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The Trichoptera of Panama. VI. Seven new species of microcaddisflies (Insecta: Trichoptera: Hydroptilidae) from Mount Totumas Cloud Forest and Biological Reserve

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and Biological Reserve

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The Trichoptera of Panama. VI. Seven new species of microcaddisflies (Insecta: Trichoptera: Hydroptilidae) from Mount Totumas Cloud Forest and Biological Reserve

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Abstract. There have been 136 species of microcaddisflies (Trichoptera: Hydroptilidae) recorded from the Republic of Panama. Herein we describe seven new species from the Mount Totumas Cloud Forest and Biological Reserve, in the upper reaches of the Río Chiriquí Viejo watershed (*Costatrichia devastiva*, *C. dietrichi*, *Metrichia brocha*, *M. calla*, *Neotrichia atopa*, *Ochrotrichia anticheirion*, and *Rhyacopsyche totuma*). These results are part of an ongoing effort to characterize the aquatic insect fauna of Panama, and to evaluate that country's major watersheds.

Key words. Hydroptilids, Río Colorado, Río Chiriquí Viejo, watersheds, Chiriqui Province.

Introduction

Mount Totumas Cloud Forest and Biological Reserve (MTCF) is a private landholding in Chiriquí Province, adjacent to La Amistad International Park (PILA) and encompassing 160 ha. It is named for the nearby Cerro Totumas mountain (2,630 masl, maximum elevation). Whereas most of Cerro Totumas is within the PILA boundaries, the western, lower slopes fall within the biological reserve. MTCF occupies the upper portion of the Río Colorado subwatershed (Fig. 1), immediately adjacent to and west of the headwaters of the Río Chiriquí Viejo watershed. Most of the land is forested, with some pasture areas and livestock, but little or no crop-based agriculture.

During the course of surveying this portion of the Río Colorado watershed for adult caddisflies, we discovered several new species of microcaddisflies in our samples. Currently, 136 species of microcaddisflies (Trichoptera: Hydroptilidae) distributed among 18 genera are known from Panama (Armitage et al. 2015, 2016; Armitage and Harris 2018). The purpose of this paper is to describe and figure seven new species of microcaddisflies for five of the genera known from Panama.

Materials and Methods

Three streams in the upper extent of the Río Colorado watershed were sampled during 2015 and 2016 (Fig. 1). The Río Colorado, the principal stream on the MTCF property, is approximately 5–9 m wide, contains a variety of substrates ranging from large boulders to coarse sand, and serves as a tributary of the Río Chiriquí Viejo. Quebrada Norte, a second order tributary of the Río Colorado, is approximately 1–2 m wide, contains a variety of substrates from small boulders to fine sand, and joins the Río Colorado near the entrance to MTCF. An unnamed, first order tributary arises in the western portion of MTCF and flows southeastward to join the Río Colorado. It is, in general, less than 1 m wide and contains a variety of substrate types including small boulders, gravel, fine sand, and organic detrital deposits. All three streams have a wooded riparian corridor.

Single-night collections were made, in general, using UV lights and alcohol traps (Calor and Mariano 2012). Multiple-night collections were made employing Malaise traps. The sample locations were located at 1,692 m (Río Colorado and Quebrada Norte; both upstream of their confluence) and 1,922 m (unnamed tributary of the Río Colorado; approximately midway between the source and the confluence with the Río Colorado).

Morphological terminology used for male genitalia generally follows that of Marshall (1979). For simplicity, paired structures are discussed in the singular. Procedures for specimen preparation followed those explained in detail by Blahnik et al. (2007). For specimen examination and illustration, cleared genitalia were placed in a watch glass with glycerin and cotton. Genitalia were examined with an Olympus BX43 compound microscope at 250–500 \times magnification. Structures were traced in pencil with the use of a camera lucida (drawing tube) mounted on the microscope. Pencil sketches were then scanned (Fujitsu ScanScap S1500M scanner) and were then edited and digitally inked in Adobe Photoshop and Illustrator (CS5.1). Electronic “drawing” was completed with the aid of a graphics tablet (Bamboo Pen, Wacom Company, Limited). Species descriptions were constructed using the program DELTA (Dallwitz et al. 2016) and specimen management followed the procedures outlined by Holzenthal and Andersen (2004). Types of species described and other material examined are deposited in the Colección Zoológica Dr. Eustorgio Méndez (COZEM) and the personal collection of the second author (BJA) as indicated.

Results

Genus *Costatrichia* Mosely. Four species of the genus *Costatrichia* were previously known from Panama, three of which were described from Panama and one of which is currently endemic. Herein we add two new species from Mount Totumas.

Costatrichia devestiva Thomson and Armitage, sp. n.

Fig. 2.

Diagnosis. *Costatrichia devestiva* is unique from all other species in the genus due to the apparent lack of spines or sclerites on the phallus. The membranous apex seems to bear only a small pair of completely membranous lateral lobes.

Male. Forewing length 2.5–2.7 mm ($n = 5$). Head unmodified, with 3 ocelli; antennae unmodified. Tibial spur count 1, 3, 4. Color in alcohol brown, denuded. **Genitalia.** Abdominal sternum VII with simple, pointed mesoventral process. Sternum VIII anterolateral margin with 1 digitate lateral process bearing large, stout spine, 1 slender, elongate spinelike lateral process, and peglike setae apicoventrally; in ventral view posterior margin with mesal emargination between patches of peglike setae, spinelike lateral process with single basal peglike seta and small basal digitate process bearing single seta. Segment IX anterolateral margin convex, posterolateral margin straight, with posterolateral process bearing 2 small apical setae; in dorsal view anterior margin pointedly concave, posterior margin nearly straight. Inferior appendage with rounded basal emargination and apical hook curving ventrad; in ventral view fused basally, with shallow apical emargination. Tergum X with dorsal sclerite subovate; ventral sclerite semielliptic with rounded mesal production on anterior margin; membranous apex rounded in dorsal view. Phallus tubular basally, constricted at midlength with median complex bearing basal loop and pair of spherical dorsal “windows”; apex large, membranous, with pair of mesolateral membranous lobes, strongly recurved apically.

Type material. **Holotype male**—PANAMA: Chiriquí Province: Cuenca 102 (Río Chiriquí Viejo), Quebrada Norte, Mount Totumas Biological Reserve, 8.873613°N, 82.690512°W, Malaise trap, 30–31.viii.2015, J. Dietrich and B. Armitage (COZEM). **Paratypes**—ibid., 3 males (BJA); ibid., 26.iv–10.v.2015, 1 male (COZEM).

Etymology. The Latin word *devestivus* meaning “undressed”, referring to the lack of spines or sclerites on the phallus typically present in this genus.

***Costatrichia dietrichi* Thomson and Armitage, sp. n.**

Fig. 3.

Diagnosis. *Costatrichia dietrichi* is most similar to *C. zopilote* Holzenthal and Harris. In both of these species, the phallus bears a pair of large dorsal sclerites and the membranous apex curves strongly dorsad. Both species also bear large, stout apical spines on the lateral process of sternum VIII. *C. zopilote* bears 3 of these spines (Holzenthal and Harris 1999), while *C. dietrichi* bears only 2.

Male. Forewing length 2.2–2.7 mm ($n = 15$). Head unmodified, with 3 ocelli; antennae unmodified. Tibial spur count 1, 3, 4. Color in alcohol brown, denuded. **Genitalia.** Abdominal sternum VII with simple, pointed mesoventral process. Sternum VIII anterolateral margin with 2 digitate lateral processes bearing large, stout spines; in ventral view with posterior margin concave. Segment IX anterolateral margin convex, posterolateral margin convex, with posterolateral process bearing 2 apical setae; in dorsal view anterior margin concave, posterior margin shallowly concave. Inferior appendage with apical digitate projection bearing single seta; in ventral view fused basally. Tergum X with dorsal sclerite semielliptic with crenulate posterior margin; ventral sclerite semielliptic with rounded mesal production on posterior margin; membranous apex subquadrate in dorsal view. Phallus tubular basally, constricted at midlength with median complex bearing basal loop and pair of spherical dorsal “windows”; apex large, membranous, bearing pair of dorsolateral sclerites with rounded apices.

Type material. **Holotype male**—PANAMA: Chiriquí Province: Cuenca 102 (Río Chiriquí Viejo), Quebrada Norte, Mount Totumas Biological Reserve, 8.873613°N, 82.690512°W, Malaise trap, 18–23.v.2015, J. Dietrich and B. Armitage (COZEM). **Paratypes**—ibid., 30–31.viii.2015, 10 males (COZEM); ibid., 26.iv–10.v.2015, 4 males (BJA).

Etymology. Named in honor of Jeffrey Dietrich, owner and operator of Mount Totumas Cloud Forest and Biological Reserve, in recognition of his many contributions to our study there.

Genus *Metrichia* Ross. Twenty-two species of the genus *Metrichia* were previously known from Panama, ten of which were originally described from there and eight of which are currently endemic. Herein we add two new species from Mount Totumas.

***Metrichia brocha* Thomson and Armitage, sp. n.**

Fig. 4.

Diagnosis. *Metrichia brocha* is most similar to *M. spica* Bueno-Soria and Holzenthal. In both species, the inferior appendage is suborbicular in lateral view, with 2 processes along the ventral margin. However, the anterior process is truncate in *M. spica* (Bueno-Soria and Holzenthal 2003) and pointed in *M. brocha*. Additionally, the emargination between the 2 processes is larger in *M. spica* than in *M. brocha*.

Male. Forewing length 2.5–2.7 mm ($n = 7$). Head unmodified, with 3 ocelli; antennae unmodified. Tibial spur count 1, 3, 4. Color in alcohol brown, denuded. **Genitalia.** Abdominal sternum VII without mesoventral process. Segment VIII unmodified. Segment IX anterolateral margin convex, narrowing and withdrawn into segments VII–VIII, posterolateral margin convex; dorsally with posterior margin membranous, flat. Preanal appendage short, rounded. Dorsolateral hook slender, decurved. Inferior appendage setose, suborbicular with small anteroventral pointed process and large, heavily sclerotized mesoventral pointed process; ventrally, large pointed process curved inward. Tergum X membranous, amorphous. Phallus widest at base, narrowing to median constriction, membranous apex with 3 spines, 1st and 2nd curved strongly outwards, 3rd slender, elongate, extending apically.

Type material. **Holotype male**—PANAMA: Chiriquí Province: Cuenca 102 (Río Chiriquí Viejo), Quebrada Norte, Mount Totumas Biological Reserve, 8.873613°N, 82.690512°W, Malaise trap, 14.iv.2015, J. Dietrich and B. Armitage (COZEM). **Paratypes**—ibid., 18–23.v.2015, 5 males (BJA); ibid., 30–31.viii.2015, 1 male (COZEM).

Etymology. The Latin word *brochus* meaning “with projecting teeth”, referring to the 2 pointed processes

of the ventral margin of the inferior appendage.

***Metrichia calla* Thomson and Armitage, sp. n.**

Fig. 5.

Diagnosis. *Metrichia calla* is most similar to *M. sesquipedalis* Bueno-Soria and Holzenthal. Both species bear a large inferior appendage truncate basally, extended and acuminate apically. In ventral view, the broad base of the inferior appendage narrows gradually to the slender apex in *M. sesquipedalis* (Bueno-Soria and Holzenthal 2003), but does so very abruptly in *M. calla*.

Male. Forewing length 2.7 mm ($n = 1$). Head unmodified, with 3 ocelli; antennae unmodified. Tibial spur count 1, 3, 4. Color in alcohol brown, denuded. **Genitalia.** Abdominal sternum VII without mesoventral process. Segment VIII unmodified. Segment IX anterolateral margin convex, narrowing and withdrawn into segments VII–VIII, posterolateral margin convex, with small apicoventral process; dorsally, with posterior margin membranous, flat. Preanal appendage short, rounded; dorsally with posterior margin rugose. Dorsolateral hook stout, decurved. Inferior appendage interior surface bearing row of peglike setae, truncate basally, apex elongate and extended in narrow, triangular process. Tergum X membranous, apex subquadrate in dorsal view. Phallus widest at base, membranous apex with 3 spines, 1st and 2nd spiraling outward, 3rd slender, elongate, extending apically within membranous sheath.

Type material. Holotype male—PANAMA: Chiriquí Province: Cuenca 102 (Río Chiriquí Viejo), Quebrada Norte, Mount Totumas Biological Reserve, 8.873613°N, 82.690512°W, UV-light trap, 18.iii.2016, B. and T. Armitage (COZEM).

Etymology. *Calla*, referring to the shape of membranous apex of the phallus, which reminds the authors of a calla lily.

Genus *Neotrichia* Morton. Fourteen species in the genus *Neotrichia* were previously known for Panama, seven of which were described in Panama and are currently endemic. Herein we add one new species from Mount Totumas.

***Neotrichia atopa* Thomson and Armitage, sp. n.**

Fig. 6.

Diagnosis. Based on the number of ocelli and the spur formula, this species has been placed in the genus *Neotrichia*. However, the overall appearance of the male genitalia does not seem typical of the genus. The inferior appendage is short and not immediately apparent when viewed laterally, as opposed to the expected long and slender form seen in most other *Neotrichia* species. Segment IX does not appear to be fused dorsally with tergum X; the dorsal plate is not apparent. The elaborate, sclerotized structure present at the base of the subgenital plate and the inferior appendage in this species also seem unique within the genus.

Male. Forewing length 2.0 mm ($n = 1$). Head unmodified, with 3 ocelli; antennae unmodified. Tibial spur count 0, 2, 3. Color in alcohol brown, denuded. **Genitalia.** Abdominal sternum VII without mesoventral process. Segment VIII unmodified. Segment IX anterolateral margin strongly narrowing, withdrawn into segment VIII, posterolateral margin convex; in dorsal view posterior margin concave. Subgenital plate membranous dorsally; in ventral view with pair of apical setae, broadest apically. Bracteole setose, larger than, and extended past, inferior appendage. Inferior appendage small, semi-triangular in lateral view, seemingly fused basally with subgenital plate with elaborate sclerotized structure extending into segment IX. Tergum X membranous, subtriangular in dorsal view. Phallus with wide tubular base narrowing to median constriction, membranous apex with 2 slender processes; 1st process long, with apical emargination; 2nd process shorter and wrapped around 1st process.

Type material. Holotype male—PANAMA: Chiriquí Province: Cuenca 102 (Río Chiriquí Viejo), un. trib., Río Colorado, Mount Totumas Biological Reserve, 8.884717°N, 82.684077°W, UV-light trap,

2.i.2016, B. and T. Armitage (COZEM).

Etymology. The Greek word *atopos* meaning “out of place, odd, strange, unnatural”, referring to the atypical appearance of this species for this genus.

Genus *Ochrotrichia* Mosely. The genus *Ochrotrichia* in Panama previously included 25 species, 18 of which were first described from Panama and 11 of which are currently endemic. Herein we add one new species from Mount Totumas.

***Ochrotrichia anticheirion* Thomson and Armitage, sp. n.**

Fig. 7.

Diagnosis. *Ochrotrichia anticheirion* is very similar to *O. arranca* (Mosely). The arrangement and orientation of the spine-bearing processes of the ventral lobe of the inferior appendage differs between the 2 species. The single, peglike seta found on the ventral surface of the ventral lobe of the inferior appendage in *O. anticheirion* is absent in *O. arranca*. Additionally, the mesoventral process present in *O. arranca* (Mosely 1937) is absent in *O. anticheirion*.

Male. Forewing length 2.8–3.1 mm ($n = 3$). Head unmodified, with 3 ocelli; antennae unmodified. Tibial spur count 0, 3, 4. Color in alcohol brown, denuded. **Genitalia.** Abdominal sternum VII without mesoventral process. Segment VIII unmodified. Segment IX anterolateral margin concave, posterolateral margin fused dorsolaterally with tergum X. Inferior appendage setose, with dorsal and ventral lobes; dorsal lobe approximately 3 times longer than wide, parallel-sided, apex truncate; ventral lobe bearing 3 digitate processes ending in a stout spine and a single stout, peglike seta ventrally. Tergum X sclerotized, highly developed with 3 processes: 1st process slender, elongate, broadest medially, bearing 2 stout setae, apex pointed; 2nd process semi-membranous basally, lightly sclerotized apically, apex with slightly curved dorsal branch and strongly anteriorly recurved ventrolateral process; 3rd process membranous, very lightly sclerotized apicoventrally. Phallus tubular, elongate, simple, thread-like.

Type material. Holotype male—PANAMA: Chiriquí Province: Cuenca 102 (Río Chiriquí Viejo), Quebrada Norte, Mount Totumas Biological Reserve, 8.873613°N, 82.690512°W, UV-light trap, 18.iii.2016, B. and T. Armitage (COZEM). **Paratypes—**ibid., 1 male (COZEM); ibid., un. trib., Río Colorado, Mount Totumas Biological Reserve, 8.884717°N, 82.684077°W, Malaise trap, 15–18.iii.2016, J. Dietrich and B. Armitage, 1 male (BJA).

Etymology. The diminutive of the Greek word *anticheiros* meaning “thumb”, referring to the small peglike spine on the ventral surface of the inferior appendage.

Genus *Rhyacopsyche* Mueller. The genus *Rhyacopsyche* was recently recorded for the first time from Panama (Armitage and Harris 2018), with one previously described species known. Herein we add one new species from Mount Totumas, the first to be described from Panama.

***Rhyacopsyche totuma* Thomson and Armitage, sp. n.**

Fig. 8.

Diagnosis. *Rhyacopsyche totuma* is most similar to *R. intraspira* Wasmund and Holzenthal, 2007. In both species, the apex of the dorsolateral lobe of segment IX is truncate and bears peglike setae. The apex of the inferior appendage of *R. intraspira* bears 2 peglike setae (Wasmund and Holzenthal 2007), while *R. totuma* bears only one. The membranous portion of the phallus of *R. intraspira* bears spicules, which are lacking in *R. totuma*.

Male. Head unmodified, with 3 ocelli; antennae unmodified. Tibial spur count 1, 3, 4. Color in alcohol brown, denuded. **Genitalia.** Abdominal sternum VII without mesoventral process. Segment VIII unmodified. Segment IX anterolateral margin convex, posterolateral margin with truncate dorsolateral lobe bearing peglike setae. Inferior appendage elongate, setose, curved gradually upwards, apex with

triangular emargination and 1 peglike seta. Tergum X membranous, bi-lobed in dorsal view, contracted inside dorsolateral lobes of segment IX. Phallus basally tubular, elongate, narrow, apex membranous and with 2 thickened lateral spines.

Type material. Holotype male—PANAMA: Chiriquí Province: Cuenca 102 (Río Chiriquí Viejo), Quebrada Norte, Mount Totumas Biological Reserve, 8.873613°N, 82.690512°W, UV-light trap, 1.ix.2016, B. and T. Armitage (COZEM). **Paratypes**—ibid., un. trib., Río Colorado, Mount Totumas Biological Reserve, 8.884717°N, 82.684077°W, Malaise Trap, 7–13.xii.2015, 1 male, J. Dietrich and B. Armitage (BJA).

Etymology. Named for Mount Totumas Biological Reserve, the location where the holotype was collected.

Discussion

It is remarkable to find this many new species of microcaddisflies at these higher elevations. We have noted so far that microcaddisfly diversity generally decreases from the lower to higher altitudes. Given the MTCF's proximity to the Costa Rican border, where other, different species are found, it is within the realm of possibility that additional microcaddisfly species, potentially new species or new country records, will be recorded in the future from this biological reserve.

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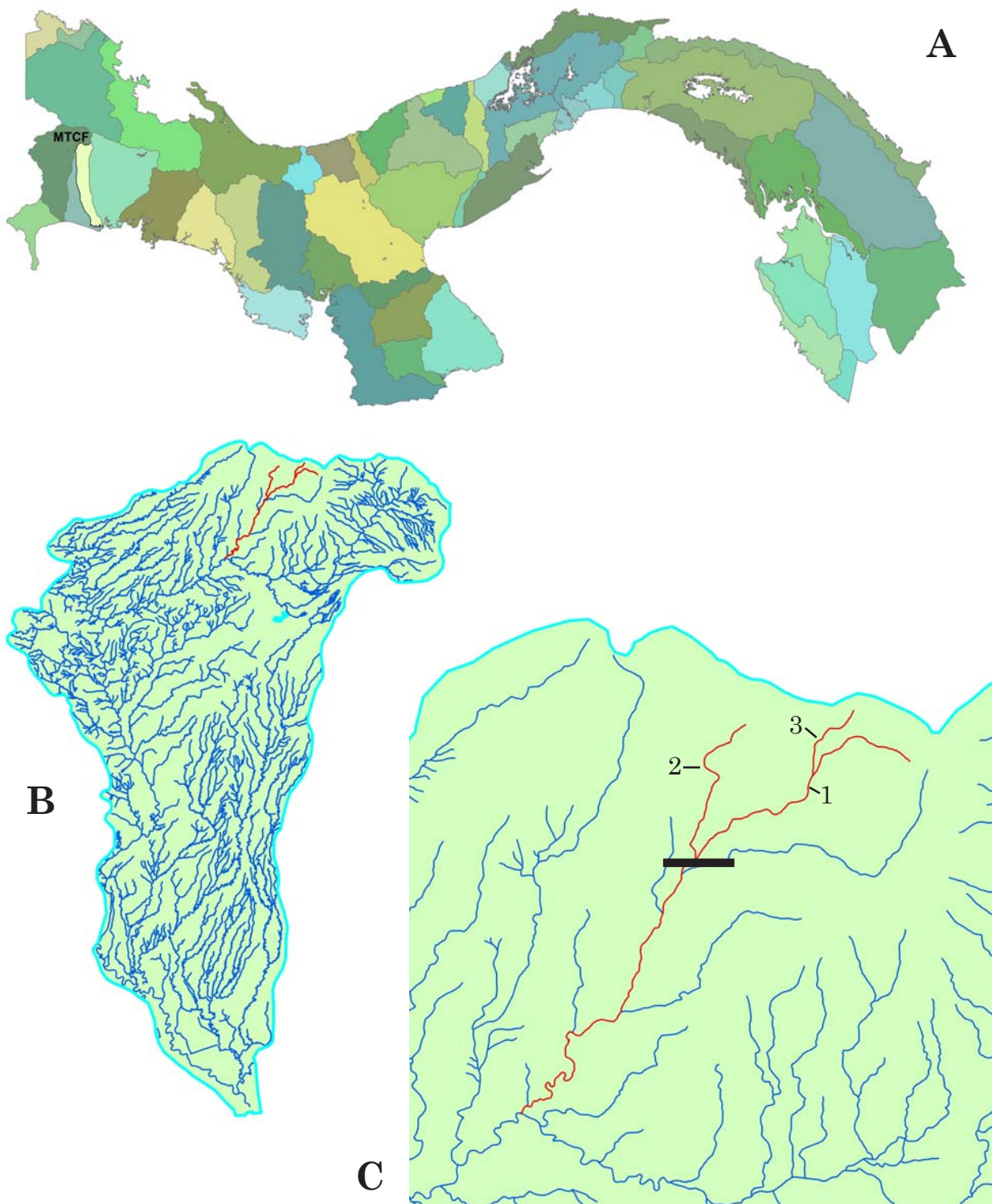


Figure 1. Maps of the study site. **A)** Major watersheds (cuencas) of Panama, with the Mount Totumas Cloud Forest and Biological Reserve (MTCF), Chiriquí Province, Panama location indicated on the far left in the Río Chiriquí Viejo watershed. **B)** Hydrography of the Río Chiriquí Viejo watershed with the study streams colored in red. **C)** Close-up of the study area (1-Río Colorado, 2-Quebrada Norte, 3-unnamed tributary of the Río Colorado). The southern limit of MTCF is approximately where Quebrada Norte enters the Río Colorado (thick black line).

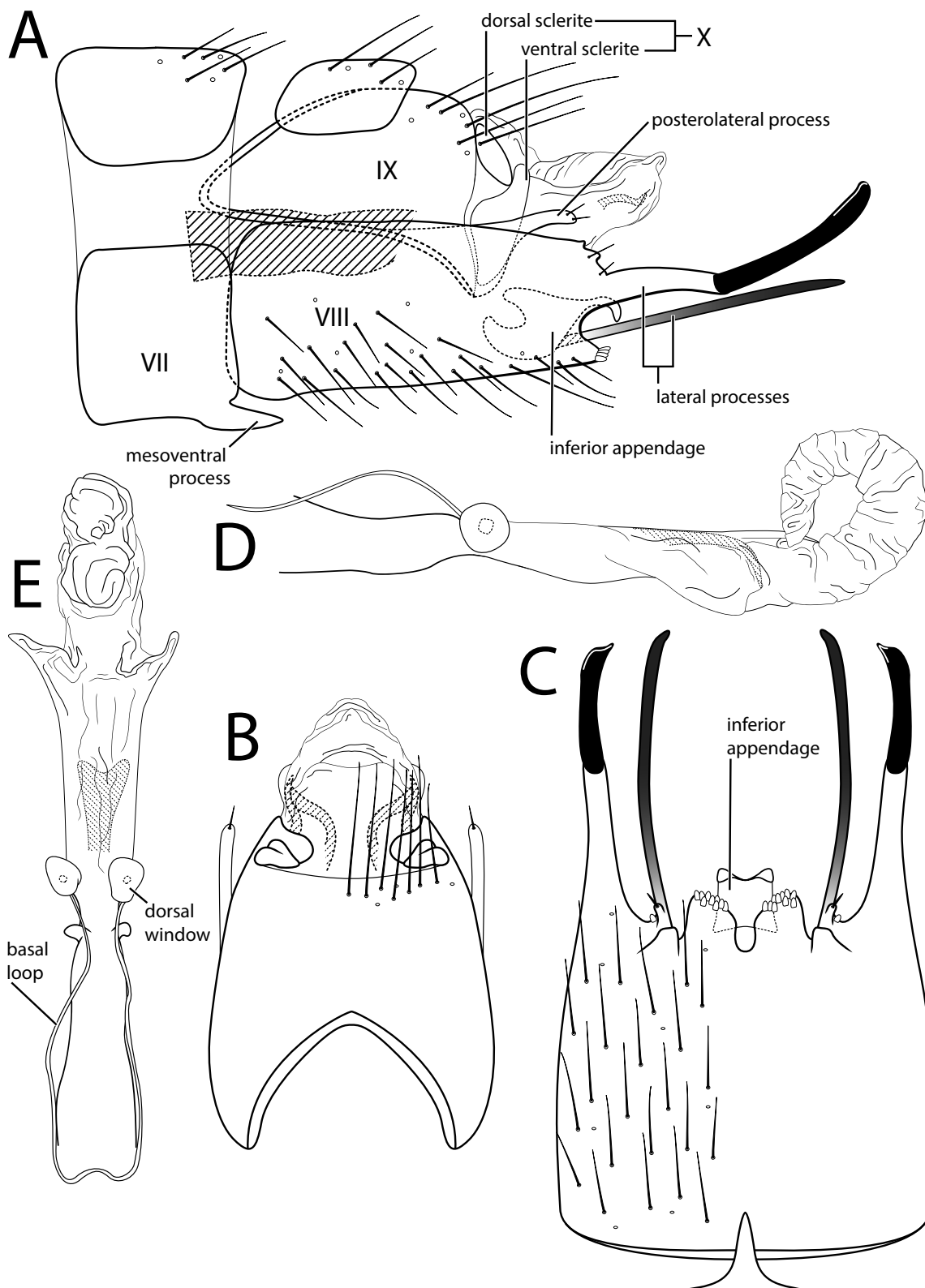


Figure 2. *Costatrichia devestiva* sp. n., male genitalia. **A)** Segments VIII–X, and segment VII mesoventral process, lateral (base of phallus crosshatched). **B)** Segments IX–X, dorsal. **C)** Segments VIII–IX and segment VII mesoventral process, ventral. **D)** Phallus, lateral phallus, dorsal. **E)** Phallus, basal loop, dorsal window.

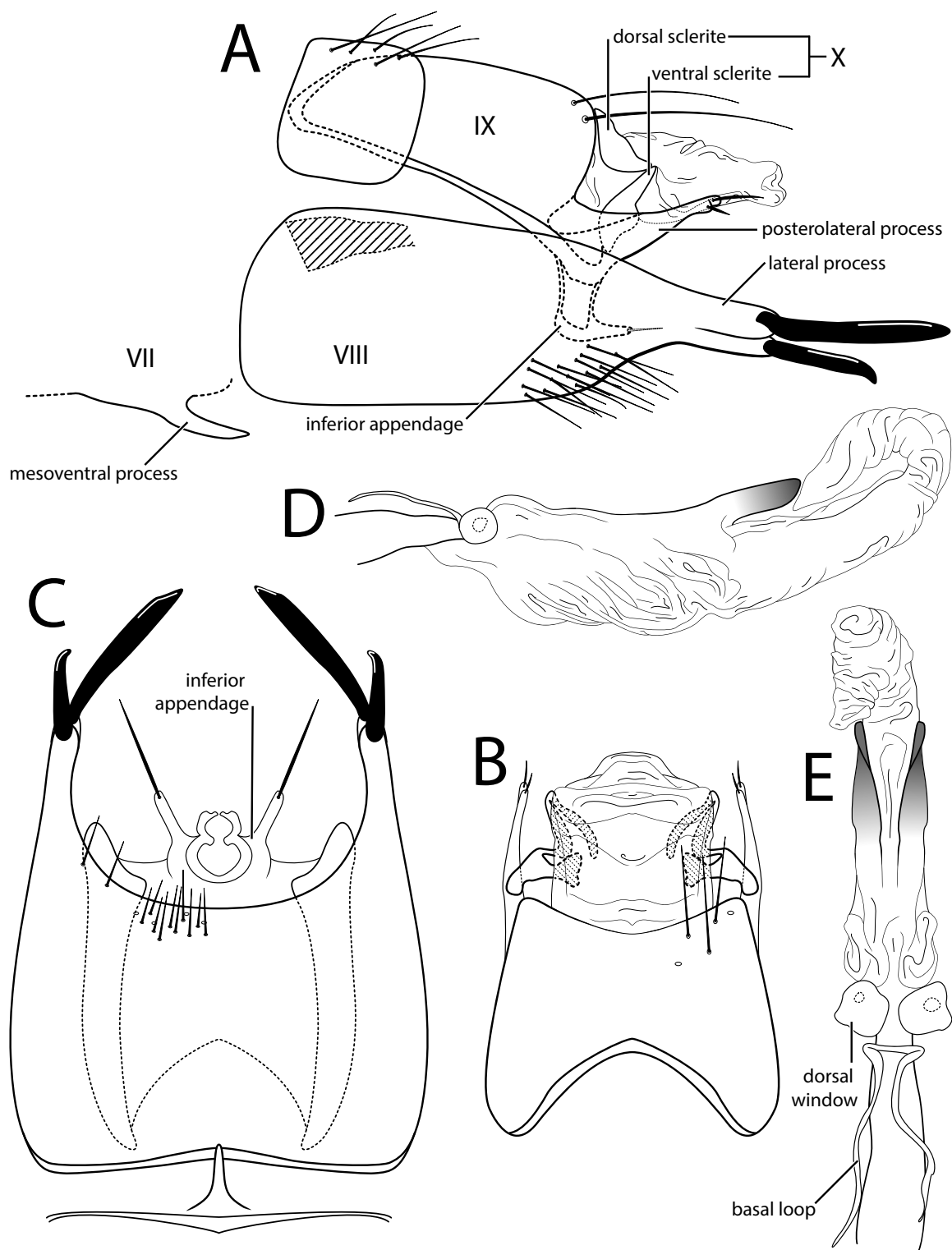


Figure 3. *Costatrichia dietrichi* sp. n., male genitalia. **A)** Segments VII–X, lateral (base of phallus crosshatched). **B)** Segments IX–X, dorsal. **C)** Segment VIII and segment VII mesoventral process, ventral. **D)** Phallus, lateral. **E)** Phallus dorsal.

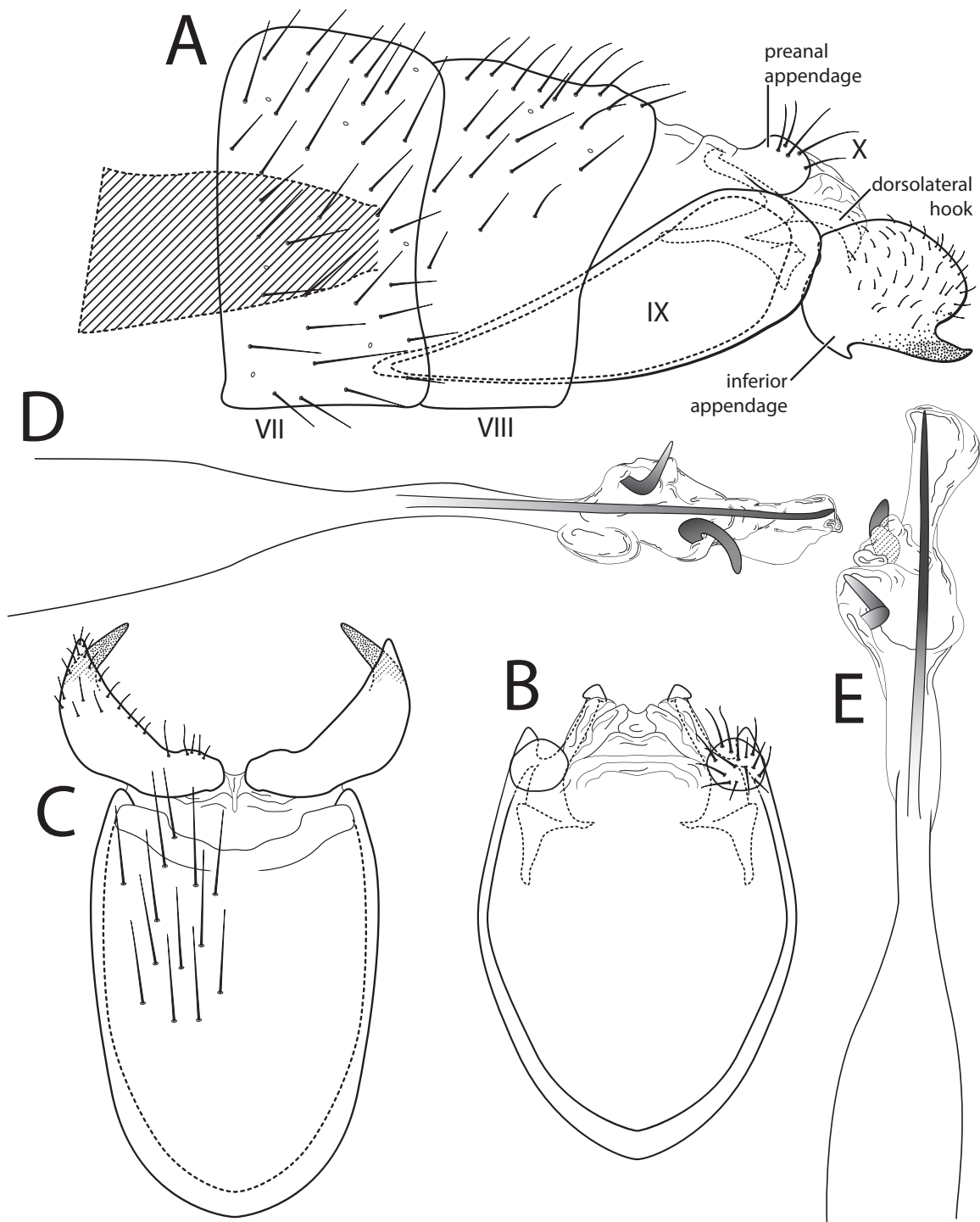


Figure 4. *Metrichia brocha* sp. n., male genitalia. **A)** Segments VII–X, lateral (base of phallus crosshatched). **B)** Segments IX–X, dorsal. **C)** Segment IX, ventral. **D)** Phallus, lateral. **E)** Phallus, dorsal.

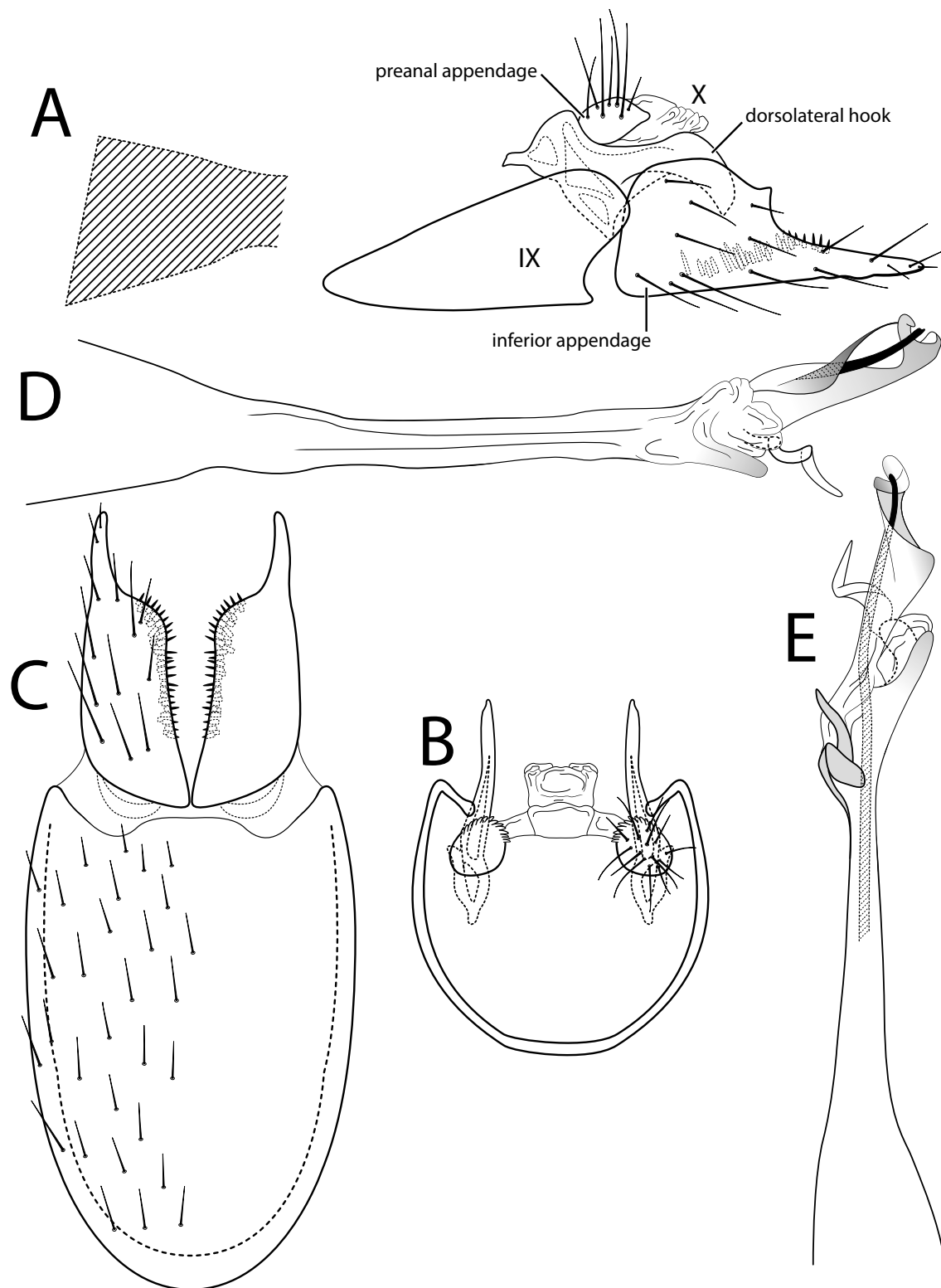


Figure 5. *Metrichia calla* sp. n., male genitalia. **A)** Segments IX–X, lateral (base of phallus crosshatched). **B)** Segments IX–X, dorsal. **C)** Segment IX, ventral. **D)** Phallus, lateral. **E)** Phallus, dorsal.

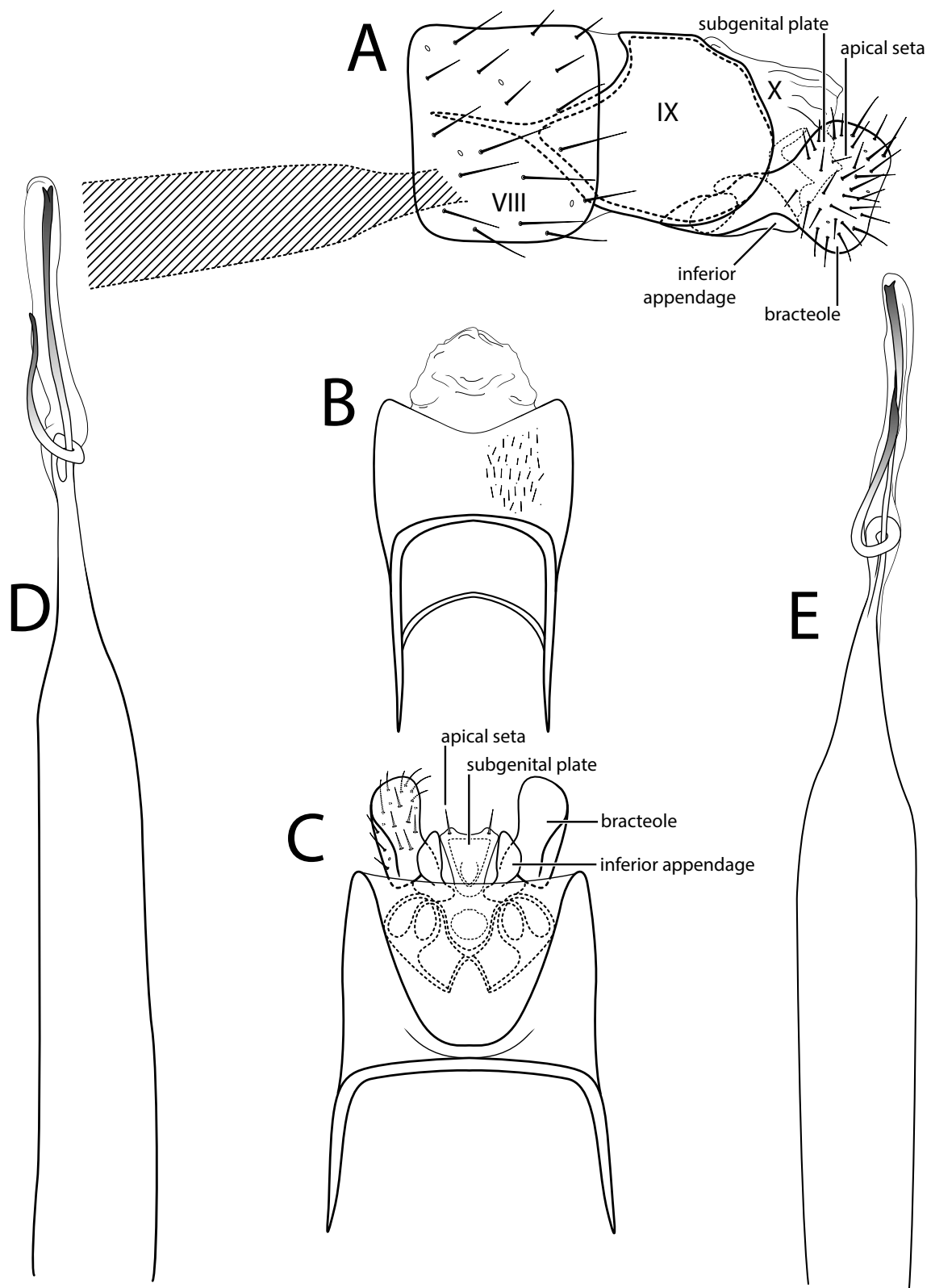


Figure 6. *Neotrichia atopa* sp. n., male genitalia. **A)** Segments VIII–X, lateral (base of phallus crosshatched). **B)** Segments IX–X, dorsal. **C)** Segment IX, ventral. **D)** Phallus, lateral. **E)** Phallus, dorsal.

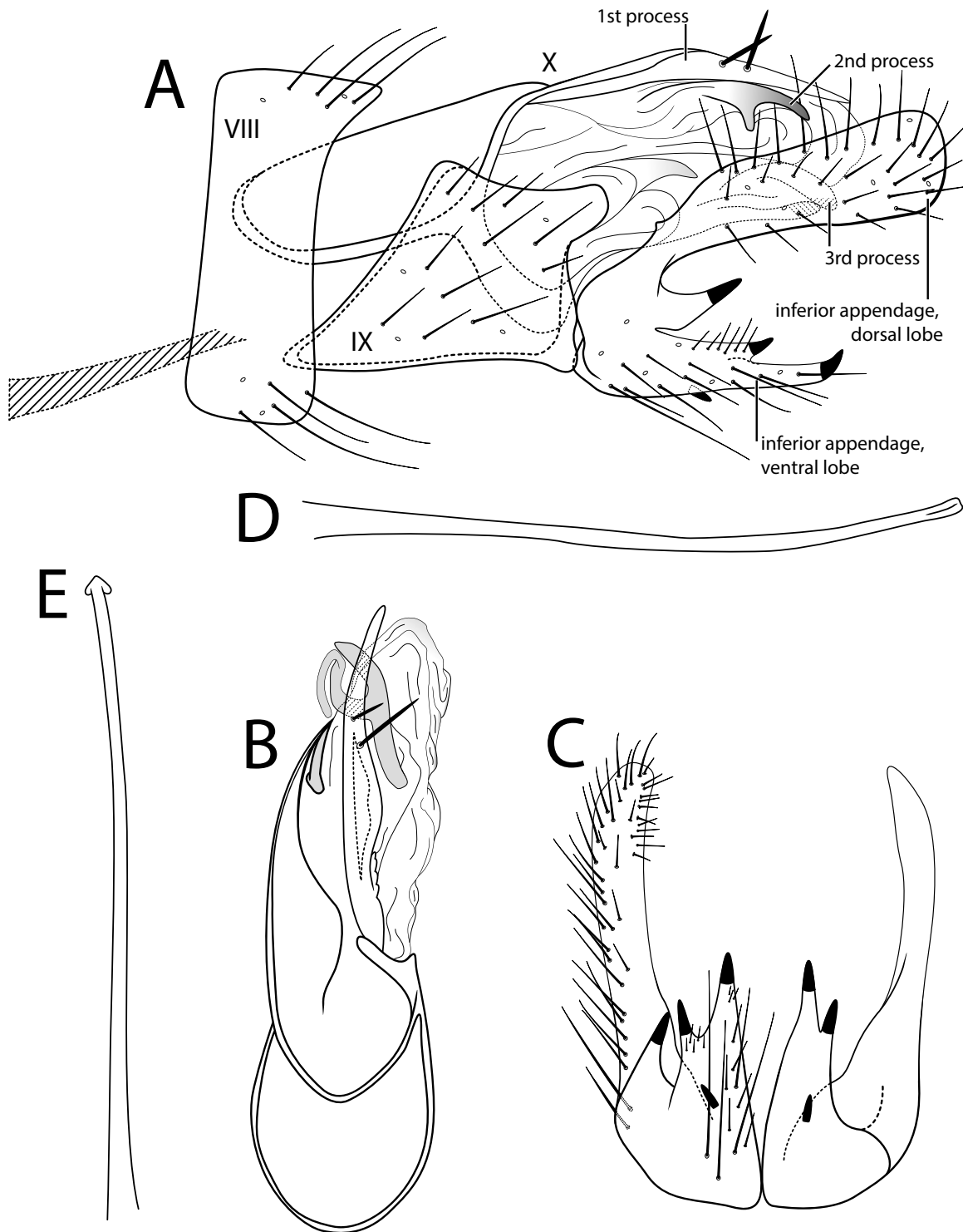


Figure 7. *Ochrotrichia anticheirion* sp. n., male genitalia. **A)** Segments VIII–IX, lateral (base of phallus crosshatched). **B)** Segments IX–X, dorsal. **C)** Inferior appendages, ventral. **D)** Phallus, lateral. **E)** Phallus, dorsal.

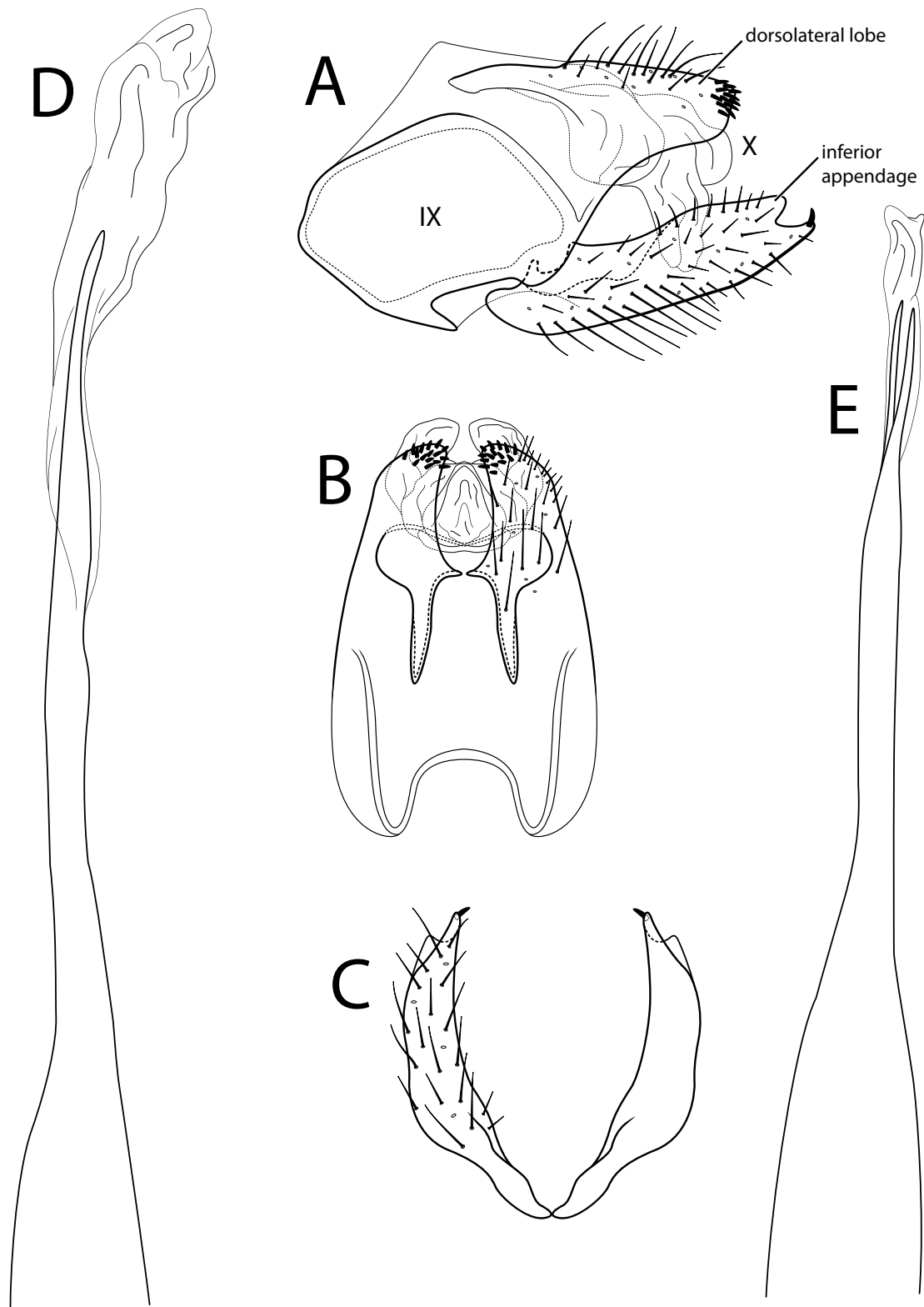


Figure 8. *Rhyacopsyche totuma* sp. n., male genitalia. **A)** Segments IX–X, lateral. **B)** Segments IX–X, dorsal. **C)** Inferior appendages, ventral. **D)** Phallus, lateral. **E)** Phallus, dorsal.

