

Review of the tribe Amorphopini (Orthoptera: Tetrigidae: Metrodorinae): Pygmy moss-lichen tetrigids from the Amazon rainforest

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Abstract

The tribe Amorphopini Günther, 1939 is reviewed. It consists of two genera: *Amorphopus* Seville, 1838 and *Eomorphopus* Hancock, 1907 with three Neotropical species: *Amorphopus notabilis* Serville, 1838, *Eomorphopus antennatus* (Bolívar, 1887), and *Eomorphopus granulatus* Hancock, 1907. Two species are transferred from *Amorphopus* to the genera *Metrodora* Bolívar, 1887 and *Crimisus* Bolívar, 1887, and two new combinations are proposed: *Metrodora gibbosula* (Walker, 1871), **comb. nov.** and *Crimisus humeralis* (Walker, 1871), **comb. nov.** New synonyms are proposed: *Amorphopus notabilis* Serville, 1838 = *Amorphopus griseus* Bolívar, 1887, **syn. nov.**; *Metrodora gibbosula* (Walker, 1871) = *Platyttettix reticulatus* Hancock, 1906, **syn. nov.**; and *Crimisus humeralis* (Walker, 1871) = *Allotettix bolivianus* Brunner, 1913, **syn. nov.** Neotypes of *Amorphopus notabilis* and *Eomorphopus antennatus* as well as the lectotype of *E. granulatus* are designated. The description of *Amorphopus testudo* Saussure, 1861 is based on an immature specimen and we considered it as *nomen dubius* and the type depository of *Eomorphopus purpurascens* is unknown so we considered it, too, as *nomen dubius*. The tribe Amorphopini and all included taxa were redescribed and illustrated. A key to the genera and species is provided. Data on distribution, behavior, camouflage with lichens, polychromy, as well as ecological aspects of the species are reported.

Keywords

behavior, camouflage, chromatic variation, lectotype, neotype, redescription

Introduction

Metrodorinae is a cosmopolitan subfamily currently composed of five tribes (Cleostratini Bolívar, 1887; Amorphopini Günther, 1939; Clinophaestini Storozhenko, 2013; Miriatriini Cadena-Castañeda & Cardona-Granda, 2015; and Ophiotettigini Tumbrinck & Skejo, 2017) and about 70 genera of uncertain placement (Cigliano et al. 2019). The tribe Amorphopini Günther, 1939 [*sensu* Cadena-Castañeda and Cardona-Granda (2015)] is exclusive to the New World and

includes three genera: *Amorphopus* Serville, 1838 and *Eomorphopus* Hancock, 1907 from the northern region of South America (Cigliano et al. 2019), and *Platythorus* Morse, 1900 from Central America (Brunner et al. 1900–1909, Cigliano et al. 2019). Among the Amorphopini, *Amorphopus* is morphologically similar to *Eomorphopus* but can be easily distinguished by the enlarged fore and mid-legs (Buzzetti and Devriese 2007, Cadena-Castañeda and Cardona-Granda 2015).

Amorphopus was described by Serville (1838) and it is distinguished by its flattened (depressed) body dorsoventrally, fore and middle femur strongly carinate, shield-like shape, and ovoid tegmina (Hancock 1907, Günther 1939, Cadena-Castañeda and Cardona-Granda 2015). Currently *Amorphopus* includes five species: *A. notabilis* Serville, 1838 (type species); *A. testudo* Saussure, 1861; *A. gibbosulus* Walker, 1871; *A. humeralis* (Walker, 1871); and *A. griseus* Bolívar, 1887 (Cigliano et al. 2019).

Eomorphopus was defined by Hancock (1907) and was characterized by a strongly depressed body, granulose surface, oblique face, vertex truncated anteriorly, frontal costa compresso-elevated, moderately sulcate, between the antennae; pronotum anteriorly truncated and posteriorly acuminate, tegmina oval sublanceolate; fore femur strongly carinated (but not shield-like as in some *Amorphopus*), with the superior carinae often bi- or tri-undulate and inferior carina with only one lobe, middle femur clypeate and foliaceous (see Hancock 1907, Cadena-Castañeda and Cardona-Granda 2015). Similarly, to *Amorphopus*, the genus *Eomorphopus* is distributed only within South America and includes three species: *E. purpurascens* (Olivier, 1791), *E. antennatus* (Bolívar, 1887), and *E. granulatus* Hancock, 1907 (Cigliano et al. 2019). The monotypic genus *Platythorus* was described by Morse (1900) and is found in Nicaragua and Costa Rica. *Platythorus* lacks wings, the body is not flattened as in the other genera and, unlike *Amorphopus* or *Eomorphopus*, it lacks expanded or carinate fore or mid femora (Hancock 1907, Cadena-Castañeda and Cardona-Granda 2015).

In the present study, we review the tribe Amorphopini and its species, study the status of the genera and species and their ecological associations and behaviors, and provide an updated identification key. Additionally, we also present updated distribution maps for all known Amorphopini species. This paper is part of the cooperative study of Neotropical Tetrigidae led by Daniela Santos Martins Silva and Oscar J. Cadena-Castañeda.

Material and methods

Specimen preparation.—The studied specimens were deposited in the following institutions: Colección de Artrópodos y otros Invertebrados de la Universidad Distrital Francisco José de Caldas, Bogotá, Colombia (CAUD), Academy of Natural Sciences, Philadelphia, Pennsylvania, USA (ANSP), Naturhistoriska Riksmuseet, Sweden, Stockholm (NHRS), The Natural History Museum [formerly British Museum (Natural History)], London, England (BMNH), Naturhistorisches Museum Wien, Vienna, Austria (NMW), Museo Natural de Ciencias Naturales, Madrid, Spain (MNCN), and Coleção de Invertebrados do Instituto Nacional de Pesquisas da Amazônia, Manaus, Brazil (INPA).

Specimen photos were taken with a Leica DFC295 attached to a stereomicroscope M205. The photographs of ANSP types were taken in a photo lightbox with a Canon EOS T3i digital camera equipped with a EF 100mm f/2.8 L macro lens. Photographs of living specimens were taken using a Nikon D7100 digital camera, with a 60 mm 2: 8 lens. The illustrations were made using Adobe Illustrator CS6 and Adobe Photoshop CS6.

Terminology and measurements follow Devriese (1996) and Tumbrinck (2014). The measures that most discriminated Amorphopini species were the following: Body length from the tip of the fastigium projection to the posterior tip of the pronotum (CFP); pronotum length (PL); pronotum lateral lobes maximal width (PLB); fore femur length (FF); fore tibia length (FL); middle femur length (MFL); middle tibia length (MTL); hind femur length (HL); hind femur maximal width (HW); and hind tibia length (HL).

Maps and distribution data.—Maps were drawn with Simplemapp (Shorthouse 2010). Data included in the maps were collected from the studied specimens and from visits to the different collections previously mentioned, and maps are intended to correct erroneous or doubtful records in the literature. Distribution data of photographed specimens were also recorded and identifications could be reliably made from photographs.

Results and discussion

Tribe Amorphopini Günther, 1939

Taxa included.—The type genus *Amorphopus* Serville, 1838 and *Eomorphopus* Hancock, 1907.

Diagnosis.—Small to medium size, robust insects with the body depressed dorso-ventrally (Figs 1A, 2A, 6A, 8A, 9A). Vertex does not project between the eyes, slightly tapering, truncate anteriorly; the median carina is short and distinct, the lateral carinae slightly more elevated than the median one, fossulae and supra-ocular tubercle absent. Facial carinae significantly pronounced between the antennae, with variable width from very narrow to form a scutellum. Eyes globose in lateral and frontal view. Antennae of moderate length with 15 filiform segments, originating

at the mid-point frontal costa, lateral ocelli present between the eyes and the frontal costa bifurcated initially (Figs 1B, 2B, 6B, 8B, 9B). Tegmina and wings always present on the known genera (Figs 1C, 2C, 6C, 8C, 9C). Pronotum granulated and surpassing the abdomen apex, anterior margin truncated, lateral lobe projecting sideways, prozonal carina slightly developed, midline from mesozona to the apex. Fore femur carinated and middle femur strongly expanded (Figs 1E, 2E, 6E, 8E, 9E); dorsal and ventral margin of middle femur lobed or foliaceous (Figs 1F, 2F, 6F, 8F, 9F), hind femur with antegenicular tooth, transversal ridge (or “chevrons”) between the dorso and ventro external carinae, and transversal ridge between the dorsal margin of the hind femur and dorso-external carina.

Comments.—Amorphopini was erected as a tribe by Cadena-Castañeda and Cardona-Granda (2015) to contain three genera: *Amorphopus*, *Eomorphopus*, and *Platythorus*. This tribe was characterized by globose eyes in lateral view (Figs 1C, 2C, 6C, 8C, 9C); body strongly flattened (Figs 1A, 2A, 6A, 8A, 9A); fore femur carinated and middle femur strongly expanded; dorsal and ventral margin of middle femur lobed or foliaceous (Figs 1E, F, 2E, F, 6E, F, 8E, F, 9E, F); and body camouflage frequently resembling lichens or bryophytes (Fig. 3) (Cadena-Castañeda and Cardona-Granda 2015) since *Amorphopus* and *Eomorphopus* are found in humid environments such as rivers and lakes (Amédégnato and Devriese 2008). In addition to the previously mentioned characters, Amorphopini differs from the tribes established to date in Metrodorinae by lacking a prolonged vertex (which is common in Clinophaestini, Cleotrastini *sensu* Storozhenko 2016, and Miriatriini *sensu* Cadena-Castañeda and Cardona-Granda 2015), and by having filiform antennae. Clinophaestini and some Ophiotettigini, have widened antennal segments.

Platythorus is monotypic with only one female type, *Platythorus camurus* Morse, 1900, and occurs in Nicaragua and Costa Rica (Bruner et al. 1900–1909). This genus is easily distinguished from other Amorphopini by the lack of tegmina and wings and the middle femur that is not strongly expanded. This genus has morphology rather different from Amorphopini and is placed out of Amorphopini, as a Metrodorinae genus without tribal placement.

Distribution.—The Amorphopini species, as well as other species in South America, exhibit a very peculiar geographical distribution (see Silva et al. 2017, Cadena-Castañeda et al. 2019). There is a large area in the north region of South America (mainly Amazon Forest) where these genera are not known to occur (Figs 12–14). In addition, there is only one record for an *Eomorphopus* species that probably refers to the Atlantic Forest of Bahia State (Brazil), but Günther (1939) did not provide an exact location. *Eomorphopus* probably does occur in those areas, but its species haven't been sampled or identified due to limited zoological expeditions and taxonomic effort focused on tiny litter insects.

Key to genera and species of the tribe Amorphopini

- 1 Body moderately depressed (Figs 6A, D, 8A, D). Scutellum narrow (Figs 6B, 8B), only middle femora flattened (Figs 6F, 8F), the fore femur is carinated (Figs 6E, 8E), tegmina sublanceolate (Figs 6C, 8C)2
- Body strongly depressed (Figs 1A, D, 2A, D). Scutellum wide (Figs 1B, 2B), fore and middle femora flattened, foliaceous and clypeate (Fig. 1E, F), tegmina ovoid (Figs 1C, 2C)*Amorphopus notabilis* Serville, 1838

- 2 Mid-sized (♀ 19–19.5 mm, ♂ 18 mm). Apex of the lateral lobe of the pronotum (sideway projection) triangular shaped and moderately sharp (Figs 8D, 9D). Body granulose, prozona with rounded sculpturing..... *Eomorphopus antennatus* (Bolívar, 1887)
- Small sized (♀ 16.5–17.5 mm, ♂ 15–16 mm). Apex of the lateral lobe of the pronotum (sideway projection) rounded (Figs 4C, 5C, 6D). Body mostly smooth and slightly granulose, prozona without sculpturing..... *Eomorphopus granulatus* Hancock, 1907

***Amorphopus* Hancock, 1907**

Type species.—*Amorphopus notabilis* Serville, 1838.

Diagnosis.—Body strongly depressed dorsoventrally and minutely granulate (Figs 1A, 2A, 3). Eyes globose, not prominent; vertex anteriorly truncated; face very distinctly oblique; frontal costa with a wide scutellum between the lower part of the eyes, slightly compressed-elevated, sinuate below (Figs 1B, 2B). Lateral lobes of pronotum outwardly ampliate with both margins undulate. Tegmina oval and wings to the pronotum apex (Figs 1C, 2C). Legs short, fore and middle femora flattened, foliaceous and clypeate (Figs 1E, F, 2E, F), antegenicular tooth of the hind femur slightly developed, hind tibia very sparingly spinose, minutely serrulate; the first and third articles of the hind tarsi equal in length.

***Amorphopus notabilis* Serville, 1838**

Figs 1, 2, 3, 12

Neotype.—COLOMBIA • ♀; Amazonas, PNN Amacayacu; 03°44'19"S, 70°13'7"W; C. Rodríguez leg (CAUD).

Description.—**Head.** Not protruding from the body; face very distinctly oblique (Fig. 1B, C); antennae filiform with 15 segments, inserted below the eyes; vertex anteriorly truncated and equal in width to one of the eyes; frontal costa with a wide scutellum between the lower part of the eyes, slightly compressed-elevated, sinuate below; eyes globose, not prominent; posterior ocelli placed between the inferior part of the eyes (Fig. 1B). **Thorax.** Meso-pleura expanding to the sides and covering the coxae in dorsal view. **Pronotum.** Macropronotal and strongly depressed dorso-ventrally. Lateral view. Median carina slightly undulated on prozona and extended to pronotal disc apex, prozonal carina and humero-apical carina visible, reaching the sulci; tegminal and ventral sinus present; length of the infrascapular area mid-sized covering to first abdominal tergite; humeral angles obtuse (Fig. 1A). Dorsal view. anterior and posterior margins truncated, also the first one undulated; prozonal carina visible; lateral lobes of pronotum ampliate and projected sideways, with the margins undulated and with a blunt spine (Fig. 1D). **Wings.** Tegmina and hind wings developed; tegmina ovoid, hind wings as long as the pronotum apex, opaque with the apical veins between the C and Sc yellowish. **Legs.** Fore and middle femora rectangular, longer than wide and with margins undulated (Fig. 1E, F), fore and middle tibiae narrow and short. Hind femur with the pre-genicular tooth slightly developed, small foliose plate present between the ventro and dorso-external carinae (Fig. 1D), hind tibia narrow and with few spines on the meso-distal portion. **Abdomen.** Narrow and slim, subgenital plate with the distal edge wavy with a rounded prolongation in the middle (Fig. 1G); ovipositor with narrow valves and with denticulations of moderate size (Fig. 1H).

Male. Similar to the female, except for the post-abdomen characters (Fig. 2A–F). Subgenital plate moderately prolonged, with

the dorsal edge straight and the apex rounded (Fig. 2G), conical and robust cerci (Fig. 2H).

Coloration. Predominantly white with scattered gray spots. Face and ventral surface of the body black with scattered whitish bands; pronotal disc from the level of the third pair of coxae with gray stripes, which extend and alternate towards the posterior area of the pronotum; fore femur white, fore tibia black with a white ring in the mesal region; femur and mid tibia, as well as the basal half of the hind femur, light pink, distal half of the hind femur white with gray stripes in similar appearance to the pronotal disc (Fig. 3).

Variations.—The margin undulations of the fore and mid femora may be more conspicuous in some specimens and the lateral lobes with the posterior angles may have sinuato-dentate or serrato-crenate margins.

Measurements (in mm).—**Female.** CFP: 14.0–15.5; PL: 13.6–14.2; PLB: 5.5–5.9; FF: 2.6–2.8; FL: 2.1–2.3; MFL: 2.7–3.0; MTL: 2.6–2.9; HL: 6.0–6.2; HW: 1.7–1.9; HL: 4.3–4.6. **Male.** CFP: 11.5–12.2; PL: 11.2–11.5; PLB: 4.8–5.1; FF: 2.3–2.5; FL: 2.0–2.1; MFL: 2.9–3.1; MTL: 2.0–2.2; HL: 5.1–5.5; HW: 1.8–2.0; HL: 3.9–4.1.

Specimens examined.—**Museum specimens.** BRAZIL • 1♀. Amazonas, Manaus, Reserva Adolpho Ducke; 02°55'49"S, 59°58'31"W; 14–18 Apr. 2010, Rede entomológica, V. Linard leg.; AM-010, km 26 • 2♀♀; same collection data as for preceding; Coleta manual, D.M.M. Mendes leg. • 1♂. Amazonas, Manaus. ZF2, km 14; 02°35'21"S, 60°04'55"W; 1–15 Apr. 2016, Malaise grande no chão, J.A. Rafael and F.F. Xavier F leg. • 1♀. Amazonas, Tefé, Terra Firme; 03°25'19"S, 64°37'05"W; 10–26 Jun. 2016, malaise, J.A. Oliveira, D.M.M. Mendes and J.A. Rafael leg. (INPA). **Photographic records.** ECUADOR • Sumaco NP, Bigal River Forest Reserve (Arthur Anker). PERU • Huánuco, Tingo María (Huamán Cuespán et al. 2014).

Comments.—Currently *A. notabilis* has two synonyms: *Tetrix cnemidotus* Burmeister, 1838 and *Amorphopus caiman* Saussure, 1861, both synonymized by Günther (1939). *A. testudo* Saussure, 1861 is an immature specimen (Günther 1939) and currently the type depositary is unknown (Hollier 2013); this specimen could possibly be an immature of *A. notabilis*, but we kept it as *nomen dubius*.

Bruner (1910) separated *A. griseus* Bolívar, 1887, *A. notabilis* Serville, 1838, *A. cnemidotus* (Burmeister, 1838), and *A. caiman* by the size of the females and the coloration of the specimens. The size and coloration in this species may vary, depending on the area, availability of resources, and camouflage strategies (Cadena-Castañeda 2011a, b, 2013a, b, c). Moreover, colors of specimens preserved in museums may vary by virtue of the preservation method used, such as storage in alcohol, which usually makes the specimens lose its color (Cadena-Castañeda 2012, Cadena-Castañeda and Páez 2013). By studying the type specimens, the synonymy of these species is confirmed, and we propose that *Amorphopus griseus* Bolívar, 1887 **syn. nov.**, be considered as a new synonym under *A. notabilis*.

To the two remaining species of the genus, the following nomenclatural acts are proposed: 1. *A. gibbosulus* Walker, 1871 is transferred to *Metrodora* Bolívar, 1887, and it is synonymized with *Metrodora reticulata* (Hancock, 1906) **syn. nov.** (originally described as *Platyettix reticulatus* Hancock, 1906) under *Metrodora gibbosulus* (Walker, 1871) **comb. nov.** This synonym is proposed by comparison of the type specimens of both species. It is observed that there is no variation in the shape of the fastigium of

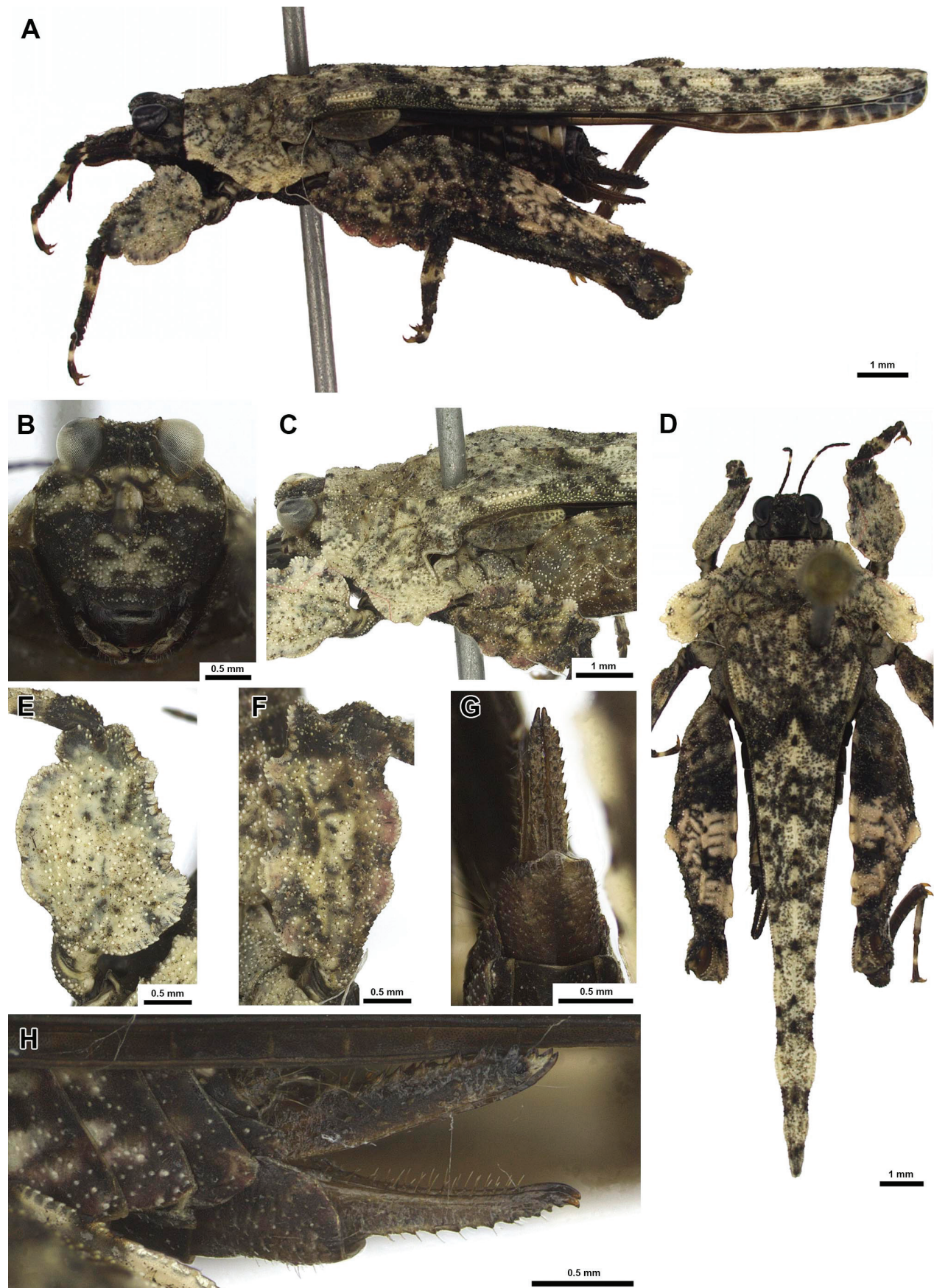


Fig. 1. *Amorphopus notabilis* (female). A. Habitus in lateral view; B. Frons; C. Head, lateral lobes of pronotum and tegmina in lateral view; D. Habitus in dorsal view; E. Fore-femur; F. Mid-femur; G. Terminalia in ventral view; and H. In lateral view.

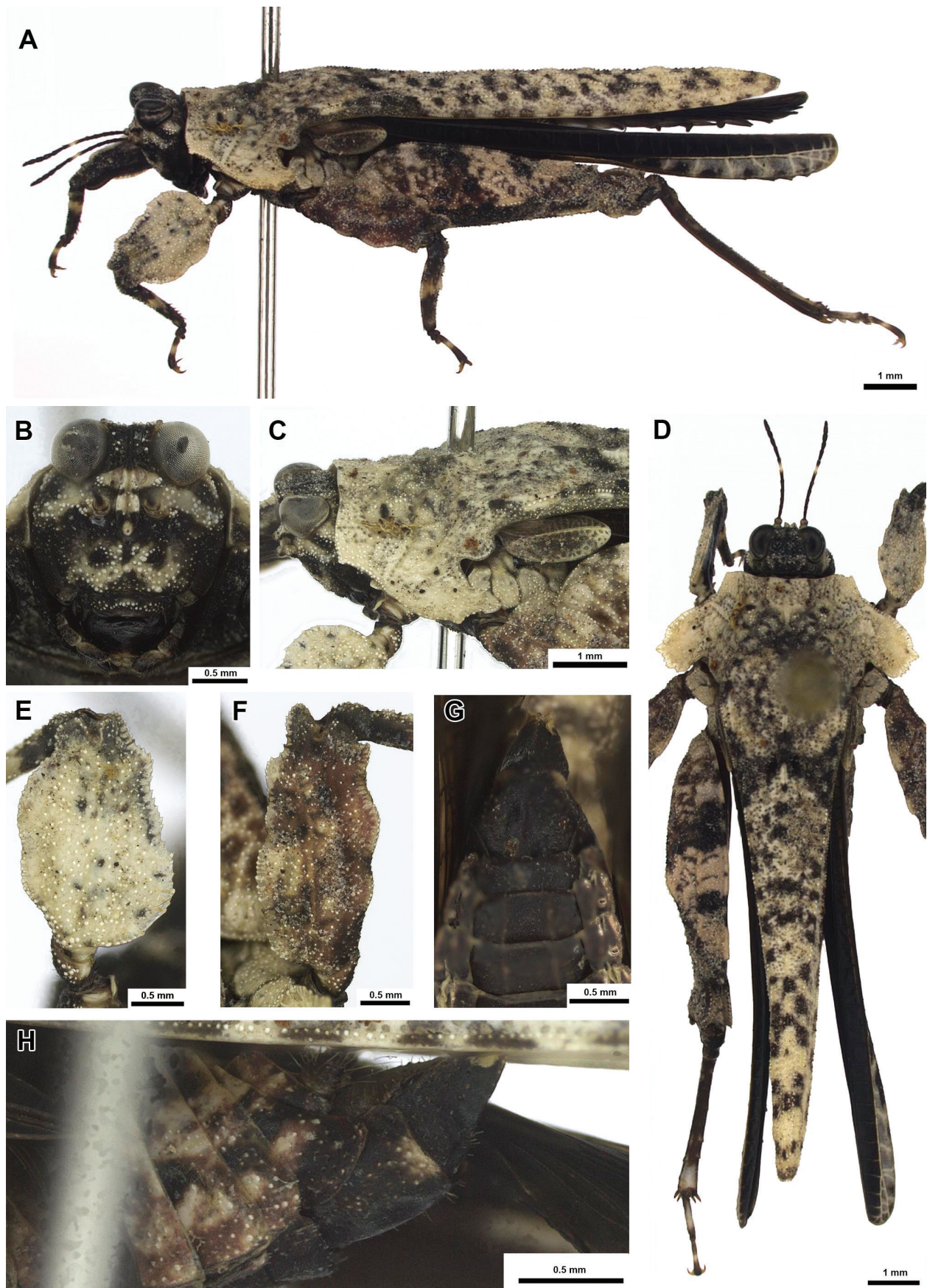


Fig. 2. *Amorphopus notabilis* (male). A. Habitus in lateral view; B. Frons; C. Head, lateral lobes of pronotum and tegmina in lateral view; D. Habitus in dorsal view; E. Fore-femur; F. Mid-femur; G. Terminalia in ventral view; and H. In lateral view.



Fig. 3. Live *Amorphopus notabilis* from Brazilian Amazon.

the vertex, since both species have a broad frontal costa, similar to the species of the subfamily Cladonotinae. The pronotum has a curvature in the prozone that rises significantly; the apex of the pronotum is curved slightly upwards and the lateral lobes of the pronotum project towards the sides, with the inferior margin triangular in shape. Since these diagnostic characters are present in specimens of both species, they cannot be maintained as separate specific entities, much less belonging to different genera.

2. Similarly, *A. humeralis* (Walker, 1871) (= *Tettix humeralis*) is transferred to *Crimisus* Bolívar, 1887, and it is synonymized with *Crimisus bolivianus* (Bruner, 1913), **syn. nov.** (originally described as *Allotettix bolivianus* Bruner, 1913) under *Crimisus humeralis* (Walker, 1871), **comb. nov.** The type specimens of both species are females, but, unfortunately, the legs in the holotype of *A. humeralis* are missing, so the legs were not compared. Nevertheless, both species share the same characteristics: narrow frontal costa, lower margins of the pronotal lobes rounded, without projecting to the sides as in the previous case, subgenital plate triangular, with a small prolongation at the apex. The aforementioned characters are observed in the type specimens of both species, indicating that they belong to a single species. Since they do not have expanded anterior and middle femora, it is ruled out that they belong to the Amorphopini tribe, fitting better in the genus *Crimisus*.

The two species described by Walker (1871), *A. gibbosulus* and *A. humeralis*, were not studied again and were not included in the Orthoptera Species File until Dr. J. Tumbrinck photographed the specimens and updated the information. If historical authors like Hancock and Günther had access to those specimens, for example, certainly they would have considered them to be synonyms. The nomenclatural acts were carried out by comparing the type specimens and their photographs; *A. gibbosulus* and *A. humeralis* do not meet the diagnostic characteristics to be included in *Amorphopus*, but they are similar to

Metrodora reticulata **syn. nov.** (now *Metrodora gibbosulus*) and *Crimisus bolivianus* **syn. nov.** (now *Crimisus humeralis*), respectively, in diagnostic structures such as pronotum structure, face, and terminalia shape.

Finally, the genus *Amorphopus* is kept monotypic and its known distribution is extended through the Amazonian slope, similarly to *Pterochroza ocellata* (Linnaeus, 1758), a species that was once considered several different species, but is now known to be a single, very variable species (Xiberras and Ducaud 2004).

A neotype specimen is designated as the carrier-name of the species and is supported by the following reasons (ICZN 1999 Art. 75): 1. The location of the only type specimen is unknown. It was deposited in NHRS, but Josef Tumbrinck visited that collection and did not find the type specimen (pers. comm.) "Some of the types of Serville are lost. Some of them are in Paris. But Josip Skejo did not find *Amorphopus notabilis* in Paris. So - today - the type is lost". The holotype female specimen has as type locality "Brazil, Para". This specimen could not be traced from its original description (Arts. 75.3.1., 75.3.4.), but the author provided figures, and when compared with the neotype specimen here designated, it agrees with the drawings by Serville (1838). 2. Not having specimens from the type locality, a female from a nearby and available locality of similar geological characteristics was designated (Arts. 75.3.5, 75.3.6; recommendation 75A ICZN). 3. A detailed description is written of the neotype that is in agreement with the general idea of the identity of this species, differentiating itself from other taxa, ensuring the recognition of the designated specimen, and conveying a consensus in identifications and wide distribution that characterizes the species, ensuring that most identifications from the past are correct (Arts. 75.3.2, 75.3.3, 75.3.5; recommendation 75B). 4. The neotype is deposited in CAUD, a collection of a recognized scientific institution, which maintains adequate facilities to preserve the types and makes them accessible for study (Art. 75.3.7).

Behavioral notes.—The Brazilian specimens were collected only in non-flooded ombrophilous forests (Terra Firme). In this environment they are usually found on the trunk and branches of fallen trees, where, due to their coloration and flattened body, they are easily confused with the tree's bark. Once physically stimulated, the specimens exhibited thanatosis behavior, where the individual remained immobile, leaving its femurs parallel to the body, with the lobes of the femora that mimic foliage lying alongside the body and the tibia folded against the femora. Thus, the body of the insect is very similar to a small fragment of bark, and it remains in this position for several minutes even on physical stimulation. Only after several minutes did the observed specimens leave the thanatosis behavior and move (D. Mello Mendes pers. obs.).

Eomorphopus Hancock, 1907

Type species.—*Eomorphopus antennatus* (Bolívar, 1887).

Description.—Body moderately depressed dorsoventrally (Figs 4A, 5A), granulate and moderately rugose. Eyes slightly conical with a flattened base; vertex narrowed forward, truncate anteriorly, not advancing beyond the eyes; frontal costa with a narrow scutellum between the antennae and moderately sulcate (Figs 4D, 5D), lateral lobes outwardly dilated below, the posterior angles oblong (Figs 4C, 5C, 6D) or acute (Figs 8D, 9D). Tegmina sublanceolate and wings surpassing the pronotum apex (Figs 4A, 8A). Fore femur strongly carinate, but not entirely clypeate (Figs 6E, 8E, 9E); mid femur flattened, margins above sub-straight, below strongly foliaceous-expanded, often sinuate toward the apices (Figs 6F, 8F, 9F); antegenicular tooth of hind femur developed; the first and third articles of the hind tarsi equal in length.

Comments.—For a long time, *Eomorphopus* species were described as *Amorphopus*, except for *E. purpurascens*, which was originally described as *Acrydium purpurascens* by Olivier (1791) and is still almost unknown, without photos and with scant morphological information. Additionally, some of the available morphological information on *E. purpurascens* is non-traditional, such as the description of the coloration used by Oliver (1791). Characteristics of this kind can be lost over time (e.g., wings with purplish coloration). Furthermore, the type species was not defined in the original description and the depository is unknown. The distribution is known only for Trinidad Island (Olivier 1791). For that reason, we propose as *nomen dubius* this species, and *Eomorphopus* only contains two valid species: *E. granulosus* and *E. antennatus*.

Behavioral notes.—The Brazilian specimens were collected in low-land floodplains in areas of the Solimões River and non-flooding ombrophilous forests (Terra Firme). They are commonly found in litter on the ground and occasionally on trunks of fallen trees. They are usually found in the same environment with other pygmy grasshoppers, such as *Scaria* (Cadena-Castañeda et al. 2019). They are easily unnerved and usually jump when approached.

Eomorphopus granulosus Hancock, 1907

Figs 4–7, 13

Eomorphopus granulosus Hancock 1907: 38 [general description], lectotype female (ANSP) and paralectotype male designated, Plate 4, figs 35–35a; type-locality: "Dutch Guiana, S. America". Kirby 1910: 22 [synonymic catalogue of Orthoptera]. Bruner 1910 [key, new localities]. Rehn 1913: 82 [New localities "Suriname"] Rehn

1916: 268 [new localities]. Rehn 1918: 167 [new localities]. Bruner 1919–1922: 8 [new localities]. Günther 1939: 263 [new localities]. Liebermann 1955: 331 [catalogue of Brazilian Orthoptera]. Otte D. 1979 (1978): 39 [catalogue of primary types at ANSP].

Type material.—Lectotype female, by present designation, deposited at ANSP and labeled as follows: "*Eomorphopus granulosus* Hancock H573 [handwritten] TYPE [printed, red label]/Hancock's [printed] Type *Eomorphopus granulosus* [handwritten, white label]/Dutch Guiana [handwritten, white label]". Conservation status. Bad condition, both antennae missing; specimen glued on card and remnants of fungi on body. Paralectotype male, by present designation, deposited at ANSP and labeled as follows: "*Eomorphopus granulosus* Allotype Hancock ♂ [handwritten] PARATYPE HEBARD CLN [printed, yellow label]/Dutch Guiana [handwritten, white label]". Conservation status. Bad condition, both antennae missing; right fore and middle tarsi missing; specimen glued on card and remnants of fungi on body.

Redescription (Female lectotype, Fig. 4).—Body surface granulated. **Head.** Lateral view (Fig. 4A, B): protuberant and slightly conical eyes with a flattened base; vertex and fastigium visible between eyes; antennal groove situated between lower margin of compound eyes; frontal costa elevated. Frontal view (Fig. 4D). Fastigium of vertex slightly conic; frontal costa bifurcation placed between compound eyes with narrow scutellum; fascial carinae between both superior ocelli; median ocelli placed between fascial carinae and frontal carina, but not touching on the base by frontal carina; antennal groove situated between lower margin of compound eyes and medial ocelli. Dorsal view (Fig. 4C). Vertex with distance between eyes as long as horizontal diameter of eyes; medial carina conspicuous and continuing towards frontal costa; area of fastigium to occiput granulated; occipital area visible and anterior margin of pronotum distant from the eyes. **Pronotum.** Macropronotal and flattened dorso-ventrally. Lateral view (Fig. 4A, B). Anterior margin of pronotum truncated and slightly elevated; median carina slightly undulated, prozonal carina and humero-apical carina visible and short, not reaching the sulci; extralateral carina inconspicuous; ventral sinus present; lateral lobe with anterior margin truncated and without spine; tegminal sinus present; length of infrascapular area shorter than length of fore tibiae; two deep sulci between prozona and humero-apical carina; paranota granulated and triangularly shaped; humero-apical carina continuous to external lateral carina and both parallel to median carina. Frontal view (Fig. 4D). Lateral lobes of pronotum projected and directed sideways. Dorsal view (Fig. 4C). Dorsum granulated; prozonal carina visible and short, not reaching the sulci; median carina continuous; humero-apical carina conspicuous; anterior and posterior margin of pronotum truncated; lateral lobe directed sideways. **Sternomentum.** The sternomentum could not be checked due to it being glued on card. **Wings.** (Fig. 4A, B). Tegmina and hindwings visible; tegmina oval, sublanceolated shape; hindwings dark brown and surpassing pronotum apex. **Legs.** Fore legs (Fig. 4A, B, D). Fore femur flattened laterally, dorsal and ventral margins of femur carinated with three undulations in the dorsal margin and one in ventral margin; tibia as long as femur. Middle legs (Fig. 4A–C). Middle femur shieldlike shape, flattened laterally and strongly foliaceous; dorsal and ventral margin slightly undulated; ventral margin expanded, with rounded teeth (crenated) near tibia; femur longer than tibia. Hind legs (Fig. 4A, B). Dorso-external and ventro-external of femur granulated; antegenicular tooth conspicuous; dorso-external carina and ventro-external carina conspicuous; transversal ridges visible on external surface; tibia not

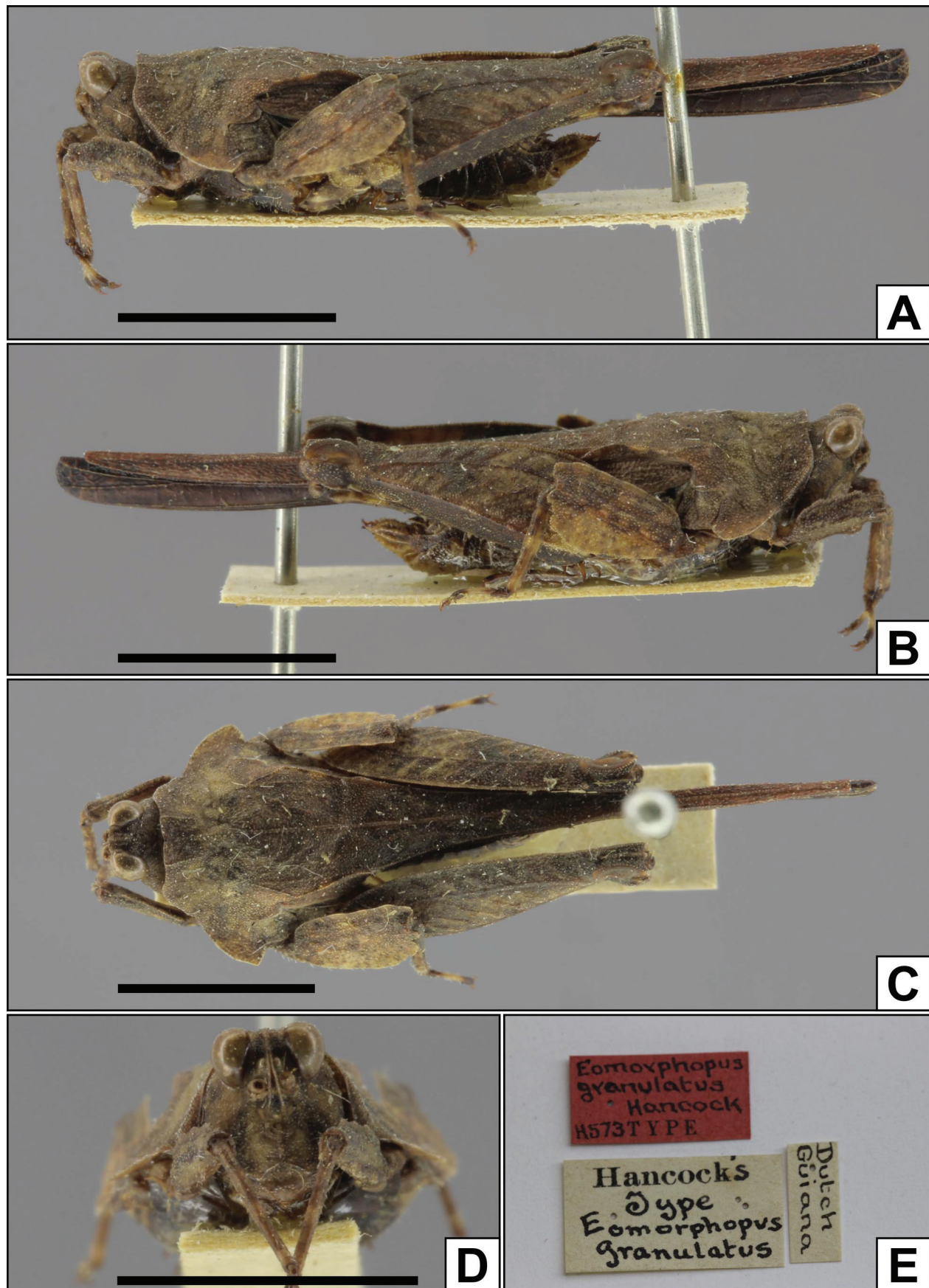


Fig. 4. *Eomorphopus granulatus* (female lectotype) A. Lateral left habitus; B. Lateral right habitus; C. Dorsal view; D. Head details in frontal view; and E. Labels. Scale bars: 5 mm.

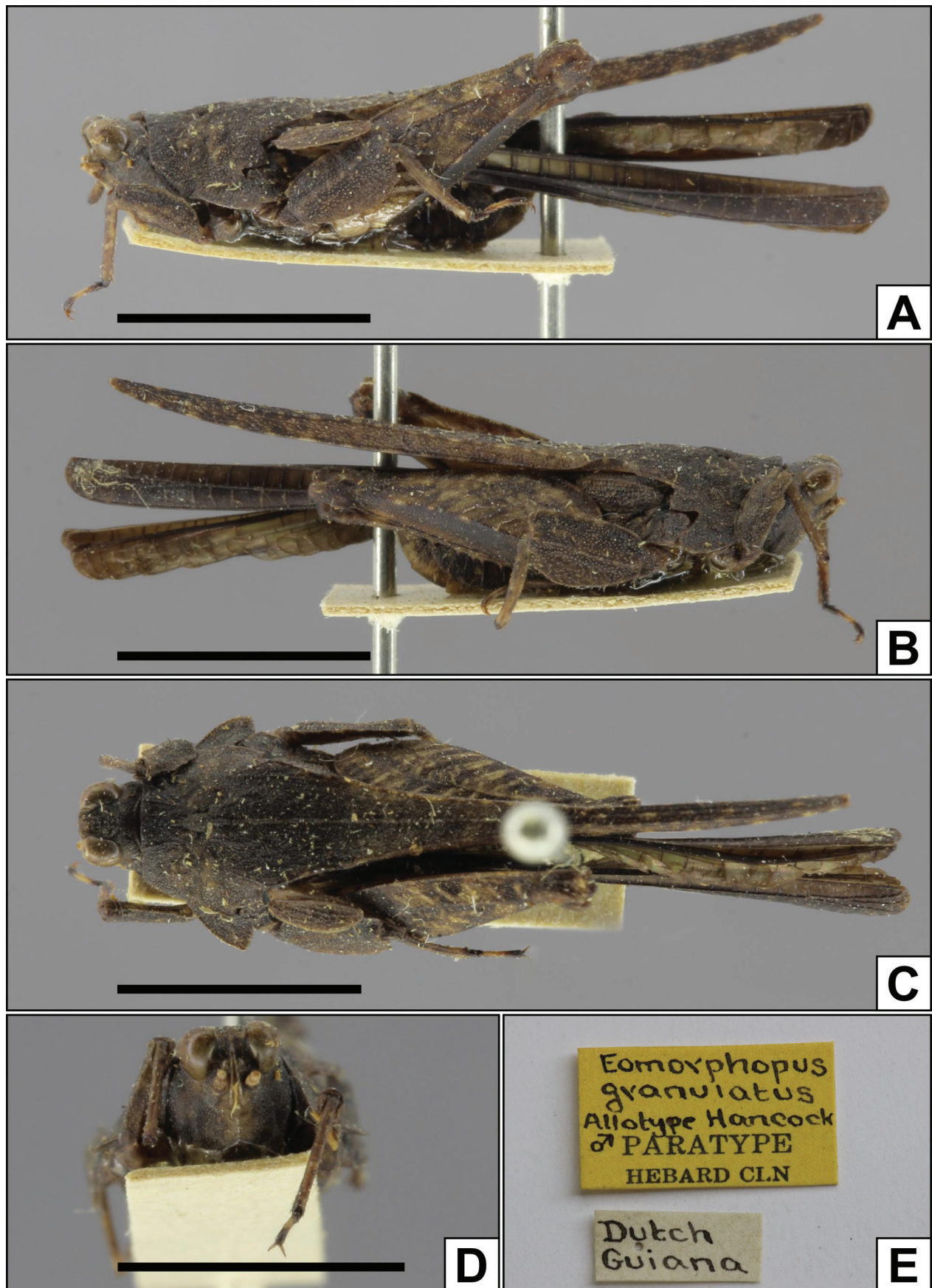


Fig. 5. *Eomorphopus granulatus* (male paralectotype) A. Lateral left habitus; B. Lateral right habitus; C. Dorsal view; D. Head details in frontal view; and E. Labels. Scale bars: 5 mm.



Fig. 6. *Eomorphopus granulatus* (male not a type) A. Habitus in lateral view; B. Frons; C. Head, lateral lobes of pronotum and tegmina in lateral view; D. Habitus in dorsal view; E. Fore-femur; F. Mid-femur; G. Terminalia in ventral view; and H. In lateral view.



Fig. 7. Live *Eomorphopus granulatus* from Brazilian Amazon.

visible and hidden behind the femur. **Abdomen.** (Fig. 4A, B). Sternites not visible due to specimen glued on card; ovipositor valves short and robust, superior margin of dorsal and ventral valve with teeth. Measurements (in Hancock, 1907). Total length of female body: 16.5 mm; pronotum: 14.5 mm; hind femur: 7 mm.

Male (paralectotype, Fig. 5).—Similar to female, except: **Head.** Frontal view (Fig. 5D). Fastigium straight. **Pronotum.** Lateral view (Fig. 5A, B). Humero-apical carina not continuous to external lateral carina. Measurements (in Hancock 1907). Total length of male body: 15 mm; pronotum: 13 mm; hind femur: 6 mm.

Measurements (from additional specimens studied; in mm).—**Female.** CFP: 18; PL: 15.2; PLB: 5.8; FF: 3; FL: 3.2; MFL: 3.5; MTL: 3.7; HL: 8; HW: 2.4; HL: 7.2. **Male.** CFP: 16.5–17.4; PL: 15.0–16.0; PLB: 5.0–5.2; FF: 2.2–2.5; FL: 2.8–3.0; MFL: 3.0–3.1; MTL: 3.1–3.2; HL: 7.0–7.5; HW: 2.0–2.2; HL: 6.4–6.6.

Specimens examined.—COLOMBIA • 1♀; Putumayo, Puerto Asis, Vda. Nariño, Nariño; 0°29'20.9"N, 76°24'23.6"W; 273 m; 25 Mar. 2015; N. Jimenez leg. • 1♂; Caquetá, Florencia, Corregimiento Venecia, Vereda Balcanes, Granja Agroecológica Balcanes de la Universidad de la Amazonia; 01°25'34.7"N, 75°30'58.6"W; 266 m; 21 Sep. 2017; D. Cabra leg. (CAUD). BRAZIL • 1♂; Amazonas, Uarini, Boca do Mamirauá; 03°07'29.4"S, 64°47'32.1"W; 5 Sep. 2018; D.M.M. Mendes, J.C. Oliveira and J. Oliveira leg (INPA).

Comments.—*Eomorphopus granulatus* Hancock 1907 has been recorded from Guyana, French Guyana, Suriname, and Brazil. *E. granulatus* is the only species of *Eomorphopus* with type species housed at

ANSP. Both specimens of the museum have labels, with the female labeled as "Type" and the male labeled as "Allotype"/"Paratype". As the author did not designate the holotype in the original description, we designated the female as the lectotype and, consequently, the male specimen became the paralectotype. We believe that this redescription will facilitate species recognition in the future. In his description, Hancock (1907) indicated that the body was subtly granulated and cinereous or fuscus-cinereous (ash-colored; gray tinged with blackish), see Smith (1906). Actually, this type has overall brownish-yellow and brown color.

Eomorphopus antennatus Bolívar, 1887

Figs 8–11, 14

Neotype.—COLOMBIA • ♀; Amazonas, San Juan de Loreto Yacu; 03°37'0"S; 70°33'59.3"W; 180 m; N. Ruiz leg. (CAUD).

Description.—**Female.** This species is very similar to *E. granulatus*, but *E. antennatus* is larger. Furthermore, it is differentiated by the following characters: Body surface more granulated than *E. granulatus* (Fig. 8A). Eyes globose and prominent, fastigium visible between the eyes, median carina slightly developed and continuing towards frontal costa; area of fastigium to occiput abundantly granulated (Fig. 8B). Pronotum with rounded sculpturing on prozona, median carinae undulate at level of humeral sinus, length of infra-scapular area as long as fore femur (Fig. 8C); prolongation of the pronotum constricting and resuming its thickness rapidly, close to the distal third, apex of the lateral lobe of the side projection triangular shaped and moderately sharp; anterior and posterior margin of pronotum truncated; lateral lobes directed sideways (Fig. 8D).

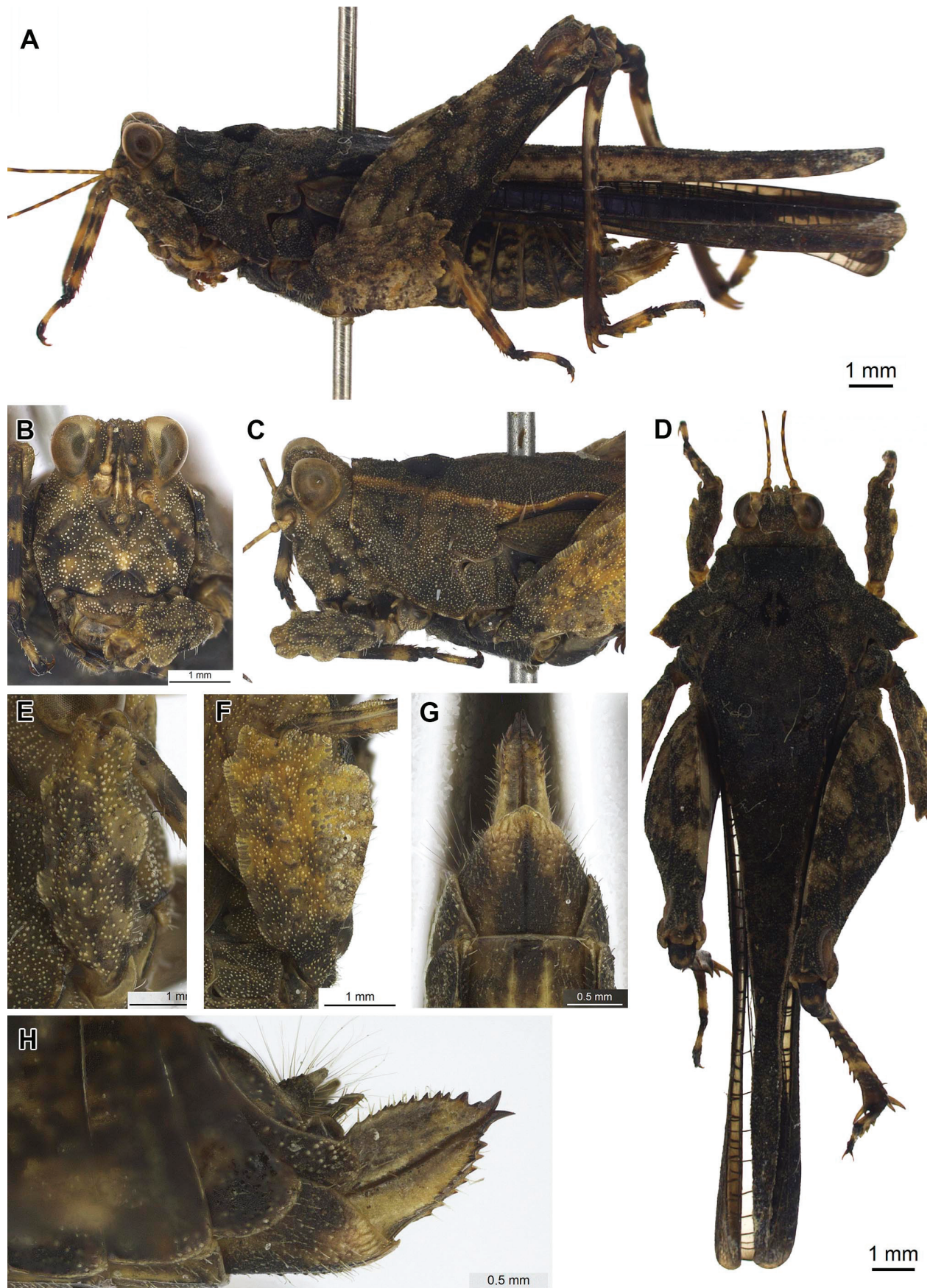


Fig. 8. *Eomorphopus antennatus* (female) A. Habitus in lateral view; B. Frons; C. Head, lateral lobes of pronotum and tegmina in lateral view; D. Habitus in dorsal view; E. Fore-femur; F. Mid-femur; G. Terminalia in ventral view; and H. In lateral view.

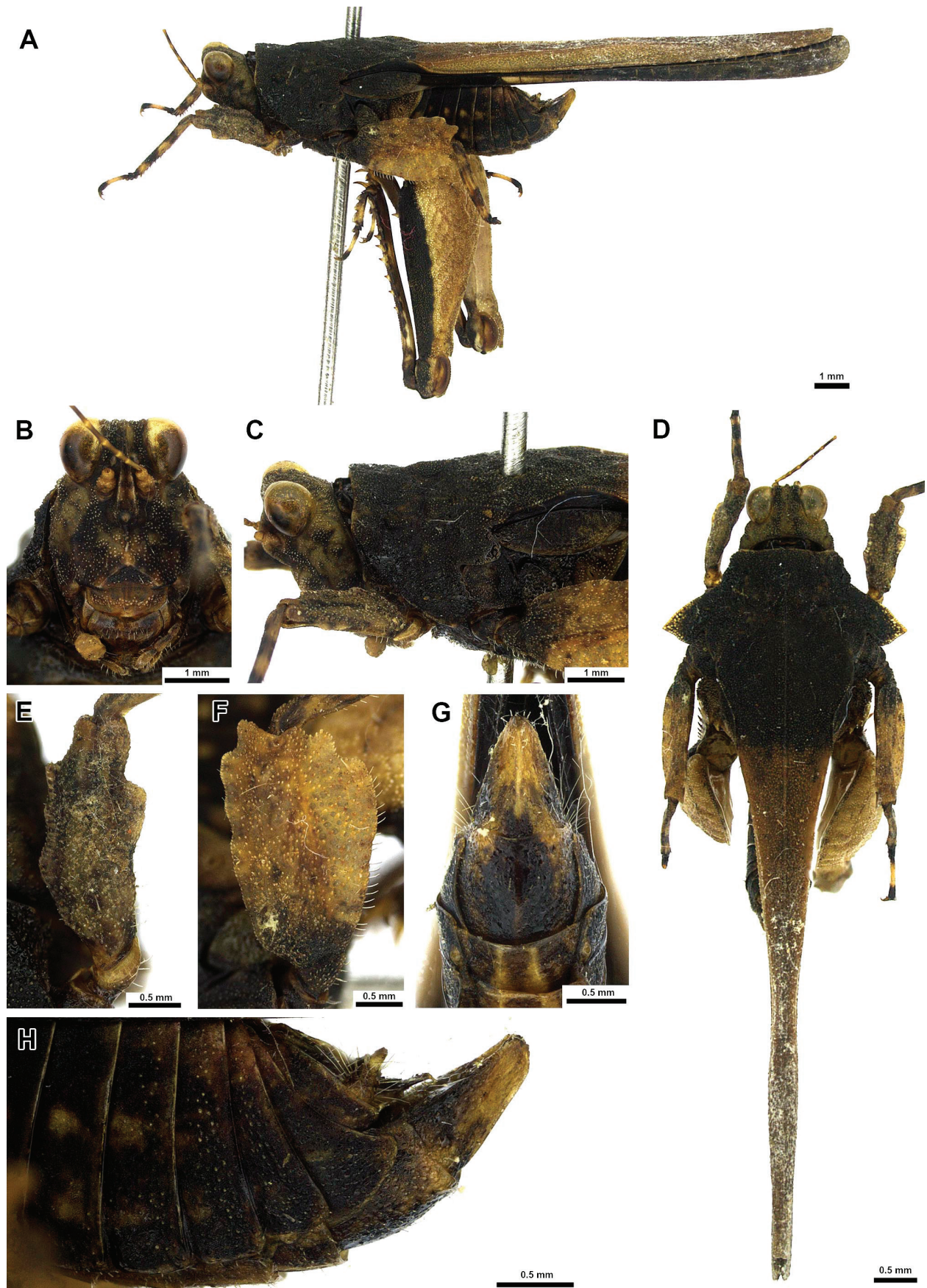


Fig. 9. *Eomorphopus antennatus* (male) A. Habitus in lateral view B. Frons; C. Head, lateral lobes of pronotum and tegmina in lateral view; D. Habitus in dorsal view; E. Fore-femur; F. Mid-femur; G. Terminalia in ventral view; and H. In lateral view.



Fig. 10. Live *Eomorphopus antennatus* female from Brazilian Amazon.



Fig. 11. Live *Eomorphopus antennatus* male from Brazilian Amazon.

Fore femur flattened laterally, dorsal and ventral margins carinated with two or three undulations in the dorsal margin and one or two in ventral margin (Fig. 8E); middle femur shield like in shape, flattened laterally and strongly foliaceous (mid-femur notably wider than *E. granulatus*), dorsal and ventral margin slightly undulated; ventral margin expanded, with rounded teeth in the apex (Fig. 8F). Subgenital plate triangular shaped, slightly longer than wide, with a small mid triangular tooth (Fig. 8G).

Male. Similar to the female, distinguished by the ambisexual characters (Fig. 9A–F): subgenital plate prolonged, in ventral view triangular shaped and with rounded apex (Fig. 9G), cerci cylindrical, slightly reducing in thickness from the base to the apex (Fig. 9H).

Variations.—The main variations observed in this species are related to the coloration, that will be detailed later. Morphologically, the undulations of the middle and anterior femur may be more conspicuous in some individuals than others, although it was observed that they are more conspicuous in males than in females. Moreover, the undulations of the dorsal margin of the anterior femur can vary from two, three, or four, distorting the use of this character to separate the two species of *Eomorphopus*. (Bruner (1910) suggested that *E. granulatus* had three undulations and *E. antennatus* had two).

Measurements (in mm).—**Female.** CFP: 19.4–19.5; PL: 17.4–17.9; PLB: 5.5–5.9; FF: 3.4–3.6; FL: 2.7–3; MFL: 3.3–3.4; MTL: 3–3.3; HL: 7.1–7.3; HW: 1.9–2.2; HL: 6.7–6.8. **Male.** CFP: 18.3; PL: 16.4; PLB: 5.5; FF: 2.8; FL: 2.7; MFL: 3.6; MTL: 2.8; HL: 7.4; HW: 2.3; HL: 6.1.

Specimens examined.—**Museum specimens.** COLOMBIA • 1♀; same data as neotype • 1♀; Amazonas, Leticia; 27 Oct. 1996. • 1♀; La Pedrera; 100 m; 18 May. 2011; C. Linares. • 1♂; Caquetá, Florencia, Vda. La Victoriosa, Centro de Investigaciones Amazónicas CIMAZ, Macagual. 01°30'37"N, 75°40'29"W; 233 m.; 20 Sep. 2017; A. Quiroga leg. • 1♂; Meta, San Juan de Arama, Bosque de Galería, Caño Curia; 24 Sep. 1987. (CAUD). BRAZIL, • 1♀1♂; Amazonas, Manaus, Bosque da Ciência, INPA; 1–20 May. 2010; J.T. Câmara leg. • 1♀; same data collection data as for preceding; 22 May. 2009; coleta manual, T. Mahlmann leg. • 1♀; Amazonas, Rio Abacaxis; 05°15'09"S, 58°41'52"W; 35m; 27–29 May. 2008; Armadilha luz sobre o barco, J.A. Rafael e equipe leg. • 1♂; Amazonas, Manaus, Reserva Adolpho Ducke, km 26; 02°55'49"S, 59°58'31"W; 30 Apr. – 4 May. 2014; Coleta manual, K.F.S. Cezar leg. • 2♀; Amazonas, Tefé, Lago Tefé, Ilha em frente de Tefé; 03°19'55"S, 64°41'11.9"W; 1 Sep. 2018; Coleta em floresta de várzea, D.M.M. Mendes, J.C. Oliveira and J. Oliveira leg. • 1♂; Amazonas, Uarini, Boca do Mamirauá; 03°07'29.4"S, 64°47'32.1"W; 5 Sep. 2018; Coleta em floresta de várzea, D.M.M. Mendes, J.C. Oliveira and J. Oliveira leg. • 1♀; Amazonas, Careiro Castanho, BR-319, km 181, Sítio São Paulo; 04°12'48"S, 60°49'04"W; 24 Mar. 2017; J.A. Rafael and F.F. Xavier F. leg. **Photographic records.** PERU, • 1♀; Loreto Tamshiyacu-Tahuayo Reserve.

Comments.—*Eomorphopus antennatus* was described by Bolívar (1887) as *Amorphospus*, and in 1907, Hancock reallocated this species to the new genus *Eomorphopus*. *E. antennatus* is very similar to *E. granulatus* but is distinguished by the biundulated fore femur dorsal margin vs. the triundulated fore femur dorsal margin in *E. granulatus* (Bruner 1910). *E. antennatus* has several records: Peru, Guyana, Venezuela, Ecuador, Suriname, Brazil, and

Trinidad Island. Currently, the depository of the primary type is unknown (Cigliano et al. 2019) and there is a female from Alto Amazonas in Bolívar's Tetragoidea collection, housed at the National Museum of Natural History, Madrid, Spain (MNCN) (Paris 1993–1994).

A neotype specimen is designated as the carrier-name of the species and is supported by the following reasons (ICZN 1999) Art. 75) 1. The status of the only type specimen is lost. It was deposited in MNCN, but this specimen could not be traced from its original description (Arts. 75.3.1., 75.3.4.). 2. The type female specimen has as type locality Peru, Upper Amazonas, but not having specimens from the same locality, a female from a nearby and available locality of similar geological characteristics was designated (Arts. 75.3.5, 75.3.6; recommendation 75A ICZN). 3. A detailed description is written for the neotype that is in agreement with the general idea of the identity of this species, differentiating it from other taxa, ensuring the recognition of the designated specimen, and conveying a consensus in identifications and wide distribution that characterizes the species, ensuring that most identifications from the past are correct (Arts. 75.3.2, 75.3.3, 75.3.5; recommendation 75B). 4. The neotype is deposited in CAUD, a collection of a recognized scientific institution, which maintains adequate facilities to preserve the types and makes them accessible for study (Art. 75.3.7).

Amorphopini camouflage

The species of this tribe have the peculiarity of camouflaging themselves among lichens and bryophytes in humid environments of the Amazon (Cadena-Castañeda and Cardona-Granda 2015). When the Amorphopini feel threatened, they take positions to go unnoticed, placing themselves flattened on the substrate to ensure their camouflage with the environment. The front legs are extended towards the front and the middle and the rear legs remain next to the pronotum.

The most striking case is of *A. notabilis*. The individuals of this species exhibit a peculiar design that simulates the surface of trees or rocks covered by diverse lichen and bryophyte communities (Fig. 3). Its whitish coloration simulates foliose lichen (Parmeliaceae and Lobariaceae) or scabby/crustacean lichen (Stereocaulaceae and Roccellaceae), and the reddish to pink coloration of the middle and half of the basal surface of the posterior femur resembles the scabby lichens of the family Arthoniaceae. The gray stripes and other greenish ones give the appearance of surrounding bryophytes mainly of the families Plagiochilaceae and Leucobryaceae. They are usually observed covered by a green dust that consists of microalgae.

Polychromy in Amorphopini species

Color variation is more conspicuous in *Eomorphopus* species. The individuals of this genus are bluish black, yellowish with brown spots of different shades, light or dark brown (Fig. 7); parts of the body are light or dark brown, with or without stripes (Figs 10, 11). These color variations do not define geographic populations, can occur in specimens from the same locality, and the function of the color variation is still unknown but it may be linked to the microenvironments that individuals inhabit. In *A. notabilis*, the variations are very subtle and are restricted to the intensity of the gray stripes on the body and the reddish color of the middle and hind legs.

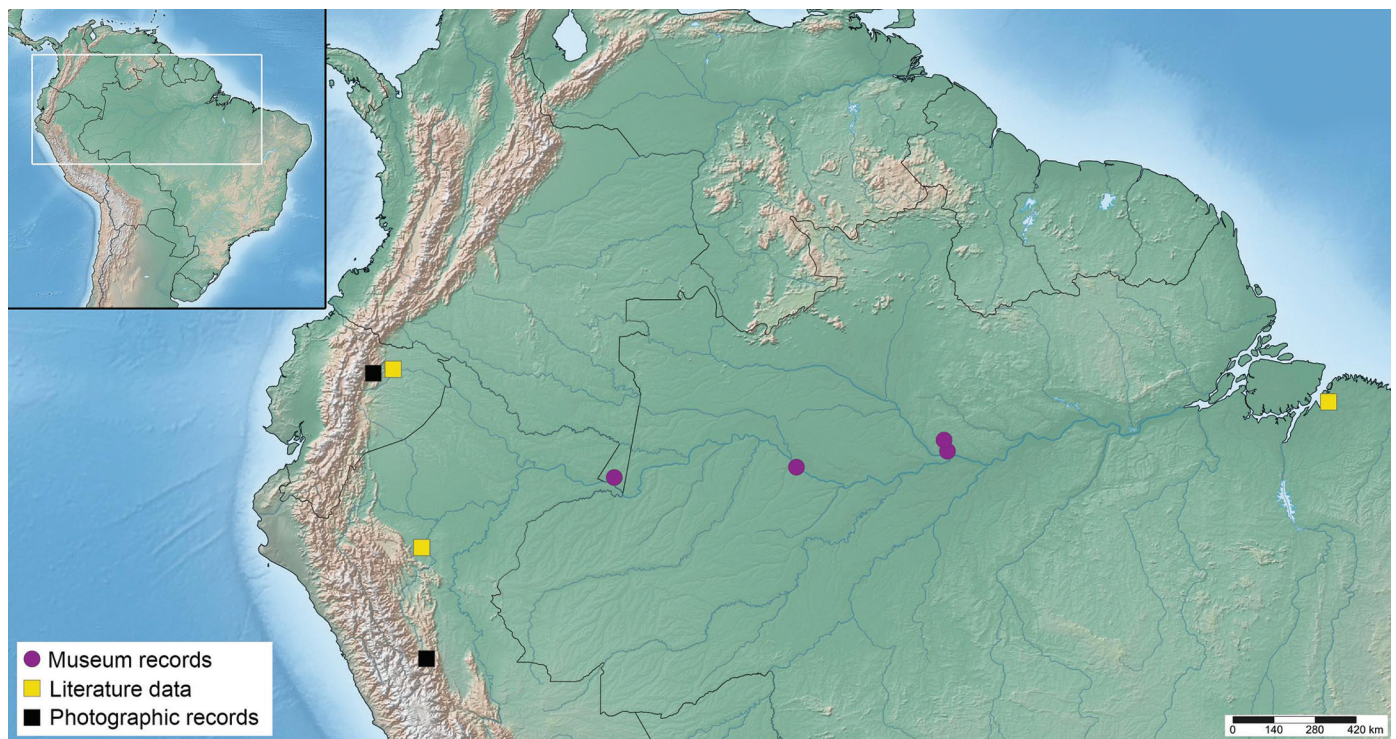


Fig. 12. *Amorphopus notabilis* distribution.

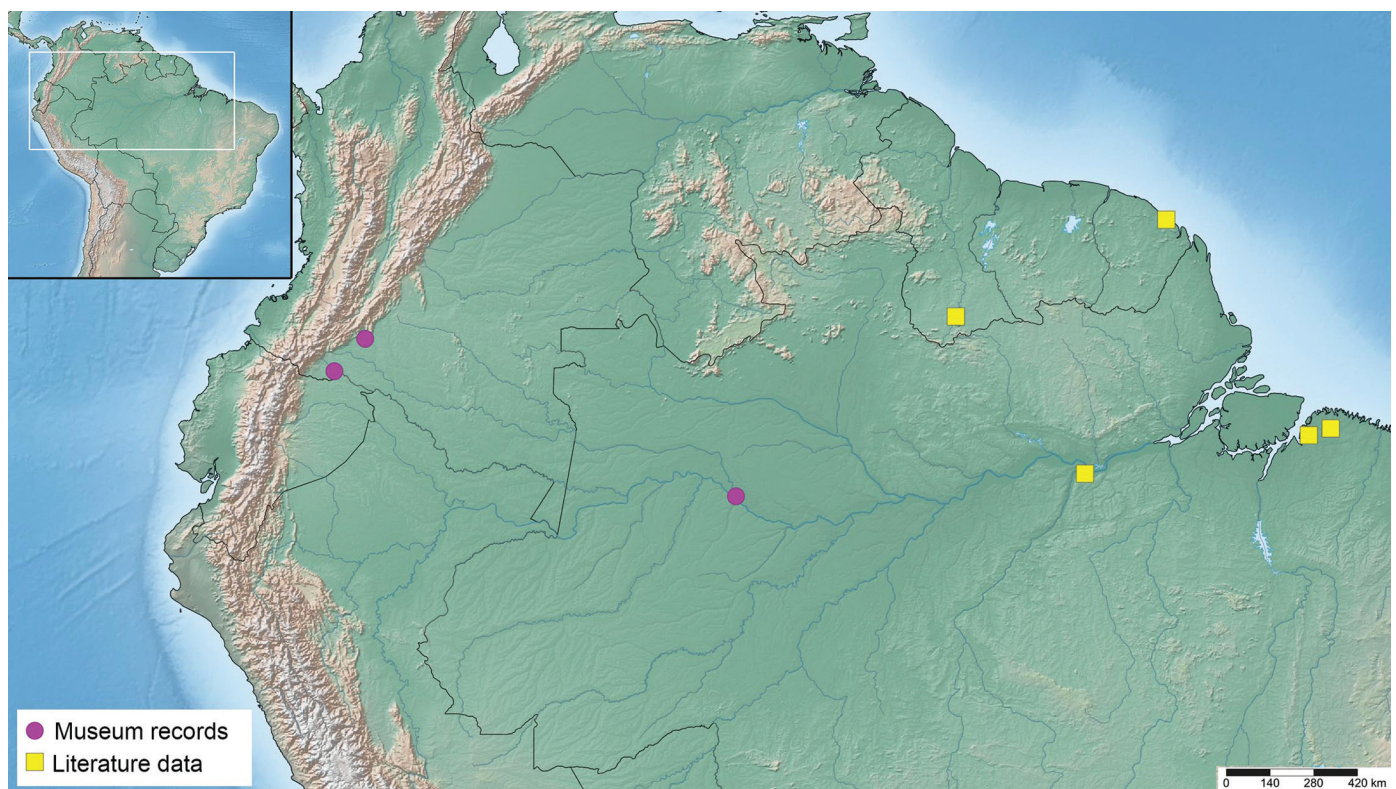


Fig. 13. *Eomorphopus granulatus* distribution.

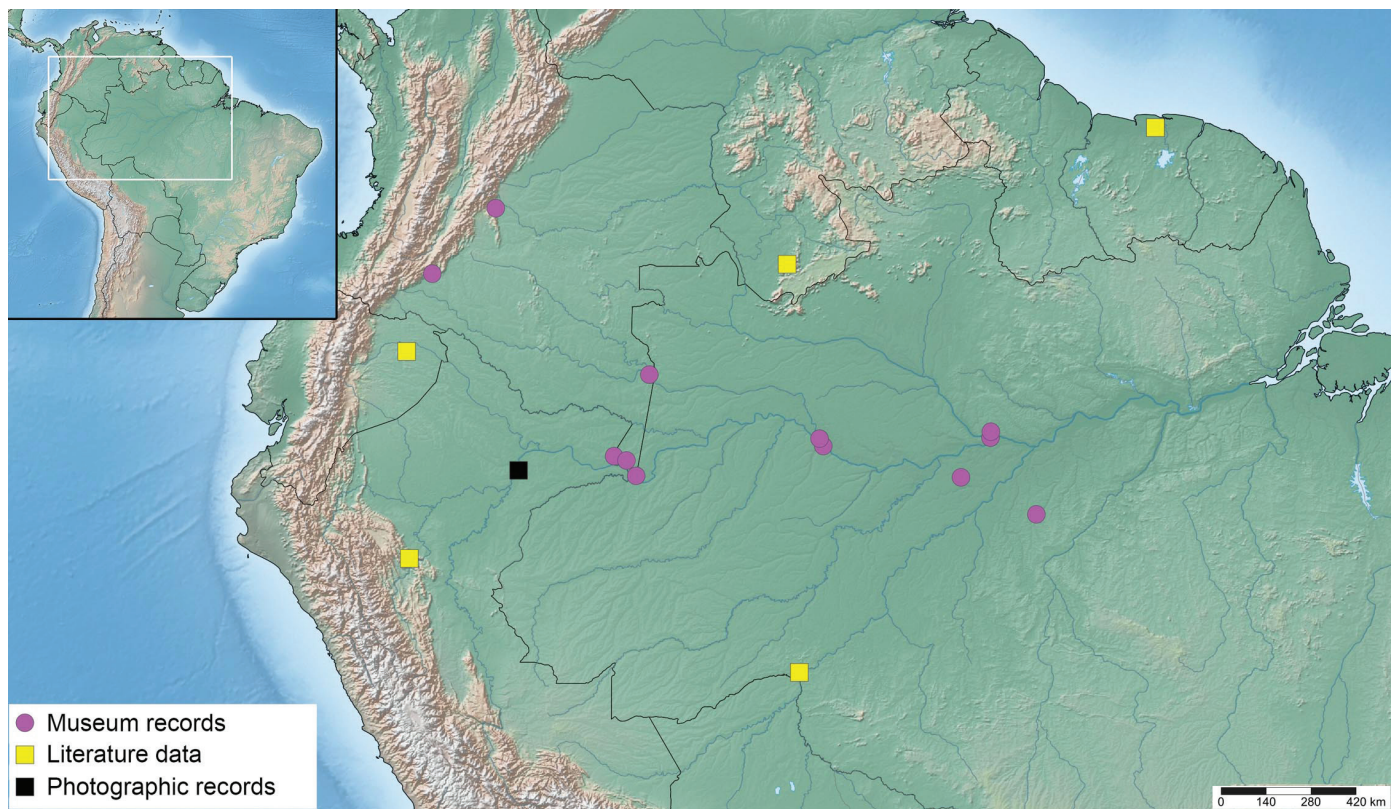


Fig. 14. *Eomorphopus antennatus* distribution.

Acknowledgements

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