bol.cient.mus.hist.nat. 28(2), julio-diciembre, 2024. 33-47. ISSN: 0123-3068 (Impreso) ISSN: 2462-8190 (En línea)

BOLETÍN CIENTÍFICO
CENTRO DE MUSEOS
MUSEO DE HISTORIA NATURAL

Intraspecific variability of the flower fly *Toxomerus flaviplurus* (Hall, 1927) (Diptera: Syrphidae), with new distribution records in Colombia and Bolivia.

Henry Mauricio Parada-Marin [1], Augusto León-Montoya [2], Yardany Ramos-Pastrana [1,2], Eric Córdoba-Suarez [1], Ximo Mengual [3]

Abstract

Objective: To demonstrate the intraspecific variability of *Toxomerus flaviplurus* (Hall, 1927) and expand its geographic distribution area. **Scope:** Promote knowledge of the diversity of Syrphidae in Colombia and Bolivia. **Methodology:** This study was based on specimens collected using entomological nets and Malaise traps during the term of the "Taxonomy of Pipunculidae (Diptera: Insecta) of Colombia" project which included rural areas (sugarcane crops, *Saccharum officinarum* L.) and secondary forest (soil) areas in sixteen municipalities of the Departments of Antioquia and Caquetá in Colombia and Cochabamba in Bolivia. **Results:** With more than 140 described species, *Toxomerus* Macquart, 1855 (Diptera: Syrphidae) is widely distributed in America. In this work, the distribution range is extended to the Andean region and *T. flaviplurus* is registered for the first time in the Andean-Amazonian region of Colombia and Bolivia, being its southernmost distributional record. Intraspecific variation is described and illustrated, including photographs of males and females. **Conclusions:** The results make it possible to understand the intraspecific variability of *T. flaviplurus* and to know a little more about its geographical distribution.

Key words: Amazonian foothills, geographic records, morphological characters, Neotropic

*FR: 10-VII-2023. FA: 17-III-2025.

[1] Entomology Research Group, Universidad de la Amazonia -GIEUA-, Entomology Laboratory, Universidad de la Amazonia, Florencia, Caquetá, Colombia. h.parada@udla.edu.co
orcid.org/0000-0002-5387-4495 **Google Scholar**
ya.ramos@udla.edu.co
orcid.org/0000-0002-3193-6659 **Google Scholar**
e.cordoba@udla.edu.co
orcid.org/0000-0002-2477-7581 **Google Scholar**
[2] Institute of Biology, Entomology Group Universidad de Antioquia – GEUA (for its acronym in Spanish), Medellín, Colombia. aleon.montoya@udla.edu.co
orcid.org/0000-0003-3307-034X **Google Scholar**
[3]Zoologisches Forschungsmuseum Alexander Koenig, Leibniz-Institut zur Analyse des Biodiversitätswandels, Adenauerallee 127, D-53113 Bonn, Germany. x.mengual@leibniz-lib.de
orcid.org/0000-0002-6185-9404 **Google Scholar**

HOW TO CITE:
Parada-Marin, H.M., Montoya, A.L., Ramos-Pastrana, Y., Córdoba-Suarez, E. & Mengual, X. (2024). Intraspecific variability of the flower fly *Toxomerus flaviplurus* (Hall, 1927) (Diptera: Syrphidae), with new distributional records in Colombia and Bolivia. *Bol. Cient. Mus. Hist. Nat. Univ. Caldas, 28*(2), 33-47. https://doi.org/10.17151/bccm.2024.28.2.2

Variabilidad intraespecífica de la mosca de las flores *Toxomerus flaviplurus* (Hall, 1927) (Diptera: Syrphidae), con nuevos registros de distribución en Colombia y Bolivia

Resumen

Objetivo: Demostrar la variabilidad intraespecífica de *Toxomerus flaviplurus* (Hall, 1927) y ampliar su área de distribución geográfica. Alcance. Promover el conocimiento de la diversidad de Syrphidae de Colombia y Bolivia. **Metodología:** Este estudio se basó en especímenes colectados utilizando red entomológica y trampas Malaise, durante la vigencia del proyecto "Taxonomía de Pipunculidae (Diptera: Insecta) de Colombia"; el cual incluyó áreas rurales (cultivos de caña de azúcar, *Saccharum officinarum* L.) y de bosque secundario (suelo) en los dieciséis municipios del departamento de Antioquia y Caquetá en Colombia y Cochabamba en Bolivia. **Resultados:** Con más de 140 especies descritas, *Toxomerus* Macquart, 1855 (Diptera: Syrphidae) está ampliamente distribuido en América. En el presente trabajo ampliamos el rango de distribución en la región Andina y registramos por primera vez a *T. flaviplurus* en la región Andino-Amazónica de Colombia y Bolivia, siendo su registro distribucional más austral. Se describe e ilustra la variación intraespecífica, incluyendo fotografías de machos y hembras. **Conclusiones:** Los resultados nos ayudan a entender la variabilidad intraespecífica de *T. flaviplurus* y a conocer un poco más su área de distribución geográfica.

Palabras clave: Caracteres morfológicos, piedemonte amazónico, registros geográficos, Neotropico.

Introduction

Toxomerus Macquart, 1855 (Diptera: Syrphidae: Syrphinae) is the second most representative genus of flower flies in the Neotropical region, including more than 140 described species distributed from southern Canada to southern Chile and Argentina (Thompson, 1981; Thompson and Thompson, 2006; Borges and Couri, 2009; Reemer, 2010; Thompson et al., 2010; Mengual, 2011). Although native to America, *Toxomerus floralis* (Fabricius, 1798) has recently been recorded in several countries in the African continent (Jordaens et al., 2015). In Colombia, *Toxomerus* is the third most representative genus, with 32 species distributed from 0 to 3,900 meters above sea level (Montoya et al., 2012; Montoya, 2016).

Adults of *Toxomerus* are found in habitats with varying degrees of human disturbance, and are common in open areas. Little is known about their biology and only larvae from a handful of species are known (Mengual, 2011; Mengual et al., 2012). They are mostly predators that feed on soft-bodied arthropods (Rojo et al., 2003) and some immatures feed on pollen (Marín, 1969; Smith, 1974; Reemer and Rotheray, 2009; Jordaens et al., 2015), and are even kleptoparasites that feed on prey trapped in the sticky leaves of carnivorous plants (*Drosera* L., Droseraceae) (Fleischmann et al., 2016; 2022).

Until recently, *Toxomerus* was considered the only member of the tribe Toxomerini (Vockeroth, 1969; Mengual, 2011) based mainly on the characteristic postanal process of the male genitalia (located between the bases of the surstyle) and the distinctive abdominal pattern. Recent molecular studies (Mengual, 2015; 2020; Mengual et al., 2008; 2012; 2015; 2021; Mengual and Thompson, 2011; Miranda et al., 2016) accumulated evidence for a Toxomerini embedded within Syrphini, and Mengual et al., (2023) finally placed *Toxomerus* within this tribe.

Toxomerus flaviplurus (Hall, 1927) is a small to medium-sized flower fly, measuring 6.2 to 8.0 mm in length and with a wing span of 6.0 to 7.0 mm. Knowledge of their biology is still incipient (Borges and Couri, 2009; Mengual, 2011). Originally the species was described from Puerto Barrios, Guatemala (Hall, 1927), and since then, it has been recorded from Costa Rica, Brazil, Panama, Trinidad, Venezuela, Colombia (Montoya, 2016) and Ecuador (Marín-Armijos et al., 2017). Therefore, it is assumed that the species is widely distributed in the Neotropics (Borges and Couri, 2009; Mengual, 2011). This taxon presents a very variable abdominal pattern: with or without yellow vittae on tergites 2–4 or sub-medial vittae on tergites 3–5. As Thompson (1981) pointed out, morphological determinations of *Toxomerus* species are difficult because so far, the taxonomy has been based almost exclusively on abdominal marks and variable color patterns. It is therefore recommended that determinations be based on characters of the male (or female) genitalia (Thompson, 1981).

Reemer (2010) considered *T. flaviplurus* as a minor synonym of *T. costalis* (Wiedemann, 1830) based on examination of photographs of a male paratype of *T. flaviplurus* and the holotype of *T. costalis*. In addition, he provided photographs of the pale form of *T. flaviplurus* from Suriname (Reemer, 2010: 185, Figs 94, 95). However, Mengual (2011) revised the paratypes of *T. flaviplurus* and the holotype of *T. costalis* and refuted this nomenclatural action based on molecular evidence.

In this study, the distribution range of *T. flaviplurus* is expanded, being recorded for the first time in the Andean-Amazonian region of Colombia, with Bolivia as a range expansion and representing the southernmost distributional record. A comparison of the intraspecific variation of *T. flaviplurus* is presented, including photographs of males and females.

Materials and methods

This study is based on pinned specimens deposited in the following collections:

LEUA: Colección del Laboratorio de Entomología (Entomology Laboratory Collection) Universidad de la Amazonia, Florencia, Caquetá, Colombia;
CEUA: Colección Entomológica (Entomological Collection) Universidad de Antioquia, Medellín, Colombia;
CSCA: California State Collection of Arthropods, California, U.S.A;

The following abbreviations are used in the text:

Ah	Aedeagal hood;
Ahp	Appendix hypandrium (Superior lobe);
Cer	Cercus;
Epd	Epandrium;
Hyp	Hypandrium;
Pp	Postanal Process;
Sa	Surstylar apodeme;
Sur	Surstyle.

Morphological terminology follows van Steenis et al. (2023). High-resolution photographs of males and females at different focal depths were taken using a Leica DFC 450 camera coupled to a Leica M205 stereoscope with an auxiliary lens of 0.63x and 1.0x. Stacked images were created following the protocol by Mengual (2022). Adobe® Photoshop CC was used to edit the stacked images. The measurements of the body, wing and genitalia dissection were carried out following the methodology proposed by Montoya et al. (2022).

The geographic distribution map was made using SimpleMappr (Shorthouse, 2010). In the list of examined material, label data are given as they appear on the labels. The square brackets ([]) are used to indicate supplementary data not present on the specimen labels. Forward slash (/) indicate a new line in label text and two slashes (//) indicate different labels. New records for the country are included and referred as a "new record" in geographical distribution. Data for specimens with identical data were simplified with *idem* and only the data that differing from the previous labels were written.

Results

Toxomerus flaviplurus (Hall, 1927)

(Figs 1–19)

Mesogramma flaviplura Hall, 1927: 239 (descr.); Curran, 1930: 1 (key); 1934: 398 (key).
Mesogramma flavipleura Hull, 1943: 15, 28 (key & ill.).
Mesograpta flaviplura Fluke, 1956: 222 (cat.).
Toxomerus flaviplurus. Thompson et al., 1976: 50 (cat. & n. comb.); Borges and Couri, 2009: 17, figs 7, 13, 28, 47–49, 98–100 (key, pleuron, wing, abdomen, male & female genitalia, descr.); Reemer, 2010: 185, figs 94, 95 (Suriname, syn. of *T. costalis*); Mengual, 2011: 13, figs 10, 14 (diag., key, notes); Montoya, 2016: 481 (Colombia); Marín-Armijos et al., 2017: 180 (Ecuador).

Examined material. (5♂, 1♀). **COLOMBIA, Antioquia, Puerto Berrío,** / Malena, Barrio La Malena, / 6,488765, -74,401812, 113-126 m[eters], / Pastizal, Cerca de laguna, Red entomológica, / 11-Oct[x]-2008, A. Bustamante-C (1♂, CEUA 43836); **Antioquia, Carepa,** CORPOICA, Estación Biológica Tulenapa, / 7,7805556, -76,6760278, 25-47 m[eters], / Bosque, Red entomológica, 07-Jul[vii]-2015, / A. L. Montoya (1♀, CEUA 87038); **Caquetá,** Florencia, / Vda. [Vereda] La Viciosa, Fca. [Finca] Macagual, 01°29'55.8"N/75°39'25.1"W, 249 m[eters], / 15-Abr[iv].2014, / entomological handnet in forest, leg. Y. Ramos-Pastrana (1♂, LEUA–55130, dissected) (photographed specimen); **Caquetá,** Albania, Vereda La Florida Uno, Finca El Jardín, 01°15'08.9"N/75°53'0.52"W, 283 m[eters], / 1–15 Feb[ii].2017, / Malaise trap in crop, Y. Ramos-Pastrana, leg. (1♂, LEUA–55131); **Caquetá,** Albania, Vereda La Florida Uno, Finca El Jardín, 01°15'08.9"N/75°53'35.2'W, 283 m[eters], / 15-Feb[ii] -01-Mar[iii].2017, / Malaise trap in crop, / Y. Ramos-Pastrana leg. (1♂, LEUA–55132); **Caquetá,** Albania, Vereda, La Florida Uno, Finca El Jardin, 01°15'08.9"N/75°53'05.2"W, 283 m[eters], Malaise trap in crop, 1–15 Mar[iii].2017, Y. Ramos-Pastrana leg. (1♂, LEUA–55133). **BOLIVIA: Cochabamba Prov.**, 20 km SW Villa Tunari, Rio Avispha [=Avispa], 17°01'31.2"S/65°31'39.8"W, 460 m[eters], Malaise trap, 4–6 Sept[ix].2000, M. Hauser, S. Gaimari, D. Yeates, leg. (1♂, 1♀, CSCA, dissected).

Diagnosis. The face of *T. flaviplurus* is yellow with black medial vitta, about 1/3 to 1/2 as long as the compound eye in lateral view. The shield is completely black laterally, without yellow lateral vittae, with a yellow postpronotum and a partially yellow postalar callus. The pleuron is black to metallic blue, except for the posterior third of the posterior anepisternum which is yellow. The wing is entirely microtrichose, tinged with brown, with an elongated and narrow alula (narrower than cell bm). The femora are black, except for the yellow apical and basal extremities. The abdomen

is mostly black with diffuse yellow to orange markings on tergites 3–5 (in the dark form), or with evident yellow markings on tergites 2–5 (in the pale form). Abdominal segment 8 enlarged with a posterior bulge. Male genitalia with nearly semi-circular, elongated surstylus, and a long postanal process (about 3/4 of the length of the surstylus or slightly more, with acute to obtuse apex).

Length (literature and new records): Body: 6.2–8.0 (7.1) mm, wing 6.0–7.0 (6.5) mm.

Intraspecific variability. Borges and Couri (2009) provided a complete description and illustrations of the Brazilian specimens of *Toxomerus flaviplurus*. However, a high morphological variability was found in the Bolivian and Colombian specimens, including those previously reported by Montoya (2016), which do not present morphological differences with those examined in this study. Thus, a comparison between the Bolivian, Brazilian and Colombian specimens is provided (in parenthesis, when applicable).

Male. (Figs 1–15) **Length:** 6.2–6.5 mm (versus 7–8 mm in Brazilian and 7.1–7.3 mm in Bolivian specimens). **Head** (Figs 1–2): Face 1/2 as long as the eye, median black vitta, white pilose laterally, medially sparsely yellow pilose in Colombian specimens (Fig. 1) [*versus* face 1/3 as long as eye width, shiny except sparsely white pollinose and pilose laterally in the Brazilian specimens in Borges and Couri (2009: 34) *versus* face 1/3 as long as eye width, with a median light brown vitta in the Bolivian specimens (Fig. 2)]. Frontal triangle white, sparsely pilose yellow (Fig. 1) [*versus* frontal triangle yellow, white pilose in the Brazilian specimens in Borges and Couri (2009: 34) *versus* frontal triangle light yellow, light yellow pilose in the Bolivian specimens (Fig. 2)], Vertical triangle narrow and black, sparsely black pilose (Fig. 1) [*versus* vertical triangle black, bronze pollinose with black pilose in the Brazilian specimens in Borges and Couri (2009: 34) *versus* vertical triangle black, white pilose and white pruinose anteriorly, bronze pruinose and black pilose medially in the Bolivian specimens (Fig. 2)]. Occiput beige pruinose with a short row of black pile superiorly (Fig. 3) [*versus* occiput black, silver pollinose, with thick white pile, with a short row of brownish pile superiorly in the Brazilian specimens in Borges and Couri (2009: 34) *versus* occiput black, silvery pruinose with white pile meso- and ventrally and brownish pile dorsally in the Bolivian specimens (Fig. 4)].

Thorax (Figs 3–6): postpronotum yellow in the Colombian specimens (Fig. 3) [*versus* postpronotum yellow to brownish in the Brazilian specimens see figure 7 in Borges and Couri (2009) *versus* postpronotum yellow with brownish markings in the Bolivian specimens (Fig. 4)]. Proepisternum brown bare, supraprocoxal yellow macula absent (Fig. 3) [*versus* proepisternum black, white pollinose in the Brazilian specimens, see figure 7 in Borges and Couri (2009) *versus* proepisternum black with metallic blue iridescence and sparsely white pruinose in the Bolivian specimens (Fig. 4)]. Proepimeron

blue metallic (Fig. 3) [*versus* proepimeron black in the Brazilian specimens, see figure 7 in Borges and Couri (2009)]. Scutum broadly black, black pruinose, with a medial metallic blue vitta and 2 submedial dark brown-black vittae (Fig. 5) [*versus* scutum black except yellow laterally after transverse suture, bronze pollinose except for bluish-white pollinose medial vitta, yellow pilose in the Brazilian specimens, see figure 7 in Borges and Couri (2009) *versus* scutum dark, with yellow margin, with a medial metallic blue vitta, 2 submedial dark brown vittae and 2 sublateral metallic blue vittae in the Bolivian specimens (Fig. 6)], Scutellum black, yellow pilose, except for a yellow apex (Figs 3, 5) [*versus* scutellum usually black, sometimes black with yellow margins, yellow pilose in the Brazilian specimens, see figure 7 in Borges and Couri (2009) *versus* scutellum black with yellow margin, yellow pilose in the Bolivian specimens (Figs 4, 6)]. Anterior anepisternum metallic blue (Fig. 3) [*versus* anterior anepisternum black, long yellow pilose in the Brazilian specimens, see figure 7 in Borges and Couri (2009) *versus* anterior anepisternum black with metallic blue iridescence, yellow pilose in the Bolivian specimens (Fig. 4)]. Posterior anepisternum cream yellow (Fig. 3) [*versus* posterior anepisternum black anterior 2/3, yellow pilose dorsally, and yellow posterior 1/3, yellow pilose in the Brazilian specimens, see figure 7 in Borges and Couri (2009) *versus* posterior anepisternum black with metallic blue iridescence, except for the yellow posterior 1/2, yellow pilose in the Bolivian specimens (Fig. 4)]. Katepisternum metallic blue, except 1/3 brownish apical (Fig. 3) [*versus* katepisternum black, with macula yellow dorsally in the Brazilian specimens, see figure 7 in Borges and Couri (2009) *versus* katepisternum black with metallic blue iridescence in the Bolivian specimens (Fig. 4)]. Anepimeron completely metallic blue (Fig. 3) [*versus* anepimeron black in the Brazilian specimens, see figure 7 in Borges and Couri (2009)]. Calypter dark brown (Fig. 3) [*versus* calypter yellow to brownish with brownish fringe except brown fringe on dorsal lobe in the Brazilian specimens, see figure 7 in Borges and Couri (2009) *versus* calypter light brown in the Bolivian specimens (Fig. 4)], Posterior mesothoracic pleuron (katepimeron, meron, katatergum, anatergum and postscutellum) blue metallic (Fig. 3) [*versus* posterior mesothoracic pleuron (katepimeron, meron, katatergum, anatergum and postscutellum) black in the Brazilian specimens, see figure 7 in Borges and Couri (2009)]. Metathoracic pleuron blue metallic (Fig. 3) [*versus* metathoracic pleuron black in the Brazilian specimens, see figure 7 in Borges and Couri (2009)]. Metasternum blue metallic (Fig. 3) [*versus* metasternum black in the Brazilian specimens, see figure 7 in Borges and Couri (2009)].

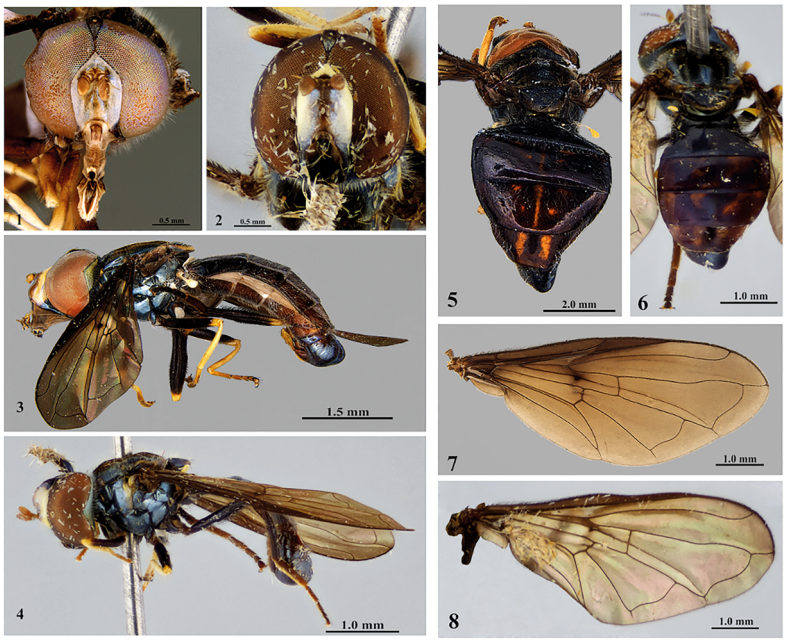
Wing (Figs. 7–8): brownish, entirely microtrichose in the Colombian specimens (Fig. 7) [*versus* wing brownish light in the Bolivian specimens (Fig. 8)]. Alula narrow, as broad as cell bm (Fig. 7) [*versus* alula as broad as cell bm apically or as broad as cell c, microtrichose in the Brazilian specimens, see figure 13 in Borges and Couri (2009) *versus* alula narrower than cell bm in the Bolivian specimens (Fig. 8). Costal cell and pterostigma brown (Fig. 7).

Abdomen (Figs. 5–6): tergites black with yellowish to slightly orange markings and black pilose in the Colombian specimens (Fig. 5) [*versus* terga black with yellow markings and black pilose in Brazilian specimens, see figure 28 in Borges and Couri (2009) *versus* tergites black with dark orange markings, sparsely black pilose in Bolivian specimens (Fig. 6). 1st tergum entirely black, 2nd tergum entirely black with a metallic blue macule medially (Fig. 5) [*versus* 2nd tergum usually black with medial yellow fascia interrupt medially in Brazilian specimens, see figure 28 in Borges and Couri (2009) *versus* 2nd tergum entirely black in Bolivian specimens (Fig. 6). 3rd tergum with triangle basolateral brownish maculae and one sublateral brownish maculae. 4th tergum triangle basolateral and sublateral arcuate yellowish to slightly orange maculae (Fig. 5) [*versus* 3rd to 4th terga black with yellow fascia on anterior 1/3 with sub-lateral triangular projection, sub-medial arcuate projection and medial yellow vitta extending from anterior to posterior brownish fascia in the Brazilian specimens, see figure 28 in Borges and Couri (2009) *versus* 3rd and 4th tergum with rectangular orange lateral maculae, basolateral and sublateral arcuate orange maculae and a black medial vitta in the Bolivian specimens (Fig. 6)]. 5th tergum square lateral macula yellowish to slightly orange, sublateral and medial black vitta, maculae sub-lateral arcuate yellowish to slightly orange (Fig. 5) [*versus* 5th tergum usually black with medial yellow vittae and lateral and posterior yellow maculae in the Brazilian specimens, see figure 28 in Borges and Couri (2009) *versus* 5th tergum with lateral, rectangular, brownish maculae and submedial orange maculae, broad black midline in the Bolivian specimens (Fig. 6)].

Legs (Fig. 3–4): coxae blue metallic (Fig. 3) [*versus* coxae black, yellow or black pilose in the Brazilian specimens in Borges and Couri (2009: 34)]. Femora dark brown, metafemur black, except yellow on apical 1/6 (Fig. 3) [*versus* femora black, yellow on basal and apical extremities, yellow and black pilose in the Brazilian specimens in Borges and Couri (2009: 34) *versus* femora black, black pilose, except yellow apical and basal extremities which are yellow pilose in the Bolivian specimens (Fig. 4)]. Pro and mesotibia yellow; metatibia black, except yellow on the basal 1/5 (Fig. 3) [*versus* pro and mesotibiae yellow, yellow and black pilose in the Brazilian specimens in Borges and Couri (2009: 34) *versus* pro and mesotibia yellow, yellow pilose, metatibia dark brown, except 1/8 basal yellow, dark brown pilose in the Bolivian specimens (Fig. 4)]. Pro and mesotarsomeres yellow, yellow-brownish pilose; metatarsus black, black pilose (Fig. 3) [*versus* tarsi brown, black pilose in the Brazilian specimens in Borges and Couri (2009: 34) *versus* pro and mesotarsomeres yellow and metatarsomeres dark brown, all yellow pilose, metatarsus brown, brown pilose in the Bolivian specimens (Fig. 4)].

Terminalia (Figs 9–15): cercus elongated, basally thin and medially widened, surstylus yellowish to brownish, antero-posteriorly convex with long setae in the Colombia specimens (Figs 9–13) [*versus* surstylus very convex laterally and very concave medially,

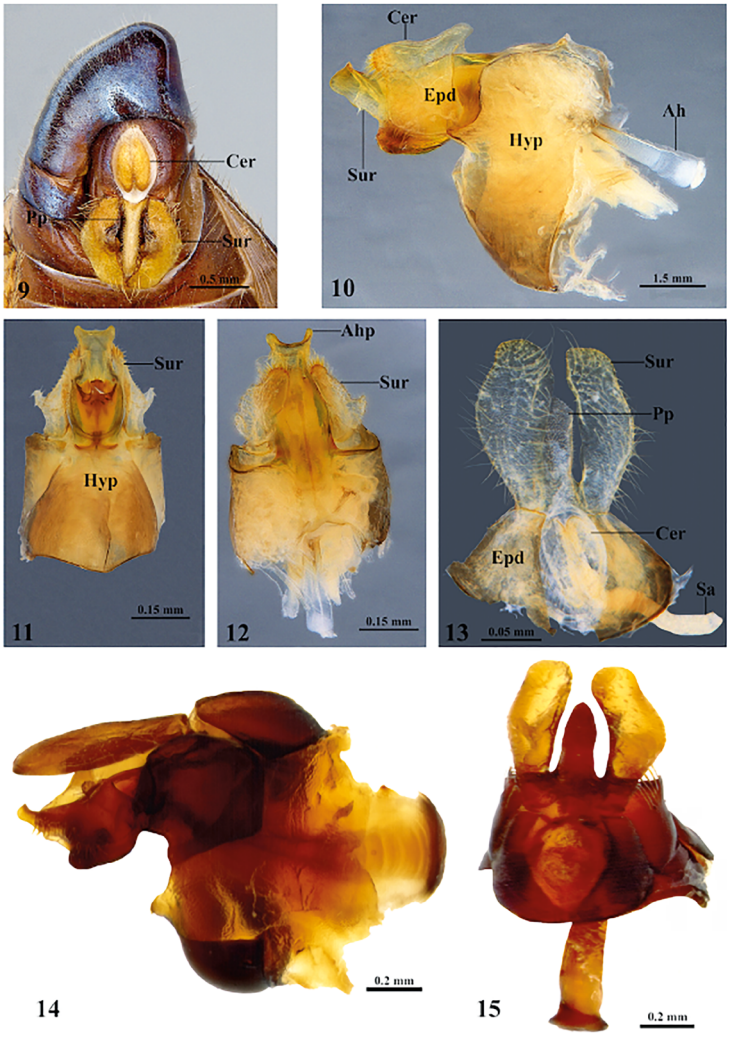
with scattered short setae in the Brazilian specimens see figures 47–49 in Borges and Couri (2009) *versus* surstylus broad, ventrally convex in the Bolivian specimens (Fig 14–15)]. Postanal process 3/4 shorter than surstylus, sharp apex (Fig. 13) [*versus* postanal process rounded apex in the Brazilian specimens, see figures 47–49 in Borges and Couri (2009) *versus* postanal process with apex obtuse in the Bolivian specimens (Fig. 15)]. Epandrium semi-triangular, in lateral view (Fig. 10). Surstylus from side view hammerhead-shaped (Fig. 10): Hypandrium from ventral view T-shaped (Fig. 11). Aedeagus enlarged (Figs. 10, 12). Superior lobe (hypandrium appendix) elongated (Fig. 11–12) [*versus* superior lobe somewhat quadrangular with short dorsal extension, with hairs anteroventrally, with small lobe posterodorsally with hairs in the Brazilian specimens, see figure 47–49 in Borges and Couri (2009)].



Figures 1–8. *Toxomerus flaviplurus* (Hall, 1927) male: **1.** Head, frontal view, Colombian specimens (LEUA–55130); **2.** Head, frontal view Bolivian specimen (CSCA); **3.** Habit, lateral view, Colombian specimens; **4.** Habit, lateral view Bolivian specimen; **5.** Abdomen, dorsal view, Colombia specimens; **6.** Abdomen, dorsal view, Bolivian specimen; **7.** Wing, Colombian specimens; **8.** Wing, Bolivian specimen.

Female. (Figs 16–18). Similar to male, except for pruinose yellow-white occiput, white pilose laterally in the Bolivian specimens (Fig.16–17) [*versus* black, silver pollinose occiput, with thickened white pile, with a short row of superior brown pile in the Brazilian specimens in Borges and Couri (2009: 34)].

Geographical distribution. (Fig. 19). *Toxomerus flaviplurus* is known from Guatemala, Costa Rica, Brazil, Panama, Trinidad, Colombia (Valle del Cauca), Venezuela and Ecuador. In this study, the species is recorded for the first time in the low Andes and Andean-Amazonian forests of the departments of Antioquia and Caquetá, Colombia (25-283 m.), with its southernmost distribution expanding to Cochabamba, Bolivia (new record) (460 m.).



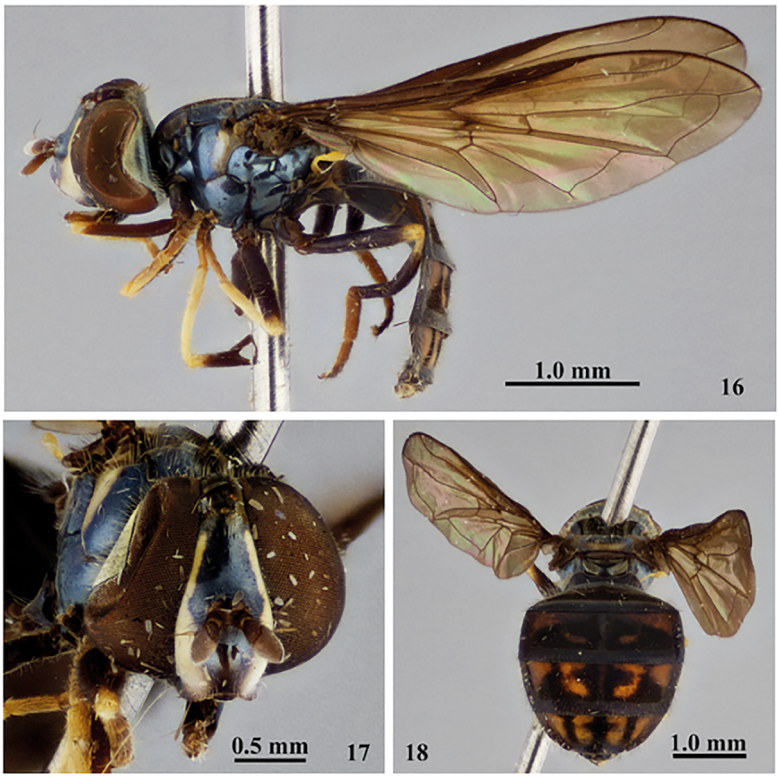
Figures 9–15. Male genitalia of *Toxomerus flaviplurus* (Hall, 1927), 8th-9th tergum and associated structures: **9.** Surstylus, cercus, and postanal process, ventral view; **10.** Complete genitalia including epandrium, hypandrium, cercus and surstylus, lateral view; **11.** Hypandrium, ventral view; **12.** Hypandrium, dorsal view; **13.** Surstylus and cercus, ventral view, Colombian specimens; **14.** Complete genitalia including epandrium, hypandrium, cercus and surstylus, lateral view; **15.** Surstylus, cercus and postanal process, ventral view, Bolivian specimen. Abbreviations used in male genitalia structures are as follows: **Ah** = Aedeagal hood; **Ahp =** appendix hypandrium (superior lobes); **Cer** = Cercus; **Epd** = Epandrium; **Hyp** = Hypandrium; **Pp** = Postanal Process; **Sa**= Surstylar apodeme; **Sur** = Surstyle.

Discussion

The flower fly fauna in the Andean region has been extensively studied, especially in the paramos, where the largest number of syrphids species in Colombia is found (Montoya et al. 2012, 2021; Montoya 2016), probably due to the wide topographic variety of the region (1000-5,400 m asl), as well as the cloud forests and the paramo complex, which act as geographic barriers, causing the speciation of many taxonomic groups (Montoya et al. 2012). In recent years, new species of *Argentinomyia* Lynch-Arribálzaga, 1891 (Montoya & Wolff, 2020; 2023), *Lycopale* Hull, 1944 (Montoya et al. 2024) and *Quichuana* Knab, 1813 (Montoya et al., 2017) have been described from the Andean region.

The Amazon Region is recognized worldwide for its high concentration of endemism, unmatched species diversity and invaluable provision of ecosystem services (Myers et al., 2000; Haffer, 2008). Despite this, the region is currently considered one of most threatened by global warming and increasing anthropogenic pressures, facing alarming and uncontrolled deforestation rates (Salati, 1985; Fearnside, 1993; Myers et al., 2000; Vulinec, 2000; Colwell et al., 2008; Murcia et al., 2014; FCDS, 2022).

These regions are home to a high diversity of flower flies (Reemer and Ståhls, 2013; Reemer, 2016; Miranda et al., 2014; Miranda, 2017; Carvalho-Filho et al., 2019; Montoya et al., 2021; Montoya and Wolff, 2023; Parada-Marin et al., 2024a, 2024b), with important recent contributions to the knowledge of the Colombian Andean-Amazonian fauna, including the description of the new species, *Copestylum enriquei* (Montoya, Parada-Marín & Ramos-Pastrana, 2021; *Alipumilio aureus* Parada-Marin, Mengual & Ramos-Pastrana, 2024a) and the extension of the range of rare genera and species (*Cepa apeca* Thompson, 2007 and *Nausigaster meridionalis)* in the country (Parada-Marín et al., 2021, Parada-Marin et al., 2024b). Although the region has been poorly explored, the new distributional record and its southernmost range extension highlight the potential that further research in unexplored areas of the Andean-Amazon region of Colombia and Bolivia should provide new records of distribution as well as discover new species for science, as has been evidenced in recent contributions.



Figures 16–18. Female *Toxomerus flaviplurus* (Hall, 1927) from Bolivia, (CSCA). **16.** Habitus, lateral view; **17.** Head, frontal view; **18.** Habitus, dorsal view.

Finally, the high morphological variation of *Toxomerus flaviplurus* evidenced in this work is in line with other species like *T. dispar* (Fabricius, 1794) and *T. floralis* (Fabricius, 1798), whose abdominal and thorax patterns are highly variable [for *T. dispar* see Thompson (1981): figure 91a-c; also see Thompson and Thompson (2006): figures 5–7; Borges and Couri (2009): figures 6, 25; Reemer (2010): figures 68–69; see Mengual (2011): figures 1–5. For *T. floralis* see Thompson (1981): figure 92; Thompson and Thompson (2006): figures 8–9; Borges and Couri (2009): 35; Reemer (2010): figure 70–71; Jordaens et al. (2015): figure 1a-c]. The comparative discussion provided in this study for the intraspecific variation of *T. flaviplurus* can help to determine this species and avoid misidentifications in further studies.

Figure 19. Geographical distribution of *Toxomerus flaviplurus* (Hall, 1927).

Acknowledgments

We would like to thank Universidad de la Amazonia and Ministerio de Ciencia Tecnología e Innovación for their support through the projects "Taxonomía de Pipunculidae (Diptera: Insecta) de Colombia" No. 1131712497–49–2015 and "Fortalecimiento de vocaciones científicas en jóvenes mediante becas-pasantías en la Región centro Sur, Caquetá, Amazonas, Putumayo, Huila y Tolima" BPIN 2022000100076.

References

Borges, Z.M. & Couri, M.S. (2009). Revision of *Toxomerus* Macquart, 1855 (Diptera: Syrphidae) from Brazil with synonymic notes, identification key to the species and description of three new species. *Zootaxa*, 2179: 1–72. https//doi.org/10.11646/zootaxa.2179.1.1

Carvalho-Filho, F.D.S., Martins, M.B., De Souza, M.T. & Reemer, M. (2019). Revision of the Neotropical genus *Domodon* Reemer (Diptera: Syrphidae), with description of three new species. *Zootaxa*, 4648(3): 523–536. https://doi.org/10.11646/zootaxa.4648.3.7

Colwell, R., Brehm, G., Cardelús, C. & Gilman, A. (2008). Global warming, elevational range shifts, and lowland biotic attrition in the wet tropics. *Science*, 322 (5899): 258–261.
https://doi.org/10.1126/science.1162547

Curran, C.H. (1930). New Diptera belonging to the genus *Mesogramma* Loew (Syrphidae). *American Museum Novitiates*, 405: 1–14.

Fabricius, J.C. (1794). *Entomologia systematica emendata et aucta*. C. G. Proft, Hafniae, 472p.

Fabricius, J.C. (1798) *Supplementum entomologiae systematicae*. C. G. Proft et Storch, Hafniae [= Copenhagen], 572p.

Fearnside, P.M. (1993) Deforestation in the Brazilian Amazonia: The effect of population and land tenure. *Ambio*, 22: 537–545.

Fleischmann, A., Gonella, P., Rojo, S. & Mengual, X. (2022) Attracted to feed, not to be fed upon on the biology of *Toxomerus basalis* (Walker, 1836), the kleptoparasitic 'sundew flower fly' (Diptera: Syrphidae). *Journal of Tropical Ecology*, 38: 1–13. https://doi.org/10.1017/S0266467422000128.

Fleischmann, A., Rivadavia, F., Gonella, P.M., Pérez-Bañón, C., Mengual, X. & Rojo, S. (2016). Where Is My Food? Brazilian Flower Fly Steals Prey from Carnivorous Sundews in a Newly Discovered Plant-Animal Interaction. *Plos One*, 11(5): e0153900.

https://doi.org/10.1371/journal.pone.0153900
Fluke, C.L. (1956). Catalogue of the family Syrphidae in the Neotropical Region. *Revista Brasileira de Entomologia*, 6: 193–268.
Fundación para la Conservación y el Desarrollo Sostenible (FCDS). (2022). Monitoreo de pérdida de cobertura vegetal enero - febrero 15 de 2022. Informe 01, 12p.
Haffer, J. (2008). Hypotheses to explain the origin of species in Amazonia. *Brazilian Journal of Biology*, 68(4): 917–947.
https://doi.org/10.1590/S1519-69842008000500003
Hall, D.G. (1927). A new syrphid (Diptera) from Guatemala. *Entomological News*, 38: 239–240.
Hull, F.M. (1943). The genus *Mesogramma*. *Entomologica Americana*, 23: 1–41.
Jordaens, K., Goergen, G., Kirk-Spriggs, A.H., Vokaer, A., Backeljau, T. & De Meyer, M. (2015). A second New Word hoverfly, *Toxomerus floralis* (Fabricius) (Diptera: Syrphidae), recorded from the Old World, with description of larval pollen-feeding ecology. *Zootaxa*, 4044(4): 567–576.
https://doi.org/10.11646/zootaxa.4044.4.6
Macquart, J. (1855). Diptères exotiques nouveaux ou peu connus. *5e Supplément des Mémoires de la Societé des Sciences de l'Agriculture et des Arts de Lille*, 1854: 25–156.
Marín, A.J.C. (1969). Nota sobre las larvas de *Mesograpta polita* (Say) (Syrphidae, Diptera) en espigas de maíz (*Zea mays* L.) en El Limón, Aragua, Venezuela [Note on the larvae of *Mesograpta polita* (Say) (Syrphidae, Diptera) on the staminate flowers of corn (*Zea mays* L.) in El Limón, Aragua, Venezuela]. *Agronomía Tropical*, 19: 335–339.
Marín-Armijos, D., Quezada-Ríos, N., Soto-Armijos C. & Mengual X. (2017). Checklist of the flower flies of Ecuador (Diptera, Syrphidae). *ZooKeys*, 691: 163–199.
https://doi.org/10.3897/zookeys.691.13328
Mengual, X., Ståhls, G. & Rojo, S. (2015). Cladistics Phylogenetic relationships and taxonomic ranking of pipizine flower flies (Diptera: Syrphidae) with implications for the evolution of aphidophagy. *Cladistics*, 31(5): 491–508. https://doi.org/10.1111/cla.12105
Mengual, X. (2011). Black-tie dress code: two new species of the genus *Toxomerus* (Diptera, Syrphidae). *Zookeys*, 140: 1–29.
https://doi.org/10.3897/zookeys.140.1930.
Mengual, X. (2020). Phylogenetic relationships of the bacchine flower flies (Diptera: Syrphidae) based on molecular characters, with a description of a new species of *Melanostoma* (Schiner, 1860). *Contributions to Zoology*, 89: 210–244. https://doi.org/10.1163/18759866-20191410
Mengual, X. (2015). The systematic position and phylogenetic relationships of *Asiobaccha* Violovitsh (Diptera, Syrphidae). *Journal of Asia-Pacific Entomology*, 18: 397–408. https://doi.org/10.1016/j.aspen.2015.03.010
Mengual, X. (2022). New species of *Myolepta* Newman, 1838 (Diptera, Syrphidae) from the Indomalayan Realm. *European Journal of Taxonomy*, 833: 97–120. https://doi.org/10.5852/ejt.2022.833.1885.
Mengual, X. & Thompson, F.C. (2011). Carmine cochineal killers: the flower fly genus *Eosalpingogaster* Hull (Diptera: Syrphidae) revised. *Systematic Entomology*, 36(4): 713–731.
https://doi.org/10.1111/j.1365-3113.2011.00588.x
Mengual, X., Ståhls, G. & Rojo, S. (2008). Molecular phylogeny of *Allograpta* (Diptera, Syrphidae) reveals diversity of lineages and non-monophyly of phytophagous taxa. *Molecular Phylogenetics and Evolution*, 49(3): 715–727.
https://doi.org/10.1016/j.ympev.2008.09.011
Mengual, X., Mayer, C., Burt, T.O., Moran, K.M., Dietz, L., Nottebrock, G., Pauli, T., Young, A.D., Brasseur, M.V., Kukowka, S., Kelso, S., Etzbauer, C., Bot, S., Hauser, M., Jordaens, K., Miranda, G.F.G., Ståhls, G., Van, Steenis, W., Peters, R.S. & Skevington, J.H. (2023) Systematics and evolution of predatory flower flies (Diptera: Syrphidae) based on exon- capture sequencing. *Systematic Entomology*, 48: 250–277.
https://doi.org/10.1111/syen.12573
Mengual, X., Ståhls, G. & Rojo, S. (2012). Is the mega-diverse genus *Ocyptamus* (Diptera, Syrphidae) monophyletic? Evidence from molecular characters including the secondary structure of 28S rRNA. *Molecular Phylogenetics and Evolution*, 62: 191–205. https://doi.org/10.1016/j.ympev.2011.09.014
Mengual, X., Ståhls, G. & Skevington, J.H. (2021). Life on an Islan: the phylogenetic placement of *Loveridgeana* and Afrotropical *Sphaerophoria* (Diptera: Syrphidae) inferred from molecular characters. *Systematics and Biodiversity*, 19: 22–53. https://doi.org /10.1080/14772000.2020.1795743
Miranda, G.F.G. (2017). Identification key for the genera of Syrphidae (Diptera) from the Brazilian Amazon and new taxon records. *Acta Amazonica*, 47(1): 53–62. http://doi.org/10.1590/1809-4392201601022
Miranda, G.F.G., Marshall, S.A. & Skevington, J.H. (2014). Revision of the genus *Pelecinobaccha* Shannon, description of *Relictanum* gen. nov., and redescription of *Atylobaccha flukiella* (Curran, 1941) (Diptera: Syrphidae). *Zootaxa*, 3819(1): 1–154. https://doi.org/10.11646/Zootaxa.3819.1.1
Miranda, G.F.G., Skevington, J.H., Marshall, S.A. & Kelso, S. (2016) The genus *Ocyptamus* Macquart (Diptera: Syrphidae): a molecular phylogenetic analysis. *Arthropod Systematics and Phylogeny*, 74: 161–176.
Montoya, A.L. & Wolff, M. (2023). Taxonomic revision of the Neotropical genus *Argentinomyia* Lynch-Arribálzaga, 1891 (Diptera: Syrphidae), with description of 16 new species. *Zootaxa*, 5234(1): 1–157.
https://doi.org/10.11646/zootaxa.5234.1.1
Montoya, A.L. (2016). Family Syrphidae. *Zootaxa*, 4122(1): 457–537. https://doi.org/10.11646/zootaxa.4122.1.39
Montoya A.L., Ricarte, A. & Wolff, M. (2017) Two new species of *Quichuana* Knab (Diptera: Syrphidae) from the Paramo ecosystems in Colombia. *Zootaxa* 4244(3), 390–402. http://doi.org/10.11646/zootaxa.4244.3.7
Montoya, A.L. & Wolff, M. (2020) Description of six new large species of *Argentinomyia* Lynch-Arribálzaga, 1891 and redescription of *Talahua fervida* (Fluke, 1945) (Diptera, Syrphidae, Syrphinae). *ZooKeys*, 929, 19–51. https://doi.org/10.3897/zookeys.929.37666
Montoya, A.L. (2024). Description of two new species of *Lycopale* (Diptera: Syrphidae) from the northwestern Tropical Andes Hotspots, with the redescription of *Lycopale magnifica*. *Acta Entomologica Musei Nationalis Pragae*, 64(2): 307-325. https://doi.org/10.37520/aemnp.2024.022.

Montoya, A.L., Parada-Marín, H.M. & Ramos-Pastrana, Y. (2022). Description of a new flower fly species of the *Copestylum vagum* group (Diptera: Syrphidae) from pristine Amazonian rainforests of Colombia and Suriname. *Zootaxa*, 5091(3): 401–415. https://doi.org/10.11646/zootaxa.5091.3.1

Montoya, A.L., Parra, J.L. & Wolff, M. (2021). Structure and diversity of hoverflies (Diptera: Syrphidae) in northwestern Colombian Páramos: towards the identification of bioindicator species in the Tropical Andes. *Journal Insect Conservation*, 25(4): 1–20. https://doi.org/10.1007/s10841-021-00346-3

Montoya, A.L., Pérez, S. & Wolff, M. (2012). The diversity of lower Flies (Diptera: Syrphidae) in Colombia and their Neotropical distribution. *Neotropical Entomology*, 41(1): 46–56. https://doi.org/10.1007/s13744-012-0018-z.

Murcia, U., Medina, R., Rodríguez, J., Hernández, A., Herrera, E. & Castellanos, H. (2014). *Cambio de uso del suelo: Monitoreo de los bosques y otras coberturas de la Amazonia Colombiana, a escala 1:100.000. Cambios multitemporales 2002 al 2012, con énfasis en el periodo 2007-2012*. Instituto Amazónico de Investigaciones Científicas "SINCHI". Bogotá, D.C., 144p.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., Da Fonseca, G.A.B. & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, 403: 853–858. https://doi.org/10.1038/35002501

Parada-Marín, H.M., Montoya, A.L. & Ramos-Pastrana, Y. (2021). New record of *Cepa apeca* (Diptera, Syrphidae, Eristalinae, Merodontini) in the Andean-Amazonian region of Colombia and expansion of its geographic range. *Acta Amazonica*, 51: 162–165. http://doi.org/10.1590/1809-4392202003841

Parada-Marin, H.M., Mengual, X. & Ramos-Pastrana, Y. (2024a). A new species of *Alipumilio* Shannon, 1927 (Diptera: Syrphidae), with the description of the male of *A. avispas* Vockeroth, 1964 and *A. femoratus* Shannon, 1927. *Zootaxa*, 5506(3): 350–368. https://doi.org/10.11646/zootaxa.5506.3.3

Parada-Marin, H.M., Mengual, X., Ramos-Pastrana, Y. (2024b). First record of *Nausigaster meridionalis* Townsend (Diptera: Syrphidae) from Colombia. *Caldasia*, 46(3). https://doi.org/10.15446/caldasia.v46n3.112651

Reemer, M. & Rotheray, G.E. (2009). Pollen feeding larvae in the presumed predatory syrphine genus *Toxomerus* Macquart (Diptera, Syrphidae). *Journal of Natural History*, 43: 939–949. https://doi.org/10.1080/00222930802610576.

Reemer, M. & Ståhls, G. (2013). Generic revision and species classification of the Microdontinae (Diptera, Syrphidae). *Zookey*, 288: 1–213. https://doi.org/10.3897/zookeys.288.4095

Reemer, M. (2010). A second survey of Suriname Syrphidae (Diptera): Introduction and Syrphidae. *Tijdschrift voor Entomologie*, 53: 163–196. http://doi.org/10.1163/22119434-900000295

Reemer, M. (2016). Syrphidae (Diptera) of Surinam: Eristalinae and synthesis. *Tijdschrift voor Entomologie*, 159: 97–142. https://doi.org/10.1163/22119434-15902002

Rojo, S., Gilbert, F., Marcos-García, M.A., Nieto, J.M. & Mier, P.M. (2003). *A world review of predatory hoverflies (Diptera, Syrphidae: Syrphinae) and their prey*. CIBIO, Alicante, España. 319p.

Salati, E. (1985). The climatology and hydrology of Amazonia. In: Prance, G.H. & Lovejoy, T.E. (Eds.). Key environments: Amazonia. Pergamon Press, Oxford. p. 18–48.

Shorthouse, D.P. (2010). SimpleMappr, an online tool to produce publication-quality point maps (https://www.simplemappr.net) Accessed 28/06/2022.

Smith, J.G. (1974). Observações sobre larvas de *Toxomerus politus* (Say), 1823 (Dipt., Syrphidae) alimentando-se em pólen de milho (Zea mays L.) [Observations on the larvae of *Toxomerus politus* (Say, 1823) (Diptera, Syrphidae) feeding on maize pollen (*Zea mays* L.)]. *Ciência & Cultura*, 26(7): 353.

Thompson, F.C. & Thompson, B.J. (2006). A new *Toxomerus* species from Chile (Diptera: Syrphidae). *Studia dipterologica*, 13: 317–331.

Thompson, F.C. (1981). The flower flies of the West Indies (Diptera: Syrphidae). *Memoirs of the Entomological Society of Washington*, 9: 1–200.

Thompson F.C. (2016). The Cocos Island flower fly (Diptera: Syrphidae, *Toxomerus* Macquart). *Entomologist's Monthly Magazine*, 152: 49–51.

Thompson, F.C., Rotheray, G.E. & Zumbado M.A. (2010). Syrphidae (Flower flies). In: Brown, B.V., Borkent, A., Cumming, J.M., Wood, D.M., Woodley N.E. & Zumbado, M.A. (Eds.). Manual of Central American Diptera, Volume 2. NRC Research Press, Ottawa. p. 763–792.

Thompson, F.C., Vockeroth, J. R., Sedman, Y.S. & Papavero, N. (1976). *A Catalogue of the Americas South of the United States: Family Syrphidae*. Vol. 46. Museu de Zoologia, São Paulo, 195p.

van Steenis, J., Miranda, G.F.G., Tot, T., Mengual, X. & Skevington, J.H. (2023) Glossary of morphological terminology of adult Syrphidae (Diptera): an update and extension. *Journaal van Syrphidae*, 2 (4), 1–99. https://doi.org/10.55710/1.AIMS1978

Vockeroth, J.R. (1969). A revision of the genera of the Syrphini (Diptera: Syrphidae). *Memoirs of the Entomological Society of Canada*, 62: 1–176.

Vulinec, K. (2000): Dung Beetles (Coleoptera: Scarabaeidae), monkeys and conservation in Amazonian. *Florida Entomologist*, 83: 229–241.