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The Little Harlequin Katydid—a new species of *Paraxiphidium* Redtenbacher, 1891 (Orthoptera: Tettigoniidae: Conocephalinae; Conocephalini) from the Amazonian Rainforest

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Abstract

Paraxiphidium is a genus of flashy Neotropical katydids belonging to Conocephalini. *Paraxiphidium iriodes* **sp. nov.** is described from the Brazilian Amazon region. This is the first record of the genus for Brazil. The description of stridulatory file, male internal genitalia and data on natural history is provided. A key is included to the species of the group and a map with the geographical records completes the paper.

Key words: Spine-headed katydid, Brazilian Amazon, colorful katydids, *Conceveiba*

Resumo

Paraxiphidium é um gênero de vistosas esperanças Neotropicais pertencentes a Conocephalini. *Paraxiphidium iriodes* **sp. nov.** é descrita para a região Amazônica Brasileira. É feito pela primeira vez o registro do gênero para o Brasil, assim como a descrição das fileiras estridulatórias, genitália interna masculina e dados sobre história natural. É apresentado uma chave para as espécies do grupo e um mapa com os registros geográficos.

Palavras chaves: Esperança cabeça-de-cone, Amazônia brasileira, esperanças coloridas, *Conceveiba*

Introduction

The genus *Paraxiphidium* Redtenbacher, 1891 is one of the nine Neotropical genera of Conocephalini (Tettigoniidae: Conocephalinae) (Cigliano *et al*., 2019).

Paraxiphidium is a genus (Cigliano *et al.*, 2019), comprising only a single species, *Paraxiphidium versicolor* Redtenbacher, 1891. It is currently known only from Peru. Although it is a very impressive katydid due to its colorful body, neither natural nor behavioral history data is known.

This paper aims to describe a new species of *Paraxiphidium*, provide an identification key to the species of the genus, a distribution map and notes on behavioral data observed during field activities.

Material and methods

The studied specimens were deposited in the Coleção de Invertebrados of the Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil.

Specimens were collected night and day at the municipality of Tefé, Amazonas, Brazil. Specimens were exam-

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ined under a Nikon SMZ460 stereomicroscope. Tegmina and phallic complex were dissected and photographed. One phallus of each species was dissected and immersed for 24 hours in 10% aqueous solution of KOH and then washed with 1% acetic acid for five minutes and stored in plastic vials with glycerin. The genital terminology follows Chamorro-Rengifo & Lopes-Andrade (2014).

Photographs in lateral view were taken from live specimens using a Nikon D7100 digital camera, with a 60 mm 2:8 lens. The remaining images of body parts were taken with a Leica DFC295 attached at a stereoscopic microscope M205. Illustrations were made using the Adobe Illustrator CS6 and Adobe Photoshop CS6. The map was elaborated with Simplemappr (Shorthouse 2010).

We use the following abbreviations for measurements (in mm): total body length, TL; maximum tegmen length, TegL; maximum tegmen height, TegH; maximum frontal width, WF; pronotum dorsal length at midline, PL; maximum pronotum lateral height, PH; length of the forefemur, FF; length of the foretibia, FT; length of the midfemur, MF; length of the midtibia, MT; length of the hindfemur, HF; length of the hindtibia, HT; length of the subgenital plate, Lplac; Length of the cercus, LC; length of the ovipositor, OL.

Results

Key to known species of *Paraxiphidium*

1. Apex of the cercus with lateral projection ensiform (Fig. 1B); cercus base with rectangular and straight projection (Fig. 1B). Head dorsally with one brown band (Fig. 1C). Pronotum dorsally green and with a brown band not reaching anterior pronotal margin (Fig. 1C). Hind femur with overall black coloration with beige and blue spots (Fig. 1C) . . . . . ***Paraxiphidium versicolor*** Redtenbacher, 1891

- Apex of the cercus with lateral projection triangular (Fig. 1A); cercus base with narrow and curved projection (Fig. 1A). Head dorsally with two brown bands (Fig. 1D). Pronotum dorsally with a black band (Fig. 1D). Hind femur with overall reddish coloration and green and blue spots (Fig. 1D) . . . . . ***Paraxiphidium iriodes* sp. nov.**

Paraxiphidium versicolor Redtenbacher, 1891

Figures 1 and 11

Paraxiphidium versicolor Redtenbacher, 1891: 493; Kirby, 1906: 271; Hollier, 2012: 22; Cigliano *et al.*, 2019.

Diagnosis. Cercus apex bifurcate, with lateral projection ensiform 2 times longer than apical projection (Fig. 1B); base with lateral projection subrectangular (Fig. 1B). Head dorsally with one brown band (Fig. 1C); compound eyes light gray. Pronotum dorsally green with a brown band not reaching anterior pronotal margin (Fig. 1C); pronotal spot bluish-green under pronotal disc brown band. Hind femur with black general coloration and beige and blue spots (Fig. 1C).

Geographical records. Peru (specific locality of collection not informed in the original publication) (Fig. 11).

Comments. Species originally described by Redtenbacher (1891) and until this work was the only species in *Paraxiphidium*. Despite having an impressive color pattern, which attracts the attention of nature enthusiasts and photographers, many important taxonomic characters still remain unknown, such as the morphology of the stridulatory file and the morphology of the internal male genitalia.

Paraxiphidium iriodes Mendes & Oliveira, sp. nov.

Figures 1–11

Diagnosis. Cercus apex bifurcate, with recurved triangular lateral projection, with the same length of apical projection (Fig. 1A); base with narrow and curved projection (Fig. 1A). Head dorsally with two brown bands (Fig. 1D); compound eyes dark blue. Pronotum dorsally with a black band (Fig. 1D); pronotal spot light blue under pronotal black band (Fig. 1D). Hind femur with overall reddish coloration and green and blue spots (Fig. 1D).

Etymology. From Latin *iriodes* = like the rainbow. It refers to the bright and colorful body of this katydid, resembling the color of a rainbow.

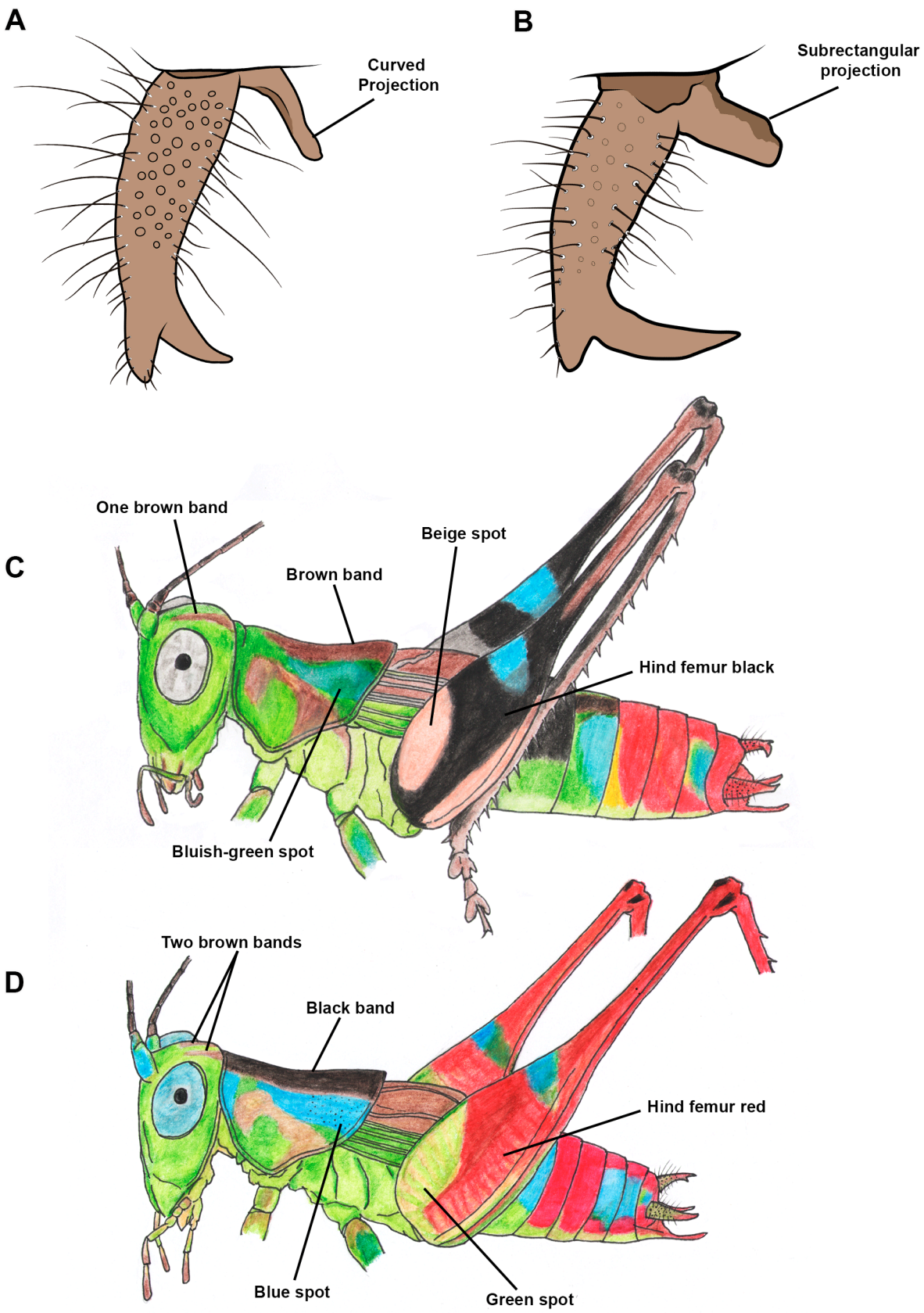

FIGURE 1. A: *Paraxiphidium iriodes* **sp. nov.**, right cerci, in dorsal view; B: *Paraxiphidium versicolor*, right cercus, in dorsal view; C: *P. versicolor*, lateral *habitus*; D: *P. iriodes* **sp. nov.**, lateral *habitus*.

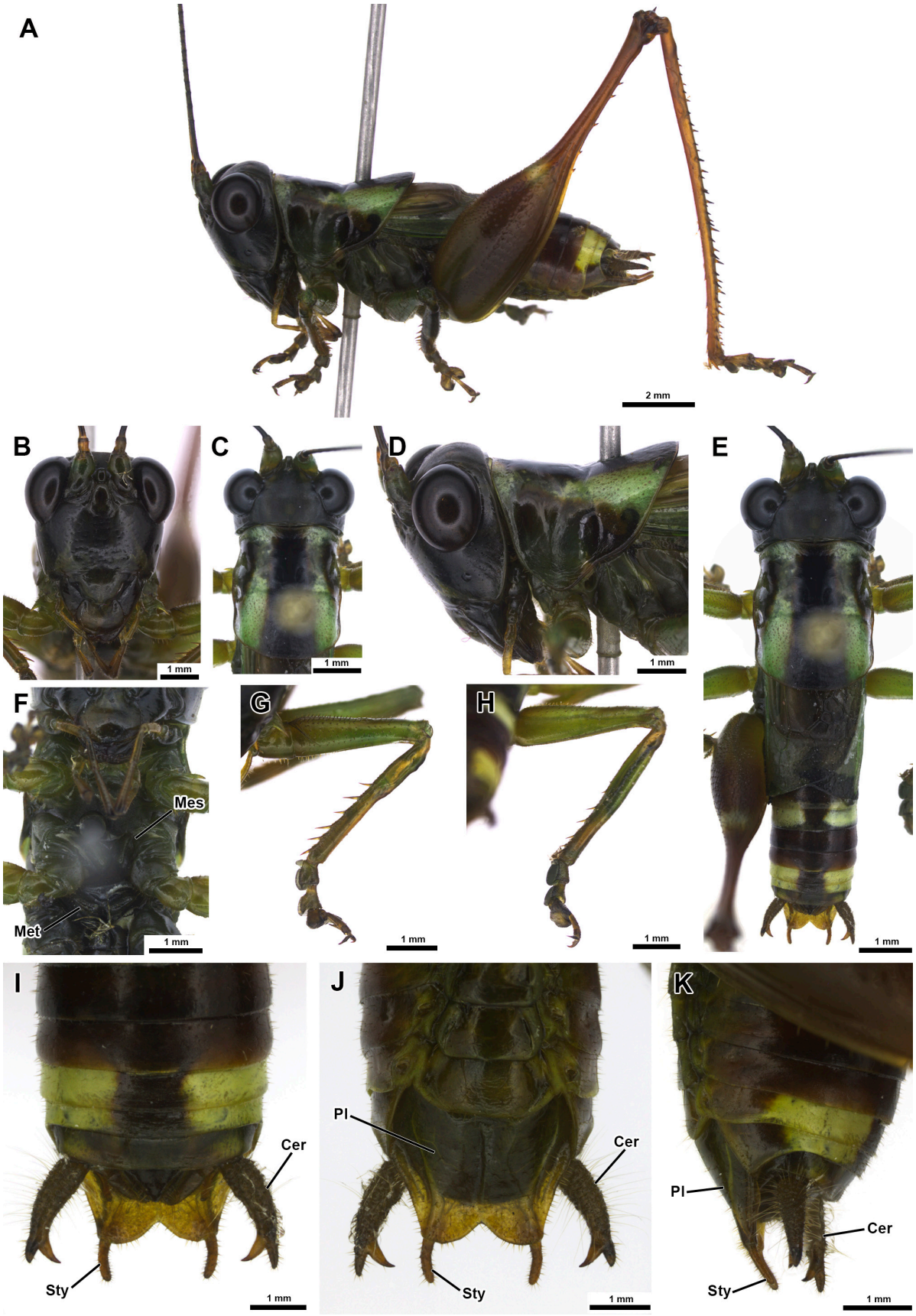

FIGURE 2. *Paraxiphidium iriodes* **sp. nov.**, male. A: *habitus*, lateral view; B: head, frontal view; C: head and pronotum, dorsal view; D: head and pronotum, lateral view; E: Body, dorsal view; F: Thoracic sternites, ventral view; G: foreleg, lateral view; H: midleg, lateral view; I–K: Terminalia in dorsal, ventral and lateral view respectively. Abbreviations: Mes: mesobasisternum; Met: metabasisternum; Cer: cerci; Sty: styli; Pl: subgenital plate.

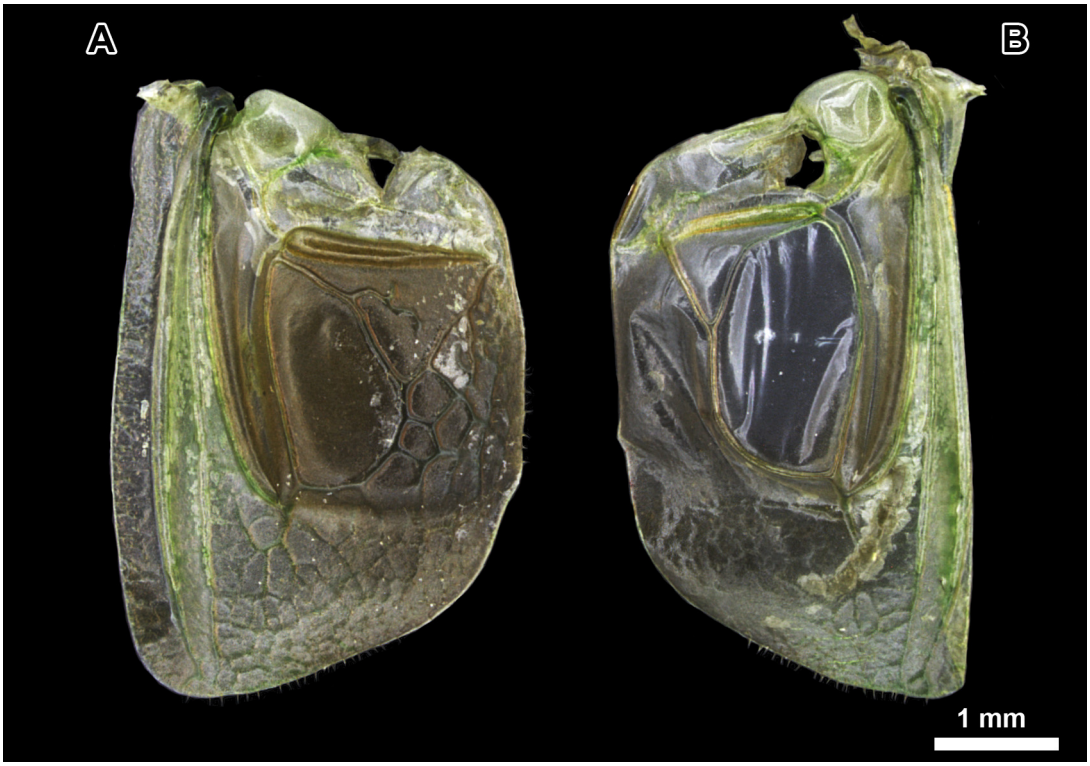

FIGURE 3. *Paraxiphidium iriodes* **sp. nov.,** tegmen of male in dorsal view. A: left tegmen; B: right tegmen.

FIGURE 4. *Paraxiphidium iriodes* **sp. nov.**, stridulatory file of male. A: left file; B: right file.

Type material. Holotype ♂: BRASIL, *Amazonas*, Tefé, Estrada da EMADE, km 20, Comunidade Bom Jesus, 06°07'29"S / 68°02'41"W, 25.xi.2018, coleta manual, D.M.M. Mendes & J.C. Oliveira *leg*. (INPA); Paratypes: *idem*, 18.ii.2018 (2♀–INPA).

Geographical records. Brazil: Amazonas (Fig. 11).

Description. Holotype Male.

Head. Head apex rounded, with fastigium-vertex short, slightly projecting, apex obtuse (Fig. 1B–D). Frons wrinkled and covered by short bristles (Fig. 1B). Compound eyes rounded (Fig. 1D).

Thorax. Head with apex rounded, fastigium of vertex short feebly prominent, apically truncate (Fig. 2B–C). Posterior portion of pronotal disc projecting and divided by a transverse suture (Fig. 2E); lateral lobes cephalically straight, medially curved and posteriorly slightly concave to the apex, when viewed laterally (Fig. 2D). Mesobasisternum and metabasisternum trapezoidal, posteriorly with triangular concavity (Fig. 2F).

Wings. Tegmina short, apex not meeting middle of abdomen (Fig. 2A); stridulatory region subrectangular, right tegmen with membranous region elliptical (Fig. 3); tegminal apex with a row of short bristles (Fig. 3). Right stridulatory file with base curved and apex slightly curved (Fig. 4B); total length 2 mm, greater width of the vein of 0.2 mm and 83 teeth; left stridulatory file with base curved and apex straight (Fig. 4A), total length of 1.5 mm, greater width of the vein of 0.1 mm and 68 teeth; medial teeth similar, short, broad and very close to each other (Fig. 4A–B); basal teeth rounded, spaced and decreasing in size towards base; apical teeth close to each other and decreasing towards apex (Fig. 4A–B).

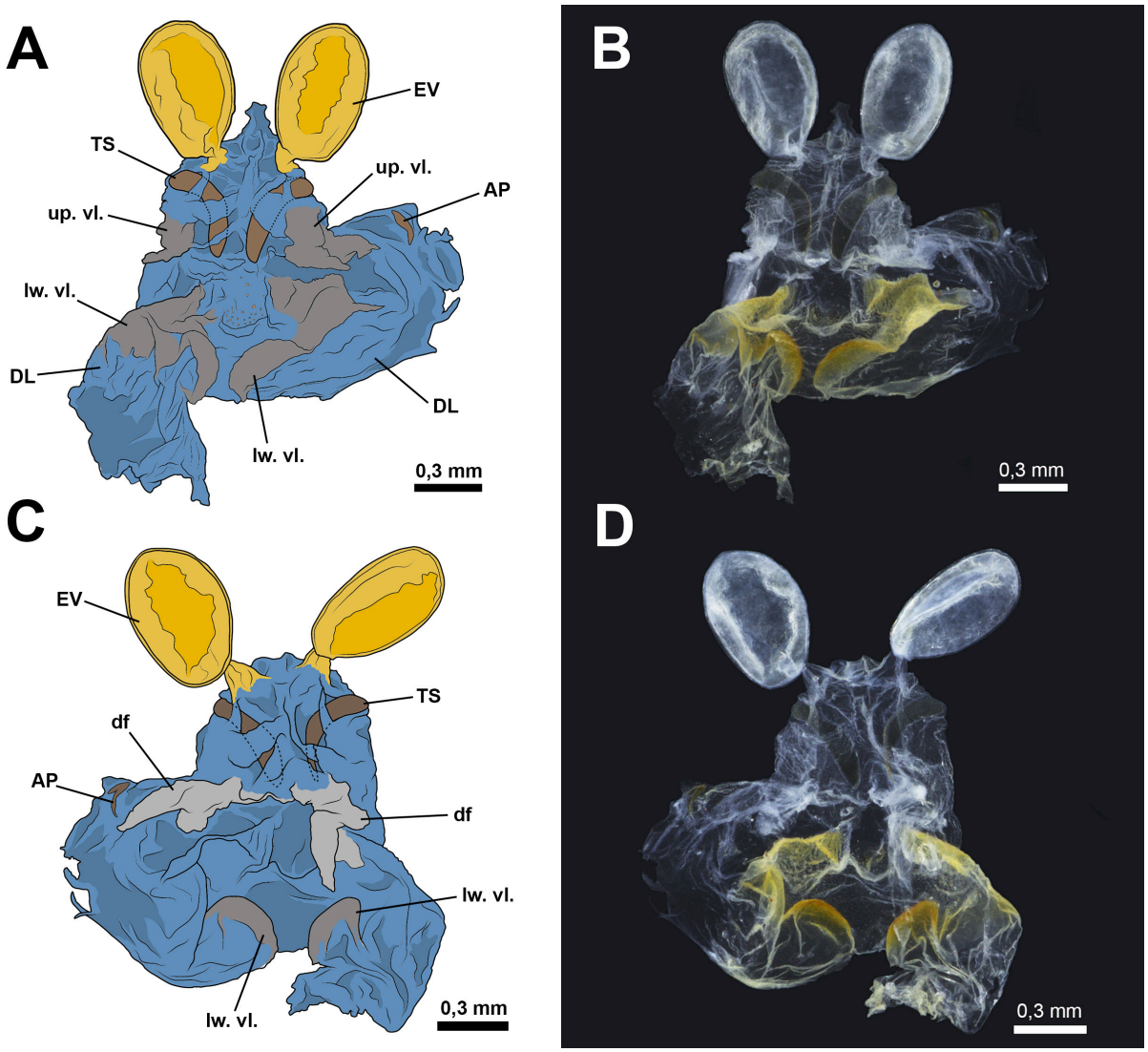

FIGURE 5. *Paraxiphidium iriodes* **sp. nov.**, male internal genitalia. A–B: phallus, ventral view; C–D: phallus, dorsal view. Abbreviations: AP: sclerites of apodemes; DF: dorsal fold; DL: dorsal lobe(s); EV: ejaculatory vesicles; TI: titillator process; TS: titillator sclerite; Lw. vl.: lower folds of ventral lobe; Up. vl.: upper folds of ventral lobe.

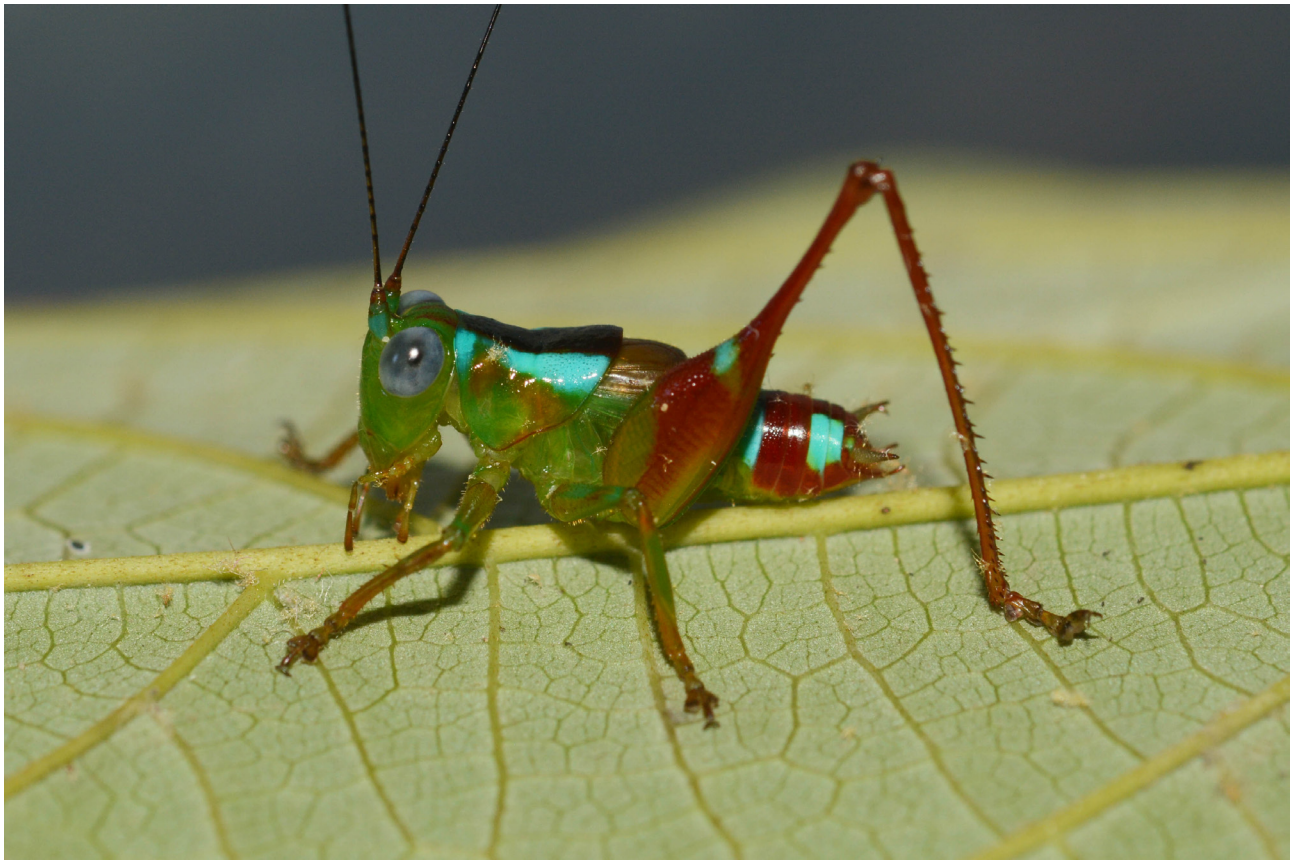

FIGURE 6. Male of *Paraxiphidium iriodes* **sp. nov.**, lateral view.

Legs. Fore and middle femora without spines (Fig. 2G–H). Fore tibia with tympanic region slightly enlarged and with six ventral spines (Fig. 2G). Hind femur basally thick, narrowing medially and becoming narrower apically; bearing five ventral spines (Fig. 2A).

Abdomen. Cercus and subgenital plate bearing numerous bristles (Fig. 2I–K), slightly curved, with medial portion wider than the apex and the base (Fig. 2I–K); apex bifurcate, with lateral projection curved and triangular, as long as apical projection (Fig. 2I–K); base with projection narrow and curved (Fig. 2I–K). Subgenital plate trapezoidal, with lateral margins slightly convex, apex bilobed (Fig. 2J); styli short, curved inwards (Fig. 2I–K).

Internal male genitalia. Ejaculatory vesicles elliptical (Fig. 5A–D). Upper folds of ventral lobe asymmetrical, not connected. Titillator a double sclerite slightly curved and opposing. Apodemes sclerites short and curved (Fig. 5A–D). Lower folds of ventral lobe split, curved, lobed with numerous small rounded nodules, in dorsal view (Fig. 5A–B); dorsal folds elongate and bilobed, in ventral view; dorsal lobes rounded (Fig. 5C–D).

Coloration. Described based on photos of live specimens (Fig. 6). Body light green mixed with some areas dark green. Scape light blue, pedicel brown, flagellum brown with black spots. Compound eyes gray-blue. Head dorsally with two brown bands. Pronotal disc dorsally with a black band with two light blue bands laterally parallel. Lateral pronotal lobes with a spot medially light brown and other areas dark green. Tegmina dorsally light brown and laterally dark green. Fore and mid femur light green, with brown and blue-green spots. Hind femur dark red, basally with yellowish-green spots and medially with light blue and dark green spots. Hind tibia basally dark red and medially with shades of light red to the apex. Abdomen dorsally dark red, with light blue bands on three segments; ventrally light green. Cerci light green with dark red apex. Subgenital plate and styles dark red.

Female. Morphologically similar to the male, except by the following characteristics:

Wings. (Fig. 2A). Tegmina reduced, barely crossing pronotal disc (Fig. 7C and 7E).

Abdomen. Cerci with numerous bristles, with the smallest at the apex (Fig. 7H); shape conical, slightly curved, with apex straight and acuminate (Fig. 7H). Subgenital plate trapezoidal, with apex slightly convex (Fig. 7I). Ovipositor slightly curved, with smooth margins (Fig. 7J), apex acuminate, with the dorsal valve crossing the apex of ventral valve (Fig. 7J). Ovipositor length almost equal to body length (Fig. 7A).

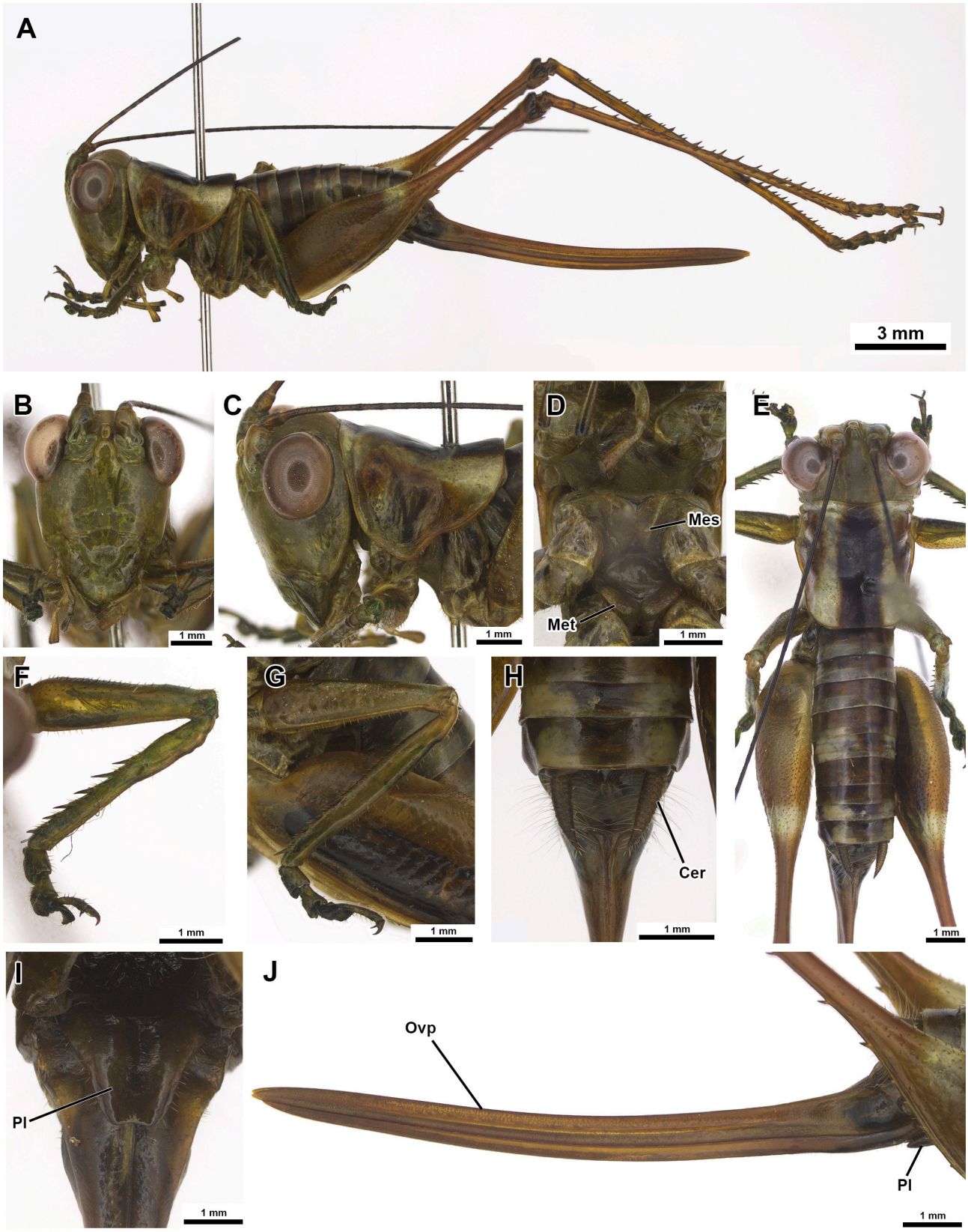

FIGURE 7. *Paraxiphidium iriodes* **sp. nov.**, female. A: habitus, lateral view; B: head, frontal view; C: head and pronotum, lateral view; D: Thoracic sternites, ventral view; E: Body, dorsal view; F: Foreleg, lateral view; G: Midleg, lateral view; H: Terminalia, dorsal view; I: Subgenital plate, ventral view; J: Ovipositor, lateral view. Abbreviations: Cer: cerci; Pl: subgenital plate; Ovp: ovipositor.

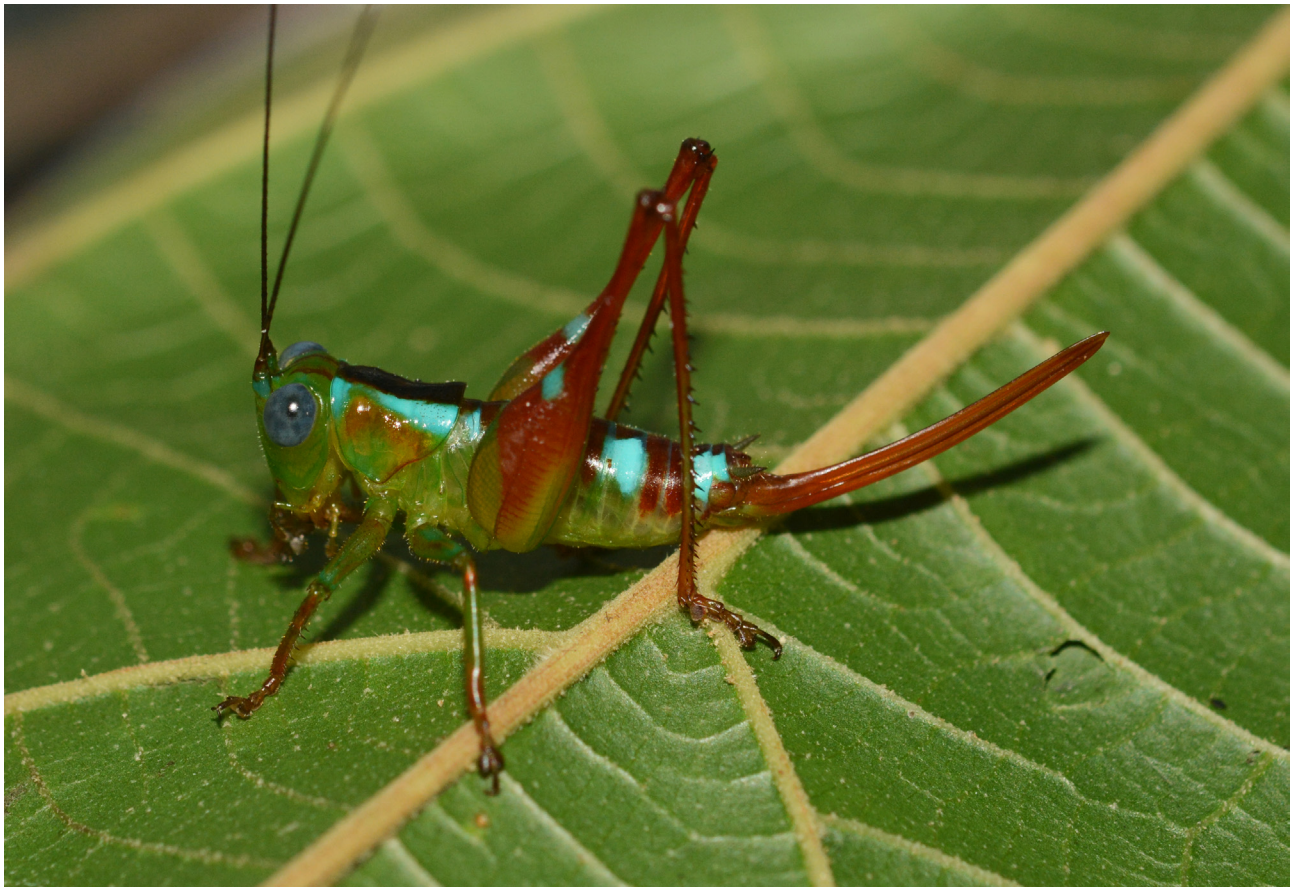

FIGURE 8. Female of *Paraxiphidium iriodes* **sp. nov.**, lateral view.

Coloration. Described based on photos of live specimens (Fig. 8). Compound eyes dark blue with gray spots. Cerci and subgenital plate light green. Ovipositor light red.

Nymph. Old nymphs are very similar to adults, with differences only in the coloration and terminalia morphology (Fig. 9B–C). However, the young nymphs have a different aspect from the adults, which for a long time intrigued the authors of this work about what would be the true identity of this katydid. Only with the rearing of the old nymphs and adults it was possible to realize this association.

Young nymphs (Fig. 9A). Compound eyes light blue. Antennae dark red with blue bands. Body bright red with many spots and light blue bands. Femur dark red with blue bands. Fore and mid tibia light green medially with blue and brown bands. Hind tibia brown with light green bands. Abdomen dorsally with dark green band.

Old nymphs (Fig. 9B–C). Compound eyes dark blue. Body dark red dorsally and gradually shifting to light green ventrally. Legs light green with blue bands. Hind femur apex with a black spot. Hind tibia black with two white bands. Abdomen dorsally with light green band and a lateral rectangular black spot. Last instar nymphs (Fig. 9C) are very similar in coloration to adults, however differing themselves by the black antennae with white bands and the lighter reddish shade of the body.

Measurements. Holotype ♂: TL: 11,2; TegL: 3,5; TegH: 1,3; WF: 3,4; PL: 4,5; PH: 3,3; FF: 4,1; FT: 3,9; MF: 4,9: MT: 4,5; HF: 9,9; HT: 10,7; Lplac: 2,1; LC: 1,9. Paratypes: Female**:** TL: 13,9; WF: 3,5; PL: 4,9; PH: 3,4; FF: 4,8: FT: 4,9; MF: 3,8: MT: 4,1; HF: 13,4; HT: 13,1; Lplac: 1,2; LC: 1,5; OL: 11,5. Male (Nymph): TL: 10,8; WF: 3,3; PL: 3,5; PH: 3,1; FF: 3,5; FT: 3,3; MF: 3,4: MT: 3,9; HF: 9,7; HT: 10,3; Lplac: 1,7; LC: 1,3.

Observation on behaviour. Adult specimens were collected at Terra Firme Rainforest diurnally, in open areas or edges of the forest with transition to a secondary vegetation. Adults are very active, with a very fast behavior, fleeing rapidly with the collector approach.

Immatures were found only at night, mainly in leaves of *Conceveiba* sp. (Euphorbiaceae) (Fig. 10). This type of plant is commonly found on the edges of forests and is also widely used for other katydid, with emphasis on some species of Meconematinae (Mendes *et al.* 2017; Mendes *et al.* 2018).

FIGURE 9. Live immatures of *Paraxiphidium iriodes* **sp. nov.**: A. Young nymph; B. Old nymph; C. Pre-adult nymph.

FIGURE 10. Immature male on leaves of *Conceveiba* sp. (Euphorbiaceae).

FIGURE 11. Geographical records of species *Paraxiphidium*.

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