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The Trichoptera of Panama. XII. Contributions to the family Glossosomatidae (Insecta: Trichoptera) in Panama

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Abstract. Herein we describe five new species in the trichopteran family Glossosomatidae Wallengren (Insecta: Trichoptera) from Panama: *Mortoniella calovebora* Blahnik and Armitage, **n. sp.**, *M. yayas* Blahnik and Armitage, **n. sp.**, *Protoptila inflata* Blahnik and Armitage, **n. sp.**, *P. totumas* Blahnik and Armitage, **n. sp.**, and *P. rambala* Blahnik and Armitage, **n. sp.** Three of the species were collected as part of ongoing biological surveys of Panama's national parks. We also record three new country records for Panama for this family: *Culoptila costaricensis* Flint, 1974, *Mortoniella opinionis* Blahnik and Holzenthal, 2008, and *Protoptila spirifera* Flint, 1974. Thirty-one species of glossosomatid caddisflies, nine of them endemic, are now known from Panama.

Key words. National parks, *Culoptila*, *Mortoniella*, *Protoptila*.

Introduction

In the Republic of Panama, the caddisfly family Glossosomatidae Wallengren previously was represented by 23 species distributed among three genera: *Culoptila* Mosely (1 species), *Mortoniella* Ulmer (13 species), and *Protoptila* Banks (9 species). More than one-third of these species were added to Panama's fauna since 2015 (Armitage et al. 2015, 2016, 2018) as new country records. Herein, we add five new species from this family: two in the genus *Mortoniella* and three in the genus *Protoptila*. We also add three new country records, one species in each of the three genera. Thus, there are now 31 species in this family recorded from Panama.

Some of the species described or recorded in this publication were discovered as a result of general surveys of Panama's caddisfly fauna. This ongoing effort is now formalized in a registered project at the Museo de Peces de Agua Dulce e Invertebrados (MUPADI) of the Universidad Autónoma de Chiriquí (UNACHI) in David, Panama. The publication series (The Trichoptera of Panama) within which this paper is included now serves as the official series for this project. Other species described or recorded in this publication were discovered during work on a new project, initiated in 2017, involving biological surveys of Panama's national parks. Designated "Proyecto Sistema de Producción Sostenible Conservación de la Diversidad (PSPSCD)", this project is managed by Panama's Ministerio de Ambiente and, in collaboration with the Instituto Conmemorativo Gorgas de Estudios de la Salud (Gorgas Institute), executed by the Colección Zoológica Dr. Eustorgio Méndez (COZEM). These biodiversity surveys are included under the framework of the "Sistema Nacional de Información y Monitoreo de la Diversidad Biológica", or National Biological Diversity Information and Monitoring System, to better understand the country's biodiversity. Primary funding was provided by the World Bank. The various components of this latter project include one on aquatic invertebrates, including Trichoptera.

Materials and Methods

Panama is divided into 52 hydrographic basins (cuencas), established by the Central American Hydrometeorological Project (http://www.hidromet.com.pa/cuencas.php?idioma=ing). Sample locations are presented in Fig. 1, which shows outlines of these basins. During 2017, four of Panama's national parks were surveyed. Figure 1 also displays the names and borders of these parks. Other collection information about the national park samples is found in Kondratieff and Armitage (2019). In all cases, specimens were collected either by UV-light traps or Malaise traps as specified in the Materials Examined section for each species.

Specimens were prepared and examined following standard methods outlined in Blahnik and Holzenthal (2004). Forewing length was measured from base to apex using a 5-mm microscale (BioQuip Products, Rancho Dominguez, California, USA). Male genitalia were soaked in 5% KOH overnight and rinsed in distilled water and acidified alcohol prior to examination. Pencil sketches were made using an Olympus SZX12 stereomicroscope, outfitted with an ocular grid. The sketches were then scanned and placed into an Adobe Illustrator CS6 document to serve as template to prepare digital illustrations. Morphological terminology follows that of Holzenthal and Blahnik (2006) for *Protoptila* and Blahnik and Holzenthal (2017) for *Mortoniella*.

Types of the new species and other material examined are deposited in the Colección Zoológica Dr. Eustorgio Méndez (COZEM) of the Instituto Conmemorativo Gorgas de Estudio de la Salud (Gorgas Institute) as indicated in each species treatment. Citation information for species authorities mentioned in this paper can be found in the Trichoptera Literature Database (http://www.trichopteralit.umn.edu/).

Results

Five new species of glossosomatid caddisflies are described and figured below. In addition, collection data for three new country records in this family are presented. The genera and species of this family currently known from Panama can be found in Table 1.

Genus *Mortoniella*

This genus has been treated comprehensively for the neotropics in a series of revisions by Blahnik and Holzenthal (2008, 2011, 2017). The reader is referred to the last of these publications for a discussion of the terminology used here and illustrations of structures. The two new species from Panama fall within the "florica subgroup" of the leroda group, as originally defined by Blahnik and Holzenthal (2008). The subgroup was subsequently merged within the leroda subgroup (Blahnik and Holzenthal 2017), due to uncertainty about the monophyly of the latter group as originally defined. The two subgroups represent the majority of the species of *Mortoniella* in Central America. Species assigned to the "florica subgroup" are characterized by paired, rounded dorsolateral projections on the phallicata, as well as paired apicoventral projections on the fused inferior appendages and a prominent apicoventral spine on the endophallic membrane.

Mortoniella (*Mortoniella*) *calovebora* Blahnik and Armitage, new species

Fig. 2

Diagnosis. This is a rather typical, but distinctive, species of the "florica subgroup." *Mortoniella calovebora* is easily distinguished from other described species of the subgroup by the length and asymmetry of the apicoventral lobes of the inferior appendages (Fig. 2C). The asymmetry of the ventral lobes of the inferior appendages seems to be a consistent feature of this species and is a unique character within the genus.

Description. Length of forewing: male 3.0–3.3 mm; female 3.2–3.3 mm. Forewing with forks I, II, and III present, hind wing with forks II and III. Spur formula 0:4:4. Overall color (in alcohol) light brown, anastamosis unpigmented, but otherwise not evidently marked.

Table 1. List of species in the Glossosomatidae from Panama. The literature citation in which each species was first mentioned from Panama is given, if different from that of an original description (*) or this paper (+).

Species	Initial Literature Citation	Distribution
Suborder Integripalpia Martynov		
Superfamily Glossosomatoidea Wallengren		
Family Glossosomatidae Wallengren		
Culoptila costaricensis Flint, 1974	+	Costa Rica*, Panama
Culoptila unispina Blahnik and Holzenthal, 2006	*	Costa Rica*, Panama
Mortoniella akantha Blahnik and Holzenthal, 2008	Armitage et al. 2018	Costa Rica*, Panama
Mortoniella anakantha Blahnik and Holzenthal, 2008	*	Costa Rica*, Panama
Mortoniella aviceps Blahnik and Holzenthal, 2008	*	Costa Rica*, Panama
Mortoniella calovebora Blahnik and Armitage, 2019	+	Panama*
Mortoniella carinula Blahnik and Holzenthal, 2008	Armitage et al. 2016	Costa Rica*, Panama
Mortoniella falcicula Blahnik and Holzenthal, 2008	Armitage et al. 2018	Mexico*, Panama
Mortoniella munozi Blahnik and Holzenthal, 2008	*	Costa Rica*, Panama
Mortoniella opinionis Blahnik and Holzenthal, 2008	+	Costa Rica*, Panama
Mortoniella panamensis Blahnik and Holzenthal, 2008	*	Panama*
Mortoniella pectinella Blahnik and Holzenthal, 2008	*	Panama*
Mortoniella redunca Blahnik and Holzenthal, 2008	Armitage et al. 2015	Costa Rica*, Panama
Mortoniella rovira (Flint, 1974)	*	Costa Rica, Panama*
Mortoniella tapanti Blahnik and Holzenthal, 2008	*	Costa Rica*, Panama
Mortoniella taurina Blahnik and Holzenthal, 2008	*	Costa Rica*, Panama
Mortoniella umbonata Blahnik and Holzenthal, 2008	*	Panama*
Mortoniella yayas Blahnik and Armitage, 2019	+	Panama*
Protoptila altura Holzenthal and Blahnik, 2006	Armitage et al. 2015	Costa Rica*, Panama
Protoptila boruca Flint, 1974	Armitage et al. 2018	Costa Rica*, Panama
Protoptila cana Flint, 1974	*	Costa Rica*, Panama
Protoptila chitaria Holzenthal and Blahnik, 2006	Armitage et al. 2015	Costa Rica*, Panama
Protoptila inflata Blahnik and Armitage, 2019	+	Panama*
Protoptila laterospina Flint, 1967	McElravy et al. 1981	Costa Rica*, Panama
Protoptila orotina Flint, 1974	*	Costa Rica*, Panama
Protoptila perdida Bueno-Soria, Santiago-Fragosa, and Barba-Alvarez, 2004	*	Panama*
Protoptila rambala Blahnik and Armitage, 2019	+	Panama*
Protoptila spirifera Flint, 1974	+	Costa Rica*, Panama
Protoptila tojana Mosely, 1954	Holzenthal and Blahnik 2006	Costa Rica, Honduras, Mexico*, Nicaragua, Panama, Peru
Protoptila totumas Blahnik and Armitage, 2019	+	Panama*
Protoptila trichoglossa Holzenthal and Blahnik, 2006	Armitage et al. 2015	Costa Rica*, Panama

Male genitalia. Ventral process of segment VII laterally compressed, short, ventrally projecting, rounded apically, length slightly greater than width at base, process slightly retracted anterobasally. Segment IX nearly evenly rounded anterolaterally, length greatest midlaterally, posterolateral margin rounded dorsally, narrowing ventrally; segment deeply excised dorsally and ventrally, forming lateral lobes, separated dorsomesally by much less than ½ width of segment. Tergum X relatively elongate, lateral margins subparallel, apically with short, subtriangular mesal projection; apicolateral lobes elongate, compressed, subacute, slightly mesally curved; ventrolateral lobes nearly obsolete; ventromesal lobes not evident. Inferior appendages without dorsolateral lobes, but with apicoventral lobes elongate, upturned, and asymmetrically developed, that of the right side narrower apically and more distinctly out-turned, both lobes acute apically. Mesal pockets of inferior appendage with apical processes short and weakly curved. Paramere appendage elongate, narrow, extending about same length as dorsal phallic spine, slightly widened preapically, widened apex with narrow, adpressed, scale-like spines. Dorsal phallic spine, as viewed laterally, undulate in contour, spine distinctly widened on ventral margin at about middle, ventral bulge articulating with dorsal margin of phallicata, apex acute, weakly upturned; in dorsal view (Fig. 2D), lightly widened in middle and preapically, apex acute. Phallicata moderately elongate, dorsal margin with broadly rounded, paired, dorsolateral projections, lateral margin with slightly produced, rounded and compressed projection. Endophallic membrane simple, with single prominent curved ventromesal spine; phallotremal spines absent.

Female and immatures. Unknown.

Holotype male (alcohol). PANAMA: Veraguas: Cuenca 097, Río Calovebora, 8.55038°N and 81.16486°W, PSPSCD-PNSF-C097-2017-006, 461 m, Malaise trap, 23–27.iv.2017, A. Cornejo, T. Ríos, E. Álvarez, and C. Nieto, (**COZEM**).

Paratypes. PANAMA: Veraguas: Cuenca 097, Río Calovebora, 8.55038°N and 81.16486°W, PSPSCD-PNSF-C097-2017-006, 461 m, Malaise trap, 23–27.iv.2017, A. Cornejo, T. Ríos, E. Álvarez, and C. Nieto, 7 males (COZEM); ibid., Cuenca 132, Río Mulaba–Isleta, 8.54513°N and 81.1197°W, PSPSCD-PNSF-C132-2017-015, 412 m, Malaise trap, 2 males and 4 females (COZEM); ibid., Río Mulaba–afluente 1er Brazo, 8.51706°N and 81.1214°W, Control: PSPSCD-PNSF-C132-2017-008, 770 m, UV light trap, 19.iv.2017, T. Ríos, E. Álvarez, and C. Nieto, 1 male (UMSP).

Etymology. This new species is named for the Río Calovebora from which it was first collected. The name is formulated as a noun in apposition.

Mortoniella (*Mortoniella*) *yayas* Blahnik and Armitage, new species

Fig. 3

Diagnosis. This is another species of the "florica subgroup" of *Mortoniella*. The species is not particularly distinctive, differing from other species of the "subgroup" mostly by its own peculiar combination of characters. It is probably most closely related to *M. pectinella* Blahnik and Holzenthal, also from Panama, resembling that species in the structure of tergum X, particularly in its prominent, acute lateral lobes and broadly triangular mesal projection. In other details, however, it is quite different, lacking the pectinate apical projections on the paramere appendages of *M. pectinella*, and in having acute, rather than rounded, apices to the inferior appendages. Other characters useful in diagnosing the new species include the relatively narrow dorsolateral lobes of the phallicata, the narrow, concavely excavated apices of the paramere appendages, and the generally weakly inflected and posteriorly oriented apex of the dorsal phallic spine.

Description. Length of forewing: male 3.5 mm. Forewing with forks I, II, and III present, hind wing with forks II and III. Spur formula 0:4:4. Overall color (in alcohol) brown, anastamosis unpigmented, but otherwise not evidently marked.

Male genitalia. Ventral process of segment VII laterally compressed, short, ventrally projecting, rounded apically, length slightly greater than width at base, process not retracted anterobasally. Segment IX nearly evenly rounded anterolaterally, length greatest midlaterally, posterolateral margin

slightly rounded and produced dorsally, narrowing ventrally; segment deeply excised dorsally and ventrally, forming lateral lobes, separated dorsomesally by much less than ½ width of segment. Tergum X moderately elongate, lateral margins subparallel, apically with broad, subtriangular mesal projection, subequal in length to apicolateral lobes; apicolateral lobes subtriangular, distinctly sclerotized, compressed, acute apically; ventrolateral lobes nearly obsolete; ventromesal lobes not evident. Inferior appendages without dorsolateral lobes, apicoventral lobes posteriorly projecting, relatively short, narrow, acute apically. Mesal pockets of inferior appendage with apical processes, short and weakly curved. Paramere appendage elongate, narrow, extending about same length as dorsal phallic spine, extreme apex concavely excavated on ventral margin. Dorsal phallic spine, as viewed laterally, undulate in contour, distinctly widened on ventral margin at about middle, ventral bulge articulating with dorsal margin of phallicata, apex acute, posteriorly directed; spine, in dorsal view (Fig. 3D), slightly widened in middle, narrowing apically, apex acute. Phallicata moderately elongate, dorsal margin with relatively narrow, paired, dorsolateral projections, lateral margin without compressed projection, ventral margin, as viewed ventrally (Fig. 3C), with elongate, weakly rounded lateral projections. Endophallic membrane simple, with single prominent curved ventromesal spine; phallotremal spines absent.

Female and immatures. Unknown.

Holotype male (alcohol). PANAMA: Cocle: Cuenca 134, Quebrada Las Yayas, La Pintada, El Harino, PSPSCD-PNGDOTH-C134-2017-004, 8.66168°N and 80.5952°W, 602 m, 25.iii.2017, UV light trap, E. Álvarez, E. Pérez, and T. Ríos (COZEM).

Etymology. This new species is named after the Las Yayas stream from which it was collected. The name is formulated as a noun in apposition.

Genus *Protoptila*

This genus is considered the sister taxon to *Mortoniella* (Robertson and Holzenthal 2013). Both genera are characterized by having a pair of short appendages attached to the ventral margin of the phallobase, which engage with a hollowed receptacle on the mesal surface of the inferior appendages or phallic ensemble. This is a unique character, not otherwise found within the subfamily Protoptilinae. The genus has a number of distinctive apomorphies in its male genitalia, most distinctive of which are a ventral extension of sternum VIII beneath segment IX, and the structure of the phallic apparatus, which has an enlarged, blade-like apodeme basodorsally and an elongate and often arched phallicata, which is fused to the phallobase. Additionally, inferior appendages are generally absent or vestigial. Other characters, varying greatly among individual species, include the structure of the lateral lobes of tergum X and the structure of the paramere appendages. Nearly 100 species are currently known, making it the second largest genus in Protoptilinae (behind *Mortoniella*). Although the individual species are, in general, relatively easy to diagnose, because of the complexity and variability of structures of the genitalia, the genus as a whole has never been treated comparatively or comprehensively. Consequently, it is often difficult to determine relationships among species, or group of species. This is true of the species treated here, each of which is distinctive in its own right, but difficult to compare to other described species.

Protoptila inflata Blahnik and Armitage, new species

Fig. 4

Diagnosis. *Protoptila inflata* is best diagnosed by the relatively elongate, down-turned lateral lobes of tergum X, greatly inflated apex of the phallus (as viewed laterally), and hooked apices of the paramere appendages.

Description. Length of forewing: male 2.7–2.8 mm. Forewing with forks I, II, and III present; hind wing with fork II only, wing narrow and acute apically, costal margin with pronounced invagination. Spur formula 0:4:4. Overall color (in alcohol) brown (specimens cleared).

Male genitalia. Sternum VI process relatively prominent, posteriorly directed, longer than wide, apex subacute. Tergum VIII with row of elongate setae along posterior margin; sternum VIII moderately

densely setose, setae elongate, posterior margin distinctly produced, slightly curved upward, extending beyond dorsolateral lobes of tergum X; as viewed ventrally, with ventral projection narrow, forked apically, apices of fork subacute. Segment IX with anterior margin broadly rounded, sternum mesally produced into short, acute process, posterolateral margin of segment IX without processes. Preanal appendages absent. Tergum X, as viewed laterally, with lateral lobes not obviously subsegmented, but somewhat bent or flexed basally, posterior margin of lateral lobe with small sclerotized mesal projection at flexion point, dorsal margin between lobes narrow and continuous, textured with minute spines, apex of mesal projection with short, bilobed, membranous projection; lateral lobes simple, moderately elongate and narrow, downturned, with several short marginal setae, apex narrowed and with ventrally-directed, spine-like projection. Phallobase dorsally with large, laterally compressed apodeme, ventrally with pair of short, rod-like, articulated appendages with membranous apices, appendages fitting into sclerotized pockets on ventral margin of phallobase, ventral margin of each pocket with short, hook-like projection. Phallicata, as viewed laterally, tubular, fused to phallobase, relatively short, dorsally arched, distinctly widened apically on ventral margin; as viewed dorsally, relatively narrow, apical enlargement slightly channeled dorsomesally, bilobed apically. Phallotremal sclerite not evident. Parameres each with "nested" membranous basal structure and relatively short, narrow, rod-like, sclerotized paramere appendage, appendage nearly straight, apex hooked or somewhat spirally curved.

Female and immatures. Unknown.

Holotype male (alcohol). PANAMA: Cocle: Cuenca 134, Quebrada Las Yayas, La Pintada, El Harino, PSPSCD-PNGDOTH-C134-2017-004, 8.66168°N and 80.5952°W, 602 m, 22-26.iii.2017, Malaise trap, E. Álvarez, E. Pérez, and T. Ríos (COZEM).

Paratypes. Same data as holotype, 1 male (UMSP).

Etymology. This new species is named for the inflated apex of the phallus in lateral view. The genus name is feminine and the species name adjectival.

Protoptila totumas Blahnik and Armitage, new species

Fig. 5

Diagnosis. *Protoptila totumas* is distinctive and unlikely to be confused with any other described species. The most distinctive and usefully diagnostic feature of this new species is the structure of the paramere appendages, which are relatively elongate and narrow and each possesses a corkscrew-like spiral at midlength, subtending and crossing over each other beneath the phallicata, with the apices dorsal to the phallicata. Although the exact structure is somewhat variable in the material examined, the symmetrical arrangement of the appendages, as in Fig. 5E, is probably the most common configuration. Other usefully diagnostic features include the structure of tergum X, which has relatively elongate, narrow lateral lobes, each with two acute mesal projections, one in the basal half of the lobe (not readily observed in lateral view), and the other preapically, and also the structure of the phallicata, which is relatively narrow and arched dorsally, as viewed laterally, but is distinctively bulged in its basal half, as viewed dorsally, and has acute apicolateral projections.

Description. Length of forewing: male 3.2 mm. Forewing with forks I, II, and III present; hind wing with fork II only, wing narrow and acute apically, costal margin with pronounced invagination. Spur formula 0:4:4. Overall color (in alcohol) brown, anastamosis unpigmented, but otherwise not evidently marked.

Male genitalia. Sternum VI process relatively prominent, posteriorly directed, slightly curved, longer than wide, apex subacute. Tergum VIII with row of elongate setae along posterior margin; sternum VIII densely setose with elongate setae, posterior margin distinctly produced, slightly curved upward, extending nearly as far as dorsolateral lobes of tergum X; as viewed ventrally, with ventral projection narrow, weakly and bluntly forked apically. Segment IX with anterior margin broadly rounded, sternum mesally produced into short, acute process, with single apical seta, posterolateral margin of segment IX without processes. Preanal appendages absent. Tergum X, as viewed laterally, with lateral lobes not obviously subsegmented, each lobe relatively elongate and narrow, downturned, forked preapically, ventral branch

forming mesally directed, trianguloid projection with spine-like apex, dorsal branch extending as narrow, apically acute, finger-like projection; as viewed dorsally, with additional acute, mesal projection in basal half, not readily observable in lateral view. Phallobase dorsally with large, laterally compressed apodeme, ventrally with pair of short, rod-like, articulated appendages with membranous apices, appendages fitting into sclerotized pockets on ventral margin of phallobase. Phallicata, as viewed laterally, tubular, fused to phallobase, dorsally arched, slightly widened preapically; as viewed dorsally, with lateral margins distinctly rounded and widened in basal half, narrowing apically, preapically with acute, trianguloid, lateral projections on either side. Phallotremal sclerite forming curved, narrow, tube-like structure, upturned as viewed laterally. Parameres each with membranous basal structure and elongate, narrow, sclerotized paramere appendage, with a helical spiral past midlength; appendages apparently crossing over each other beneath phallicata and converging dorsally, apices relatively straight and acute.

Female and immatures. Unknown.

Holotype male (alcohol). PANAMA: Chiriquí: Cuenca 102, afluente de Río Colorado, Mount Totumas Biological Reserve, 8.884717°N and 82.684077°W, 1950 m, 11–17.i.2016, Malaise trap, B. Armitage and J. Dietrich (COZEM).

Paratypes. Same locality as holotype, 7–13.xii.2015, Malaise trap, J. Dietrich, 2 males (COZEM, UMSP).

Etymology. This new species is named after the Mount Totumas Cloud Forest and Biological Reserve from which it was collected. The name is formulated as a noun in apposition.

Protoptila rambala Blahnik and Armitage, new species

Fig. 6

Diagnosis. The most useful diagnostic features of *Protoptila rambala* include its relatively short paramere appendages, with broad brush-like apices (Fig. 6B); the structure of the lateral lobes of tergum X (Fig. 6A), which are more or less jointed in their basal half and have their apices shaped somewhat like a bird's head (with a downward-pointed, acute "beak"); and the forked ventromesal apex of segment IX, which is nearly as long as the subtending and also apically forked ventral projection of sternum VIII (Fig. 6C).

Description. Length of forewing: male 2.5 mm. Forewing with forks I, II, and III present; hind wing with fork II only, wing narrow and acute apically, costal margin with pronounced invagination. Spur formula 0:4:4. Color apparently brown (specimens completely cleared, in alcohol).

Male genitalia. Sternum VI process relatively prominent, posteriorly directed, longer than wide, apex subacute. Tergum VIII with row of setae along posterior margin; sternum VIII densely setose with relatively elongate setae, posterior margin distinctly produced, slightly curved upward, extending nearly as far as dorsolateral lobes of tergum X; as viewed ventrally, with ventral projection relatively narrow, weakly and bluntly forked apically. Segment IX with anterior margin broadly rounded, sternum mesally produced into forked process, slightly wider than and extending nearly as far as ventral lobe of sternum VIII, posterolateral margin of segment IX with weakly sclerotized, broadly rounded, dorsolateral lobe on either side. Preanal appendages absent. Tergum X, as viewed laterally, with lateral lobes jointed (apparently subsegmented), basal lobe short, only slightly longer than width, apical lobe broadly rounded basally, apically narrowed and appearing like a bird's head, with downward pointing, acute apical "beak," apex (head) of lobe with small sensilla; tergum with bilobed membranous mesal projection between lateral lobes. Phallobase dorsally with large, laterally compressed apodeme, ventrally with pair of short, rod-like, articulated appendages with membranous apices, appendages fitting into sclerotized pockets on ventral margin of phallobase. Phallicata, as viewed laterally, narrow, tubular, fused to phallobase, projecting nearly straight, apparently with widened lateral flanges (difficult to see). Endophallic membrane narrow and membranous, phallotremal sclerite rather indistinct. Parameres each with membranous basal structure and relatively short sclerotized paramere appendage, appendage somewhat rod-like, broadened apically into brush-like structure with narrow spines.

Female and immatures. Unknown.

Holotype male (alcohol). PANAMA: Bocas del Toro: Quebrada Rambala, Rambala Jungle Lodge, 3.74 km SSE Rambala, 8.91627°N and 82.15469°W, 120 m, 21-31.xii.2016, Malaise trap, Eric Carlson (COZEM).

Paratypes. Same locality as holotype, 6-12.ii.2017, Malaise trap, Eric Carlson, 1 male (COZEM).

Etymology. This new species is named after Quebrada Rambala from whence it was collected. The name is formulated as a noun in apposition.

New Country Records

***Culoptila costaricensis* Flint, 1974**

Material examined (alcohol). PANAMA, Chiriquí Province, Cuenca 108, tributary of Quebrada Grande, Boquete, Valle Escondido, 8.78291˚N and 82.44579°W, 1253 m, UV light trap, B. Armitage and T. Arefina-Armitage, 11 March 2018, 1 male (COZEM).

Distribution. Costa Rica, Panama.

***Mortoniella opinionis* Blahnik and Holzenthal, 2008**

Material examined (alcohol). PANAMA, Chiriquí Province, Cuenca 108, Volcan Baru National Park, Quebrada Cascante, PSPSCD-PNVB-C108-2017-018, 8.84939°N and 82.49349°W, 1947 m, Malaise trap, T. Ríos, E. Álvarez, and E. Pérez, 5-8 June 2017, 1 male (COZEM).

Distribution. Costa Rica, Panama.

***Protoptila spirifera* Flint, 1974**

Material examined (alcohol). PANAMA, Chiriquí Province, Cuenca 102, La Amistad International Park, near Mount Totumas, high altitude bog, 8.89044°N and 82.66684°W, 2075 m, UV light trap, J. Dietrich, 16 May 2015, 1 male (COZEM).

Distribution. Costa Rica, Panama.

Discussion

Of the 31 species of caddisflies in the family Glossosomatidae now known from Panama, more than half (n = 16) have been added since 2015 from our general surveys and the national parks project. Of these recent additions, the majority (n = 11) have been new country records, most represented by species first collected in and described from Costa Rica. These results give further credence to the assumptions made when the second author moved to Panama and initiated these surveys; that previous adult caddisfly collections in Panama were inadequate to define the fauna and were too restricted to reflect distributions within the country. Twenty-one of the species are shared with Costa Rica (Fig. 8), and only one species, *Protoptila tojana*, is found in South America (Holzenthal and Calor 2017). The lack of known occurrence of many of these species in other Central American countries is, in part, due to a lack of collecting. The 246 species known from Panama prior to 2015 has now grown to well over 400 species, with no real end in sight. We anticipate doubling the pre-2015 fauna total within a year or so, but have no firm idea how far above is the asymptote. The second author is training several Panamanians in adult caddisfly systematics, and feels confident that they will continue to contribute to our knowledge of caddisflies in this incredibly diverse country into the future.

The approximately 30% level of endemics in this family is consistent with other localized and general collections we have made. We, however, do not anticipate that this is a true reflection of endemicity in Panama, but rather, once again, the result of a marked lack of data from other Central American countries. Only Costa Rica and Mexico to the north and Colombia to the south, have been extensively sampled.

Altitudinal distribution. This subject is normally addressed at the assemblage level in an effort to confirm or modify the notion that species richness of an assemblage decreases with increased altitude

(Kikkawa and Williams 1971; Diamond 1972; MacArthur 1972; Terborgh 1977). An excellent summary of this line of inquiry was given by Rahbek (1995), when he questioned whether the decreasing gradient of species richness with increasing altitude was a uniform pattern. Analyzing empirical data from 97 papers and 163 examples, he found that they support the intuitive assumption that species richness declines with altitude, but not necessarily in a linear fashion. There are many factors that must be considered when applying this question to the collection of empirical data. Some of these factors include, among others, scale (e.g., local, system, and/or region), the gradient width, the level of taxonomic accuracy (e.g., families, genera, or species), the existence and percentage of endemics in each system, the presence, location and degree of current human perturbations (generally more likely at lower elevations), historical perturbations (natural and human-induced), environmental factors (e.g., humidity, temperature, velocity of water in aquatic systems), sampling effort and duration (e.g., one time grab samples through regular sampling over one or more years using one or more collection methods), the effect of sampling area, relationship(s) with latitudinal gradients, climatic factors, and collinear reduction in productivity. The degree of decline with altitude and the shape of the resultant slope (e.g., monotonic–linear, monotonic–nonlinear, or other) can be affected by these factors singly or in combination. Questions about these and other factors should be considered and applied *a priori* when designing a study, not investigated after the data has been collected. Otherwise, in system-level or regional studies, inappropriate comparisons can be made.

Our interest in altitudinal distribution is quite different from this, and, ultimately, we seek to ask different questions. However, many of the factors mentioned above are pertinent as well to our investigative approach. We are working at the species level within one family and three genera, not the assemblage level. Our ultimate goal is to explain individual species distributions along altitudinal axes. Figure 7 represents all available data on the distribution of Panama's glossosomatid species by altitude (current study, Blahnik and Holzenthal 2006, 2008; Holzenthal and Blahnik 2006, Ralph W. Holzenthal-unpublished data). At this juncture, we are not convinced we have sufficient incidence data to begin asking species-specific questions. Additional collections will no doubt modify the range of elevation for some of these species. However, we do have sufficient current information to believe that some percentage of these ranges are realistic representations. It is not expected that all these species will be found at all altitudes in Panama, or elsewhere. We know that other species of caddisflies are only found at higher elevations (e.g., *Limnephilus hamifer*: Limnephilidae; Flint 1963) due to phylogeographic processes, so restriction to certain altitudes does occur. In addition, some of the glossosomatid species represented in Figure 7 are endemic and are perhaps either constrained in some manner from spreading up and/or down in elevation, or have not had sufficient time to do so, or are so rare that collecting them at other altitudes is not probable. It seems intuitive to us that at least a few of these species, after much verification, will prove to occupy only a narrow altitudinal range. Then, and only then, will we be able to ask specific questions about why this is so, consider at least some of the factors mentioned above, and delve into tolerances and other types of limitations on a species by species basis. Therefore, at this juncture in time, Fig. 7 is only intended to contribute to our developing knowledge about altitudinal distribution within the Glossosomatidae in Panama and to serve as a baseline for comparison with data from future research.

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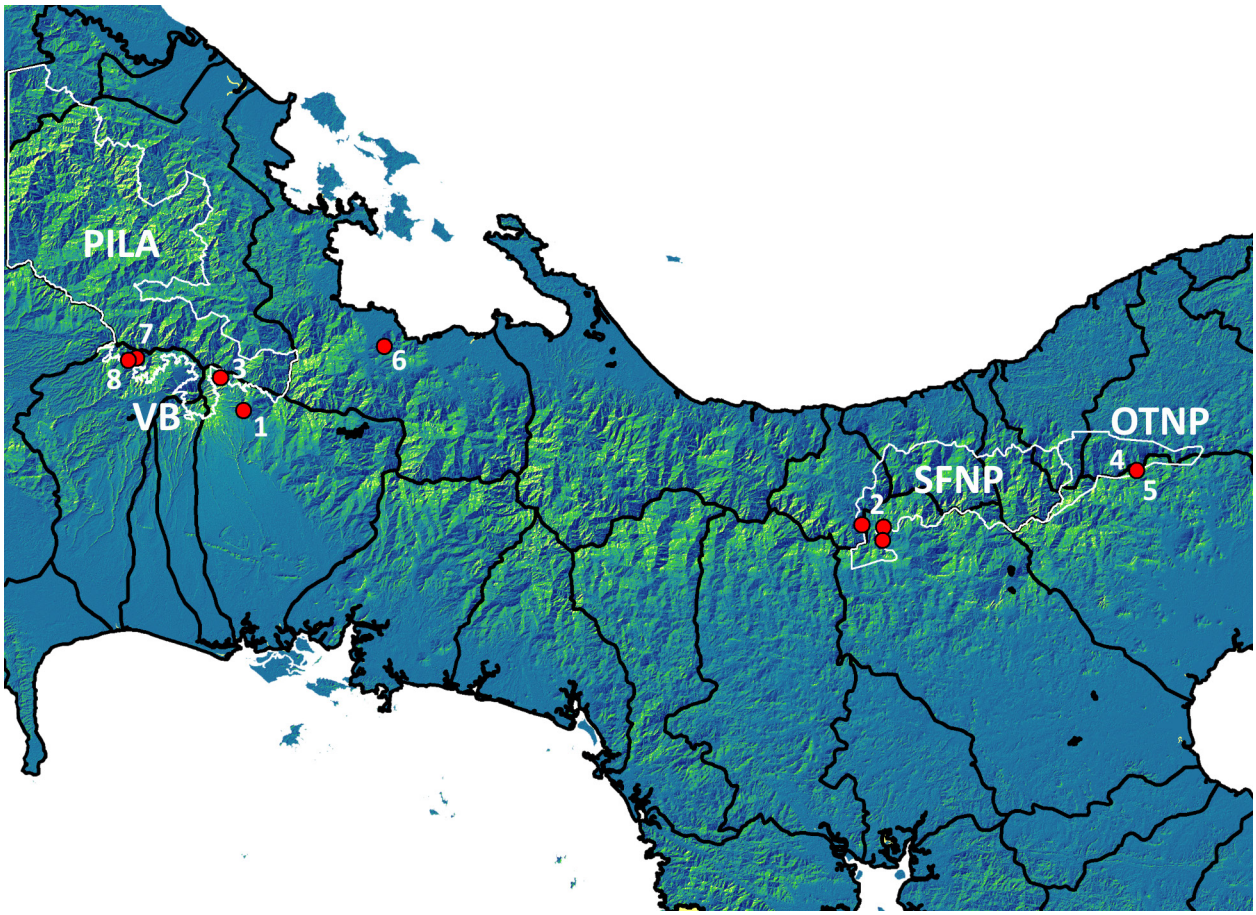

Figure 1. Map showing collection locations for new species or new country records of Glossosomatidae in Panama. The map is divided into the 52 hydrographic basins (black lines) established for Panama, with an overlay of four national parks (white lines) surveyed during 2017. [**PILA**–La Amistad International Park; **VB**–Volcan Baru National Park; **SFNP**–Santa Fe National Park; **OTNP**–Omar Torrijos National Park; **1**–*Culoptila costaricensis*; **2**–*Mortoniella calovebora*; **3**–*Mortoniella opinionis*; **4**–*Mortoniella yayas*; **5**–*Protoptila inflata*; **6**–*Protoptila rambala*; **7**–*Protoptila spirifera*; **8**–*Protoptila totumas*].

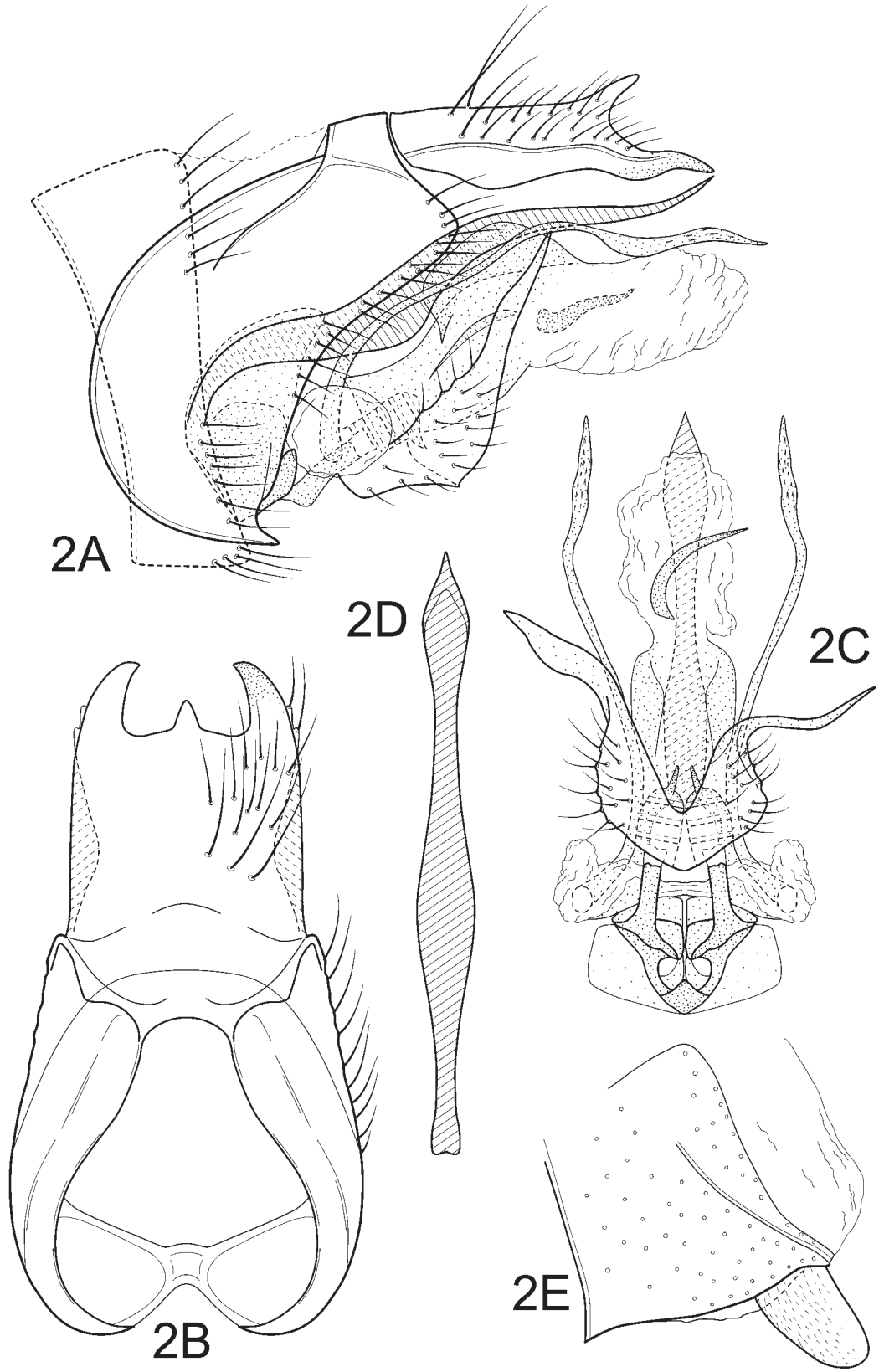

Figure 2. *Mortoniella* (*Mortoniella*) *calovebora*, new species, male genitalia. **A)** Lateral. **B)** Segment IX and tergum X, dorsal. **C)** Phallic ensemble, ventral. **D)** Dorsal phallic spine, dorsal. **E)** Ventral process of segment VI, lateral.

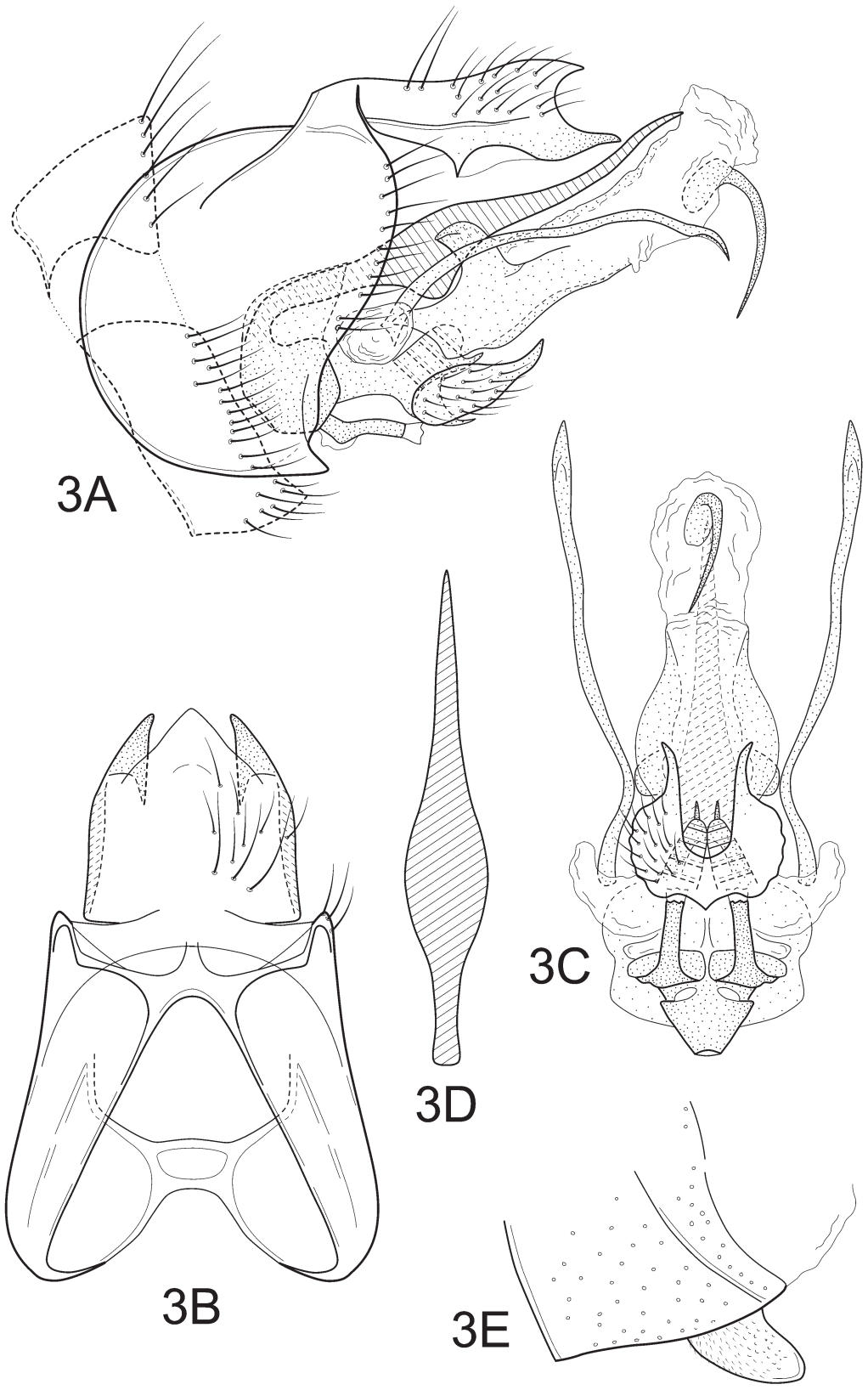

Figure 3. *Mortoniella* (*Mortoniella*) *yayas*, new species, male genitalia. **A)** Lateral. **B)** Segment IX and tergum X, dorsal. **C)** Phallic ensemble, ventral. **D)** Dorsal phallic spine, dorsal. **E)** Ventral process of segment VI, lateral.

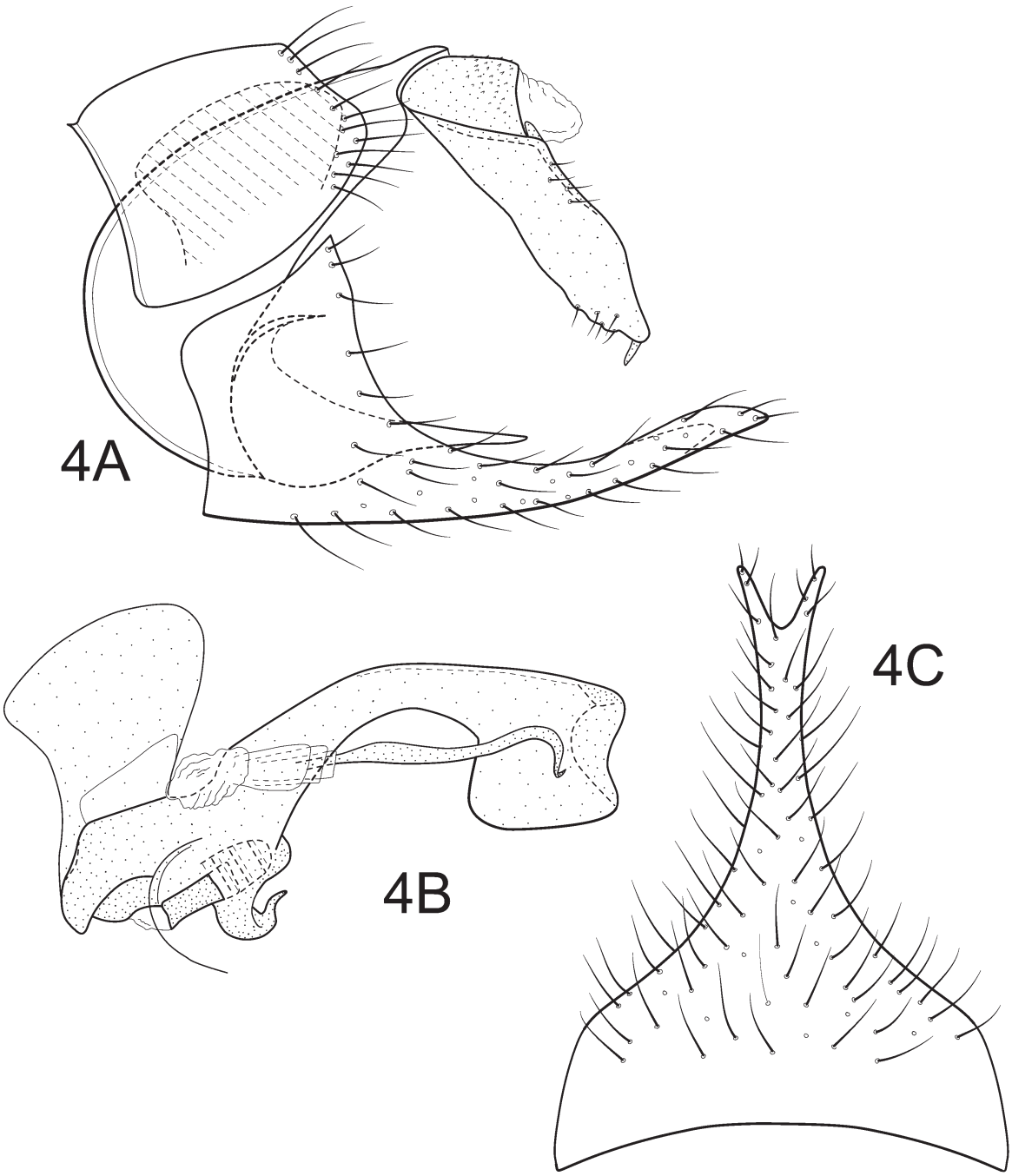

Figure 4. *Protoptila inflata*, new species, male genitalia, **A)** Lateral (position of phallic ensemble in genital capsule indicated with cross hatches). **B)** Phallic ensemble, lateral. **C)** Sternum VIII, ventral.

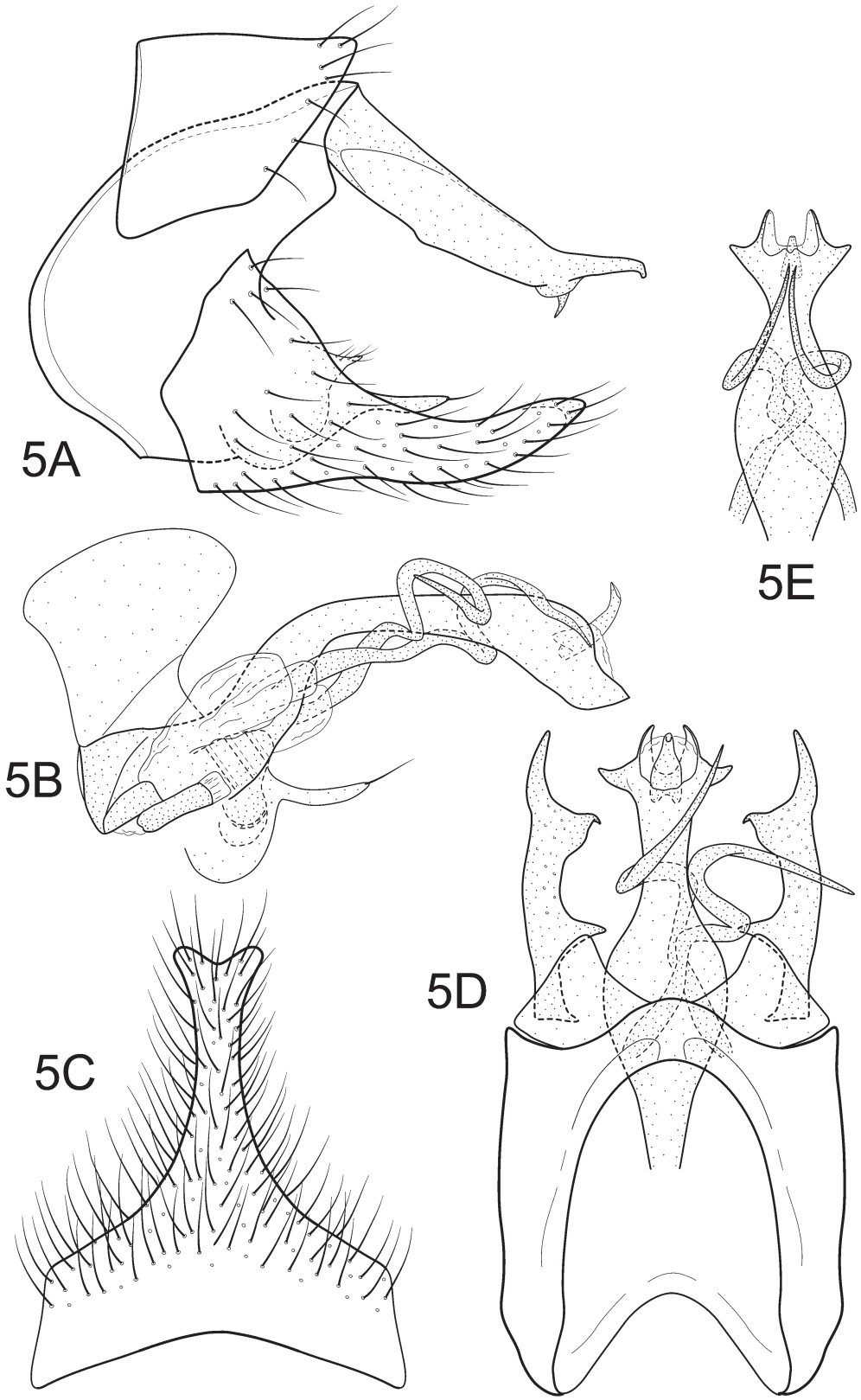

Figure 5. *Protoptila totumas*, new species, male genitalia, **A)** Lateral (phallic ensemble removed). **B)** Phallic ensemble, lateral. **C)** Sternum VIII, ventral. **D)** Dorsal of segment IX, tergum X and apex of phallic ensemble. **E)** Variant of apex of phallic ensemble and parameres, dorsal.

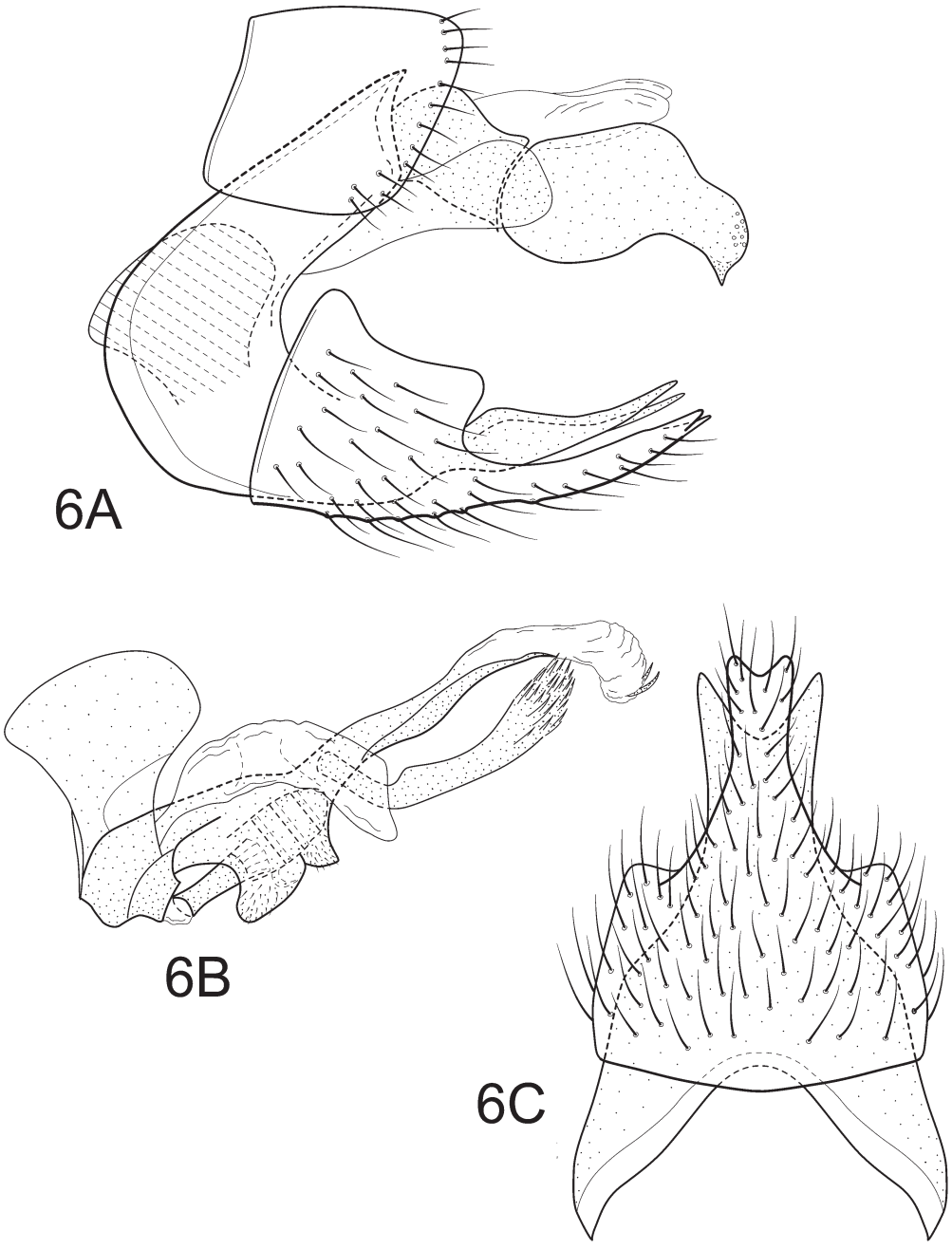

Figure 6. *Protoptila rambala*, new species, male genitalia, **A)** Lateral (position of phallic complex in genital capsule indicated with cross hatches). **B)** Phallic ensemble, lateral. **C)** Sternum VIII and segment IX, ventral.

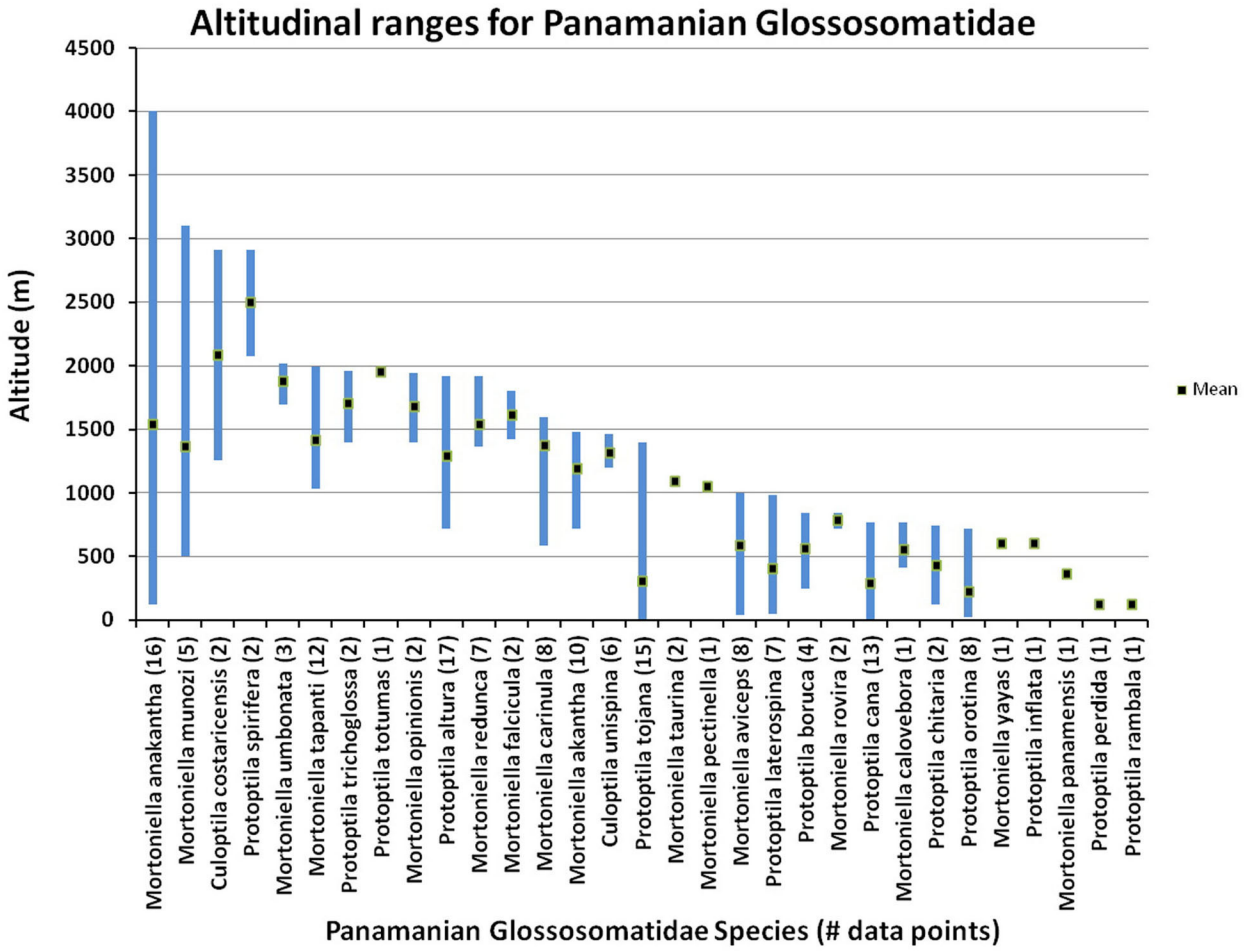

Figure 7. Plot of altitudinal ranges for each glossosomatid species present in Panama. The order from left to right is sorted by maximum recorded altitude. The number of included data points for each species is given in parentheses adjacent to each species name on the X-axis.

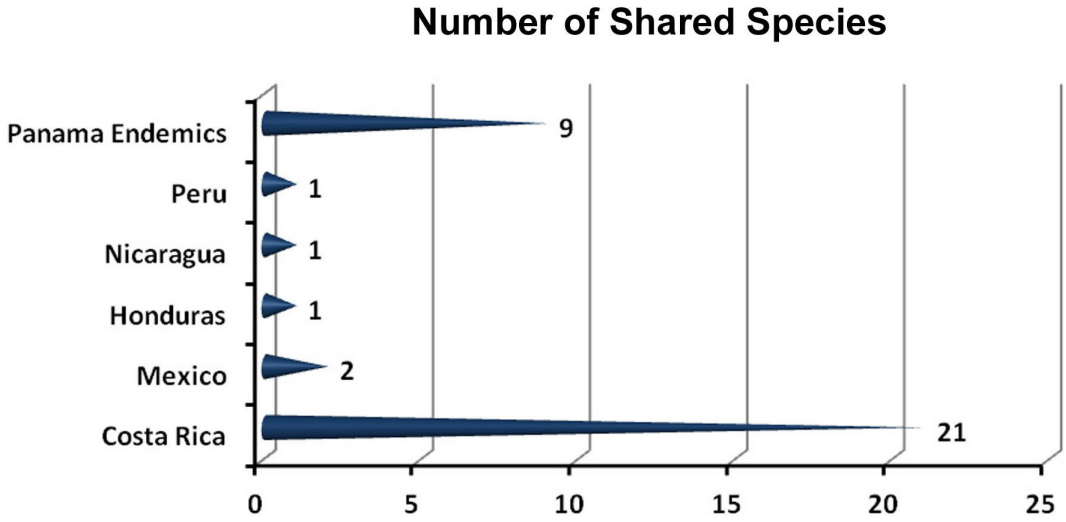

Figure 8. Number of shared species between Panamanian glossosomatids and those of other Neotropical countries.