



## The *Tachytrechus alatus* species group (= *Syntomoneurum* Becker) revisited: new species and revised species group limits (Diptera: Dolichopodidae)

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### Abstract

The *Tachytrechus alatus* species group is revised. The species group is defined within the genus *Tachytrechus* on the basis of possession of a strong basiventral bristle on the fore femur and very reduced pulvilli on the mid- and hindlegs of both sexes. Males also possess a strongly reduced vertical bristle, and a cluster of 2–3 strong bristles on both the fore femur and mid coxa. The *T. alatus* species group is now known from southern Mexico, Central and South America and comprises eight Neotropical species including three new species: *Tachytrechus alatus* (Becker), *Tachytrechus analis* (Parent), *Tachytrechus costaricensis* Brooks **sp. nov.**, *Tachytrechus dios* Brooks **sp. nov.**, *Tachytrechus giganteus* (Brooks), *Tachytrechus peruicus* Yang & Zhang, *Tachytrechus transversus* (Van Duzee) and *Tachytrechus zumbadoi* Brooks **sp. nov.** A revised key to species is provided, as well as remarks on the phylogeny and zoogeography of the group.

**Key words:** Dolichopodidae, Dolichopodinae, *Tachytrechus*, Neotropical, new species, key, phylogeny, zoogeography

### Introduction

The *Tachytrechus alatus* species group was originally recognized as the genus *Syntomoneurum* Becker and was placed in the subfamily Hydrophorinae (Becker 1922; Parent 1931, 1934, 1954; Robinson 1970). More recently, *Syntomoneurum* has been classified in the Dolichopodinae (Negrobov 1980; Ulrich 1981; Brooks & Wheeler 2002; Brooks 2005). Brooks & Wheeler (2002) provided evidence supporting Ulrich's hypothesis of a close relationship between *Syntomoneurum* and *Tachytrechus* Haliday, and noted that *Syntomoneurum* may represent a species group within *Tachytrechus*, making the latter paraphyletic. Brooks (2005) verified this prediction and *Syntomoneurum* was accordingly synonymized with *Tachytrechus*.

Following the publication of Brooks & Wheeler's (2002) revision of *Syntomoneurum*, Harold Robinson (in litt.) advised us that *Tachytrechus transversus* (Van Duzee), from Guatemala and Mexico, is also part of this lineage. In addition, we have found three new species belonging to this group, including two from Costa Rica and one from Peru. The *T. alatus* species group now includes eight species. The purpose of this paper is to revise the *T. alatus* species group to incorporate these additional species, provide a new key, and to examine the phylogenetic relationships and possible zoogeographic history of this lineage.

### Material and methods

Specimens examined in this study were obtained from the following collections: Canadian National Collection of Insects, Ottawa, Canada (CNC); Utah State University Insect Collection, Logan, Utah, USA (EMUS);

Instituto Nacional de Biodiversidad, Santo Domingo de Heredia, Costa Rica (INBC); Muséum National d'Histoire Naturelle, Paris, France (MNHN); Staatliches Museum für Tierkunde, Dresden, Germany (SMTD); United States National Museum of Natural History, Washington, DC, USA (USNM); Museum für Naturkunde der Humboldt Universität zu Berlin, Berlin, Germany (ZMHB).

Morphological terminology mainly follows McAlpine (1981) and Cumming & Wood (in press). Terms for male genitalic structures follow Cumming et al. (1995), Sinclair (2000) and Brooks (2005). Body length is measured from the base of the antenna to the tip of abdominal segment 7. Wing length is measured from the humeral crossvein to the wing apex. All available specimens were used to establish body and wing lengths. The relative lengths of each tarsomere are representative ratios expressed using the following formula:  $t_1/t_2/t_3/t_4/t_5$ , where  $t_1$  refers to the basitarsus and  $t_5$  refers to the 5th tarsomere. Macrotrichia are referred to as bristles, setae, setulae, or hairs depending on relative decreasing size.

Male genitalia were macerated in either 10% KOH, which was heated on a hot plate, or in 85% lactic acid heated in a microwave oven. Female terminalia were macerated in 10% KOH, which leaves the sclerites and membranes more pliable than maceration with lactic acid, allowing the telescopic terminalia to be pulled out easily, without causing damage. Terminalia macerated in KOH were subsequently washed in a series of baths (i.e. water, followed by 75% EtOH, followed by acetic acid) in order to stop the clearing action by the KOH solution.

Figures showing the male genitalia in lateral view are oriented as they appear on the intact specimen (rotated 180° and lateroflexed to the right), with the morphologically ventral surface of the genitalia facing up, dorsal surface down, anterior end facing right and posterior end facing left. Figures showing aspects of the male genitalia in ventral view are correspondingly oriented with the anterior end facing right and posterior end facing left.

In the cladistic analysis the outgroups consisted of *Tachytrechus dilaticosta* (Van Duzee) and *T. castus* (Wheeler) (see justification under "Phylogeny and Zoogeographic Considerations"). *Tachytrechus dilaticosta* was used to root the tree. All characters were equally weighted and treated as unordered, and the single multi-state character was treated as non-additive. The character state matrix was analyzed using PAUP\* Version 4.0b10 (Swofford 2002). An exhaustive search was conducted to find the most parsimonious tree, with the parsimony reconstruction option set to collapse branches if the maximum branch length was zero. Character state distribution was examined using MacClade version 4.06 (Maddison & Maddison 2003).

## Systematics

### *Tachytrechus alatus* species group

**Diagnosis.** Vertical bristles strongly reduced in males; face broad; clypeus projected below lower margin of eyes; palpus large; scape setose dorsally and ventrally; males (and females of some species) with white-tipped arista-like stylus; 1–2 notopleural bristles; fore femur (Fig. 10C) and hind basitarsus with strong basiventral bristle; male mid femur with ventral tubercle before middle; pulvilli of mid- and hindlegs very reduced; basiventral surface of fore femur (Fig. 10C) and anterior surface of mid coxa with cluster of 2–3 strong bristles; mid femur with 1 strong anterior preapical bristle; hind femur with 1–3 anterior preapical bristles; male abdominal sternite 5 emarginate and membranous posteriorly with eversible glandular structure usually present; male abdominal tergite 6 bare; male segment 7 pedunculate, bare; hypopygium large; apicoventral epandrial lobe with branched seta; apex of postgonite distally upturned at a right angle and flared laterally, bifurcate with well-developed apicoventral arms; ejaculatory apodeme with basal projection elongate and flexed ventrally; female abdominal tergites 6 and 7 divided medially, tergite 10 of female divided into subtriangular hemitergites, each with inner medial spine.

**Remarks.** The diagnostic features listed above include at least five character states that can be considered synapomorphic for the *T. alatus* species group, namely the reduced vertical bristles in males (state 1.1), strong basiventral bristle on the fore femur (state 4.1), reduced pulvilli on the mid- and hindlegs (state 9.1), and ventral cluster of 2–3 strong bristles on the fore femur (state 5.1) and mid coxa (state 7.1) of males (see “Phylogeny and Zoogeographic Considerations”).

In the *T. alatus* species group the vertical bristles of males are dramatically reduced, such that they are subequal to the uppermost postocular seta in most species. Brooks (2005) noted reduction of vertical setae in some additional species of *Tachytrechus* including *T. laevigatus* (Becker), *T. flabellifer* (Osten Sacken) and *T. seriatus* (Robinson). In some other species of *Tachytrechus* the vertical bristles of males are somewhat weaker than those of females, but they are strong compared to the condition in males of the *T. alatus* species group.

Some undescribed species of the closely related *T. castus* species group (see “Phylogeny and Zoogeographic Considerations”) from Mexico and Costa Rica (USNM, CNC) also possess several long setae on the ventral surface of the fore femur and on the anterior surface of the mid coxa; however, these setae are not consolidated into a distinct cluster as in males of the *T. alatus* species group. One of these undescribed species, which is known from a single male labelled “Mex.” (USNM), also possesses a very weak, hair-like basiventral seta on the fore femur, which is possibly homologous with the strong basiventral bristle observed in the *T. alatus* species group. However, this species possesses strong, straight, parallel vertical setae on the head, indicating it belongs to the *T. castus* group (see “Phylogeny and Zoogeographic Considerations” below).

The large membraneous region on abdominal tergite 5, which was listed as a synapomorphy of the entire *T. alatus* species group in Brooks (2005, character 35), is more difficult to discern when some of the new species and *T. transversus* are taken into account. This character, which is difficult to code into discrete states, is described under each species treatment, but is not included in the group diagnosis and present analysis (see “Phylogeny and Zoogeographic Considerations”). In addition, because the white-tipped arista-like stylus of males of the *T. alatus* species group occurs in males of some species of the *T. flabellifer* species group and in some apparently undescribed species of the *T. castus* species group (EMUS, USNM) (but not *T. dilaticosta* or *T. castus*), it is also excluded from the present analysis.

At present, very little is known about the ecology and habitats of the *T. alatus* species group. Detailed habitat information has only been noted for the type series of *T. giganteus* (Brooks). This species was collected in a wet forest near a pair of narrow (about 30 cm wide) streams a few centimeters deep with overhanging vegetation and streambeds comprising bedrock, boulders, gravel and sand (Brooks & Wheeler, 2002). The *T. alatus* species group has been collected within an elevational range of 150–2000 m.

### Key to species of the *Tachytrechus alatus* species group

1. Two notopleural bristles, posterior bristle sometimes very reduced ..... 2
  - One notopleural bristle ..... 4
2. Palpus with large, stout seta on lower margin (Fig. 8A); face and upper third of clypeus metallic greenish-coppery, abruptly pale yellow on lower part of clypeus; mid tarsus with tarsomere 2 subequal or shorter than basitarsus. Male: clypeus with strong medial carina, lower margin truncate (Fig. 8A); wing with two adjacent costal swellings (Fig. 8B); hypandrium lacking elongate ventral projection and subapical process (Figs. 9C, 9D) (southern Mexico and Guatemala, Fig. 12) ..... *transversus* (Van Duzee)
  - Palpus lacking large, stout seta on lower margin (Figs. 3A, 3B, 10A); face and clypeus not as above; mid tarsus with tarsomere 2 longer than basitarsus. Male: clypeus lacking medial carina, lower margin rounded (Figs. 3A, 10A); wing without costal swelling (Figs. 3C, 10B); hypandrium with elongate ventral projection and lamellate subapical process on right side (Figs. 4A, 4B, 11A, 11B) ..... 3
3. M with distinct S-shaped bend; R<sub>4+5</sub> and M subparallel in distal portion (Figs. 3C, 3D); tibiae and tarsi

- mainly dark; upper part of face metallic greenish or bluish, lower part of face and clypeus silvery. Male: wing membrane unevenly infuscated (Fig. 3C); fore tibia mainly dark, apex slightly swollen with silvery anterodorsal patch; male fore tarsomeres 2 and 3 enlarged with anterior surface bare and silvery (Fig. 3E) (northern Costa Rica, Fig. 12) ..... *costaricensis* Brooks **sp. nov.**
- M with weak sinuous bend;  $R_{4+5}$  and M slightly converging distally (Fig. 10B); tibiae and basal part of tarsi pale; face and clypeus brownish. Male: wing membrane evenly infuscated (Fig. 10B); fore tibia pale, apex unmodified; fore tarsomeres 2 and 3 not as above, tarsomere 2 with anterodorsal row of long curved hairs (Fig. 10D) (southern Costa Rica, Fig. 12) ..... *zumbadoi* Brooks **sp. nov.**
4. M with two 90° bends (Figs. 1A, 1B);  $R_{2+3}$  of male very short, ending at costa before midpoint of wing; crossvein dm-cu of male close to wing base, well before midpoint of wing (Fig. 1A); crossvein dm-cu of female just before midpoint of wing, slightly shorter than distal part of  $CuA_1$  (Fig. 1B); right basiventral epandrial lobe with prominent basal projection; hypandrium with a pair of sickle-shaped projections on right margin just beyond middle (Fig. 1C) (Peru, Fig. 13) ..... *alatus* (Becker)
    - Bends in M obtuse;  $R_{2+3}$  of male ending at costa well beyond midpoint of wing; crossvein dm-cu at or slightly beyond midpoint of wing in both sexes, longer than distal part of  $CuA_1$  (Figs. 2A, 5A, 6A, 6B, 7A, 7B); right basiventral epandrial lobe lacking prominent basal projection; hypandrium either lacking pair of sickle-shaped projections on right margin (Figs. 2B, 6D, 7C), or with single elongate sickle-like projection near middle and lamellate subapical process both on right side (Figs. 5C, 5E)..... 5
  5. M with weak sinuous bend;  $R_{4+5}$  and M convergent distally (Figs. 6A, 6B); hind femur dark metallic green; larger flies (body length 7.9–8.5 mm, wing length 10–11 mm). Male: wing with elongate costal swelling (Fig. 6A); clypeus parallel sided and truncate below (Fig. 6C); hind femur with 2–3 preapical bristles; right and left basiventral epandrial lobes greatly elongated, symmetrical, curved and tapered distally; apicoventral epandrial lobe short, projected posteriorly (Fig. 6E); cercus round (Colombia, Fig. 13) ..... *giganteus* (Brooks)
    - M with pronounced S-shaped bend;  $R_{4+5}$  and M subparallel distally (Figs. 2A, 5A, 7A, 7B); hind femur mainly or entirely pale; smaller flies (body length 5.0–5.7 mm, wing length 5.1–5.8 mm). Male: wing lacking costal swelling; clypeus rounded below; hind femur with 1 preapical bristle; right and left basiventral epandrial lobes relatively short, asymmetrical with right lobe more developed; apicoventral epandrial lobe elongate, projected ventrally (Figs. 2C, 5C, 5D, 7D); cercus subrectangular (Fig. 5D) ..... 6
  6. Male fore tarsus with tarsomeres 4 and 5 enlarged (Fig. 5B); hypandrium with lamellate process subapically on right side, with lamellate process along left lateral margin, and with elongate sickle-like projection near middle on right side (Figs. 5C, 5E) (Peru, Fig. 13) ..... *dios* Brooks **sp. nov.**
    - Male fore tarsus with tarsomeres 4 and 5 not enlarged; hypandrium not as above, simple, at most with weak dentiform projection on right margin (Figs. 2B, 7C) ..... 7
  7. Face mainly metallic green. Male: basitarsus of foreleg with weak silvery reflections anteriorly, basitarsus and tarsomere 2 with curved setae ventrally; M and  $CuA_1$  not thickened basally (Fig. 2A); apicoventral epandrial lobe extremely well-developed with pointed apex, medial seta positioned near base, lateral seta near middle (Fig. 2C); hypandrium wide, right margin with dentiform projection (Fig. 2B) (Colombia, Fig. 13)..... *analis* (Parent)
    - Face mainly brownish with weak silvery-green reflections. Male: fore tarsus distinctly silvery anteriorly, basitarsus lacking curved ventral setae; M and  $CuA_1$  thickened in basal section (Fig. 7A); apicoventral epandrial lobe with blunt apex bearing medial and outer setae (Fig. 7D); hypandrium narrow, right margin lacking projection (Fig. 7C) (Peru, Fig. 13) ..... *peruicus* Yang & Zhang

### ***Tachytrechus alatus* (Becker)**

(Figs. 1, 13)

*Syntomoneurum alatum* Becker 1922: 124.

*Tachytrechus alatus* (Becker): Brooks 2005: 121.

**Diagnosis.** Body length 6.4–7.1 mm, wing length 6.6 mm–7.5 mm; face and clypeus coppery with green reflections; clypeus rounded below; 1 notopleural bristle; male fore tarsus with basal three-quarters of basitarsus and tarsomeres 3–5 flattened and silvery on anterior surface; hind femur mainly yellow with 1 anterior preapical bristle; M with two 90° bends;  $R_{4+5}$  and M parallel distally (Figs. 1A, 1B); male wing with two adjacent swellings of the costa immediately proximal to insertion of  $R_1$ ,  $R_{2+3}$  very short, ending at costa before midpoint of wing, crossvein dm-cu close to wing base (Fig. 1A); female wing with  $R_{2+3}$  ending beyond midpoint of wing, crossvein dm-cu slightly before midpoint of wing (Fig. 1B); abdominal tergite 5 of male with large posterior membranous region, extended laterally as broad band to ventral margin of sclerite; hypopygium (Figs. 1C, 1D): right basiventral epandrial lobe with rounded basal projection and subquadrate inner distal projection, left basiventral epandrial lobe weakly developed; apicoventral epandrial lobe moderately developed, subquadrate in lateral view, short, projected posteriorly; accessory epandrial process present medial to apicoventral epandrial lobe; ventral surstylar lobe with series of parallel diagonal ridges on ventral surface; apicoventral arm of postgonite with medial process present, apex with hook-like process; cercus subquadrate in dorsal view, apical and lateral margin dark; right margin of hypandrium with pair of sickle-shaped projections; phallus with weakly sclerotized fin-like projection near middle. Female sternite 8 undivided, lacking medial invagination.

**Type material examined.** Lectotype ♂, PERU: Pasco, road to Rio Pichis, 300–700 m, 4.i.1904, C.A.W. Schnuse (ZMHB). Paralectotypes, 1 ♂ and 4 ♀ (SMTD), 1 ♀ (ZMHB) all from same locality as holotype.

**Distribution.** *Tachytrechus alatus* is known only from the type locality near the Rio Pichis in Peru (Fig. 13).

### ***Tachytrechus analis* (Parent)**

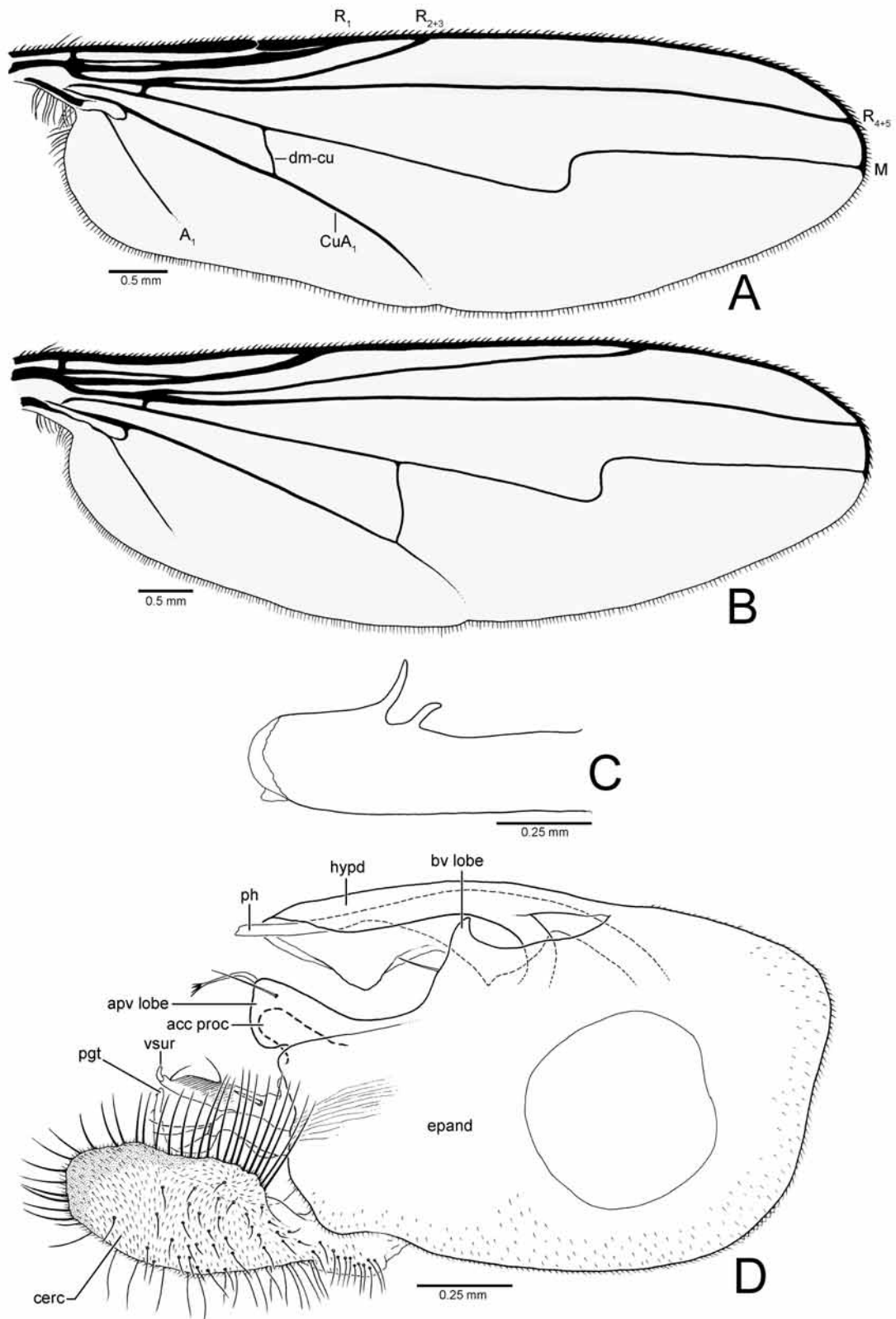
(Figs. 2, 13)

*Syntomoneurum anale* Parent 1954: 226.

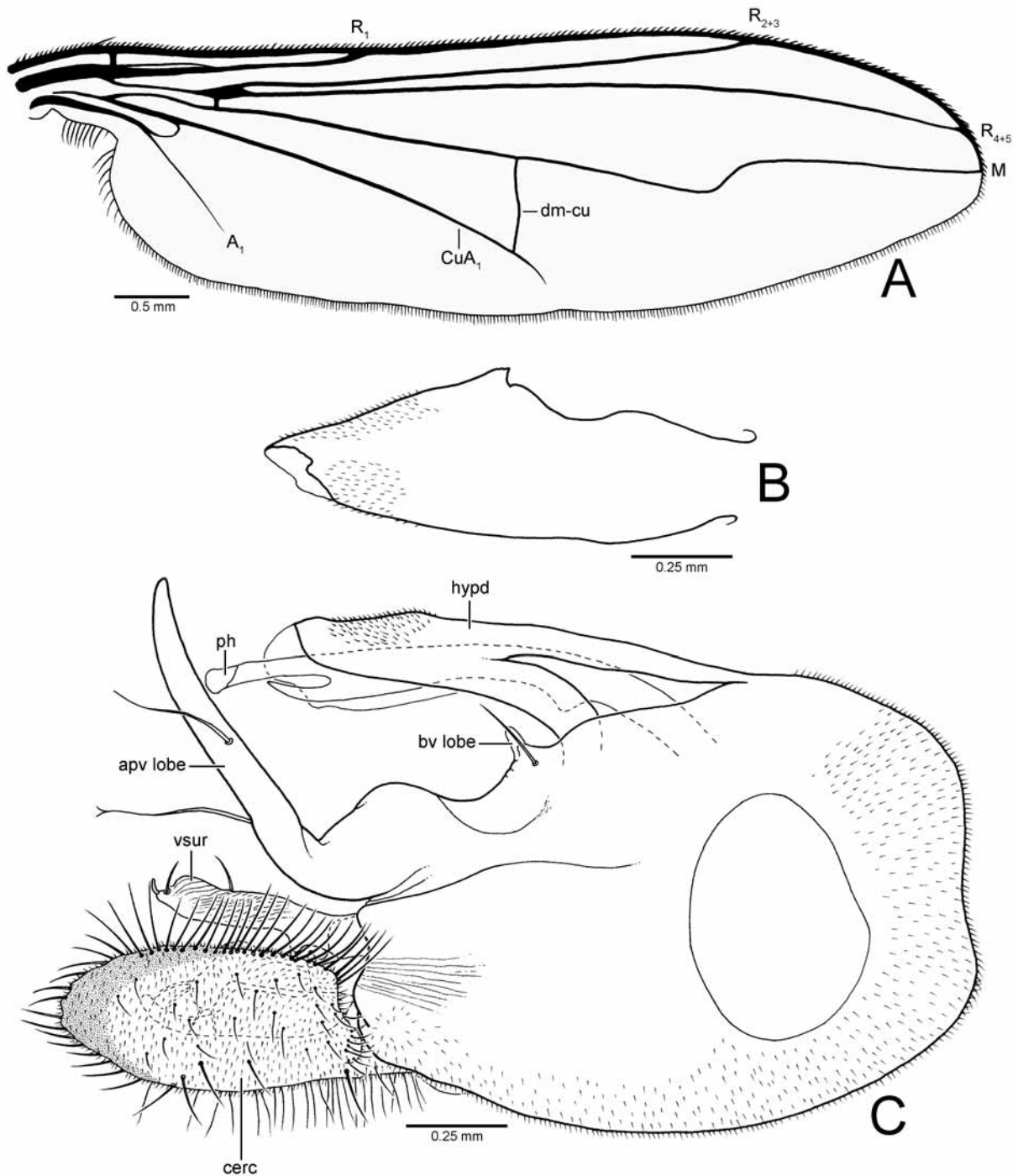
*Syntormoneurum anale*, misspelling by Parent 1954: 226.

*Tachytrechus analis* (Parent): Brooks (2005): 121.

**Diagnosis. Male.** Body length 5.7 mm, wing length 5.8 mm; face mainly metallic green with brownish background coloration; clypeus rounded below; 2 notopleural bristles; fore tarsus with weak silvery reflections anteriorly, basitarsus and tarsomere 2 with curved setae ventrally; hind femur mainly yellow with 1 anterior preapical bristle; wing (Fig. 2A) lacking costal swelling;  $R_{2+3}$  ending at costa well beyond midpoint of wing; bends in M distinct, obtuse;  $R_{4+5}$  and M subparallel distally; abdominal tergite 5 with large posterior membranous region, extended laterally as broad band to ventral margin of sclerite; hypopygium (Figs. 2B, 2C): right and left basiventral epandrial lobe very weakly developed; apicoventral epandrial lobe extremely well-developed, long, digitiform, projected ventrally, with medial seta positioned near base, lateral seta near middle; accessory epandrial process absent; apicoventral arm of postgonite with medial process present, apex with hook-like process; cercus subrectangular in dorsal view, longer than wide, apical and lateral margin dark; hypandrium wide, asymmetrical in ventral view, right margin with dentiform projection; ventral surstylar lobe with series of parallel diagonal ridges on ventral surface; phallus with weak projection near middle and elongate, digitiform projection subapically.



**FIGURE 1.** *Tachytrechus alatus* (Becker): (A) male wing; (B) female wing; (C) hypandrium (ventral view); (D) hypopygium (left lateral view). Adapted from Brooks & Wheeler (2002). Abbreviations:  $A_1$ : anal vein; acc proc: accessory epandrial process; apv lobe: apicoventral epandrial lobe; bv lobe: basiventral epandrial lobe; cerc: cercus;  $CuA_1$ : 1<sup>st</sup> anterior branch of cubital vein; dm-cu: discal medial-cubital crossvein; epand: epandrium; hypd: hypandrium; M: medial vein; pgt: postgonite; ph: phallus;  $R_1$ : 1<sup>st</sup> radial vein;  $R_{2+3}$ : 2<sup>nd</sup> + 3<sup>rd</sup> radial vein;  $R_{4+5}$ : 4<sup>th</sup> + 5<sup>th</sup> radial vein; vsur: ventral lobe of surstylus.



**FIGURE 2.** *Tachytrechus analis* male (Parent): (A) wing; (B) hypandrium (ventral view); (C) hypopygium (left lateral view). Adapted from Brooks & Wheeler (2002). Abbreviations:  $A_1$ : anal vein; apv lobe: apicoventral epandrial lobe; bv lobe: basiventral epandrial lobe; cerc: cercus;  $CuA_1$ : 1<sup>st</sup> anterior branch of cubital vein; dm-cu: discal medial-cubital crossvein; hypd: hypandrium; M: medial vein; ph: phallus;  $R_1$ : 1<sup>st</sup> radial vein;  $R_{2+3}$ : 2<sup>nd</sup> + 3<sup>rd</sup> radial vein;  $R_{4+5}$ : 4<sup>th</sup> + 5<sup>th</sup> radial vein; vsur: ventral lobe of surstylus.

**Female:** Unknown.

**Type material examined.** Holotype ♂, COLOMBIA: Boyaca, Muzo, 900 m, 1936, J. Bequaert (MNHN).

**Distribution.** *Tachytrechus analis* is known only from the type locality in Muzo, Colombia (Fig. 13).

***Tachytrechus costaricensis* Brooks sp. nov.**

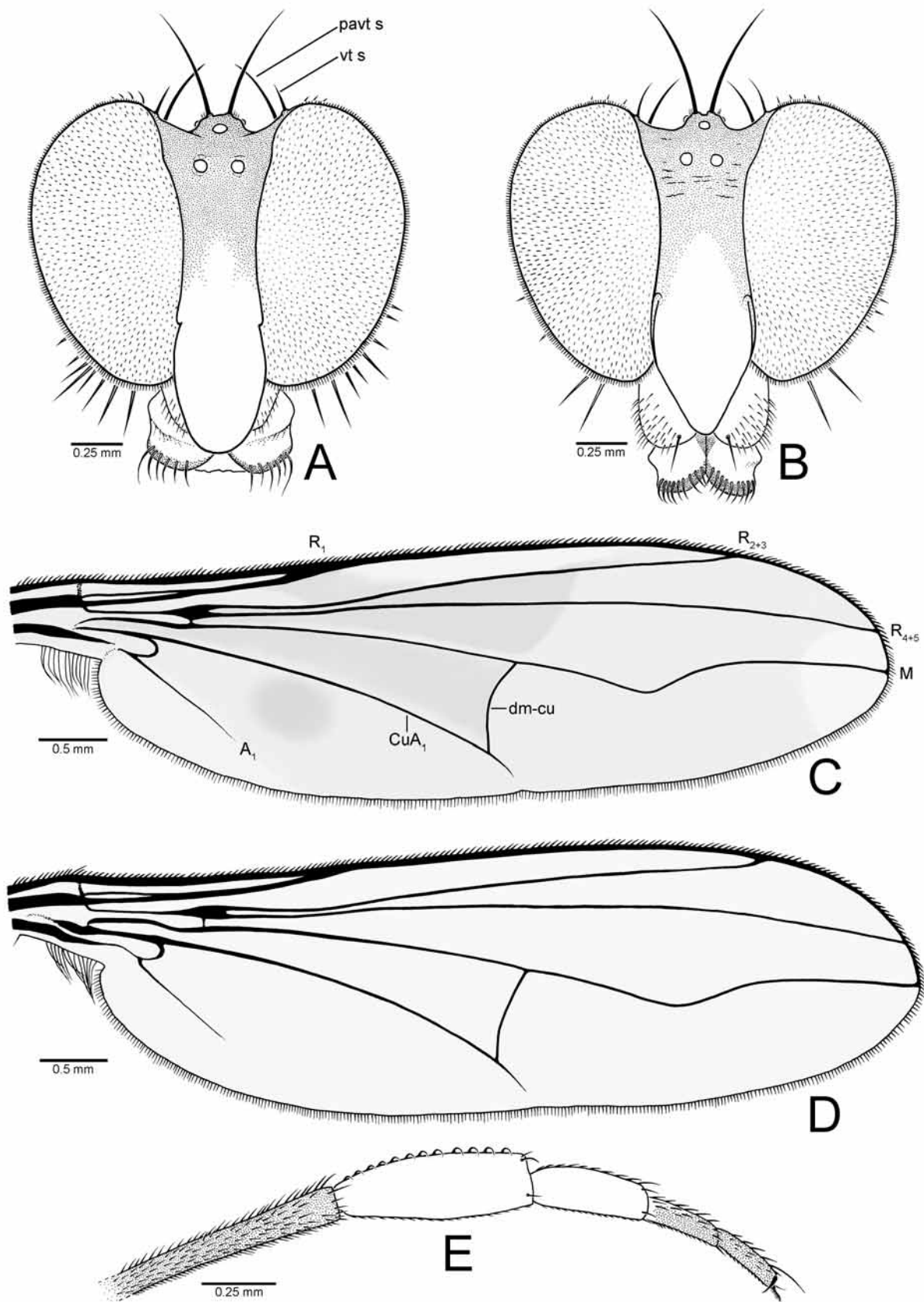
(Figs. 3, 4, 12)

**Diagnosis.** Upper part of face metallic greenish or bluish, lower part of face and clypeus silvery; 2 notopleural bristles;  $R_{4+5}$  and M subparallel in distal portion (Figs. 3C, 3D), male wing membrane unevenly infuscated and lacking costal swelling (Fig. 3C); tibiae and tarsi mainly dark; male fore tibia slightly swollen apically with silvery anterodorsal patch, male fore tarsomeres 2 and 3 enlarged with anterior surface bare and silvery (Fig. 3E); tarsomere 2 of midleg longer than basitarsus; hypandrium with elongate ventral projection and lamellate subapical process on right side (Figs. 4A, 4B).

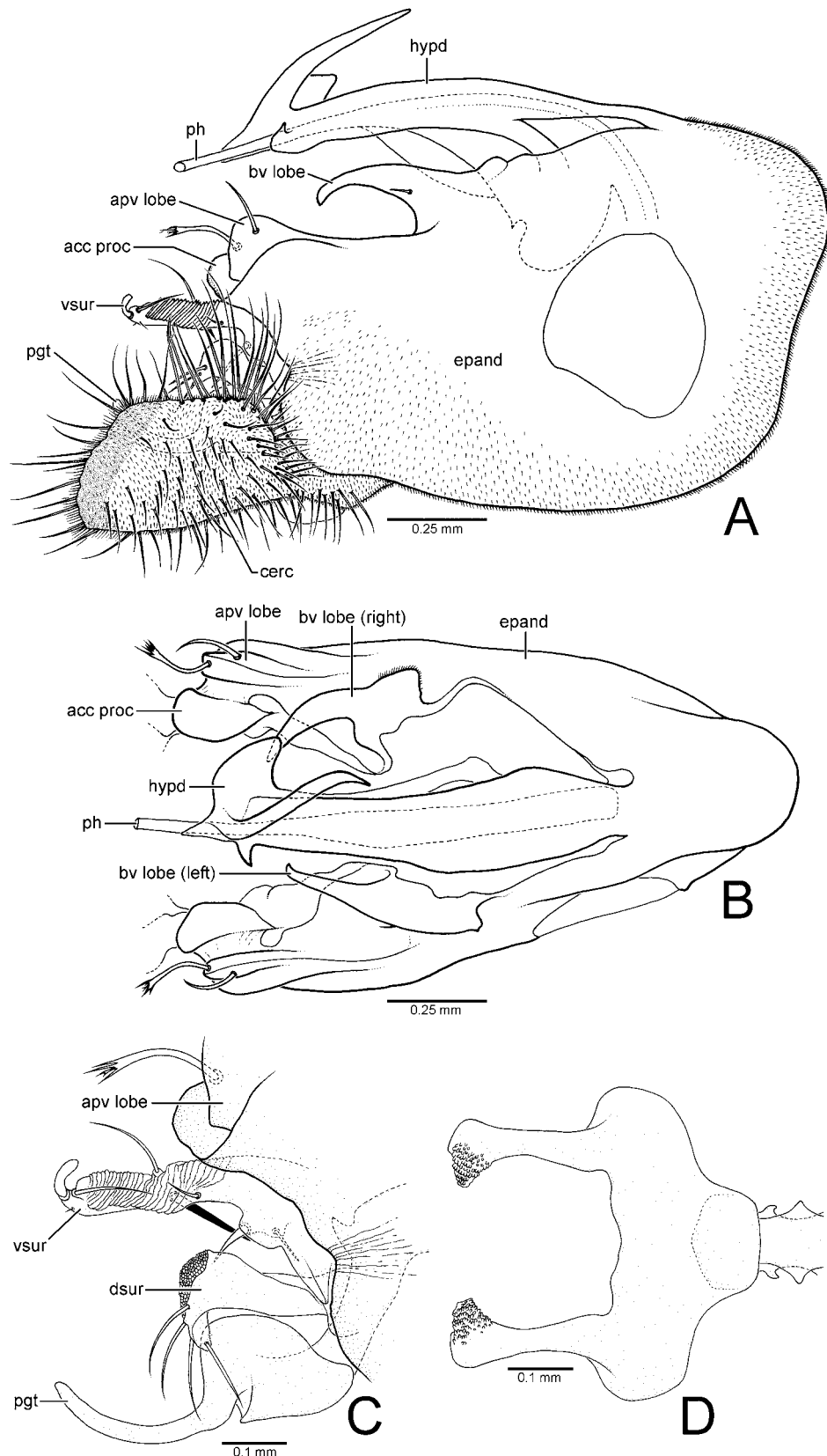
**Description. Male:** Body length: 6.8–7.0 mm, wing length: 6.2–6.4 mm.

**Head** (Fig. 3A): Vertex distinctly excavated, vertical bristle weak and short, less than half as long as paravertical bristle, subequal to upper postocular seta, pair of strong ocellar bristles, pair of strong paravertical bristles. Postoculars mainly white, becoming stronger ventrally, upper five postoculars black, short. Frons dark metallic green with bronze reflections. Upper part of face metallic blue with bronze reflections, weakly metallic green medially, lower part of face and clypeus silvery, clypeus broadly rounded below. Palpus brown with pale yellow margin, ground color obscured by silvery pruinosity at certain angles, with pale hairs, with or without distinct apical seta. Antenna: Scape subtriangular in lateral view, laterally compressed, blackish dorsally, brownish ventrally, about 0.7x as long as pedicel and postpedicel combined; pedicel blackish; postpedicel mainly blackish, ovoid, about 1.6x as long as wide; arista-like stylus subapical, black with white apex, about 3.6x as long as postpedicel, basal article about 0.1x as long as distal article. **Thorax:** Notum metallic greenish-blue with coppery reflections, with metallic blue-violet vitta lateral to acrostichals, with grayish pruinosity anteriorly, lateral margin mainly dark bronze; acrostichals biserial, 6 dorsocentrals, 1 presutural, 1 sutural, 2 supraalars, 1 postalar, 1 posthumeral, 1 postpronotal bristle with 1–2 weaker setae, 2 notopleural bristles, posterior bristle weak. Pleuron with silvery pruinosity, metaepisternum bare. Scutellum greenish-blue with coppery reflections, with strong inner bristle and weak outer seta. **Legs:** Fore coxa yellow, mid coxa mainly dark with pale apex, with silvery pruinosity, hind coxa mainly dark on outer surface with silvery pruinosity, anterior surface pale; femora dark metallic greenish or blackish dorsally, yellow ventrally; tibiae mainly dark brown or dark metallic green, paler ventrally; tarsi dark, fore tarsus with tarsomeres 2–3 modified (see below). **Foreleg:** Coxa with pale pile and weak setae, silvery-white at certain angles, apical margin with 2 strong outer and 4–5 weak inner setae; femur with distinct tubercle behind basal cluster of 2 strong bristles, posterior preapical seta present; tibia with 1–2 anterodorsal setae, 1–2 posterodorsals, 2 apicals, apex swollen with silvery anterodorsal patch; tarsus slightly longer than tibia, tarsomeres 2 and 3 enlarged with anterior surface bare and silvery (Fig. 3E), tarsomere 2 with anterodorsal row of curved setae, tarsomere ratio: 4.1/3.1/2.0/1.1/1.0. **Midleg:** Coxa with row of 2–3 weak black setae medial to cluster of 3 strong bristles; femur with distinct tubercle on ventral surface proximal to mid-length, 1 strong anterior preapical bristle, tibia with 3–4 anterodorsal setae, 3 posterodorsals, 3 ventrals, 4 apicals; tarsus 1.5x longer than tibia, tarsomere ratio: 6.2/7.8/2.1/1.0/1.4. **Hindleg:** Femur with 1 strong anterodorsal preapical bristle; tibia with 4 anterodorsal setae, 2–3 posterodorsals, 5–7 ventrals, 1 preapical dorsal, 2 apicals, with dentiform posteroapical process; tarsus about 1.3x longer than tibia, with hook-shaped posterobasal process opposite apical dentiform process of tibia, tarsomere ratio: 4.4/9.1/2.5/1.0/1.3. **Wing** (Fig. 3C): Veins dark brown, membrane unevenly infuscated; costa unmodified, without costal swelling; M with S-shaped bend;  $R_{4+5}$  and M subparallel in distal part; crossvein dm-cu near midpoint of wing, longer than distal section of  $CuA_1$ . Calypter with black setae. **Abdomen:** Tergites 1–5 metallic green with coppery reflections, with silvery pruinosity laterally, posterior margin of tergites dark brown; tergite 5 with large posterior membranous region, extended laterally as broad band to ventral margin of sclerite; sternite 5 with eversible glandular structure; tergite 6 blackish with metallic green reflections; segment 7 dark brown; sternite 8 subtriangular with several long setae near posterior margin, largely covered with silvery pruinosity, dull metallic blue basally. **Hypopygium** (Figs. 4A, 4B): Epandrium black with





**FIGURE 3.** *Tachytrechus costaricensis* Brooks **sp. nov.**: (A) male head; (B) female head; (C) male wing; (D) female wing; (E) male foretarsus (anterior view). Abbreviations: A<sub>1</sub>: anal vein; CuA<sub>1</sub>: 1<sup>st</sup> anterior branch of cubital vein; dm-cu: discal medial-cubital crossvein; M: medial vein; pavt s: paraverticilar seta; R<sub>1</sub>: 1<sup>st</sup> radial vein; R<sub>2+3</sub>: 2<sup>nd</sup> + 3<sup>rd</sup> radial vein; R<sub>4+5</sub>: 4<sup>th</sup> + 5<sup>th</sup> radial vein; vt s: vertical seta.



**FIGURE 4.** *Tachytrechus costaricensis* Brooks **sp. nov.** hypopygium: (A) left lateral view; (B) ventral view (postgonite, surstylus and cerci not shown); (C) surstylus, postgonite and apical margin of epandrium (left lateral view); (D) postgonite (dorsal view). Abbreviations: acc proc: accessory epandrial process; apv lobe: apicoventral epandrial lobe; bv lobe: basiventral epandrial lobe; cerc: cercus; dsur: dorsal lobe of surstylus; epand: epandrium; hypd: hypandrium; pgt: postgonite; ph: phallus; vsur: ventral lobe of surstylus.

metallic green-blue reflections; basiventral epandrial lobe elongate, digitiform, pointed apically, with basiventral protuberance, seta present, near base of lobe; apicoventral epandrial lobe short, projected posteriorly, ventral margin rounded, posterodorsal margin truncate, with pair of pale setae, medial seta branched apically; accessory epandrial process present medial to apicoventral epandrial lobe. Surstylus (Fig. 4C): Ventral lobe digitiform, slightly flattened dorsoventrally, with ridged ventral surface, apex with blunt curved seta; dorsal lobe about half as long as ventral lobe, flared apically, apex with setae laterally and rugose membranous portion medially. Apicolateral arm of postgonite (Figs. 4C, 4D) lacking medial process, apex expanded and granulated. Cercus pale yellow with dark apical margin, subquadrate in dorsal view, lateral margin with long setae. Hypandrium with lamellate lateroventral process subapically on right side and elongate claw-like projection ventrally (Figs. 4A, 4B). Phallus simple, tubular in distal part, widened in middle section with acute dorsal projection (Fig. 4A).

**Female:** Body length: 6.6–6.8 mm, wing length: 6.0–6.6 mm. Similar to male except as follows: **Head:** Vertical bristle stronger, subequal to paravertical (Fig. 3B); upper part of face dull metallic green-bronze; clypeus acutely rounded below (Fig. 3B); tip of stylus whitish, but not as pronounced as in male. **Thorax:** Metaepisternum sometimes with 1 weak hair. **Legs:** *Foreleg:* Femur lacking ventral tubercle and associated cluster of bristles; tibia with 2–4 anterodorsal setae, sometimes with 1–2 weak posterior setae, apex only slightly enlarged, lacking silvery anterodorsal patch; tarsomeres 2 and 3 unmodified, dark, tarsomere 2 lacking curved setae anterodorsally. *Midleg:* Setation of coxa similar to male but weaker; femur lacking ventral tubercle. *Hindleg:* Tibia lacking dentiform posteroapical process; tarsus lacking hook-shaped posterobasal process. **Wing** (Fig. 3D): Membrane evenly infuscated, brownish. **Abdomen:** Tergites 1–5 subrectangular, metallic green with coppery and violet reflections, with silvery pruinosity laterally, posterior margin of tergites dark; sternites brownish-black, tergite 1 very short, band-like, tergites 2–5 subrectangular; tergites 6 and 7 wider than long, divided medially into subquadrate halves, sternites 6 and 7 smaller, undivided, sternite 7 broadly V-shaped; tergite 8 divided medially, narrowly connected to sternite 8 anterolaterally, sternite 8 undivided, lacking deep medial invagination; tergite 10 divided into subtriangular hemitergites, each with 3–5 spines.

**Type material.** Holotype ♂, COSTA RICA: Guanacaste, Estación Maritza, west side of Volcan Orosi, II curso Parataxonomos, August 1990, L-N-326900, 373000, INBIO CRI000 253845 (INBC). Paratypes, 1 ♂ with same data as holotype; 1 ♂ and 7 ♀, COSTA RICA: Alajuela, Rio San Lorencito, 900 m, R.F. San Ramón, 5 km N of Colonia Palmareña, 13–18.vi.1993, I curso Scarabaeidae, L-N-244500, 470700 (INBC).

**Distribution.** *Tachytrechus costaricensis* is known from the type locality near Volcan Orosi, Guanacaste, and from Alajuela, along the Rio San Lorencito, Costa Rica (Fig. 12).

**Etymology.** The new species name is derived from the country of the type locality.

**Remarks.** The holotype male and the two male paratypes are quite badly damaged.

### *Tachytrechus dios* Brooks sp. nov.

(Figs. 5, 13)

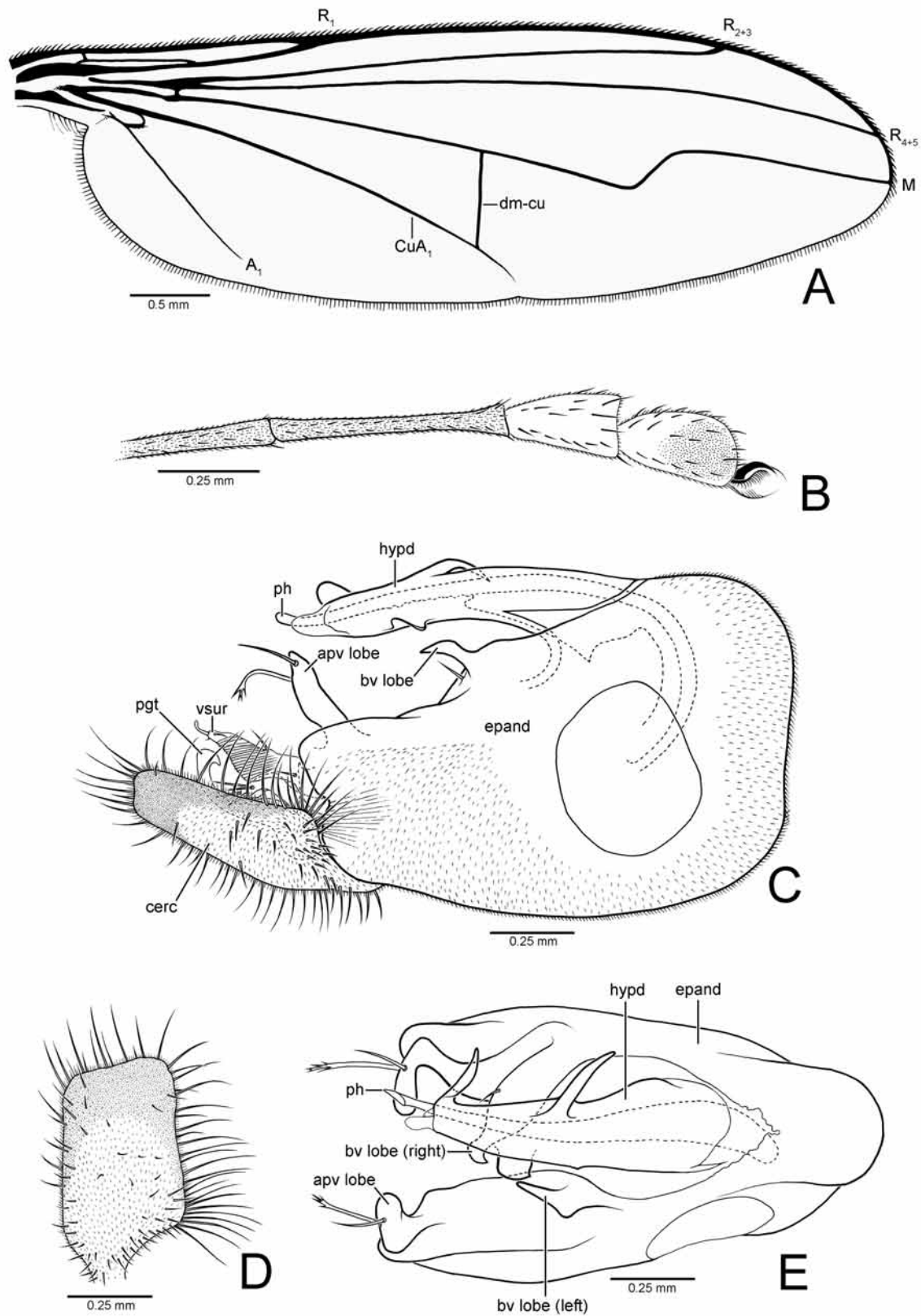
**Diagnosis. Male.** One notopleural bristle; M with pronounced S-shaped bend;  $R_{4+5}$  and M subparallel distally (Fig. 5A); wing lacking costal swelling; fore tarsus with tarsomeres 4 and 5 enlarged (Fig. 5B); hind femur mainly or entirely pale; right and left basiventral epandrial lobes relatively short, asymmetrical with right lobe more developed; apicoventral epandrial lobe elongate, projected ventrally (Figs. 5C, 5D); cercus subrectangular (Fig. 5D); hypandrium with lamellate process subapically and on left lateral margin, elongate sickle-like projection near middle on right side (Figs. 5C, 5E).

**Description. Male:** Body length: 5.0 mm, wing length: 5.1 mm. **Head:** Vertex distinctly excavated, vertical bristle weak and short, less than half as long as paravertical bristle, subequal to upper postocular seta, pair

of strong ocellar bristles, pair of strong paravertical bristles. Postoculars mainly white, becoming stronger ventrally, upper 4–5 postoculars black, short. Frons blackish with metallic blue reflections. Face broad, narrowest at middle. Face and upper part of clypeus dark metallic greenish-brown, margin and lower part of clypeus golden yellow, clypeus rounded below. Palpus white with pale hairs and a distinct black apical seta. Antenna: Scape subtriangular in lateral view, laterally compressed, dark brown dorsally, yellowish ventrally, about 0.5x as long as pedicel and postpedicel combined; pedicel yellowish; postpedicel yellow basally, blackish on apical 2/3 on lateral surface, more extensively blackish on medial surface, ovoid with narrowed apex, about 1.7x as long as wide; arista-like stylus subapical, black, white at extreme tip, about 3x as long as postpedicel, basal article about 0.1x as long as distal article. **Thorax:** Notum metallic green with coppery reflections, with black medial vitta with metallic blue margin, silvery pruinosity anteriorly and laterally; acrostichals biserial, 6 dorsocentrals, 1 presutural, 1 sutural, 2 supraalars, 1 postalar, 1 posthumeral, 1 postpronotal, 1 notopleural bristle (see Remarks). Scutellum metallic green with strong inner bristle and weak outer seta. Pleuron with silvery pruinosity, metaepisternum with 1–2 weak hairs. **Legs:** Fore coxa yellow, mid and hind coxae brownish with silvery pruinosity; femora mainly yellow, posterodorsal surface of fore and mid femur dark with metallic reflections; tibiae yellow; tarsi yellowish basally, becoming brownish from apical portion of tarsomere 2 onwards, tarsomeres 4–5 modified (see below). *Foreleg:* Coxa with pale pile and weak setae, apical margin with 2 strong outer and several weak inner setae; femur with distinct tubercle behind basal cluster of 2 strong bristles, posterior preapical seta present; tibia with 3 dorsal setae, 2 posteriors and 2 apicals; tarsus longer than tibia, tarsomeres 4–5 enlarged (Fig. 5B), tarsomere 4 and base of 5 pale, distal portion of tarsomere 5 dark brown, tarsomere ratio: 2.5/1.9/1.8/1.0/1.0. *Midleg:* Femur with distinct tubercle on ventral surface proximal to mid-length, 1 strong anterior preapical bristle, 1 distinct posteroventral preapical seta; tibia with 4 anterodorsal setae, 1 posterodorsal in basal portion, 2 dorsals, 2–3 ventrals, 4 strong apicals; tarsus 1.5x longer than tibia, tarsomere ratio: 6.0/6.5/2.5/1.0/1.3. *Hindleg:* Femur with 1 strong anterodorsal preapical bristle; tibia with 3 anterodorsal setae, 3 posterodorsals, 1 preapical dorsal, 2 apicals, with dentiform posteroapical process; tarsus about 1.4x longer than tibia, with hook-shaped posterobasal process opposite weak apical dentiform process of tibia, tarsomere ratio: 4.3/7.6/3.0/1.0/1.2. **Wing** (Fig. 5A): Veins dark brown, membrane with gray tinge; costa unmodified, without swelling; M with two strong obtuse bends in distal half;  $R_{4+5}$  and M parallel distally; crossvein dm-cu at midpoint of wing, longer than distal section of  $CuA_1$ . Calypter with black setae. **Abdomen:** Tergites 1–5 metallic green with coppery reflections, with silvery pruinosity laterally, posterior margin of tergites coppery; tergite 5 with large posterior membranous region, extended laterally towards ventral margin of sclerite; sternite 5 with eversible glandular structure (retracted in holotype); tergite 6 and segment 7 coppery brown with silvery pruinosity; sternite 8 silvery pruinose with a few long setae near posterior margin. *Hypopygium* (Figs. 5C, 5D): Epandrium brownish-metallic green; left basiventral epandrial lobe short, pointed apically, seta present adjacent to base of lobe, right basiventral epandrial lobe larger, projected medially, tapered towards apex, apex slightly expanded and hooked, seta present near middle of lobe; apicoventral epandrial lobe elongate, projected ventrally, laterally flattened, with pair of pale setae, right lobe longer than left lobe; accessory epandrial process absent. Surstylus: Ventral lobe digitiform, flattened dorsoventrally, with ridged ventral surface, apex with blunt curved seta; dorsal lobe about half as long as ventral lobe, flared apically, apex with several setae laterally and rugose membranous portion medially. Apicolateral arm of postgonite with medial process present, with hook-like process apically. Cercus (Fig. 5D) subrectangular in dorsal view, pale yellow with apical and lateral margin black, lateral margin with long setae. Hypandrium (Fig. 5E) narrowed apically, with subapical lamellate process on right lateral margin, with lamellate process along left lateral margin, and with elongate lateroventral sickle-like projection near middle on right side. Phallus simple, tubular in distal part, with fin-like dorsal projection in middle section (Fig. 5C).

**Female:** Unknown.

**Type material.** Holotype ♂, PERU: Madre de Dios, Avispas, 10–20.ix.1962, 400 m, L. Peña (CNC).



**FIGURE 5.** *Tachytrechus dios* Brooks **sp. nov.**: (A) male wing; (B) apical part of male foretarsus; (C) hypopygium (left lateral view); (D) cercus (dorsal view); (E) hypopygium ventral view (postgonite, surstylus and cerci not shown). Abbreviations: A<sub>1</sub>: anal vein; apv lobe: apicoventral epandrial lobe; bv lobe: basiventral epandrial lobe; cerc: cercus; CuA<sub>1</sub>: 1<sup>st</sup> anterior branch of cubital vein; dm-cu: discal medial-cubital crossvein; epand: epandrium; hypd: hypandrium; M: medial vein; pgt: postgonite; ph: phallus; R<sub>1</sub>: 1<sup>st</sup> radial vein; R<sub>2+3</sub>: 2<sup>nd</sup> + 3<sup>rd</sup> radial vein; R<sub>4+5</sub>: 4<sup>th</sup> + 5<sup>th</sup> radial vein; vsur: ventral lobe of surstylus.

**Distribution.** (Fig. 13). *Tachytrechus dios* is known only from the type locality of Avispas, Peru.

**Etymology.** The new species name is derived from Madre de Dios, the Peruvian Department of the type locality.

**Remarks.** Most of the thoracic bristles of the unique male holotype are missing. As such, chaetotaxy was assessed based on the setal sockets.

### ***Tachytrechus giganteus* (Brooks)**

(Figs. 6, 13)

*Syntomoneurum giganteum* Brooks in Brooks and Wheeler 2002: 321.

*Tachytrechus giganteus* (Brooks): Brooks (2005).

**Diagnosis.** Large; body length 7.6–8.5 mm, wing length 10–11 mm; male face silvery, strongly depressed with vertical median line in male; female face dull metallic green with grey sides; male clypeus parallel sided and truncate below (Fig. 6C); 1 notopleural bristle; male fore tarsus unmodified; hind femur dark metallic green, male with 2–3 anterior preapical bristles, female with 1–2 anterior preapical bristles; M with weak obtuse, sinuous bend in distal half;  $R_{4+5}$  and M convergent distally (Figs. 6A, 6B); male wing with elongate costal swelling along middle third (Fig. 6A) extended to insertion point of  $R_{2+3}$ , anterior margin of costal swelling with very fine setae; abdominal tergite 5 of male with large posterior membranous region, extended laterally towards ventral margin of sclerite; hypopygium (Figs. 6D, 6E): basiventral epandrial lobe well-developed, elongate, curved and tapered apically; apicoventral epandrial lobe weakly developed with rounded apex, short, projected posteriorly; accessory epandrial process absent; ventral surstylar lobe with denticulate ventral surface; apicolateral arm of postgonite with medial process present, apex rounded, unmodified; cercus rounded in dorsal view with strong, black setae on apical margin, margin not darkened; hypandrium asymmetrical in ventral view, rugose dorsolaterally; middle third of phallus with weak dentiform projection proximally and rounded fin-like projection distally. Female sternite 8 undivided, heavily sclerotized, with deep medial invagination.

**Type material examined.** Holotype ♂, COLOMBIA: Antioquia, 10 km East of Medellin on road to Las Palmas, 2000 m, 21.ii.1984, C.M. & O.S. Flint, Jr. Paratypes, 1♂ and 2♀, from same locality as holotype (USNM).

**Other material examined.** 1♂, 2♀ same data as holotype (USNM).

**Distribution.** This species is known only from the type locality near Medellin, Colombia (Fig. 13).

### ***Tachytrechus peruicus* Yang & Zhang**

(Figs. 7, 13)

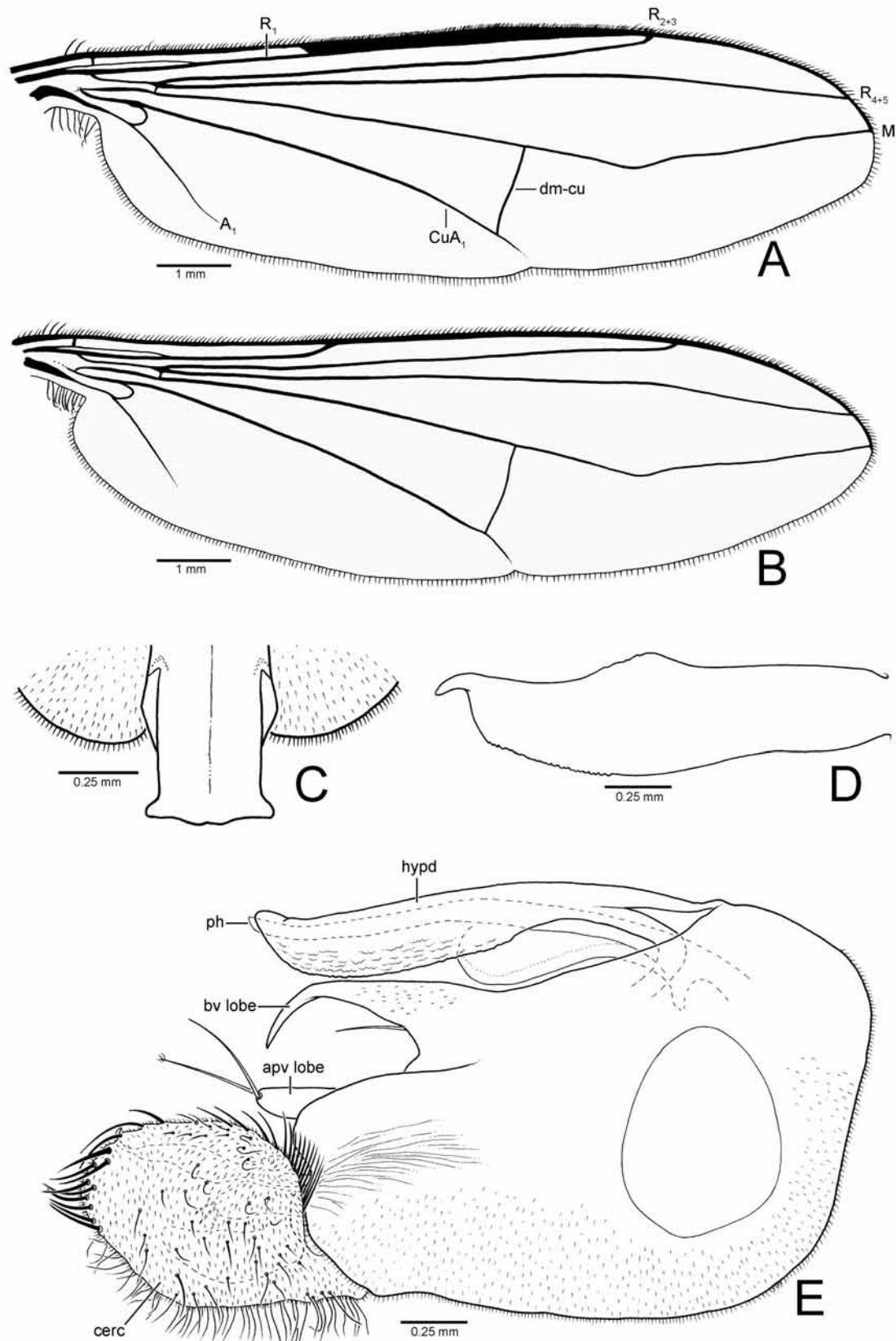
*Syntomoneurum beckeri* Parent 1931: 17.

*Syntormoneurum beckeri*, misspelling by Parent 1931: 17.

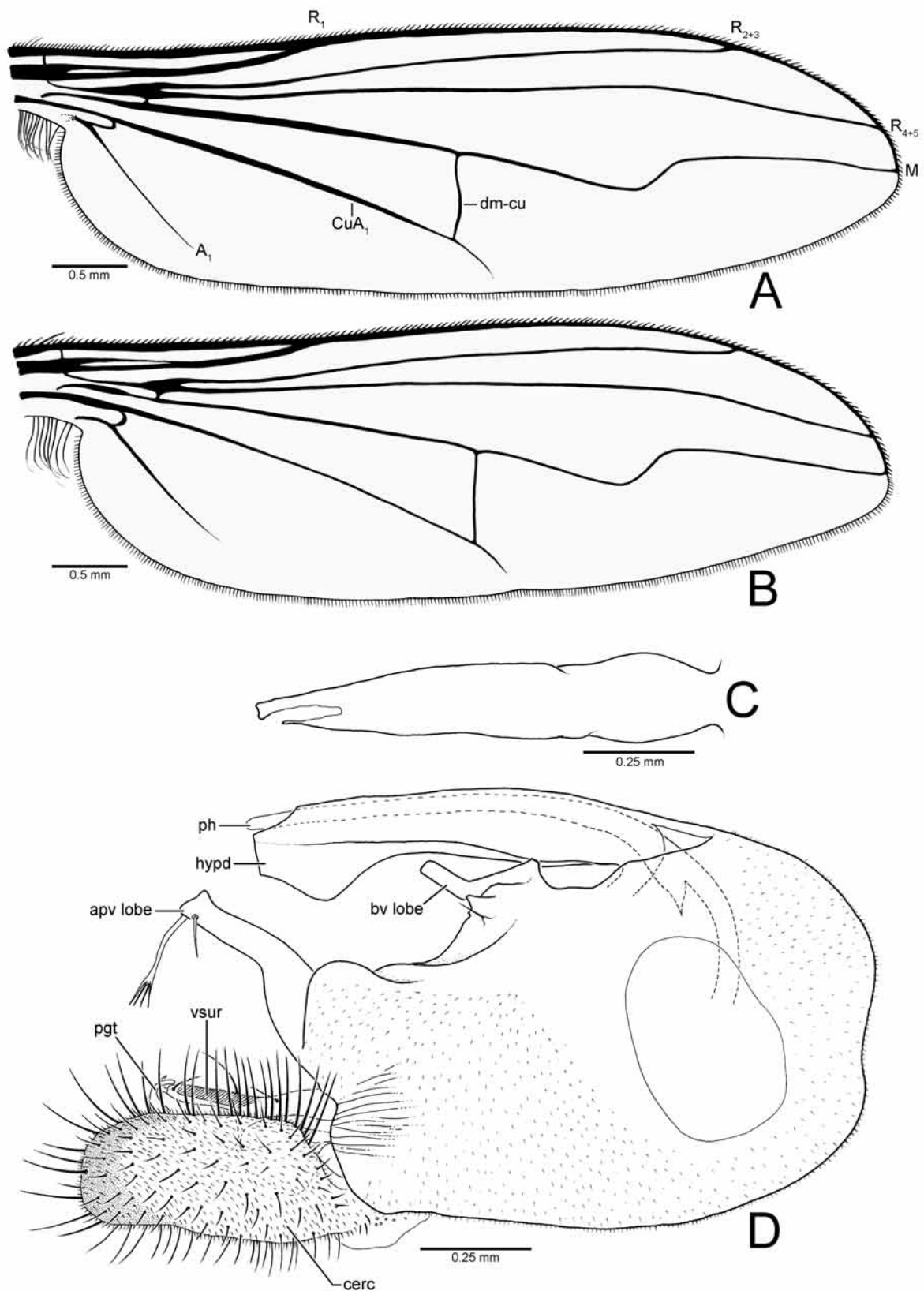
*Tachytrechus beckeri* (Parent): Brooks (2005).

*Tachytrechus peruicus* Yang & Zhang in Yang et al. (2006); replacement name for *Tachytrechus beckeri* (Parent) 1931; preoccupied by *Tachytrechus beckeri* Lichtwardt, 1917.

**Diagnosis.** Body length 5.3–5.4 mm; wing length 5.3–5.5 mm; face brownish with weak silvery-green reflections; male clypeus rounded below; 1 notopleural bristle; male fore tarsus distinctly silvery anteriorly, basitarsus lacking curved ventral setae, tarsomeres 3 and 4 flattened; hind femur mainly yellow with 1 anterior preapical bristle; bends in M distinct, obtuse;  $R_{4+5}$  and M subparallel distally (Figs. 7A, 7B); male wing (Fig. 7A) without costal swelling, with M and  $CuA_1$  thickened in basal section; male tergite 5 with posterior



**FIGURE 6.** *Tachytrechus giganteus* (Brooks): (A) male wing; (B) female wing; (C) male clypeus; (D) hypandrium (ventral view); (E) hypopygium (left lateral view). Adapted from Brooks & Wheeler (2002). Abbreviations: A<sub>1</sub>: anal vein; apv lobe: apicoventral epandrial lobe; bv lobe: basiventral epandrial lobe; cerc: cercus; CuA<sub>1</sub>: 1<sup>st</sup> anterior branch of cubital vein; dm-cu: discal medial-cubital crossvein; hypd: hypandrium; M: medial vein; ph: phallus R<sub>1</sub>: 1<sup>st</sup> radial vein; R<sub>2+3</sub>: 2<sup>nd</sup> + 3<sup>rd</sup> radial vein; R<sub>4+5</sub>: 4<sup>th</sup> + 5<sup>th</sup> radial vein.



**FIGURE 7.** *Tachytrechus peruicus* Yang & Zhang: (A) male wing; (B) female wing; (C) hypandrium (ventral view); (D) hypopygium (left lateral view). Figure D adapted from Brooks & Wheeler (2002). Abbreviations: A<sub>1</sub>: anal vein; apv lobe: apicoventral epandrial lobe; bv lobe: basiventral epandrial lobe; cerc: cercus; CuA<sub>1</sub>: 1<sup>st</sup> anterior branch of cubital vein; dm-cu: discal medial-cubital crossvein; hypd: hypandrium; M: medial vein; pgt: postgonite; ph: phallus; R<sub>1</sub>: 1<sup>st</sup> radial vein; R<sub>2+3</sub>: 2<sup>nd</sup> + 3<sup>rd</sup> radial vein; R<sub>4+5</sub>: 4<sup>th</sup> + 5<sup>th</sup> radial vein; vsur: ventral lobe of surstylus.



membraneous region bordering and mostly confined to dorsal portion of sclerite (cf. Fig 9A); hypopygium (Figs. 7C, 7D): right and left basiventral epandrial lobes digitiform, right lobe longer; apicoventral epandrial lobe elongate, projected ventrally, with blunt, expanded apex bearing medial and outer setae; accessory epandrial process absent; apicolateral arm of postgonite with medial process present, with long hook-like process apically; cercus subrectangular in dorsal view, longer than wide, apical and lateral margin darkened; hypandrium narrow and symmetrical in ventral view; ventral surstylar lobe with series of parallel diagonal ridges on ventral surface; dorsal lobe about half as long as ventral lobe; phallus with fin-like projection before middle. Female sternite 8 divided medially, lacking deep medial invagination.

**Type material examined.** Holotype ♀, PERU: Cusco, Rio Urubamba, Umahuankilia, 500 m, 13.xi.1903, C.A.W. Schnuse (SMTD).

**Other material examined.** 1♂ and 1♀, PERU: “?rég. côtière du N.” (MNHN).

**Distribution.** *Tachytrechus peruicus* is known from the type locality near the Rio Urubamba in southeastern Peru, and from two specimens collected in the northern coastal region of Peru (Fig. 13); however the precise location of the latter locality is unknown and has been approximated on Fig. 13 (indicated with a “?”).

**Remarks.** Yang and Zhang in Yang et al. (2006) proposed the name *T. peruicus* for *T. beckeri* (Parent) 1931 in order to remove the homonymy with older name *T. beckeri* Lichtwardt 1917, which resulted from the synonymy of *Syntomoneurum* with *Tachytrechus* by Brooks (2005). The eversible glandular structure present in the other species was not found in the single male specimen of *T. peruicus*. However, the abdomen of this specimen was partially damaged prior to our examination and dissection, and the eversible gland, if present, may have been lost as a result.

### ***Tachytrechus transversus* (Van Duzee)**

(Figs. 8, 9, 12)

*Polymedon transversus* Van Duzee 1929: 52.

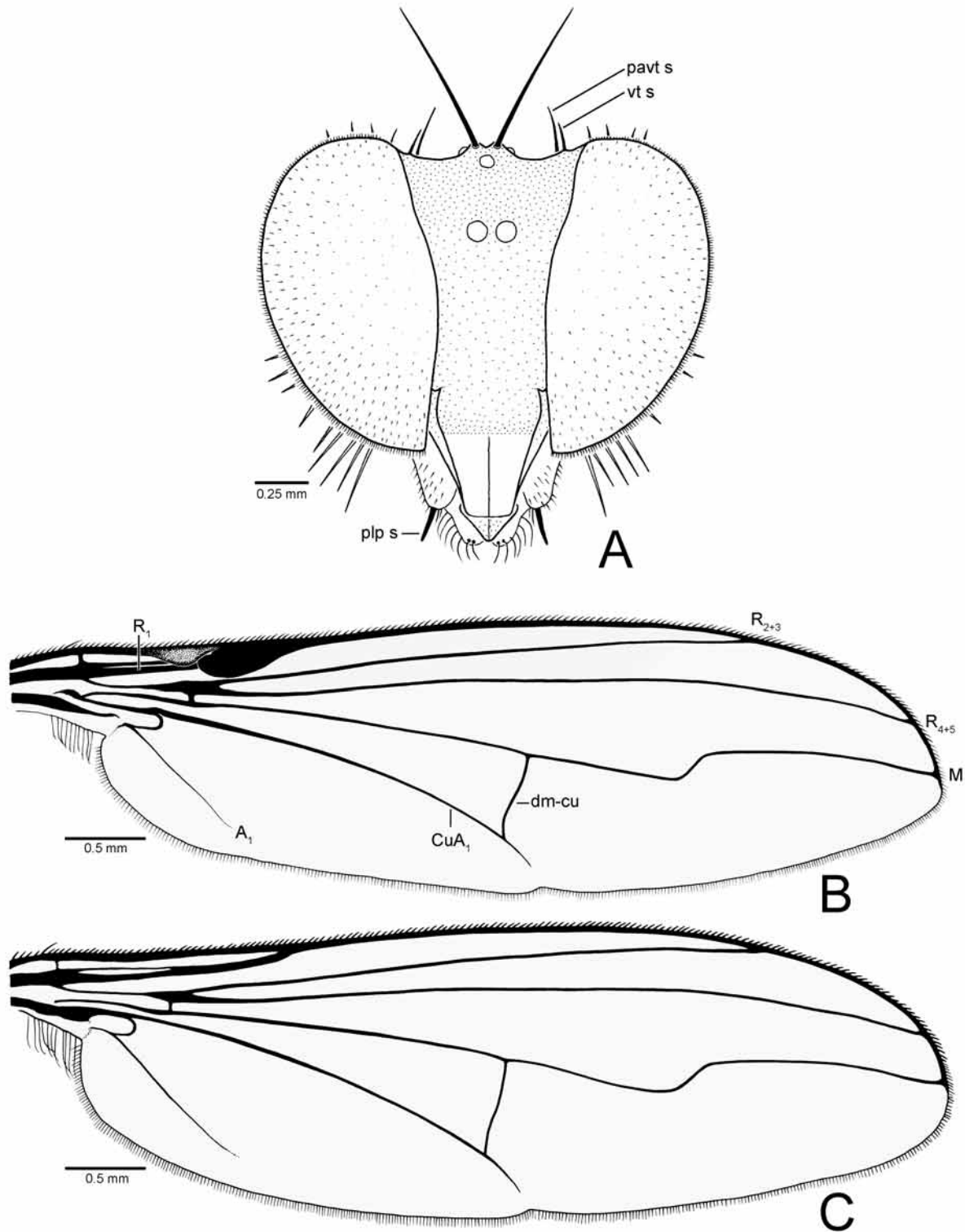
*Tachytrechus transversus* (Van Duzee): Robinson, 1970: 56 (catalogue).

**Diagnosis.** Body length 5.5–6.2 mm, wing length 5.4–5.6 mm; face and upper part of clypeus metallic greenish-coppery, abruptly pale yellow in lower part of clypeus, male clypeus with sharp medial and lateral carinae; palpus with large, stout seta on lower margin (Fig. 8A); 2 notopleural bristles; male fore tarsus unmodified; hind femur with 1 anterior preapical bristle; M with two strong obtuse bends in distal half;  $R_{4+5}$  and M parallel distally (Figs. 8B, 8C); male wing (Fig. 8B) with two adjacent flap-like costal swellings immediately proximal to insertion of  $R_1$ ; male tergite 5 with posterior membraneous region bordering and mostly confined to dorsal portion of sclerite (Fig 9A); male sternite 5 with large complex eversible glandular structure (Figs. 9A, 9B); hypopygium (Figs. 9C, 9D): right and left basiventral epandrial lobes well-developed, digitiform, projected dorsally and lying adjacent to medial surface of apicoventral epandrial lobes, apex of right lobe with 90° bend; apicoventral epandrial lobe flared apically, projected posteriorly; accessory epandrial process absent; ventral surstylar lobe with series of parallel diagonal ridges ventrally; apicolateral arm of postgonite lacking medial process, apex rounded, unmodified; cercus subquadrate in dorsal view, margin not darkened; hypandrium asymmetrical in ventral view, right margin with rounded process near middle; phallus with large fin along middle third, weak dentiform projection subapically. Female sternite 8 divided medially, lacking deep medial invagination.

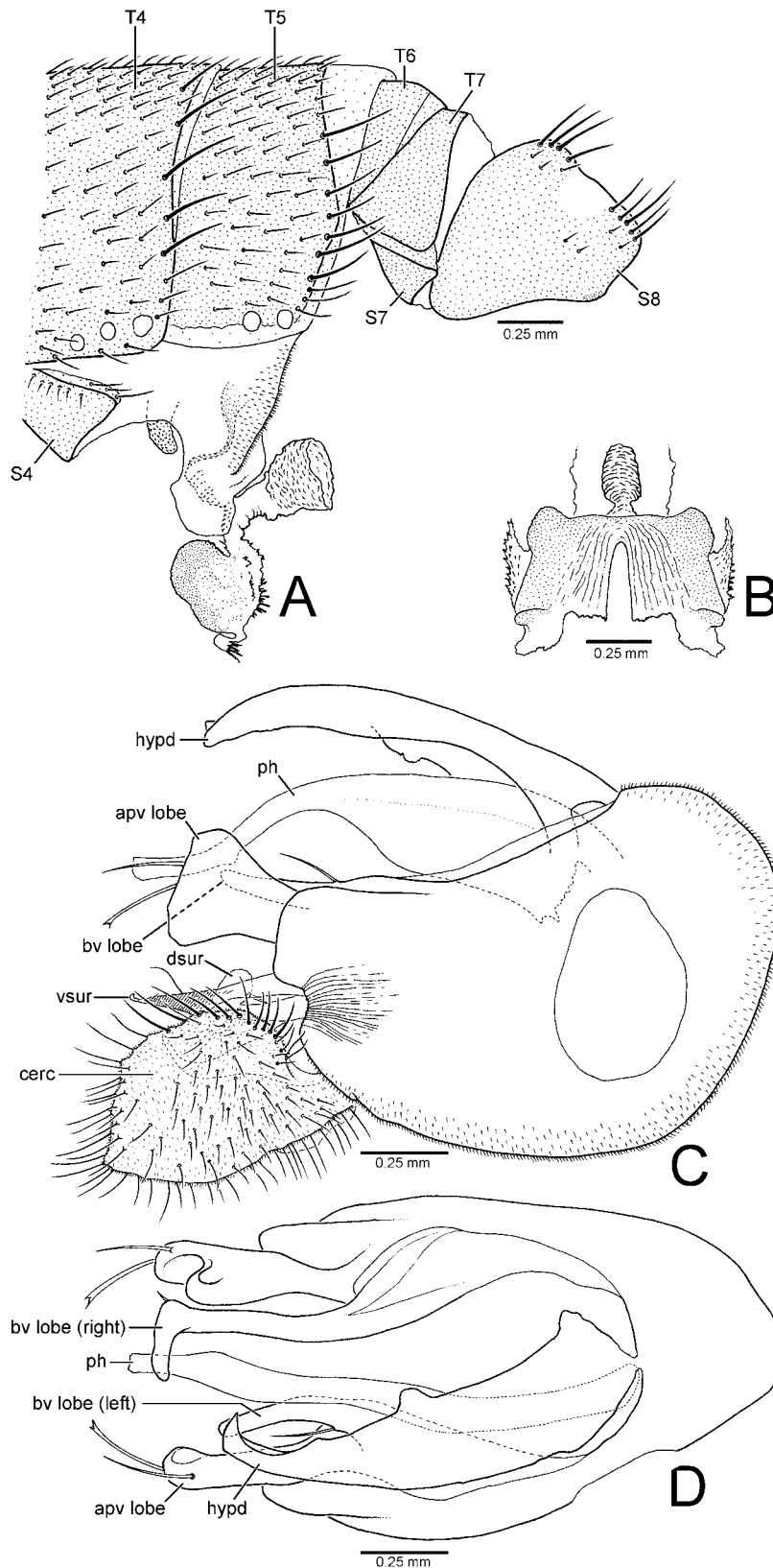
**Type material examined.** Holotype ♂, GUATEMALA: Zacapa, El Jicara, 11.v.1926; J.M. Aldrich (USNM Type No. 41062). Paratypes, 3♀, with same locality and collection date as holotype (USNM).

**Other material examined.** 1♂, MEXICO: Chiapas, above Arriaga, over crest, 22.v.1963, H. Robinson: 1♂ (USNM).

**Distribution.** *Tachytrechus transversus* is known from the type locality in Guatemala and also from a single male collected near Arriaga, Chiapas, Mexico (Fig. 12).



**FIGURE 8.** *Tachytrechus transversus* (Van Duzee): (A) male head; (B) male wing; (C) female wing. Abbreviations: A<sub>1</sub>: anal vein; CuA<sub>1</sub>: 1<sup>st</sup> anterior branch of cubital vein; dm-cu: discal medial-cubital crossvein; M: medial vein; pavt s: paraverticla seta; plp s: palpal seta; R<sub>1</sub>: 1<sup>st</sup> radial vein; R<sub>2+3</sub>: 2<sup>nd</sup> + 3<sup>rd</sup> radial vein; R<sub>4+5</sub>: 4<sup>th</sup> + 5<sup>th</sup> radial vein; vt s: vertical seta.



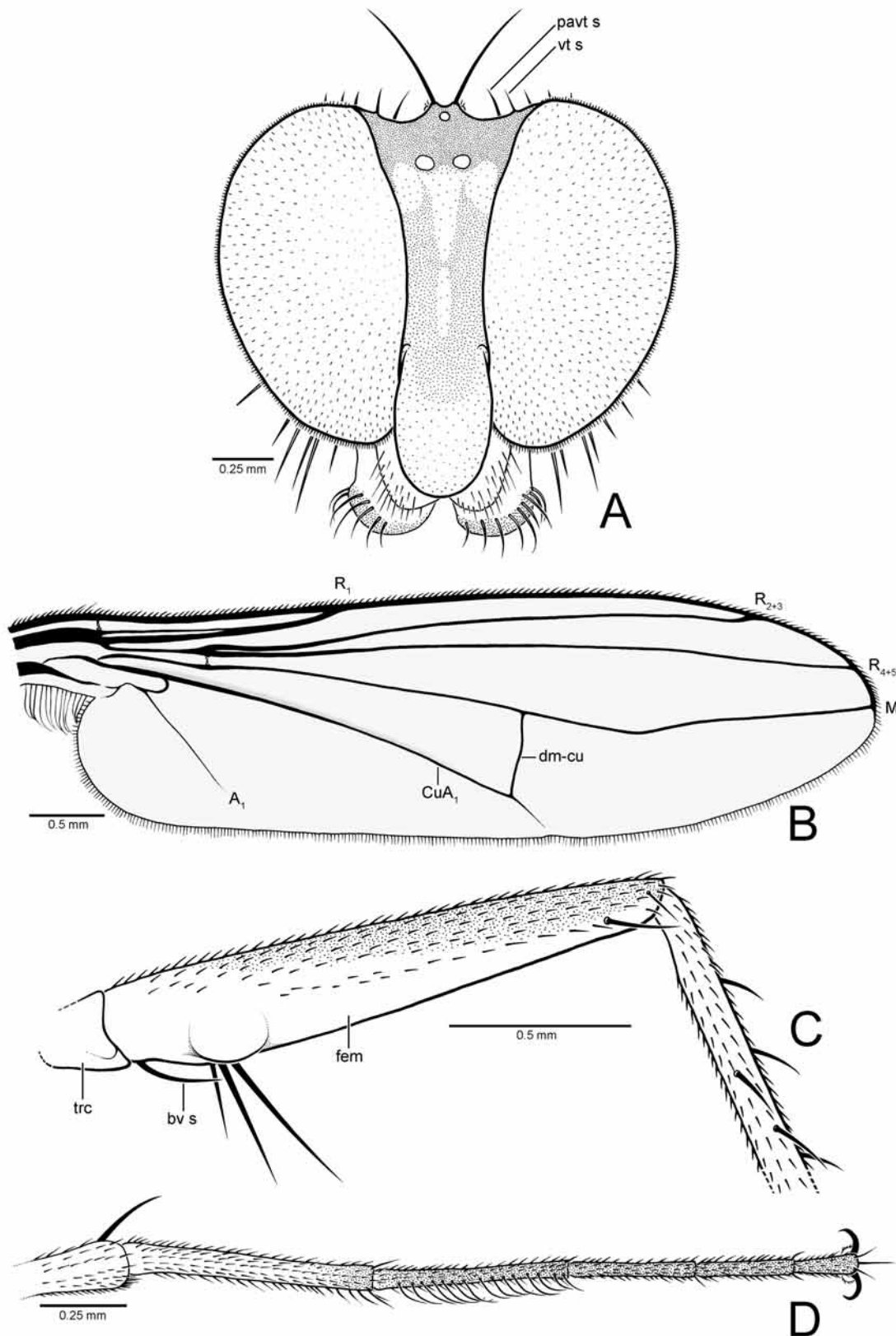
**FIGURE 9.** *Tachytrechus transversus* (Van Duzee) male abdomen and hypopygium: (A) apical portion of abdomen (hypopygium removed); (B) apex of eversible pregenitalic structure (ventral view); (C) hypopygium (left lateral view); (D) hypopygium ventral view (postgonite, surstylus and cerci not shown). Abbreviations: apv lobe: apicoventral epandrial lobe; bv lobe: basiventral epandrial lobe; cerc: cercus; dsur: dorsal lobe of surstylus; hypd: hypandrium; ph: phallus; S: sternite; T: tergite; vsur: ventral lobe of surstylus.

***Tachytrechus zumbadoi* Brooks sp. nov.**

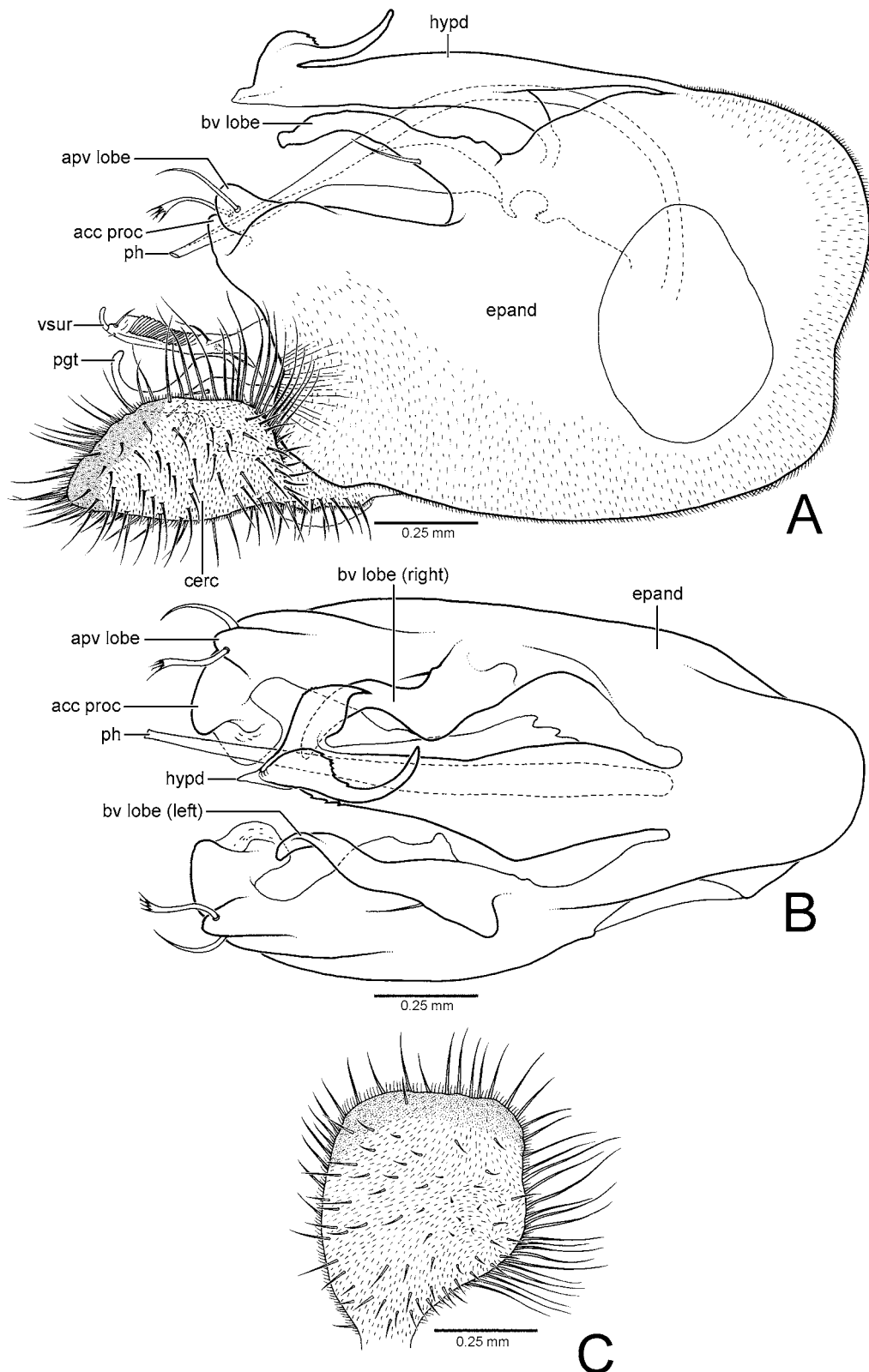
(Figs. 10, 11, 12)

**Diagnosis. Male.** Face and clypeus brownish; 2 notopleural bristles;  $R_{4+5}$  and M slightly converging distally (Fig. 10B); wing membrane evenly infuscated and lacking costal swelling (Fig. 10B); tibiae and basal part of tarsi pale; tarsomere 2 of foreleg with anterodorsal row of long curved hairs (Fig. 10D); tarsomere 2 of midleg longer than basitarsus; hypandrium with elongate ventral projection and lamellate subapical process on right side (Figs. 11A, 11B)

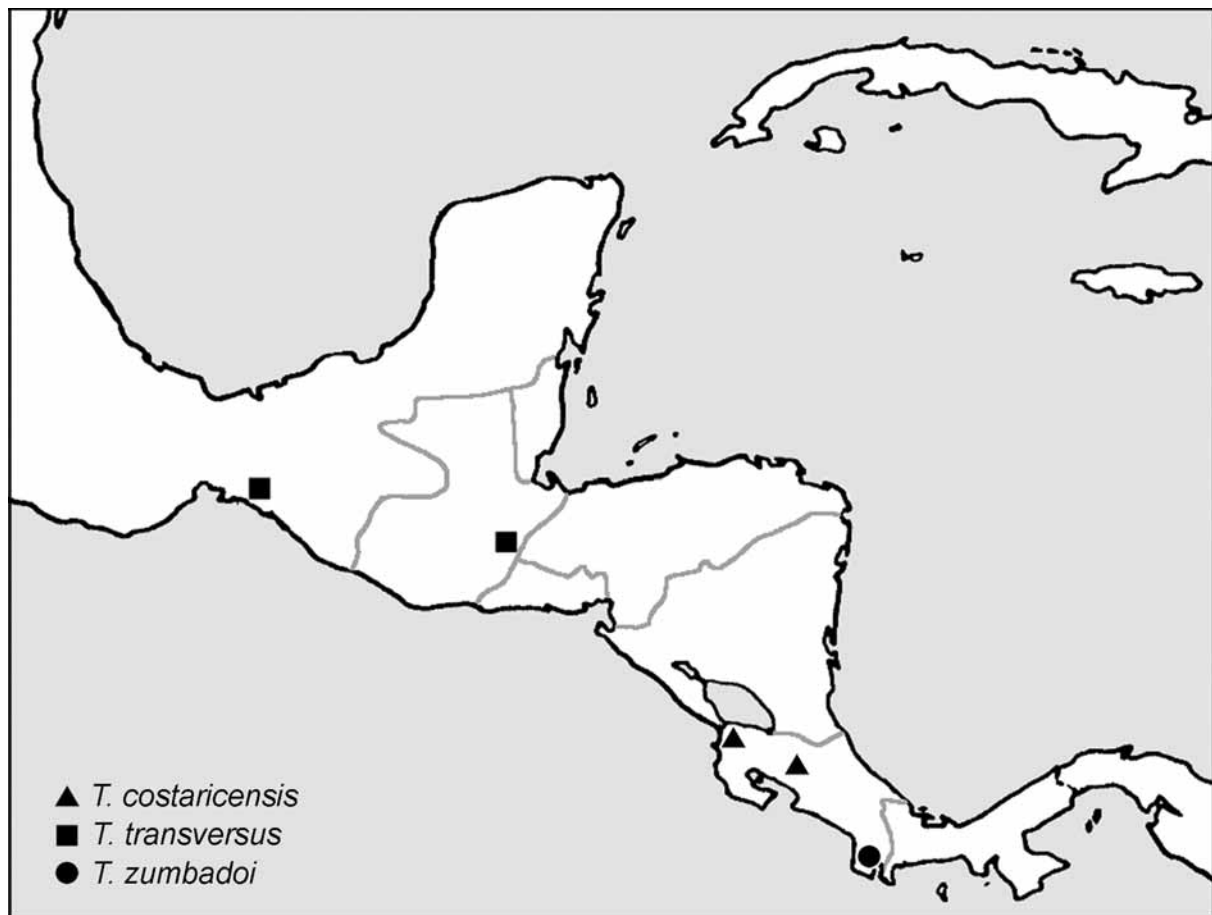
**Description. Male:** Body length 5.7 mm, wing length 5.2 mm. **Head** (Fig. 10A): Vertex distinctly excavated, vertical seta weak and short, less than half as long as paravertical seta, subequal to upper postocular, pair of strong ocellar bristles, pair of strong paravertical setae. Postoculars mainly white, becoming stronger ventrally, upper three postoculars black, short. Frons blackish with metallic green reflections. Face broad, narrowest at middle. Face and clypeus brownish, lower 2/3 of face and upper third of clypeus darkened with very weak metallic reflections; clypeus rounded below. Palpus white with pale setulae, lacking distinct apical seta. Antenna: Scape subtriangular in lateral view, laterally compressed, blackish dorsally, pale brownish ventrally, about 0.8x as long as pedicel and postpedicel combined; pedicel brown; postpedicel blackish with lower third and ventral margin yellow, ovoid with narrowed apex, about 1.6x as long as wide; arista-like stylus subapical, black with white apex, elongate, about 5x as long as postpedicel, basal article about 0.05x as long as distal article. **Thorax:** Coloration largely obscured on unique male (see Remarks). Notum metallic green with silvery pruinosity; acrostichals biserial, 6 dorsocentral setae, 1 presutural, 1 sutural, 2 supraalar, 1 postalar, 1 posthumeral, 1 postpronotal with 1–2 weaker setae, 2 notopleural bristles, posterior bristle weak. Pleuron with silvery pruinosity, metaepisternum bare. Scutellum dark greenish-blue with central bronze patch, with strong inner bristle and weak outer seta. **Legs:** Fore coxa yellow, mid and hind coxae mainly dark, concolorous with thorax; femora mainly yellow, posterodorsal surface of fore and mid femora dark with metallic reflections, distal portion of hind femur weakly infuscated posterodorsally; tibiae yellow; tarsi with tarsomere 1 yellow, darkened apically, tarsomeres 2–5 darkened. **Foreleg:** Coxa with pale pile and weak setae, apical margin with 2 strong outer and 4 weak inner setae; femur with distinct tubercle behind basal cluster of 2–3 strong setae (Fig. 10C), posterior preapical seta present; tibia with 4 dorsal setae, 2 posteriors and 2 apicals; tarsus slightly longer than tibia, tarsomeres 2–5 weakly flattened laterally, tarsomere 2 with anterodorsal row of curved setae (Fig. 10D), tarsomere ratio: 3.7/2.7/1.8/1.2/1.0. **Midleg:** Coxa with row of 4–5 weak black setae medial to cluster of strong setae; femur with distinct tubercle on ventral surface proximal to mid-length, 1 strong anterior preapical, 1 distinct posteroventral preapical seta; tibia with 4 anterodorsal setae, 3 posterodorsals, 2 dorsals, 4 strong apicals; tarsus 1.5x longer than tibia, tarsomere ratio: 6.1/8.0/2.1/1.0/1.3. **Hindleg:** Femur with 1 strong anterodorsal preapical; tibia with 4 anterodorsal setae, 3 posterodorsals, 4–5 weak ventrals, 2 apicals, with or without preapical dorsal seta, with dentiform posteroapical process; tarsus about 1.4x longer than tibia, with hook-shaped posterobasal process opposite apical dentiform process of tibia, tarsomere ratio: 4.0/7.9/2.2/1.0/1.1. **Wing** (Fig. 10B): Veins dark brown, membrane with brownish tinge; costa unmodified, lacking costal swelling; M with weak sinuous bend in distal half;  $R_{4+5}$  and M slightly convergent; crossvein  $dm-cu$  beyond midpoint of wing, longer than distal section of  $CuA_1$ . Calypter with black setae. **Abdomen:** Coloration of sclerites obscured on unique male (see Remarks); tergite 5 with large posterior membranous region, extended laterally as broad band to ventral margin of sclerite; sternite 5 with eversible glandular structure (retracted in holotype); sternite 8 subtriangular with several long setae near posterior margin. **Hypopygium** (Figs. 11A, 11B): Epandrium: Basiventral epandrial lobe elongate, digitiform, with basiventral protuberance, seta present, near base of lobe; apicoventral epandrial lobe short, projected posteriorly, rounded apically with pair of pale setae, medial seta branched apically; accessory epandrial process present medial to apicoventral epandrial lobe. Surstylus: Ventral lobe digitiform, flattened dorsoventrally, with ridged ventral surface, apex with blunt curved seta; dorsal lobe about half as long as ventral lobe, flared apically, apex with setae laterally



**FIGURE 10.** *Tachytrechus zumbadoi* Brooks **sp. nov.** male: (A) head; (B) wing; (C) base of foreleg (posterior view); (D) apex of tibia and foretarsus (dorsal view). Abbreviations: A<sub>1</sub>: anal vein; bv s: basiventral bristle; CuA<sub>1</sub>: 1<sup>st</sup> anterior branch of cubital vein; dm-cu: discal medial-cubital crossvein; fem: femur; M: medial vein; pavt s: paravertical seta; R<sub>1</sub>: 1<sup>st</sup> radial vein; R<sub>2+3</sub>: 2<sup>nd</sup> + 3<sup>rd</sup> radial vein; R<sub>4+5</sub>: 4<sup>th</sup> + 5<sup>th</sup> radial vein; trc: trochanter; vt s: vertical seta.



**FIGURE 11.** *Tachytrechus zumbadoi* Brooks **sp. nov.** hypopygium: (A) left lateral view; (B) ventral view (postgonite, surstylus and cerci not shown); (C) cercus (dorsal view). Abbreviations: acc proc: accessory epandrial process; apv lobe: apicoventral epandrial lobe; bv lobe: basiventral epandrial lobe; cerc: cercus; epand: epandrium; hypd: hypandrium; pgt: postgonite; ph: phallus; vsur: ventral lobe of surstylus.



**FIGURE 12.** Known distribution of *Tachytrechus costaricensis* Brooks **sp. nov.**, *T. transversus* (Van Duzee) and *T. zumbadoi* Brooks **sp. nov.**

and rugose membranous portion medially. Apicolateral arm of postgonite lacking medial process, apex expanded and granulated. Cercus (Fig. 11C) subquadrate in dorsal view, apical and lateral margin darkened, lateral margin with long setae. Hypandrium with lamellate lateral process subapically on right side, with elongate claw-like projection ventrally (Fig. 11B). Phallus simple, tubular in distal part, widened in middle section with dorsal projections near middle (Fig. 11A).

**Female:** Unknown.

**Type material.** Holotype ♂, COSTA RICA: Puntarenas, Albergue Cerro de Oro, 150 m, 5–12.v.1995, M.A. Zumbado, L\_S\_279650\_518450 #6028, INBIO CRI002 307704 (INBC).

**Distribution.** *Tachytrechus zumbadoi* is known only from the type locality in the province of Puntarenas, Costa Rica (Fig. 12).

**Etymology.** The specific name is a patronym in honor of Instituto Nacional de Biodiversidad dipterist, Manuel Zumbado, who collected the holotype of this species.

**Remarks.** The coloration of the thorax and abdomen of the male holotype is largely obscured by a dark, greasy coating.

### Phylogeny and Zoogeographic Considerations

The analysis of the character state matrix (Table 1) produced a single most parsimonious tree with a length = 24, consistency index (CI) = 0.83, CI excluding uninformative characters = 0.80, retention index (RI) = 0.86, and a rescaled consistency index (RC) = 0.72 (Fig. 14). The tree is rooted with *T. dilaticosta* at its base. This

species is a member of the New World *T. flabellifer* (Osten Sacken) species group, which Brooks (2005, fig. 2) hypothesized as closely related to *T. castus* and the *T. alatus* species group primarily on the basis of the shared possession of a frayed or branched seta on the apicoventral lobe of the epandrium (Fig. 4C), although this feature occurs sporadically in some other species of *Tachytrechus* and *Pelastoneurus* Loew.

The second outgroup exemplar chosen here, *Tachytrechus castus*, shares a number of character states with the *T. alatus* species group, including ventral setae on the scape (state 2.1), a ventral tubercle on the mid femur (state 8.1), an elongate and ventrally flexed basal projection of the ejaculatory apodeme (state 12.1, see fig. 36B in Brooks, 2005), and tergite 10 of the female with inner medial spines (state 19.1, see fig. 36B in Brooks, 2005). *Tachytrechus castus*, which is known from Arizona, Utah and New Mexico, appears to belong to a species group that includes at least four additional undescribed species from Mexico and Costa Rica (see “Remarks” following the diagnosis of the *T. alatus* species group above). Males of this group have strong, straight vertical setae that are parallel to one another in frontal view, which is probably synapomorphic for the entire *T. castus* species group.

**TABLE 1.** Character state matrix for cladistic analysis. Missing data are indicated by “?”.

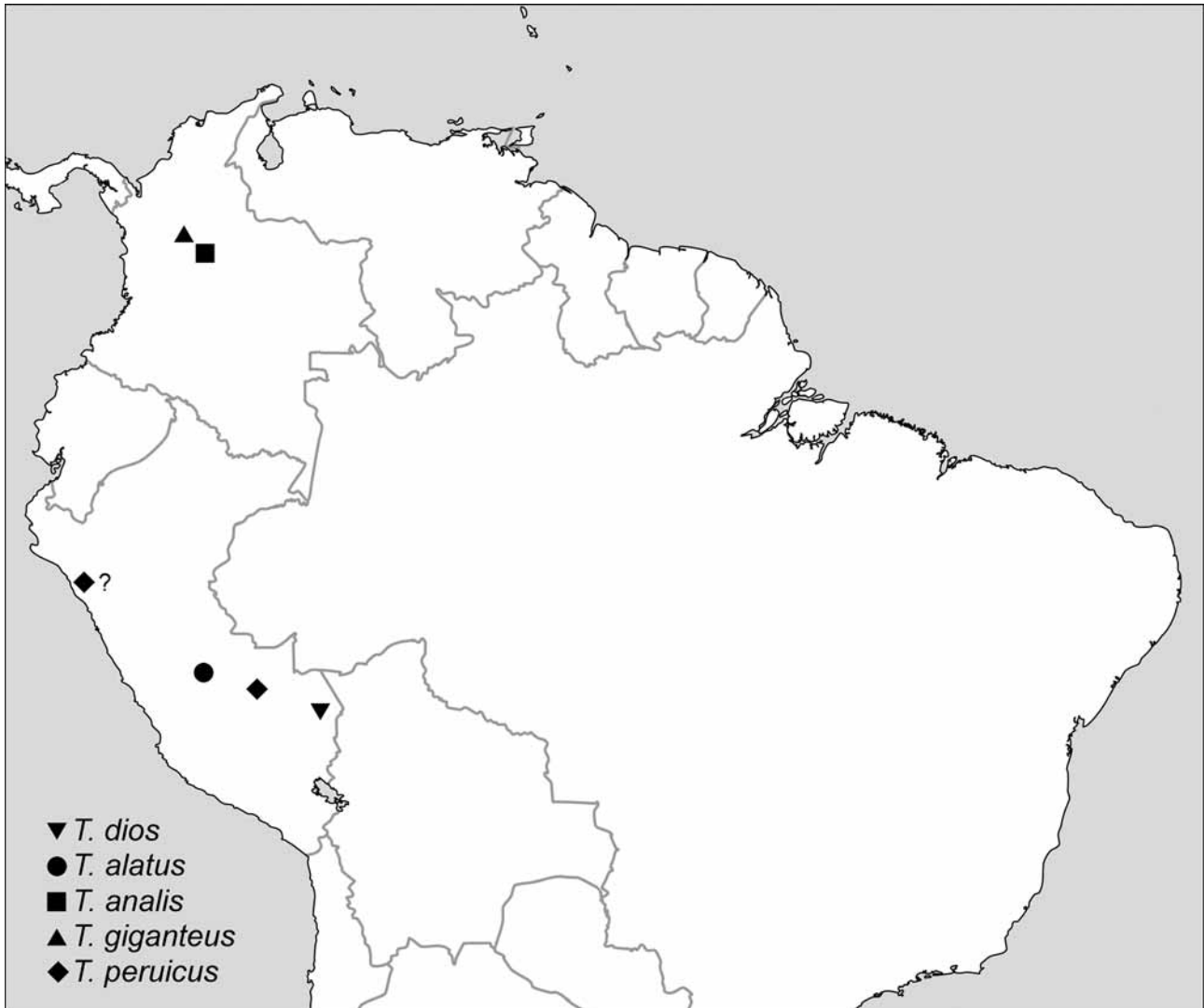
	1111111111
	1234567890123456789
<i>T. dilaticosta</i>	000000000000000020
<i>T. castus</i>	0100000100010000001
<i>T. transversus</i>	1101101110010000001
<i>T. costaricensis</i>	1101111110111101001
<i>T. zumbadoi</i>	110111111011110100?
<i>T. giganteus</i>	1111101110010000101
<i>T. alatus</i>	1111101110110010101
<i>T. dios</i>	111110111101111011?
<i>T. peruiicus</i>	1111101111010010111
<i>T. analis</i>	111111111101001011?

Characters

1. Head: vertical seta of males: (0) strong; (1) reduced (Figs. 3A, 8A, 10A).
2. Scape: ventral setae: (0) absent; (1) present.
3. Notopleuron: (0) with 2 bristles; (1) with 1 bristle.
4. Male fore femur: strong basiventral bristle: (0) absent; (1) present (Fig. 10C).
5. Male fore femur: ventral cluster of 2–3 strong bristles: (0) absent; (1) present (Fig. 10C).
6. Male foreleg: curved setae on tarsomere 2: (0) absent; (1) present (Figs. 3E, 10D).
7. Male mid coxa: cluster of 2–3 strong bristles: (0) absent; (1) present.
8. Male mid femur tubercle: (0) absent; (1) present.
9. Pulvilli of mid- and hindlegs: (0) not reduced; (1) strongly reduced.
10. Apicoventral epandrial lobe: (0) short, projected posteriorly (Figs. 1D, 4A, 6E, 9C, 11A); (1) elongate, projected ventrally (Figs. 2C, 5C, 7D).
11. Accessory epandrial process medial to apicoventral epandrial lobe (0) absent; (1) present (Figs. 1D, 2A, 2B, 11A, 11B).
12. Ejaculatory apodeme: basal projection: (0) short, projected laterally; (1) elongate and flexed ventrally.
13. Hypandrium: subapical lamellate process: (0) absent; (1) present (Figs. 4B, 5C, 5E, 11B).
14. Hypandrium: elongate ventral projection: (0) absent; (1) present (Figs. 4A, 4B, 5C, 5E, 11A, 11B).
15. Apex of apicolateral arm of postgonite: (0) not hooked or recurved; (1) hooked or recurved (Fig. 5C).
16. Apex of apicolateral arm of postgonite: (0) not expanded and granulated; (1) expanded and granulated (Fig. 4D).
17. Apicolateral arm of postgonite with medial process: (0) absent; (1) present.
18. Cercus shape: (0) subquadrate or rounded, as wide as long (Fig. 11C); (1) subrectangular, longer than wide (Fig. 5D); (2) with medial and apical projections.
19. Female terminalia: tergite 10: inner medial spines: (0) absent; (1) present (cf. fig. 21 in Brooks & Wheeler, 2002).



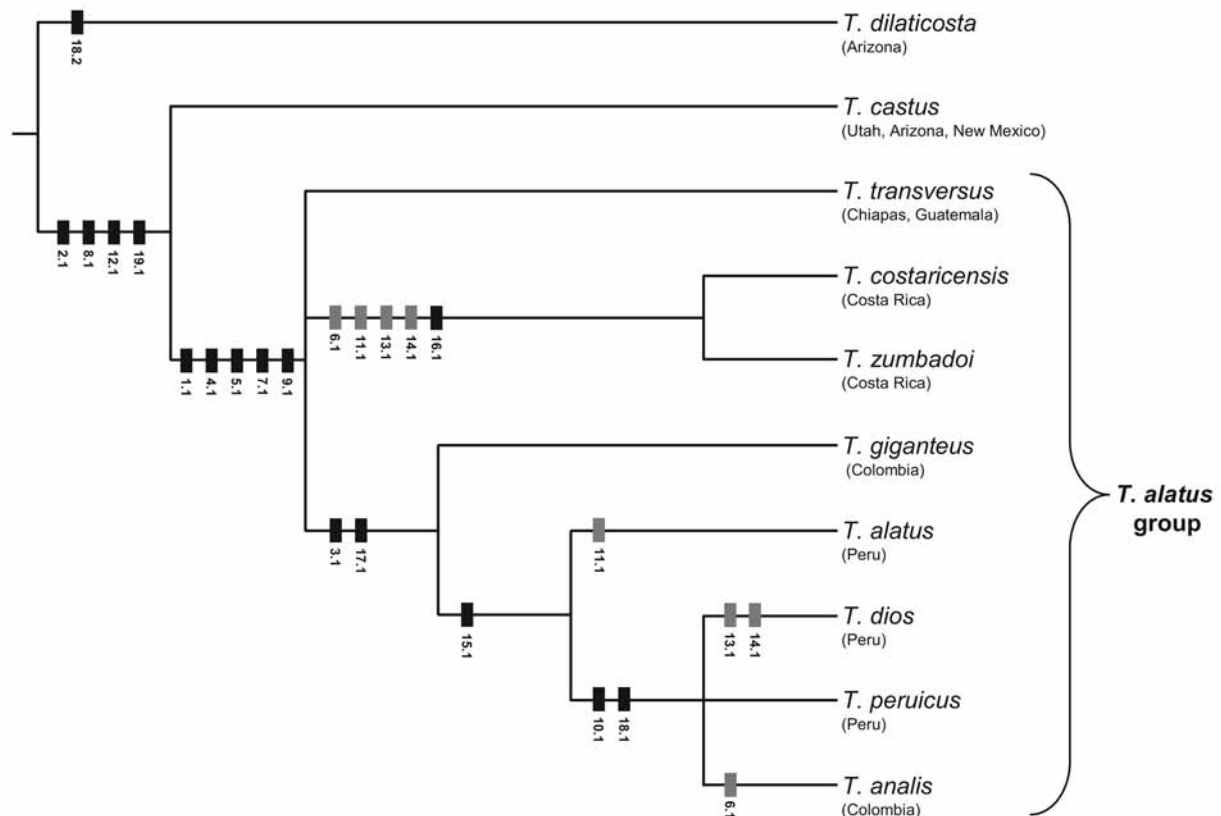
The monophyly of the *T. alatus* species group is supported by the possession of a strong basiventral bristle on the fore femur (state 4.1, Fig. 10C), and strongly reduced pulvilli on the mid- and hindlegs (state 9.1) in both sexes. Male-associated synapomorphies include strongly reduced vertical bristles (state 1.1), and the possession of a ventral cluster of 2–3 strong bristles on the fore femur (state 5.1, Fig. 10C) and mid coxa (state 7.1) (See “Remarks” following the diagnosis of the *T. alatus* species group above).



**FIGURE 13.** Known distribution of *Tachytrechus alatus* (Becker), *T. analis* (Parent), *T. dios* Brooks **sp. nov.**, *T. giganteus* (Brooks) and *T. peruicus* Yang & Zhang.

Within the *T. alatus* species group, the southern Mexican/Guatemalan species *T. transversus* is placed in an unresolved trichotomy with a clade including the two new Costa Rican species (*T. costaricensis* and *T. zumbadoi*), and a clade including the five remaining species (*T. giganteus*, *T. alatus*, *T. dios*, *T. peruicus* and *T. analis*), which all occur in South America.

*Tachytrechus costaricensis* and *T. zumbadoi* form a monophyletic group based on the uniquely expanded and granulated apex of the apicolateral arm of the postgonite (state 16.1, Fig. 4D). Four other homoplasious character states support this clade, including the presence of curved setae on tarsomere 2 of the male foreleg (state 6.1, Figs. 3E, 10D) that also occur in *T. analis*, an accessory epandrial projection (state 11.1, Figs. 11A, 11B) that also occurs in *T. alatus* (Fig. 1D), and two features of the hypandrium, i.e. a subapical lamellate process (state 13.1, Figs. 4B, 11B) and a long ventral projection (state 14.1, Figs. 4A, 4B, 11A, 11B) that both also occur in *T. dios* (Figs. 5C, 5E).



**FIGURE 14.** Single most parsimonious cladogram produced by analysis of data matrix in Table 1. Character distributions shown by black hash marks for uniquely derived states and gray hash marks for homoplasious states.

The South American clade including, *T. giganteus*, *T. alatus*, *T. dios*, *T. peruicus* and *T. analis*, is supported by the loss of the posterior notopleural bristle (state 3.1) and the possession of a medial process on the apicoventral arm of the postgonite (state 17.1). *Tachytrechus giganteus* is the basal member of this clade and the remaining four species form a monophyletic group based on the possession of a hooked or recurved apex of the apicolateral arm of the postgonite (state 15.1, Figs. 5C, 7D). *Tachytrechus dios*, *T. peruicus* and *T. analis* form the sister clade to *T. alatus* based on the possession of an elongate ventrally projected epandrial lobe (state 10.1, Figs. 2C, 5C, 7D) and a subrectangular cercus (state 18.1, Figs. 5D, 11C); however, the relationships among these three species remain unresolved.

With the addition of the three new species described here and the inclusion of *T. transversus*, the range of the *T. alatus* species group has been extended north from the tropical Andes of Colombia and Peru (Fig. 13) to Central America (i.e. Costa Rica, Guatemala) and the northern Neotropics of Chiapas, Mexico (Fig. 12). The phylogeny is suggestive of a southern vicariant expansion of the *T. alatus* species group from Neotropical Middle America into South America along the Andes Mountains. However, support for this hypothesis will require resolution of the trichotomy at the base of the *T. alatus* species group cladogram, and further collecting to more precisely document the geographical distributions of these rarely collected species.

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