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A new tribe of Tropiduchidae (Hemiptera: Fulgoroidea) with revision of the genus *Buca* and description of asymmetric hind leg spinulation

Vladimir M. Gnezdilov[1], Charles R. Bartlett[2], and Thierry Bourgoin[3]

Abstract

A new tribe Bucini **trib. nov.** is erected for the genus *Buca* Walker, 1858 in Tropiduchidae (Elicinae), with a discussion of tribal features with respect to the New World fauna. Two new species of *Buca* are described from Ecuador (*Buca asymmetrospinata* **sp. nov.**) and French Guiana (*Buca truncoptera* **sp. nov.**). Keys to *Buca* species and to higher taxa of New World Tropiduchidae are provided. Male and female genitalia of *Buca* species are illustrated for the first time.

Key Words: Issidae; Elicinae; new species; Neotropical; asymmetry; morphology

Resumen

Se describe una nueva tribu, Bucini trib. nov.,para el género *Buca* Walker, 1858 en los Tropiduchidae Elicinae, con una discusión de las características de la tribu con respecto a la fauna del Nuevo Mundo. Se describen dos nuevas especies de *Buca* de Ecuador (*Buca asymmetrospinata* n. sp.) y de Guayana Francesa (*Buca truncoptera* n. sp). Se proveen claves de identificación para las especies de *Buca* y de los taxones superiores de los Tropiduchidae del Nuevo Mundo. Se ilustran por primera vez las genitales masculinos y femeninos de especies *Buca*.

Palabras Clave: Issidae; Elicinae; nueva especie; Neotrópico; asimetría; morfología

As a medium size family within the Fulgoromorpha, Tropiduchidae Stål, 1866 currently comprises 652 described species in 183 genera, or about 4.9% and 7.8%, respectively, of all Fulgoromorpha (Bourgoin 2016). Its global latitudinal profile is distributed between the north temperate and the south subtropical bioclimatic zones, but mainly in the warmer regions (Bourgoin 2016). Most species feed on shrubs and trees, and some are crop pests (Fennah 1982; Wilson et al. 1994; O'Brien 2002); their association with host plants is quite diverse concerning 21 plant orders, including some monocots (Bourgoin 2016).

The first higher classification of the Tropiduchidae was presented by Melichar (1914). Later, based on various body structures and forewing venation, Fennah (1982) recognized 15 extant tribes (3 of them divided into subtribes). Subsequently, 4 extinct tribes (Jantaritambiini Szwedo, 2000; Emilianini Shcherbakov, 2006; Austrini Szwedo & Stroiński, 2010; and Patollini Szwedo & Stroiński, 2013) were described (Szwedo 2000; Shcherbakov 2006; Szwedo & Stroiński 2010, 2013). Gnezdilov (2007) transferred the subfamily Trienopinae Fennah, 1954 from Issidae Spinola, 1839 to Tropiduchidae together with the subtribe Gaetuliina Fennah, 1978 from Nogodinidae Melichar, 1898, with tribal status for both. The Gaetuliini were subsequently synonymized with Elicini Melichar, 1915, and 2 additional tribes (Parathisciini and Chrysopuchini) were described (Gnezdilov 2013b). Based on female genitalia characters (shape and dentition of the gonoplacs and the shape of gonapophyses IX), the family was also divided into 2 subfamilies Tropiduchinae Stål, 1866 and Elicinae Melichar, 1915 (Gnezdilov 2013b) with 19 and 5 tribes, respectively (Table 1). The tribe Hiraciini Melichar, 1914 was removed from the Tropiduchidae by Fennah (1982) and remains unplaced within the Fulgoroidea (Gnezdilov 2013b).

The Neotropical genus *Buca* Walker, 1858 is currently considered as an *incertae sedis* taxon (Gnezdilov 2013a). The genus was erected for the single species *Buca simplex* Walker, 1858 from "Villa Nova," Brazil. To date, the genus is known only by the holotype of the type species. Originally placed under the subtribe Flatoides in the tribe Issites, the genus was first transferred into Issidae Spinola, 1839 (Issinae) by Muir (1930) but without tribal assignment. Shortly after that, Muir (1931) re-described the type specimen and illustrated it for the first time (Muir 1931, Fig. 10a–c therein). *Buca* was listed within the Issini by Metcalf (1958) before being finally removed from Issidae and provisionally placed in the family Tropiduchidae by Gnezdilov (2013a) (Fig. 1).

Here we revise *Buca* based on specimens from Ecuador, Bolivia, Brazil, and French Guiana representing 3 species, 2 of which are new and described below. The species differ by coloration and forewing shape and venation, but are little differentiated by male genitalia. We also discuss the features of the higher classification of New World Tropiduchidae as they pertain to *Buca* and provide a key to higher taxa.

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Table 1. Summary of modern classification of Tropiduchidae (including the new tribe described below).

Elicinae Melichar, 1915	Tropiduchinae Stål, 1866
Austrini† Szwedo & Stroiński, 2010	Alcestini Melichar, 1914
Bucini **trib. nov.**	Catulliini Melichar, 1914
Elicini Melichar, 1915	Chrysopuchini Gnezdilov, 2013
Parathisciini Gnezdilov, 2013	Cixiopsini Fennah, 1982
Patollini† Szwedo & Stroiński, 2013	Cyphoceratopini Fennah, 1945
	Emilianini† Shcherbakov, 2006
	Eporini Fennah, 1982
	Clardeina Fennah, 1982
	Eporina Fennah, 1982
	Kazerunina Dlabola, 1974
	Isporisini Fennah, 1982
	Jantaritambiini† Szwedo, 2000
	Eutropistini Kirkaldy, 1906
	Duriina Fennah, 1982
	Eutropistina Kirkaldy, 1906
	Neommatissini Fennah, 1982
	Paricanini Melichar, 1914
	Remosini Fennah, 1982
	Tambiniini Kirkaldy, 1907
	Tangiini Melichar, 1914
	Neotangiina Fennah, 1982
	Tangiina Melichar, 1914
	Trienopini Fennah, 1954
	Tropiduchini Stål, 1866
	Trypetimorphini Melichar, 1914
	Turneriolini Fennah, 1982

Materials and Methods

The specimens examined were deposited in the following collections:

BMNH— The Natural History Museum, London, United Kingdom;

LBOB— Lois O'Brien collection, Green Valley, Arizona (affiliated with the California Academy of Sciences, San Francisco, California);

MNHN— Muséum National d'Histoire Naturelle, Paris, France;

UDCC— University of Delaware, Department of Entomology and Wildlife Ecology, Newark, Delaware;

USNM— Smithsonian Institution, National Museum of Natural History, Washington, District of Columbia;

ZIN— Zoological Institute, Russian Academy of Sciences, Saint Petersburg, Russia.

Terminology of external morphological characters primarily follows Anufriev & Emeljanov (1988) and Gnezdilov et al. (2014), except for the female genitalia nomenclature, which follows Bourgoin (1993) and Gnezdilov (2002), and with the male terminalia nomenclature modified after Bourgoin (1988) and Bourgoin & Huang (1990). Nomenclature for wing venation follows Bourgoin et al. (2015) for the forewing and Anufriev & Emeljanov (1988) for the hind wing. Measurements and photographs at UDCC were taken using a digital imagery system consisting of a Nikon SMZ1500 microscope, Nikon Digital Sight DS-U1 camera, and NIS Elements Imaging software (version 3.0), and at the National Museum of Wales (Cardiff, United Kingdom) using a Leica MZ8 with JVC video camera KY F7OB with the software Synoptics Automontage. Measurements were made directly from the specimens (for *B. asymmetrospinata* **sp. nov.**) or from calibrated photographs (for *B. simplex*, and *B. truncoptera* **sp. nov.**). Features ascribed to the genus are not repeated in the species level descriptions. Labels of name-bearing types are provided quoted verbatim using "/" to indicate a line break and "//" to indicate a new label and with supplemental information given in brackets. For other material examined, label data were rewritten to maintain consistency in pattern, beginning with the country, state, or province, followed by more specific locality information, collection date, and collector; the number and sex of specimens and the depository where the specimens are located are given in parentheses. Specimens at the UDCC (including loan) were provided 2D barcode labels, and label data were captured for online presentation (visualized at Discover Life at www.discoverlife.org, these data accessible from iDigBio at https://www.idigbio.org/) using "Arthropod Easy Data Capture" (Schuh et al. 2010; Schuh 2012; Arthropod Easy Capture 2013).

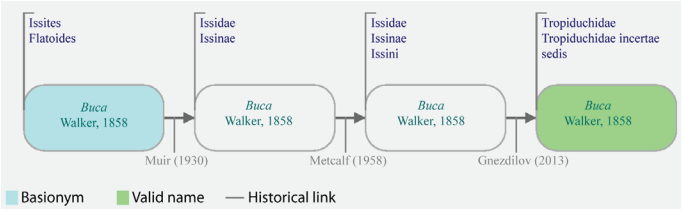


Fig. 1. Evolution of the classification of genus *Buca* Walker, 1858 within Fulgoroidea since its first description.

Results

Family Tropiduchidae Stål, 1866

General characters of the family were given by Fennah (1982), Anufriev & Emeljanov (1988) and more recently modified by Gnezdilov (2007, 2013b), who separated the family into 2 subfamilies: Elicinae and Tropiduchinae. Currently, tropiduchids may be separated from other Fulgoroidea by the combination of characters as follows: postclypeus sometimes with lateral longitudinal carinae; pronotum with elevated, arcuate disc; scutellum usually with sharply expressed step-like scuto-scutellar boundary; forewings sometimes thickened; costal area—topologically after CA (margin) and anteriorly to Pc+CP vein = costal cell (Bourgoin et al. 2015)—may be developed with transverse veins; clavus open (Pcu+A1 runs into more or less pointed apex of clavus); hind wings well developed (2- or 3-lobed) or rudimentary; hind tibiae with several lateral spines or without spines; 2nd metatarsomere with only 2 latero-apical spines; female genitalia with gonapophyses IX flattened dorsoventrally, gonospiculum bridge with 3 distinct long rods connected with gonapophyses IX, anterior connective lamina of gonapophyses VIII comb-like and with small denticles on its disc; gonoplacs with denticles; for male genitalia most Tropiduchidae are distinguished by having the aedeagus in the shape of a narrow curved tube with hook-shaped processes, phallotheca usually short (except Bucini **trib. nov.**), and gonostyli with distinctive finger-shaped lateral tooth.

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Diagnostic Key to Higher Taxa of New World Tropiduchidae

1.— Wings shallowly tectiform, usually with distinct nodal line (forewings often slightly inflected at nodal line) with venation distinctly reticulate distally; ovipositor flattened laterally, elongated (styletized), gonoplacs usually with distinct marginal teeth; gonapophyses IX in shape of isosceles triangle . . . . . Tropiduchinae

1′.— Wings more steeply tectiform, nodal line not distinct, forewing venation either not reticulate or entire forewing reticulate; ovipositor rounded, gonoplacs without marginal teeth or with denticles; gonapophyses IX elongate, but not triangular . . . . . Elicinae 2

2.— Wings steeply tectiform, almost parallel to body, wings broad, well exceeding abdomen, with forewing venation not reticulate (with few crossveins); costal area almost without transverse veins, CuA impair (i.e., with single branch; if forked, after the clavus), clavus with transverse vein cup-(pcu+a1); hind tibiae and 2nd metatarsus with asymmetrical apical spinulation; color green yellowish to pale yellow (possibly green in life); phallotheca covering aedeagus almost completely; gonostylus with plate-shaped lateral tooth . . . . . Bucini **trib. nov.**

2′.— Wings less steeply tectiform, broad or narrowed, barely exceeding abdomen (at most); forewing venation reticulate (with many crossveins); costal area with many transverse veins; CuA furcates into CuA1 and CuA2 before end of the clavus, clavus without transverse vein cup-(pcu+a1); hind tibiae and 2nd metatarsus with symmetrical apical spinulation; color varied (rarely yellow or green); phallotheca short, not covering aedeagus; gonostylus with finger-shaped lateral tooth . . . . . Elicini

Subfamily Elicinae Melichar, 1915

Tribe Bucini **trib. nov.**

Type genus: *Buca* Walker, 1858

Diagnosis. Head narrower than thorax, projecting in front of eyes, coryphe (~vertex) broad. Rostrum short, reaching only middle coxae; 3rd segment of rostrum shorter than 2nd. Forewings broad with prominent venation, held steeply tectiform, veins not reticulate, transverse veins absent in costal area; long impair CuA (Fig. 7A); transverse veinlets cup-(pcu+a1) on the clavus in a distal position. Hind wings trilobed with 2 weak marginal clefts between CuA and CuP and A1 and A2, venation simple (Fig. 7B). Hind tibiae with a single lateral spine. Hind tibiae and 1st metatarsus with asymmetrical apical spinulation. Ovipositor rounded (not styletized), gonoplacs without marginal teeth. Phallus recurved with well developed phallotheca almost reaching apex of aedeagus. Aedeagus bearing a pair of ventral hooks arising in its apical third (Figs. 9A, 10A). Gonostyli with plate-shaped lateral tooth (Figs. 9C, D and 10D, E).

Genus *Buca* Walker, 1858

Type species: *Buca simplex* Walker, 1858

Emended diagnosis. Head (including eyes) much narrower than pro- and mesothorax. Metope (~frons) heptagonal in frontal view, slightly convex, sharply widest near antennae, abruptly narrowed above compound eyes, with distinct median carina, sublateral carinae absent. Metopoclypeal suture distinct and concave (Figs. 2C and 4A). Median carina of clypeus weak or absent. Coryphe broad and projected anterior to eyes, fastigium carinate and strongly inflected, posterior margin of coryphe concave. Coryphe, pro-, and mesonotum with median carina. Antennal scape short, pedicel elongately cylindrical with sensory plaques clustered primarily on the distal dorsal surface. Ocelli present below compound eye, anterodorsad of antennae. Pronotum short, broadest medially and abruptly narrowed within eyes, paranota narrow and elongate (nearly reaching tegulae), posterior margin concave with shallow median notch. Mesonotum large, 5–7 times as long as pronotum medially. Scutellum separated from mesonotum by transverse groove. Tegulae large, curved. Macropterous, wings broad and elongate, well exceeding abdomen, held steeply tectiform (almost parallel to body) in repose. Forewings transparent, basal cell large, costal area present (Pc+CP separated from CA), costal area lacking crossveins; forewing venation (Figs. 7A and 8): Radius 3–6 branched, 2–4 r-m crossveins, Media with MP1 multibranched (from 2 to 5), MP2 and MP3 unibranched, MP4 2-branched, a postnodal line built from 3–6 im crossveins; 1 m-cua crossvein, CuA (except short fur-

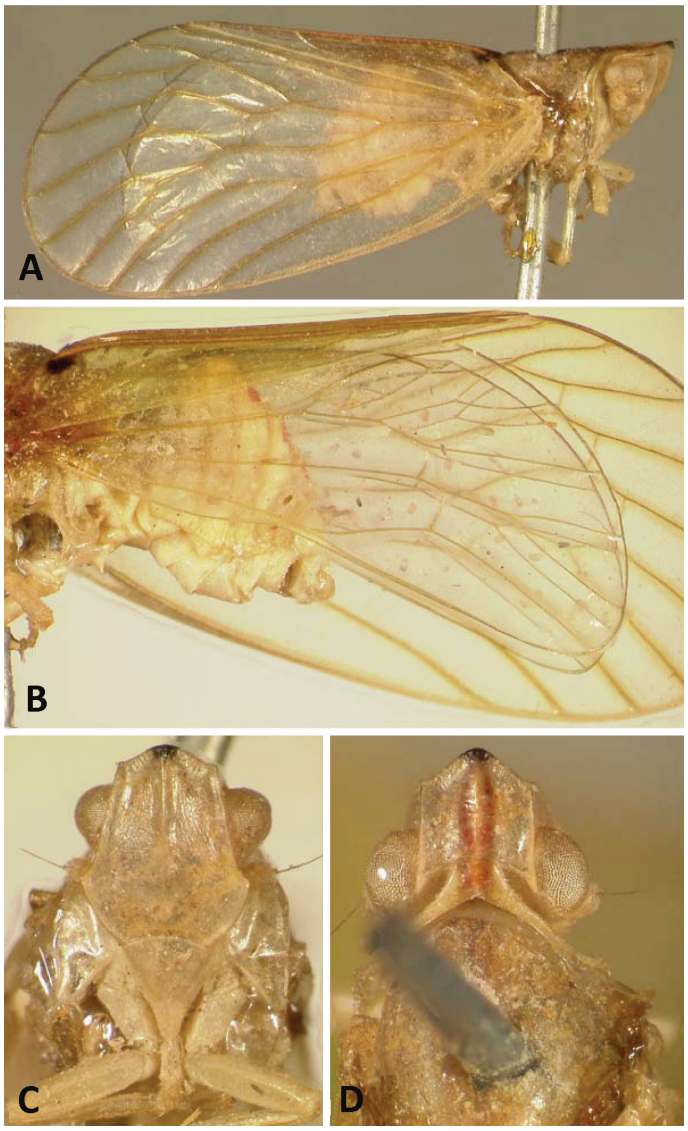


Fig. 2. *Buca simplex* Walker (holotype); A) habitus, right lateral view; B) hind wing and abdomen, left lateral view; C) metope and clypeus, frontal view; D) head and thorax, dorsal view.

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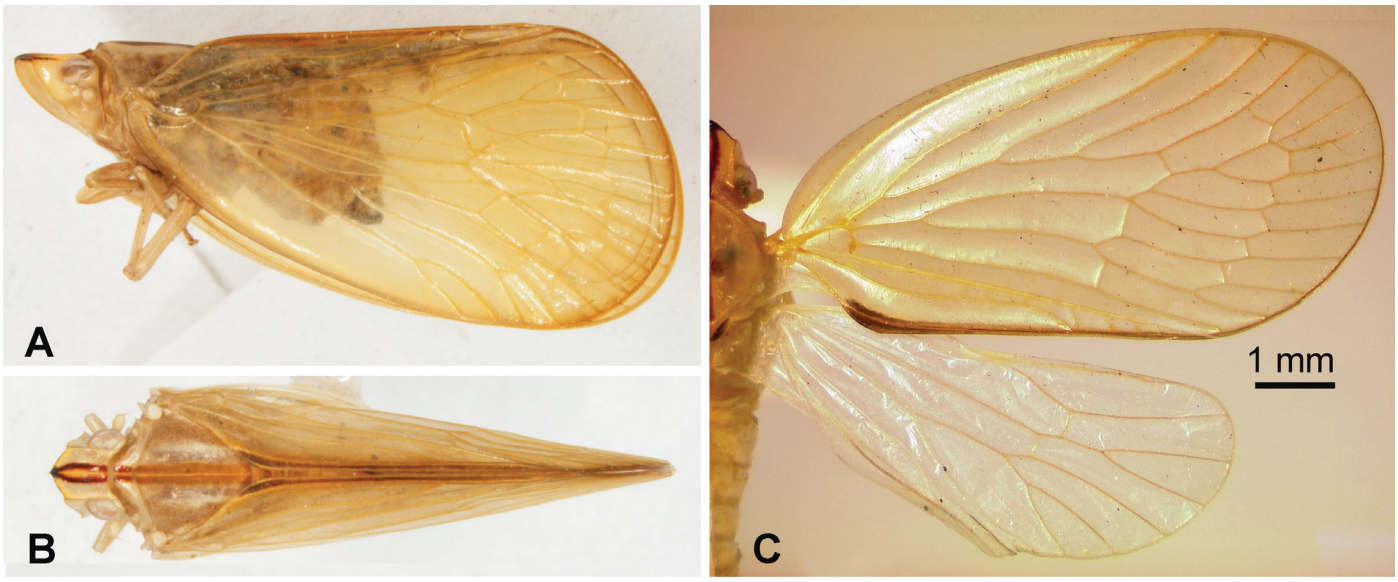


Fig. 3. *Buca asymmetrospinata* **sp. nov.**, (paratypes, A–B, Onkone Gare ♀; C, Shushufindi); A) habitus, left lateral view; B) habitus, dorsal view; C) right wings.

cation in *B. truncoptera* **sp. nov.**) and CuP usually unibranched; Pcu + A1 fused in distal half of clavus, A1 following postclaval margin contour defining very narrow anal cell on trailing margin of wing. Cell C1 long and open, C3 long and closed, not in contact with C4. Abdomen convex (in lateral view), tergites with peculiar median red spots or an even stripe.

Spinulation of hind tibiae apex asymmetrical, 1 large latero-apical spine and a row of 5 or 6 small intermediate spines. First metatarsomere with 2 latero-apical spines and row of 4–6 intermediate spines between them, each intermediate spine bears a long subapical seta. Second metatarsomere asymmetric, with a single latero-apical spine that is exceeded by a large lobe projecting from its ventral surface (instead of 2nd latero-apical spine; Fig. 6).

Abdomen arched dorsally. Phallus upcurved, phallotheca almost entirely covering aedeagus, which has a pair of elongate ventral retrose hooks in its distal third. Gonostyli with long apically enlarged and medially curved capitulum, bearing a distinct lateral lobe-shaped tooth. Pygofer in lateral view relatively narrow and tall, concave on anterior margin and convex on caudal margin. Anal tube narrow and elongate in lateral view. Paraproct about half as long as anal tube.

Etymology. The origin of the genus name was not stated in Walker (1858), and the derivation of the genus name is not evident and can only be speculated upon. We treat *Buca* as derived as an arbitrary combination of letters of feminine gender.

Key to Species

1. — Trailing margin of forewing roundly convex; forewing with ScP+RA unforked; general coloration yellowish, apical cells of forewing transparent without dark markings at apex of wing 2

1'.— Trailing margin of forewing roundly truncate; forewing with RA separated from ScP apically; general coloration light green yellowish (mid-dorsal stripe of head and thorax dark and very pronounced), apical cells of forewing with dark brown patches; French Guiana . . . . . *B. truncoptera* **sp. nov.**

2.— Forewing with RP 3-branched and MP1 3- to 5-branched (Fig. 8A); gonostylus of male genitalia with concave hind margin (Fig. 10D); male anal tube in dorsal view slightly narrowing subapically (Fig. 10C); ventral aedeagal hooks slightly enlarged proximally (Fig. 10A); Ecuador. . . . . *B. asymmetrospinata* **sp. nov.**

2'.— Forewing with RP and MP1 each 2-branched; gonostylus with convex hind margin (Fig. 9C); male anal tube in dorsal view not narrowing subapically (Fig. 9B); ventral aedeagal hooks not enlarged proximally (Fig. 9A); Brazil, Bolivia . . . . . *B. simplex* Walker

Buca simplex Walker, 1858 (Figs. 2, 7, 9)

Emended diagnosis. Color dull yellowish, mid-dorsal vitta weak on mesonotum; forewings lacking dark coloration at apices. Trailing margin of forewings roundly convex, forewing venation with 2 branches of RP, ScP and RA fused, 6 branches of MP and 2 r-m crossveins. Gonostylus with convex hind margin. Ventral aedeagal hooks long and narrow. Male anal tube with convex lateral margins.

Supplementary description. Color. Body pale dull yellowish (possibly greenish in life; Muir 1931) with reddish mid-dorsal red to brown stripe following median carinae of coryphe and pronotum, weaker on midline mesonotum and commissural margin of forewings. Dark spot at middle of fastigium. Abdominal tergites IV-VI each with big median red spot. *Structure*. Body length (with wings; ♀ holotype) 9.3 mm [Bolivian male 8.0 mm], body length (without wings), 5.0 mm. Metope wide (L:W at widest point 1.14), sharply enlarged above clypeus (near level of antennae in frontal view), with distinct median carina running from fastigium to level of antennae, obsolete ventrad of antennae. Lateral margins of metope sharp, laterally projected, hiding scape in frontal view. Clypeus with carina absent. Coryphe broad (Fig. 2D), length at midline approxi-

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Fig. 4. *Buca asymmetrospinata* **sp. nov.** (paratypes, Onkone Gare); A) metope and clypeus, frontal view; B) head and thorax, dorsal view; C) female genitalia in situ, ventral view; D) male genitalia in situ, ventral view.

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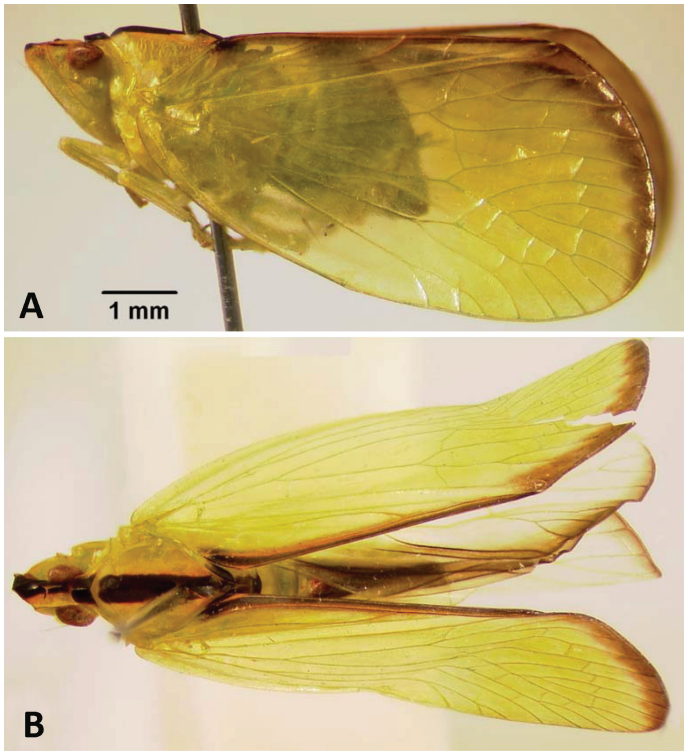


Fig. 5. *Buca truncoptera* **sp. nov.** (holotype, ♀); A) habitus, left lateral view; B) habitus, dorsal view.

mately equal to width (L:W ratio 0.91); lateral margins parallel; anterior margin of coryphe convex, posterior margin concave. Pronotum short with median carina, disc small, paranota narrow, acutely angulate, nearly reaching tegulae, without carinae. Mesonotum very large, approximately 7 times as long as pronotum medially (ratio of mesonotum length excluding scutellum to pronotum length = 7.04), with weak median and very weak lateral carinae. Forewings long (7.4 mm), extending well past end of abdomen, and wide (3.8 mm), apically rounded (Fig. 2A). Forewing venation: ScP+RA, 2 RP, 2 r-m, 2 MP1, 1 MP2, 1 MP3, 2 MP4, 1 m-cua, 1 CuA, distal cup-(pcu+a1) (Fig. 7A). Hind wing venation: RA, RP, r-m, 1 MP1, 1 MP2, m-cua1, 3 CuA1, CuA2, CuP, Pcu, 2A1, A2 (Fig. 7B). Nodal cells with C1 long and open, C2 closed, C3 not connected to both C2 and C4, C4 open, C5 absent by an impair CuA.

Male terminalia. Pygofer with slightly convex caudal margin. Phallus strongly curved in lateral view, dorsolateral phallothecal lobes fused and weakly sclerotized dorsally, each lobe with narrow subapical process; ventral phallothecal lobe not reaching apical phallotheca margin. Apical aedeagal processes with rounded apices, visible above phallothecal margin. Aedeagus with pair of long (2/3 aedeagal length) and narrow ventral hooks, apically acuminate. Gonostyli with long and narrow capitulum (in dorsal view), bearing a plate-shaped lateral tooth; hind margin of gonostylus convex, caudo-dorsal angle nearly right. Anal tube almost 3 times as long as wide, with convex lateral margins (in dorsal view), flattened (in lateral view). Paraproct long, almost 2.5 times as long as anal tube.

Remarks. Walker (1858) specifies the type locality as "Villa Nova" from the [Henry Walter] Bates collection. This locality is on the Amazon River and appears to be located at 3.3580°S, 64.7052°W in Estado do Amazonas. This species was previously re-described by Muir (1931).

Type material examined. Holotype, Brazil: "Villa / Nova" [round label, handwritten] "55 / 44" [backside of round label, indicating 1855, BMNH registry entry 44, i.e., "Collector Mr Bates Purchased from Stevens"] // "Buca simplex" (♀, BMNH).

Other material examined. **Bolivia**. Beni [Department], Rio Itenez / opposite Costa Marques / (Brazil), Sept. 4–6, 1964 / [J.K.] Bouseman & Lusenhop (1♂, LBOB). **Brazil**. Amazonas [State], Manaos, Monacapuru / March 1928 / S.M. Klages (1♀, LBOB).

Buca asymmetrospinata **sp. nov.** (Figs. 3, 4, 6, 8A, 10, 11)

Diagnosis. Color yellowish, mid-dorsal vitta orangish across mesonotum; forewings lacking dark coloration at apices. Trailing margin of forewing roundly convex, forewing venation with 3–5 branches of RP and 7–9 branches of MP and 2 r-m crossveins.

Description. Color. Body pale yellowish with mid-dorsal red to brown stripe following median carinae of coryphe, pronotum, and mesonotum and more weakly along the commissural margin of forewings (darkest on the vertex); black marking at apex of fastigium and extending to lateral margin. Abdominal tergites III-VI each with big median red spot. *Structure*. Body length (with wings), ♂ 8.48 ± 0.35 mm (*n* = 5), ♀8.68 ± 0.32 mm (*n* = 5); body length (without wings), ♂ 5.51 ± 0.26 (*n* = 5), ♀ 4.79 ± 0.23 (*n* = 5). Metope width (L:W at widest point 1.23 ± 0.05, *n* = 10), sharply enlarged above clypeus (near level of antennae in frontal view), with distinct median carina running from fastigium to level of antennae, but obsolete ventrad of antennae. Lateral margins of

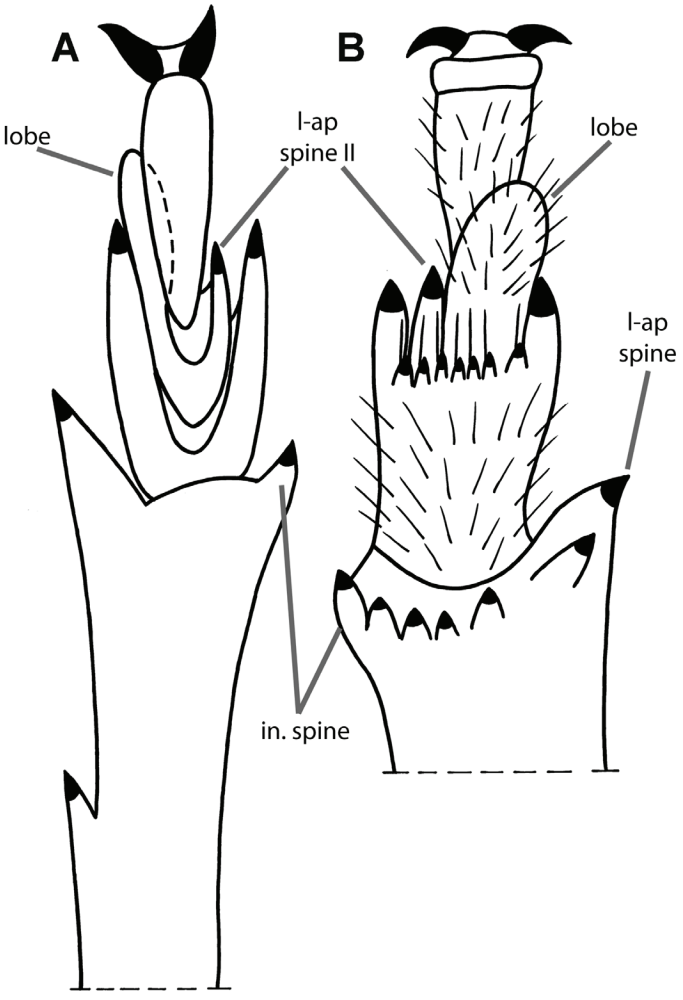
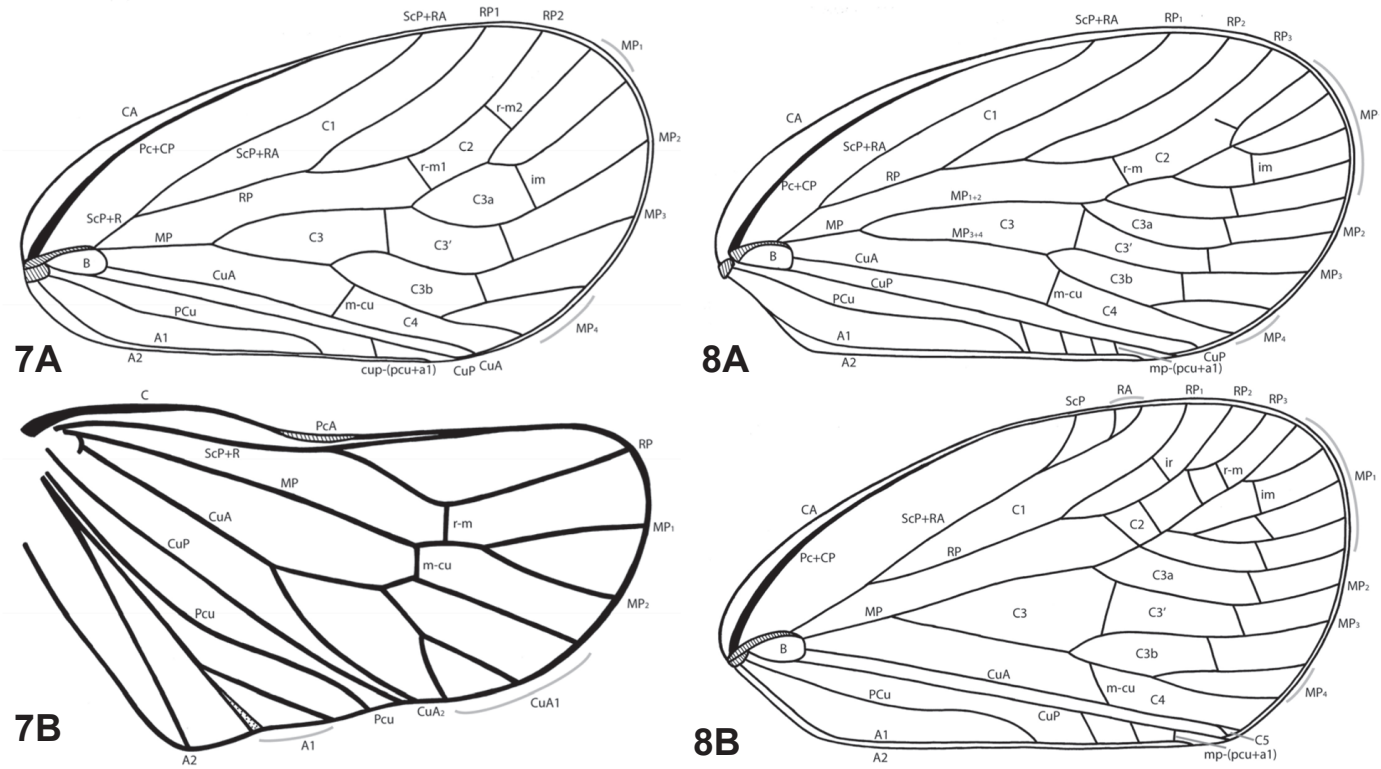


Fig. 6. Apex of metatibia and metatarsus of *B. asymmetrospinata* **sp. nov.** (*in. spine* = apical intermediate spines of metatibia; *l-ap spine* = latero-apical spines of metatibia; *l-ap spine II* = latero-apical spines of 2nd metatarsomere; *lobe* = ventral lobe of second metatarsomere); A) dorsal view; B) ventral view (same leg).

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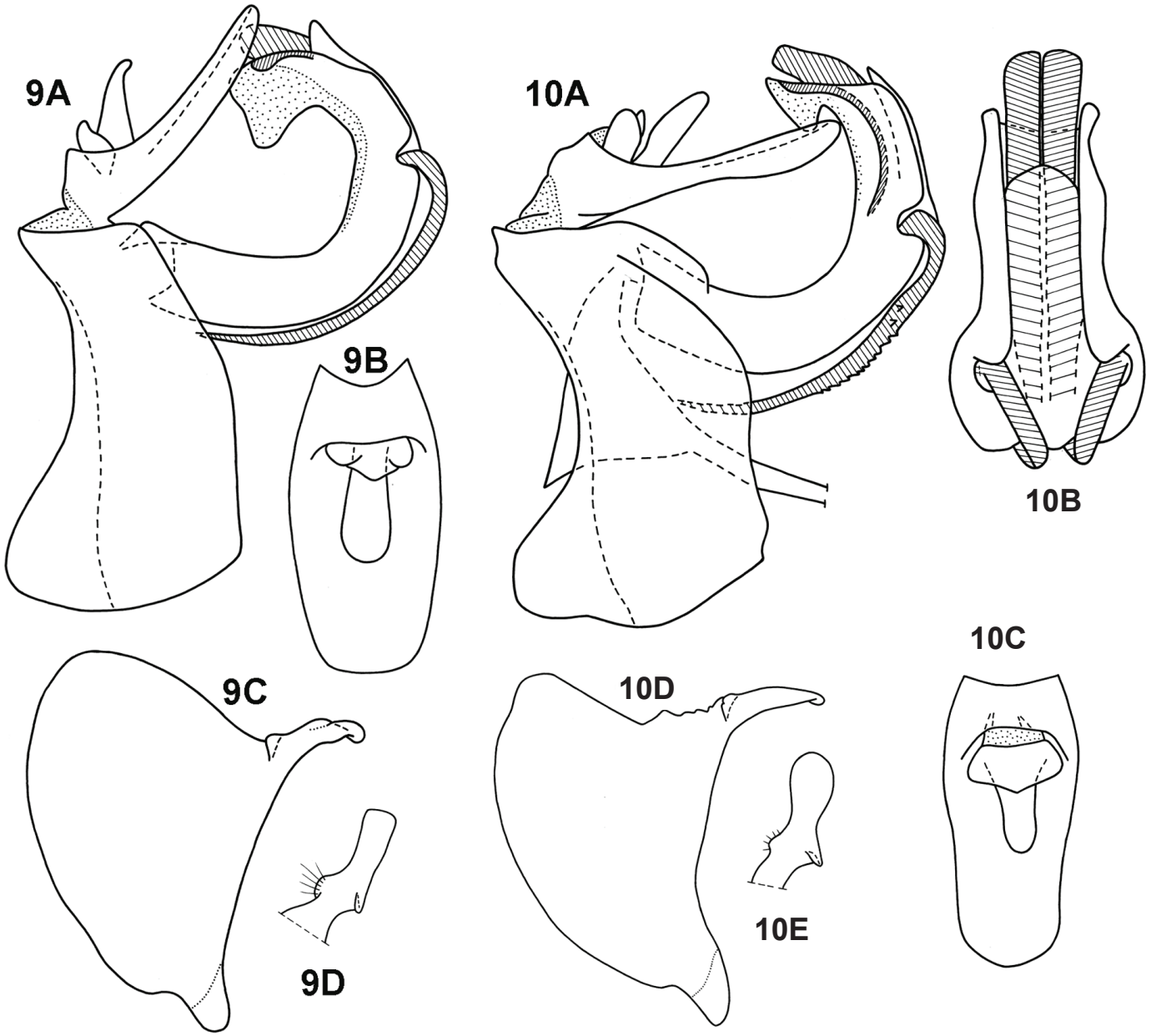
Figs. 7 and 8. Wing venation. **Fig. 7**. Wing venation of *Buca simplex* Walker; A) forewing (holotype); B) hind wing (Bolivia). Annotations: A1, A2 = anal veins; B = basal cell; C1, C2, C3 (C3a, C3', C3b), C4 = Cells 1-4; C = Costa; CA = anterior Costa; CP = posterior Costa; CuA = anterior Cubitus; CuP = posterior Cubitus; cup-(pcu+a1) = transverse vein from CuP to Cpu+A1 veins; im = intramedial crossvein; m-cu = medial-cubitus crossvein; MP = posterior Media; Pc = Precosta; PcA = anterior Precosta; Pcu = postcubitus; r-m = radial-media crossvein; R = Radius; RP = posterior Radius; ScP = posterior Subcosta. **Fig. 8**. Forewing venation; A) *Buca asymmetrospinata* **sp. nov.** (paratype); B) *Buca truncoptera* **sp. nov.** (holotype). Annotations: A1, A2 = anal veins; B = basal cell; C1, C2, C3 (C3a, C3', C3b), C4, C5 = Cells 1-5; C = Costa; CA = anterior Costa; CP = posterior Costa; CuA = anterior Cubitus; CuP = posterior Cubitus; cup-(pcu+a1) = transverse vein from CuP to Cpu+A1 veins; im = intramedial crossvein; m-cu = medial-cubitus crossvein; MP = posterior Media; Pc = Precosta; PcA = anterior Precosta; Pcu = postcubitus; r-m = radial-media crossvein; R = Radius; RP = posterior Radius; ScP = posterior Subcosta.

metope sharp, laterally projected to hide scape from frontal view. Clypeus with weak carina. Coryphe broad (Fig. 4B), length at midline approximately equal to width at widest point (near apex; L:W ratio 0.99 ± 0.08, *n* = 10); lateral margins subparallel, very weakly diverging distally; anterior margin of coryphe convex, posterior margin concave. Pronotum short with median carina, disc (median part of pronotum) small, paranota narrow, acutely angulate, nearly reaching tegulae, without carinae. Mesonotum very large, over 6 times as long as pronotum medially (ratio of mesonotum length excluding scutellum to pronotum length = 6.39 ± 0.59, *n* = 10), with distinct median and weak lateral carinae. Scutellum separated by a transverse sulcus. Forewings long (7.12 ± 0.33 mm, *n* = 10), extending well past end of abdomen, and wide (3.60 ± 0.28 mm), with costal area lacking transverse veins (Figs. 3C, 8A). Forewing with crossveins absent in costal area; basal cell large; ScP+RA (branch ScP+RA forked from RP in proximal third of wing), RP 3; 2 r-m crossveins; MP 7–9 branched (1st M fork just distad of 1st R fork), following a proximal nodal cell C3, postnodal media cells divided into distal and proximal cells by 6 or 7 im crossveins in a post-nodal line; 1 m-cu crossvein; CuA and CuP usually simple; C5 absent or very distally and open; clavus long, open; Pcu reaching A1 past distal third of wing in apical portion of clavus; 1–4 transverse veins CuP and Pcu near apex of clavus; A1 arched to follow contour of postclaval margin, creating narrow (and usually darkened) cell between A1 and trailing margin of wing.

Male terminalia. Pygofer in lateral view relatively narrow, broadest ventrally (underside concave from ventral view), with convex caudal margin. Phallus recurved in lateral view, dorsolateral phallothecal lobes fused dorsally, each with a narrow subapical process; ventral phallothecal lobe narrow, rounded apically, not reaching apical phallotheca margin. Apical aedeagal processes truncate. Aedeagus with pair of long (2/3 aedeagal length) ventral hooks, apically acuminate, sometimes with marginal teeth. Gonostyli with long, apically enlarged capitulum (in dorsal view), bearing a plate-shaped lateral tooth; hind margin of gonostylus angularly concave, caudo-dorsal angle right. Anal tube narrow and elongate (in lateral view), nearly parallel-sided, distal portion usually slightly expanded (in dorsal view). Paraproct long, almost half as long as anal tube.

Female terminalia. Gonoplacs in lateral view nearly rectangular; gonoplac lobes fused along the median line (in dorsal view)—1st and 2nd gonoplac lobes completely fused, 3rd lobes narrow, separated apically. Posterior connective laminae of gonapophyses IX elongate (in ventral view). Lateral fields of the gonapophyses flat. Distal portions of the laminae straight. Median field convex (in lateral view); lobes fused, with pair of folds directed inside of the field perpendicularly to the field. Gonospiculum bridge narrow. Hind margin of gonocoxae VIII not protruding. Anterior connective lamina of gonapophyse VIII wide. Apical group of teeth of the lamina with 3 teeth, lateral group with 4 teeth (3 of which are keeled; Fig. 11E). A large tooth is present below the apical group outside of lateral group. Endogonocoxal process wide, with forked apex. Anal tube narrowing apically—spear-shaped, in dorsal view twice as long as wide (Fig. 11A); flat in lateral view (Fig. 11B). Paraproct very long, reaching anal tube apex.

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Figs. 9 and 10. Male terminalia and genitalia. **Fig. 9**. Male terminalia of *Buca simplex* Walker (Bolivia); A) terminalia, right lateral view (styli removed); B) dorsal view of anal tube and paraproct (distal margin downward); C) left gonostylus (hind margin upward); D) detail view of gonostylus capitulum (in dorsal view). **Fig. 10**. *Buca asymmetrospinata* **sp. nov.** male genitalia (paratype); A) terminalia, right lateral view (styli removed); B) distal portion of phallus, ventral view; C) dorsal view of anal tube and paraproct (hind margin right); D) left gonostylus (hind margin upward); E) detail view of gonostylus capitulum (in dorsal view).

Etymology. The specific epithet is derived from the Greek word "*asymmetros*" (without symmetry, disproportionate) joined with the Latin word "*spine*" bearing the feminine termination "*-ata*" (possession, belonging to), indicating the asymmetric spinulation on the hind leg.

Type material examined. Holotype. "1064EcuadorOrellana / ErwinTransect / Onkone Gare Camp / Reserve Ethica Waorani // 00 39' 25.7"S 076 27'10.8"W / 2.vii.95 T.L. Erwin et al. / Fogging terre firme forest // UDCC_TCN 00055238 // photo [handwritten, green paper]// HOLOTYPE / *Buca* / *asymmetrospinata* / Gnezdilov et al. 2015" [red paper].

Paratypes (MNHN: 1♂, 1♀; USNM: 39♂, 34♀). **Ecuador**. Sucumbíos Province: "Muséum Paris / Shushufindi / Equateur / Rec. B. Perthuis / 1984–1986 // Muséum Paris / MNHN(EH) / 7352" (1♀, MNHN); "Equateur, Shushufindi, Rec. B. Perthuis, 1984–1986", "MNHN(EH)7352" (1♂, MNHN). Orellana Province [formerly part of Napo Province]: Onkone Gare Camp, Reserve Ethica Waorani, Erwin Transect, 0039′ 25.7″ S 076 27′ 10.8″ W, T. L. Erwin et al., fogging terre firme forest (Erwin samples USNM, exemplars retained at ZIN and UDCC): sample 578, 15.I.1994 (1♂); sample 688, 20.VI.1994 (1♂); sample 695, 21.VI.1994 (2♀); sample 719, 21.VI.1994 (1♀); sample 862, 4.X.1994 (1♀); sample 866, 4.X.1994 (1♀); sample 868, 4.X.1994 (1♂); sample 907, 7.X.1994 (1♀); sample 913, 9.X.1994 (1♂); sample 992, 10.II. 1995 (1♂); sample 1038, 12.II.1995 (1♂); sample 1039, 12.II.1995 (3♂ 2♀); sample 1040, 12.II.1995 (1♀); sample 1044, 12.II.1995 (1♀); sample 1056, 15.II.1995 (1♀); sample 1093, 3.VII.1995 (1♂); sample 1104, 4.VII.1995 (1♀); sample 1136, 9.VII.1995 (1♀); sample 1190, 6.X.1995 (1♀); sample 1199, 5.X.1995 (1♀); sample 1213, 6.X.1995 (1♂); sample 1214,

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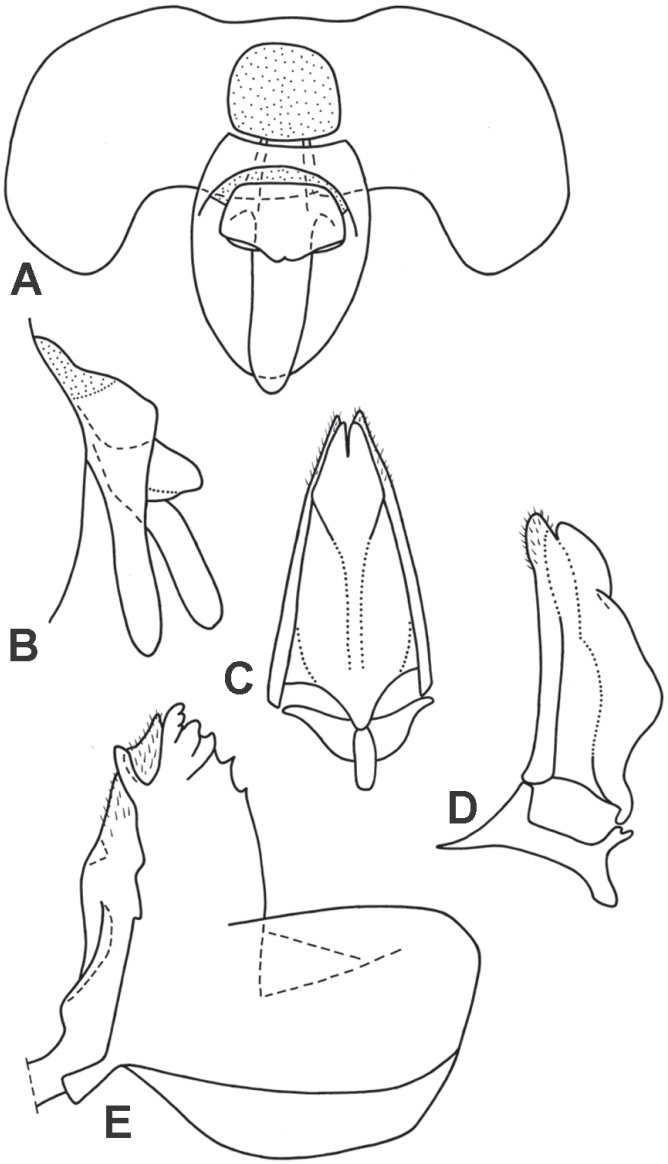


Fig. 11. *Buca asymmetrospinata* **sp. nov.** female terminalia (paratype); A) dorsal view of segment IX, anal tube and paraproct; B) lateral view of anal tube and paraproct; C) ventral view of gonapophyses IX and gonospiculum bridge; D) right lateral view of gonapophyses IX and gonospiculum bridge; E) right lateral view of gonapophysis VIII (distal portion upward).

6.X.1995 (1♀); sample '230, 6.X.1995 (1♀); sample 1231, 7.X.1995 (2♂); sample 1419, 4.II.1996 (1♀); sample 1420, 5.II.1996 (2♀); sample 1424, 5.II.1996 (1♂); sample 1426, 5.II.1996 (1♂); sample 1429, 5.II.1996 (1♂); sample 1444, 7.II.1996 (1♀); sample 1445, 7.II.1996 (1♂); sample 1461, 7.II.1996 (2♂, 1♀); sample 1469, 8.II.1996 (1♂); sample 1487, 10.II.1996 (1♀, 1 deformed); sample 1548, 21.VI.1996 (1♀); sample 1564, 22.VI.1996 (1♂); sample 1588, 26.VII.1996 (2♂); sample 1589, 26.VI.1996 (1♂); sample 1704, 2.X.1996 (1♂, 1♀); sample 1706, 2.X.1996 (1♂); sample 1727, 3.X.1996 (1♀); Tiputini Biodiversity Station, near Yasuni National Park, Erwin Transect T/2, 220–250 m, 0037′55″S 07608′39″W, T.L. Erwin et al. fogging terre firme forest: sample 1854, 1.VII.1998 (1♀); sample 1865, 4.VII.1998 (1♂); sample 1873, 4.VII.1998 (1♂); sample 1937, 24.X.1998 (1♀); sample 1954, 26.X.1998 (1♂); sample 1957, 26.X.1998 (1♂); sample 1962, 22.X.8 (1♂); sample 1970, 22.X.1998 (1♂); sample 1971, 22.X.1998 (1♀); sample 1973, 22.X.1998 (1♀); sample 1865, 4.VII.1998 (1♂); sample 2004, 9.II.1999 (1♂); sample 2007, 9.II.1999 (1♀); sample 2010, 9.II.1999 (1♀); sample 2012, 9.II.1999 (1♂); sample 2068, 8.II.1999 (1♀); sample 2033, 8.II.1999 (1♀); sample 2068, 6.II.1999 (1♂); sample 2070, 6.II.1999 (2♂); sample 2096, 5.II.1999 (1♂).

Remarks. Specimens from the Ecuador canopy fogging study (e.g., Erwin & Geraci 2009) are currently housed at the USNM (representatives retained at UDCC and ZIN), but it is expected that representatives will subsequently be repatriated to the Quito Catholic Zoology Museum at the Pontifical Catholic University of Ecuador (PUCE) by the USNM.

Buca truncoptera **sp. nov.** (Figs. 5, 8B)

Diagnosis. Color green yellowish with very dark dorsal vitta across coryphe, pronotum, and mesonotum; apical cells of wing with dark brown patches. Trailing margins of forewings truncately rounded with ScP+RA separated before the margin in ScP and 2 branches of RA, 9 branches of MP and 4 r-m crossveins.

Description. Color. General coloration light green yellowish. Metope with black spot medially below its upper margin. Third segment of rostrum orange apically. Coryphe, pro-, and mesonotum with wide dark median stripe, black with orange margins; stripe continuing on claval margins of forewings. First anal vein of forewings orange. Apical cells of forewing with dark brown patches. Hind wings with postcubitus and anal veins black. Abdominal tergites V–VII with red median stripe. Leg spines with black apices. *Structure*. Body length (with wings; ♀ holotype) 8.5 mm, body length (without wings), 5.4 mm. Metope sharply enlarged near level of antennae in frontal view, with distinct median carina running from fastigium to level of antennae, obsolete ventrad of antennae. Lateral margins of metope sharp, laterally projected, hiding scape in frontal view. Clypeus with carina absent. Coryphe broad (Fig. 5B), anterior margin of coryphe convex, posterior margin concave. Pronotum short with median carina, disc small, paranota narrow, acutely angulate, nearly reaching tegulae. Mesonotum very large, approximately 6 times as long as pronotum medially (ratio of mesonotum length excluding scutellum to pronotum length = 6.08), with weak carinae. Forewings long (6.9 mm), extending well past end of abdomen, and wide (3.8 mm), truncately rounded (Figs. 5A and 8B). Forewing venation: forewing with crossveins absent in costal area; basal cell large; ScP+RA (branch ScP+RA forked from RP in proximal third of wing) branched into ScP, RA1, and RA2 distally; RP 3-branched with rp1-rp2 crossvein; 4 r-m crossveins; MP 9-branched (MP1 with 5 branches and MP4 with 2), 1 m-cu crossvein, CuA only very distally forked for a minute C5, 3 cup-pcu crossveins near apex of clavus. Hind tibiae with 7 spines apically.

Female terminalia. Anal tube short, slightly narrowing apically, truncated.

Remarks. This species is described from a single female specimen with the right side of the head damaged.

Etymology. The specific epithet is derived from the Latin word "*truncus*" (maimed, cut off) combined with the Greek term "*pteron*" with the feminine termination "*-a*"; a reference to the relatively truncate forewings.

Type material. Holotype. "Guyane Française / Piste de Bélizon P.K., 7–16.IX.1991 / Exp. H. de Toulgoët // H. de Toulgoët–J. Navatte–P. Bleuzen–L. Sénicaux // Mus. nat. Hist. nat. don de H. de Toulgoët" (1♀, MNHN).

Discussion

The spinal arrangement on the apex of the hind tibiae of *Buca* shows a peculiar asymmetry, and the 2nd metatarsomere presents a reduction of the internal latero-apical spine and replacement of the

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2nd external one with an enlargement of ventral surface. This arrangement may be unique within the Tropiduchidae, but not within the Fulgoroidea. Reductions of 1 latero-apical spine on 1st and 2nd metatarsomeres are documented for the genera *Gelastissus* Kirkaldy, 1906 and *Nubianus* Gnezdilov & Bourgoin, 2009 from the Caliscelidae (Gnezdilov 2008; Gnezdilov & Bourgoin 2009). Impair reduction or even complete loss of the 2nd metatarsomere lateral spines is also reported in some tettigometrid species (Bourgoin 1987) but not constantly enough to make it a specific character for these species as in *Buca*.

Buca has a rounded ovipositor with gonoplacs missing marginal teeth which is consistent with Elicinae *sensu* Gnezdilov (2013b), but the structure of male genitalia and wing venation discussed below are not consistent with either of the described tribes (Elicini and Parathisciini), and so a new tribe is described to include the genus.

The general structure of male genitalia in *Buca* (phallus with well-developed phallotheca, aedeagus bearing ventral hooks, and gonostylus with plate-shaped lateral tooth) is similar to that of the Issidae. However, the genus *Buca* Walker and accordingly the tribe Bucini **trib. nov.** do not belong to the family Issidae as this genus has hind wings with simple venation including separated postcubitus (Pcu) and 1st anal vein (A1) (Fig. 7B), whereas the Issidae have much more complex venation with many transverse veins and for many species a characteristic partial fusion of postcubitus and 1st anal vein in their mid-length (Gnezdilov 2012, Figs. 2 and 3 therein). Also the general pattern of forewing venation with characteristic steps of intermediate veins between branches of median in distal half of the wing and shape and carination of metope (*Buca* lacks the sublateral carinae of the metope) do not allow us to place this taxon into the Issidae as it is defined by Gnezdilov (2013c) and Gnezdilov et al. (2014).

According to the pattern of hind wing shape and venation, *Buca* species are close to Colpopterinae of Nogodinidae and Parathisciini of Tropiduchidae (Gnezdilov 2013b). In general aspect, *Buca* resembles Parathisciini (Elicinae; see Gnezdilov, 2013b, Figs. 8–11 therein); however, the Parathisciini are restricted to Africa and have reticulate forewing venation (leaf-like wings). The Nogodinidae also have reticulate forewing venation (near the wing apex in Colpopterinae).

Buca does fit within the general concept of the Elicinae of the Tropiduchidae (sensu Gnezdilov 2013b). Within the New World fauna, all the Elicinae are placed in the Elicini (which include the Gaetuliina of Fennah 1978); however, the Elicini are often brachypterous, have reticulate forewing venation (including crossveins in the costal area), with wings just exceeding the abdomen and phallus with short phallotheca. Thus at the moment, we place this very peculiar genus as a separate tribe in the subfamily Elicinae Melichar (according to the rounded ovipositor) of the family Tropiduchidae, which is in need of phylogenetic revision.

Apparently these taxa of so-called "issidoid group of families" sensu Gnezdilov (2013c) are a complex of related groups that evolved recently, and perhaps rapidly, and represent different lineages of morphological evolution of male and female genitalic structures (convergence is possible as well). Phylogenetic analyses are needed to help solve the problem of the evolution of these structures and to support the classificatory solutions proposed here. However, recent investigations of the evolution of the higher Fulgoroidea using molecular data (Gnezdilov 2013c; Gnezdilov et al. 2015) show the difficulties in building a phylogeny of this complex of families.

Of the 76 specimens of *Buca asymmetrospinata* **sp. nov.** examined, 74 were from Terry Erwin's canopy fogging studies in Orellana Province, Ecuador (e.g., Lucky et al. 2002; Erwin & Geraci 2009). Few other specimens of *Buca* were available for study, suggesting that this is principally a canopy-dwelling species, not likely to be taken by most common collecting methods. Still few data on forest canopy planthopper fauna are published. Thus, this is first confirmed canopy record of Elicinae. For the Neotropics, recently 1 issid species, *Oronoqua ibisca* Gnezdilov, Bonfils, Aberlenc & Basset, 2010 was described from mid-canopy of Panama and 3 more issid species were recorded from canopy of China and Brunei (Gnezdilov et al. 2010; Meng et al. 2013; Gnezdilov 2015). Apparently, we are just at the beginning of discovering canopy planthopper biodiversity.

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References Cited

Anufriev GA, Emeljanov AF. 1988. Suborder Cicadinea (Auchenorrhyncha). pp. 12–495 *In* Ler PA [ed.], Opredelitel' nasekomykh Dal'nego Vostoka SSSR, 2 [Keys to the Insects of the Far East of the USSR, In 6 Volumes. Volume II. Homoptera and Heteroptera]. Nauka, Leningrad, Russia.

Arthropod Easy Capture. 2013. Arthropod Easy Capture, Version: 1.34. Available from https://sourceforge.net/projects/arthropodeasy (last accessed 16 Jun 2015).

Bourgoin T. 1987. Etude des Tettigometridae africains. II. Un remarquable nouveau genre représentant une nouvelle tribu. Etude de la monophylie de la famille (Hemiptera Fulgoromorpha). Nouvelle Revue d'Entomologie (Nouvelle Serie) 4: 393–405.

Bourgoin T. 1988. A new interpretation of the homologies of the Hemiptera male genitalia illustrated by the Tettigometridae (Hemiptera, Fulgoromorpha), pp. 113–120 *In* Vidano C, Arzone A [eds.], Proceedings of the 6th Auchenorrhyncha Meeting, Turin, Italy, 7–11 Sep 1987.

Bourgoin T. 1993. Female genitalia in Hemiptera Fulgoromorpha, morphological and phylogenetic data. Annales de la Société Entomologique de France (Nouvelle Serie) 29: 225–244.

Bourgoin T. 2016. FLOW (Fulgoromorpha Lists on the Web): a world knowledge base dedicated to Fulgoromorpha. Version 8, updated 2 Jul 2015, http://hemiptera-databases.org/flow/ (last accessed 24 Mar 2016).

Bourgoin T, Huang J. 1990. Morphologie comparée des genitalia m□les des Trypetimorphini et remarques phylogénétiques (Hemiptera Fulgoromorpha : Tropiduchidae). Annales de la Société Entomologique de France (Nouvelle Serie) 26: 555–564.

Bourgoin T, Wang RR, Asche M, Hoch H, Soulier-Perkins A, Stroiński A, Yap S, Szwedo J. 2015. From micropterism to hyperpterism: recognition strategy and standardized homology-driven terminology of the forewing venation patterns in planthoppers (Hemiptera: Fulgoromorpha). Zoomorphology 134: 63–77.

Erwin TL, Geraci CJ. 2009. Chapter 4. Amazonian rainforests and their richness of Coleoptera, a dominant life form in the *critical zone* of the Neotropics, pp. 49–67 *In* Foottit RG, Adler PH [eds.], Insect Biodiversity: Science and Society. Wiley-Blackwell Publishing, Hoboken, New Jersey.

Fennah RG. 1978. The higher classification of the Nogodinidae (Homoptera: Fulgoroidea) with a description of a new genus and species. Entomologist's Monthly Magazine 113: 113–120.

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Fennah RG. 1982. A tribal classification of the Tropiduchidae (Homoptera: Fulgoroidea), with the description of a new species on tea in Malaysia. Bulletin of Entomological Research 72: 631–643.

Gnezdilov VM. 2002. Morphology of the ovipositor in members of the subfamily Issinae (Homoptera, Cicadina, Issidae). Entomologicheskoe Obozrenie 81: 605–626. English translation in Entomological Review (2004) 82: 957–974.

Gnezdilov VM. 2007. On the systematic positions of the Bladinini Kirkaldy, Tonginae Kirkaldy, and Trienopinae Fennah (Homoptera, Fulgoroidea). Zoosystematica Rossica 15: 293–297.

Gnezdilov VM. 2008. Revision of the genus *Gelastissus* Kirkaldy (Hemiptera, Fulgoroidea, Caliscelidae). Zootaxa 1727: 22–28.

Gnezdilov VM. 2012. Revision of the tribe Colpopterini Gnezdilov, 2003 (Homoptera, Fulgoroidea, Nogodinidae). Entomologicheskoe Obozrenie 91: 757–774 + 4 photo plates. English translation in Entomological Review (2013) 93: 337–353.

Gnezdilov VM. 2013a. Modern classification and the distribution of the family Issidae Spinola (Homoptera, Auchenorrhyncha, Fulgoroidea). Entomologicheskoe Obozrenie 92: 724–738. English translation in Entomological Review (2014) 94: 687–697.

Gnezdilov VM. 2013b. Contribution to the taxonomy of the family Tropiduchidae Stål (Hemiptera, Fulgoroidea) with description of two new tribes from Afrotropical Region. Deutsche Entomologische Zeitschrift 60: 179–191.

Gnezdilov VM. 2013c. Issidisation of fulgoroid planthoppers (Homoptera, Fulgoroidea) as an evidence of parallel adaptive radiation. Entomologicheskoe Obozrenie 92: 62–69. English translation published in Entomological Review (2013) 93: 825–830.

Gnezdilov VM. 2015. Description of a new genus and species of Hemisphaeriini from Brunei with an identification key to the Bornean species of the tribe (Hemiptera: Fulgoroidea: Issidae). Acta Entomologica Musei Nationalis Pragae 55: 9–18.

Gnezdilov VM, Bourgoin T. 2009. First record of the family Caliscelidae (Hemiptera: Fulgoroidea) from Madagascar, with description of new taxa from the Afrotropical Region and biogeographical notes. Zootaxa 2020: 1–36.

Gnezdilov VM, Bonfils J, Aberlenc HP, Basset Y. 2010. Review of the Neotropical genus *Oronoqua* Fennah, 1947 (Insecta, Hemiptera, Issidae). Zoosystema 32: 247–257.

Gnezdilov VM, Holzinger WE, Wilson MR. 2014. The Western Palaearctic Issidae (Hemiptera, Fulgoroidea): an illustrated checklist and key to genera and subgenera. Proceedings of the Zoological Institute RAS, Vol. 318, Supplement 1.

Gnezdilov VM, Bourgoin T, Mozaffarian F, Manzari S. 2015. Difficulties in building a molecular phylogeny of the issidoid planthopper lineages (Insecta: Hemiptera: Fulgoroidea), pp. 218–227 *In* 1st Iranian International Congress of Entomology, 29–31 Aug 2015, Tehran, Iran.

Lucky A, Erwin TL, Witman JD. 2002. Temporal and spatial diversity and distribution of arboreal Carabidae (Coleoptera) in a Western Amazonian rain forest. Biotropica 34: 376–386.

Melichar L. 1914. Monographie der Tropiduchinen (Homoptera). Verhandlungen des naturforschenden Vereines in Brünn 53: 1–145.

Meng R, Wang Y, Qin D. 2013. A new genus of the tribe Hemisphaeriini (Hemiptera: Fulgoromorpha: Issidae) from China. Zootaxa 3691: 283–290.

Metcalf ZP. 1958. Fascicle 4. Fulgoroidea. Part 15. Issidae. General Catalogue of the Homoptera (North Carolina State College [now University], Raleigh, North Carolina) 4(15): [i]-vii, 1–561.

Muir FAG. 1930. On the classification of the Fulgoroidea. Annals and Magazine of Natural History (Series 10) 6: 461–478.

Muir FAG. 1931. New and little-known Fulgoroidea in the British Museum (Homoptera). Annals and Magazine of Natural History (Series 10) 7: 297–314.

O'Brien LB. 2002. The wild wonderful world of Fulgoromorpha, pp. 83–102 *In* Holzinger W [ed.], Zikaden: Leafhoppers, Planthoppers, and Cicadas (Insecta: Hemiptera: Auchenorrhyncha). Denisia, Volume 4. Oberösterreichisches Landesmuseum, Linz, Austria.

Schuh RT. 2012. Integrating specimen databases and revisionary systematics. ZooKeys 209: 255–267.

Schuh RT, Hewson-Smith S, Ascher JS. 2010. Specimen databases: a case study in entomology using Web-based software. American Entomologist 56: 206–216.

Shcherbakov DE. 2006. The earliest find of Tropiduchidae (Homoptera: Auchenorrhyncha), representing a new tribe, from the Eocene of Green River, USA, with notes on the fossil record of higher Fulgoroidea. Russian Entomological Journal 15: 315–322.

Szwedo J. 2000. First fossil Tripiduchidae with a description of a new tribe Jantaritambiini from Eocene Baltic Amber (Hemiptera: Fulgoromorpha). Annales de la Société Entomologique de France (Nouvelle Serie) 36: 279–286.

Szwedo J, Stroiński A. 2010. Austrini—a new tribe of Tropiduchidae planthoppers from the Eocene Baltic amber (Hemiptera: Fulgoromorpha). Annales de la Société Entomologique de France 46: 132–137.

Szwedo J, Stroiński A. 2013. An extraordinary tribe of Tropiduchidae from the Eocene Baltic amber (Hemiptera: Fulgoromorpha: Fulgoroidea). Zootaxa 3647: 371–381.

Walker F. 1858. List of the specimens of homopterous insects in the collection of the British Museum. Supplement. Printed by Order of the Trustees, London, United Kingdom.

Wilson SW, Mitter C, Denno RF, Wilson MR. 1994. Evolutionary patterns of host plant use by delphacid planthoppers and their relatives, pp. 7–45 & Appendix *In* Denno RF, Perfect TJ [eds.], Planthoppers: Their Ecology and Management. Chapman and Hall, New York, New York.

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