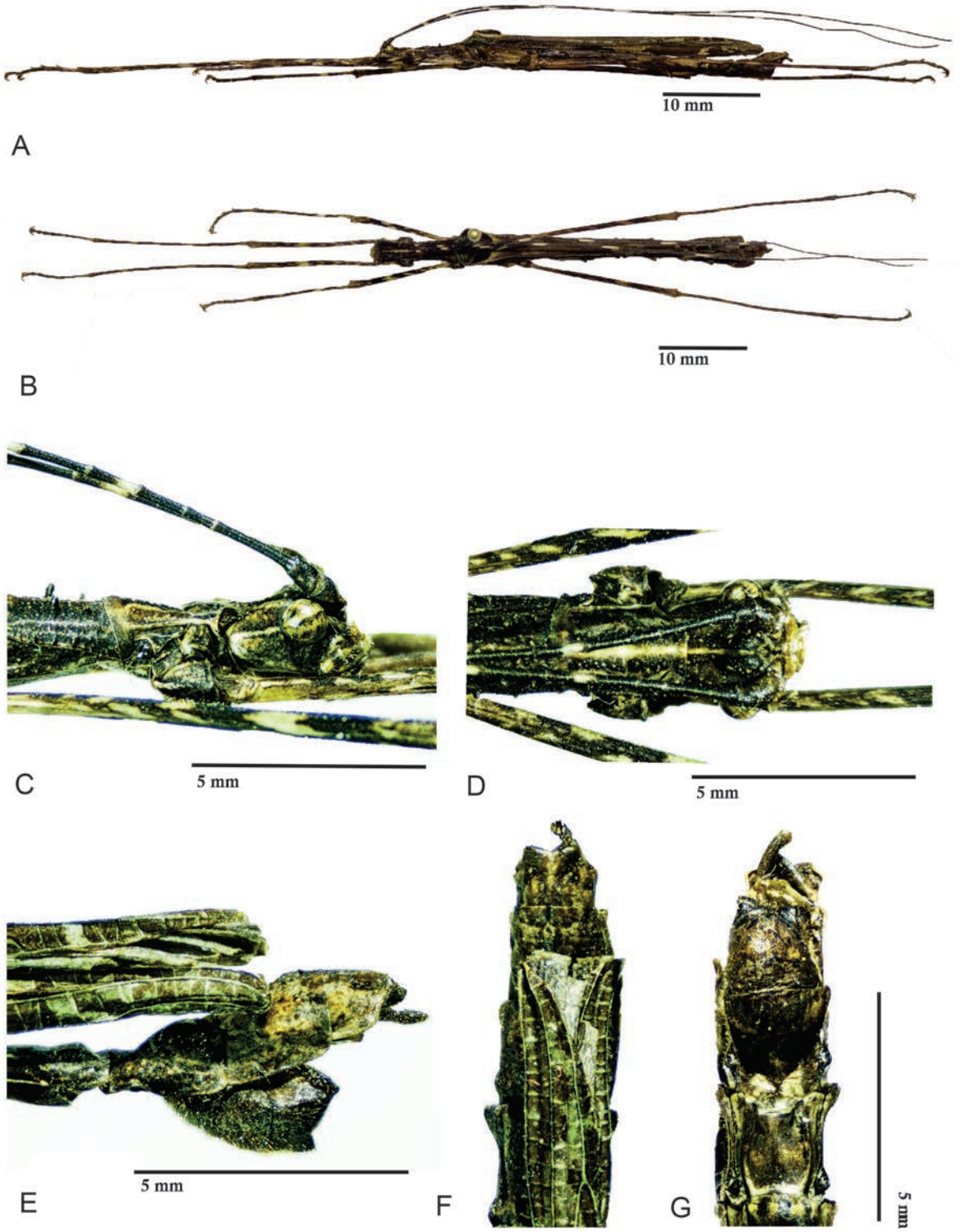


Figure 23. *Nubilophasma chicaquensis* **new genus and new species.** (Male). **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views respectively.

extending to lateral edges of the pronotal disc; dark brown antennae with irregularly arranged yellow bands; brown eyes with broken green lines through; all legs brown with yellow transverse bands. Body generally smooth, except mesonotum, with conspicuous tubercles. **Head.** Slightly longer than wide, wider towards eyes tapering towards the rear, with ocelli present and, very large and prominent spherical eyes (Fig. 23C–D); antennae very long, surpassing the last abdominal segment (Fig. 23A–B), scape rectangular in dorsal view with a medial groove running longitudinally, slightly compressed dorsoventrally; pedicel cylindrical, almost as long as scape, third antennomere round on cross-section, as long as scape and pedicel combined; other 80 antennal segments very elongate, club-shaped, and variable in length. **Thorax.** Pronotum rectangular with parallel sides, pronotal disc with elevated lateral margins, almost as wide as head, slightly longer; anterolateral angles raised and rounded for defensive glands (Fig. 23C–D). Mesonotum 1.2 times longer than wide and slightly longer than the pronotum, with small granules along its lateral margins and armed with four spines on the anterior half of the mesonotum, the two anterior are smaller, and the two posteriors more conspicuous (Fig. 23A–B). Metanotum wider than mesonotum and slightly shorter, with parallel sides, with a convex posterior margin, covered by the tegmina. Tegmina short, extending to mid-metanotum, strongly convex, with oval margins; costal margin constricted at base; hind wings projecting to middle of tergite IX (Fig. 23A–B). Prosternum longer than wide. Mesosternum smooth and elongated with parallel sides, distinctly longer than prosternum. Metasternum smooth and moderately longer than mesosternum, anterior margin narrower becoming progressively wider near its posterior margin; metafurcal groove greatly invaginated. **Legs.** Long, pro- and metathoracic legs equal in length but more prolonged than mesothoracic legs; femora slightly flared apically. Profemur with four edges and somewhat curved basally. Mesothoracic legs with four edges nearly rectangular in cross-section. Metafemur with four edges, long and reaching near the posterior margin of the sixth abdominal segment. Tibiae with area apicalis present; pro- and metatibiae distinctly longer than the second one, metatibiae longer than previous two. Probasitarsus and metabasitarsus very elongated, as long as the sum of the other tarsomeres; mesobasitarsus twice as long as the second tarsomere. **Abdomen.** Cylindrical, median segment slightly wider than long, half as long as the second tergite. Segments II–VIII smooth, with small posterolateral projections; tergite II longer than wide; tergite III longer than wide, widened from anterior to posterior margin; tergites IV–V narrower than the other tergites, more elongated and with parallel sides; tergite VI as long as V but widening on its posterior margin, tergite VII slightly longer than wide and shorter than tergite VI; tergite VIII quadrangular; tergite IX slightly elevated with anterior margin wider than posterior margin; tergite X wider than long and shorter than the rest of the tergites, half as long as tergite IX, anterior margin straight, lateral margins abruptly compressed on its posterior half, posterior margin concave and smoothly emarginate on its apex. Sternites II–IV smooth and distinctively longer than wide and progressively increasing in length; sternite V longer than wide, with a very prominent projection that forks distally into two spines located on its posterior margin; sternite VI equal in size to V; sternite VII a quarter shorter in length than sternite VI but wider; sternite VIII shorter than the other sternites, wider than long, with anterior margin straight, and its posterior margin concave; poculum strongly convex with prominent ventral prolongation, 2.5 times longer than sternite VIII, longer than wide, anterior margin convex, posterior margin extending to anterior margin of anal segment. Cerci curved, as long as tergite X with numerous setae, round and flared distally, cerci slightly exposed in dorsal view (Fig. 23E–G).

Female. Body coloration as the male; tegmina like those of the male but differ in the costal region of the wing, which is brown colored with discontinuous stripes yellow; body robust and longer (Fig. 24A–B). **Head.** Globose and without ocelli (Fig. 24C–D). **Thorax.** Mesonotum twice as long as wide and longer than pronotum (Fig. 24B). Hind wings extending to the middle of the tergite VIII (Fig. 24A–B). **Abdomen.** Segments elongate, but broader than male, tergites II–IX with distinctively large posterolateral projections. Tergites V–IX elevated with a medial carina passing through them and projecting slightly over their posterior margins; tergite IX as long as wide, posterolateral projections slightly visible dorsally; tergite X narrower than the rest of the tergites, posterior border with the moderately prolonged ends. Sternite II as long as wide; sternites III–VI smooth and longer than wide, sternite VII with a small preopercular organ located near the posterior margin. Subgenital plate elongated, 2.5 times longer than wide, extending near the apex of the tergite X, slightly convex with its posterior margin oval (Fig. 24E–G).

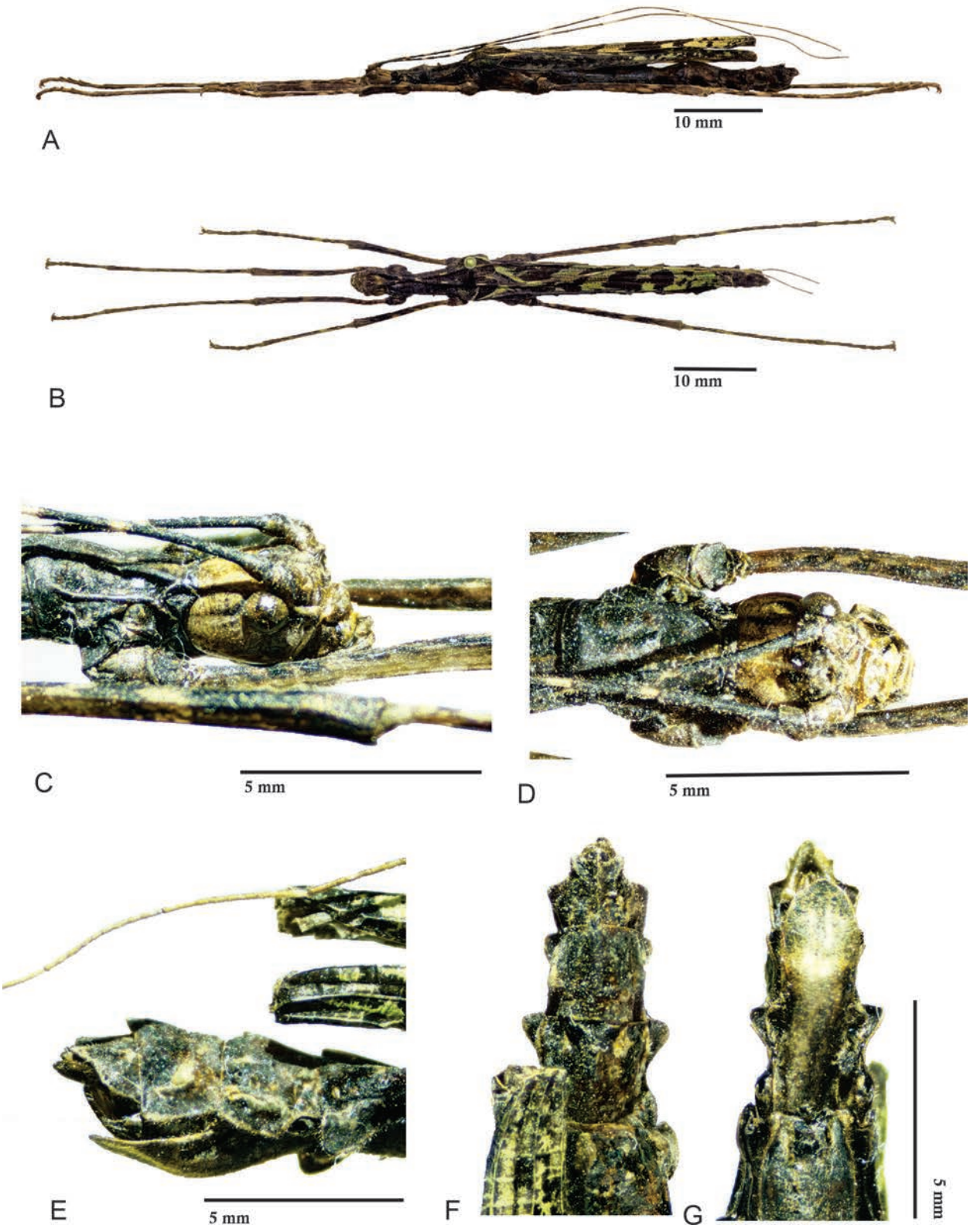


Figure 24. *Nubilophasma chicaquensis* **new genus and new species**. (Female). **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views respectively.

Figure 25. *Nubilophasma chicaquensis* **new genus and new species**. Eggs**. A)** Dorsal view. **B)** Ventral view. **C)** Anterior pole.

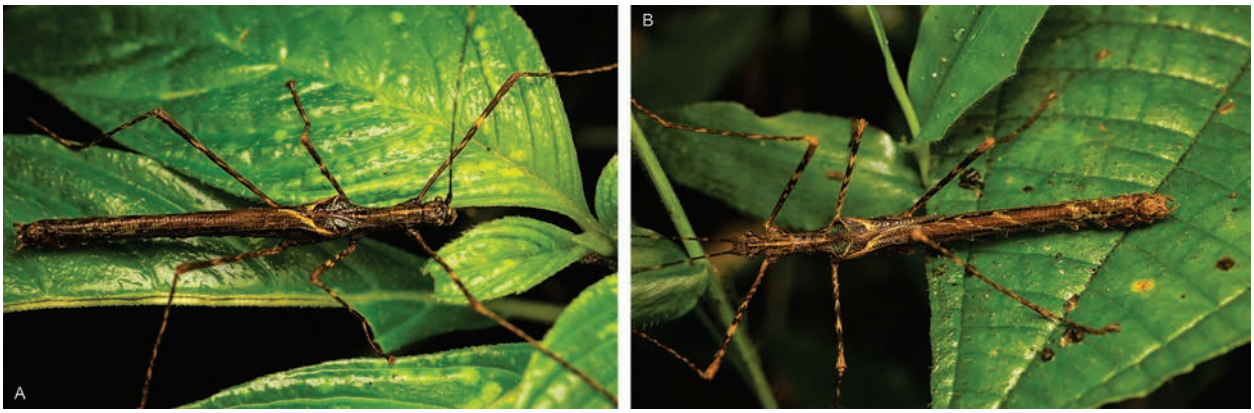


Figure 26. *Nubilophasma chicaquensis* **new genus and new species**. Live male and coloration variation. **A)** Specimens with the costal region of the wings brown. **B)** With discontinuous green stripes.

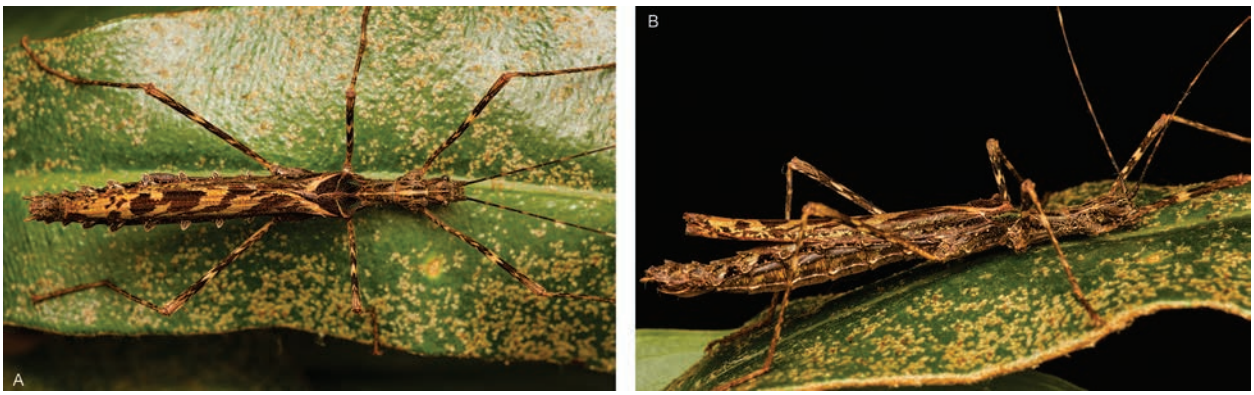


Figure 27. *Nubilophasma chicaquensis* **new genus and new species.** Live female. **A–B)** Dorsal and lateral views respectively.

Measurements (mm). ♂/♀ TL: 43–44 / 50, Pr: 3–3 / 4, Ms: 5–5 / 6, Mt: 4–5 / 5, MSeg: 2–2 / 3, Pf: 16–16.5 / 16, Mf: 11–11.5 / 11, Hf: 16–16.3 / 18, Pt: 16–16.5 / 17, Mt: 10–11 / 11, Ht: 16–17 / 18, Ant: 55–60 / 58.

Eggs. Light brown with dark spots, capsule granulated. Capsule rectangular, 1.4 times longer than wide and 1.2 times longer than tall (Fig. 25). The dorsal surface is slightly convex and tapers slightly towards the polar area, the ventral surface is slightly convex (Fig. 25B). Operculum ovoid and flat (Fig. 25C); micropylar plate circular on the central region of the dorsal capsule, abruptly compressed posteriorly, slightly raised on the inner part, and thin margins. The micropylar cup is located near the posterior margin of the micropylar plate (Fig. 25A). 10 eggs examined.

Measurements (mm). Length: 2.8, capsule height: 2, capsule width: 2, operculum diameter: 1.

Etymology. It refers to the Chicaque Natural Park where the type series was collected.

Comments. The males have slight variations in the general coloration of the tegmina and the costal region of the wings, being completely brown in some individuals (Fig. 26A) or with discontinuous green stripes (Fig. 26B). Female with intermittent yellow stripes on the costal region of the wings (Fig. 27A–B).

Subfamily Xerosomatinae Bradley and Galil, 1977
Tribe Xerosomatini Bradley and Galil, 1977

Mirophasma cf *cirsium* Redtenbacher, 1906
(Fig. 28)

Comments. Two immature specimens were found on moss, where they chromatically blend with the background, being almost unnoticed (Fig. 28B); for this reason, few specimens were found. They occasionally were seen on dry leaves when they moved, becoming exposed due to their coloration and ornamentation (Fig. 28A). These bryophytomorphic species can use mosses as biological corridors that facilitate their dispersion through the forest in mountainous ecosystems (Gutiérrez et al. 2014).

Previously, the locality of the species *Mirophasma cirsium* was unknown; it was only recorded for Colombia (Redtenbacher, 1906). But with our results, this species possibly occurs in the center of Colombia on the eastern Andes, in Cundinamarca, municipality of San Antonio del Tequendama 2220–2430 m. It is necessary to collect adults to corroborate the identity of the specimens studied.

Measurements (mm). ♂/♀ TL:19/19, Pr:2.5/2.5, Ms:4/4, Mt: 2.5/2.5, Pf:4.5/5, Mf: 5/6, Hf: 6/7, Pt: 4/6, Mt: 5/6, Ht: 6/7, Ant: 7/3.

Distribution. Colombia, Cundinamarca, Chicaque Natural Park.

Figure 28. *Mirophasma* cf *cirsium* female immature. **A)** In lateral view on a leave. **B)** In dorsal view on bryophytes.

Specimens examined. 1 male and 1 female, both immatures: 1♀ 4°36′32″N 74°18′19″W 2513 m. 28 January 2017. 1♂ 4°37′05″N 74°18′47″W 2230 m. 30 July 2018 (CAUD).

Pachyphloea magnoliae Murcia, Cadena-Castañeda, Noriega and García García, 2019

(Fig. 29)

Comments. Specimens frequently observed perched on ferns and feeding on them (Fig. 29A–B). Additionally, a light brown female was found with discontinuous green, and white spots located on her integument, with very conspicuous spines and tubercles (Fig. 29C), different from the specimens studied and described by Murcia et al. (2019).

Measurements (mm). ♂/♀ TL: 24 / 24, Pr: 3 / 3, Ms: 5 / 5, Mt: 2 / 2, MSeg: 1 / 0.9, Pf: 7 / 7, Mf: 5 / 6, Hf: 8 / 9, Pt: 7 / 7, Mt: 6 / 6, Ht: 10 / 10, Ant: 10 / 20.

Distribution. Previously described to the Parque Natural Chicaque, 2300–2530 m.

Specimens and eggs examined. 1 male and 1 female, specimens different from those studied in the original description. 3 eggs: 1♂ 1♀ 4°36′30″N 74°18′22″W 2524 m. 13 September 2020 (CAUD).

Tribe Prexaspini Zompro, 2004

Isagoras franciscoverai Murcia and Cadena-Castañeda, new species

(Fig. 30–34)

Holotype. ♂. Colombia, Cundinamarca, San Antonio de Tequendama, Chicaque Natural Park. 4°36′39″N, 74°18′34″W. 2267m. 4 October 2020 (CAUD).

Paratypes. 3♀ Same data as holotype. 2♂. 4°36′48″N 74°18′38″W. 2202 m. 22 November 2012 (CAUD).

Description. Male. General coloration and texture of the body brown and slightly rough (Fig. 30A–B). Head longer than wide, rectangular in shape, with parallel sides; vertex flattened and without spines (Fig. 30C–D); eyes small and dark with an oval outline; antennae reaching the tergite X (Fig. 30A–B); antennal scape rectangular in dorsal view, pedicel almost as long as the scape and round transversely; flagellum with 35 segments. **Thorax.** Pronotum rectangular, as long and wide as the head, pronotal disc with a longitudinal median suture and a deeper transverse suture (Fig. 30–D). Mesonotum three times longer than pronotum. Metanotum short, less than half the length of the mesonotum, with posterior margin concave (Fig. 30–B). Prosternum short, wider than long, but compressed laterally by the coxae; mesosternum smooth and parallel-sided, about five times longer than the prosternum; metasternum smooth, and half the mesosternum. **Legs.** Smooth and unarmed, fore- and metathoracic

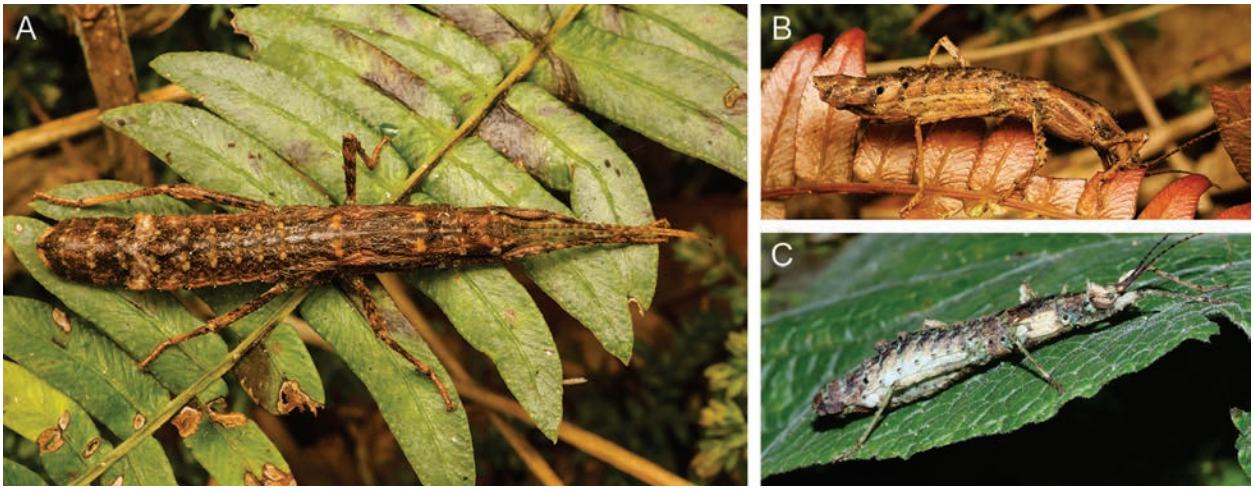


Figure 29. *Pachyphloea magnoliae*. **A)** Female perched on fern. **B)** Female feeding on fern. **C)** Female greenish form on leaves (Photo A. Avila).

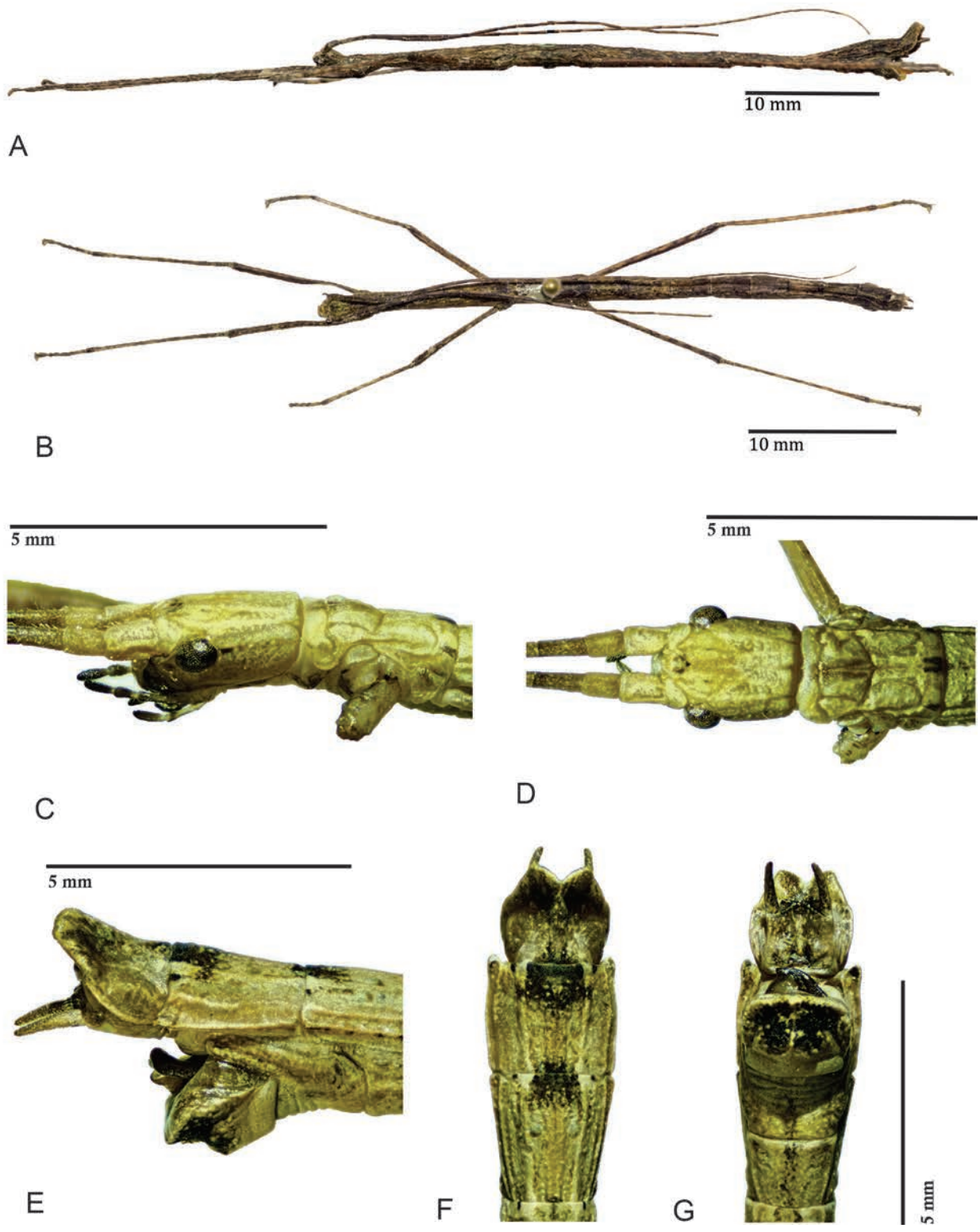


Figure 30. *Isagoras franciscoverai* **new species**. (Male) **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views, respectively.

legs similar in length, mesothoracic legs slightly shorter, metathoracic legs slightly surpassing the abdomen. Femora with four edges, rectangular in cross-section, smooth, without spines or lobes. Profemur compressed basally, about as long as head, pro, and mesonotum combined. Metafemur extends to the middle of the fourth tergite. Tibiae with four edges and area apicalis present. Basitarsi as long as the next two tarsi combined, the rest of the tarsomeres progressively reduced in size. **Abdomen.** Smooth and slightly longer than head and thorax combined, tergites elongate. Median segment visible (only in males), as long as half of the metanotum, with the anterior margin convex. Tergite II slightly wider than median segment; tergites III–VI longer than wide but gradually narrowing, tergite VII as long as tergite VI, posterior margin moderately broaden; tergite VIII as long as tergite VII, widening distinctly from anterior to posterior margin; tergite IX slightly wider than tergite VIII and quadrangular in dorsal view; tergite X distinctively narrower than tergite IX, as wide as long, with lateral margins convex, posterior margin medially excavated and slightly raised towards the apex, with a spinous area on its inner margins. Cerci projecting slightly above the abdominal apex, slender and constricted towards its apex, round in cross-section. Median segment triangular-shaped, sternites II–IV similar in length and laterally compressed, sternites V–VII gradually widening; sternite VII with a somewhat elevated preopercular organ placed towards the posterior margin with two cuticular extensions apically; sternite VIII widening towards posterior margin. Poculum twice as long as sternum IX, slightly elevated anteriorly, but strongly convex posteriorly; posterior margin reaching anterior margin of the anal segment (Fig. 30E–G). Subgenital plate narrower than all the sternites, the posterior margin is compressed laterally and with a pointed apex reaching the anterior margin of the tergite IX.

Female. Body similar to male but more robust; general coloration of the body light brown, with grains or tubercles and striations on the integument (Fig. 31A–B). Head with small granules arranged transversely on posterior part (Fig. 31C–D); the antennae extend to the posterior margin of the IV tergite (Fig. 31A–B). **Thorax.** Pronotum slightly rough with small granules arranged parallel and longitudinal to the median suture (Fig. 31D). Mesonotum distinctly wider than pronotum, gradually widening towards posterior margin, with two rows of conspicuous granules running longitudinally to the rear portion. Metanotum more than half the length of mesonotum, slightly wider than mesonotum and a little widened posteriorly (Fig. 31B). The mesosternum is smooth and distinctively broadened towards its posterior margin. **Legs.** Profemora curved and compressed basally, longer than wide, and with four prominent edges; tarsomeres I–IV gradually decreasing in size, pretarsi elongated. **Abdomen.** With striations and slightly granular, enlarged abdominal tergites. Median segment not visible; abdominal tergites II–III quadrangular; tergites IV–V distinctively wider than long, shorter than tergite III; tergite VI as long as V; constricting towards its posterior margin; tergite VII elevated, narrower and shorter than tergite VI, with slightly concave anterior margin, convex and prominent posterior margin; tergite VIII thinner than the other tergites, constricted in the middle, with a smooth longitudinal carina that crosses its entire length; tergite IX shorter than VIII; tergite X is the shortest of the abdominal tergites, parallel-sided, slightly narrow towards its anterior margin, posterior margin slightly convex. Sternites II–VI with parallel sides slightly longer than wide, sternite VII shorter than sternite VI, with slightly elevated preopercular organ and placed on the posterior margin with two cuticular prolongations apically. Subgenital plate narrower than all sternites, its posterior margin is laterally compressed with a pointed apex reaching the anterior margin of tergite IX (Fig. 31E–G).

Comparison. This new species is located in *Isagoras* as it has external-dorsal and ventral edges of the profemur conspicuously laminated or with dorsal lobes. Meso- and metafemora with distinctive ventromedial carina, males with thin elongated mesonotum no wider than head. Within *Isagoras*, there are only two wingless species similar to *I. franciscoverai* **new species**: *Isagoras molorchus* (Westwood, 1859) and *Isagoras pygmaeus* (Redtenbacher, 1906). *Isagoras molorchus* differs from the new species in that it has a round dilation on each side of segment VI, IX and X segments keeled. *Isagoras pygmaeus* differs due to its fragile appearance, and in having a tectiform and carinate anal segment.

Measurements (mm). ♂/♀ TL: 40–45 / 42–43, Pr: 2–3 / 2.5–3, Ms: 9–10 / 8–8.5, Mt: 5–5.2 / 5–5.5, MSeg: 2–2.2 /—, Pf: 9–10 / 8–9, Mf: 6–8 / 6–6.5, Hf: 10–12 / 8–9, Pt: 9–10 / 8–8.5, Mt: 6–7 / 6–6.5, Ht:10–10.5 / 9–9.5, Ant: 37–40 / 27–29.

Eggs. Small, brown capsule covered with prominent carinae with granular areas (Fig. 32). Oval 1.5 times longer than wide and 1.3 times longer than tall (Fig. 32A). Dorsal surface convex (Fig. 32B), operculum ovoid, and granulated with pseudocapitulum with margins projecting onto egg capsule (Fig. 32C). Micropylar plate located

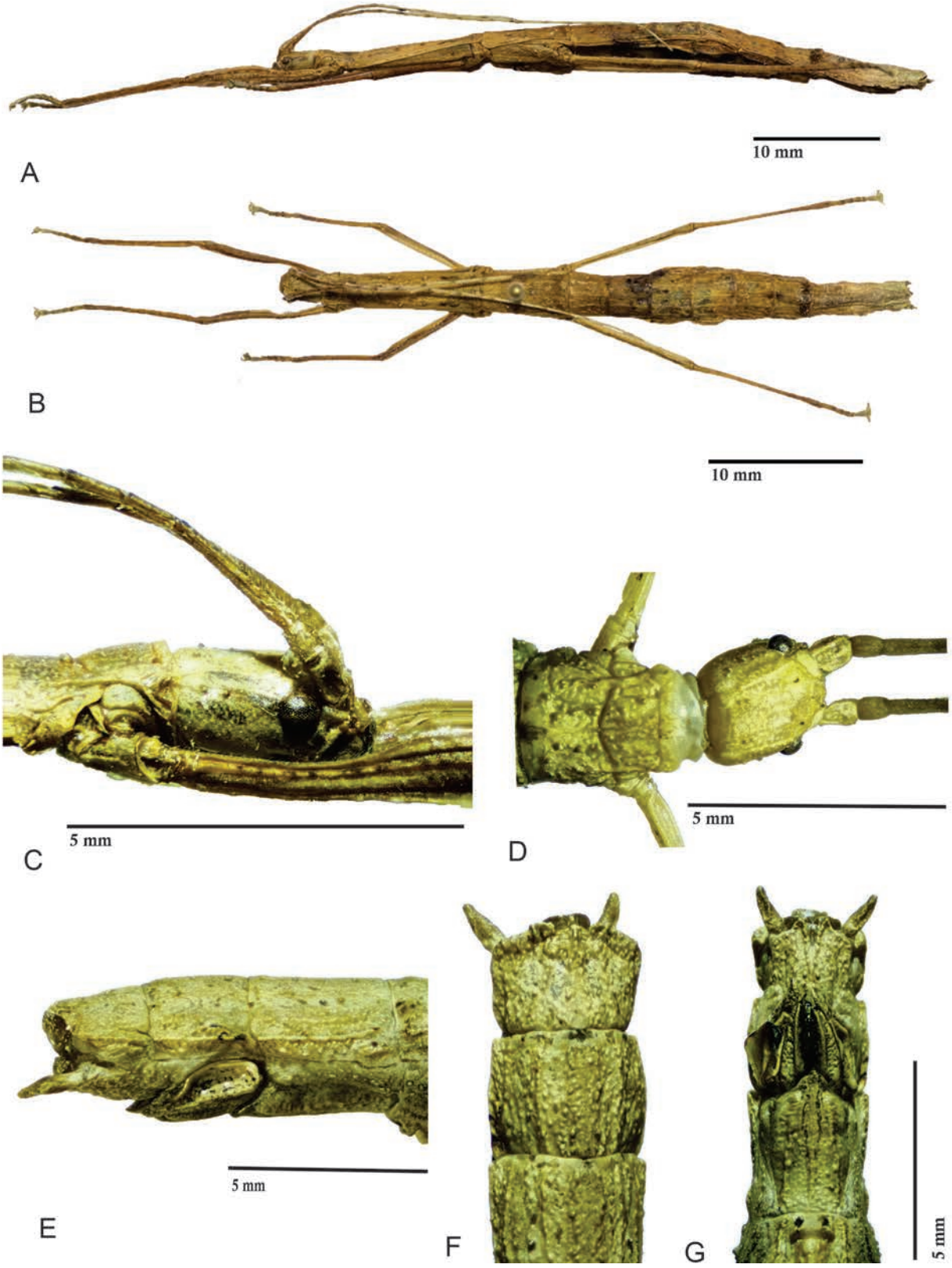


Figure 31. *Isagoras franciscoverai* **new species**. (Female) **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views, respectively.

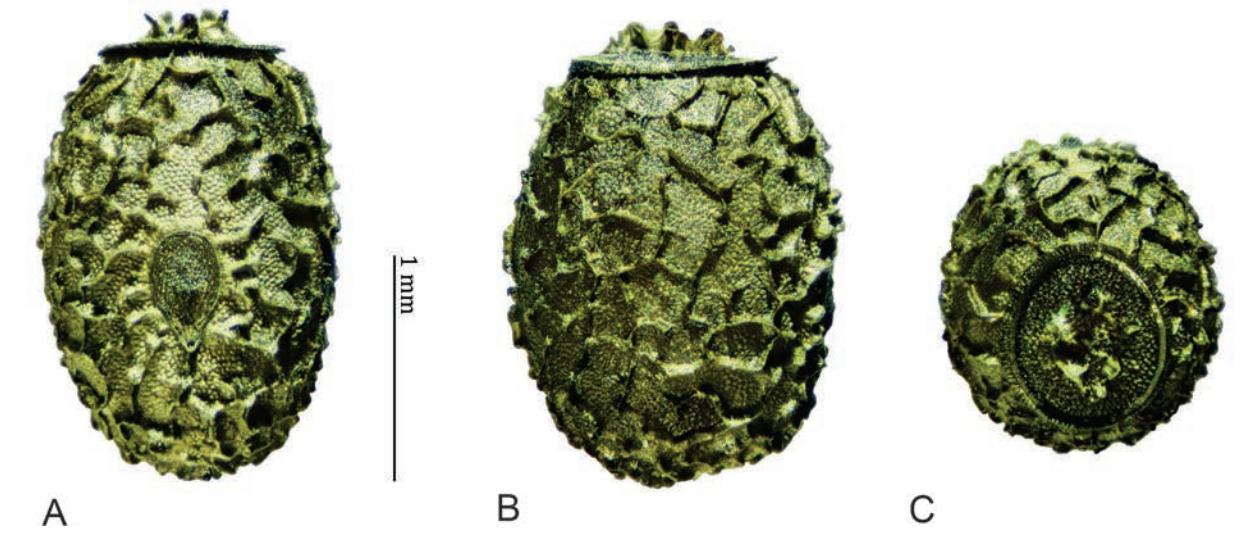


Figure 32. *Isagoras franciscoverai* **new species**. Eggs**. A)** Dorsal view. **B)** Ventral view. **C)** Anterior pole.

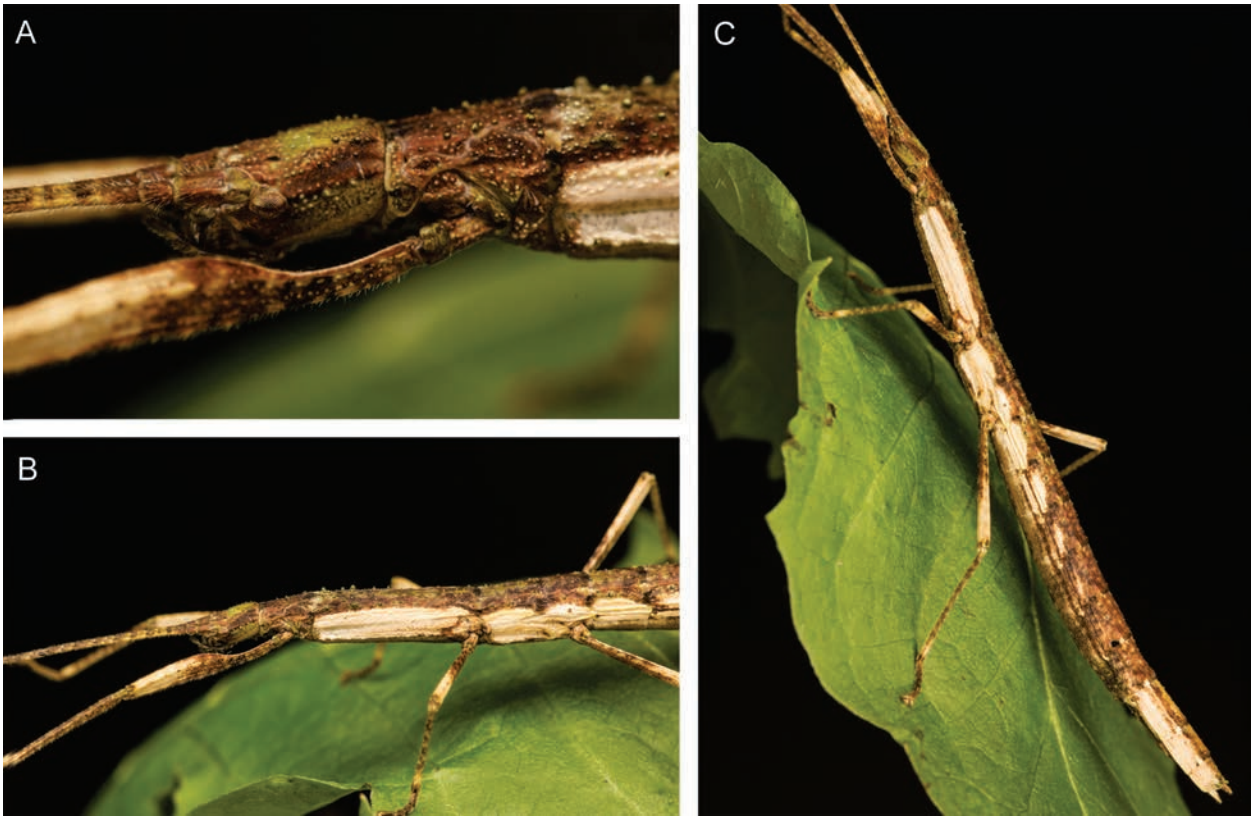


Figure 33. *Isagoras franciscoverai* **new species**. Live female. **A)** Detail of head and pronotum. **B)** Detail of head and thorax. **C)** Body complete.

in the central part of the egg, round and compressing towards the rear, with slightly raised inner part and prominent margin, micropylar cup large, placed on the posterior margin of the micropylar plate (Fig. 32A). 20 eggs examined.

Figure 34. *Isagoras franciscoverai* **new species**. In copulation.

Measurements (mm). Length 1.8, capsule height 1.5, capsule width 1.3, operculum diameter 0.6.

Etymology. This species is dedicated to Francisco Javier Vera, a Colombian climate activist, in recognition of his commitment to caring for the planet and for being the inspiration for many boys and girls around the world.

Comments. Yellow to brown specimens, with patterns of white or green spots, resemble bark (Fig. 33A–C). The granules on the surface of its cuticle may be significantly more prominent in some individuals (Fig. 33A–B). A couple was seen in copulation where the marked sexual dimorphism is observed, the female being distinctively more robust than the male (Fig. 34).

Family Heteronemiidae
Subfamily Heteronemiinae

Paraceroys quadrispinosus (Redtenbacher, 1906)

(Fig. 35–39)

Diagnosis. Body opaque reddish-brown (Fig. 35A–B, 36A–B). Head elongated in both sexes, with four small transverse spines projecting backward on the posterior margin (Fig. 35C–D, 36C–D). Pronotum with two anterior and two posterior conspicuous spines (Fig. 35C–D, 36C–D). Mesonotum with two prominent spines near posterior margin, lateral margins with small longitudinal spines (Fig. 35A, 36A). Male metanotum armed with three spines, two anterior located on the middle of the metanotum and one very close to its posterior margin; female with a single spine near the rear margin of metanotum. Legs medium-sized, the metafemora do not exceed the tergite V. Tergites IV–VI armed with a dorsal spine in male; female with a dorsal spine on tergites IV–VII, posterior margin of tergite IX spiniform and elevated. Male cerci elongated and slightly compressed apically, surpassing the apex of the last tergite. Poculum indistinctly elevated, the posterior margin with sharp lateral angles and centrally emarginate. Male subgenital plate lanceolate and elongated about four times longer than wide, with the posterior margin convex.

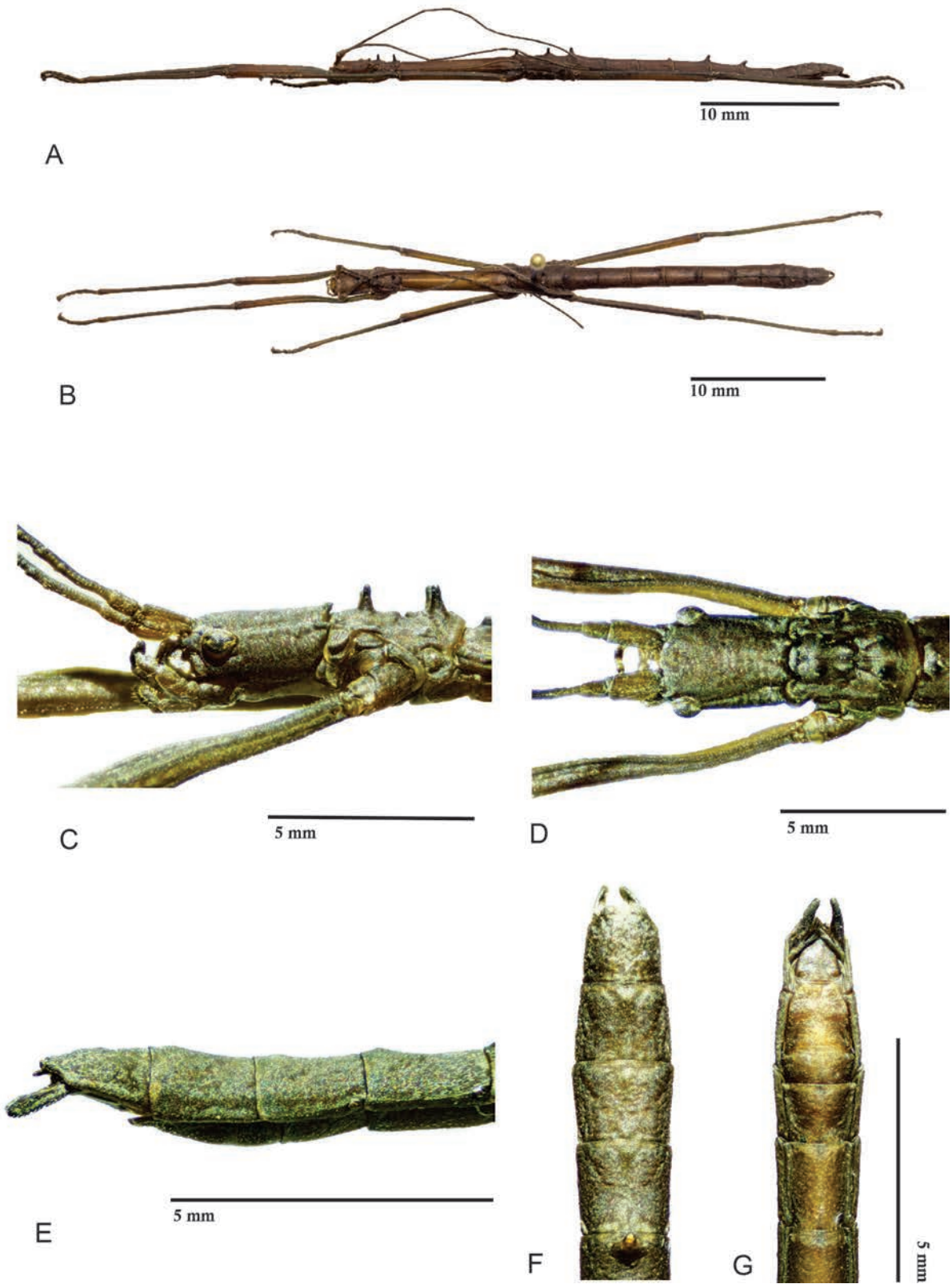


Figure 35. *Paraceroys quadrispinosus* (Male). **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views, respectively.

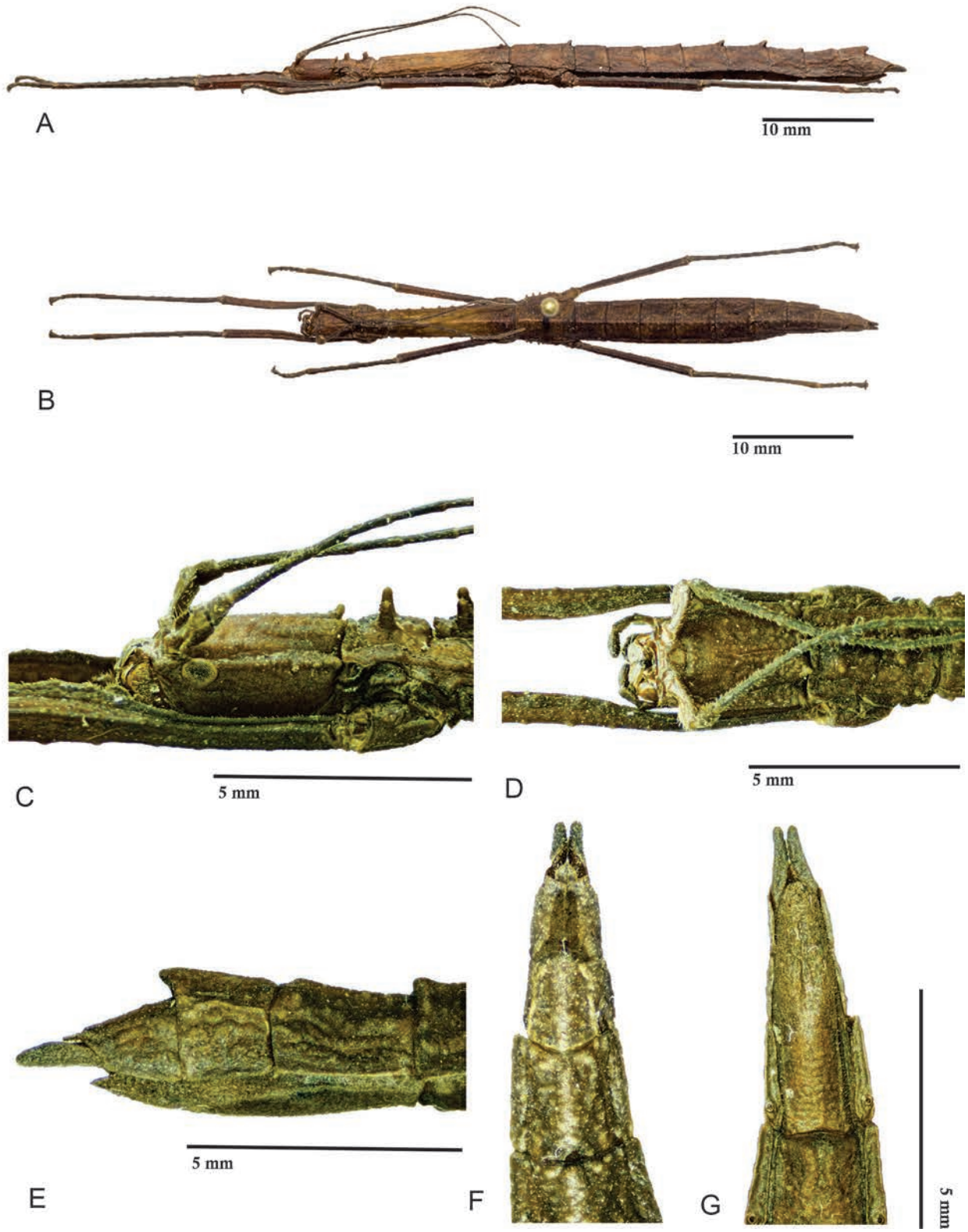


Figure 36. *Paraceroys quadrispinosus* (Female). **A–B)** Habitus in lateral and dorsal view. **C–D)** Head and pronotum in lateral and dorsal view. **E–G)** Terminalia in lateral, dorsal, and ventral views, respectively.

Figure 37. *Paraceroys quadrispinosus*. Eggs**. A)** Dorsal view. **B)** Latero-dorsal view. **C)** Ventral view. **D)** Anterior pole.

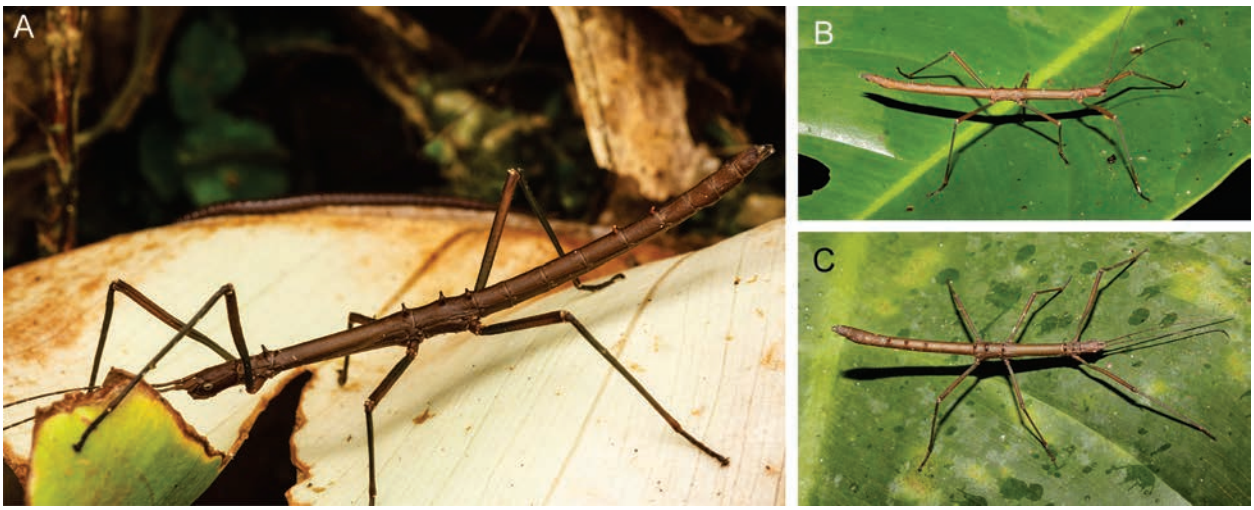


Figure 38. *Paraceroys quadrispinosus*. Live males. **A–B)** Reddish brown individuals with basally green femurs and green tibiae. **C)** Light brown form.

Color variation. Males 1. Reddish-brown color with basally green femurs and green tibiae (Fig. 38A–B). 2. Light brown (Fig. 38C). Females with shades ranging from light brown to reddish (Fig. 39A–B).

Measurements (mm). ♂/♀ TL: 39–40 / 46, Pr: 2.5–3 / 3.5, Ms: 9–10 / 11, Mt: 3.5–3.5 / 4, MSeg: 1 / 1, Pf: 10–11 / 10, Mf: 7–8 / 8, Hf: 11–11 / 10, Pt: 11–11.5 / 10, Mt:7 / 7, Ht:11–11.5 / 11, Ant: 20–23 / 17.

Eggs. Pale brown, capsule irregular, strongly rough (Fig. 37). Capsule 2.3 times longer than wide and 2.5 times longer than tall (Fig. 37C). The dorsal surface is straight and rough, rising posteriorly, progressively compressing towards the apex of the capsule (Fig. 37A–B). Ventral surface smooth, adhesive, almost straight, and somewhat narrower towards the polar area. Small irregular ovoid operculum surrounded by a collar with multiple pointed extensions, inserted at a 45° angle (Fig. 37C–D). Micropylar plate displaced anteriorly and lance-shaped, slightly

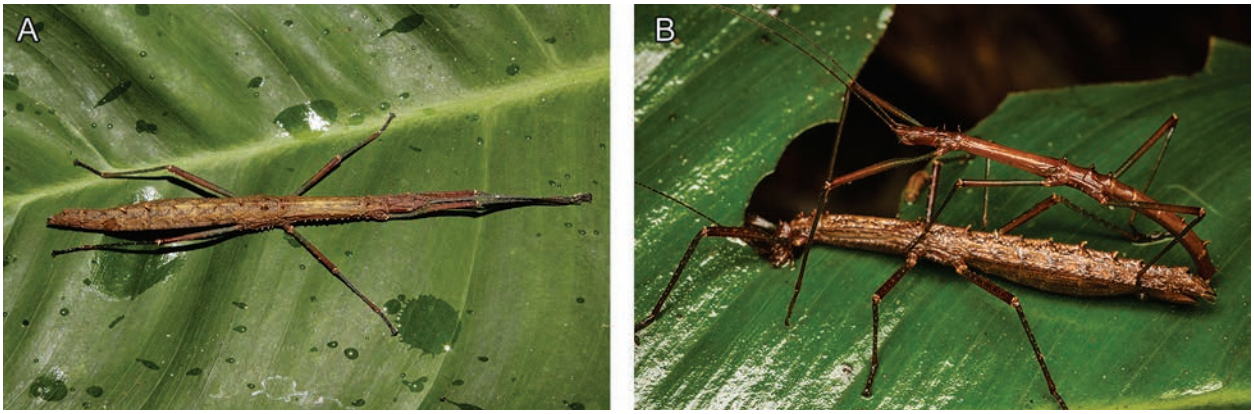


Figure 39. *Paraceroys quadrispinosus*. **A)** Live female. **B)** In copulation.

raised inner part with wide and raised margins. Micropylar cup on the margin of the micropylar plate (Fig. 37A). 6 eggs examined.

Measurements (mm). Length 4, height of capsule 1.5, width of capsule 1.5, diameter of operculum 0.8.

Distribution. Only known from Colombia, in the departments of Meta, Cundinamarca, Boyacá and Nariño (Conle et al. 2011, Gutiérrez and Bacca 2014).

Specimens and eggs examined. 3 males and 1 female: 2♂ 4°37′13″N 74°18′47″W 2557 m. 31 May 2021, 1♀ 4°36′57″N 74°18′44″W 2197 m. 31 May 2021 (CAUD).

Discussion

Studies on stick insects in Colombia are scarce and not very detailed. However, as a result of the contributions of Conle et al. (2011), Pineda and Ramírez (2005), Gutiérrez and Bacca (2014), and the papers published by Murcia et al. (2017, 2019, 2020) in recent years, 80 new species have been added and described for the country (Brock et al. 2022), including the new species here described. Colombia has a high representation of the order Phasmatodea, is the second country with more species (184 species) of stick insects in America, only surpassed by Brazil with 219 species (Brock et al. 2022; Heleodoro and Rafael 2022).

The Chicaque Natural Park is located on the slopes of the Eastern Andes and has a complex topography with an altitude gradient that goes from 2000 to 2700 m, allowing good conditions for montane biodiversity (Fig. 40). Andean species are the least studied, so few species are known in high mountain and paramo areas (Murcia et al. 2019). In the Chicaque Natural Park and areas of influence, few studies have been carried out on arthropods, including the descriptions of new species of Hemiptera (Castro-Huertas and Forero 2017), Lepidoptera (Erebidae, Geometridae, Megalopygidae, Noctuidae, Saturniidae, Sphingidae; Hernández 2019), Coleoptera (Ramírez-Salamanca et al. 2020), Orthoptera (Cadena-Castañeda and García 2012), Phasmatodea (Murcia et al. 2019), and Opiliones (Lombana 2018). Regarding the vegetation of the Chicaque Natural Park, Rivera and Córdoba (1998) published a study that shows a high species richness, providing a greater understanding of the flora found in the park.

The genus *Libethra* is an enigmatic group with numerous revisions. It is considered polymorphic due to the variations in its sculpture and ornamentation. Besides, its intraspecific delimitation is very complex due to the variability showed in females of most species (Gutiérrez-Valencia et al. 2017). Many species are only known from a single-sex specimen's description (Conle et al. 2011). For Colombia, *L. rabdota* is distributed in the three mountain ranges. However, it is a wingless species with little dispersal capacity. Therefore, more specimens from different localities are needed to investigate its intraspecific limits. *Ramandeun* **new genus** is placed in Diapheromerini, the most diverse tribe of Diapheromrinae with 303 species in 35 genera (Brock et al. 2022). Therefore, the description of new species of *Ramandeun* **new genus** will provide new localities to understand the distribution pattern of this new genus.

Figure 40. Common landscapes of Chicaque National Park. **A)** Colonial trail in the upper area of the park 2540 m. **B)** Trail in the lower area of the park 2227 m. **C)** View of the park at 2400m. **D)** View of the highest area of the park 2643 m.

Atratomorpha jorgei **new species** is very similar to *A. atrata*, recorded only from its type locality, North of the Andes in the Magdalena region, in the Sierra Nevada de Santa Marta above 2500 m (Hebard 1919, Conle et al. 2011). This new species is found on the eastern mountain range between 2300 and 2500 m. Since the two species are wingless and inhabit high mountains, the distance from the north of the Andes to the center of the eastern mountain range (which are separated by the depression of the Cesar and Ranchería river valleys) is a sufficient geographic barrier for the divergence between these two species and the others described for *Atratomorpha*.

We consider *Nubilophasma* **new genus**, to be morphologically similar to *Ignacia* from Pseudophasmatini. However, features here presented as distinctly longer mesonotum than pronotum, absence of spiniform anal segment processes, and lack of the prominent sickle-shaped prolongations of the costal margin of the tegmina are diagnostic for separating *Nubilophasma* **new genus** from *Ignacia*.

The eggs of stick insects are of significant taxonomic value, as they often have a morphology that vary from species to species. In this study, we described the eggs of *L. rabdota* and *L. inchoata*, which are really similar if the capitulum is missing. Additional observations show that these species go down to the ground where they bury their eggs in the rearing terrariums (pers. obs.). The eggs of *Atratomorpha jorgei* **new species** coincide with the general form and structure of the other species of Anisomorphini, such as those described here for *Nubilophasma chicaquensis* **new genus** and **new species** lacking a capitulum and being similar in size. For the previously unknown *P. quadrispinosus* eggs, we found that the egg has a smooth ventral zone; also, we observed that they prefer to adhere their eggs individually to substrate surfaces over the ventral adhesive area. The egg of *Isagoras franciscoverai* **new species** is very different from some already known eggs of the same genus as *Isagoras similis* Conle et al., 2020 as it does not present the surface covered by numerous setae throughout the capsule and the absence of a midline as observed in this species. With *Isagoras asperus* (Bellanger and Conle, 2013) it shares the capsule laterally compressed but differs markedly by its sculpturing with prominent carinae with granular areas between them, but to *I. asperus* the capsule is smooth and shiny. The micropylar plate is elongated and lanceolate located over the center of the capsule and not central and rounded as in *I. franciscoverai* **new species**.

The species studied in this research correspond to 5% of the 184 species reported in Colombia; this is a small sample, even though it is clear that most of the country is unexplored or poorly sampled (Conle et al. 2011; Murcia et al. 2019, 2020). It should be noted that a number of records and new taxa are included in this study, as well as the description of their eggs that provide valuable information on the ecology, and taxonomy. This information allows delimiting the taxa of this heterogeneous group of high mountain species. For future studies, it is suggested to extend the sampling methods in unexplored areas, such as the forest canopy, where have been observed large species of stick insects, but which could not be collected, so the number of species that inhabit this park can be even higher. In addition, more sampling on mosses is needed, since it was in this habitat where bryophytomorphic species such as *Mirophasma* cf *cirsium* live, of which only the adult female is known, its eggs remain unknown. Unfortunately, in this study, only two immature specimens were sampled. Future contributions from the stick insects of the Colombian Andes are expected to provide more information to broaden the understanding of the species that inhabit this complex mountain system, including new taxa, records, and the description of still unknown eggs. It is important to keep in mind that these insects are part of food webs serving as food for birds, small mammals, reptiles, and some arachnids (Waterhouse and Norris 1987); they also serve as hosts for parasitoid wasps of the subfamilies Amiseginae and Loboscelidiinae (Hymenoptera: Chrysididae) considered obligate parasites of their eggs and their geographic distribution overlaps worldwide with that of phasmids (Yamada et al. 2021).

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