ZOOTAXA

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Magnolia Press
Auckland, New Zealand

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(*Zootaxa* 511)

80 pp.; 30 cm.

14 May 2004

ISBN 1-877354-42-2 (Paperback)

ISBN 1-877354-43-0 (Online edition)

FIRST PUBLISHED IN 2004 BY

Magnolia Press

P.O. Box 41383

Auckland 1030

New Zealand

e-mail: zootaxa@mapress.com

http://www.mapress.com/zootaxa/

ISSN 1175-5326 (Print edition)

ISSN 1175-5334 (Online edition)

Zootaxa 511: 1–80 (2004)
www.mapress.com/zootaxa/

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ZOOTAXA
ISSN 1175-5334 (online edition)

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The caddisfly genus *Triaenodes* in the Neotropics (Trichoptera: Leptoceridae)

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Accepted by A. Whittington: 30 Apr. 2004; published: 14 May 2004

ABSTRACT

The genus *Triaenodes* as it occurs in the Neotropics is diagnosed and discussed in the context of the world fauna. Twenty new species are described and illustrated: *T. acanthus* (Mexico), *T. chirripo* (Costa Rica), *T. clauseni* (Costa Rica, Nicaragua, Panama), *T. cuyotenango* (Guatemala), *T. flintorum* (Mexico), *T. guadaloupe* (Panama), *T. hodgesi* (Ecuador), *T. hornitos* (Panama), *T. kilambe* (Nicaragua), *T. mexicanus* (Mexico), *T. moncho* (Costa Rica), *T. morai* (Costa Rica, Nicaragua), *T. nicaraguensis* (Nicaragua), *T. oaxacensis* (Mexico), *T. tajo* (Costa Rica), *T. talamanca* (Costa Rica), *T. tapanti* (Costa Rica, Panama), *T. tico* (Costa Rica, Panama), *T. tuxtlensis* (Mexico), and *T. woldai* (Panama). In addition, 4 previously described species are redescribed and figured: *T. abruptus* Flint 1991 (Colombia), *T. anomalus* Flint 1967 (Nicaragua, Mexico), *T. delicatus* Navás 1924 (Costa Rica, Panama), and *T. peruanus* Flint & Reyes 1991 (Colombia, Ecuador, Peru). The status of *Triaenodes columbicus* Ulmer 1909, is discussed. The larval and pupal stages of a Costa Rican species and the females of 9 species are described, representing the first descriptions of these life history stages for Neotropical *Triaenodes*. The genus *Ylodes* Milne is returned to synonymy with *Triaenodes*, as a subgenus. A key to the males of Neotropical *Triaenodes* is provided.

Key words: Trichoptera, Leptoceridae, *Triaenodes*, new species, Neotropics, key, *Ylodes*, synonymy

INTRODUCTION

The genus *Triaenodes* McLachlan 1865, is a large, cosmopolitan group of long-horned caddisflies. Species are especially diverse in the Old World tropics (Schmid 1994; Neboiss & Wells 1998; Andersen & Holzenthal 2001; 2002). In the Neotropics, *Triaenodes* species occur from southern Mexico to Peru, where the genus appears to be particularly diverse in the mountains of southern Mexico and Central America. To date, however, only 5 species have been described.

The genus belongs to the subfamily Leptocerinae, tribe Triaenodini, the latter erected by Morse (1981) for the genera *Adicella* McLachlan 1877, *Allosetodes* Banks 1931, *Erote-*

sis McLachlan 1877, *Triaenodes* McLachlan 1865, and *Ylodes* Milne 1934. Andersen & Holzenthal (1999) synonymized *Allosetodes* with *Triaenodes*. Yang & Morse (1993) outlined the phylogeny of the Triaenodini and split *Triaenodes* into 3 subgenera – the nominate subgenus, *Triaenodella* Mosely 1932, and *Austrotriaena* Yang & Morse 1993, the latter for 8 species occurring in the Oriental and Australasian biogeographical regions. However, Yang & Morse (1993) did not include the Neotropical *Triaenodes* species in their analysis and Neboiss & Wells (1998) questioned the validity of Yang & Morse's subgenera. Four of the 5 previously described Neotropical species, *T. abruptus* Flint 1991, *T. anomalus* Flint 1967, *T. delicatus* Navás 1924, and *T. peruanus* Flint & Reyes 1991, as well as the new species herein described all belong to a distinctive, morphologically uniform subgroup within the genus, limited to the region. Flint (1967) noted the distinctiveness of the group, at least from the North American *Triaenodes*, imparting the name "*anomalus*" to the Mexican species to highlight its oddness. As pointed out by Flint (1991), *T. columbicus* Ulmer 1909, from Colombia, shows similarities to certain West African *Triaenodes* species. Since Ulmer (1909) also described African species in the same article in which *T. columbicus* was described (e.g., a species from Cameroon), it is almost certain that the type was mislabeled. Unfortunately, the abdomen of the type has been lost (Flint 1966).

Many larvae of North American *Triaenodes* species and those in the closely related genus *Ylodes* inhabit beds of aquatic vegetation in lentic and lotic waters where they swim by rapid strokes of their densely setose hind legs (Wiggins 1996). Larvae of the Neotropical species have not been described previously, but material from Costa Rica herein described was collected from submerged mats of riparian tree rootlets along the edge of a small mountain stream. A similar habitat was described for the North American species, *T. taenius* Ross 1938, by Manuel & Braatz (1984). These larvae have reduced setal fringes on the hind legs and do not swim, a behavior apparently shared by the Costa Rican species, as well as other species of *Triaenodes* and *Ylodes* (Glover 1996).

The present paper began as part of an ongoing project to fully document the caddisfly fauna of Costa Rica and is also part of a series of papers on the Neotropical Leptoceridae initiated by Holzenthal. The current work, therefore, is expanded to include new and previously described species from other Latin American countries, thus increasing the utility of this work.

MATERIAL AND METHODS

Morphological terminology

Terminology used for genitalia generally follows that of Yang & Morse (1993), with additions for specializations in the male genitalia as proposed by Neboiss & Wells (1997). Terminology for wing venation is adapted from Schmid (1998).

Specimen preparation

To observe internal and external structures of the male and female genitalia, abdomens were removed and placed in small glass shell vials (9 x 30 mm) containing 10–12% KOH at room temperature following the standard method outlined by Ross (1944). After 6–12 hours, specimens were removed from the KOH and placed in distilled water in a watch glass. A small bore tuberculine syringe (1 cc) was used to forcefully flush macerated internal tissues from the abdomen; additional tissue was teased out with a fine tipped forceps or a microprobe. The cleared abdomen was then transferred to a second watch glass containing a solution of 10 ml glacial acetic acid in 100 ml 80% ethanol to neutralize the KOH. Genitalia thus prepared were examined in small, glycerin filled U.S.B.P.I. (United States Bureau of Plant Industry) watch glasses. Cleared genitalia were stored in genitalia microvials, either pinned through the vial's stopper below the pinned specimen, or closed with cotton and returned to the vial containing the remaining body parts if the specimen was preserved in alcohol. In removing and preparing genitalia, extreme care must be taken to ensure that disarticulated parts of specimens remain correctly associated.

A second method, using hot 85% lactic acid, was also employed to prepare genitalia (Cummins 1992; Prather 2003). The method has the advantage of affecting more complete eversion of the phallic endotheca and lessens the chance of unintentional over clearing of the specimen. However, hot lactic acid has the tendency to rupture delicate intersegmental membranes more readily than clearing in KOH. Abdomens were placed in separate, small test tubes (10 x 75 mm) filled to 1/3 with lactic acid. Test tubes were placed in a beaker bath of glycerin heated to 110–125°C, for 10–30 minutes or until internal tissues were macerated. Test tubes were removed, allowed to cool, and the outside wiped clean of glycerin. Prepared abdomens were removed and place directly in glycerin in small watch glasses where any remaining tissue was teased out with forceps or a microprobe. Specimens were examined and stored as above.

Illustrations

For illustrations, cleared genitalia were placed in a U.S.B.P.I. watch glass containing glycerin and a small wad of cotton. Strands of the cotton were used to ensnare the genitalia and hold them stationary in exact dorsal, lateral or ventral position. Genitalia structures were traced in pencil using a camera lucida (drawing tube) mounted on an Olympus BH-2 compound microscope at 250–500 X magnification, depending on the size of the species. Final illustrations were prepared with black India ink on 100% rag vellum by tracing pencil sketches on a light box. Inked illustrations were scanned (Epson® Perfection 2400 Photo scanner) and edited in Adobe Photoshop® (v. 7.0, Adobe Systems Inc.). Final plates were organized and labeled in Photoshop. For several species, pencil sketches were scanned in Photoshop then "placed" as a template in Adobe Illustrator® (v. 10, Adobe Systems Inc.)

and traced electronically to produce a vector graphic equivalent to an inked illustration. Electronic tracing was facilitated by the use of a graphics tablet (Intuos® 2, Wacom Technology Co.). Non-genital illustrations (larva, pupa, adult head and thorax, wing venation) were prepared with traditional pen and ink techniques from pencil sketches drawn from a camera lucida (drawing tube) on an Olympus SZX 12 stereomicroscope at different magnifications, depending on the size of the structure.

To facilitate comparisons between species, lettering of the figures has been standardized in views of the male and female genitalia as follows: For male genitalia: A—lateral view, abdominal segments IX and X, and associated appendages; B—dorsal view, segment IX and X (inferior appendages omitted); C—ventral view, segment IX and inferior appendages; D—lateral view of the phallic apparatus; E–G and insets, details of specific structures as needed. For female genitalia: A—lateral view, segments VIII–X and internal structures of vaginal apparatus; B—dorsal view, segments IX and X; C—ventral view, segments VIII–X and internal structures of vaginal apparatus.

Species descriptions and key

Species descriptions were generated using the DELTA system (Dallwitz 1980; Dallwitz et al. 1993 onwards) to ensure consistently formatted, comparative descriptions. Characters and character states of species were encoded into a matrix through the Delta Editor v. 1.04 (Dallwitz 1980; Dallwitz et al. 1999 onwards). Natural language descriptions were generated using the "layout for natural language descriptions" and "translate into natural language – RTF, single file for all taxa" directives of the Delta Editor's "Action Sets" function. The resulting RTF file was edited in Microsoft® Word. Characters in the original data matrix were recoded and edited for use in a dichotomous key and the key written using the Delta Editor's "Translate into KEY format" directive.

Measurements (in mm) of eye width and antennal scape, maxillary palp segments, and wing lengths for both sexes are given as a range followed by the mean if more than two specimens were measured.

Material examined and specimen management

Each pinned specimen examined, or lot of specimens if in alcohol, received a barcode label (4 mil polyester, 8 x 14 mm, code 49) with a unique alphanumeric identification number beginning with the prefix "UMSP" (the prefix is not meant to imply ownership by the University of Minnesota Insect Collection, but only to indicate that the specimen is databased at that collection). Specimen taxonomic and collection data were stored in Biota® (v. 2.0, Sinauer Associates, Inc.) (Colwell 2003) and material examined lists were generated automatically from the Biota database. Specimen barcode numbers for holo-

types are included in the list of material examined, but not for paratypes. A detailed list of all material examined, including individual specimen barcode numbers, is maintained at UMSP and can be downloaded from http://www.entomology.umn.edu/museum/databases/BIOTAdatabase.html or is available upon request from the senior author.

Types of the species described herein and other material examined are deposited, as indicated in the species descriptions, in the following institutions:

BMNH	Natural History Museum, London, England
CAS	California Academy of Sciences, San Francisco, California, USA
INBIO	Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica
MNHNP	Musum National d'Histoire Naturelle, Paris, France
NMNH	National Museum of National History, Washington, DC, USA
UMSP	University of Minnesota Insect Collection, Saint Paul, Minnesota, USA

SYSTEMATICS

Position of the Neotropical *Triaenodes* within the Triaenodini

Three questions concern us here. First, do the Neotropical *Triaenodes* form a monophyletic unit? Second, what are the relationships of the Neotropical *Triaenodes* to other members of the tribe Triaenodini? Third, if the Neotropical taxa are monophyletic, does the clade warrant formal recognition as a new genus or subgenus? The answers to these questions will be addressed in reference to the phylogeny proposed by Yang & Morse (1993).

Yang & Morse (1993) provided the first assessment of genus-group relationships within the Triaenodini, based on 26 synapomorphies distributed among the taxa of Triaenodini and its sister group. Yang & Morse (1993) established a sister-group relationship between the Triaenodini and Oecetini, which contradicted a sister-group relationship between Triaenodini and [Oecetini + Setodini + Mystacidini] proposed earlier by Morse (1981). The former relationship was based on the synapomorphy of tergum X divided into upper and lower parts (Yang & Morse 1993). The synapomorphy defining the originally proposed clade of [Oecetini + Setodini + Mystacidini], male sternum IX and phallic sclerotized strips lost (Morse 1981), was shown to be homoplastic, since several species of *Oecetis* (*Oecetis*) possess these strips. The Neotropical *Triaenodes* also possess these strips (Fig. 11D) and thus display the plesiomorphic condition.

Neotropical *Triaenodes* belong to the Triaenodini + Oecetini clade as defined by Yang & Morse since tergum X is divided into upper and lower parts, if one assumes that the setose lobe(s) emerging dorsomesally from tergum X in the Neotropical species is the "upper part" of the tergum (e.g., Figs. 6A–B, 8A–B, 14A–B, 17A–B). Yang & Morse (1993:161) state, "This upper part of tergum X was called the 'intermediate appendage' by Korboot (1964) and Schmid (1980 [=Schmid 1998]). We fully agree with Ross (1944) and Nielsen

(1957) that it belongs to segment X. In summary, we infer that the presence of a divided tergum X is a strong synapomorphy linking Oecetini with Triaenodini." This statement implies that the "upper part of tergum X" and the "intermediate appendages" are homologous structures. However, the intermediate appendages are part of the groundplan of Trichoptera (Schmid 1989, although he attributed them to segment XI) and thus cannot be used to define a monophyletic Triaenodini + Oecetini. If it is not their presence in Triaenodini + Oecetini that is synapomorphic, but their nature, this is not stated by Yang & Morse (1993). Thus, there appears to be no synapomorphy holding the Triaenodini and Oecetini together. Until the homology of segment X and its appendages is resolved, we prefer to refer to its "upper part" or "intermediate appendage" as simply the "dorsomesal process of tergum X" in the descriptions below. The latter term refers only to the position of the structure and implies no knowledge of its homology (i.e., as an "intermediate appendage") or its evolutionary derivation (i.e., as an "upper part").

Yang & Morse (1993) next presented 2 synapomorphies for the Triaenodini: "fork 5 in hindwing absent" (their character 2) and "male genitalia with upper part of tergum X trifid" (their character 3). In the Neotropical *Triaenodes* hindwing fork V is indeed absent. However, the "upper part of tergum X" (our dorsomesal process of tergum X) is never trifid, but usually a single, digitate process bearing a few setae at its apex (Figs. 7A–B, 10 A–B, 12 A–B). Occasionally, it is bifid (Figs. 8A–B, 9A–B), spatulate (Figs. 14A–B), short and conical (Figs. 5A–B), or very reduced (Figs. 29A–B). The Neotropical *Triaenodes* fit within the Triaenodini unequivocally only by the former character, and by the latter only if one assumes secondary loss of the lateral processes of Yang and Morse's "upper part of tergum X."

Yang & Morse (1993) listed 3 synapomorphies for a clade containing the genera *Ylodes*, *Allosetodes*, and *Triaenodes*. Recall that Andersen & Holzenthal (1999) synonymized *Allosetodes* and *Triaenodes*, offering detailed evidence supporting their opinion. Nevertheless, Yang & Morse's synapomorphies for this clade — "forewing with Fork 2 sub-triangular" (their character 11), "forewing stem of M incomplete or weak (their character 12), and "basal plate of inferior appendage with pair of long, recurved processes" (their character 13) — are all shared with the Neotropical *Triaenodes* such that the latter group of species falls within the larger clade (now containing only *Triaenodes* and *Ylodes*) as defined by Yang & Morse.

Monophyly for *Ylodes* is supported by 3 synapomorphies according to Yang & Morse (1993): "one paramere spine from dorso-mesal apex of phallobase" (their character 14), "phallobase secondarily very short, phalicata not retractile" (their character 15), and "apex of long, curved basal plate rod hidden in lateral view" (their character 16). Regarding Yang & Morse's character 14, we agree with Schmid (1998) that this spine is not a true paramere, but instead a neoformation of the phallobase itself. We have examined *Ylodes reuteri* McLachlan 1880, males from Minnesota and observe that the spine emerges from, and is continuous with, the basodorsal face of the phallobase. It clearly does not arise from

the endothecal membranes, which in *Y. reuteri* have no paramere spines. Thus, while we agree with Yang & Morse (1993) that this structure is apomorphic for *Ylodes*, we disagree with their interpretation of its homology. In our opinion, *Ylodes* has no paramere spines. Nevertheless, in Neotropical *Triaenodes* there are 2 paramere spines (occasionally 3) and these clearly arise from the endothecal membranes between the phallobase and phalicata. These states thus represent the primitive condition in Leptoceridae (Morse 1975). Regarding character 15 of Yang & Morse, the phallobase in the Neotropical *Triaenodes* species is short, but not particularly so and not as short as in *Ylodes*. The plesiomorphic condition is stated to be "much longer than tall in other Triaenodini." However, it is difficult to discern what Yang & Morse mean by "short" and what degree of shortness imparts uniqueness to the character state. Similarly, the qualification "much longer than tall" is also equivocal. In any case, it does not appear that the phallobase in the Neotropical *Triaenodes* is modified in any way to consider its condition "derived" from that of the groundplan state. Similarly, the state "phalicata not retractile" is not explained further (what is meant by retractile?) nor is the plesiomorphic state presented. In the Neotropical *Triaenodes* and in *Y. reuteri*, the phalicata is long, slender and trough-like, and is connected to the phallobase by way of the endothecal membranes, these themselves capable of some degree of protraction and retraction (possibly through pressure from the haemolymph) and thus affect the movement of the phalicata. In no instance does this represent a derived condition. Finally, Yang & Morse's character 16 does not apply to Neotropical *Triaenodes*, the species of which have long "recurved basal plate processes" clearly visible in lateral view.

Yang & Morse (1993) defined the genus *Triaenodes* based on 4 synapomorphies: "male antennal scapes each with hairy scent organ, covered with a long flap" (their character 18), "basal plate not articulating with phallobase" (their character 19), "paramere spines absent" (their character 20), and "phalicata absent or fused with phallobase" (their character 21). The Neotropical *Triaenodes* display the plesiomorphic condition of all of these characters except character 19. In Neotropical *Triaenodes*, the basal plate of the inferior appendages clearly does not articulate with the phallobase. Regarding character 18, a few species described in *Triaenodes* also lack male scape scent organs, but these species were shown to be members of the genus based on other characters (Yang & Morse 1993) and may represent primitive species within the genus.

Yang & Morse (1993) went on to list synapomorphies for the 3 subgenera of *Triaenodes* (*Triaenodes*, sensu stricto, *Triaenodella*, and *Austrotriaena*). None of these synapomorphies apply to the Neotropical members of the genus. Returning to the question posed at the beginning of this section – do the Neotropical species form a monophyletic unit? – the answer is yes. Morphologically, all of the Neotropical species fit within a very distinctive morphotype. Overall, however, this morphotype possesses several primitive characters, whose derived states occur in *Triaenodes* (Morse & Yang 1993): antennal scape lacks scent organ, paramere spines present, and phalicata present. The reduction in the complexity of the inferior appendage of the Neotropical species, specifically the absence of both

the mesal baso-dorsal process and the lateral baso-dorsal process, in combination with the well developed apicomesal lobe, seems to be unique to the Neotropical species. With *Ylodes* and *Triaenodes*, the Neotropical triaenodines share all of the unique wing venational characters as well as the pair of long recurved processes of the basal plate. With *Ylodes* the Neotropical species share only, and equivocally, the short phallobase. With *Triaenodes* and its subgenera they share no synapomorphies, save the lack of articulation between the basal plate and the phallobase [note that Schmid (1998) observed that this articulation was absent in *Ylodes*, an observation we confirmed through our examination of *Y. reuteri*; thus the character is homoplastic in *Ylodes* and *Triaenodes* or apomorphic for the clade *Ylodes* + *Triaenodes*]. Maintaining the Yang & Morse classification would require the erection of a new genus to accommodate the Neotropical species. Furthermore, the erection of this new genus is necessitated by the generic status of *Ylodes* in the present classification. We find both the erection of a new genus and the recognition of the genus *Ylodes* unnecessary.

Within the tribe Triaenodini the groups of species presently circumscribed by the genera *Triaenodes* (including its subgenera and those species formerly included in *Allosetodes*), *Ylodes*, and the Neotropical triaenodines are tightly defined by the wing venational characters discussed by Yang & Morse (1993). Further, this venational pattern was shown by Yang & Morse (1993: 161–162) to be distinct from a similar pattern in *Adicella* and diagnosable from other Leptocerinae wing venation. Similarly, larvae of the three clades are nearly identical (Glover 1996; Wiggins 1996) and together distinct from other leptocerine larvae, including *Adicella* and *Erotesis* (Lepneva 1971). The characters used to separate the larvae of *Ylodes* and *Triaenodes* are very slight (Glover 1996; Wiggins 1996) and we are unable to separate larvae of the Neotropical *T. tico*, n. sp., from these two genera. While the male genitalia of *Ylodes* species are distinct, apomorphic, and well circumscribed, they are objectively no more distinct or apomorphic than the male genitalia of the Neotropical species or other groups of species within *Triaenodes* (e.g., Neboiss & Wells 1998). Glover (1996) discussed the taxonomic history of *Ylodes* and questioned its generic validity. When Schmid (1980) resurrected the genus he stated, “Ce genre est très voisin de *Triaenodes*, dont il pourrait n’être qu’un sous-genre, spécialement en ce qui concerne la nervation qui est identique chez les deux lignées” [“This genus is very closely related to *Triaenodes* and could be a subgenus of the latter, particularly with respect to the venation that is identical in both genera.” Translation from Schmid (1998)]. Manuel & Nimmo (1984) defended the generic status of *Ylodes*, but did not present their argument in a phylogenetic context; several of their larval and pupal characters have been shown to be inconsistent (Glover 1996; Wiggins 1996). We agree with Glover’s assessment and Schmid’s hesitation and here return *Ylodes* to its status as a subgenus of *Triaenodes*, where it was placed by Ross in 1944. Thus, while we recognize the distinctiveness of the Neotropical *Triaenodes* species, we refrain from establishing a subgenus for it and prefer to refer to the clade as the “Neotropical *Triaenodes*” whose relationship with other members of *Triaeno-*

des is unresolved. This conservative approach is in accordance with Neboiss & Wells' (1997, 1998) division of the Australian *Triaenodes* fauna into informal species groups and complexes. We also agree with Neboiss & Wells that a full, species level revision and phylogenetic assessment of *Triaenodes* and related genera are warranted as a prerequisite to future establishment of new genus-group taxa in the Triaenodini.

Returning to the questions posed at the beginning of this section, the Neotropical *Triaenodes* species form a monophyletic unit whose relationship to other clades within *Triaenodes*, sensu lato, is unresolved. Futher, this group does not warrant formal recognition as a genus or subgenus, nor do we believe that *Ylodes* should be regarded as a genus distinct from *Triaenodes*, at least until a comprehensive review of the world triaenodine genera is accomplished.

Diagnosis of the Neotropical *Triaenodes*

Adult: Head with midcranial sulcus absent. Male scape longer than wide, without scent organ (Fig. 3A). Mesopleural katepisternum constricted dorsally. Forewing color golden brown, light brown, or pale yellow, often with narrow line of cream colored hairs along anal margin. Forewing length 4.2–8.3 mm male, 4.8–7.9 mm female. Forewing stem of M lacking (i.e., thyridial cell absent), forks I, II (if defined by nygma, Betten 1934), and V present, fork II subrectangular (Fig. 4A). Hind wing with forks I and II present; stem of M incomplete, Cu unbranched (Fig. 4B). Tibial spurs 1-2-2.

Male genitalia: Abdominal segment IX anterior margin rounded or straight, produced anteroventrally, posterior margin usually straight, occasionally rounded, pleural region membranous or very lightly sclerotized, usually setose; sternum IX heavily sclerotized, truncate or triangular, extended posteriorly with posterior margin sinuate or rounded and separated from rest of segment IX by a deep cleft [or "groove" according to Neboiss & Wells (1997; 1998); Schmid (1994) believed what we here refer to as sternum IX, his "*grande pièce*"and labeled "c" in his illustrations, is a specialized development of the phallotheca (=phallobase) or the phallocrypt, but more probably of the "*tendon interne*" of the inferior appendage. He further noted that it was present in several North American *Triaenodes* and in *Ylodes*. We see no reason to consider this formation to be anything other than the modified sternum of segment IX]; sternum IX heavily setose; tergum IX, in dorsal view, with posteromesal margin indistinct, triangular, rounded, truncate, or produced into digitate lobe, usually with pair of dorsomesal papillae and pair of small acrotergites at anterior border. Preanal appendage [superior appendage of Neboiss & Wells (1997; 1998)] setose, short or long, broad or constricted basally, apex subacute or rounded. Dorsomesal process of tergum X [intermediate appendage of Schmid (1998), Manual & Nimmo (1984); upper part of tergum X of Yang & Morse (1993)] digitate, bifid, conical, or spatulate, originating basally, subapically, or medially, long or short, with apical setae, body of tergum X [lower part of tergum X of Yang & Morse (1993)], in dorsal view, with lateral

margins sinuate, subparallel, broadly rounded, or subtriangular, apex rounded, acute, or excavate, segment X with or without lateral flange, apicolateral margins usually with microtrichia. Inferior appendage uniarticulated, united mesally, subquadrangular or rounded basally, setose, with or without tapering apicoventral projection; recurved process arising from basal plate, downturned, narrow and tapering or broad, apex attenuate, often with subbasal or medial flange; apicomesal lobe heavily setose, elongate; mesal baso-dorsal process and lateral baso-dorsal process of Yang & Morse (1993) lacking. Phallobase small, triangular, with lateral sclerotized strips articulating with apicomesal edge of sternum IX; endothecal membranes prominent, highly convoluted, with 2 or 3 long, slender paramere spines emerging from endotheca; phalicata troughlike, especially apically, straight or curved, apex cleft, acute, or rounded; phallotremal sclerite, when evident, u-shaped.

Female genitalia: Abdominal segment VIII with sternum setose posteriorly, pleural region highly membranous. Posterior margin of tergum IX rounded or triangular in dorsal view, usually with pair of papillose lobes; valves heavily setose, elliptical, rounded or subquadrangular. Tergum X setose, triangular or subquadrate in lateral view, ventrolateral margin straight, rounded, or shallowly excavate, apex acute or blunt, in dorsal view, uniformly wide or constricted medially, apex rounded or truncate; appendage of segment X setose, narrow or broad basally, elliptical or rounded. Structures of internal genitalia complex, vaginal chamber in ventral view circular or cordate.

Larva: Head (Fig. 1A): head oval, longer than broad; ventral apotome quadrate (Fig. 1E); subocular ecdysial line present; head setal pattern as in Fig. 1B, typical for family; mandibles falcate. Excavated mesally, molar region smooth, apically with several shallow teeth. Thorax (Fig. 1B): pronotum sclerotized, anterolateral corners rounded, with long setae anteriorly and laterally; mesonotum with pair of large medial sclerites, *sa*1 with single long seta, *sa*2 with 1 short and 2 long setae, *sa*3 sclerites absent, but anterolateral corner of mesonotum bearing long setae; metanotum membranous, *sa*1 without setae, *sa*2 with 1 long and 1 short seta, *sa*3 with 2 long setae; thoracic setal pattern as is Fig. 1B. Head and thoracic sclerites light brown or yellow with darker muscle scars. Legs long and slender; hind tibia subdivided; legs without distinct fringe of swimming hairs, but with long setae generally distributed over leg segments, fore and mid tibiae with numerous, short, thin setae ventrally; tibiae and tarsi of all legs also with short spinelike setae ventrally; tarsal claws long, slender, with short basal seta. Abdomen (Fig. 1A): lateral hump sclerite of abdominal segment I oval or tear-drop shaped (Fig. 1F), bearing single, long seta and covered with short microtrichia; single, short tracheal gills present on abdominal segment I (anterolateral, posterolateral, anteroventral) and segment II (anterolateral, anteroventral); lateral fringe present of segments III–VII; lateral tubercles present on VIII; abdominal tergum IX with oval sclerites bearing about 12 long setae; base of each anal proleg with ventral band of small spines on each side of anal opening as well as patch of longer spines lateral to these.

Larval case: Long slender, only slightly tapered; composed of short pieces of plant material arranged in a spiral. Length 10–11 mm (n=4).

Pupa: Head: setal pattern as in Fig. 2B, with 1 pair of setae on vertex, 3 setae on antennal scape, 2 pairs of frontal setae; labrum with 2 pairs of short setae at basolateral corners; mandibles slender, tapered, especially apically, with small, subapical, mesal tooth. Abdomen (Fig. 2A and inset): abdominal tergum I with pair of spinose ridges, hook plates III, IV, Va, Vp, and VI distributed on abdominal terga III–VI as indicated in Fig. 2A and inset; abdominal segments I–VI with small dorsal setae; lateral fringe absent; abdominal gills not apparent; dorsum of segment IX with pair of small, moundlike, seta-bearing protuberances; anal process (Fig. 2C) long, slender, gently sinuate, apex acute, bearing small, flat, minute setae medially and very small setae apicomesally.

SPECIES DESCRIPTIONS

Triaenodes abruptus Flint

Fig. 5

Triaenodes abruptus Flint, 1991: 96 [Type locality: Colombia, Dpto Antioquia, Quebrada La Ayura, Envigado (trap B); NMNH; male].

Triaenodes abruptus is a member of the large group of species that possess an apicoventral projection on the inferior appendage, but it is the only species in that group that has a short, conical dorsomesal process of tergum X. It can be further distinguished by the rounded apex of tergum X when viewed dorsally.

Adult. Male (n=1). Forewing length 6.2 mm, hind wing length 5.3 mm. Eye 0.39 mm wide. Antennal scape 0.43 mm long. Maxillary palp segment lengths (in mm): 0.29, 0.35, 0.43, 0.21, 0.45. Forewing pale yellow, denuded.

Male genitalia. Abdominal segment IX anterior margin broadly rounded; pleural region membranous, setose; tergum IX, in dorsal view, with posteromesal margin indistinct, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X conical, originating basally, short, with apical setae; tergum X, in dorsal view, with lateral margins broadly rounded, apex rounded; in lateral view, triangular, tapering to apex, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with long, tapering, apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, straight, tapering; phalicata troughlike, gently curved, narrow throughout length, apex mucronate, phallotremal sclerite not evident.

Material examined. **COLOMBIA: Antioquia:** Mun. Envigado, Quebrada La Ayura, 1750 m, 16.viii.1983, U Matthias — 1 male (paratype, NMNH).

Distribution. Colombia.

***Triaenodes acanthus*, new species**
Fig. 6, 30

The subapicoventral projection on the recurved process of the inferior appendage and the long, striate, denticulate parameres render this new species unique among those related species possessing apicoventral projections of the inferior appendages and digitate dorsomesal processes of tergum X.

Adult (male: n=2). Forewing length 6.1–6.6 mm, hind wing length 4.9–5.1 mm. Eye 0.39–0.41 mm wide. Antennal scape 0.42–0.45 mm long. Maxillary palp segment lengths (in mm): 0.26–0.31, 0.38–0.39, 0.53–0.56, 0.23, 0.52. Forewing light brown, denuded.

Male genitalia. Abdominal segment IX anterior margin nearly straight, slightly produced anteroventrally; pleural region membranous, setose; tergum IX, in dorsal view, with posteromesal margin indistinct, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating basally, short, about half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subtriangular, apex slightly excavate medially; in lateral view, parallel sided, apex rounded, slightly excavate subapicoventrally, with lateral flange, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with long, tapering, apicoventral projection; recurved process gradually downturned, broad along basal 2/3, with subapicoventral projection, apex sharply attenuate; apicomesal lobe heavily setose, elongate, elliptical. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, straight, tapering, with longitudinal striae and subapical denticle; phalicata troughlike, straight, narrow throughout length, apex with deep, wide cleft, phallotremal sclerite large, u-shaped.

Holotype male: MEXICO: Veracruz: Río Jamapa, 6 km. N Coscomatepec, 26.v.1981, C & O Flint — 1 male (UMSP000067429) (NMNH).

Paratype: MEXICO: Veracruz: Fortin de las Flores, 22.v.1965, Rabago — 1 male (NMNH).

Distribution. Mexico.

Etymology. From *akantha* the Greek word for thorn or prickle, referring to the sharp, thornlike apicoventral projection on the recurved process of the inferior appendage.

***Triaenodes anomalus* Flint**
Fig. 7

Triaenodes anomalus Flint, 1967: 16 [Type locality: Mexico, Guerrero, near Chilpancingo, route 95, km. 297; NMNH; male].

This species is similar to a number of other species, including *T. acanthus*, *T. delicatus*, *T. hodgesi*, *T. tico*, and especially *T. flintorum*, all species that have tergum X excavate apically and bearing a digitate dorsomesal process. It differs from *T. flintorum* and the other species in possessing bifid apicolateral projections on the apex of the phalicata.

Adult (male: n=6, female: n=1, palps broken). Forewing length 6.4–6.6 mm, hind wing length 5.1–5.5, 5.2 mm (male); female wings lost. Eye 0.34–0.42, 0.39 mm wide (male), 0.36 mm wide (female). Antennal scape 0.42–0.49, 0.45 mm long (male), 0.46 mm long (female). Maxillary palp segment lengths (in mm): 0.32–0.34, 0.33; 0.4–0.47, 0.43; 0.52–0.55, 0.53; 0.31–0.32, 0.53–0.56 (male). Forewing light brown, denuded.

Male genitalia. Abdominal segment IX anterior margin nearly straight, slightly produced anteroventrally; pleural region membranous, sparsely setose (or not evident); tergum IX, in dorsal view, with posteromesal margin indistinct, with pair of small dorsomesal papillae; sternum IX in lateral view with posterior margin sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating medially, long, extending beyond apex of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subparallel, apex excavate medially; in lateral view, parallel sided, apex rounded, slightly excavate subapicodorsally, with lateral flange, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with long, tapering, apicoventral projection; recurved process abruptly downturned medially, narrow, tapering throughout length, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, angularly broadened medially. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, gently curved, tapering; phalicata troughlike, strongly curved, narrow throughout length, apex with deep, narrow cleft, phallotremal sclerite not evident.

Female genitalia. Abdominal segment VIII with sternum setose posteriorly, pleural region highly membranous. Posterior margin tergum IX broadly triangular in dorsal view, with pair of digitate papillose lobes. Valves heavily setose, elliptical. Tergum X setose, triangular in lateral view, ventrolateral margin rounded, apex acute, slightly upturned; in dorsal view uniformly wide, apex truncate. Appendage of segment X setose, narrow basally, elliptical. Structures of internal genitalia as in Figs. 30A, C; vaginal chamber in ventral view cordate.

Material examined. **MEXICO: Guerrero:** nr. Chilpancingo, rt. 95, km. 297, 15–16.vii.1965, Flint & Ortiz — 1 female (paratype), 1 male (holotype) (UMSP000067438) (NMNH); **Michoacán:** P. N. Morelia, nr. Morelia, 14.iii.1966, Flint & Ortiz — 1 male

(NMNH). **NICARAGUA: Jinotega:** Cerro Kilambé, 13°34'00"N, 085°43'00"W, 1520 m, viii.1997, Maes & Hernandez — 1 male (UMSP); Area Protegida Datanlí-El Diablo, La Quebradona, Río Arriba, 2 kms NE of Santa Maura, 13°10'23"N, 085°51'24"W, 1050 m, 29.vii.2000, Chamorro, Lacayo & Christensen — 1 male (UMSP).

Distribution. Mexico, Nicaragua.

***Triaenodes chirripo*, new species**
Fig. 8, 31

Belonging to the group of species with apicoventral projections on the inferior appendages and bifid dorsomesal processes of tergum X (*T. kilambe* and *T. clauseni*), this new species differs from those species in having the setae on the dorsomesal process appearing on papillate processes and having the apex of tergum X more attenuate.

Adult (male: n=1, female: n=1). Forewing length 6.5 mm (male), 6.4 mm (female); hind wing length 5.1 mm (male), 5.0 mm (female). Eye 0.42 mm wide (male), 0.43 mm wide (female). Antennal 0.43 mm long (male), 0.42 mm long (female). Maxillary palp segment lengths (in mm): 0.23, 0.37, 0.50, 0.27, 0.55 (male), female palps broken. Forewing golden brown, with narrow line of cream colored hairs along anal margin.

Male genitalia. Abdominal segment IX anterior margin slightly rounded, slightly produced anteroventrally; pleural region membranous, setose; tergum IX, in dorsal view, with posteromesal margin triangular, with pair of small dorsomesal papillae; sternum IX in lateral view with posterior margin sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X bifid, originating basally, short, less than half length of tergum X, with apical setae on papillate processes; tergum X, in dorsal view, with lateral margins subparallel, apex strongly excavate medially; in lateral view, parallel sided, apex attenuate, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with long, tapering, apicoventral projection; recurved process abruptly downturned subapically, narrow, tapering throughout length, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, slightly angularly broadened subbasally. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, gently curved, tapering, with microtrichia along length; phalicata troughlike, straight, widest subapically, abruptly tapering apically, apex with shallow cleft, phallotremal sclerite not evident.

Female genitalia. Abdominal segment VIII with sternum setose posteriorly, pleural region highly membranous. Posterior margin tergum IX triangular in dorsal view, with papillose lobes not evident. Valves heavily setose, elliptical. Tergum X setose, triangular in lateral view, ventrolateral margin rounded, apex acute, slightly upturned; in dorsal view constricted medially, apex rounded. Appendage of segment X setose, narrow basally, elliptical. Structures of internal genitalia as in Figs. 31A, C; vaginal chamber in ventral view cordate.

Holotype male: COSTA RICA: Cartago: Quebrada Platanillo, ca. 5 km E Moravia de Chirripó, 09°49'16"N, 083°24'25"W, 1130 m, 6.viii.1987, Holzenthal, Morse & Clausen (UMSP000083712) (UMSP).

Paratype: COSTA RICA: Cartago: Same data as holotype — 1 female (UMSP).

Distribution. Costa Rica.

Etymology. Named for Cerro Chirripó in the Cordillera de Talamanca, at 3819 m Costa Rica's highest peak, and Central America's second highest peak.

***Triaenodes clauseni*, new species**
Fig. 9, 32

Like the former species, this species is similar to *T. kilambe*, but it differs from both *T. chirripo* and *T. kilambe* in the shape of the dorsomesal process and apex of tergum X.

Adult (male: n=7, female: n=2). Forewing length 5.0–5.8, 5.4 mm (male), 5.7–6.2 mm (female); hind wing length 4.2–4.8, 4.5 mm (male), 4.8–5.0 mm (female). Eye 0.35–0.40, 0.38 mm wide (male), 0.37–0.41 mm wide (female). Antennal scape 0.44–0.48, 0.46 mm long (male), 0.41–0.42 mm long (female). Maxillary palp segment lengths (in mm): 0.26–0.31, 0.28; 0.37–0.42, 0.39; 0.44–0.52, 0.48; 0.24–0.31, 0.27; 0.53–0.58, 0.56 (male); 0.31–0.33, 0.36–0.39, 0.49–0.54, segments IV and V missing (female). Forewing golden brown.

Male genitalia. Abdominal segment IX anterior margin slightly rounded, slightly produced anteroventrally; pleural region very lightly sclerotized, setose; tergum IX, in dorsal view, with posteromesal margin rounded, with pair of small dorsomesal papillae; sternum IX in lateral view with posterior margin slightly sinuate. Preanal appendage setose, at least twice as long as wide, broad basally, apex subacute. Dorsomesal process of tergum X bifid, originating medially, short, less than half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subtriangular, apex strongly excavate medially; in lateral view, parallel sided, apex rounded, slightly excavate subapicodorsally, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with short, tapering, apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, but constricted subapically, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, gently curved, tapering, apices slightly curved; phalicata troughlike, straight, widest medially, tapering apically, apex rounded, phallotremal sclerite not evident.

Female genitalia. Abdominal segment VIII with sternum setose posteriorly, pleural region highly membranous. Posterior margin tergum IX triangular in dorsal view, with pair of small papillose lobes. Valves heavily setose, elliptical. Tergum X setose, subquadrate in lateral view, ventrolateral margin rounded, apex acute; in dorsal view constricted medially,

apex rounded. Appendage of segment X setose, narrow basally, elliptical. Structures of internal genitalia as in Figs. 32A; vaginal chamber in ventral view circular.

Holotype male: COSTA RICA: Alajuela: Cerro Campana, Río Bochinche trib. 6 km (air) NW Dos Rios, 10°56'42"N, 085°24'47"E, 600 m, 22–23.vii.1987, Holzenthal, Morse & Clausen (UMSP000083714) (UMSP).

Paratypes: COSTA RICA: Alajuela: Cerro Campana, Río Bochinche trib. 6 km (air) NW Dos Rios, 10°56'42"N, 085°24'47"E, 600 m, 22–23.vii.1987, Holzenthal, Morse & Clausen — 3 males (UMSP); Reserva Forestal San Ramón, Río San Lorencito & tribs., 10°12'58"N, 084°36'25"W, 980 m, 1–4.x.1986, I & A Chacón — 1 male (UMSP); 30.iii.–1.iv.1987, Holzenthal, Hamilton & Heyn — 2 males (UMSP); **Guanacaste:** Parque Nacional Guanacaste, ca. 0.7 km N Est. Maritza, 10°57'36"N, 085°30'00"E, 550 m, 31.viii.1990, Huisman & Quesada — 1 male (INBIO). **NICARAGUA: Jinotega:** Cerro Maz, 14°33'00"N, 085°07'00"W, 220 m, 7–10.ix.1997, Maes & Hernández — 1 male (NMNH); **Zelaya:** Cerro Saslaya, 13°44'00"N, 085°01'00"W, 700 m, iii.1996, Maes & Hernandez — 3 males (NMNH). **PANAMA: Bocas del Toro:** Miramar, 09°00'00"N, 082°15'00"W, 26.xii.1979–1.i.1980, H Wolda — 1 male (NMNH); **Chiriqui:** Fortuna Dam Site nr. Hornitos, 08°55'00"N, 082°16'00"W, 1050 m, 3.viii.–6.ix.1977, H Wolda — 3 males (NMNH); 9–15.xi.1977, H Wolda — 1 male (NMNH); 4.i.–7.iii.1978, H Wolda — 1 female, 1 male (NMNH); 16.viii.–12.ix.1978, H Wolda — 2 males (NMNH); 20–26.xii.1978, H Wolda — 1 female, 2 males (NMNH); 21–27.iii.1979, H Wolda — 1 male (NMNH); 13.vi.–10.vii.1979, H Wolda — 2 males (NMNH).

Distribution. Costa Rica, Nicaragua, Panama.

Etymology. The species is named in honor of Dr. Philip J. Clausen, Curator, University of Minnesota Insect Collection, in recognition of his near life-long commitment to the care and well-being of the collection.

Triaenodes cuyotenango, new species

Fig. 10

Triaenodes cuyotenango and a number of other species have a digitate dorsomesal process of tergum X, with tergum X having a rounded or truncate apex (*T. mexicanus*, *T. peruanus*, *T. tuxtlensis* and variants of *T. delicatus*). This new species can be separated from the others by its very long dorsomesal process.

Adult (male: n=2). Forewing length 5.6–6.3 mm, hind wing length 4.8–5.2 mm. Eye 0.42–0.43 mm wide. Antennal scape 0.46–0.47 mm long. Maxillary palp segment lengths (in mm): 0.26–0.32, 0.35–0.39, 0.51–0.52, 0.27–0.29, 0.48–0.53. Forewing golden brown, with narrow line of cream colored hairs along anal margin.

Male genitalia. Abdominal segment IX anterior margin slightly rounded, slightly produced anteroventrally; pleural region membranous, setose; tergum IX, in dorsal view, with posteromesal margin rounded, with pair of minute dorsomesal papillae; sternum IX in lat-

eral view with posterior margin sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating basally, long, extending beyond apex of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subtriangular, apex slightly excavate medially; in lateral view, parallel sided, apex truncate, with lateral flange, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with long, tapering, apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, apex sharply attenuate; apicomesal lobe heavily setose, elongate, narrow, slightly broadened subbasally. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, gently curved, tapering; phalicata troughlike, straight, narrow throughout length, apex with shallow cleft, phallotremal sclerite not evident.

Holotype male: GUATEMALA: Suchitepquez: Cuyotenango, 10–20.vi.1966, Flint & Ortiz (UMSP000083650) (NMNH).

Paratype: GUATEMALA: Chimaltenango: Chimaltenango, 19–20.iii.1965, P J Spangler — 1 male (NMNH).

Distribution. Guatemala.

Etymology. Named for the type locality, the town of Cuyotenango, Guatemala.

Triaenodes delicatus **Navás**

Fig. 3–4, 11–12, 33

Triaenodes delicatus Navás, 1924: 84 [Type locality: Costa Rica, La Caja; MNHNP; male].

Triaenodes delicatus is a highly variable species, especially in the structure of the apex of tergum X. The latter shows much intraspecific variation, even among individuals collected at the same time and place (Fig. 12). The apex of tergum X can range from acute and slightly upturned (Fig. 11A) to rounded (Fig.12F) or more truncate (Fig. 12E), with (Figs. 12B, E) or without a small point. Otherwise, the species is quite generalized in its genitalia, perhaps most similar to *T. peruanus*, from which it can be separated by the overall shape of segment X, which is rounded apically and broader basally. It also bears some resemblance to *T. nicaraguensis*, which may be nothing more than another variant. However, the dorsomesal process of tergum X is much longer in *T. nicaraguensis* than in *T. delicatus*, and the recurved process of the inferior appendage is wider. Until more *Triaenodes* are collected from Nicaragua, we choose to recognize the Nicaraguan species as distinct from *T. delicatus*.

Adult (male: n=10, female: n=10). Forewing length 4.6–5.3, 5.0 mm (male), 4.8–6.9, 6.2 mm (female); hind wing length 3.7–4.3, 4.0 mm (male), 4.1–5.3, 4.5 mm (female). Eye 0.35–0.40, 0.37 mm wide (male), 0.39–0.44, 0.41 mm wide (female). Antennal scape 0.37–0.42, 0.40 mm long (male), 0.37–0.47, 0.44 mm long (female). Maxillary palp seg-

ment lengths (in mm): 0.26–0.32, 0.29; 0.32–0.39, 0.35; 0.39–0.47, 0.43; 0.21–0.26, 0.25; 0.39–0.47, 0.42 (male); 0.31–0.36, 0.34; 0.35–0.44, 0.40; 0.46–0.53, 0.48; 0.24–0.32, 0.28; 0.48–0.57, 0.55 (female). Forewing golden brown, with narrow line of cream colored hairs along anal margin.

Male genitalia. Abdominal segment IX anterior margin slightly rounded, slightly produced anteroventrally; pleural region membranous, setose; tergum IX, in dorsal view, with posteromesal margin rounded, with pair of small dorsomesal papillae; sternum IX in lateral view with posterior margin sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating basally, long, about half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subtriangular, apex variable, truncate with slight excavation or mesal point to acute or slightly rounded; apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with tapering apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, slightly broadened subbasally. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, curved, tapering, with small medial denticle; phalicata troughlike, gently curved, narrow throughout length, apex acute, phallotremal sclerite not evident.

Female genitalia. Abdominal segment VIII with sternum setose posteriorly, pleural region highly membranous. Posterior margin tergum IX triangular in dorsal view, with pair of small papillose lobes. Valves heavily setose, elliptical. Tergum X setose, subquadrate in lateral view, ventrolateral margin rounded, apex acute; in dorsal view constricted medially, apex rounded. Appendage of segment X setose, narrow basally, elliptical. Structures of internal genitalia as in Figs. 33A, C; vaginal chamber in ventral view circular.

Material examined. **COSTA RICA: Alajuela:** Reserva Forestal San Ramón, Río San Lorencito & tribs., 10°12’58”N, 084°36’25”W, 980 m, 2–4.vii.1986, Holzenthal, Heyn & Armitage — 2 females (UMSP); 13–16.vi.1988, C & O Flint & Holzenthal — 1 male (UMSP); 6–10.iii.1991, Holzenthal, Muñoz & Huisman — 1 female, 1 male (UMSP); Reserva Bosque Nubosa Monte Verde, Río Peñas Blancas, 10°18’00”N, 084°44’24”W, 950 m, 1.iii.1986, Holzenthal & Fasth — 1 female (UMSP); **Guanacaste:** Parque Nacional Rincón de la Vieja, Quebrada Agua Apinolada, 10°47’42”N, 085°17’31”W, 795 m, 25.vi.1986, Holzenthal, Heyn & Armitage — 1 male (UMSP); Parque Nacional Guanacaste, Río Tempisquito, Estacion Maritza, 10°57’29”N, 085°29’49”W, 550 m, 19–20.vii.1987, Holzenthal, Morse & Clausen — 1 female, 6 males (UMSP); 17–18.vi.1988, Flint & Holzenthal — 3 males (UMSP); 30–31.viii.1990, Huisman, Blahnik & Quesada — 2 males (UMSP); Quebrada Alcornoque, El Hacha, 11°00’32”N, 085°34’37”W, 250 m, 26.vii.1987, Holzenthal, Morse & Clausen — 3 females, 5 males (UMSP); Quebrada Pedregal, El Hacha, 10°58’59”N, 085°32’20”W, 300 m, 27.vii.1987, Holzenthal, Morse & Clausen — 1 female, 1 male (INBIO); ca. 0.7 km N Est. Maritza, 10°57’36”N,

085°30’00”E, 550 m, 31.viii.1990, Huisman & Quesada — 1 male (UMSP); **Limón:** Reserva Biolgica Hitoy-Cerere, Río Cerere, 500 m, 09°40’16”N, 083°01’41”W, 90, 23–24.iii.1987, Holzenthal, Hamilton & Heyn — 1 male (UMSP); Parque Nacional Braulio Carrillo, Quebrada González, 10°09’36”N, 083°56’20”W, 480 m, 12–14.v.1990, Holzenthal & Blahnik — 1 male (UMSP); **Puntarenas:** Río Guineal, ca 1 km (air) E Finca Helechales, 09°04’34”N, 083°05’31”W, 840 m, 4.viii.1987, Holzenthal, Morse & Clausen— 1 male (UMSP); Río Jaba, rock quarry, 1.4 km (air) W Las Cruces, 08°47’24”N, 082°58’12”W, 1150 m, 14.vi.1986, Holzenthal, Heyn & Armitage — 1 male (UMSP); 9.viii.1990, Holzenthal, Blahnik & Muñoz — 2 females, 8 males (UMSP); 15.iii.1991, Holzenthal, Muñoz & Huisman — 1 female, 5 males (UMSP); Jardín Botanico R & C Wilson, unnamed trib., Sendero del Agua, 08°48’00”N, 082°57’36”W, 1180 m, 8.viii.1990, Holzenthal, Blahnik & Muñoz — 2 males (UMSP); Arenal, Queb. Tronadorcita, 24.vii.1967, O S Flint — 1 male (UMSP); **San José:** Escazu, 20–27.v.1987, H Townes — 2 females, 3 males (UMSP). **PANAMA: Bocas del Toro:** Miramar, 09°00’00”N, 082°15’00”W, 26.xii.1979–1.i.1980, H Wolda — 1 male (NMNH); **Canal Zone:** Juan Gallegas, 3.vi.1981, R B Kimsey — 2 males (CAS); **Chiriqui:** Fortuna Dam Site nr. Hornitos, 08°55’00”N, 082°16’00”W, 1050 m, 20–26.xii.1978, H Wolda — 2 males (NMNH); **Panama:** Canal Zone, Barro Colorado Island, 27.ii.1967, R D Akre — 2 males (CAS); 9.iii.1967, R D Akre — 3 males (CAS); 12.iii.1967, R D Akre — 1 female, 3 males (CAS); Barro Colorado Island, Snyder-Molino Trail, marker 3, 19–25.vii.1978, H Wolda — 2 males (NMNH); 18–24.x.1978, H Wolda — 1 female, 1 male (NMNH); 8–14.xi.1978, H Wolda — 1 male (NMNH); 22–28.xi.1978, H Wolda — 1 male (NMNH); 6–12.xii.1978, H Wolda — 5 males (NMNH); 27.xii.1978–2.i.1979, H Wolda — 1 male (NMNH); 3–9.i.1979, H Wolda— 2 males (NMNH); 10–16.i.1979, H Wolda— 1 male (NMNH); 24–30.i.1979, H Wolda — 1 male (NMNH); 31.i.–6.ii.1979, H Wolda — 2 males (NMNH); 7–13.ii.1979, H Wolda — 1 male (NMNH); 21–27.ii.1979, H Wolda — 1 male (NMNH); 28.ii.–6.iii.1979, H Wolda — 1 male (NMNH); 16–22.v.1979, H Wolda — 1 male (NMNH); 30.v.–5.vi.1979, H Wolda — 3 males (NMNH); 6–12.vi.1979, H Wolda — 2 females, 1 male (NMNH); 22–28.viii.1979, H Wolda — 1 male (NMNH); 29.viii.–4.ix.1979, H Wolda — 1 male (NMNH); 5–11.ix.1979, H Wolda — 1 male (NMNH); 19–25.ix.1979, H Wolda — 1 male (NMNH); 31.x.–6.xi.1979, H Wolda — 2 males (NMNH); 7–13.xi.1979, H Wolda — 3 males (NMNH); 21–27.xi.1979, H Wolda — 2 males (NMNH); 20.iv.–30.vi.1987, H Wolda — 1 female, 5 males (NMNH); 26.viii.–1.ix.1987, H Wolda — 1 male (NMNH); 9–15.ix.1987, H Wolda — 1 male (NMNH); 7.x.–15.xii.1987, H Wolda — 2 females, 4 males (NMNH); 13.iv.–10.v.1988, H Wolda — 2 males (NMNH); 31.viii.–29.ix.1988, H Wolda —2 females, 11 males (NMNH); 29.iii.–18.vii.1989, H Wolda — 6 males (NMNH); 27.ix.–5.xii.1989, H Wolda — 7 males (NMNH); 28.xii.1989–3.i.1990, H Wolda — 1 male (NMNH); 24–30.i.1990, H Wolda — 1 male (NMNH); 25.iv–1.v.1990, H Wolda — 1 male (NMNH); 5.ix.–25.xii.1990, H Wolda — 8 males (NMNH); 16.i.–19.ii.1991, H Wolda — 2 males (NMNH).

Distribution. Costa Rica, Panama.

***Triaenodes flintorum*, new species**
Fig. 13

Phenotypically, this species is very similar to *T. mexicanus*, the only distinctive character separating them being the rounded (*T. mexicanus*) or slightly excavated (*T. flintorum*) apex of tergum X. They are perhaps most similar in sharing the cleft apex of the phalicata. There are a number of smaller differences, but since so little material is available (one specimen of each species), it is impossible to determine whether this represent variation within a single species or not. Until more material is available for study, we prefer to assign these specimens to different species having no evidence of intermediate forms.

Adult (male: n=1). Forewing length 5.9 mm, hind wing length 4.8 mm. Eye 0.42 mm wide. Antennal scape 0.45 mm long. Maxillary palp segment lengths (in mm): 0.26, 0.39, 0.45, 0.23, 0.55. Forewing golden brown, with narrow line of cream colored hairs along anal margin.

Male genitalia. Abdominal segment IX anterior margin nearly straight, produced anteroventrally; pleural region membranous, setose; tergum IX, in dorsal view, with posteromesal margin truncate, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating basally, long, extending to apex of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subtriangular, apex slightly excavate medially; in lateral view, triangular, apex rounded, with lateral flange, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with long, tapering, apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, apex sharply attenuate; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, straight, tapering, apices more heavily sclerotized; phalicata troughlike, straight, narrow throughout length, apex cleft, phallotremal sclerite small, u-shaped.

Holotype male: MEXICO: Oaxaca: 8 km S Valle Nacional, 25.v.1981, C & O Flint (UMSP000083658) (NMNH).

Distribution. Mexico.

Etymology. We name this species in honor of Dr. Oliver S. Flint, Jr. and his wife, Carol Flint, in recognition of their discovery of this and many other new species of Neotropical caddisflies.

***Triaenodes guadaloupe*, new species**
Fig. 14

This is a distinctive species among those that lack the apicoventral projection on the inferior appendage. It is most similar to *T. morai* in the possession of a spatulate dorsomesal process of tergum X, but differs from that species in its much larger size (7.4 mm vs. 5.3 mm forewing length in *T. morai*), by having 2 instead of 3 parameres, and by having both shorter preanal appendages and apex of tergum X.

Adult (male: n=1). Forewing length 7.4 mm, hind wing length 5.4 mm. Eye 0.38 mm wide. Antennal scape 0.38 mm long. Maxillary palp segment lengths (in mm): 0.26, 0.35, 0.50, 0.27, 0.65. Forewing pale yellow, denuded.

Male genitalia. Abdominal segment IX anterior margin nearly straight; pleural region membranous, sparsely setose (or not evident); tergum IX, in dorsal view, with posteromesal margin rounded, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin slightly sinuate. Preanal appendage setose, shorter than wide, broad basally, apex rounded. Dorsomesal process of tergum X spatulate, originating medially, short, extending to apex of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins sinuate, apex slightly excavate medially; in lateral view, parallel sided, apex truncate, apicolateral margins without microtrichia (or not evident). Inferior appendage rounded basally, setose, with sharp apicolateral flange, without apicoventral projection; recurved process abruptly downturned subapically, narrow, tapering throughout length, apex sharply attenuate, with subbasal flange; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with single, curved paramere; phalicata troughlike, gently curved, narrow throughout length, apex with very slight cleft, phallotremal sclerite not evident.

Holotype male: PANAMA: Chiriqui: Guadalupe Arriba, 08°52’26”N, 082°33’13”W, 19–25.vi.1985, H Wolda (UMSP000027126) (NMNH).

Distribution. Panama.

Etymology. Named for the type locality, the town of Guadalupe Arriba, Panama.

***Triaenodes hodgesi*, new species**
Fig. 15, 34

The very shallowly excavate apex of tergum X, the digitate, but short dorsomesal process of tergum X, and the angularly broadened subbasal portion of the inferior appendage render the species distinct. However, in overall aspect it is quite similar to *T. peruanus*.

Adult (male: n=2, female: n=2). Forewing length 4.7–5.5 mm (male), 6.2–6.5 mm (female); hind wing length 3.9–4.8 mm (male), 5.1–5.4 mm (female). Eye 0.41–0.45 mm wide (male), 0.42–0.44 mm wide (female). Antennal scape 0.39–0.44 mm long (male), 0.47–0.49 mm long (female). Maxillary palp segment lengths (in mm): 0.25–0.28, 0.30–

0.33, 0.47–0.52, 0.23, 0.50 (male); 0.28–0.31, 0.38–0.40, 0.51–0.53, 0.29–0.32, 0.53–0.56 (female). Forewing pale yellow, denuded.

Male genitalia. Abdominal segment IX anterior margin slightly rounded; pleural region membranous, setose; tergum IX, in dorsal view, with posteromesal margin indistinct, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin slightly sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating basally, short, less than half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subtriangular, apex slightly excavate medially; in lateral view, triangular, tapering to apex, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with short, tapering, apicoventral projection; recurved process abruptly downturned subapically, narrow, tapering throughout length, but constricted subapically, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, angularly broadened subbasally. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, straight, tapering; phalicata troughlike, gently curved, narrow throughout length, apex mucronate, phallotremal sclerite not evident.

Female genitalia. Abdominal segment VIII with sternum setose posteriorly, pleural region highly membranous. Posterior margin tergum IX broadly triangular in dorsal view, with pair of small papillose lobes. Valves heavily setose, subquadrangular. Tergum X setose, triangular in lateral view, ventrolateral margin straight, apex acute; in dorsal view uniformly wide, apex truncate. Appendage of segment X setose, broad basally, elliptical. Structures of internal genitalia as in Figs. 34A, C; vaginal chamber in ventral view circular.

Holotype male: ECUADOR: Pichincha: Sto. Domingo de los Colorados, 14 km E, 5.vii.1975, Langley & Cohen (UMSP000083729) (NMNH).

Paratypes: ECUADOR: Esmeraldas: Río Coyapas, Sapali Grande, 152 m, 20.iii.1958, R W Hodges — 1 male (NMNH); **Pichincha:** Las Palmas, 5.ii.1958, R W Hodges — 2 females, 2 males (NMNH).

Distribution. Ecuador.

Etymology. We name this species in honor of Dr. Ronald W. Hodges, U.S. Department of Agriculture, who collected most of the known material.

***Triaenodes hornitos*, new species**
Fig. 16

While perhaps related to other species lacking an apicoventral projection on the inferior appendage, this species is distinct from those species and other Neotropical *Triaenodes*. The spatulate, but bifid dorsomesal process of tergum X, the long, broad preanal appendage, and the curved apex of the inferior appendage combine to render *T. hornitos* unique.

Adult (male: n=4). Forewing length 4.9–5.1 mm; hind wing length 4.0–4.4, 4.2 mm. Eye 0.32–0.34, 0.33 mm wide. Antennal scape 0.39–0.42, 0.40 mm long. Maxillary palp segment lengths (in mm): 0.24–0.27, 0.26; 0.29–0.34, 0.31; 0.39–0.40; 0.22–0.23; 0.47–0.49. Forewing pale yellow, denuded.

Male genitalia. Abdominal segment IX anterior margin nearly straight; pleural region membranous, sparsely setose (or not evident); tergum IX, in dorsal view, with posteromesal margin triangular, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin rounded. Preanal appendage setose, at least twice as long as wide, broad basally, apex rounded. Dorsomesal process of tergum X bifid, originating subapically, short, less than half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subtriangular, apex slightly excavate medially; in lateral view, triangular, apex truncate, slightly upturned, apicolateral margins without microtrichia (or not evident). Inferior appendage rounded basally, setose, without apicoventral projection; recurved process gradually downturned, broad along basal 2/3, apex attenuate, with medial flange; apicomesal lobe heavily setose, elongate, narrow, parallel sided, apex curved caudad. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with three parameres, two parameres subequal, long, straight, tapering, third shorter, more needlelike; phalicata troughlike, gently curved, widest medially, tapering apically, apex with very slight cleft, phallotremal sclerite not evident.

Holotype male: PANAMA: Chiriqui: Fortuna Dam Site nr. Hornitos, 08°55’00”N, 082°16’00”W, 1050 m, 14–20.xii.1977, H Wolda (UMSP000083372) (NMNH).

Paratypes: PANAMA: Chiriqui: Fortuna Dam Site nr. Hornitos, 08°55’00”N, 082°16’00”W, 1050 m, 13–19.iv.1977, H Wolda — 1 male (NMNH); 25.iv.–29.v.1979, H Wolda — 2 males (NMNH).

Distribution. Panama.

Etymology. Named for the type locality, the town of Hornitos, Panama.

***Triaenodes kilambe*, new species**
Fig. 17

Of those species with an apicoventral projection on the inferior appendage and a bifid dorsomesal process on tergum X (*T. chirripo*, *T. clauseni*), this is the only one in which the dorsomesal process is completely divided to its base.

Adult (male: n=2). Forewing length 6.1 mm, hind wing length 4.8–4.9 mm. Eye 0.34–0.39 mm wide. Antennal scape 0.39–0.43 mm long. Maxillary palps broken. Forewing pale yellow, denuded.

Male genitalia. Abdominal segment IX anterior margin slightly rounded, produced anteroventrally; pleural region membranous, setose; tergum IX, in dorsal view, with posteromesal margin truncate, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin slightly sinuate. Preanal appendage setose, about as long as wide,

constricted basally, apex subacute. Dorsomesal process of tergum X completely divided, originating basally, short, less than half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subtriangular, apex strongly excavate medially; in lateral view, triangular, tapering to apex, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with short, tapering, apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, but constricted subapically, apex sharply attenuate; apicomesal lobe heavily setose, elongate, narrow, slightly broadened subbasally. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, gently curved, tapering, apices slightly bent; phalicata troughlike, gently curved, narrow throughout length, apex cleft, phallotremal sclerite small, u-shaped.

Holotype male: NICARAGUA: Jinotega: Cerro Kilambé, 13°34'00"N, 085°43'00"W, 1520 m, viii.1997, Maes & Hernández (UMSP000027123) (UMSP).

Paratype: NICARAGUA: Jinotega: Peñas Blancas, 13°17'00"N, 085°33'00"W, 1300 m, 25.vii.1997, Maes & Hernández — 1 male (UMSP).

Distribution. Nicaragua.

Etymology. Named for the type locality, the mountain of Cerro Kilambé, Nicaragua.

***Triaenodes mexicanus*, new species**
Fig. 18

As discussed above, this species is very similar to *T. flintorum* and may be a variant of it.

Adult (male: n=1). Forewing length 7.3 mm, hind wing length 6.5 mm. Head missing. Forewing light golden brown, with narrow line of cream colored hairs along anal margin.

Male genitalia. Abdominal segment IX anterior margin nearly straight, slightly produced anteroventrally; pleural region membranous, sparsely setose (or not evident); tergum IX, in dorsal view, with posteromesal margin indistinct, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating basally, long, about half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subparallel, apex rounded; in lateral view, parallel sided, apex rounded, with lateral flange, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with long, tapering, apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, angularly broadened medially. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres short, stout, apices more heavily sclerotized; phalicata troughlike, straight, narrow throughout length, apex with deep, wide cleft, phallotremal sclerite small, u-shaped.

Holotype male: MEXICO: Morélos: Cuernavaca, vi.1911, Godman & Salvin (UMSP000083660) (BMNH).

Distribution. Mexico.

Etymology. Named for the country in which the type was collected.

***Triaenodes moncho*, new species**
Fig. 19

This is a very distinctive species in a number of features. First, like several other Neotropical *Triaenodes*, it lacks an apicoventral process on the inferior appendage, but in this species the base of the inferior appendage is especially heavily sclerotized and setose. In addition, the broad, flat recurved process of the inferior appendage and the long, thin, subapically curved pair of parameres, in addition to a third paramere, render it distinct.

Adult (male: n=1). Forewing length 5.0 mm, hind wing length 3.9 mm. Eye 0.31 mm wide. Antennal scape 0.34 mm long. Maxillary palp segment lengths (in mm): 0.23, 0.29, 0.34, 0.21, segment V missing. Forewing pale yellow, denuded.

Male genitalia. Abdominal segment IX anterior margin nearly straight; pleural region membranous, sparsely setose (or not evident); tergum IX, in dorsal view, with posteromesal margin rounded, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin strongly sinuate. Preanal appendage setose, at least twice as long as wide, broad basally, apex rounded. Dorsomesal process of tergum X digitate, originating basally, long, less than half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins sinuate, narrowing apically, apex slightly excavate medially; in lateral view, triangular, tapering to apex, with broad lateral flange, apicolateral margins without microtrichia (or not evident). Inferior appendage rounded basally, heavily setose, especially apically, without apicoventral projection; recurved process gradually downturned, broad, flat throughout length, apex attenuate, hooklike, with subbasal flange; apicomesal lobe heavily setose, elongate, irregularly elliptical. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with three parameres, two parameres subequal, long, thin, subapically curved, third shorter, straight, very needlelike; phalicata troughlike, straight, narrow throughout length, apex rounded, phallotremal sclerite not evident.

Holotype male: COSTA RICA: Alajuela: Reserva Forestal San Ramón, Río San Lorencito & tribs., 10°12’58”N, 084°36’25”W, 980 m, 30.iii.–1.iv.1987, Holzenthal, Hamilton & Heyn (UMSP000027129) (UMSP).

Distribution. Costa Rica.

Etymology. *Moncho* is the nickname in Spanish for the masculine name Ramón, in honor of the forest reserve of San Ramón.

***Triaenodes morai*, new species**
Fig. 20

As discussed above, this species is most similar to *T. guadaloupe*.

Adult (male: n=5). Forewing length 5.0–5.5, 5.3 mm; hind wing length 4.0–4.6, 4.3 mm. Eye 0.34–0.37, 0.35 mm wide. Antennal scape 0.37–0.39, 0.38 mm long. Maxillary palp segment lengths (in mm): 0.19–0.24, 0.21; 0.26–0.32, 0.29; 0.35–0.43, 0.39; 0.16–0.21; 0.35–0.45. Forewing dark golden brown.

Male genitalia. Abdominal segment IX anterior margin nearly straight, slightly produced anteroventrally; pleural region membranous, heavily setose; tergum IX, in dorsal view, with posteromesal margin rounded, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin sinuate. Preanal appendage setose, at least twice as long as wide, broad basally, apex rounded. Dorsomesal process of tergum X spatulate, originating medially, short, about half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subparallel, apex excavate medially; in lateral view, triangular, apex rounded, apicolateral margins with microtrichia. Inferior appendage rounded basally, setose, without apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, apex sharply attenuate, with subbasal flange; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with three parameres, two parameres subequal, long, curved, tapering, third paramere short, thin; phalicata troughlike, gently curved, narrow throughout length, apex very thin, acute, phallotremal sclerite not evident.

Holotype male: COSTA RICA: Alajuela: Reserva Forestal San Ramón, Río San Lorencito & tribs., 10°12’58”N, 084°36’25”W, 980 m, 6–10.iii.1991, Holzenthal, Muñoz & Huisman (UMSP000083728) (UMSP).

Paratypes: COSTA RICA: Alajuela: Reserva Forestal San Ramón, Río San Lorencito & tribs., 10°12’58”N, 084°36’25”W, 980 m, 6–10.iii.1991, Holzenthal, Muñoz & Huisman — 1 male (UMSP). **NICARAGUA: Jinotega:** Peñas Blancas, 13°17’00”N, 085°33’00”W, 1300 m, 25.vii.1997, Maes & Hernández — 3 males (UMSP); **Zelaya:** Cerro Saslaya, 13°44’00”N, 085°01’00”W, 700 m, iv.1996, Maes & Hernandez — 1 male (UMSP).

Distribution. Costa Rica, Nicaragua.

Etymology. Named in honor of Mr. Victor Mora, biologist and manager of the field station at the San Ramn forest reserve, Costa Rica.

***Triaenodes nicaraguensis*, new species**
Fig. 21

The similarity of this species to *T. delicatus* was discussed above.

Adult (male: n=3). Forewing length 4.9–5.0 mm, hind wing length 3.9–4.0 mm. Eye

0.39–0.42 mm wide. Antennal scape 0.37–0.40 mm long. Maxillary palp segment lengths (in mm): 0.25–0.27, 0.32–0.34, 0.43–0.45, 0.24–0.26, 0.48–0.52. Forewing pale yellow, denuded.

Male genitalia. Abdominal segment IX anterior margin slightly rounded, slightly produced anteroventrally; pleural region membranous, setose; tergum IX, in dorsal view, with posteromesal margin indistinct, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating basally, long, extending beyond apex of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subparallel; in lateral view, narrowly triangular, apex acute, upturned, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with short, tapering, apicoventral projection; recurved process abruptly downturned subapically, broad along basal 2/3, apex sharply attenuate; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, gently curved, tapering, with small subapical denticle; phalicata troughlike, gently curved, narrow throughout length, apex acute, phallotremal sclerite not evident.

Holotype male: NICARAGUA: Matagalpa: 50 km E Matagalpa, El Coyolar, 85°50’00”N, 013°07’00”W, 15.v.1991, S Hue (UMSP000027133) (NMNH).

Paratypes: NICARAGUA: Zelaya: Las Américas, 13°07’00”N, 084°31’00”W, 230 m, 10.vii.1997, Maes & Hernández — 1 male (UMSP).

Distribution. Nicaragua.

Etymology. Named for the country in which the types were collected.

***Triaenodes oaxacensis*, new species**
Fig. 22

This is another species which lacks an apicoventral projection on the inferior appendage, but like other species with that character state, it stands apart from the rest. The shape of tergum X and its short, digitate, dorsomesal process, the broad preanal appendage, and the striate parameres combine to render the species unique within this group.

Adult (male: n=7). Forewing length 7.7–8.3, 8.0 mm; hind wing length 6.1–6.4, 6.3 mm. Eye 0.42–0.47, 0.43 mm wide. Antennal scape 0.50–0.56, 0.53 mm long. Maxillary palp segment lengths (in mm): 0.32–0.40, 0.35; 0.42–0.47, 0.45; 0.58–0.64, 0.61; 0.27–0.35, 0.31; 0.55–0.60, 0.57. Forewing golden brown, with narrow line of cream colored hairs along anal margin.

Male genitalia. Abdominal segment IX anterior margin slightly rounded, slightly produced anteroventrally; pleural region very lightly sclerotized, setose; tergum IX, in dorsal view, with posteromesal margin rounded, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin slightly sinuate. Preanal appendage setose, at least twice

as long as wide, broad basally, apex rounded. Dorsomesal process of tergum X digitate, originating basally, short, less than half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins sinuate, narrowing apically, apex slightly excavate medially, slightly upturned; in lateral view, parallel sided, apex rounded, apicolateral margins with microtrichia. Inferior appendage rounded basally, setose, without apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, but constricted subapically, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with three parameres, two parameres short, stout, third longer, straight, all heavily striate; phalicata troughlike, strongly curved, widest medially, abruptly tapering apically, apex very thin, acute, phallotremal sclerite not evident.

Holotype male: MEXICO: Oaxaca: 1 mi. NE of Ixtlan de Juarez, 13.viii.1967, O S Flint (UMSP000083651) (NMNH).

Paratypes: MEXICO: Oaxaca: 1 mi. NE of Ixtlan de Juarez, 13.viii.1967, O S Flint — 6 males (NMNH).

Distribution. Mexico.

Etymology. Named for the state of Oaxaca, Mexico, where the types were collected.

Triaenodes peruanus Flint & Reyes

Fig. 23, 35

Triaenodes peruanus Flint & Reyes, 1991: 488. [Type locality: Peru, Dept. La Libertad, Prov. Trujillo, Dist. Simbal, Rio Lucumar, Simbal; NMNH; male].

This is another species with a rather generalized morphology within the group of species having an apicoventral projection on the inferior appendage and a digitate dorsomesal process on tergum X. As stated earlier, it is similar to *T. delicatus*, but can be separated by the more apically rounded apex of tergum X.

Adult (male: n=3, female: n=2). Forewing length 4.2–5.1 mm (male), 4.9–5.3 mm (female); hind wing length 3.4–4.2 mm (male), 4.0–4.3 mm (female). Eye 0.32 mm wide (male), 0.34–0.35 mm wide (female). Antennal scape 0.40–0.43 mm long (male), 0.39–0.42 mm long (female). Maxillary palp segment lengths (in mm): 0.29, 0.31, 0.36, 0.20, 0.51 (male); 0.31–0.33, 0.35–0.39, 0.46–0.48, 0.21–0.25, 0.52–0.56 (female). Forewing golden brown, with narrow line of cream colored hairs along anal margin.

Male genitalia. Abdominal segment IX anterior margin slightly rounded, slightly produced anteroventrally; pleural region membranous, setose; tergum IX, in dorsal view, with posteromesal margin indistinct, with pair of minute dorsomesal papillae; sternum IX in lateral view with posterior margin slightly sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating basally, long, less than half length of tergum X, with apical setae; tergum X, in dor-

sal view, with lateral margins subtriangular, apex rounded; in lateral view, triangular, tapering to apex, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with short, tapering, apicoventral projection; recurved process abruptly downturned subapically, narrow, tapering throughout length, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, gently curved, tapering, with small subapical denticle; phalicata trough-like, gently curved, narrow throughout length, apex acute, phallotremal sclerite not evident.

Female genitalia. Abdominal segment VIII with sternum setose posteriorly, pleural region highly membranous. Posterior margin tergum IX rounded in dorsal view, with pair of small papillose lobes. Valves heavily setose, subquadrangular. Tergum X setose, triangular in lateral view, ventrolateral margin rounded, apex acute, slightly upturned; in dorsal view constricted medially, apex rounded. Appendage of segment X setose, broad basally, elliptical. Structures of internal genitalia as in Figs. 35A, C; vaginal chamber in ventral view circular.

Material examined. **COLOMBIA: Antioquia:** Queb. Honda, 12 km SW Fredonia, 22.ii.1983, O S Flint — 1 male (NMNH). **ECUADOR: Pichincha:** Río Palenque Biological Station, Río Palenque, Santo Domingo (47 km), 229 m, 29.vii.1976, J Cohen — 1 female, 1 male (NMNH). **PERU: Trujillo:** Río Lucumar-Simbal (Pueblo), 24.vi.1988, Reyes — 1 female, 1 male (paratypes, NMNH).

Distribution. Colombia, Ecuador, Peru.

***Triaenodes tajo*, new species**
Fig. 24, 36

This is yet another species similar to *T. delicatus*, all of which may represent individuals of a highly variable species. However, all of the males of *T. tajo* studied (n=6) are invariate in their morphology and differ from *T. delicatus* in the short dorsomesal process of tergum X and the broad lateral flanges basolaterally on tergum X.

Adult (male: n=6, female: n=3). Forewing length 5.7–6.5, 6.0 mm (male), 6.7–7.1 mm (female); hind wing length 4.5–5.3, 4.9 mm (male), 5.4–5.7 mm (female). Eye 0.40–0.42, 0.41 mm wide (male), 0.40–0.43 mm wide (female). Antennal scape 0.42–0.47, 0.45 mm long (male), 0.43–0.47 mm long (female). Maxillary palp segment lengths (in mm): 0.23–0.27, 0.24; 0.32–0.38, 0.35; 0.40–0.48, 0.43; 0.21–0.24, 0.22; 0.39–0.47, 0.43 (male); 0.27–0.29, 0.42–0.45, 0.50–0.53, 0.24–0.27, 0.55–0.58 (female). Forewing golden brown, with narrow line of cream colored hairs along anal margin.

Male genitalia. Abdominal segment IX anterior margin slightly rounded; pleural region membranous, setose; tergum IX, in dorsal view, with posteromesal margin indistinct, with pair of small dorsomesal papillae; sternum IX in lateral view with posterior

margin slightly sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating basally, short, less than half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins subtriangular, apex rounded; in lateral view, triangular, apex acute, slightly upturned, with broad lateral flange, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with tapering, apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, straight, tapering; phalicata troughlike, straight, narrow throughout length, apex mucronate, phallotremal sclerite not evident.

Female genitalia. Abdominal segment VIII with sternum setose posteriorly, pleural region highly membranous. Posterior margin tergum IX triangular in dorsal view, with papillose lobes not evident. Valves heavily setose, rounded. Tergum X setose, triangular in lateral view, ventrolateral margin straight, apex acute; in dorsal view constricted medially, apex rounded. Appendage of segment X setose, broad basally, elliptical. Structures of internal genitalia as in Figs. 36A, C; vaginal chamber in ventral view circular.

Holotype male: COSTA RICA: Puntarenas: Río Jaba, rock quarry, 1.4 km (air) W Las Cruces, 08°47’24”N, 082°58’12”W, 1150 m, 9.viii.1990, Holzenthal, Blahnik & Muñoz (UMSP000083719) (UMSP).

Paratypes: COSTA RICA: Puntarenas: Río Jaba, rock quarry, 1.4 km (air) W Las Cruces, 08°47’24”N, 082°58’12”W, 1150 m, 9.viii.1990, Holzenthal, Blahnik & Muñoz — 2 females, 4 males (UMSP), 1 female, 1 male (NMNH).

Distribution. Costa Rica.

Etymology. *Tajo* is Spanish for quarry in reference to the rock quarry at the Río Jaba type locality.

***Triaenodes talamanca*, new species**
Fig. 25

This species, related to those that lack an apicoventral projection on the inferior appendage, possesses several distinctive features. Its preanal appendages are short, while the dorsomesal process of tergum X is long. Tergum X itself is broadly rounded with the apex slightly excavate medially. Finally, the parameres are subequal and bear microtrichia.

Adult (male: n=1). Forewing length 4.7 mm, hind wing length 3.5 mm. Eye 0.32 mm wide. Antennal scape 0.29 mm long. Maxillary palp segment lengths (in mm): 0.15, 0.26, 0.27, 0.16, 0.32. Forewing pale yellow, denuded.

Male genitalia. Abdominal segment IX anterior margin broadly rounded, produced anteroventrally; pleural region very lightly sclerotized, sparsely setose (or not evident); tergum IX, in dorsal view, with posteromesal margin rounded, with pair of minute dor-

somesal papillae; sternum IX in lateral view with posterior margin rounded. Preanal appendage setose, about as long as wide, broad basally, apex rounded. Dorsomesal process of tergum X digitate, originating basally, long, about half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins broadly rounded, apex slightly excavate medially; in lateral view, triangular, apex truncate, slightly upturned, apicolateral margins without microtrichia (or not evident). Inferior appendage rounded basally, setose, without apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, slightly broadened subbasally. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with three parameres, two parameres subequal, gently curved, tapering, with microtrichia, third, long, curved, tapering, without microtrichia; phalicata troughlike, gently curved, widest medially, tapering apically, apex with shallow cleft, phallotremal sclerite not evident.

Holotype male: COSTA RICA: Puntarenas: Río Guineal, ca 1 km (air) E Finca Helechales, 09°04’34”N, 083°05’31”W, 840 m, 4.viii.1987, Holzenthal, Morse & Clausen (UMSP000027130) (UMSP).

Distribution. Costa Rica.

Etymology. Named for the Cordillera de Talamanca in Costa Rica, where the species was collected.

***Triaenodes tapanti*, new species**
Fig. 26, 37

This new species lacks an apicoventral projection on the inferior appendage, but among similar species the strongly upturned, acute apex of tergum X distinguishes it from all others.

Adult (male: n=10, female: n=4). Forewing length 5.6–6.5, 5.9 mm (male), 6.1–6.6, 6.3 mm (female); hind wing length 4.3–4.9, 4.6 mm (male), 4.8–4.9, 4.9 mm (female). Eye 0.27–0.34, 0.30 mm wide (male), 0.32–0.34, 0.33 mm wide (female). Antennal scape 0.31–0.39, 0.36 mm long (male), 0.34–0.40, 0.37 mm long (female). Maxillary palp segment lengths (in mm): 0.19–0.23, 0.22; 0.31–0.35, 0.33; 0.35–0.39, 0.37; 0.21–0.23, 0.21; 0.44–0.56, 0.47 (male); 0.21–0.23, 0.22; 0.35–0.39, 0.37; 0.44–0.47, 0.45; 0.19–0.24, 0.22; 0.45–0.50, 0.48 (female). Forewing dark golden brown.

Male genitalia. Abdominal segment IX anterior margin broadly rounded, produced anteroventrally; pleural region very lightly sclerotized, heavily setose; tergum IX, in dorsal view, with posteromesal margin rounded, dorsomesal papillae not evident; sternum IX in lateral view with posterior margin rounded. Preanal appendage setose, shorter than wide, broad basally, apex rounded. Dorsomesal process of tergum X digitate, originating basally, long, about half length of tergum X, with apical setae; tergum X, in dorsal view, with lateral margins sinuate, narrowing apically; in lateral view, narrowly triangular, apex acute,

strongly upturned, apicolateral margins with microtrichia. Inferior appendage rounded basally, setose, without apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, but broadest medially, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with three parameres, two parameres subequal, long, straight, tapering, third straight, very slender; phalicata troughlike, strongly curved, narrow throughout length, apex rounded, irregularly serrate, phallotremal sclerite not evident.

Female genitalia. Abdominal segment VIII with sternum setose posteriorly, pleural region highly membranous. Posterior margin tergum IX broadly triangular in dorsal view, with pair of small papillose lobes. Valves heavily setose, rounded, expanded dorsolaterally. Tergum X setose, triangular in lateral view, ventrolateral margin shallowly excavate, apex acute; in dorsal view uniformly wide, apex truncate. Appendage of segment X setose, broad basally, rounded. Structures of internal genitalia as in Figs. 37A, C; vaginal chamber in ventral view cordate.

Holotype male: COSTA RICA: Cartago: Reserva Tapantí, unnamed tribs [Quebrada Palmitos & falls], ca. 9 km (road) NW tunnel, 09°43'12"N, 083°46'48"W, 1400 m, 8–9.vi.1988, C & O Flint & Holzenthal (UMSP000083697) (UMSP).

Paratypes: COSTA RICA: Alajuela: Quebrada Virgencita, 10.2 km S Bajos del Toro, 10°10'05"N, 084°19'34"W, 1780 m, 5–6.ix.1990, Holzenthal, Blahnik & Huisman — 1 male (UMSP); **Cartago:** Reserva Tapantí, Río Grande de Orosí, 09°41'10"N, 083°45'22"W, 1650 m, 15–16.vii.1987, Holzenthal, Morse & Clausen — 1 female (UMSP); Reserva Tapantí, unnamed tribs. [Quebrada Palmitos & falls], ca. 9 km (road) NW tunnel, 09°43'12"N, 083°46'48"W, 1400 m, — 7 males (UMSP); 2–3.vi.1990, Holzenthal, Blahnik & Muñoz — 1 male (UMSP); 1–2.viii.1990, Holzenthal, Blahnik & Muñoz — 1 female (UMSP); 23.viii.1990, Holzenthal & Huisman — 1 female, 1 male (UMSP); Reserva Tapantí, waterfall, ca. 1 km (road) NW tunnel, 09°41'24"N, 083°45' 36"W, 1600 m, 2–3.viii.1990, Holzenthal, Blahnik & Muñoz — 1 female (UMSP); **San José:** Zurquí, viii.1995, P Hanson — 1 male (UMSP). **PANAMA: Chiriqui:** Guadalupe Arriba, 08°52'26"N, 082°33'13"W, 7–13.iii.1984, H Wolda — 1 male (NMNH); 11–17.iii.1984, H Wolda — 1 male (NMNH); 20–26.iii.1985, H Wolda — 1 male (NMNH); 12–18.vi.1985, H Wolda — 1 male (NMNH); 19–25.vi.1985, H Wolda — 1 male (NMNH).

Distribution. Costa Rica, Panama.

Etymology. Named for the Reserva Tapantí, Costa Rica, home to this and many other new and interesting species of Trichoptera.

Triaenodes tico, new species

Fig. 1–2, 27, 38

The combination of an apicoventral projection on the inferior appendage, digitate dor-

somesal process of tergum X, and medially excavate apex of tergum X, places this species with *T. acanthus*, *T. anomalus*, *T. flintorum*, *T. hodgesi*, and certain variants of *T. delicatus*. However, the much more deeply excavate apex of tergum X distinguishes this species from the aforementioned ones.

Adult (male: n=10, female: n=6). Forewing length 7.1–7.8, 7.4 mm (male), 7.4–7.9, 7.7 mm (female); hind wing length 5.5–6.2, 5.9 mm (male), 6.1–6.6, 6.4 mm (female). Eye 0.42–0.47, 0.44 mm wide (male), 0.37–0.42, 0.40 mm wide (female). Antennal scape 0.52–0.56, 0.54 mm long (male), 0.50–0.55, 0.53 mm long (female). Maxillary palp segment lengths (in mm): 0.26–0.34, 0.30; 0.40–0.47, 0.43; 0.56–0.66, 0.61; 0.29–0.37, 0.32; 0.58–0.63, 0.60 (male); 0.31–0.43, 0.35; 0.45–0.53, 0.48; 0.61–0.77, 0.68; 0.34–0.40, 0.36; 0.56–0.74, 0.65 (female). Forewing golden brown, with narrow line of cream colored hairs along anal margin.

Male genitalia. Abdominal segment IX anterior margin slightly rounded, produced anteroventrally; pleural region very lightly sclerotized, heavily setose; tergum IX, in dorsal view, with posteromesal margin produced into digitate lobe, with pair of small dorsomesal papillae; sternum IX in lateral view with posterior margin slightly sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating basally, long, about half length of tergum X, with apical setae, process directed dorsad; tergum X, in dorsal view, with lateral margins subtriangular, apex strongly excavate medially; in lateral view, parallel sided, apex truncate, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with tapering apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, but constricted subapically, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, gently curved, tapering; phalicata troughlike, gently curved, widest medially, tapering apically, apex acute, phallotremal sclerite not evident.

Female genitalia. Abdominal segment VIII with sternum setose posteriorly, pleural region highly membranous. Posterior margin tergum IX rounded in dorsal view, with papillose lobes not evident. Valves heavily setose, elliptical. Tergum X setose, triangular in lateral view, ventrolateral margin straight, apex acute; in dorsal view constricted medially, apex rounded. Appendage of segment X setose, narrow basally, elliptical. Structures of internal genitalia as in Figs. 38A, C; vaginal chamber in ventral view cordate.

Holotype male: COSTA RICA: San José: Río Parrita Chiquito, rt. 12, 6.5 km SW jct. rt. 2, 09°42’11”N, 083°58’12”W, 1990 m, 10.iv.1987, Holzenthal, Hamilton & Heyn (UMSP000083677) (UMSP).

Paratypes: COSTA RICA: Cartago: Reserva Tapantí, Río Dos Amigos & falls, ca. 6 km (road) NW tunnel, 09°42’14”N, 083°46’59”W, 1500 m, 4–5.viii.1990, Holzenthal, Blahnik & Muñoz — 1 female, 10 males (UMSP); **Puntarenas:** Río Bellavista, ca. 1.5 km NW Las Alturas, 08°57’04”N, 082°50’46”W, 1400 m, 10–11.viii.1990, Holzenthal, Blah-

nik & Muñoz — 1 male (UMSP); **San José:** Río Parrita Chiquito, rt. 12, 6.5 km SW jct. rt. 2, 09°42’11”N, 083°58’12”W, 1990 m, 10.iv.1987, Holzenthal, Hamilton & Heyn — 6 females, 1 male (UMSP). **PANAMA: Chiriqui:** Guadalupe Arriba, 08°52’26”N, 082°33’13”W, 28.iii.–3.iv.1984, H Wolda — 1 male (NMNH); 11–17.ix.1985, H Wolda — 1 male (NMNH).

Additional material examined**: COSTA RICA: Puntarenas:** trib. to Río Bellavista in Las Alturas (road to quarry), 08°57’07”N, 082°50’53”W, 1480 m, 13–14.viii.1990, Holzenthal Blahnik & Muñoz — 4 larvae, 3 pupae (UMSP); **San José:** Ráo Parrita Chiquito, rt. 12, 6.5 km SW jct. rt. 2, 09°42’11”N, 083°58’12”W, 1990 m, 10.iv.1987, Holzenthal, Hamilton & Heyn — 3 larvae, 3 pupae (UMSP).

Distribution. Costa Rica, Panama.

Etymology. Named for the Costa Ricans or Ticos.

***Triaenodes tuxtlensis*, new species**
Fig. 28

Triaenodes tuxtlensis, like many other Neotropical *Triaenodes*, has an apicoventral projection on the inferior appendage and a digitate dorsomesal process on tergum X. It is distinctive from all other similar species in the deeply divided parameres and the minute spines on the basoventral margin of the dorsomesal process of tergum X.

Adult (male: n=1). Forewing length 5.8 mm, hind wing length 4.7 mm. Eye 0.42 mm wide. Antennal scape 0.48 mm long. Maxillary palp segment lengths (in mm): 0.24, 0.34, 0.47, 0.23, 0.50. Forewing golden brown, with narrow line of cream colored hairs along anal margin.

Male genitalia. Abdominal segment IX anterior margin slightly rounded, slightly produced anteroventrally; pleural region membranous, sparsely setose (or not evident); tergum IX, in dorsal view, with posteromesal margin indistinct, with pair of slender dorsomesal papillae; sternum IX in lateral view with posterior margin sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X digitate, originating medially, long, extending beyond apex of tergum X, with apical setae, basoventral margin with minute spines; tergum X, in dorsal view, with lateral margins subtriangular, apex slightly excavate medially; in lateral view, parallel sided, apex rounded, with lateral flange, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with long, tapering, apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, long, straight, tapering, both bifid almost to base; phalicata trough-like, gently curved, narrow throughout length, apex cleft, phallotremal sclerite small, u-shaped.

Holotype male: MEXICO: Veracruz: Los Tuxtlas Biological Station, Los Tuxtlas area, Río Palma, above La Palma, 7–14.v.1981, C & O Flint (UMSP000083659) (NMNH).

Distribution. Mexico.

Etymology. Named for the type locality, Los Tuxtlas Biological Station, Mexico.

***Triaenodes woldai*, new species**
Fig. 29

While the inferior appendage of this new species is similar to that of *T. delicatus* and others in the genus, tergum X of *T. woldai* is unique in two characteristics: the apex is upturned and attenuate and the dorsomesal process is represented by a low setose mound.

Adult (male: n=6). Forewing length 4.3–5.3, 4.8 mm; hind wing length 3.3–4.2, 3.7 mm. Eye 0.35–0.37, 0.36 mm wide. Antennal scape 0.37–0.42, 0.39 mm long. Maxillary palp segment lengths (in mm): 0.24–0.29, 0.26; 0.26–0.35, 0.31; 0.32–0.42, 0.37; 0.18–0.21, 0.19; 0.35–0.39, 0.37. Forewing pale yellow, denuded.

Male genitalia. Abdominal segment IX anterior margin nearly straight; pleural region membranous, sparsely setose (or not evident); tergum IX, in dorsal view, with posteromesal margin indistinct, with pair of bulbous dorsomesal papillae; sternum IX in lateral view with posterior margin sinuate. Preanal appendage setose, about as long as wide, constricted basally, apex subacute. Dorsomesal process of tergum X a small setose medial protuberance; tergum X, in dorsal view, with lateral margins subtriangular; in lateral view, narrowly triangular, apex acute, upturned, with lateral flange, apicolateral margins with microtrichia. Inferior appendage subquadrangular basally, setose, with tapering apicoventral projection; recurved process gradually downturned, narrow, tapering throughout length, apex attenuate; apicomesal lobe heavily setose, elongate, narrow, parallel sided. Phallobase small, triangular, endothecal membranes prominent, highly convoluted, with pair of parameres, parameres subequal, one long, curved, tapering secnd shorter, gently curved, tapering, both with microtrichia; phalicata troughlike, gently curved, narrow throughout length, apex acute, irregularly serrate, phallotremal sclerite small, u-shaped.

Holotype male: PANAMA: Bocas del Toro: Miramar, 09°00’00”N, 082°15’00”W, 26.xii.1979–1.i.1980, H Wolda (UMSP000027136) (NMNH).

Paratypes: PANAMA: Bocas del Toro: Miramar, 09°00’00”N, 082°15’00”W, 24–30.x.1979, H Wolda — 2 males (NMNH); 21–27.xi.1979, H Wolda — 1 male (NMNH); 26.xii.1979–1.i.1980, H Wolda — 1 male (NMNH); 2–8.i.1980, H Wolda — 1 male (NMNH).

Distribution. Panama.

Etymology. We name this species in honor of Dr. Henk Wolda, who collected it and in recognition of his important research on Neotropical insect diversity and seasonality.

1. Inferior appendage with apicoventral projection (Fig. 5A) 2
   Inferior appendage without apicoventral projection (Fig. 14A) 20
2(1). Dorsomesal process of tergum X digitate (Fig. 6A), spatulate (Fig. 14A), conical (Fig. 5A), or a small setose protuberance (Fig. 29A) 3
   Dorsomesal process of tergum X bifid (Figs. 8A–B, 9A–B) or completely divided (Fig. 17A–B) 18
3(2). Apex of tergum X, in dorsal view, rounded (Fig. 5B), truncate (Fig. 28B), or excavated medially (Figs. 7B, 8B) 4
   Apex of tergum X, in dorsal view, narrow, attenuate, upturned (Figs. 21A, 26A, 29A) 15
4(3). Dorsomesal process of tergum X digitate 5
   Dorsomesal process of tergum X conical (Fig. 5) ..... ***Triaenodes abruptus*** Flint
5(4). Apex of tergum X shallowly (Figs. 6B, 7B) or deeply excavate medially (Figs. 8B, 9B) 6
   Apex of tergum X rounded (Fig. 5B) or truncate medially (Fig. 28B) 11
6(5). Apex of tergum X shallowly excavate medially (Figs. 6B, 7B) 7
   Apex of tergum X deeply excavate medially (Fig. 27)..... ***Triaenodes tico*** n. sp.
7(6). Segment X with lateral flange (Figs. 6A, 13A) 8
   Segment X without lateral flange (Fig. 15) ..... ***Triaenodes hodgesi*** n. sp.
8(7). Recurved process of inferior appendage narrow, tapering throughout its length (Fig. 5A); without subapicoventral projection; dorsomesal process of tergum X long (Fig. 7A) 9
   Recurved process of inferior appendage broad, flat along most of its length, with subapicoventral projection; dorsomesal process of tergum X short (Fig. 6) ..... ***Triaenodes acanthus*** n. sp.
9(8). Dorsomesal process of tergum X less than or about half length of tergum X; apex of phalicata without cleft, acute (Figs. 11, 12) ..... ***Triaenodes delicatus*** Navás
   Dorsomesal process of tergum X extending to or beyond apex of tergum X (Figs. 7A, 13A); apex of phalicata with cleft 10
10(9). Phalicata straight; apex of phalicata with broad cleft, apicolateral projections bifid (Fig. 13) ..... ***Triaenodes flintorum*** n. sp.
   Phalicata curved; apex of phalicata with deep narrow cleft (Fig. 7) ..... ***Triaenodes anomalus*** Flint
11(5). Segment X with lateral flange (Fig. 18A, B); dorsomesal process of tergum X long (Fig. 10A) 12
   Segment X without lateral flange; dorsomesal process of tergum X short (Fig. 23) ..... ***Triaenodes peruanus*** Flint & Reyes

12(11). Parameres deeply bifid (Fig. 28) ..... ***Triaenodes tuxtlensis*** n. sp.
Parameres not deeply bifid (Figs. 11D, 18D) 13

13(12). Dorsomesal process of tergum X less than or about half length of tergum X 14
Dorsomesal process of tergum X extending beyond apex of tergum X (Fig. 10) ....
..... ***Triaenodes cuyotenango*** n. sp.

14(13). Phalicata straight; apex of phalicata with broad cleft, apicolateral projections bifid (Fig. 18) ..... ***Triaenodes mexicanus*** n. sp.
Phalicata curved; apex of phalicata without cleft, acute (Figs. 11, 12) .....
..... ***Triaenodes delicatus*** Navás

15(3). Dorsomesal process of tergum X digitate 16
Dorsomesal process of tergum X a small setose protuberance (Fig. 29).....
..... ***Triaenodes woldai*** n. sp.

16(15). Segment X with lateral flange; recurved process of inferior appendage narrow, tapering throughout its length; dorsomesal process of tergum X less than or about half length of tergum X..... 17
Segment X without lateral flange; recurved process of inferior appendage broad, flat along most of its length; dorsomesal process of tergum X extending to or beyond apex of tergum X (Fig. 21)..... ***Triaenodes nicaraguensis*** n. sp.

17(16). Basolateral margins of segment X broad, expanded laterally; dorsomesal process of tergum X short; phalicata straight (Fig. 24) ..... ***Triaenodes tajo*** n. sp.
Basolateral margins of segment X not expanded, base of segment X more parallel sided; dorsomesal process of tergum X long; phalicata curved (Figs. 11, 12) .....
..... ***Triaenodes delicatus*** Navás

18(2). Dorsomesal process of tergum X bifid, but not completely divided to base; phalicata straight 19
Dorsomesal process of tergum X completely divided to base; phalicata curved (Fig. 17) ..... ***Triaenodes kilambe*** n. sp.

19(18). Dorsomesal process of tergum X with apical setae, but not on papillate processes; preanal appendage broad basally, long, at least twice as long as wide; phalicata narrow (Fig. 9) ..... ***Triaenodes clauseni*** n. sp.
Dorsomesal process of tergum X with apical setae on papillate processes; preanal appendage constricted basally, short, about as long as wide; phalicata wide (Fig. 8)
..... ***Triaenodes chirripo*** n. sp.

20(1). Dorsomesal process of tergum X digitate or spatulate; apex of apicomesal lobe of inferior appendage not curved caudad 21
Dorsomesal process of tergum X bifid; apex of apicomesal lobe of inferior appendage curved caudad (Fig. 16) ..... ***Triaenodes hornitos*** n. sp.

21(20). Apex of tergum X excavated medially 22
Apex of tergum X narrow, attenuate, strongly upturned (Fig. 26) .....
..... ***Triaenodes tapanti*** n. sp.

22(21). Dorsomesal process of tergum X digitate 23
Dorsomesal process of tergum X spatulate 25

23(22). Segment X with lateral flange; recurved process of inferior appendage broad, flat along most of its length, with apex hooklike, with subbasal flange (Fig. 19) ..... ***Triaenodes moncho*** n. sp.
Segment X without lateral flange; recurved process of inferior appendage narrow, tapering throughout its length, apex not hooklike, without subbasal flange 24

24(23). Preanal appendage short, about as long as wide; dorsomesal process of tergum X long; apicolateral margins of tergum X without microtrichia (or not evident); apex of phalicata with cleft (Fig. 25) ..... ***Triaenodes talamanca*** n. sp.
Preanal appendage long, at least twice as long as wide; dorsomesal process of tergum X short; apicolateral margins of tergum X with microtrichia; apex of phalicata without cleft, acute (Fig. 22) ..... ***Triaenodes oaxacensis*** n. sp.

25(22). Phallus with two parameres; dorsomesal process of tergum X long, extending to or beyond apex of tergum X; preanal appendage very short, shorter than wide (Fig. 14) ..... ***Triaenodes guadaloupe*** n. sp.
Phallus with three parameres; dorsomesal process of tergum X short, less than or about half length of tergum X; preanal appendage long, at least twice as long as wide (Fig. 20)..... ***Triaenodes morai*** n. sp.

ACKNOWLEDGMENTS

We are especially grateful to Dr. Oliver S. Flint, Jr., Smithsonian Institution, and, through him, Mr. Ken Manuel, Duke Energy, for providing us with much useful and interesting material. Lourdes Chamorro-Lacayo also kindly provided specimens from Nicaragua for inclusion is this study. We thank Dr. Roger J. Blahnik, University of Minnesota, for his insightful review of the manuscript and Dr. Aysha L. Prather, Royal Ontario Museum, for assistance with databasing and DELTA programming. Kris Kuda, St. Louis, Missouri, provided the excellent illustrations of the larva. In addition, Fernando Muñoz, Henrique Paprocki, Desi Roberson, and Hannah Gillis provided various forms of assistance throughout the course of this study. Finally, Dr. John Morse offered help and advice during the very early stages of this work.

This material is based upon work supported by the National Science Foundation under Grant Nos. 9400632, 9971885, and 0117772.

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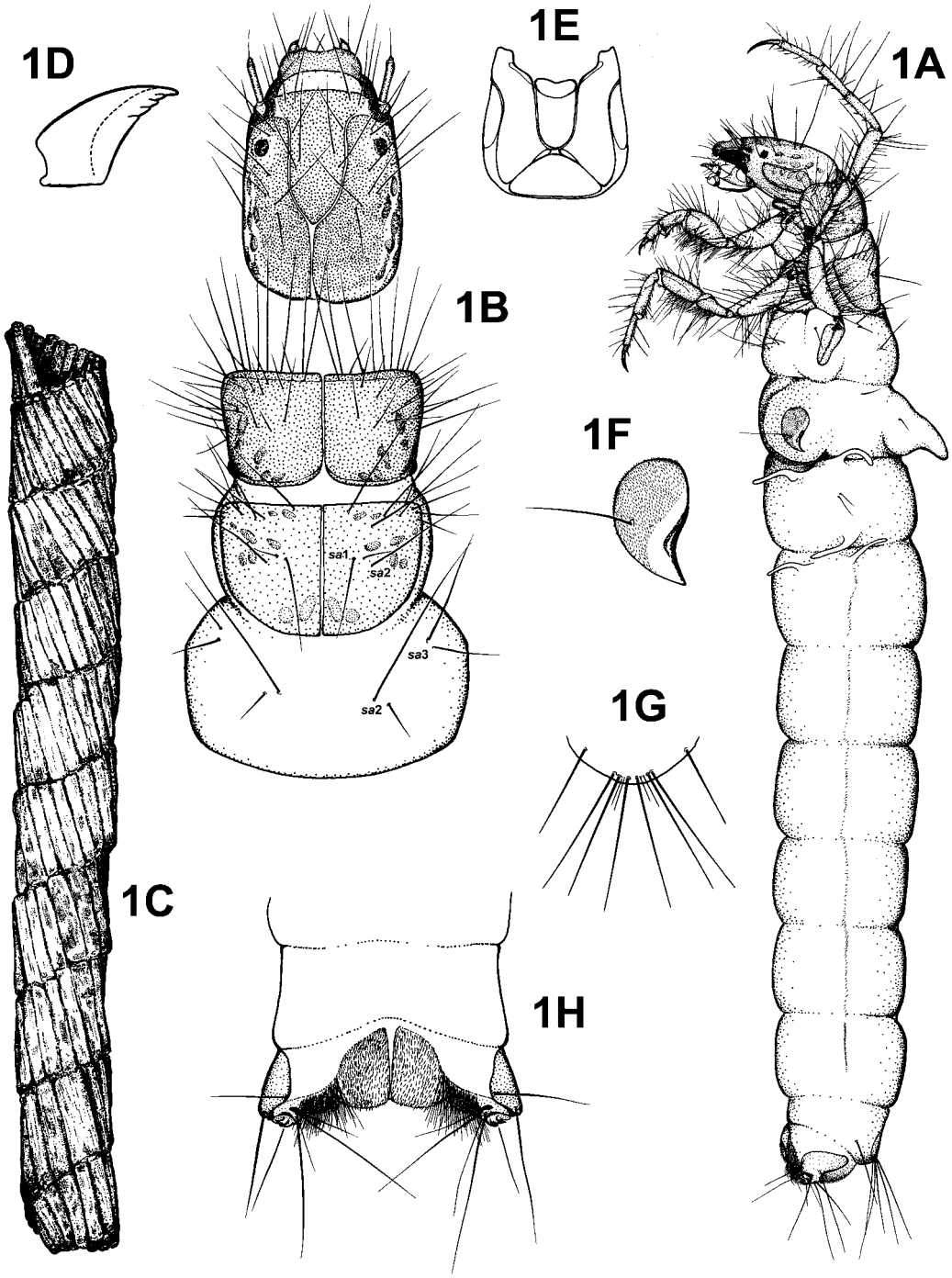


FIGURE 1. *Triaenodes tico*, new species. Larva: A—lateral; B—head and thorax, dorsal; C—case; D—left mandible, dorsal; E—head capsule, ventral; F—lateral hump sclerite; G—abdominal tergum IX sclerite, dorsal; H—abdominal segments IX–X, ventral. Abbreviations: *sa*1, *sa*2, *sa*3 = setal area 1, 2, and 3, respectively.

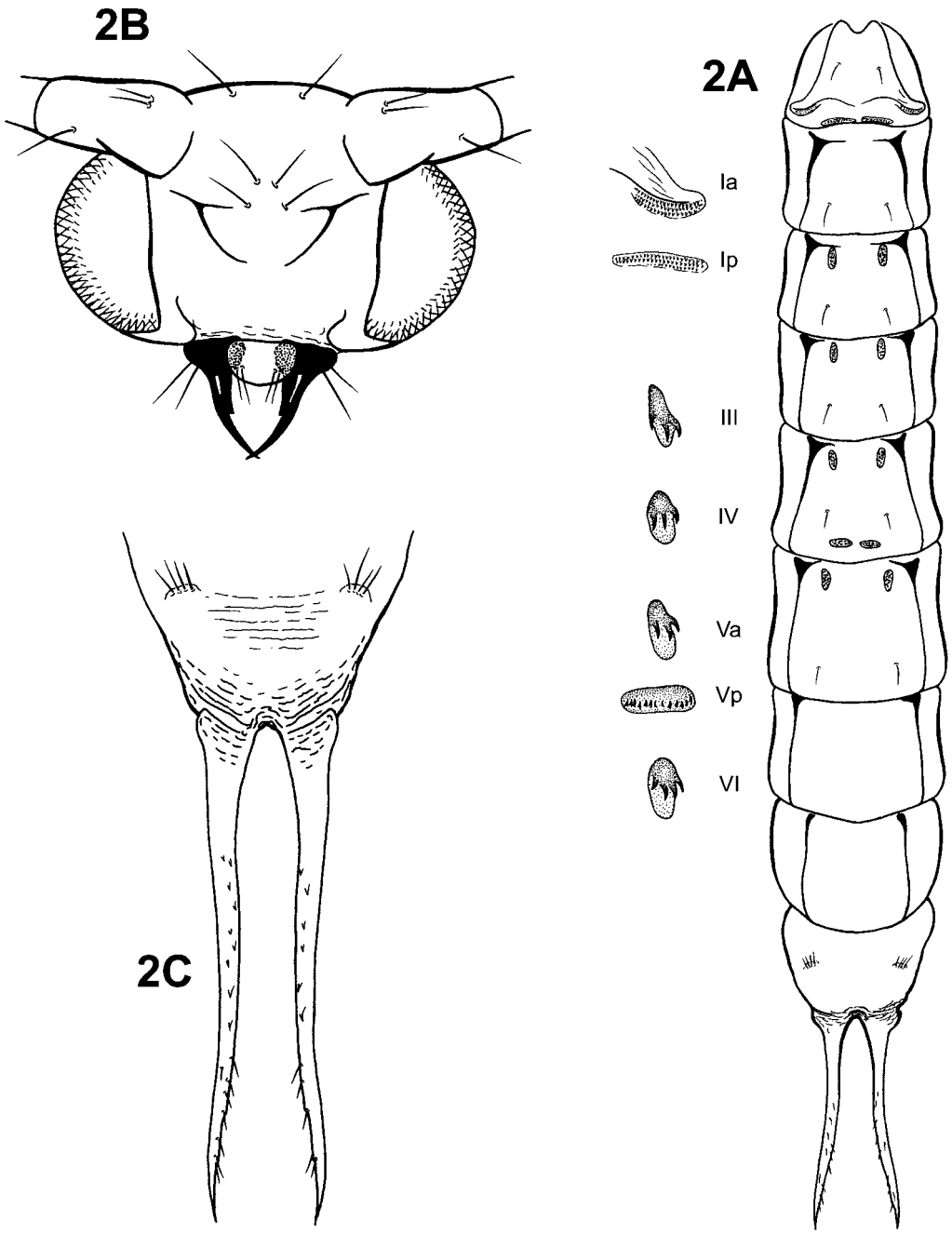
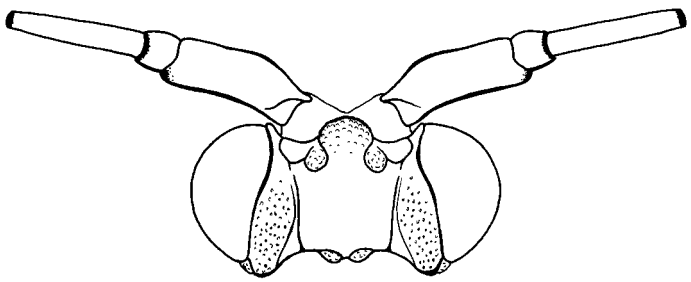
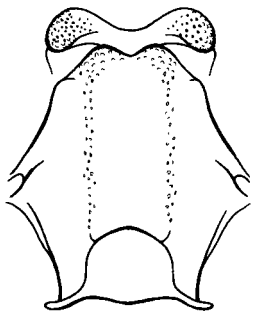


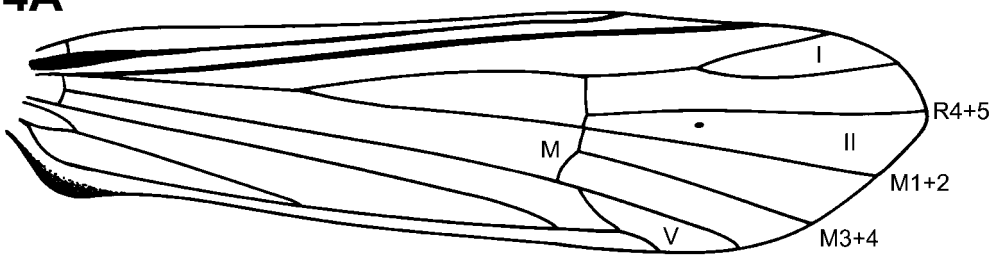
FIGURE 2. *Triaenodes tico*, new species. Pupa: A—abdomen, dorsal, abdominal hook plates enlarged; B—head, frontal; C—abdominal segments IX–X, anal processes, dorsal. Abbreviations: a=anterior, p=posterior.



3A



4A



4B

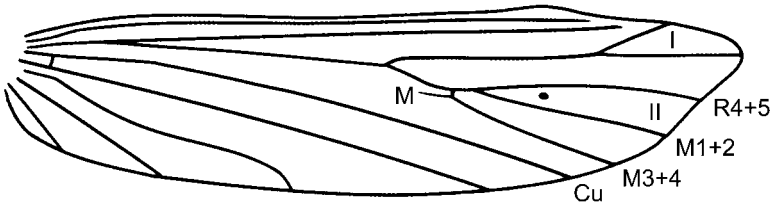


FIGURE 3. *Triaenodes delicatus* Navás. Adult: A—head and thorax, dorsal. **FIGURE 4.** *Triaenodes delicatus* Navás. Wings: A—forewing; B—hind wing.

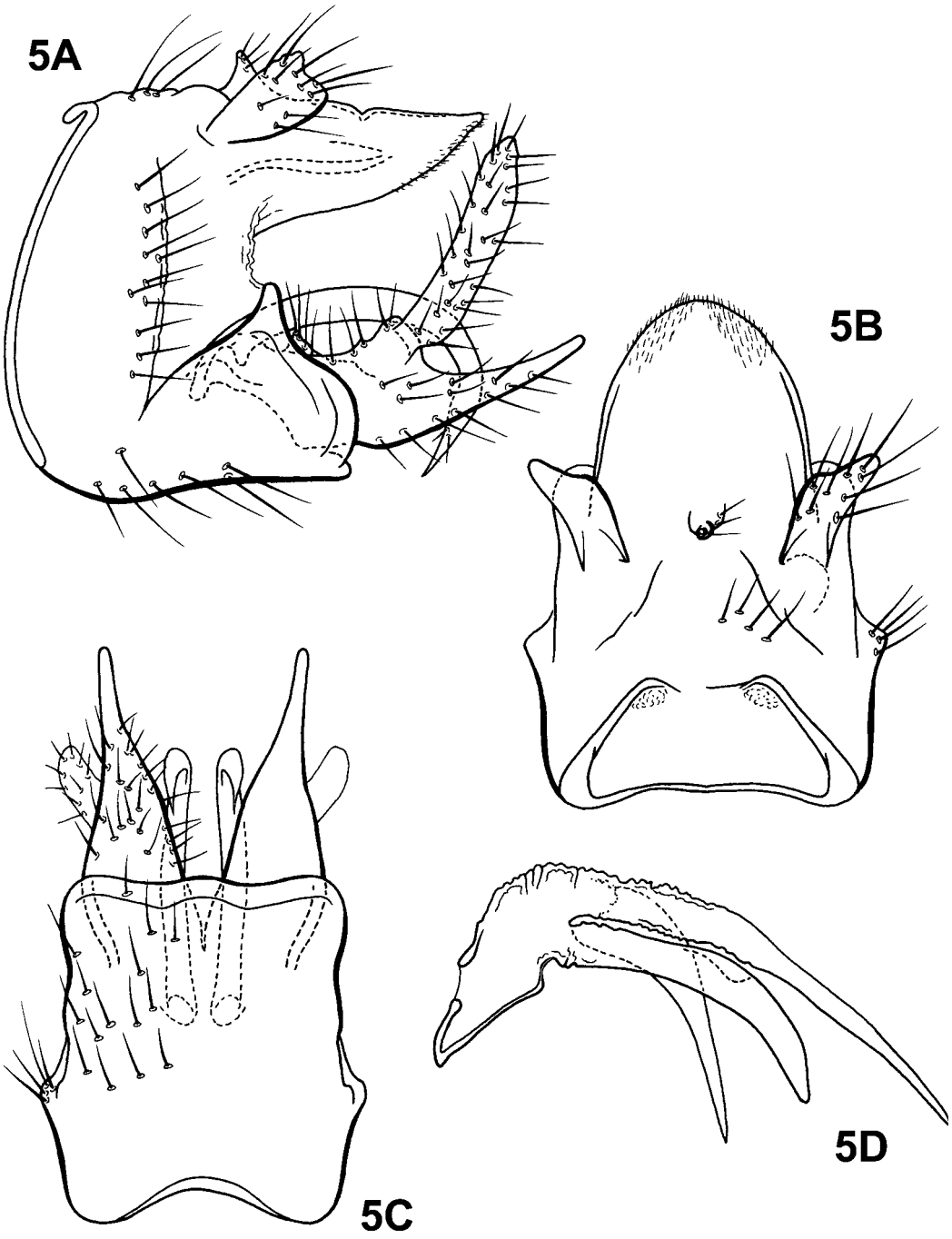


FIGURE 5. *Triaenodes abruptus* Flint. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

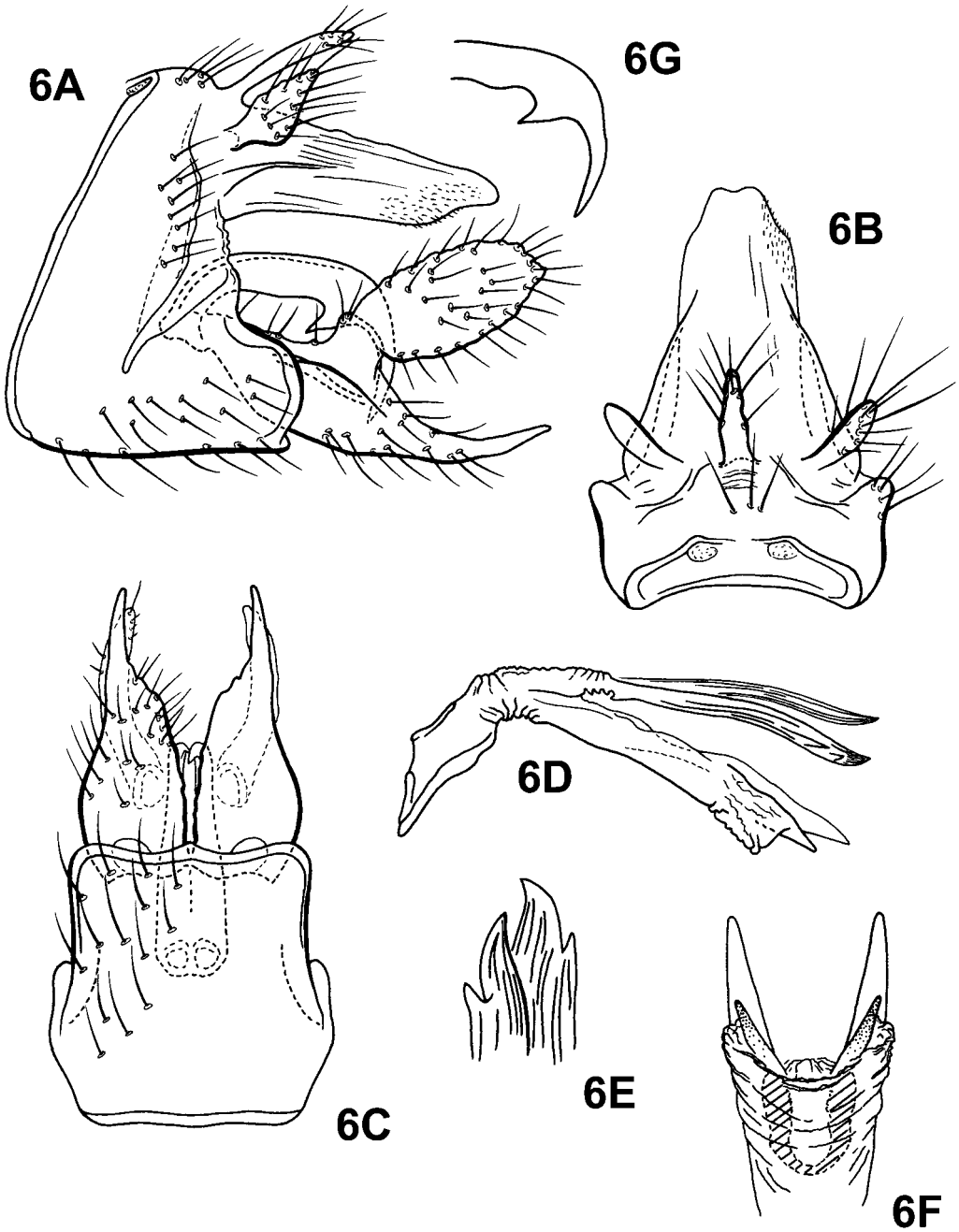


FIGURE 6. *Triaenodes acanthus*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral; E—apices of parameres, lateral; F—apex of phallus, ventral; G—apex of recurved process of inferior appendage.

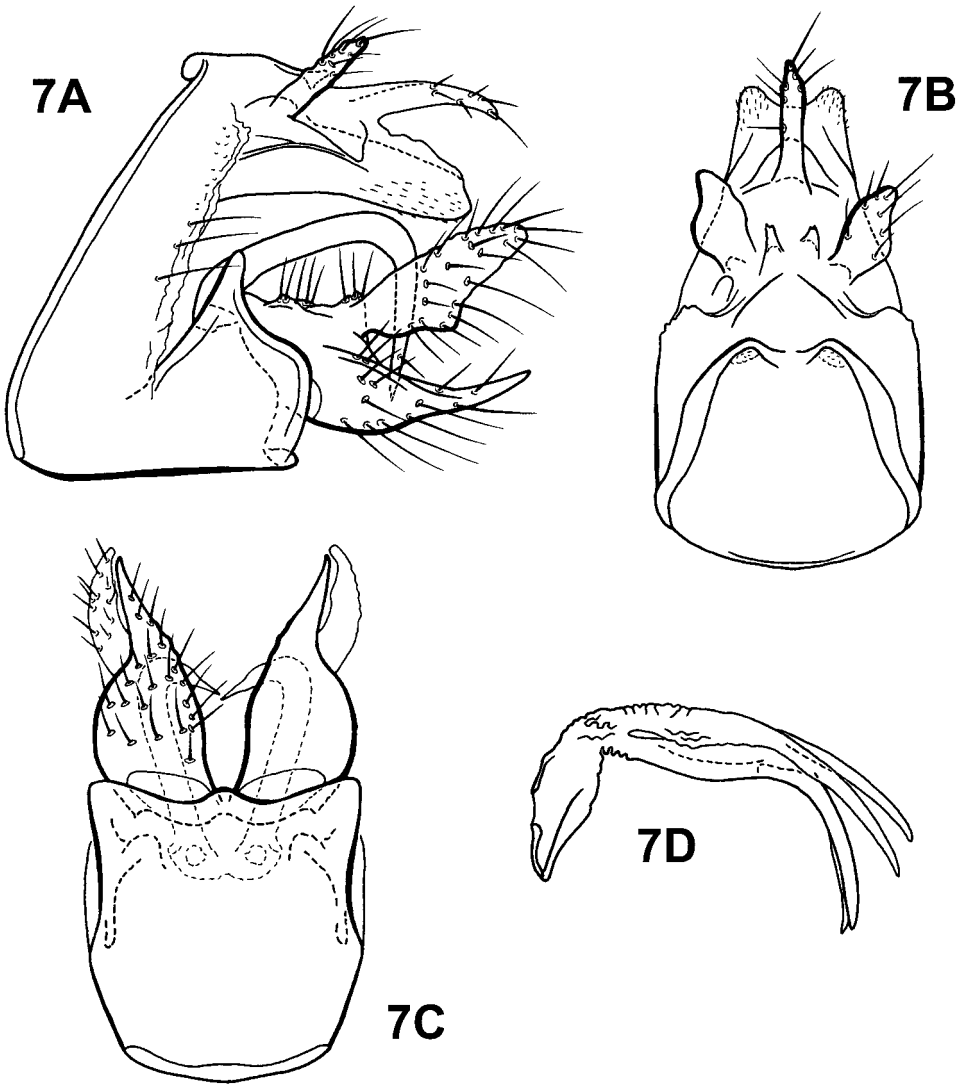


FIGURE 7. *Triaenodes anomalus* Flint. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

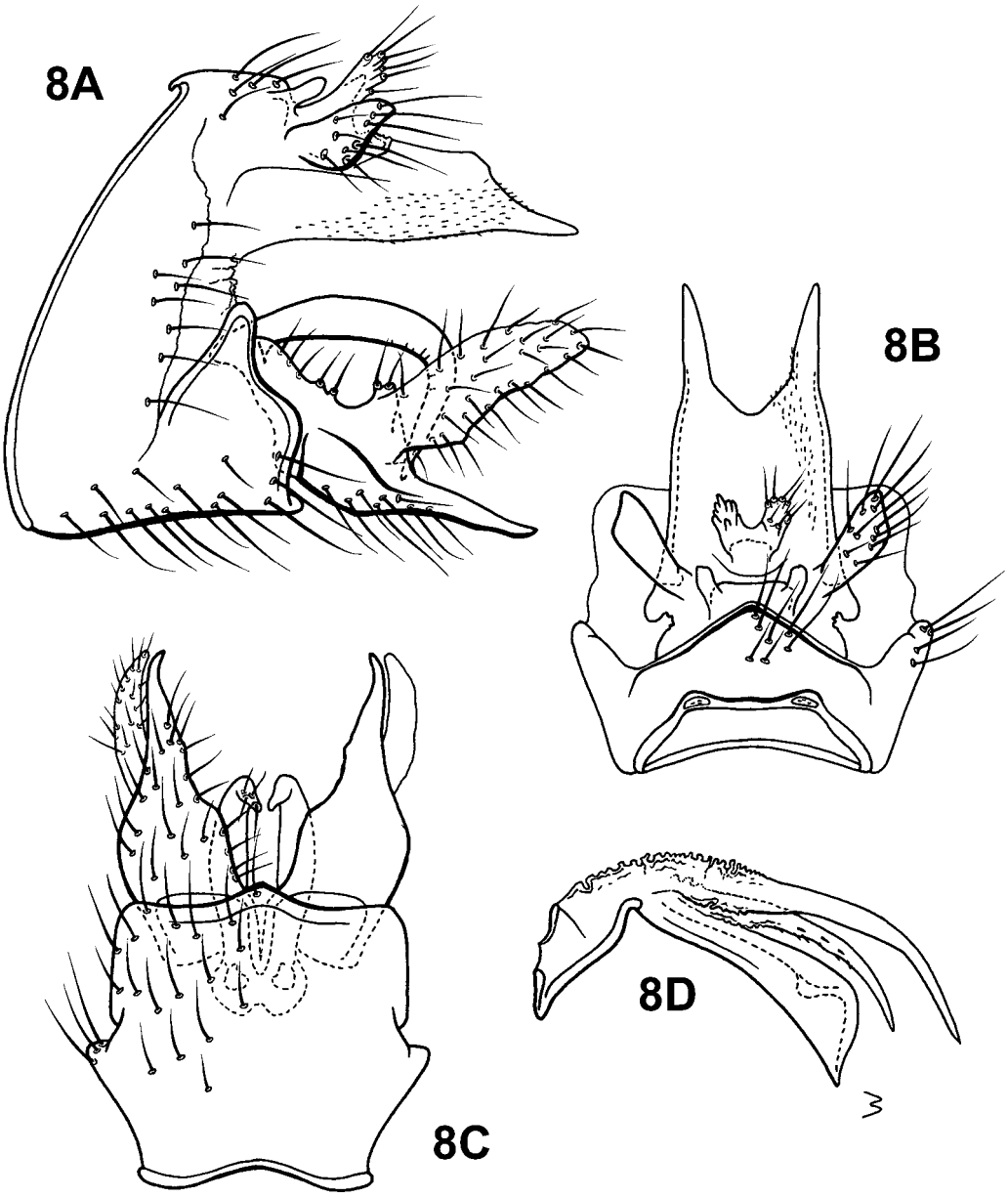


FIGURE 8. *Triaenodes chirripo*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral, inset: apex of phalicata, ventral.

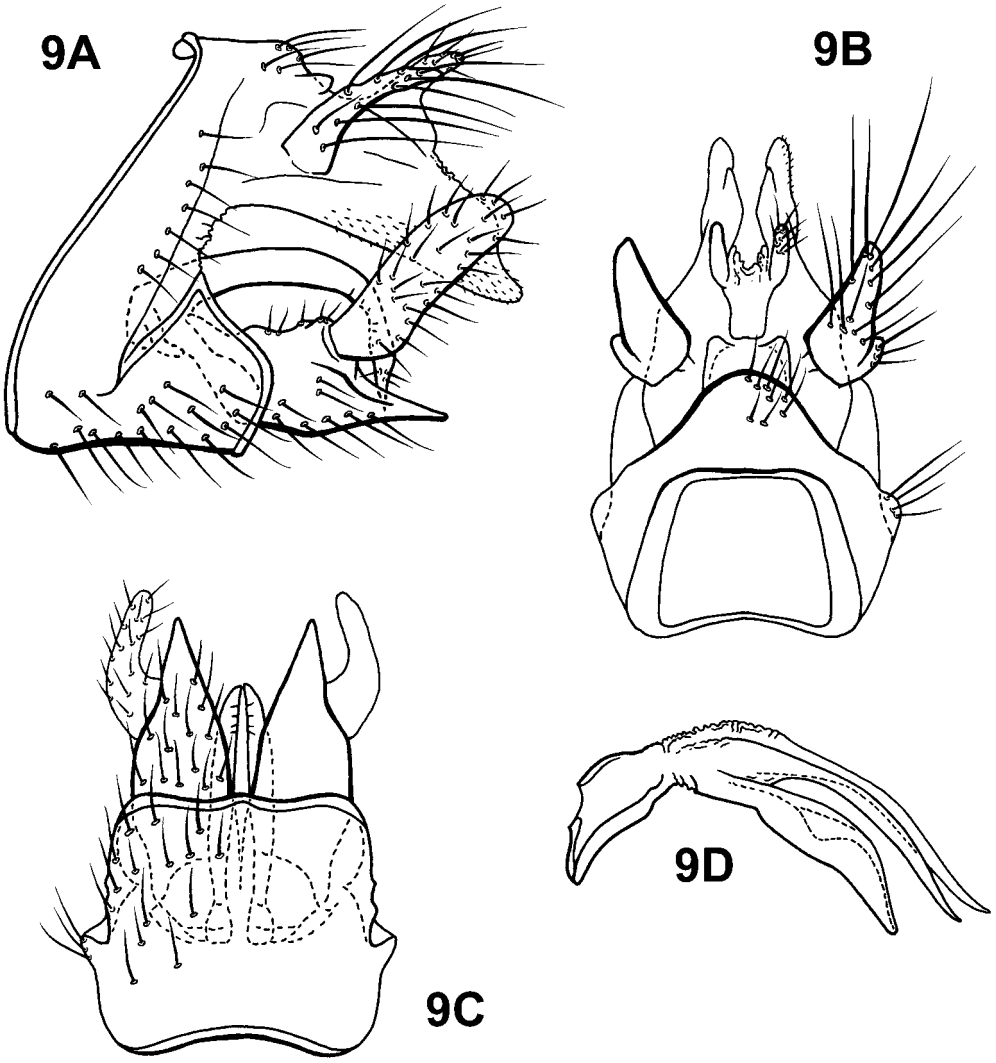


FIGURE 9. *Triaenodes clauseni*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

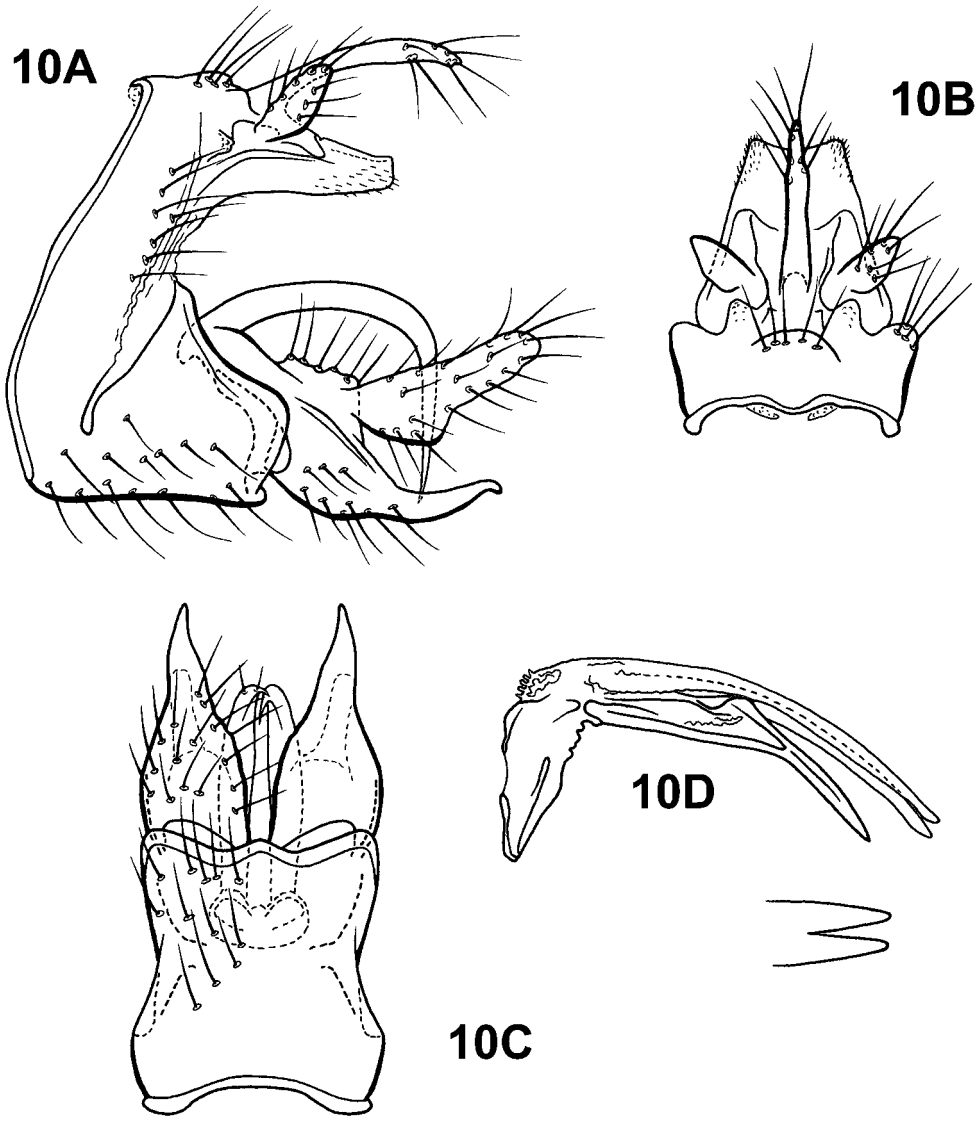


FIGURE 10. *Triaenodes cuyotenango*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral, inset: apex of phalicata, ventral.

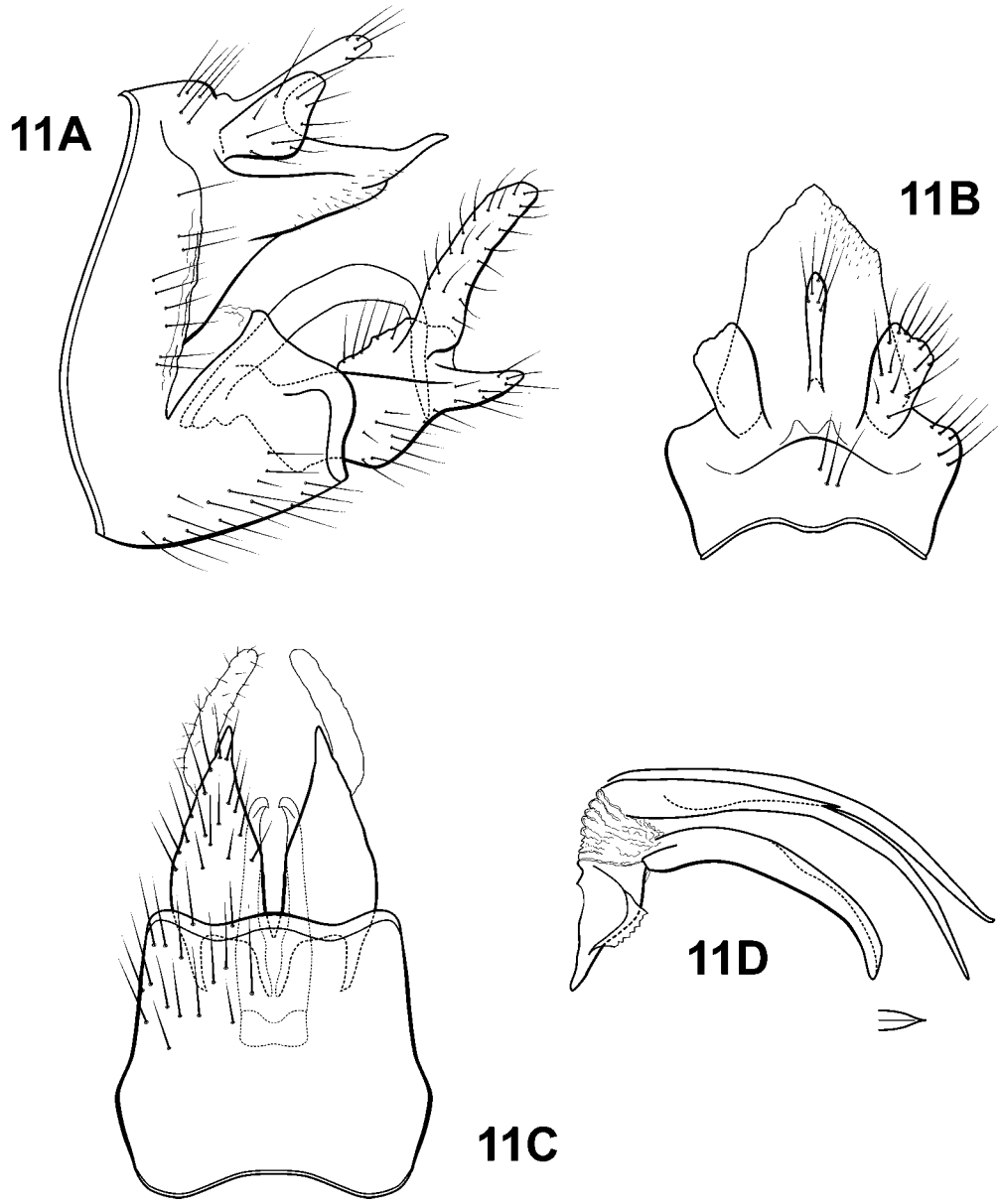


FIGURE 11. *Triaenodes delicatus* Navás. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral, inset: apex of phalicata, ventral.

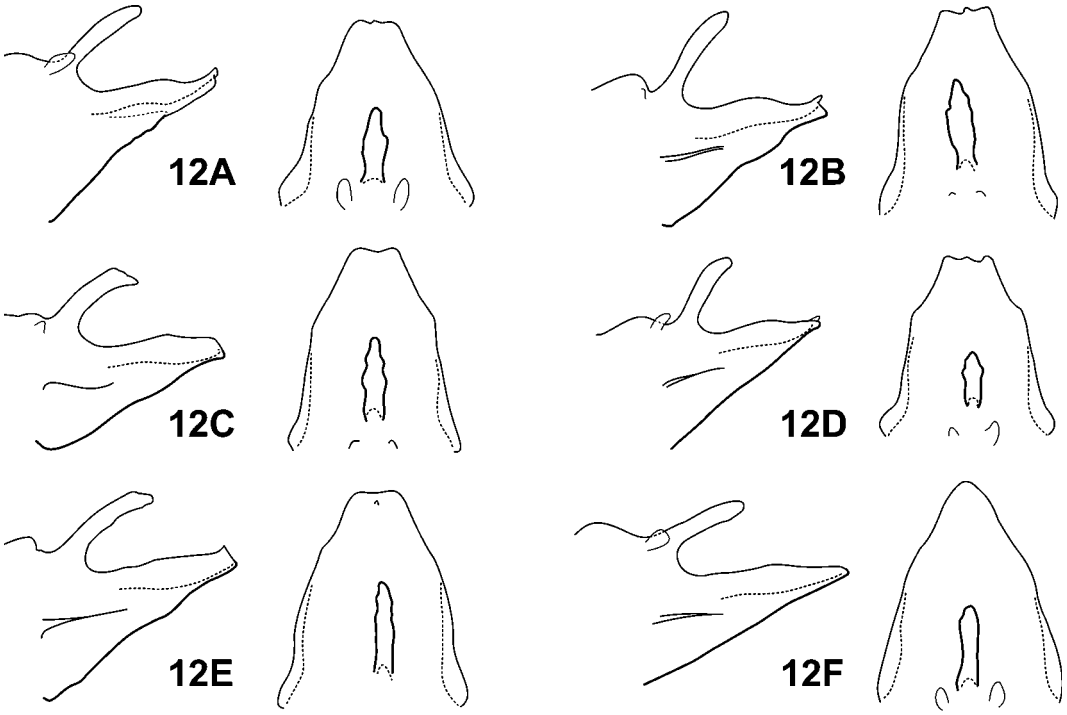


FIGURE 12. *Triaenodes delicatus* Navás. Male genitalia, variation in tergum X, lateral and dorsal views, all specimens from Panama, Barro Colorado Island, Synder-Molino trail: A—specimen from alcohol lot UMSP000065131; B—specimen from alcohol lot UMSP000065132; C—specimen from alcohol lot UMSP000065132; D—specimen from alcohol lot UMSP000065132; E—specimen from alcohol lot UMSP000065131; F—specimen from alcohol lot UMSP000065132.

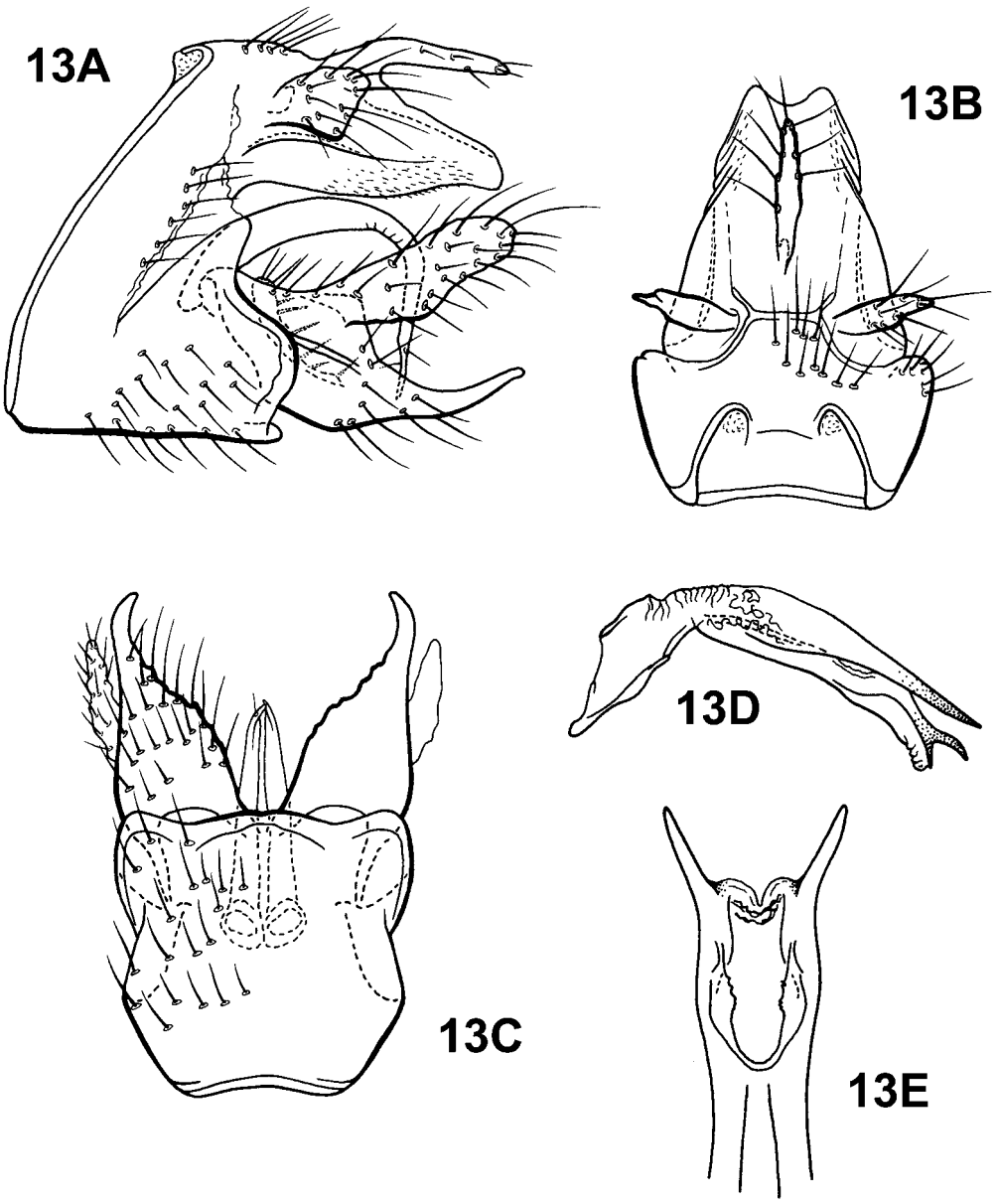


FIGURE 13. *Triaenodes flintorum*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral; E—apex of phallus, dorsal.

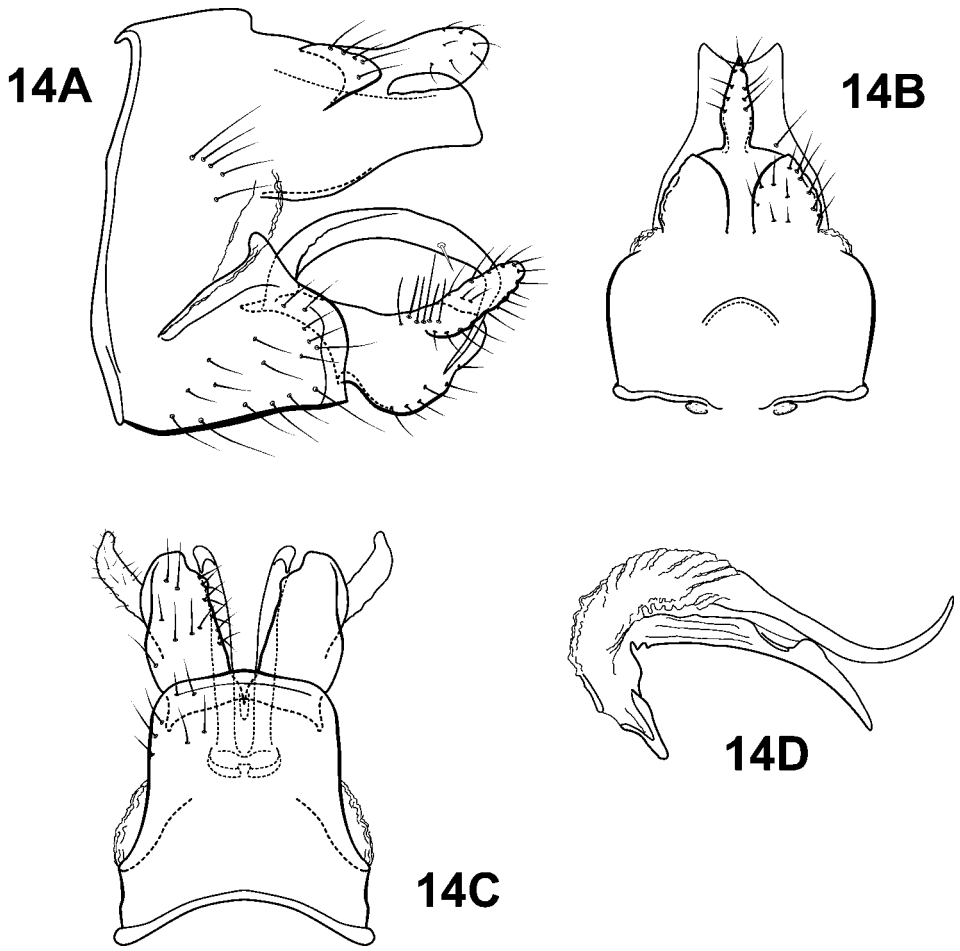


FIGURE 14. *Triaenodes guadaloupe*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

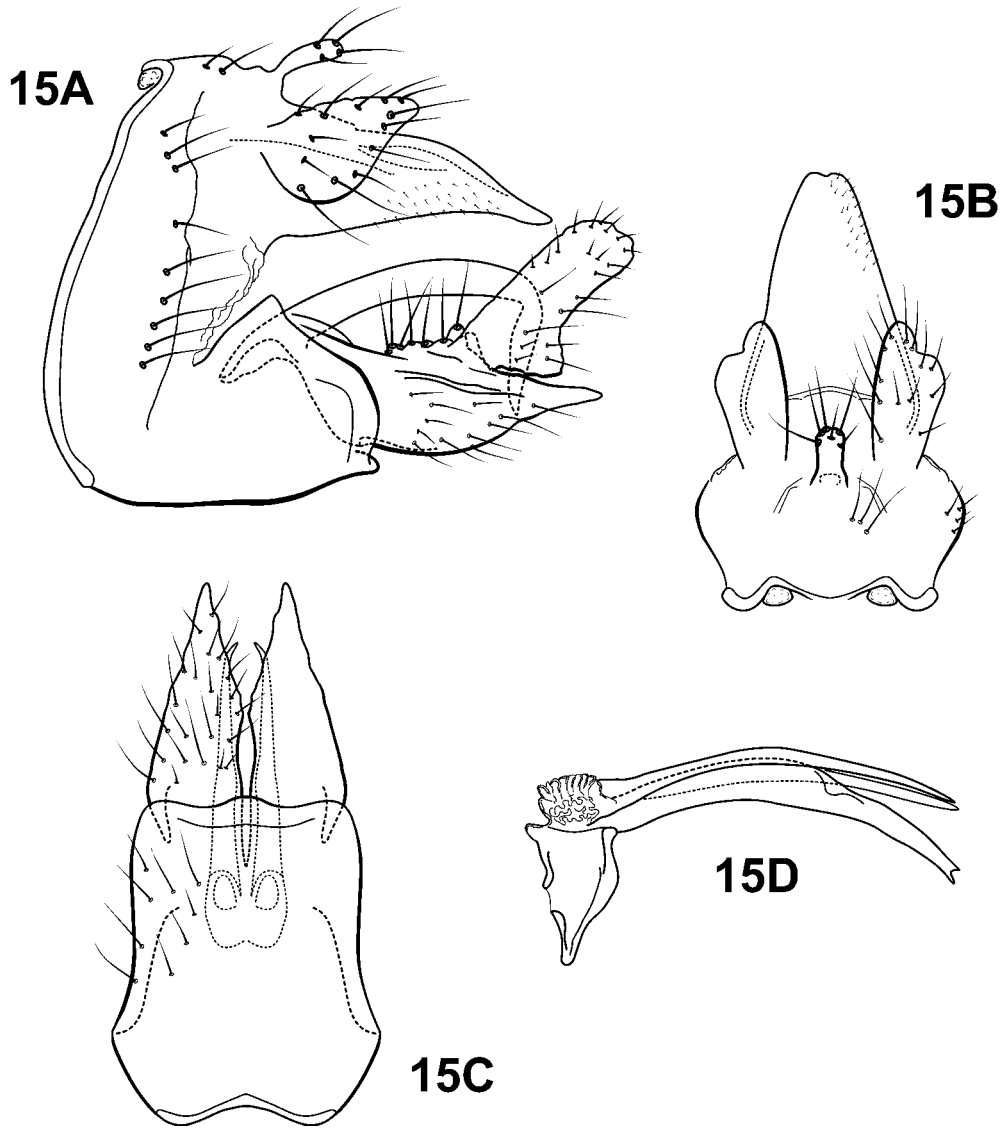


FIGURE 15. *Triaenodes hodgesi*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

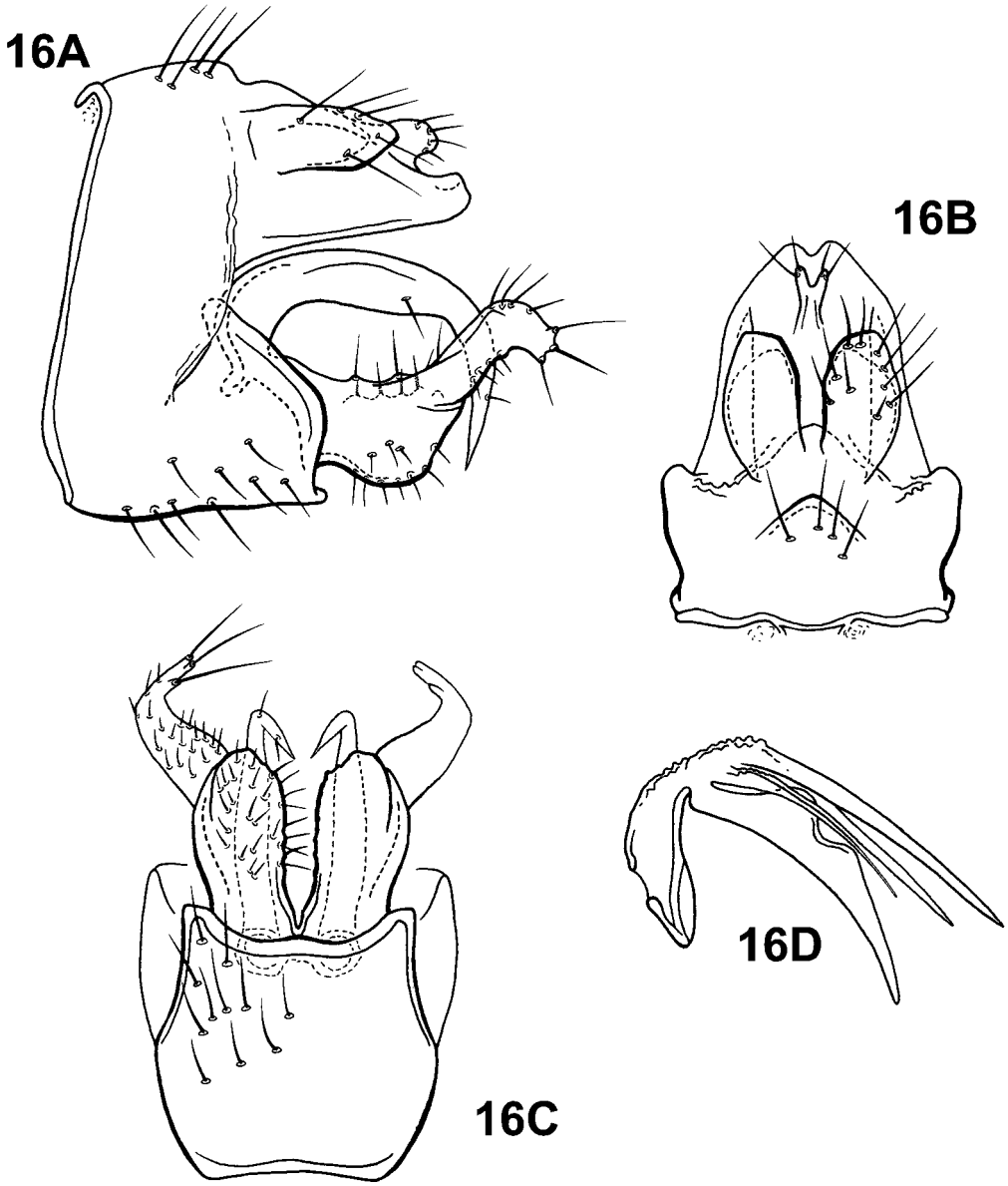


FIGURE 16. *Triaenodes hornitos*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

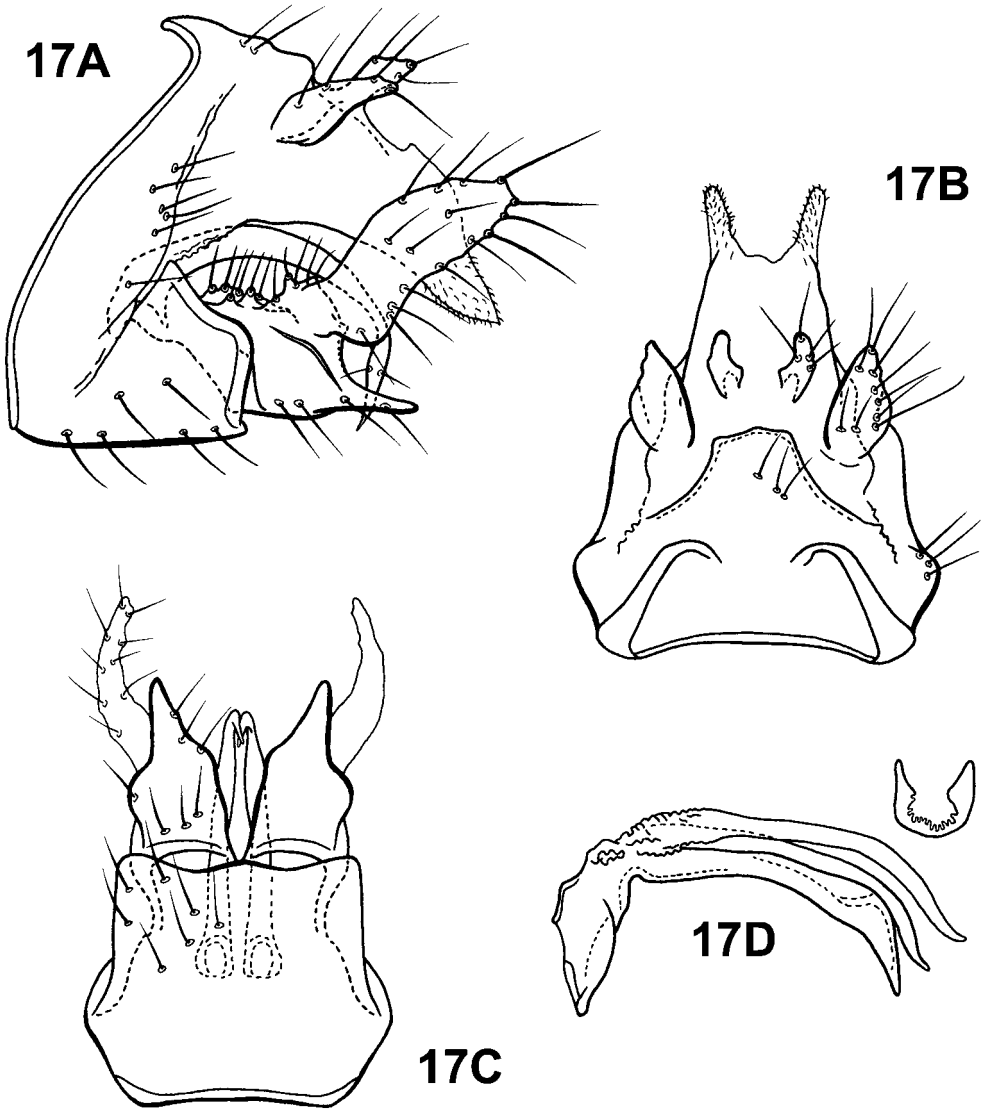


FIGURE 17. *Triaenodes kilambe*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral, inset: phallotremal sclerite, dorsal.

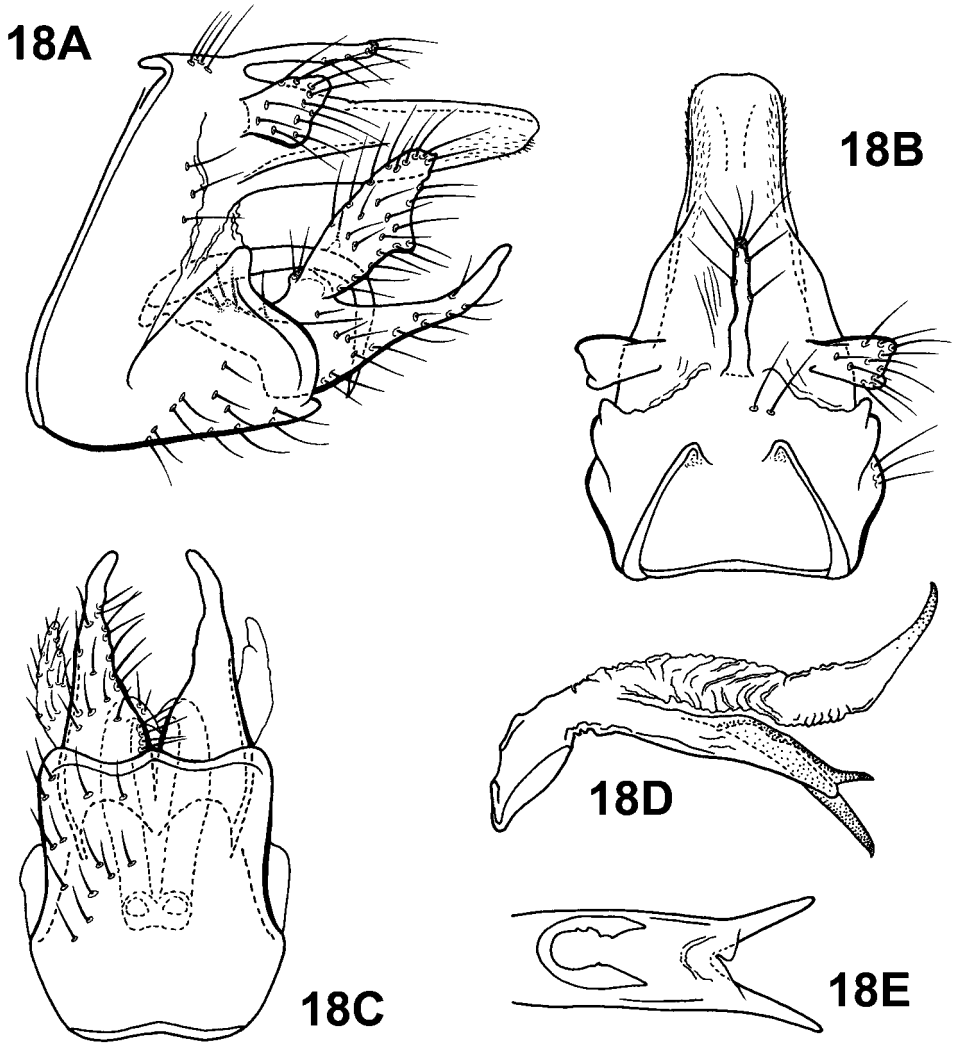


FIGURE 18. *Triaenodes mexicanus*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral; E—apex of phallus, ventral.

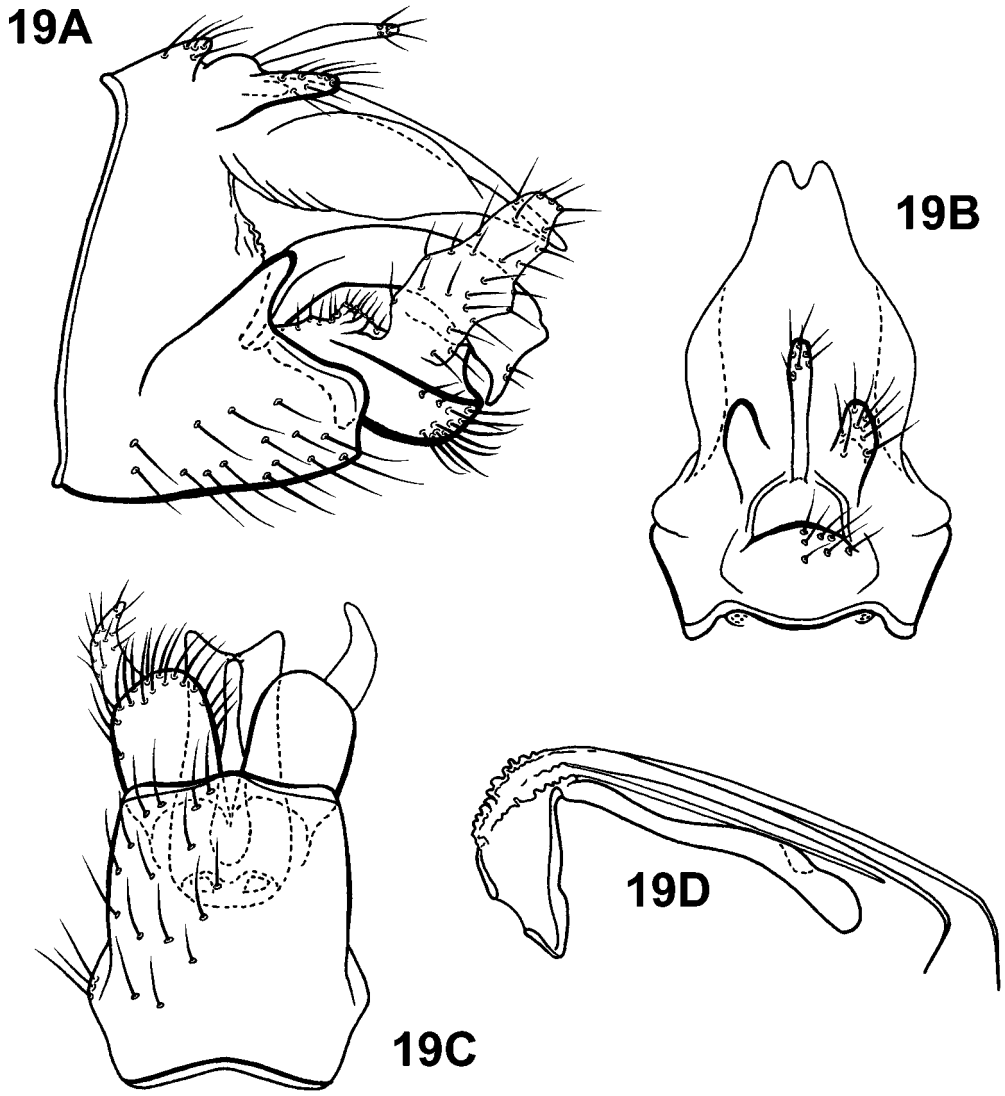


FIGURE 19. *Triaenodes moncho*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

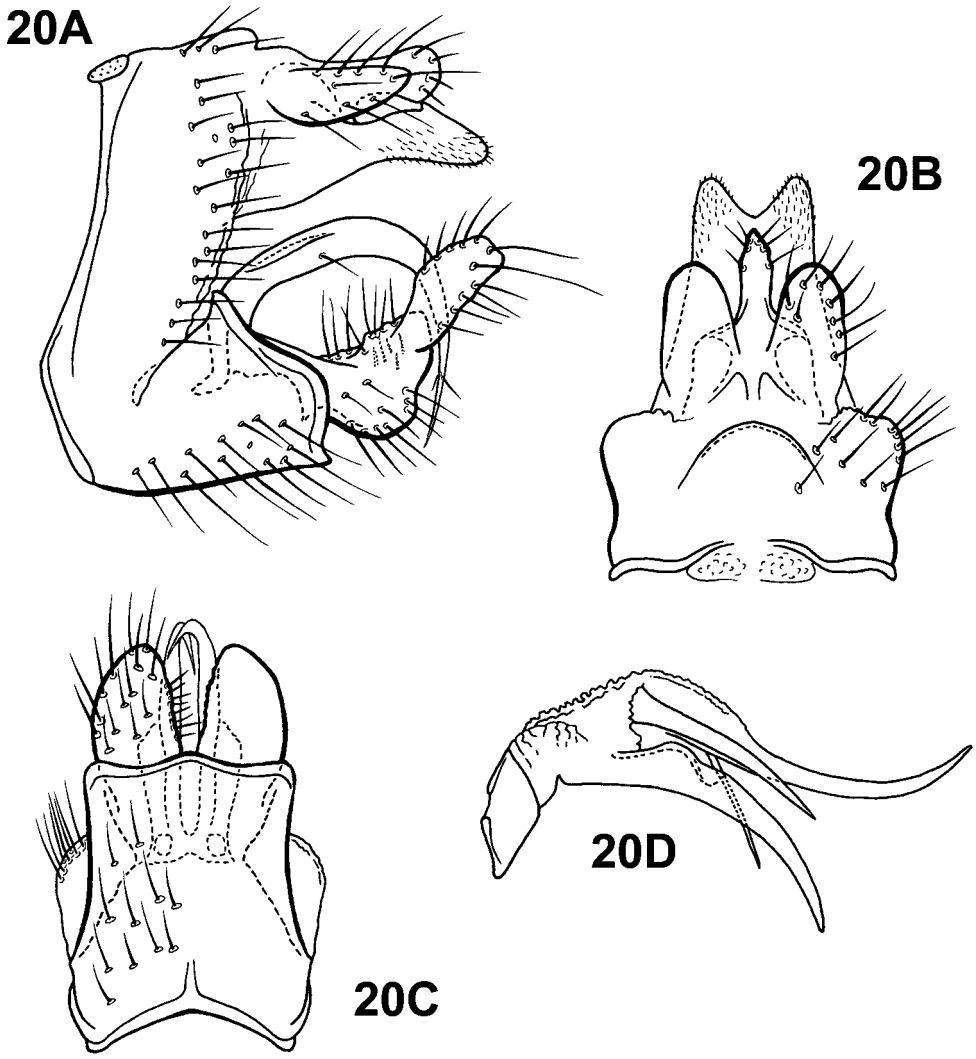


FIGURE 20. *Triaenodes morai*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

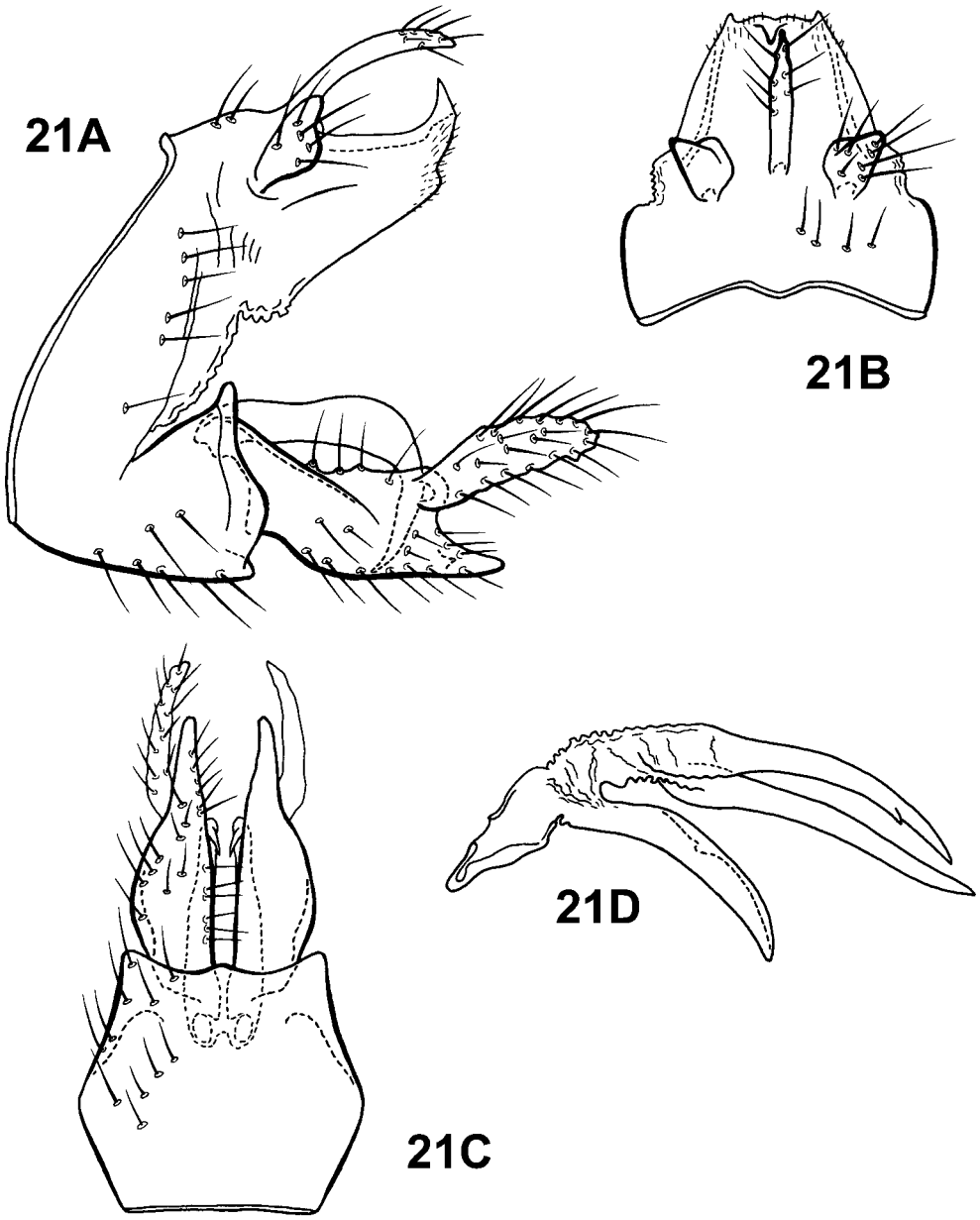


FIGURE 21. *Triaenodes nicaraguensis*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

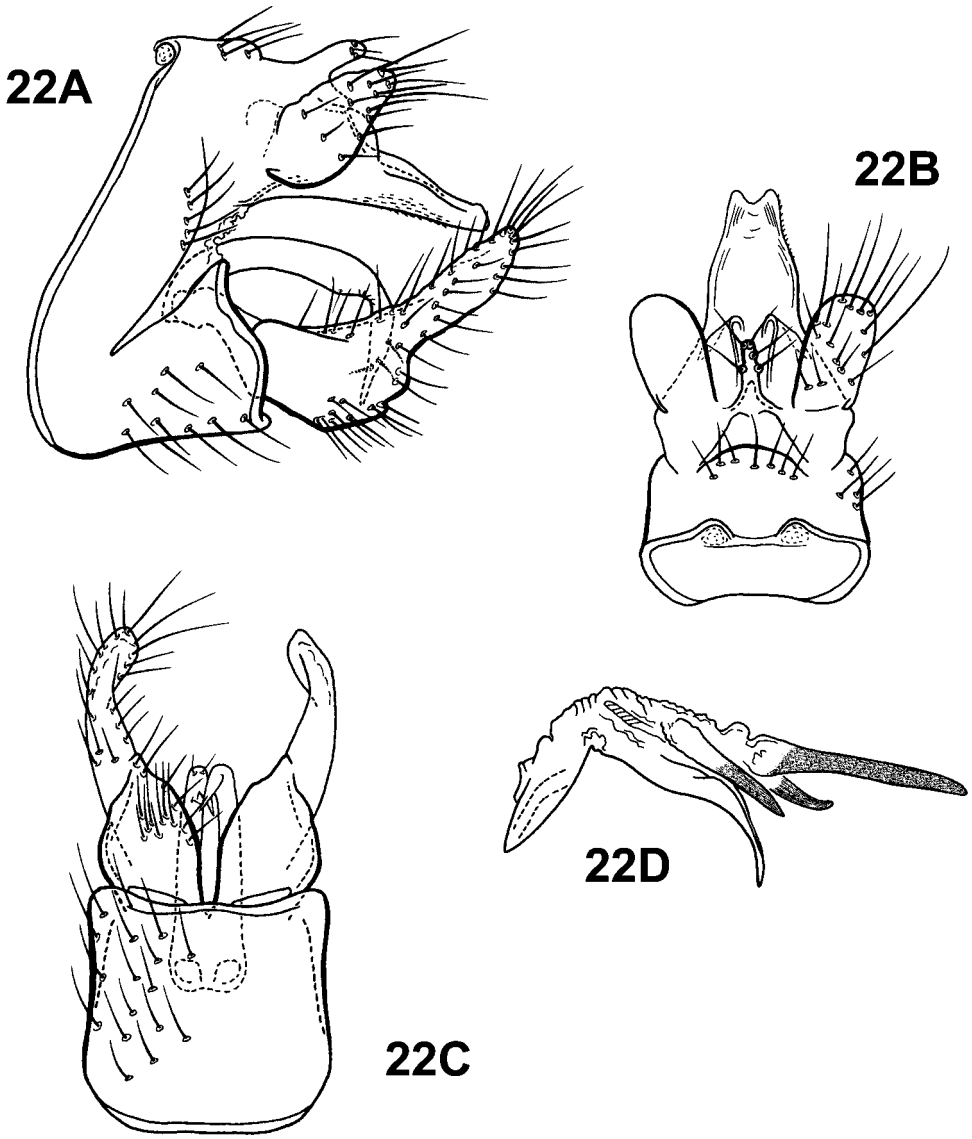


FIGURE 22. *Triaenodes oaxacensis*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

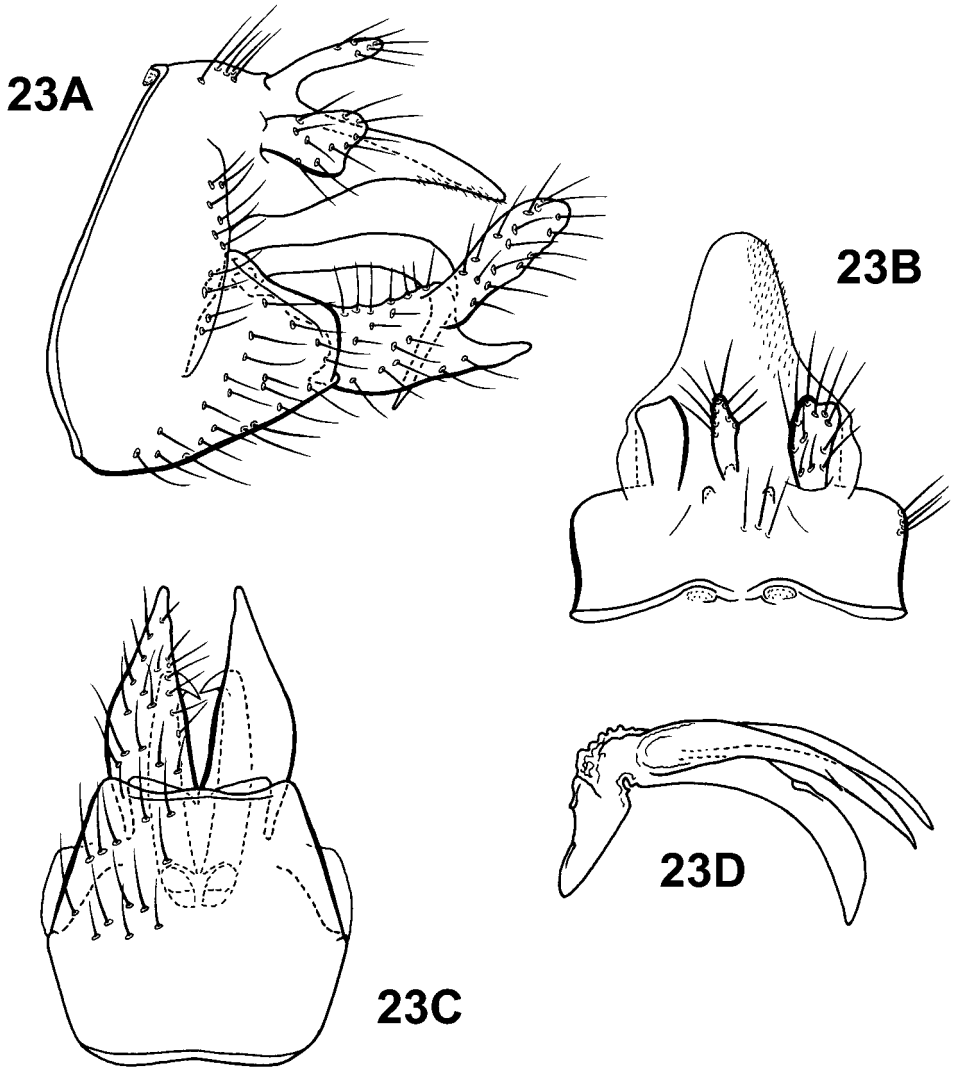


FIGURE 23. *Triaenodes peruanus* Flint & Reyes. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

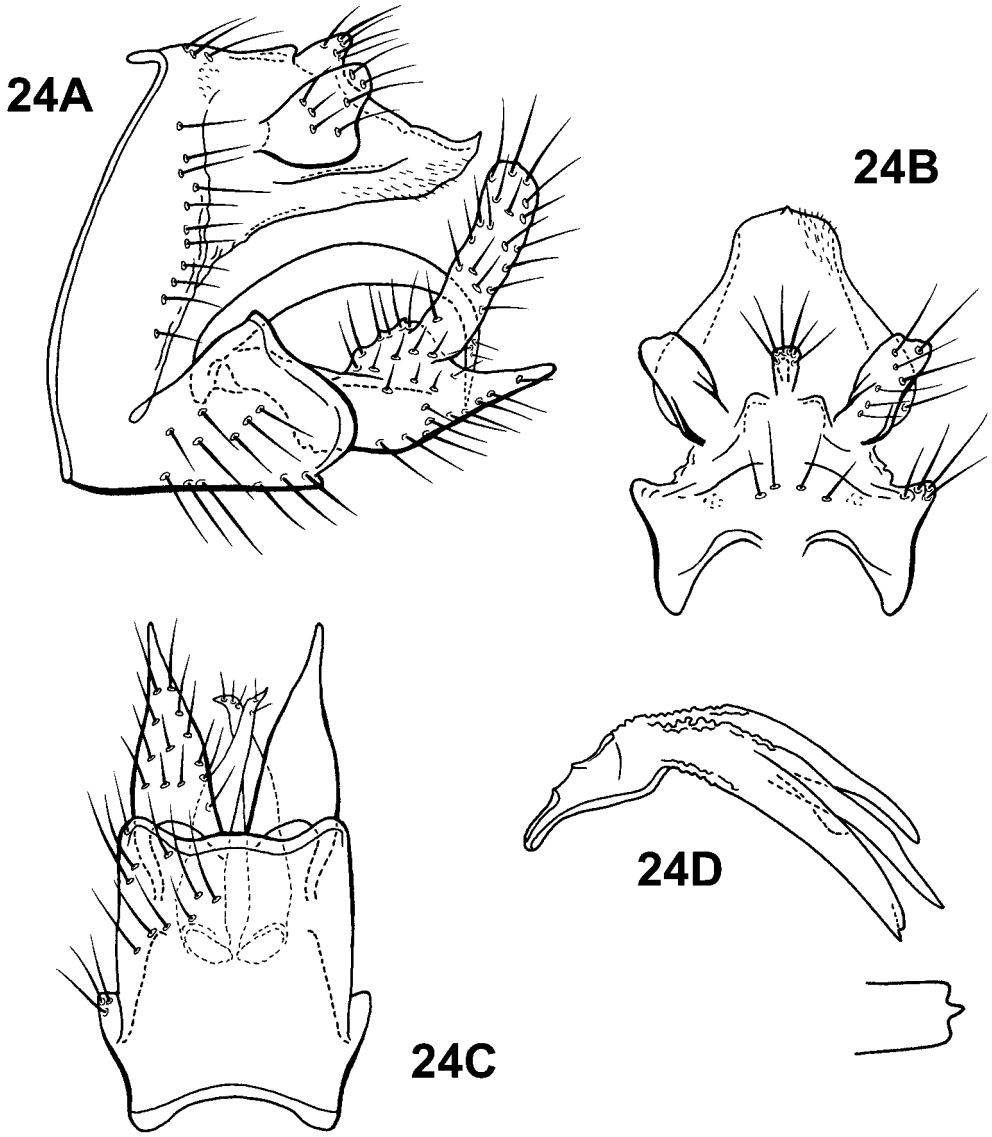


FIGURE 24. *Triaenodes tajo*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral, inset: apex of phalicata, ventral.

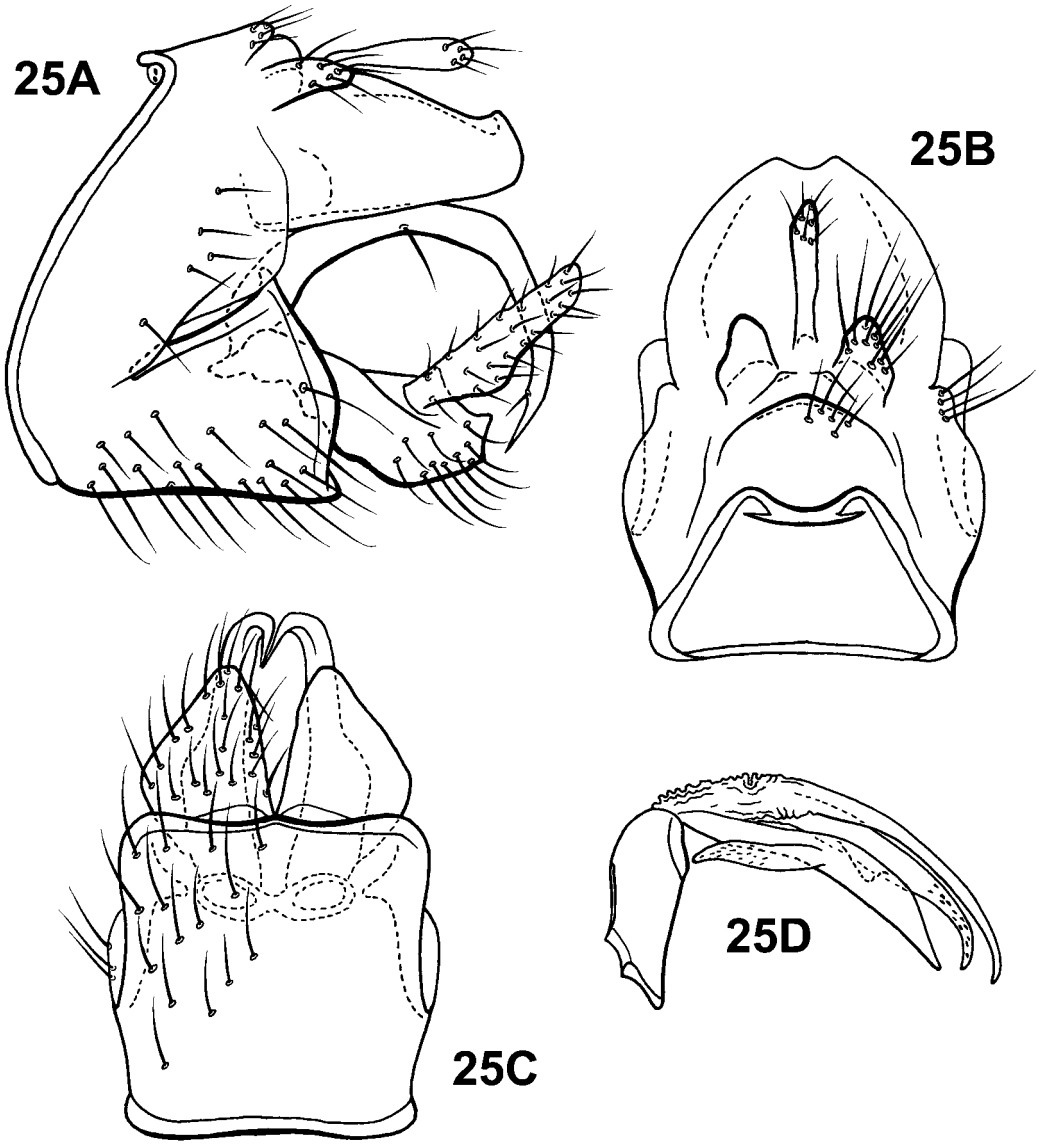


FIGURE 25. *Triaenodes talamanca*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

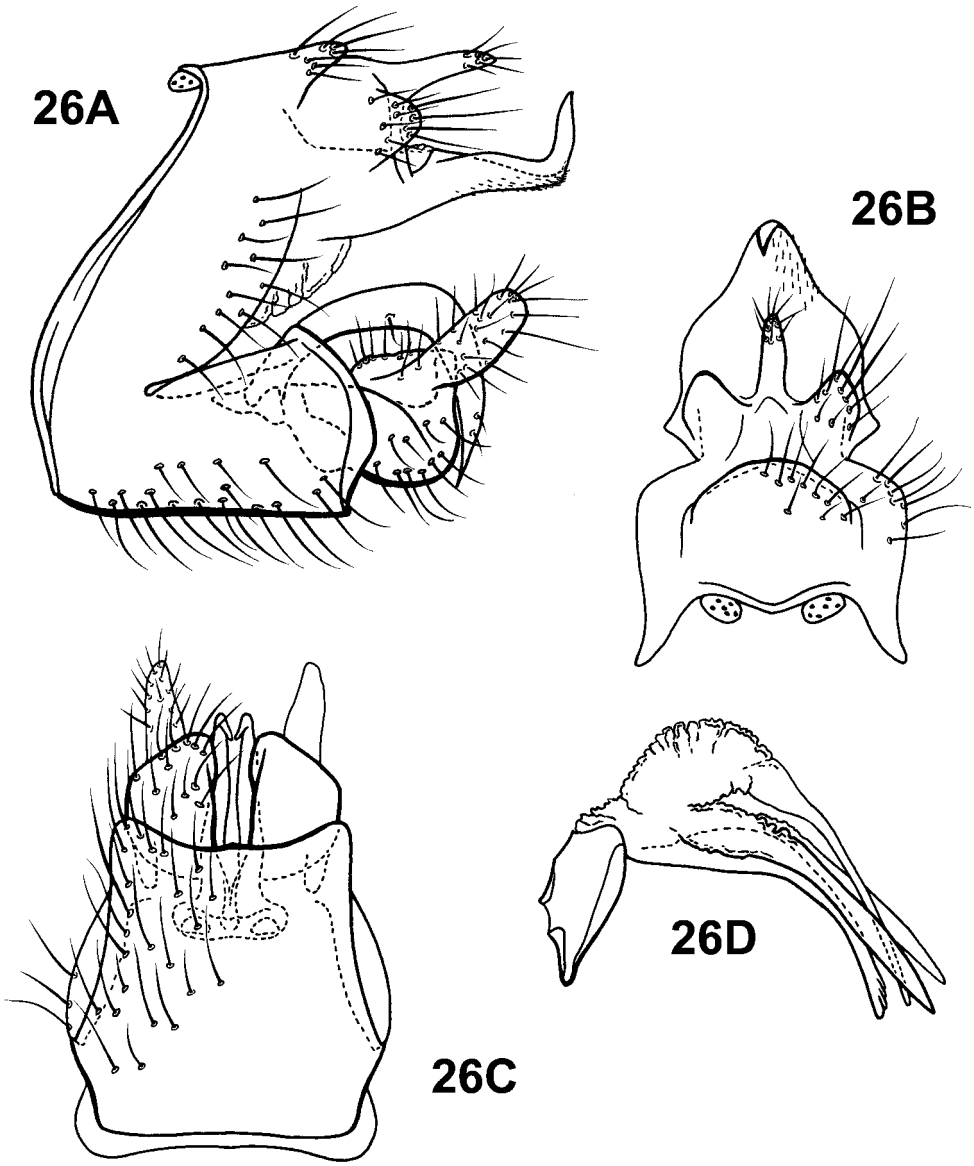


FIGURE 26. *Triaenodes tapanti*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

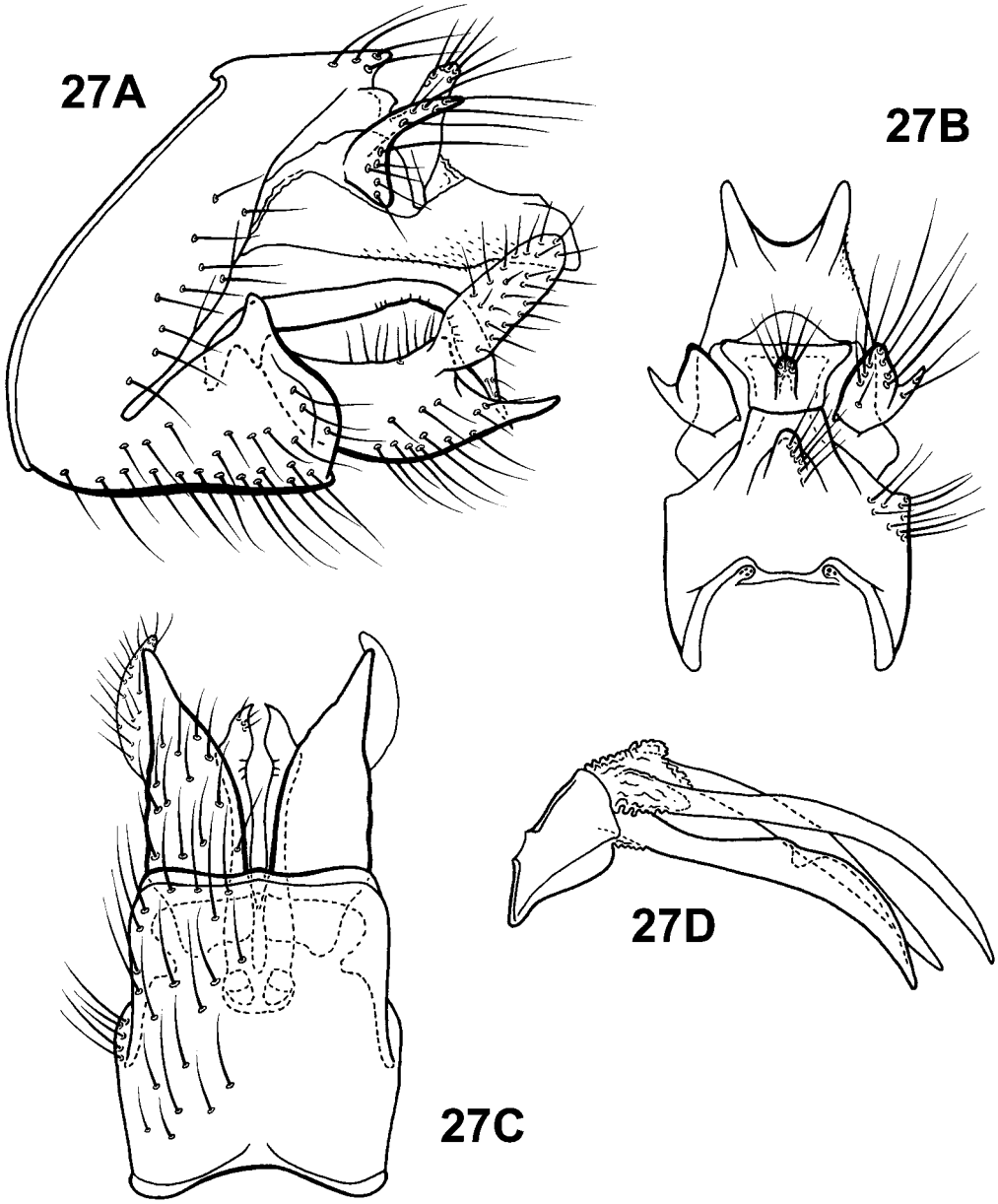


FIGURE 27. *Triaenodes tico*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral.

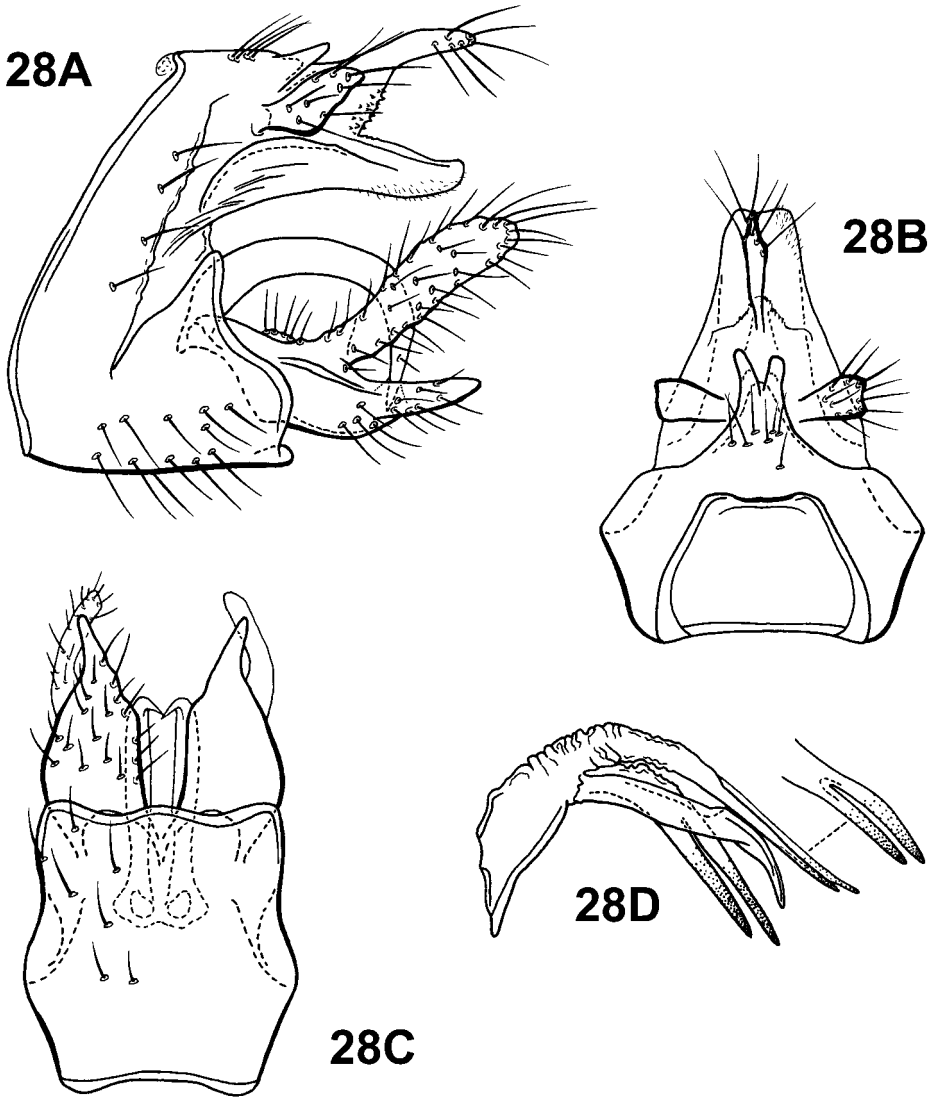


FIGURE 28. *Triaenodes tuxtlensis*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral, inset: apex of paramere, lateral.

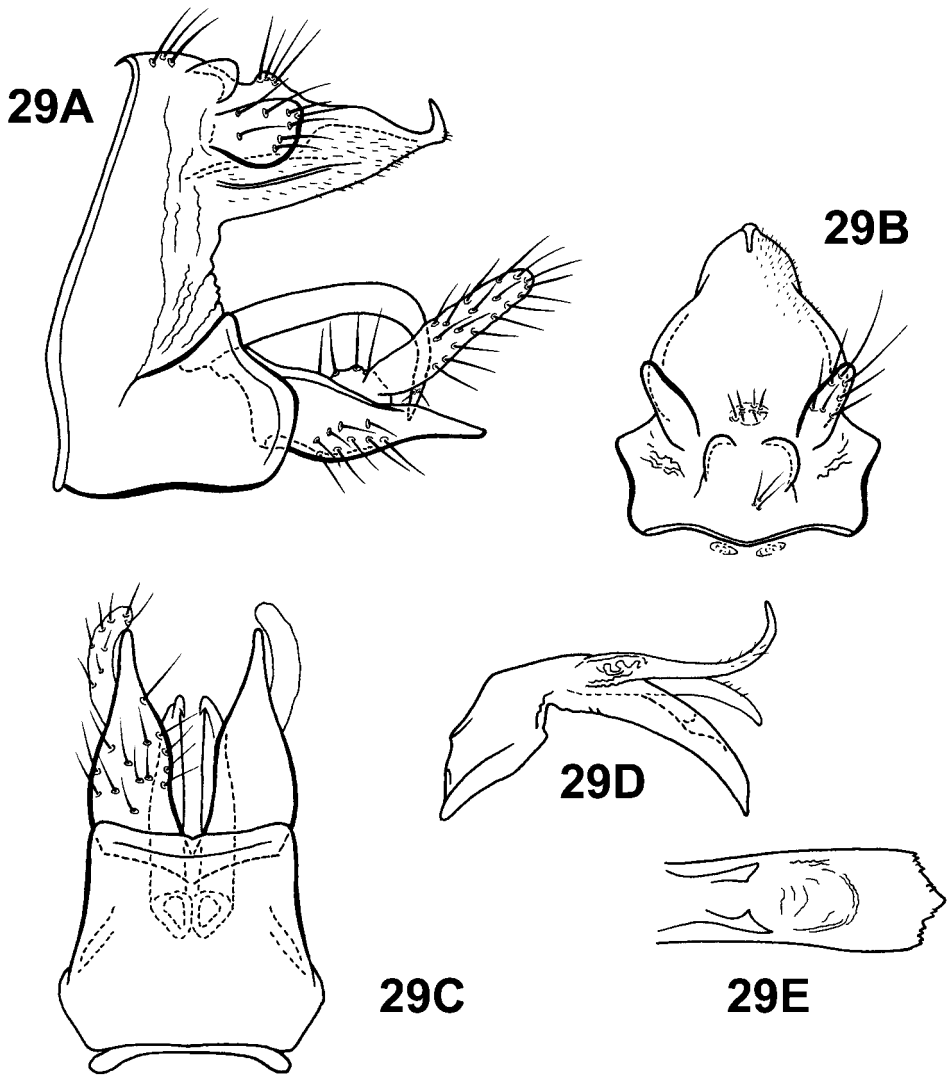


FIGURE 29. *Triaenodes woldai*, new species. Male genitalia: A—lateral; B—dorsal; C—ventral; D—phallus, lateral; E—apex of phallus, dorsal.

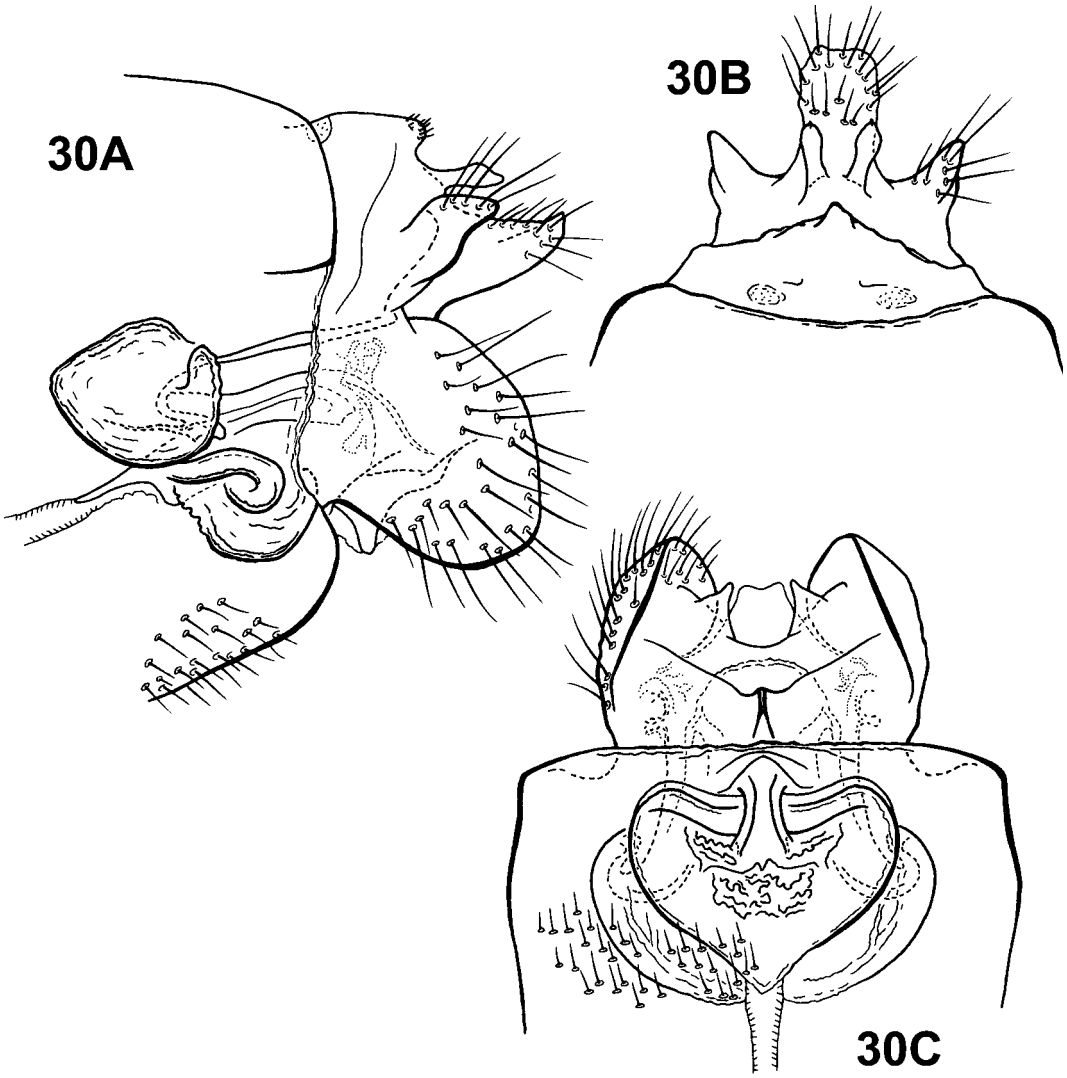


FIGURE 30. *Triaenodes anomalus* Flint. Female genitalia: A—lateral; B—dorsal; C—ventral.

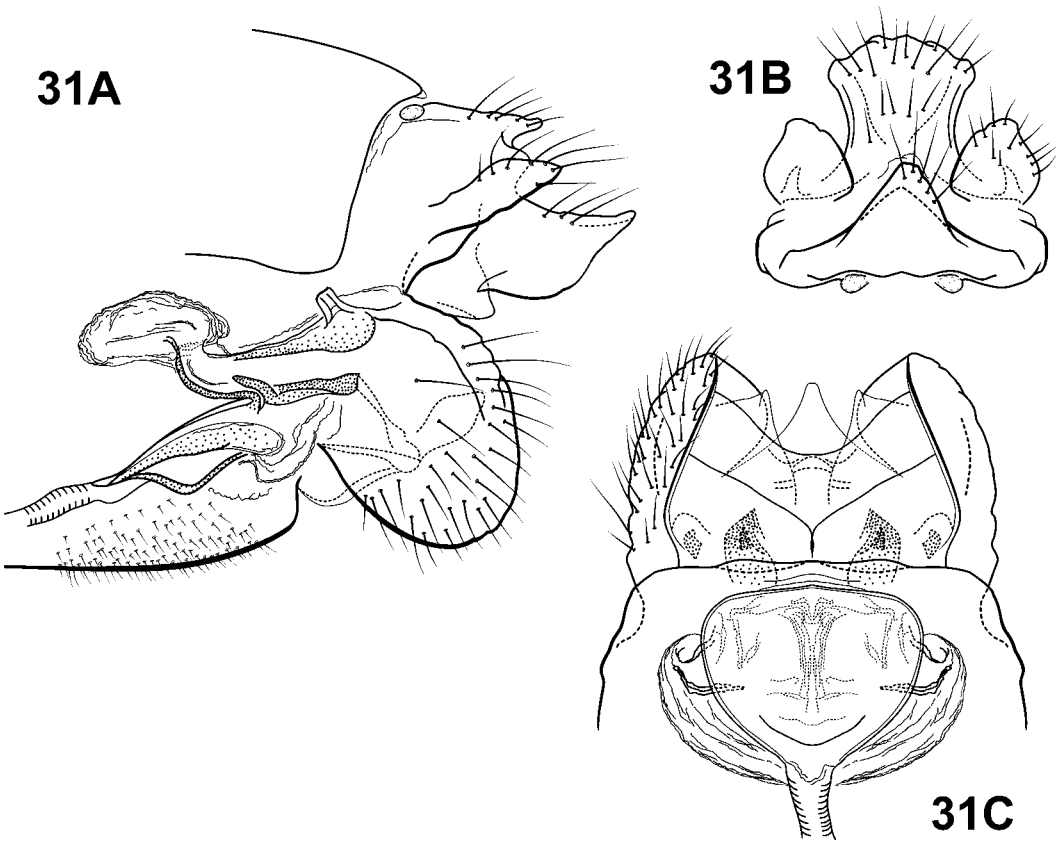


FIGURE 31. *Triaenodes chirripo*, new species. Female genitalia: A—lateral; B—dorsal; C—ventral.

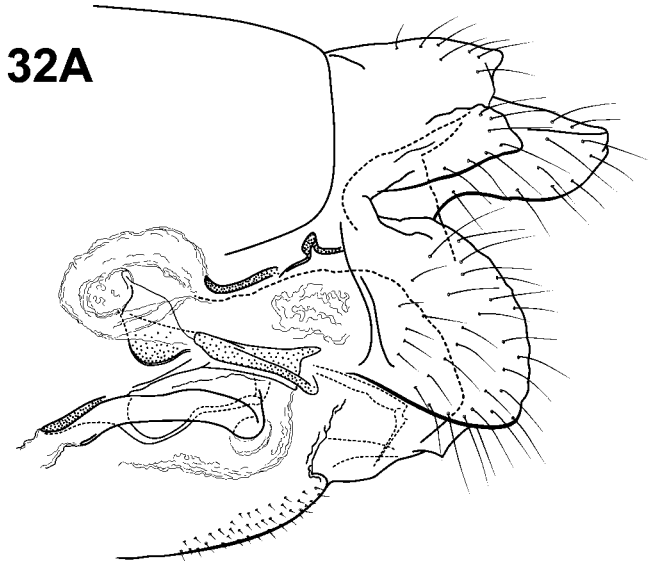


FIGURE 32. *Triaenodes clauseni*, new species. Female genitalia: A—lateral.

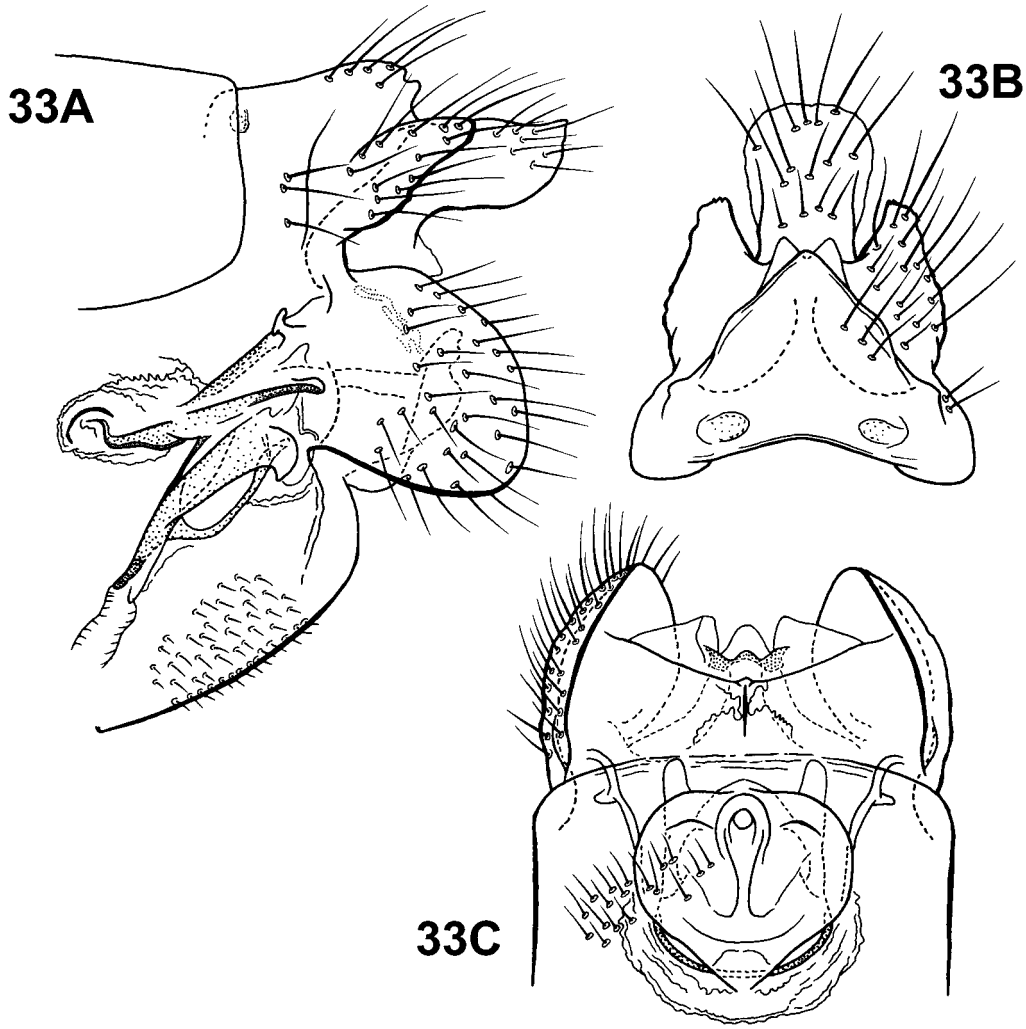


FIGURE 33. *Triaenodes delicatus* Navás. Female genitalia: A—lateral; B—dorsal; C—ventral.

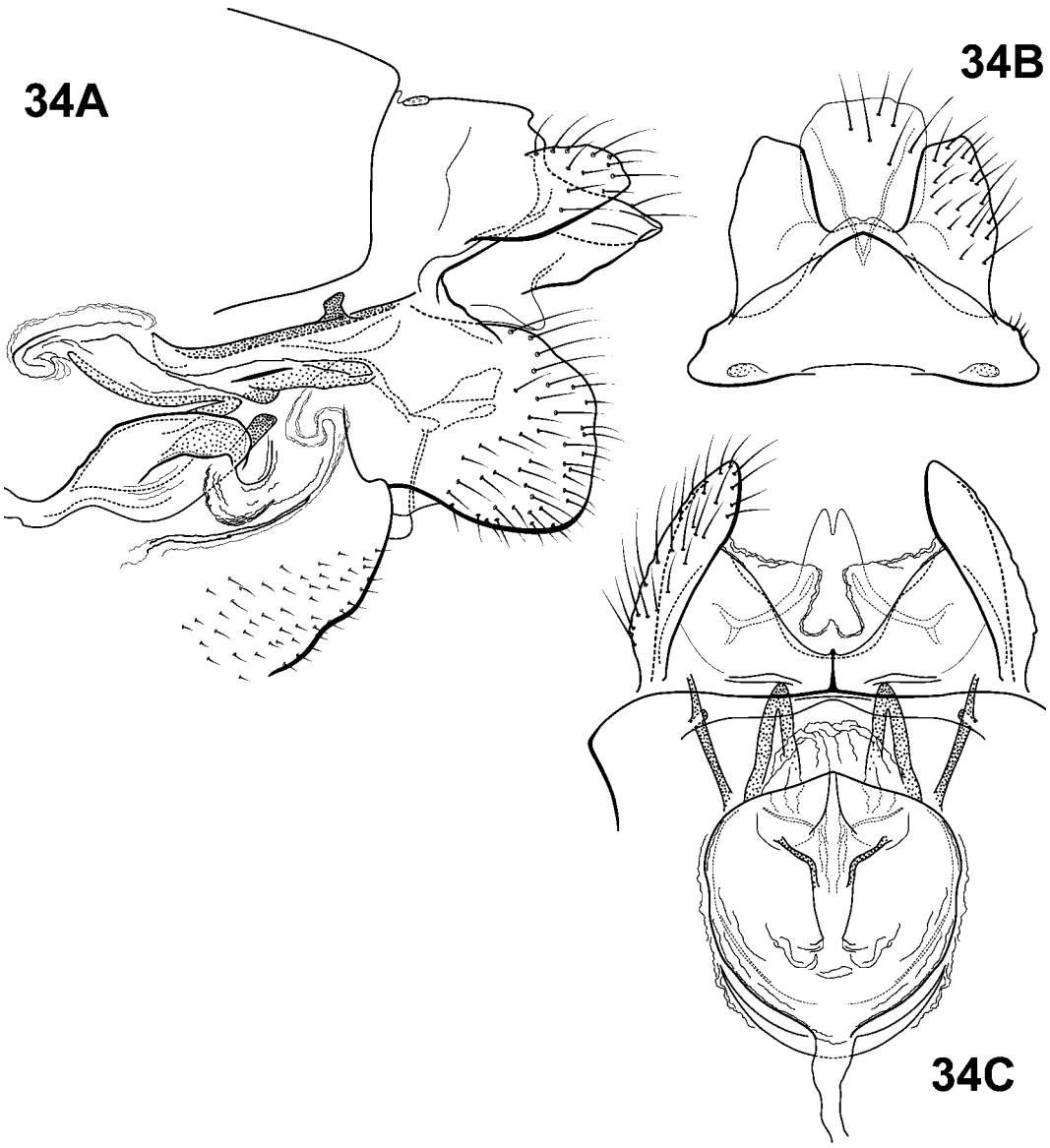


FIGURE 34. *Triaenodes hodgesi*, new species. Female genitalia: A—lateral; B—dorsal; C—ventral.

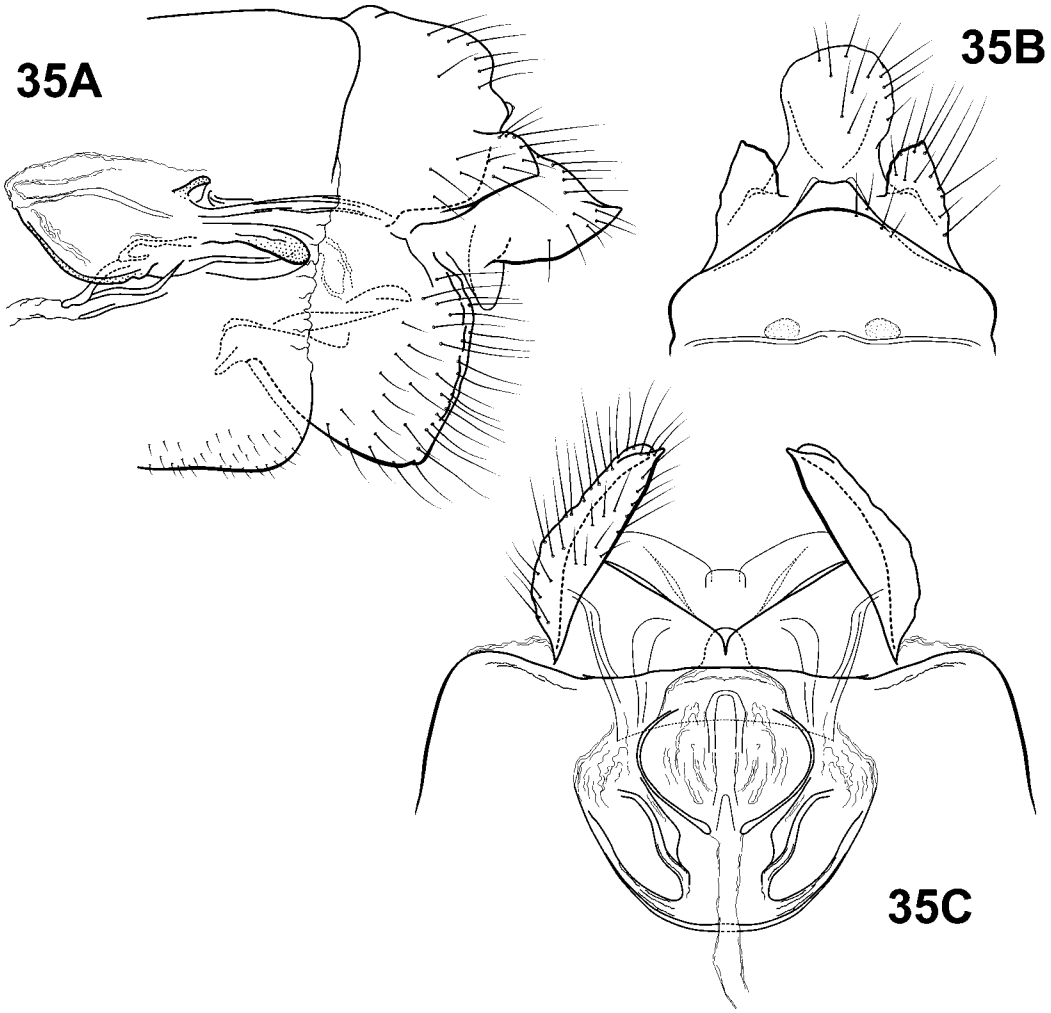


FIGURE 35. *Triaenodes peruanus* Flint & Reyes. Female genitalia: A—lateral; B—dorsal; C—ventral.

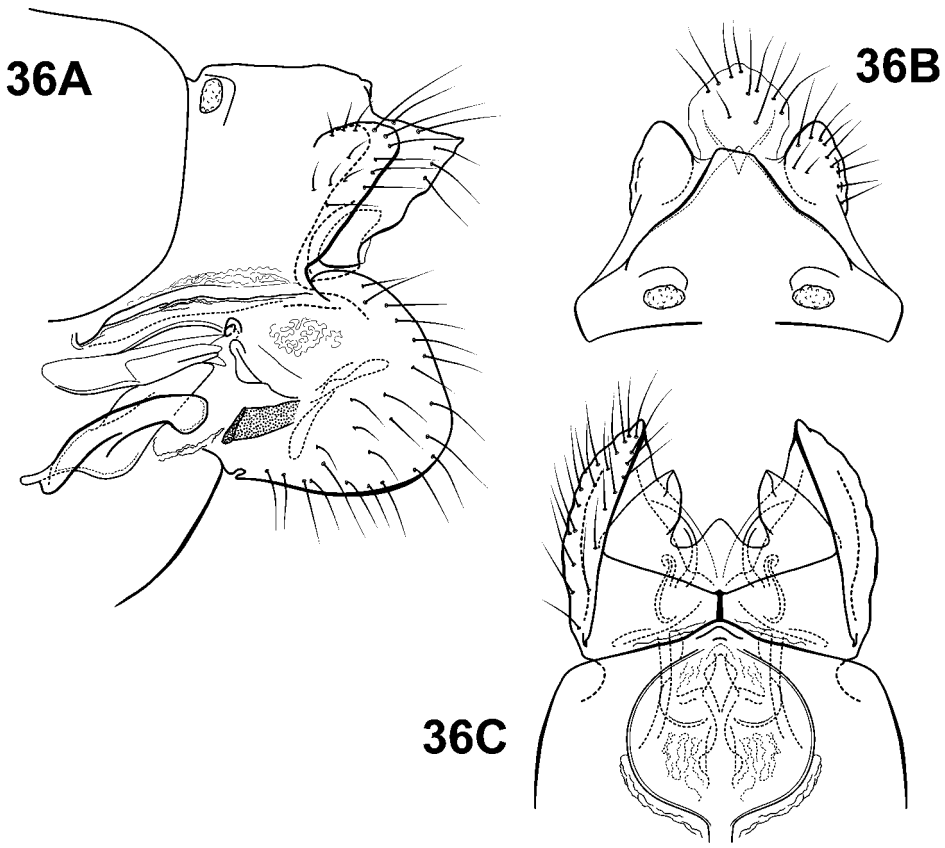


FIGURE 36. *Triaenodes tajo*, new species. Female genitalia: A—lateral; B—dorsal; C—ventral.

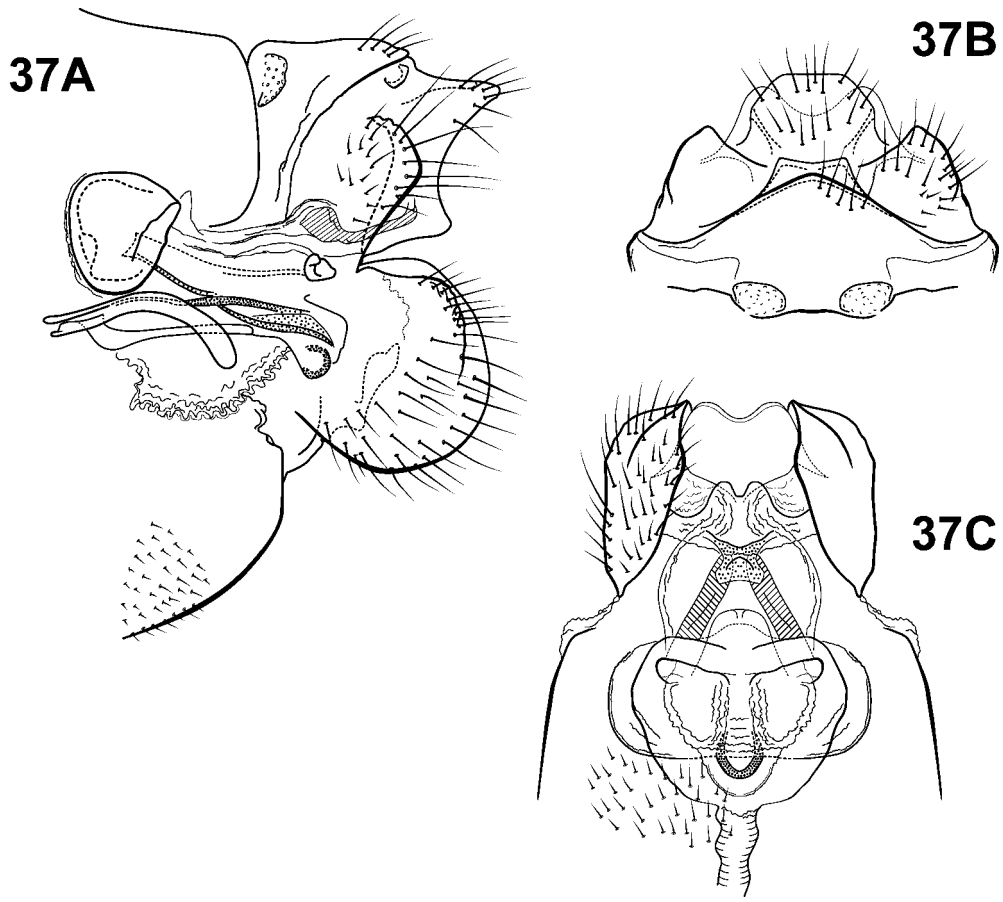


FIGURE 37. *Triaenodes tapanti*, new species. Female genitalia: A—lateral; B—dorsal; C—ventral.

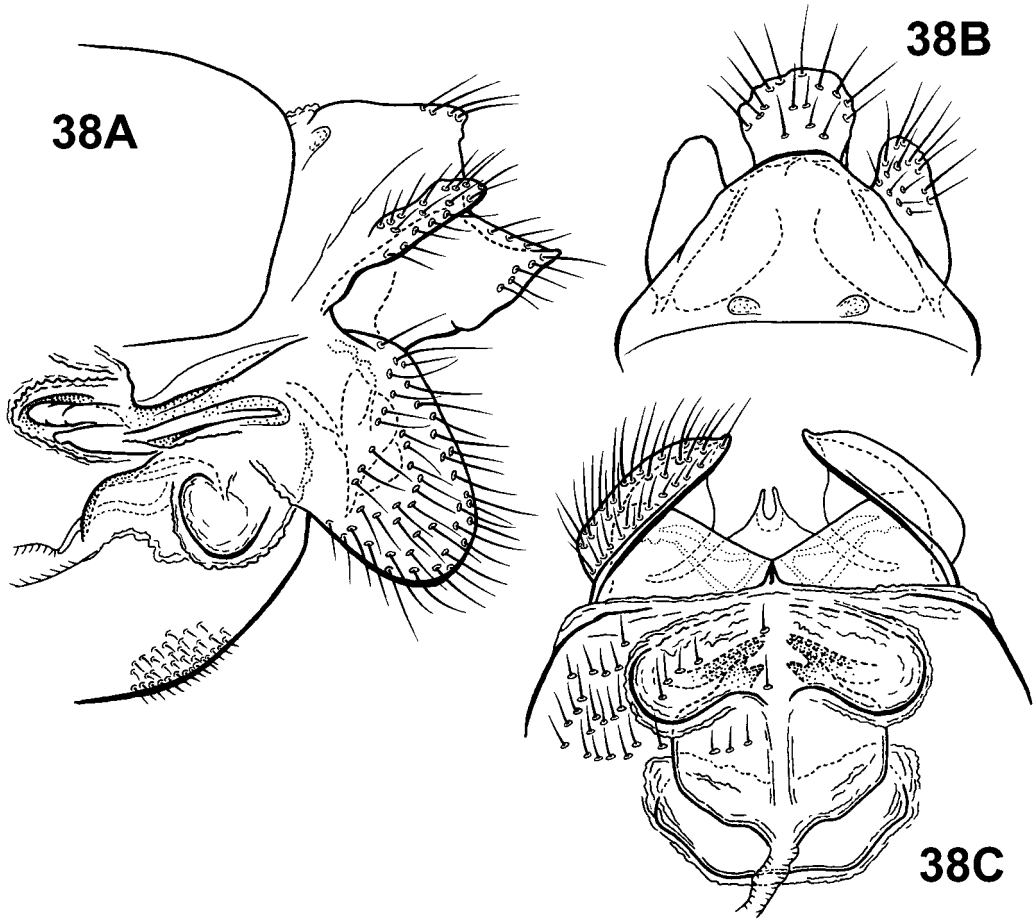


FIGURE 38. *Triaenodes tico*, new species. Female genitalia: A—lateral; B—dorsal; C—ventral.

