

A new micropterous species of *Isagoras* Stål, 1875 (Insecta: Phasmatodea) from the Atlantic Forest of Brazil

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Abstract. A new species of the pseudophasmatid stick insect genus *Isagoras* Stål, 1875 is described based on a single male from the Atlantic Forest of Marliéria, Minas Gerais, Brazil. *Isagoras peregrinus* **sp. nov.** is one of the few micropterous species of *Isagoras*, from which it can be separated by morphological differences in the head, thorax and terminalia. The internal male genitalia of the new species is also illustrated and described. Furthermore, I synonymize *Isagoras franciscoveiai* Murcia & Cadena-Castañeda, 2023 **syn. nov.** under *Isagoras pygmaeus* (Redtenbacher, 1906), which is only known from Bogotá, Colombia.

Keywords. Pseudophasmatidae; Xerosomatinae; Prexaspini; Phasmida.

INTRODUCTION

Stick insects are large nocturnal herbivores, notable for their specialized morphology of an elongated body, often adapted to camouflaging (Bradler & Buckley, 2018). In the Neotropics, several species, especially winged ones, belong to the family Pseudophasmatidae. The family constitutes a large portion of the New-World endemic Occidophasmata clade (Simon *et al.*, 2019). Among various genera of this family, *Isagoras* Stål, 1875 comprises 34 species of medium-sized, elongated stick insects, exhibiting a cryptic coloration enabling remarkable camouflage in the forests they inhabit. Most species are brachypterous to fully winged, while only three are micropterous (Brock *et al.*, 2024). Micropterous species have been mistakenly referred to as apterous (*e.g.*, Conle *et al.*, 2020; Murcia & Cadena-Castañeda, 2023), although they have very small, scale-like wings that do not extend to the dorsal surface of the thorax. The genus occurs in South America, with 15 species recorded in Brazil, almost half of the valid species it contains.

As for several stick insects, the current configuration of the genus is problematic. The type species, and first species of the genus to be described, *Isagoras obscurum* (Guérin-Ménéville, 1838), is known from Bahia state in Brazil, and its type material was not specified in the original description. Twenty-nine species of the genus, *i.e.*, almost 90% of the species, were described in the last century

or earlier, when taxonomic standards, now considered fundamental for proper research, were not established. Furthermore, the genus contains very similar species that require a detailed characterization to be differentiated (Conle *et al.*, 2020). This resulted in most *Isagoras* species being poorly defined and with potential synonyms to be discovered, an issue that can only be resolved through a thorough revision of the entire genus. At least, many species have a somewhat precise type-locality that will facilitate a revision, which is not the case for numerous other phasmid species (Brock *et al.*, 2024).

However, there are a few cases of unique representatives that can be easily distinguished from others in the genus, enabling a safe description of new species (Conle *et al.*, 2020). For example, for the few micropterous species of *Isagoras*, their wing condition allows an easy diagnosis from the majority of species, which possess larger wings at least covering the dorsal surface of the median segment (Conle *et al.*, 2020). These micropterous species are *Isagoras molorchus* (Westwood, 1859), *Isagoras pygmaeus* (Redtenbacher, 1906) and *Isagoras franciscoveiai* Murcia & Cadena-Castañeda 2023, all occurring in Colombia.

Here, I present a further remarkable species of *Isagoras* that can be differentiated from almost all other species in the genus by its microptery, presenting very small, scale-like wings. *Isagoras peregrinus* **sp. nov.** inhabits the Atlantic Forest of Brazil, in Marliéria, Minas Gerais state. Further-

more, I show that two of the other micropterous *Isagoras* represent the same taxon, and therefore I synonymize *I. franciscoverai* under *I. pygmaeus*.

MATERIAL AND METHODS

The type material of the new species is housed in the entomological collection of the Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (MZUSP), while type material examined for *Isagoras pygmaeus* is housed in the Museum für Naturkunde der Humboldt-Universität, Berlin, Germany (MfN). Other species of *Isagoras* were examined through pictures of type material available in the Phasmida Species File (PSF) online platform (Brock *et al.*, 2024), as well as original descriptions and illustrations. Genitalia dissection, treatment and terminology followed Ghirotto (2021). Measurements were taken with a digital calliper. The holotype of the new species was examined and photographed in detail under a Leica M205 C stereomicroscope. Photographs of live specimens were taken with a Samsung J7 Prime cellphone camera. Photographs of the habitus of the new species and of *I. pygmaeus* were taken with a Canon EOS 70D camera equipped with a Canon 100 mm Macro lens. The figure for *I. pygmaeus* and *I. franciscoverai*

was made using pictures available in the PSF and pictures adapted from Murcia & Cadena-Castañeda (2023). Figures were edited with Adobe Photoshop 2022.

RESULTS

Phasmatodea
Family Pseudophasmatidae
Genus *Isagoras* Stål, 1875
***Isagoras pygmaeus* (Redtenbacher, 1906)**
(Fig. 1)

Canuleius pygmaeus Redtenbacher, 1906: 69.

Isagoras franciscoverai Murcia & Cadena-Castañeda, 2023 **syn. nov.**

Canuleius pygmaeus – Zompro, 2004: 178. Zompro, 2005: 277. Otte & Brock, 2005: 82.

Planudes pygmaeus – Conle, Hennemann & Gutiérrez, 2011: 45, 331; Heleodoro & Rafael, 2018: 600.

Isagoras pygmaeus – Conle, Hennemann, Bellanger, Lelong, Jourdan & Valero, 2020: 55; Brock & Büscher, 2022: 569; Murcia & Cadena-Castañeda, 2023: 34.

Type material: Holotype of *I. pygmaeus*: male, MfN 4013, Colombia, Bogotá. Lindig. Type, Redtenb., Brunner det.

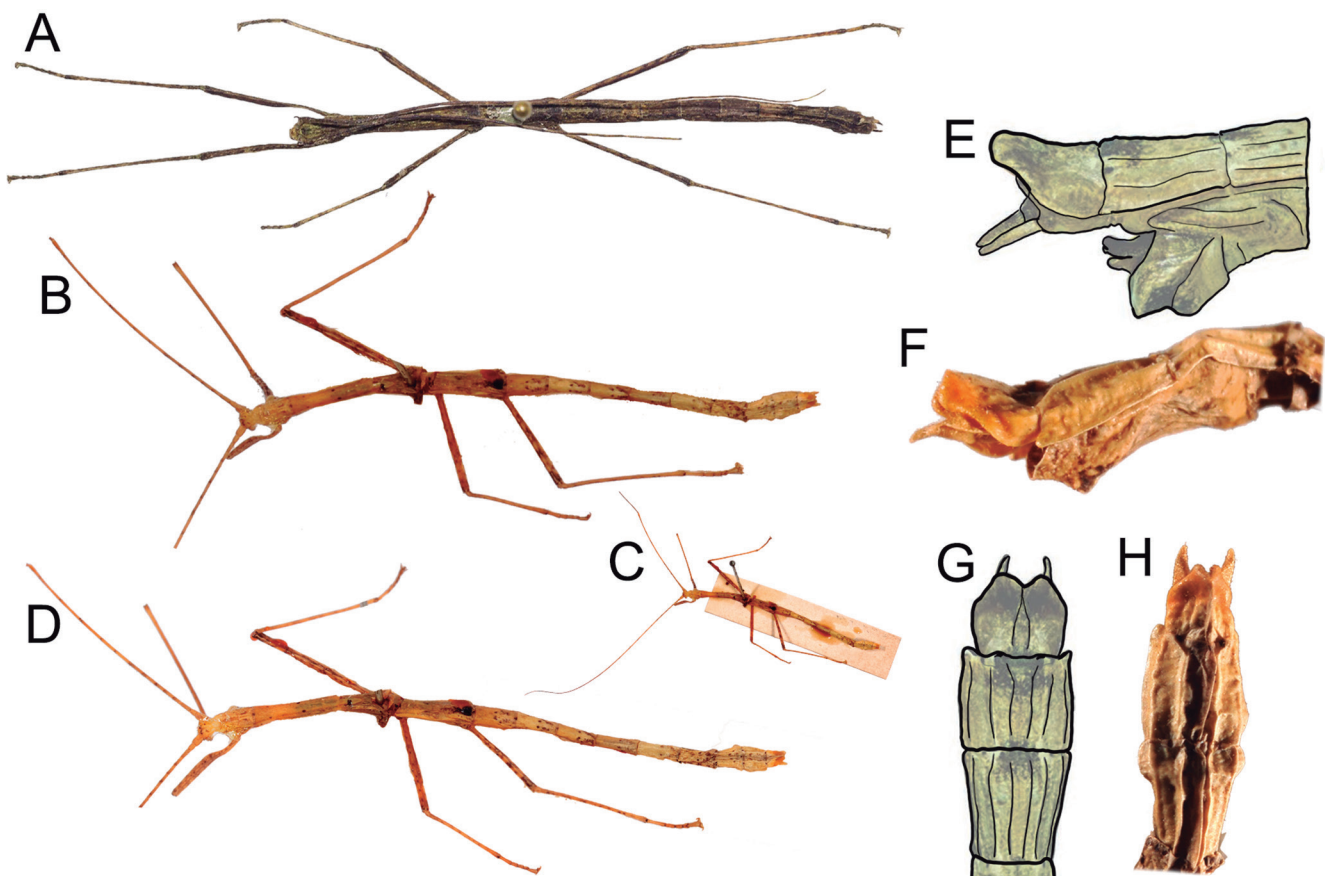


Figure 1. *Isagoras pygmaeus* (Redtenbacher, 1906). A, E, G. Holotype male of *Isagoras franciscoverai* Murcia & Cadena-Castañeda, 2023 **syn. nov.**, dorsal habitus (A), terminalia in lateral (E) and dorsal (G) views. B-D, F, H. Holotype male of *Isagoras pygmaeus*, dorsal view (B), state of the type glued to a paperboard (C), dorsolateral view (D), terminalia in lateral (F) and dorsal (H) views. The paperboard to which the specimen is glued to was digitally erased for B and D for better view. A, E, G. Adapted from Murcia & Cadena-Castañeda (2023). B-D, F, H. Copyright MfN, Berlin. Images not to scale.

(examined). Holotype of *I. franciscoverai*: male, CAUD, Colombia, Cundinamarca, San Antonio de Tequendama, Chicaque Natural Park. 04°36'39"N, 74°18'34"W. 2,267 m. 04.x.2020 (analysed through pictures and original description). Paratypes of *I. franciscoverai*: 3 females, CAUD same data as holotype; 2 males, CAUD, Colombia, Cundinamarca, San Antonio de Tequendama, Chicaque Natural Park. 04°36'48"N, 74°18'38"W. 2,202 m. 22.xi.2012 (analysed through pictures and original description).

Remarks: *Isagoras pygmaeus* was described from a single male from Bogotá, Colombia, which is glued to a paperboard, wrinkled and severed at the thorax (Fig. 1B-D, F, H). Murcia & Cadena-Castañeda (2023) described *Isagoras franciscoverai* **syn. nov.** (Fig. 1A, E, G) also from Bogotá, Colombia, based on males and females, differentiating *I. pygmaeus* from it by "its fragile appearance, and in having a tectiform and carinate anal segment". However, *I. pygmaeus* in fact is not "fragile", i.e., not slenderer than *I. franciscoverai* **syn. nov.**, and the tectiform aspect of the tergum X is actually typical for species of *Isagoras* and is also present in the type material of *I. franciscoverai* **syn. nov.** (Fig. 1E-H). The poor, wrinkled condition of the holotype of *I. pygmaeus* is commonplace for old type material of Phasmatodea. This condition is known to alter the specimen's texture and shape, making comparison with a well-preserved specimen (such as the types of *I. franciscoverai* **syn. nov.**) less accurate. Therefore, such comparisons must be done with care (Conle *et al.*, 2020). In the wrinkled type, the tectiform aspect of the tergum X gets stronger as the tergum is flattened, but the morphology of terga VIII-X matches perfectly between these representatives (Fig. 1E-H). Regarding the supposedly fragile aspect of *I. pygmaeus*, this mistake could be based on the pictures of type material available on the PSF platform. The closest picture showing the dorsal habitus of the specimen (Fig. 1D) is in fact angled and not fully dorsal, as another picture reveals (Fig. 1B-C), further agreeing with the habitus of the type material of *I. franciscoverai* **syn. nov.** (Fig. 1A).

***Isagoras peregrinus* sp. nov.**
(Figs. 2-7)

Type material: Holotype: male, MZUSP 2027, Brazil, Minas Gerais, Marliéria, próximo ao Parque Estadual do Rio Doce. V.M. Ghirotto, A.M. Gomes & S.H. Kamazuka col., 29.x.2021, V0634.

Etymology: From the Latin "*peregrinus*" meaning "wanderer" in reference to its extreme reduction of wings making it a wanderer species contrasting with most and more commonly found flying species of the genus.

Diagnosis: This species can be differentiated from most *Isagoras* species by the microptery, being almost apterous, presenting only very small scale-like wings; by the more elongated head (1.6× longer than wide), with less prominent eyes; and the elongate and larger tergum X in relation to preceding segments (1.5× longer than wide when pinned, 2× longer than high). These latter characteristics can be used to separate the new species from winged *Isagoras* that also occur in the Atlantic Forest, such as *Isagoras melzeri* (Piza, 1937) or *Isagoras perillus* (Stål, 1875), the male presenting head 1.3-1.5× longer than wide, and tergum X 1.1-1.4× longer than wide when pinned and 1.1-1.2× longer than high. *Isagoras peregrinus* **sp. nov.** differs from the also micropterous *Isagoras pygmaeus* (Redtenbacher, 1906) from Colombia by the absence of thoracic granulations, the longer median segment, which is longer than the metanotum (while it is shorter than the metanotum in *I. pygmaeus*), by presenting thinner legs, a shorter and less conical cerci, shorter tergum IX and more elongate tergum X.

Remarks: *Isagoras molorchus* (Westwood, 1859) is only known by a micropterous female from Colombia, and the unknown male of this species could also be micropterous. Males and females of *Isagoras* species share several similar features including granulation pattern and body proportions and mostly differ in robustness and wing



Figure 2. *Isagoras peregrinus* **sp. nov.**, holotype male, dorsal habitus (A) and body in dorsal (B), lateral (C) and ventral (D) views. Scale bars: 5 mm.

development (Conle *et al.*, 2020). Due to the very shortened head, the presence of conspicuous granulations on the body and the lateral expansions on the segment VI presented by *I. molorchus*, as well as the very distant occurrence area, *Isagoras peregrinus* **sp. nov.** can be safely disregarded as a possible male for *I. molorchus*.

Description: Head (Figs. 2-3): Elongate, 1.6× longer than wide, gently compressed dorsoventrally (Fig. 3A, B). Smooth, with very few small granules dorsally in the anterior portion. Vertex flat, anterior area slightly raised between the eyes, occiput round, prominent (Fig. 3A, B). Frontal suture marked, black, rounded. Scapus *ca.* 1.4× longer than wide, slightly compressed dorsoventrally, pedicellus barrel-shaped and *ca.* 0.7× the length of sca-

pus. Antennae with at least 18 segments. Gula short, rectangular (Fig. 3C). **Thorax (Figs. 2-3, 4A-C, 7A-D):** Generally smooth, dorsally and laterally with very few, small granules mostly bearing setae, denser ventrally. Pronotum 1.75× longer than wide, mesonotum 8.6× longer than wide (Fig. 2A), metanotum 1.7× longer than wide and 0.7× the length of the median segment, metathorax 3.7× longer than wide (Fig. 4A). Pronotum with concave lateral edges, sulcus marked, transversal sulci almost straight (Fig. 3A). Prothoracic gland openings large, delimited by carinae, with a shallow sulcus posteriorly. Procoxopleurite approximately elliptical, inferior edge almost straight; paranota elongate (Fig. 3B). Probasisternum slightly tapering towards anterior which is more than half as wide as the posterior width, with a short medial sulcus.

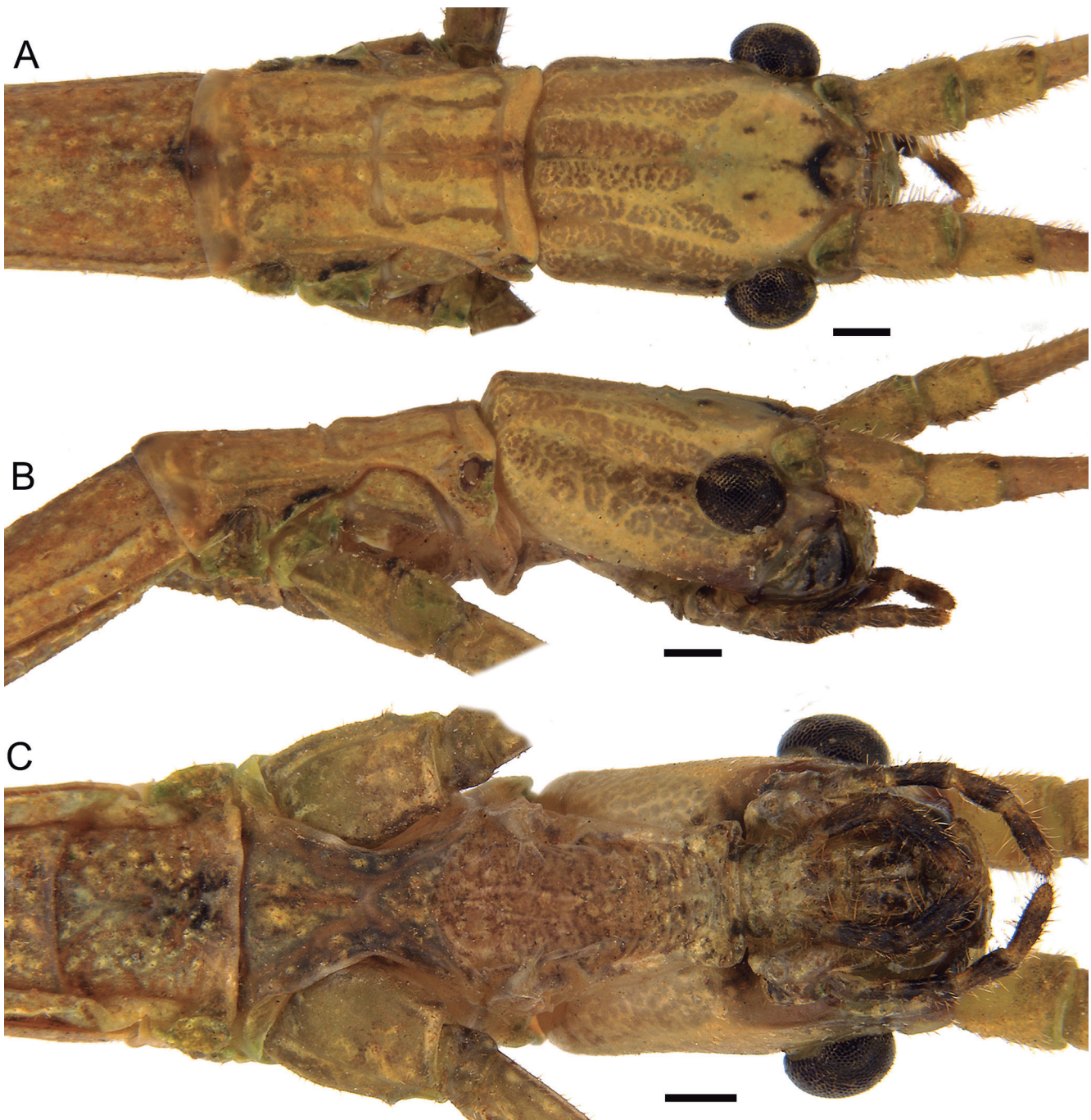


Figure 3. *Isagoras peregrinus* **sp. nov.**, holotype male, head and prothorax in dorsal (A), lateral (B) and ventral (C) views. Scale bars: 0.5 mm.

Profurcasternite quadrate, with a triangular depression from posterior edge to the center continuously to the furcasternal pit; furcasternal pit round, rather small (Fig. 3C). Mesepimeron about as long as wide, mesocoxopleurite round (Fig. 4B). Metepimeron elongate, metacoxopleurite small. Wings very small, scale-like; forewings drop-shaped, posterior edge round; hindwings subrectangular, elongate (Fig. 4C). **Legs (Figs. 2, 4D, 7A-D):** Hind legs not surpassing abdomen, slightly shorter than fore legs, mid legs shorter than hindlegs (Fig. 2). All five carinae elevated and marked by rows of short setae. Profemoral basal curvature present. Profemur slightly laterally flattened. Probasitarsi and metabasitarsi as long as the fol-

lowing four tarsomeres combined; mesobasitarsi longer than following three tarsomeres combined but shorter than four (Fig. 4D). Basitarsi bearing conical, spine-like setae mainly ventrally, with a small tuft basally (Fig. 4D). Area apicalis delimited by a somewhat wide sulcus and bearing small tuft of straight black setae (Fig. 4D). Euplantulae slightly bilobed, well developed in all tarsomeres (Fig. 4D). **Abdomen (Figs. 4A-B, 5, 7):** Bearing short setae and very few small granules. Median segment 1.4× longer than metanotum. All terga except IX longer than wide, IX as long as wide. Tergum X bearing a medial longitudinal carinae, around as long as wide in life (Fig. 7E) to 1.5× longer than wide when flattened after drying, and 2× longer



Figure 4. *Isagoras peregrinus* sp. nov., holotype male, thorax in dorsal (A) and lateral (B-C) views, and right tarsus in ventral view (D). Wings highlighted in green (C). Scale bars: 0.5 mm.

than high (Fig. 5A, 7F). Posterior margin of tergum X truncated, straight in dorsal view but strongly v-shaped in caudal view, tectiform (Fig. 5A, D-E). In lateral view, tergum X with a slight constriction post-medially; postero-inferior edge approximately right-angled (Fig. 5B). Epiproct very small and located between paraprocts and thorn pads, not seen unless thorn pads are spread out (Fig. 5E). Thorn pads very well developed, somewhat peg-like composed of two triangular plates on each side with 26-28 conical,

incurved teeth regularly distributed (Fig. 5E); the thorn pads face each other due to the tectiform aspect of the tergum X (Fig. 5D). Paraprocts somewhat wide, separated only at the apex, with a deep sulcus separating both paraprocts through almost all length (Fig. 5D). Cerci slightly tapering towards posterior, apex round, very slightly incurved, shorter than half the length of tergum X, almost hidden by tergum X in dorsal view (Fig. 5). Vomer extremely reduced, shown as a small, very wide and short bump

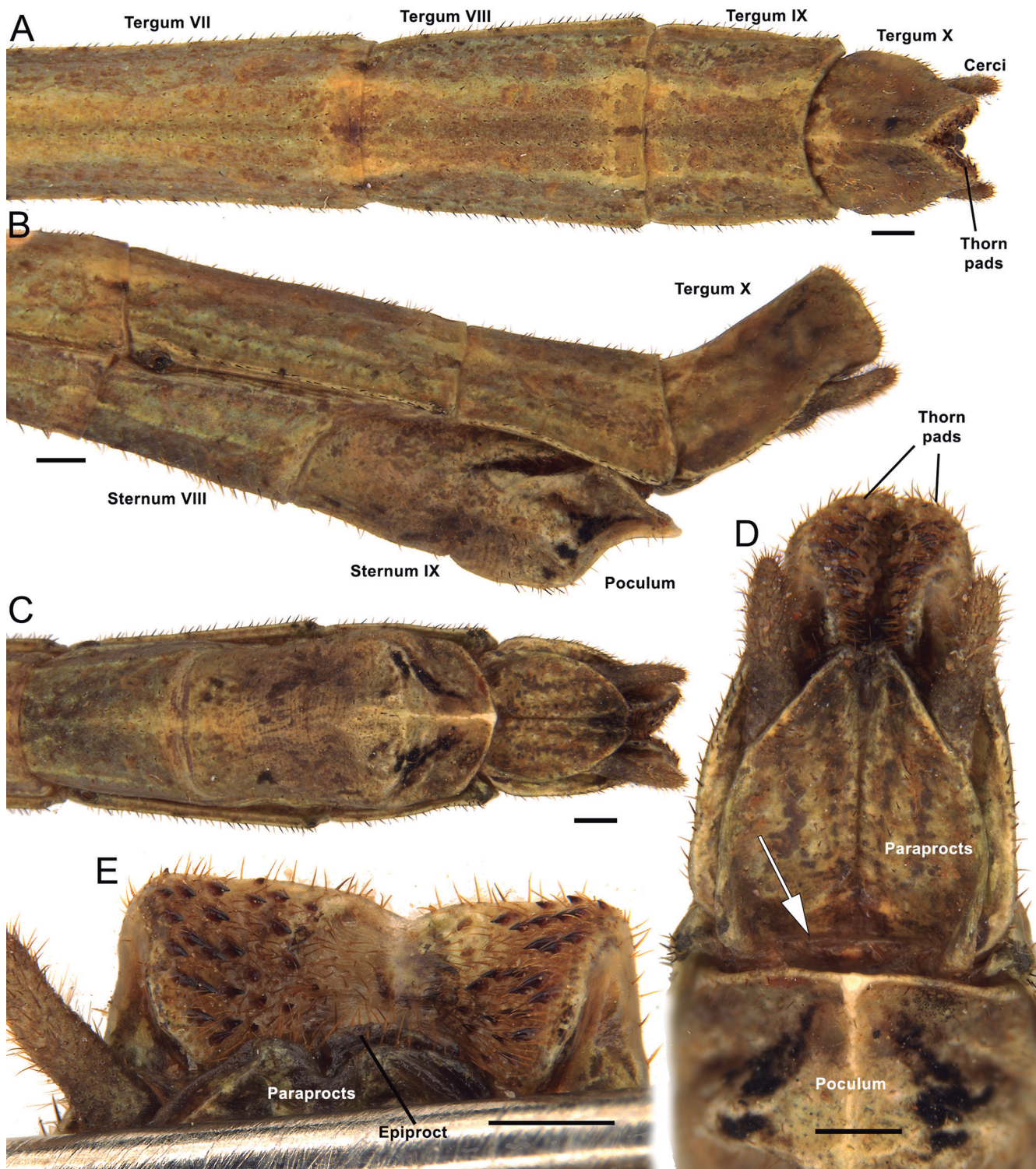


Figure 5. *Isagoras peregrinus* sp. nov., holotype male, terminalia in dorsal (A), lateral (B) and ventral (C) views, tergum X in ventral view (D) and thorn pads in ventral view (E). Arrow points to the reduced vomer. Scale bars: 0.5 mm.

(Fig. 5D: arrow). Sternum IX somewhat elongated, longer than tergum IX or tergum X (Fig. 5B); anterior portion similar to preceding segments; poculum mid-sized, only slightly higher than anterior portion of sternum IX, postero-inferior edge round, postero-superior edge elongated and projected forming a lip (Fig. 5B); ventrally with a medial longitudinal keel in the posterior surface (Fig. 5C-D). **Male genitalia (Fig. 6):** Dorsal sclerite J-shaped, long and thin, pointing to the left (Fig. 6B), basally with two large

branches (Fig. 6D). Dorsal lobe somewhat round with a conical projection (Fig. 6A). Ventral lobe with a posterior-most round lobule (Fig. 6E), a very large, cylindrical and projected lobule more basally (Fig. 6A, C-G), and a smaller, round basal lobule bearing an elongated, finger-like projection (Fig. 6E). Right basal pouch round, somewhat flattened and also bearing an elongated, finger-like projection and a small bump (Fig. 6E), that interlocks with the finger-like projection of the ventral lobe (Fig. 6A).

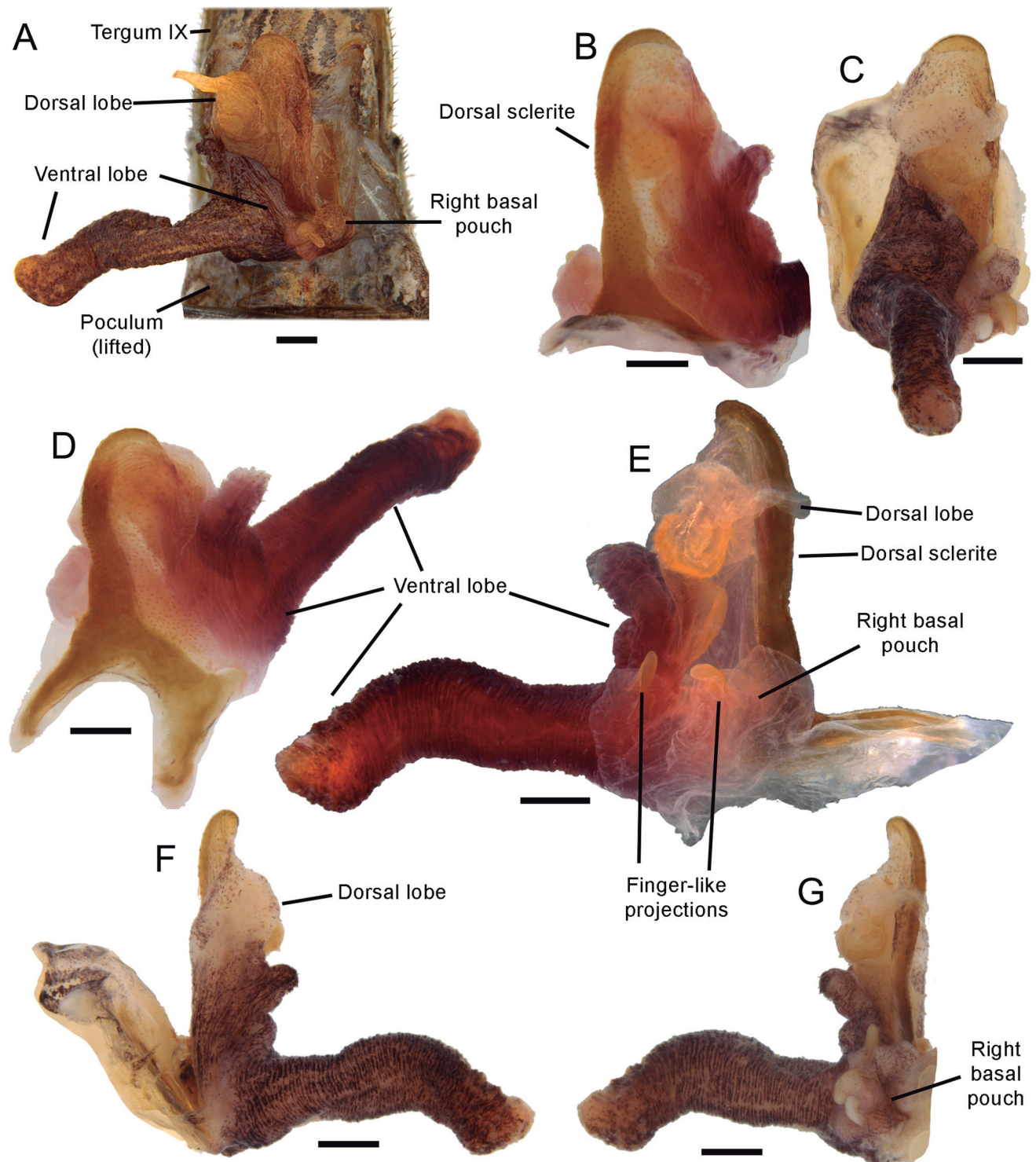


Figure 6. *Isagoras peregrinus* sp. nov., holotype male, genitalia in ventral (A, C), dorsal (B, D), right side (E, G) and left side (F) views. Genitalia still attached to the body (A), dissected and treated with KOH (B, D-E), and dissected and untreated (C, F-G). Scale bars: 0.5 mm.

Measurements (in mm): Body (without cerci) 61.6, head 3.2, antennae at least 39, pronotum 2.6, mesonotum 12.6, metanotum 3.1, median segment 4.3, abdomen (excluding median segment) 35.8, cercus 0.7, profemur 14.2, protibia 15.2, protarsus 6.0, mesofemur 10.0, mesotibia 9.7, mesotarsus 4.7, metafemur 12.8, metatibia 14.2, metatarsus 6.0.

Biology: The holotype was found wandering at night at around 50 cm above ground. In captivity, it ate *Malvaviscus arboreus* Cav. (Malvaceae) and *Eugenia uniflora* L. (Myrtaceae).

Distribution: Known only from the type locality, Marliéria, Minas Gerais, Brazil.

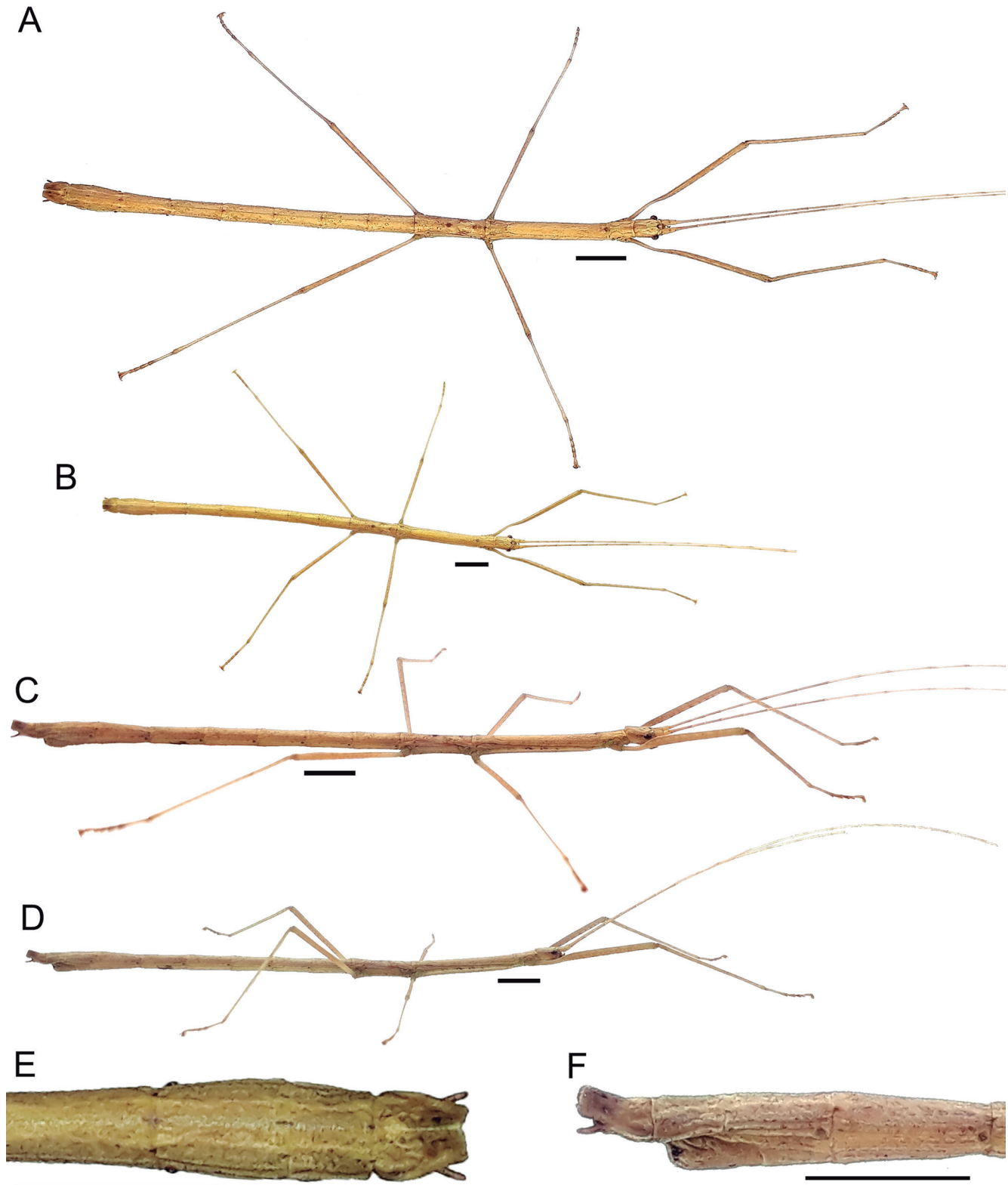


Figure 7. *Isagoras peregrinus* sp. nov., holotype male, live habitus, full body in dorsal (A, B) and lateral (C, D) views, and terminalia in dorsal (E) and lateral (F) views. Scale bars: 5 mm.

DISCUSSION

This is a small contribution to the taxonomy of the genus *Isagoras*, which still presents a chaotic taxonomic situation (Conle *et al.*, 2011). Providing a better characterization for existing and new species is a crucial step towards resolving this genus until a thorough revision is made. The male genitalia of the new species are fairly similar to those of *Isagoras melzeri* (Piza, 1937) (Chiquetto-Machado & Cancellato, 2021: Fig. 10G-H) differing in the shape of the dorsal sclerite and size of the ventral lobule but not in the general composition of the genitalia. The genitalia of *Isagoras* seem to be characterized by a thin, elongated dorsal sclerite with a well-developed base, presence of finger-like projections, a basal pouch, and a very large, cylindrical lobule of the ventral lobe. The new species is the first record of a micropterous species of the genus for the Atlantic Forest and illustrates the lack of sampling for phasmids in South America; it is expected that many new species await finding. The extreme reduction of wings (microptery) in *Isagoras* seems to be related to an elongation of the body, as all three micropterous species are fairly slenderer than its brachypterous or macropterous congeners (Conle *et al.*, 2011).

CONFLICTS OF INTEREST: Author declare there are no conflicts of interest.

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