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TAXONOMIA DE PIPUNCULIDAE (DIPTERA: INSECTA) DA COLÔMBIA

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Manaus, Amazonas
Março, 2023

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Sinopse:

Foi realizado um estudo taxonômico de Pipunculidae da Colômbia. Foram estudados 10 gêneros, foram descritas 28 espécies novas, e feitos 14 novos registros para o país. São apresentadas novas/atualizadas chaves dicotômicas para as espécies neotropicais, assim como mapas de distribuição para a Colômbia e comentários sobre os hábitats de ocorrência das espécies foram fornecidos.

Palavras Chave: Amazônia, Andes, Biodiversidade, Moscas cabeçudas, Taxonomia.

Dedico este trabalho aos meus pais Eliecer e Lucy e
à minha esposa Paola e ao meu filho Klisnmann,
com muito amor e gratidão.

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REJEIÇÃO PARA FINS DE NOMENCLATURA ZOOLÓGICA

Este trabalho, na forma em que se apresenta (tese de doutorado), não deve ser considerado como publicação válida para fins de nomenclatura zoológica. Este é o "*disclaim and denegation*" mencionado no Código Internacional de Nomenclatura Zoológica (edição 1999), capítulo três, artigos 8.2 e 8.3.

REJECTION FOR ZOOLOGICAL NOMENCLATURE PURPOSES

This work, in the form in which it is presented (PhD. thesis), should not be considered as a valid publication for zoological nomenclature purposes. This is the *disclaim and denegation* mentioned in the International Code of Zoological Nomenclature (edition 1999), chapter three, articles 8.2 and 8.3.

RESUMO

Pipunculidae (Diptera: Brachycera: Cyclorrhapha) é um grupo cosmopolita que varia de 2,0-11,5 mm de comprimento, de coloração geralmente marrom-escura a preta, olhos compostos grandes que ocupam a maior parte da cabeça hemisférica a subesférica. Possui 28 gêneros e 1.402 espécies, distribuídas em quatro subfamílias: Chalarinae, Nephrocerinae, Pipunculinae e Protonephrocerinae. A fauna Neotropical é composta por 270 espécies, alocadas em 18 gêneros, distribuídas em três subfamílias: Chalarinae, Pipunculinae e Protonephrocerinae. Chalarinae possui três gêneros, dos quais só *Chalarus* Walker, 1834 tem distribuição Neotropical. Protonephrocerinae possui dois gêneros, desses só *Protonephrocerus* Collin, 1931 com distribuição Neotropical. Pipunculinae, com maior número de espécies, comprende três tribos: Microcephalopsini, Pipunculini e Tomosvaryellini, todas com distribuição neotropical. Antes deste estudo Colômbia tinha registradas 10 espécies e cinco gêneros de Pipunculidae e, apesar de ser um país considerado megadiverso, era um dos que possuía menor conhecimento sobre este grupo. Os objetivos deste trabalho foram realizar um estudo taxonômico de Pipunculidae da Colômbia, revisar a maioria dos gêneros e espécies do país, descrevendo os táxons novos (espécies), atualizar os registros geográficos e fotográficos das espécies e elaborar chaves de identificação dicotômicas para as espécies do país e da região neotropical. Os resultados são apresentados no formato de capítulos assim estruturados: (I) Capítulo 1 – revisão das espécies de *Chalarus* da Colômbia, descrevendo duas espécies novas (*Chalarus boyacensis* **sp. nov.** e *C. chairensis* **sp. nov.**) e documentando três novos registros para o país (*C. absonus* Rafael, 1990; *C. delicatus* Rafael, 1990 e *C. connexus* Rafel, 1988); (II) Capítulo 2 – revisão das espécies de *Clistoabdominalis* da Colômbia, descrevendo uma espécie nova (*Clistoabdominalis lucyae* **sp. nov.**) e fazendo um novo registro para o país [*C. spinitibialis* (Hardy, 1954)]; (III) Capítulo 3 – revisão das espécies de *Dasydorylas* da Colômbia, descrevendo três espécies novas (*Dasydorylas colombensis* **sp. nov.**, *D. gibbera* **sp. nov.**, e *D. santainensis* **sp. nov.**) e fazendo um novo registro para o país [*D. nigellus* (Rafael, 1990)]; (IV) Capítulo 4 – revisão das espécies de *Pipunculus* da Colômbia, descrevendo três espécies novas (*Pipunculus caeruleus* **sp. nov.**, *P. chiminiguagua* **sp. nov.**, e *P. planus* **sp. nov.**). No anexo são apresentados apenas a primeira página dos artigos publicados para evitar problemas de direitos autorais): (I) Anexo 1 – revisão das espécies de *Basileunculus* da Colômbia, trabalho que descreveu três espécies (*Basileunculus elieceri* Ramos-Pastrana *et al*. 2022, *B. elongatus* Ramos-Pastrana *et al*. 2022 e *B. tayronensis* Ramos-Pastrana *et al*. 2022 e documentou um novo registro para o país (*B. rex* Curran, 1943); (II) Anexo 2 – revisão das espécies de *Cephalops* e *Semicephalops* da Colômbia, trabalho que descreveu cinco espécies (*Cephalops acutus* Ramos-Pastrana *et al*. 2022; *C. gracilis* Ramos-Pastrana *et al*. 2022; *C. klinsmanni* Ramos-Pastrana *et al*. 2022; *C. lobatus* Ramos-Pastrana *et al*. 2022 e *Semicephalops folium* Ramos-Pastrana *et al*. 2022) e fez dois registros novos para o país (*C. amapaensis* Rafael, 1990 e *S. inpaganus* Rafael, 1990); (III) Anexo 3 – revisão das espécies de *Cephalosphaera* e *Neocephalosphaera* da Colômbia, trabalho que descreveu nove espécies (*Cephalosphaera munchiquensis* Ramos-Pastrana *et al*. 2022; *Neocephalosphaera carinae* Ramos-Pastrana *et al*. 2022; *N. grisea* Ramos-Pastrana *et al*. 2022; *N. iguaquensis* Ramos-Pastrana *et al*. 2022; *N. muisca* Ramos-Pastrana *et al*. 2022; *N. paolae* Ramos-Pastrana *et al*. 2022; *N. spinifera* Ramos-Pastrana *et al*. 2022; *N. spiralis* Ramos-Pastrana *et al*. 2022 e *N. sumapazensis* Ramos-Pastrana *et al*. 2022); (IV) Anexo 4 – revisão das espécies de *Tomosvaryella* da Colômbia, trabalho que descreveu duas espécies (*Tomosvaryella macarenensis* Ramos-Pastrana *et al*. 2021 e *T. martae* Ramos-Pastrana *et al*. 2021) e fez seis novos registros para o país [*T. galapagensis* (Curran, 1934); *T. lynchi* Shannon, 1927; *T. mexicanensis* Ale-Rocha e Rafael, 1995; *T. similis* Ale-Rocha e Rafael, 1995; *T. tuberculata* Ale-Rocha e Rafael, 1995 e *T. venezuelana* Ale-Rocha e Rafael, 1995], e também registrou *T. similis* Ale-Rocha e Rafael, 1995 pela primeira vez para a América do Sul. Nos trabalhos foram apresentadas chaves dicotômicas atualizadas para as espécies Neotropicais, mapas de distribuição para a Colômbia e comentários sobre os hábitats de ocorrência das espécies. Além disso, atualiza a fauna de Pipunculidae colombiana para 52 espécies, 14 gêneros e três tribos, pertencentes a duas subfamílias (Chalarinae e Pipunculinae) tornando o país com a segunda maior diversidade de Pipunculidae na região Neotropical.

ABSTRACT

Pipunculidae (Diptera: Brachycera: Cyclorrhapha) is a cosmopolitan group of small flies, ranging from 2.0-11.5 mm. Pipunculidae are usually dark brown to black flies, characterized by having large compound eyes that occupy most of the head, which is hemispherical to subspherical, being known as big-headed flies. The family harbors 28 genera and 1,402 described species to date, classified into 28 genera or subgenera, divided into four subfamilies: Chalarinae, Nephrocerinae, Pipunculinae and Protonephrocerinae. The Neotropical fauna is composed of 270 species, classified into 18 genera, divided into three subfamilies: Chalarinae, Pipunculinae and Protonephrocerinae. Chalarinae includes three genera, of which only *Chalarus* Walker, 1834 has a Neotropical distribution. Protonephrocerinae has two genera, but only *Protonephrocerus* Collin, 1931 with neotropical distribution. Pipunculinae is the most diverse subfamily, comprising three tribes: Microcephalopsini, Pipunculini, and Tomosvaryellini, all with a neotropical distribution. Before this study, Colombia had registered 10 species and five genera and, despite being considered a megadiverse country, Pipunculidae is one of the lesser-known Diptera groups. This thesis aims to taxonomically review most of the genera and species of Pipunculidae from Colombia, describe the new taxa found, and propose new dichotomous keys and redescriptions for neotropical species, supported by full images of critical characters, and also including a comparative diagnosis, with comments on habitats preferences as well as an update on the geographical distributional in the country. The results are presented in chapters structured as follows: (I) Chapter 1 – review of the species of *Chalarus* from Colombia, describing two new species (*Chalarus boyacensis* **sp. nov.** and *C. chairensis* **sp. nov.**), including three new records for the country (*C. absonus* Rafael, 1990; *C. delicatus* Rafael, 1990 and *C. connexus* Rafael, 1988); (II) Chapter 2 – review of the species of *Clistoabdominalis* from Colombia, describing a new species (*Clistoabdominalis lucyae* **sp. nov.**) as well as a new record for the country [*C. spinitibialis* (Hardy, 1954)]; (III) Chapter 3 – review of the species of *Dasydorylas* from Colombia, describing three new species (*Dasydorylas colombensis* **sp. nov.**, *D. gibbera* **sp. nov.**, and *D. santainensis* **sp. nov.**) and a new record for the country [*D. nigellus* (Rafael, 1990)]; (IV) Chapter 4 – review of the species of *Pipunculus* from Colombia, describing three new species (*Pipunculus caeruleus* **sp. nov.**, *P. chiminiguagua* **sp. nov.**, and *P. planus* **sp. nov.**). In the annex are presented only the cover page of the article to avoid copyright issues): (I) Annex 1 – review of the species of *Basileunculus* from Colombia, work that described three new species (*Basileunculus elieceri* Ramos-Pastrana *et al*. 2022; *B. elongatus* Ramos-Pastrana *et al*. 2022 and *B. tayronensis* Ramos-Pastrana *et al*. 2022), including a new record for the country (*B. rex* Curran, 1943); (II) Annex 2 – review of the species of *Cephalops* and *Semicephalops* from Colombia, work that described five new species (*Cephalops acutus* Ramos-Pastrana *et al*. 2022; *C. gracilis* Ramos-Pastrana *et al*. 2022; *C. klinsmanni* Ramos-Pastrana *et al*. 2022; *C. lobatus* Ramos-Pastrana *et al*. 2022 and *Semicephalops folium* Ramos-Pastrana *et al*. 2022) as well as two new distributional records for the country (*C. amapaensis* Rafael, 1990 and *S. inpaganus* Rafael, 1990); (III) Annex 3 – review of the species of *Cephalosphaera* and *Neocephalosphaera* from Colombia, work that described nine new species (*Cephalosphaera munchiquensis* Ramos-Pastrana *et al*. 2022; *Neocephalosphaera carinae* Ramos-Pastrana *et al*. 2022; *N. grisea* Ramos-Pastrana *et al*. 2022; *N. iguaquensis* Ramos-Pastrana *et al*. 2022; *N. muisca* Ramos-Pastrana *et al*. 2022; *N. paolae* Ramos-Pastrana *et al*. 2022; *N. spinifera* Ramos-Pastrana *et al*. 2022; *N. spiralis* Ramos-Pastrana *et al*. 2022 and *N. sumapazensis* Ramos-Pastrana *et al*. 2022); (IV) Annex 4 – review of the species of *Tomosvaryella* from Colombia, work that described two new species (*Tomosvaryella macarenensis* Ramos-Pastrana *et al*. 2021 and *T. martae* Ramos-Pastrana *et al*. 2021), including six new records for the country [*T. galapagensis* (Curran, 1934); *T. lynchi* Shannon, 1927; *T. mexicanensis* Ale-Rocha e Rafael, 1995; *T. similis* Ale-Rocha e Rafael, 1995; *T. tuberculate* Ale-Rocha e Rafael, 1995 and *T. venezuelana* Ale-Rocha e Rafael, 1995], and also the first record of the species *T. similis* Ale-Rocha e Rafael, 1995 for South America. In this work, new updated dichotomous keys for the Neotropical species were elaborated or updated, including distributional maps for Colombia and comments on habitat preferences. Additionally, updates the Colombian Pipunculidae fauna to 52 species, 14 genera and three tribes, belonging to two subfamilies (Chalarinae and Pipunculinae), placing the country as the second with the highest Pipunculidae diversity in the Neotropical region.

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INTRODUÇÃO GERAL

Pipunculidae

Pipunculidae Walker, 1834 (Diptera: Brachycera: Cyclorrhapha) é um grupo cosmopolita que varia de 2,0-11,5 mm de comprimento, de coloração geralmente marrom-escura a preta, olhos compostos grandes que ocupam a maior parte da cabeça hemisférica a subesférica, sendo conhecidos popularmente na língua inglesa como "big-headed flies" (Rafael e Skevington 2010). Os pipunculídeos são encontrados em todos os ecossistemas terrestres, exceto na Antártida (Skevington 2022). Os adultos são normalmente encontrados pairando entre a vegetação em áreas abertas na floresta, prados úmidos, regiões ribeirinhas ou ao longo de ecótonos (Skevington e Marshall 1998; Rafael e Skevington 2010).

Pipunculidae é facilmente reconhecido pela combinação dos seguintes caracteres: na maioria dos gêneros, exceto *Chalarus* Walker, 1834 e *Dorylomorpha* Aczél, 1939, os machos apresentam olhos holópticos, antena com pós-pedicelo com ápice obtuso a filiforme e arista dorsal; tórax de coloração geralmente marrom-escura a preta, com pruinosidade cinza, marrom ou ambas; asas longas e estreitas, geralmente hialinas, com célula r_{4+5} aberta; abdômen subcilíndrico, com coloração e pruinosidade geralmente similar ao tórax; terminália do macho voltada para o lado esquerdo e situada lateral ou ventralmente (Rafael e Skevington 2010). Nas fêmeas, as garras e pulvilos são mais desenvolvidos que nos machos e a terminália é modificada em ovipositor em forma de aguilhão, o qual é utilizado para perfuração da cutícula do hospedeiro e deposição dos ovos no interior do corpo (Rafael e Skevington 2010).

Os espécimes da família têm potencial para serem utilizados no controle biológico de pragas que atacam cultivos agrícolas e pastagens, pois as suas larvas são endoparasitoides de Hemiptera Auchenorryncha (e.g. Cercopidae, Cicadellidae, Cixiidae, Flatidae, Fulgoridae, Cercopidae, Membracidae e Delphacidae), que junto com Dryinidae (Hymenoptera) e Strepsiptera, são considerados os parasitoides mais importantes destas famílias de Hemiptera (Freytag, 1985; Waloff e Jervis 1987; Skevington e Marshall 1998; Koenig e Young 2007; Rafael e Skevington, 2010). Adicionalmente, Kehlmaier e Floren (2009) registraram espécimes de Pipunculidae parasitando espécimes de Tipulidae (Diptera), mais precisamente *Nephrocerus flavicornis* Zetterstedt, 1844 parasitando *Tipula* (*Beringotipula*) *unca* Wiedemann, 1817 e *Nephrocerus scutellatus* (Maquart, 1834) parasitando *Tipula* (*Lunatipula*) *helvola* Loew, 1873, ampliando a diversidade de hospedeiros de Pipunculidae e confirmando o potencial como espécie a ser utilizada como controle biológico.

A associação com os hospedeiros é bem conhecida para as espécies europeias (Waloff e Jervis 1987; Kehlmaier e Floren 2009), seguida pelas espécies neárticas e australasianas (Skevington e Marshall 1998; Skevington 2001; Rafael e Skevington 2010). Para a maioria das espécies de outras regiões não há dados biológicos. Para a região Neotropical, incluindo México, existem três estudos publicados. Hardy (1963) associou *Eudorylas absonditus* (Hardy, 1954) com a cigarrinha *Cicadulina pastusae* Ruppel & De Long, 1956 (Hemiptera: Cicadellidae) coletada em plantações de trigo no sul da Colômbia e norte de Equador. Vega *et al*. (1991) associou *Eudorylas* sp., provavelmente *E. absonditus* com a cigarrinha *Dalbulus maidis* (De Long & Wolcott, 1923) e *D. elimatus* (Ball, 1900) (Cicadellidae), no México. Virla e Rafael (1996) associaram *Cephalops penepauculus* (Hardy, 1965) com a cigarrinha *Toya propinqua* (Fieber, 1866) e *Dicranotropis fuscoterminata* Berg, 1879 (Hemiptera: Delphacidae). Rodríguez e Rafael (2012) publicaram um catálogo de espécies da América Latina com as informações a respeito da biologia e interações com os hospedeiros. A importância dos pipunculídeos no controle biológico estabelece-se principalmente quando a larva alcança sua maturidade e deixa o hospedeiro, causando a sua morte. O empupamento ocorre no solo, na serapilheira ou na bainha das folhas (Rodríguez e Rafael 2012).

Classificação

Atualmente Pipunculidae possui 28 gêneros e 1402 espécies (Skevington 2022), distribuídas em quatro subfamílias: Chalarinae Hardy, 1965, Nephrocerinae Carpenter & Hull, 1939, Pipunculinae Walker, 1834 e Protonephrocerinae Aczél, 1948 (Motamedinia *et al*. 2021). Chalarinae possui três gêneros, dos quais só *Chalarus* tem distribuição na região Neotropical (De Meyer 1996). Protonephrocerinae possui dois gêneros, desses só *Protonephrocerus* Collin, 1931 com distribuição Neotropical (De Meyer 1996). Pipunculinae, a subfamília com maior número de espécies, compreende três tribos: Microcephalopsini Aczél, 1940, Pipunculini Walker, 1834 e Tomosvaryellini Hardy, 1943 (Motamedinia *et al*. 2021). Para a região Neotropical são registradas 428 espécies, distribuídas em 15 gêneros (Rodríguez e Rafael 2012).

Para a Colômbia, antes deste projeto que já publicou quatro artigos, existiam registros de cinco gêneros e 10 espécies [*Amazunculus cardigaster* Galinkin e Rafael, 2008; *Dorylomorpha* (*Pipunculina*) *reveloi* Hardy, 1963; *Eudorylas absonditus* (Hardy, 1954); *Eudorylas dumicolus* (Hardy 1963); *Eudorylas spinosus* (Hardy, 1948); *Eudorylas subopacus* (Loew, 1866); *Microcephalops williansi* (Hardy, 1954); *Tomosvaryella prostata* Hardy, 1963;

Tomosvaryella scopulata Hardy, 1963 e *Tomosvaryella subvirescens* (Loew, 1872)] distribuídas nas regiões Amazônica, Andina e Pacífica (Rodríguez e Rafael 2012) e, apesar de ser um país considerado megadiverso, era um dos que possuía menor conhecimento sobre este grupo.

Os pipunculídeos são relacionados filogeneticamente com os Syrphidae Latreille, 1802 e juntos tratados na superfamília Syrphoidea, grupo irmão de Schizophora (Diptera) (Griffiths 1972; McAlpine 1989; Cumming *et al*. 1995). Estudos recentes propuseram que os pipunculídeos são grupo irmão da imensa radiação de Schizophora e os sirfídeos são grupo irmão de Pipunculidae + Schizophora (Wiegmann *et al*. 2011; Tachi 2014; Pauli *et al*. 2018).

Aczél (1948) elaborou o primeiro estudo filogenético de táxons superiores de Pipunculidae usando caracteres morfológicos com polaridade determinada por fósseis. Ele propôs que Chalarinae era grupo-irmão do resto da família, Dorilaini (= Pipunculinae) era monofilético, e criou as tribos Nephrocerini (*Nephrocerus* Zetterstedt, 1838) e Protonepherocerini (*Protonephrocerus* e *Metanephrocerus* Aczél, 1948). Nephrocerini foi proposta como grupo-irmão de Protonephrocerini + Dorilaini. Albrecht (1990) fez uma filogenia dos pipunculídeos usando uma abordagem quantitativa e computacional baseada na análise de compatibilidade e focada em caracteres externos dos adultos e das pupas (ignorando os caracteres genitais devido aos problemas de homologia). Ele propôs uma filogenia para sete gêneros de pipunculídeos cujos ínstares iniciais eram conhecidos com base em quatro caracteres adultos e cinco caracteres larvais e pupais. A filogenia proposta colocava *Verrallia* Mik, 1899 como grupo-irmão do resto dos táxons, *Chalarus* como grupo irmão de Pipunculinae e sugeriu que *Pipunculus* Latreille, 1802 e *Cephalops* Fallén, 1810 eram grupo-irmãos, assim como *Eudorylas* Aczél, 1940 e *Tomosvaryella* Aczél, 1939. *Nephrocerus* não foi incluído nesta hipótese.

Rafael e De Meyer (1992) produziram a primeira análise filogenética abrangente de Pipunculidae com base em um exame minucioso de caracteres morfológicos dos 25 gêneros reconhecido naquele momento. Eles propuseram dividir os pipunculídeos em três subfamílias, Chalarinae, Nephrocerinae e Pipunculinae. Cinco tribos foram definidas em Pipunculinae (Cephalopsini, Eudorylini, Microcephalopsini, Pipunculini e Tomosvaryellini). Foi levantada a hipótese de que Chalarinae ser grupo irmão de Nephrocerinae (incluindo *Nephrocerus* e *Protonephrocerus*) + Pipunculinae. *Pipunculus* + *Parapipunculus* Rafael, 1986 foi proposto como grupo irmão dos demais gêneros de Pipunculinae. *Beckerias* Aczél, 1939, *Cephalops*, *Cephalosphaera* Enderlein, 1936 e *Wittella* Hardy, 1950 foram recuperados como um clado,

assim como *Collinias* Aczél, 1940 e *Microcephalops* De Meyer, 1989. Seus esforços lançaram luz sobre muitas relações, mas ambiguidades notáveis permaneceram em Eudorylini. Além disso, *Witella* foi sinonimizado com *Cephalops*. De Meyer (1994) tratou das relações filogenéticas em Cephalopsini e criou *Neocephalosphaera* De Meyer, 1994, *Parabeckerias* De Meyer, 1994 e *Semicephalops* De Meyer, 1994 como subgêneros.

Skevington e Marshall (1998) produziram uma filogenia morfológica para os *Pipunculus* da região Neártica e o sinonimizou com *Parapipunculus* com base em evidências de que *P. tibialis* (Hardy, 1943) (espécie-tipo do gênero) tornou *Pipunculus* parafilético. Skevington e Yeates (2000) foram os primeiros a incluir dados moleculares em uma filogenia de pipunculídeos e combinaram mtDNA 12S e 16S com dados morfológicos para análise de nove gêneros de pipunculídeos e 13 gêneros de sirfídeos. Pipunculinae e Chalarinae foram suportados como monofiléticos, mas a posição de *Nephrocerus* e *Protonephrocerus* ficou mal resolvida. O primeiro foi a hipotetizado como grupo-irmão de Chalarinae e o segundo como grupo-irmão de Pipunculinae, baseado apenas nos dados moleculares. Quando combinada com a morfologia, Chalarinae foi proposta como grupo irmão de *Nephrocerus* + (*Protonephrocerus* + Pipunculinae).

Skevington e Yeates (2001) fizeram uma análise filogenética morfológica da tribo Eudorylini, baseados em 137 caracteres de 54 espécimes do grupo. Os autores propuseram dois gêneros monofiléticos, *Clistoabdominalis* Skevington, 2001 e *Dasydorylas* Skevington, 2001, e sinonimizaram *Metadorylas* Rafael, 1987 com *Eudorylas* e *Moriparia* Kozánek & Kwon, 1991 e *Congomyia* Hardy, 1949 com *Claraeola* Azcél, 1940. *Tomosvaryella* e *Dorylomorpha* ficaram em Eudorylini. Quatro grupos de gêneros também foram propostos; o grupo *Eudorylas*, incluindo *Eudorylas* e *Clistoabdominalis*, juntamente com o Tomosvaryellini foram hipotetizados como grupo irmão do resto dos táxons de Eudorylini. *Amazunculus* Rafael, 1986 e *Elmohardyia* Rafael, 1987 foram apoiados como grupos-irmãos e *Allomethus* Hardy, 1943, *Basileunculus* Rafael, 1987 e *Claraeola* também foram resolvidos como um grupo monofilético, como anteriormente proposto por Rafael e De Meyer (1992).

Kehlmaier e Assmann (2010) apresentaram uma filogenia molecular para Chalarinae baseada em COI mtDNA, 28S rDNA e ITS2 rDNA. O estudo corroborou a monofilia da subfamília e de *Chalarus* e *Verrallia*, mas não recuperou uma linhagem monofilética para *Jassidophaga* Aczél, 1939, (*Verrallia* aninhada em *Jassidophaga*). Motamedinia *et al*. (2021) realizaram a primeira filogenia molecular abrangente de Pipunculidae, a partir de análises de 6.963 pb de DNA dos seguintes loci: subunidade I do citocromo c oxidase (COI), citocromo b

(Cytb), DNA ribossômico 12S, região de carbamoil fosfato sintetase de CAD (CAD) e alanil-tRNA sintetase (AATS). Como resultado a monofilia de Pipunculidae e das subfamílias mais conhecidas, incluindo Chalarinae, Nephrocerinae, Pipunculinae e Protonephrocerinae, foram bem suportadas, assim como a maioria dos gêneros existentes. A análise molecular revelou que Nephrocerinae, com ou sem Protonephrocerinae, dependendo do método analítico, é grupo irmão do restante da família. Dentro de Pipunculinae, Cephalopsini foi sinonimizada com Pipunculini e Eudorylini com Tomosvaryellini, deixando Pipunculinae com três tribos: Microcephalopsini, Pipunculini e Tomosvaryellini. *Jassidophaga* foi proposto como sinônimo de *Verrallia*. *Beckerias*, *Cephalops s.s.*, *Cephalosphaera s.s.*, *Neocephalosphaera*, *Parabeckerias* e *Semicephalops* foram todos elevados ao status genérico. *Eudorylas fusculus* (Zetterstedt, 1844) e *E. vineti* Dempewolff, 1996 foram transferidos para *Clistoabdominalis*, *Clistoabdominalis ruralis* (Meigen, 1824) e *C. doczkali* (Kehlmaier, 2005) para *Eudorylas*. Além disso, foi proposto quatro novos gêneros de Pipunculidae, mais só um foi descrito, *Tricosus* Skevington & Motamedinia, 2021, com duas combinações, *Tricosus cyclohirtus* (Skevington, 2002) e *Tricosus anorhaebus* (Hardy, 1968).

Subfamília Chalarinae

Chalarinae é cosmopolita, com 62 espécies (De Meyer 1996; Kehlmaier e Assmann 2008), distribuídas em três gêneros, dos quais apenas *Chalarus* tem distribuição Neotropical (De Meyer 1996). A recente análise filogenética realizada por Motamedinia *et al*. (2021) recuperou Chalarinae como monofilética e grupo irmão de Pipunculinae.

Os adultos de Chalarinae são facilmente reconhecidos pela combinação dos seguintes caracteres: cabeça hemisférica, margem posterior do olho reta ou quase reta, cerdas ocelares distintas, occipucio muito estreito, projetando-se pouco atrás dos olhos; margem do escuto e escutelo com cerdas fortes; venação da asa incompleta; veia transversal dm-m e célula dm ausente, veia M_2 ausente (só presente em *Verrallia*); tergitos e esternitos 6 e 7 fundidos em sintergoesternitos individuais, claramente visíveis em vista dorsal e ventral; sintergoesternito 8 não envolve totalmente os gonópodes; epândrio, surstilo, gonópodes e falo aparecem lateralmente achatados em comparação com outras subfamílias (Kehlmaier *et al*. 2014; Skevington e Yeates 2001).

Subfamília Pipunculinae

Pipunculinae é cosmopolita, com cerca de 1.100 espécies válidas (De Meyer 1996; De Meyer e Skevington 2000) alocadas em três tribos e 20 gêneros (Motamedinia *et al*. 2021). A recente análise filogenética realizada por Motamedinia *et al*. (2021) recuperou Pipunculinae como monofilética e grupo irmão de Chalarinae.

Os adultos de Pipunculinae são facilmente reconhecidos pela combinação dos seguintes caracteres: cabeça subesférica, pós-crânio largo, cerdas ocelares ausentes, machos com cabeça holóptica (exceto *Dorylomorpha*); face plana em vista lateral; pós-pedicelo com ápice arredondado a filiforme; tórax distintamente cerdoso, com cerdas cobrindo todo o escuto ou restritas às dorsocentrais, pequenas porém distintas; cerdas fortes ausentes; propleura bastante protraída, com ápice voltado para baixo; anepímero sem cerdas; fêmures com ctenídios ventrais, pelo menos no par mediano; venação alar completa; pterostigma presente (exceto em *Tomosvaryella* e *Dorylomorpha*); seção entre as veias r-m e dm-m abaulada; veia Rs saindo em ângulo agudo; veia M_2 presente ou ausente; veia CuA+CuP completa; lobo anal estreito; abdômen brilhante ou fosco, aproximadamente da mesma largura do tórax; tergitos subiguais no comprimento, com cerdas conspícuas ou inconspícuas; tergito 1 com cerdas laterais arranjadas em tufo, em leque ou ausentes. Machos com tergitos 6 e 7 ocultos sob o tergito 5; sintergoesternito 8 com área membranosa (raramente ausente); hipândrio oculto sob o sintergoesternito 8, gonópodes reduzidos, simétricos (exceto em *Eudorylas* e *Elmohardyia*). Fêmeas com sintergoesternito 7+8 globoso, subgloboso ou cilíndrico, com ápice do aguilhão curvo, voltado para o abdômen, ou reto (Rafael e De Meyer 1992).

Tribo Microcephalopsini

Microcephalopsini é cosmopolita com 32 espécies válidas, distribuídas em dois gêneros, dos quais apenas *Microcephalops* tem distribuição Neotropical (De Meyer 1996). A recente análise filogenética realizada por Motamedinia *et al*. (2021) recuperou Microcephalopsini como monofilética.

Os adultos de Microcephalopsini são facilmente reconhecidos pela combinação dos seguintes caracteres: cabeça esférica, margem posterior do olho reta ou quase reta, cerdas ocelares reduzidas ou ausentes; occipucio inchado e claramente visível em vista lateral; fronte inchada; face mais estreita que a parte inferior da fronte, pós-pedicelo pequeno, ligeiramente

mais comprido que o pedicelo (somente em *Microcephalops*); margem do escuto e escutelo sem cerdas fortes; propleura com um leque de cerdas; célula dm não expandida medialmente (Skevington e Yeates 2001).

Tribo Pipunculini

Pipunculini é cosmopolita com 295 espécies válidas (De Meyer 1996; De Meyer e Skevington 2000), distribuídas em sete gêneros, dos quais *Cephalops*, *Cephalosphaera*, *Neocephalosphaera*, *Pipunculus* e *Semicephalops* tem distribuição Neotropical (De Meyer 1996). A recente análise filogenética realizada por Motamedinia *et al*. (2021) recuperou Pipunculini como monofilética, além disso, eles sinonimizaram Cephalopsini com Pipunculini.

Os adultos de Pipunculini são facilmente reconhecidos pela combinação dos seguintes caracteres: cabeça esférica, margem posterior do olho reta ou quase reta; cerdas ocelares reduzidas ou ausentes; occipucio inchado e claramente visível em vista lateral; margem do escuto e escutelo sem cerdas fortes; propleura com um leque de cerdas; face não inchada e não estreitada; célula dm expandida medialmente; cerdas no tórax restritas a duas fileiras dorsocentrais e cerdas dispersas ao longo das margens, ou ao menos à porção anterior do escuto uniformemente setosa (em *Pipunculus*); veia M_2 presente (em *Cephalosphaera*, *Neocephalosphaera* e alguns *Pipunculus*); tíbia posterior com crista de cerdas mais longas apicalmente; macho com área membranosa do sintergoesternito 8 não atingindo o epândrio em *Cephalosphaera* e *Parabeckerias* e atingindo o epândrio em *Neocephalosphaera* e *Semicephalops*; veia anal ausente em *Beckerias*; tíbias com fortes espinhos medianos e apicais; abdômen longo e estreito (em *Cephalops*) (Skevington e Yeates 2001).

Tribo Tomosvaryellini

Tomosvaryellini é cosmopolita com cerca de 900 espécies válidas (De Meyer 1996; De Meyer e Skevington 2000), distribuídas em 11 gêneros, dos quais apenas *Claraeola* e *Tricosus* não têm distribuição Neotropical (De Meyer 1996). A recente análise filogenética realizada por Motamedinia *et al*. (2021) recuperou Tomosvaryellini como parafilética e grupo irmão de Eudorylini, além disso, eles sinonimizaram Eudorylini com Tomosvaryellini.

Os adultos de Tomosvaryellini são facilmente reconhecíveis pela combinação dos seguintes caracteres: margem posterior do olho reta ou quase reta; cerdas ocelares reduzidas ou

ausentes; occipucio inchado e claramente visível em vista lateral; cabeça esférica; margem do escuto e escutelo sem cerdas fortes; propleura sem cerdas; tergitos abdominais (exceto tergito 1) brilhantes, sem pruinosidade, abdômen alongado e clavado, alargando distalmente (em *Dorylomorpha*); asa com ou sem pterostigma colorido; veia transversal r-m geralmente situada no meio da célula m em *Tomosvaryella* e geralmente no terço basal da célula M nos outros gêneros; tarsos posteriores achatados em *Amazunculus*; asa totalmente hialina ou marrom-escura; veia dm-m reta; tarsos posteriores geralmente cilíndricos apenas em algumas espécies de *Claraeola*; leque de cerdas ausente ou minúsculo no tergito 1 em *Clistoabdominalis*; abdomen com cerdas laterais longas, muito mais longas que as cerdas no dorso do abdômen em *Allometus*; tíbias posteriores com cerdas ântero-mediais eretas em *Basileunculus* e *Dasydorylas*, espinhos tibiais distais ausentes em *Basileunculus*, presentes em *Dasydorylas*; tíbia posterior sem cerdas ântero-mediais proeminentes em *Eudorylas* e *Elmohardyia*; pedicelo com cerdas em *Eudorylas*, pelo menos as cerdas ventrais longas em *Elmohardyia* (Skevington e Yeates 2001).

OBJETIVOS

Objetivo Geral

- Realizar um estudo taxonômico das espécies de Pipunculidae da Colômbia.

Objetivos específicos

- Propor chaves dicotômicas para as espécies do país e da região Neotropical;
- Fornecer informações sobre os hábitats e distribuição das espécies;
- Descrever e ilustrar espécies novas de Pipunculidae;
- Atualizar os registros geográficos das espécies de Pipunculidae da Colômbia.

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OBJETIVOS

Objetivo Geral

- Realizar um estudo taxonômico das espécies de Pipunculidae da Colômbia.

Objetivos específicos

- Propor chaves dicotômicas para as espécies do país e da região Neotropical;
- Fornecer informações sobre os hábitats e distribuição das espécies;
- Descrever e ilustrar espécies novas de Pipunculidae;
- Atualizar os registros geográficos das espécies de Pipunculidae da Colômbia.

RESULTADOS

A presente tese foi dividida em oito capítulos, os capítulos 1, 2, 3 e 4 são apresentados em formato de manuscrito para publicação na revista Zootaxa; os capítulos 5, 6, 7, e 8 são apresentados como artigos já publicados.

O Capítulo 1 refere-se à revisão taxonômica das espécies de *Chalarus* da Colômbia, com descrição de duas espécies novas e três registros novos para o país.

O Capítulo 2 refere-se à revisão taxonômica das espécies de *Clistoabdominalis* da Colômbia, com descrição de uma espécie nova e um registro novo para o país.

O Capítulo 3 refere-se à revisão taxonômica das espécies de *Dasydorylas* da Colômbia, com descrição de três espécies novas e um registro novo para o país.

O Capítulo 4 refere-se à revisão taxonômica das espécies de *Pipunculus* da Colômbia, com descrição de três espécies novas.

O Anexo 1 refere-se à revisão taxonômica das espécies de *Basileunculus* da Colômbia, com descrição de três espécies novas e um registro novo para o país.

O Anexo 2 refere-se à revisão taxonômica das espécies de *Cephalops* e *Semicephalops* da Colômbia, com descrição de cinco espécies novas e dois registros novos para o país.

O Anexo 3 refere-se à revisão taxonômica das espécies de *Cephalosphaera* e *Neocephalosphaera* da Colômbia, com descrição de nove espécies novas.

O Anexo 4 refere-se à revisão taxonômica das espécies de *Tomosvaryella* da Colômbia, com descrição de duas espécies novas, um registro novo para América do Sul e sete registros novos para o país.

Subfamília: Chalarinae Hardy, 1965
Gênero: *Chalarus* Walker, 1834

CAPÍTULO 1

Ramos-Pastrana, Y. *Chalarus* Walker, 1834 (Diptera: Pipunculidae) of Colombia, with description of two new species and an updated key to males of the Neotropical species.

Manuscrito em preparação para a revista Zootaxa.

***Chalarus* Walker, 1834 (Diptera: Pipunculidae) of Colombia, with description of two new species and an updated key to males of the Neotropical species**

Abstract

Chalarus Walker, 1834 has a cosmopolitan distribution, with 10 known species in the Neotropical region, but none recorded in Colombia. Two new species of *Chalarus* are described from Colombia, namely *Chalarus boyacensis* **sp. nov.** (type-locality: Cabaña Chaina, Santuario de Fauna y Flora Iguaque) and *C. chairensis* **sp. nov.** (type-locality: Vereda Tigrera Alta, Cartagena del Chaira). *Chalarus absonus* Rafael, 1990; *C. delicatus* Rafael, 1990 and *C. connexus* Rafael, 1988 are recorded for the first time in Colombia, with amended and comparative diagnoses. Illustrations and a dichotomic key for the Neotropical species are presented.

Key words: big-headed fly, diversity, Chalarinae, taxonomy

Introduction

Chalarus Walker, 1834 (Chalarinae) is a cosmopolitan genus with 43 species (Kehlmaier & Assmann 2009; Kehlmaier 2010). Before the formal description of *Chalarus*, the species were treated under *Cephalops* Fallén, 1810 by Fallén (1816) and Westwood (1840); under *Pipunculus* Latreille, 1802 by Meigen (1824), Macquart (1835) and Verral (1901) or under *Atelenevra* Macquart, 1834 by Macquart (1834).

Hardy (1966) cataloged *Chalarus spurius* (Fallén, 1816), as the only species of the genus in most regions of Europe. Posteriorly, Coe (1966), detailed and standardized the terminology of the male genitalia and described five British species recognized as belonging to *Chalarus*. Jervis (1985) described two species from Burma. Posteriorly, Rafael (1988) redescribed *Chalarus chilensis* Collin, 1931 and described two species from the Brazilian Amazon. The Neotropical species of *Chalarus* were reviewed by Rafael (1990), reporting nine species, of which five were already described. In his study, Rafael provided illustrations, distribution, as well as a new identification key. Jervis (1992) described 11 *Chalarus* species from Europe, which were included in five species-groups proposed by him. Kehlmaier &

Assmann (2008) revised 22 European species of *Chalarus* and described four species. Skevington & Kehlmaier (2008) described one additional species from Fiji.

Rafael & De Meyer (1992) considered *Chalarus* as a monophyletic group, forming the sister group of *Verrallia* Mik, 1899 + *Jassidophaga* Aczél, 1939. Kehlmaier & Assmann (2009) confirmed the monophyly of Chalarinae as well as that of the sister groups *Chalarus* and *Verrallia* but failed to recover a monophyletic lineage for *Jassidophaga*. In recent phylogenetic analyses carried out by Motamedinia *et al*. (2021), *Chalarus* was recovered as monophyletic and placed as the sister to *Jassidophaga* + *Verrallia*.

Currently, 10 species of *Chalarus* occur in the Neotropical region (Argentina, Brazil, Mexico, and Trinidad) (Rafael 1990), but none have been recorded from Colombia. This paper aims to describe and illustrate the *Chalarus* species of Colombia and provide a new identification key to males of all the Neotropical species.

Material and methods

This study is based on pinned specimens deposited in the following collections: Colección del Laboratorio de Entomología Universidad de la Amazonia (LEUA), Florencia, Caquetá, Colombia; Colección del Instituto de Investigación de Recursos Biológicos Alexander von Humboldt (IAvH), Villa de Leyva, Boyacá, Colombia; Invertebrate Collection of Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil.

The total length of a specimen was measured in lateral view by summing the distances from the frons (antenna excluded) to the scutellum apex and from the scutellum apex to the abdomen apex. To study the internal characteristics of the male genitalia, the abdomen apex was cut off at the third tergite, placed into lactic acid (85%), and heated at 150º C over a Thermo Scientific Cimarec plate for approximately 1 hour, prior to the dissection of the genital pieces. The pieces were dissected and photographed in dehydrated glycerin using an excavated slide. After study, the pieces were stored in microvials containing glycerin. The wings were mounted on microslides with Canada balsam. The holotype specimens were pinned, mounted, and deposited in their original collections. The microvial and microslide were pinned along with the respective specimen.

The morphological terminology follows Cumming & Wood (2017). The measurements (in millimeters) that refer to the head, antenna, and wing were made as proposed by Kehlmaier (2005), Marques *et al*. (2019), and Ramos-Pastrana & Rafael (2021): F, length of frons; EM, length of eye contiguity; V, length of vertex; LW/MWW, ratio between length and maximum

width of the wing; LTC/LFC, ratio between length of third costal section by length of fourth costal section of the wing; LPP/WPP, ratio between length and maximum width of the postpedicel.

The following measurements of the ovipositor follow Skevington (2005): ovipositor length (OL), measured over a straight line from the tip of the piercer to the point where the base of the ovipositor articulates with sternite 6 dorsally; piercer length (PL), measured over a straight line from the proximal edge of the cerci to the tip of the piercer; length of the ovipositor's base (B), measured over a straight line from the proximal end of the cerci to the point where the base of the ovipositor articulates with sternite 6 dorsally.

Photographs were taken with a Leica digital camera DFC450 coupled to a stereomicroscope Leica M205A and connected to a computer with Leica Application Suite software, with automatic mounting module (synchronization software) (http://www.syncroscopy.com/syncroscopy/). The maps showing species' geographic records were plotted using the SimpleMappr software (Shorthouse 2010).

In the list of examined material, label data are given as presented on the labels. The square brackets ([]) are used to indicate complementary data that are not present in the specimen labels. New records for the country are included within each species and mentioned as a "new record" in geographical distribution. Data for specimens with identical data were simplified with *idem* and only the data that differ from the anterior labels were written.

Results

Chalarus Walker, 1834

Chalarus Walker, 1834: 269. Type species *Cephalops spurius* Fallén, 1816 (subsequent designation by Westwood, 1840: 135); Coe, 1966: 149, Figs 1–26; Jervis, 1985: 435, Figs 1–6; Rafael, 1988: 1, Figs 1–21; Morakote & Hirashima, 1990: 161, Figs 19–28; Rafael, 1990: 45, Figs 1–15; Jervis, 1992: 243, Figs 1–42; Kehlmaier & Assmann, 2008: 1, Figs 1–80; Kehlmaier & Assmann, 2009: 1, Figs 1–4; Rodríguez *et al*. 2012: 121, Figs 1–3; Motamedinia *et al*. 2021: 10.

Atelenevra Macquart, 1834, 356 (partim). Type species *Pipunculus holosericeus* Meigen, 1824 (monotypy) (partim); Verral, 1901: 120 (synonymy) (partim); Macquart, 1835: 663 (synonymy) (partim).

Ateleneura Agassiz, 1846: 3 (variant spelling).

Diagnosis. Head sub-hemispherical. Frons and ocellar triangle with setae. Males dichoptic. Occiput and face narrow. Cell dm absent and anal vein poorly developed; transverse vein dm-m and vein M_1 absent. Fore and mid femora with a row of long and black setae posterodorsally; hind femur with a row of long and black setae anterodorsally. Syntergosternite 7 present in males. Syntergosternite 6 present in females. Epandrium small. Gonopods enlarged. Phallic guide usually with subapical appendices (sometimes absent). Phallus trifid and membranous, with ejaculatory ducts symmetric (sometimes reduced).

Chalarus species from Colombia

Chalarus absonus Rafael, 1990
Figs 1–11, 55

Chalarus absonus Rafael, 1990: 6, Figs 1–3; Jervis, 1992: 346; De Meyer, 1996: 15; Kehlmaier & Assmann, 2009: 12; Rodríguez & Rafael, 2012: 10, 16; Rodríguez et al. 2012: 121, Fig. 1c.
Chalarus spurius chilensis Hardy, 1965: 2 (partim).

Diagnosis. Male. Pedicel with two setae dorsally and two ventrally. Hind tibia with one stout seta medially. Surstyli with apices rounded, with medial lobes in inner margins, right surstylus with small medial lobe in outer margin; both surstyli with small sinus at junction with epandrium; right surstylus with lower margin longer and more acute than left when seen in lateral view. Left gonopod thinner than right. Apex of phallic guide short and slightly rounded, with two subapical processes, one thinner and reaching only about half the length of the other. Phallus trifid, all ejaculatory ducts situated at apex; with lateral ejaculatory ducts with inner margins forming a semicircle when seen in dorsal view.

Intraspecific variability. We provide a comparison of the variations between the Colombian and Brazilian specimens (between parenthesis, when comparable). MALE. ***Head*** (Figs 1–2). Occiput brown, gray-brown pruinose. Antenna (Fig. 3) brown; pedicel with two setae dorsally and two ventrally. ***Thorax*** (Figs 2, 4). Notopleuron brown, brown pruinose. Mediotergite brown, gray-brown pruinose. ***Wing*** (Fig. 5). Length 2.7 mm, width 1 mm. Membrane brown infuscated; pterostigma occupying 2/3 of third costal section (*versus* pterostigma occupying 1/2 of third costal section). Halter brown. ***Legs*** (Fig. 1). Entirely dark brown, brown pruinose, except pulvilli light brown. ***Abdomen*** (Figs 1–2, 6). Tergite 1 light

brown basally, dark brown posterolaterally; tergite 6 shorter than tergite 5; syntergosternite 8 brown, gray-brown pruinose, with long apical setae (Figs 6–7). ***Terminalia*** (Figs 7–11). Epandrium and surstyli brown (Fig. 7). Surstyli (Figs 7–9) subsymmetrical, completely setose and apices rounded downward directed; both surstyli with medial lobes in inner margins; right surstylus with small medial lobe in outer margin (Fig. 7); right surstylus with lower margin longer and more acute than left when seen in lateral view (Figs 8–9). Gonopods subsymmetrical; left gonopod thinner than right (Figs 8–9). Apex of phallic guide short and slightly rounded (Fig. 10a). Ejaculatory apodeme parasol-shaped (Fig. 11). Phallus trifid, all ejaculatory ducts situated at apex, lateral ejaculatory ducts with inner margins forming a semicircle when seen in dorsal view (Fig. 10a–b).

Examined material. (1 m#). COLOMBIA, Boyacá, SFF[Santuario de Fauna y Flora] Iguaque, Cab.[Cabaña] Chaina, 05º25'N/73º27'W, 2250 m[eters], 01–14.feb[II].2001, A. Roberto M1271 (1 m# IAvH) (photographed specimen).

Geographical distribution. Brazil (São Paulo, Paraná), Colombia (Boyacá) (new record) (Fig. 55).

Habitat. The specimen was collected in the Santuario de Fauna y Flora Iguaque reserve, where the vegetation is composed of cloud Andean forests of the Cordillera of the Northeast region of Colombia.

Chalarus boyacensis **sp. nov.**

Figs 12–22, 55

Diagnosis. Male. Occiput dark brown, gray-brown pruinose. Both surstyli with one protuberance subapically inward directed, outer margins slightly straight, apices rounded and downward directed; both surstyli with apices truncated and small sinus at the junction with epandrium when seen in lateral view. Left gonopod slightly shorter, wider, and with apex more rounded than the right. Apex of phallic guide short with apex hook-shaped and two subapical appendices symmetrical. Phallus trifid, all ejaculatory ducts situated at apex; lateral ejaculatory ducts with inner margins forming a semicircle when seen in dorsal view.

Description. MALE (holotype). Body length 2.6 mm. ***Head*** (Figs 12–13). Frons with upper 3/4 dark brown, dark brown pruinose, lower 1/4 gray-brown pruinose. Occiput dark brown, gray-brown pruinose. Antenna (Fig. 14) brown, pedicel with two dorsal and two ventral setae; LPP/WPP = 1.5. ***Thorax*** (Figs 13, 15). Postpronotal lobe brown, brown pruinose. Scutum

dark brown, gray-brown pruinose. Notopleuron concolorous with scutum. Scutellum concolorous with scutum. Mesopleuron brown, gray-brown pruinose. Mediotergite concolorous with mesopleuron. ***Wing*** (Fig. 16). Length 2.6 mm. LW/MWW = 2.7; LTC/LFC = 5.1. Membrane brown infuscated. Halter stem dark brown, knob brown. ***Legs*** (Fig. 12). Entirely dark brown, except tarsomeres 1–4 brown; pulvilli light brown. ***Abdomen*** (Figs 12–13, 17). Dark brown, gray-brown pruinose, with long setae laterally and short scattered setae dorsally; tergite 1 light brown basally, dark brown posterolaterally; tergites 1–5 with transverse brown pruinose bands; tergite 6 slightly shorter than tergite 5; syntergosternite 8 brown pruinose without long apical setae (Figs 17–18). ***Terminalia*** (Figs 18–22). Epandrium and surstyli brown (Fig. 18). Surstyli (Figs 18–20) subsymmetrical and setose, with long setae apically, apices rounded and downward directed; both surstyli with one protuberance subapically in inner margins; outer margins slightly straight (Fig. 18); both surstyli with apices truncated; left surstylus slightly thinner than right, and with small sinus at junction with epandrium when seen in lateral view (Figs 19–20). Gonopods subsymmetrical; left gonopod slightly shorter, wider, and with apex more rounded than the right (Figs 19–20). Apex of phallic guide short with apex hook-shaped and two subapical appendices symmetrical (Fig. 21a). Ejaculatory apodeme parasol-shaped (Fig. 22). Phallus trifid, with all ejaculatory ducts situated at apex; lateral ejaculatory ducts with inner margins forming a semicircle when seen in dorsal view (Fig. 21a–b).

FEMALE. Unknown.

Type material. (2 m#). HOLOTYPE. Male: COLOMBIA, Boyacá, SFF[Santuario de Fauna y Flora] Iguaque, Cab.[Cabaña] Chaina, 5º25'N/73º27'W, 2550 m[eters], 01–14.feb[II].2001, A. Roberto M1271 (1 m# IAvH) (photographed specimen). PARATYPE. *idem* (1 m# LEUA)". Holotype with left wing mounted on microslide with Canada balsam. Left antenna and terminalia placed in a microvial with glycerin, both pinned along with the specimen.

Etymology. The specific epithet refers to the Department of the type locality, Boyacá, Colombia, the region in which the specimens were collected.

Geographical distribution. Colombia (Boyacá) (Fig. 55).

Habitat. The specimens were collected in the Santuario de Fauna y Flora Iguaque reserve, where the vegetation is composed of forests of the cordillera of the Northeast region.

Taxonomic notes. *Chalarus boyacensis* **sp. nov.** runs to *C. chilensis* Collin, 1931 in couplet 7 of the key presented by Rafael (1990). It differs from *C. chilensis* in having the

antenna brown; pedicel with two setae dorsally and two ventrally (Fig. 14) [*versus* antenna black, pedicel with three setae dorsally and four ventrally in *C. chilensis* Fig. 1, presented by Rafael (1988)]; scutum and scutellum dark brown (Fig. 15) (*versus* scutum and scutellum black); the other different characters can be seen in the key below.

***Chalarus chairensis* sp. nov.**

Figs 23–32, 55

Diagnosis. Male. Postpronotal lobe yellowish brown, brown pruinose. Both surstyli with one lobe medially inward directed and apices downward directed; left surstylus with apex slightly rounded and outer margin curved; right surstylus with apex slightly acute and outer margin sinuous; both surstyli with apices clearly truncated, left surstylus slightly longer than right, without sinus at junction with epandrium when seen in lateral view. Right gonopod slightly thinner and with apex acuter than left. Apex of phallic guide long, with two subapical appendices asymmetrical. Phallus trifid, all ejaculatory ducts are situated at apex; the lateral ejaculatory ducts with inner margins straight, forming an angle of approximately 110º when seen in dorsal view.

Description. MALE (holotype). Body length 2.2 mm. ***Head*** (Figs 23–24). Frons 3/4 upper dark brown, dark brown pruinose, 1/4 lower gray-brown pruinose. Occiput dark brown. Pedicel with two setae dorsally and two ventrally; pospedicel lost. ***Thorax*** (Figs 24–25). Postpronotal lobe yellowish brown, brown pruinose. Scutum brown, brown pruinose. Notopleuron concolorous with scutum. Scutellum concolorous with scutum. Mesopleuron light brown, brown pruinose. Mediotergite concolorous with mesopleuron. ***Wing*** (Fig. 26). Length 2.3 mm. LW/MWW = 3.1; LTC/LFC = 9. Membrane brown infuscated. Halter light brown. ***Legs*** (Fig. 23). Entirely brown, except tarsomeres 1–5 dark brown; pulvilli light brown. ***Abdomen*** (Figs 23–24, 27). Brown, gray-brown pruinose, with long setae laterally and short scattered setae dorsally; tergite 1 light brown basally, brown posterolaterally; tergite 1–5 with transverse bands brown pruinose; tergite 6 clearly longer than tergite 5; syntergosternite 8 with long apical setae (Figs 27–28). ***Terminalia*** (Figs 28–32). Epandrium and surstyli brown (Fig. 28). Surstyli (Figs 28–30) subsymmetrical and setose, with apices downward directed; both surstyli with one lobe medially in inner margins; left surstylus with apex slightly rounded and outer margin curved; right surstylus with apex slightly acute and outer margin sinuous (Fig. 28); both surstyli with apices clearly truncated; left surstylus slightly longer than right, without

sinus at junction with epandrium when seen in lateral view (Figs 29–30). Gonopods subsymmetrical; right gonopod slightly thinner and with apex acuter than left (Figs 29–30). Apex of phallic guide long, with two subapical appendices asymmetrical (Fig. 31a). Ejaculatory apodeme pin-shaped (Fig. 32). Phallus trifid, all ejaculatory ducts situated at apex; the lateral ejaculatory ducts with inner margins straight, forming an angle of approximately 110º when seen in dorsal view (Fig. 31a–b).

FEMALE. Unknown.

Type material. (1 m#). HOLOTYPE. Male: COLOMBIA, Caquetá, Cartagena del Chaira, Vda.[Vereda] Tigrera Alta, Fca.[Finca] Las Palmeras, 01º17'5.2"N/74º49'1.2"W, 235 m[eters], 23–Nov.[xi] –07–Dic.[XII].2016, trampa Malaise en dosel del bosque, Y. Ramos-Pastrana (1 m# LEUA–00000049759) (photographed specimen). Holotype with left wing mounted on microslide with Canada balsam. Left antenna and terminalia placed in a microvial with glycerin, both pinned along with the specimen.

Etymology. The specific epithet refers to the type locality**,** Cartagena del Chaira.

Geographical distribution. Colombia (Caquetá) (Fig. 55).

Habitat. The specimen was collected in preserved areas of tropical rainforest at the Colombian Amazonian, Department of Caquetá.

Taxonomic notes. *Chalarus chairensis* **sp. nov.** runs to *C. absonus* Rafael, 1990 in the couplet 8 of the key presented by Rafael (1990). It differs from *C. absonus* in having the postpronotal lobe yellowish brown (*versus* Postpronotal lobe brown); legs entirely brown, except tarsomeres 1–5 dark brown (Fig. 23) (*versus* legs entirely dark brown, brown pruinose); the other diverging characters can be seen in the key below.

Chalarus connexus Rafael, 1988
Figs 33–43, 55

Chalarus connexus Rafael, 1988: 6, Figs 1–13, 20–21; Rafael, 1990: 48; Jervis, 1992: 346; De Meyer, 1996: 15; Kehlmaier & Assmann, 2009: 12; Rodríguez & Rafael, 2012: 17, 28, 43.

Diagnosis. Cell r_1 closed to the confluence of the veins R_1 and R_{2+3}. Both surstyli with one lobe apically inward directed, inner margins curved and outer margins slightly straight; both surstyli without sinus at junction with epandrium; left surstylus with lower margin rounded; right surstylus with upper margin slightly straight; both surstyli with apex upwards directed, without

sinus in union with epandrium when seen in lateral view. Gonopods thickened, with apices acute; right gonopod slightly acuter than left. Apex of phallic guide straight and acute, without subapical appendices. Phallus trifid, all ejaculatory ducts situated at apex; the lateral ejaculatory ducts with inner margins forming a straight line when seen in dorsal view.

Intraspecific variability. Rafael (1988) provided a complete description and illustration of the Brazilian holotype; however, we found variations in the Colombian material, therefore, we provide a comparison of the variations between the Colombian and Brazilian specimens (between parenthesis, when comparable). MALE. ***Head*** (Figs 33–34). Occiput dark brown, brown pruinose. Antenna brown (Fig. 35) (*versus* antenna black in the holotype). ***Thorax*** (Figs 34–36). Postpronotal lobe light brown, light brown pruinose. Notopleuron concolorous with scutum. Mesopleuron brown, brown pruinose. Mediotergite, brown pruinose. ***Wing*** (Fig. 37). Length 2.2 mm (*versus* 1.8 mm), width 0.7 mm (*versus* 0.6 mm), membrane slightly infuscate, pterostigma occupying 2/3 of third costal section (*versus* pterostigma occupying a little more than half of the third costal section). Halter brown (*versus* halter dark brown). ***Abdomen*** (Figs 34–38). Tergite 1 light brown basally, dark brown posterolaterally; syntergosternite 8 dark brown, gray-brown pruinose, with long apical setae. ***Terminalia*** (Figs 39–43). Epandrium and surstyli brown (Fig. 39). Surstyli (Figs 39–41) subsymmetrical, completely setose, with long setae apically; both surstyli with one lobe apically inward directed, inner margin curved and outer margin slightly straight and lower margin slightly truncated (Fig. 39); left surstylus with lower margin rounded, right surstylus with upper margin slightly straight, both surstyli with apex upwards directed, without sinus in union with epandrium when seen in lateral view (Figs 40–41). Gonopods subsymmetrical, thickened, with apices acute, right slightly acuter than left (Figs 40–41). Apex of phallic guide straight and acute, without appendices (Fig. 42a). Ejaculatory apodeme parasol-shaped (Fig. 43). Phallus trifid, all ejaculatory ducts situated at apex; lateral ejaculatory ducts with inner margin forming a line straight, when seen in dorsal view (Fig. 42a–b).

Examined material. (1 m#). COLOMBIA, Caquetá, San Vicente del Caguan, Vda.[Vereda] Alto Quebradón, Fca.[Finca] Rancho Veracruz, Bosque piso, 02º17'55.8"N/74º44'29.3"W, 414 m[eters], 1–15.Feb[II].2017, trampa Malaise en el piso del bosque, Y. Ramos-Pastrana (1 m# LEUA–00000049808) (photographed specimen).

Geographical distribution. Brazil (Amazonas), Colombia (Caquetá) (new record) (Fig. 55).

Habitat. The specimen was collected in preserved areas of tropical rainforest at the Colombian Amazon, Department of Caquetá.

Chalarus delicatus Rafael, 1990
Figs 44–54, 55

Chalarus delicatus Rafael, 1990: 49, Figs 7–9; Jervis, 1992: 346; De Meyer, 1996: 15; Kehlmaier & Assmann, 2009, 12; Rodríguez & Rafael, 2012: 17.
Chalarus spuruius Hardy, 1965: 2 (partim).

Diagnosis. Pedicel with four setae dorsally and two ventrally. Hind tibia with 1–2 strong setae medially. Both surstyli with outer margins slightly curved; inner margin of each surstylus forming an angle of approximately 130º centrally, apices truncated and converging, without sinus at junction with epandrium when seen in lateral view. Gonopods with apices rounded; left gonopod with apex slightly thinner than right. Apex of phallic guide short and acute, without subapical processes. Phallus trifid, one ejaculatory duct apically, the others two medially and forward-directed when seen in ventral view, not visible in dorsal view.

Intraspecific variability. Rafael (1990) provided a complete description and illustrations of the Brazilian holotype; however, we found variations in the Colombian material. Therefore, we provide a comparison of the variations between the Colombian and Brazilian specimens (between parenthesis, when comparable). MALE. ***Head*** (Figs 44–45). Occiput dark brown, gray-brown pruinose. Antenna (Fig. 46) brown (*versus* antenna dark brown to black in the holotype); pedicel with four setae dorsally and two ventrally. ***Thorax*** (Figs 45, 47). Postpronotal lobe brown, gray-brown pruinose. Scutum dark brown, gray-brown pruinose (*versus* scutum black, brown pruinose). Notopleuron concolorous with scutum. Scutellum concolorous with scutum. Mesopleuron brown, gray-brown pruinose. Mediotergite concolorous with mesopleuron. ***Wing*** (Fig. 48). Membrane slightly infuscated. ***Legs*** (Fig. 44). Entirely brown, except tarsomeres 1–4 light brown (*versus* legs black, except femur-tibial articulations and all tarsomeres light brown); pulvilli light brown. ***Abdomen*** (Figs 45, 49). Brown, gray-brown pruinose, with long setae laterally and short scattered setae dorsally; tergite 1 light brown basally, dark brown posterolaterally; tergite 1–5 with transverse bands brown pruinose dorsally; tergite 6 clearly shorter than tergite 5; syntergosternite 8 with long apical setae (Fig. X). ***Terminalia*** (Figs 50–54). Epandrium and surstyli brown (Fig. 50). Surstyli (Figs

50–52) subsymmetrical and setose, with long seta apically; both surstyli with outer margins slightly curved, inner margin of each surstylus forming an angle of approximately 130º centrally, apices truncated and converging (Fig. 50); both surstyli with apices rounded; left surstylus with apex slightly thinner than right when seen in lateral view (Figs 51–52). Gonopods subsymmetrical; left gonopod with apex slightly thinner than right (Figs 51–52). Apex of phallic guide short with tip acute (Fig. 53a). Ejaculatory apodeme pin-shaped (Fig. 54). Phallus trifid, one ejaculatory duct apically, the others two medially and forward-directed when seen in ventral view, not visible in dorsal view (Fig. 53a–b).

Examined material. (1 m#). COLOMBIA, Caquetá, San José del Fragua, Vda. [Vereda] Bellavista, Fca.[Finca] Mi Ranchito, 01º18'23"N/76º00'33"W, 265 m[eters], 29.Mar[III] –12.Abr[IV].2017, trampa Malaise en dosel del bosque, Y. Ramos-Pastrana (1 m# LEUA–00000049809) (photographed specimen).

Geographical distribution. Brazil (São Paulo, Paraná, Santa Catarina), Colombia (Caquetá) (new record) (Fig. 55).

Habitat. The specimen was collected in the canopy at preserved areas of tropical rainforest in the Colombian Amazonian, Department of Caquetá.

Unidentified females

46 female specimens belonging to 14 morphospecies could not be associated with males.

Material examined. (46 f#). COLOMBIA, Amazonas, PNN[Parque Nacional Natural] Amacayacu, Matamata, 03º23'S/70º06'W, 300 m[eters], 23–30.Oct[x].2000, A. Parente M850 (1 f# IAvH); *idem* 14–21.ago[VIII].2000, M848 (1 f# IAvH); *idem* 25.sep[IX] –09.oct [x].2000, M851 (1 f# IAvH); *idem* 150 m[eters], 15–20.Nov[XI].2000, M1120 (1 f# IAvH); *idem* 17.dic[XII].1999–02.Ene[I].2000, M123 (1 f# IAvH); *idem* San Martín, 05–13.dic[XII].2000, B. Armando Leg. M1312 (1 f# IAvH); *idem* 07–28.05 [V].2001, M1866 (1 f# IAvH); Bolivar, PNN[Parque Nacional Natural] Santa Marta, El Ramo, 10º48'N/73º39'W, 2500 m[eters], 22.Nov[XI]–15.Dec[XII].2000, J. Cantillo M1047 (1 f# IAvH); *idem* Boyacá, SFF[Santuario de Fauna y Flora] Iguaque, Cab.[Cabaña] Chaina, 5º25'N/73º27'W, 2550 m[eters], 01–14.feb[II].2001, A. Roberto M1271 (10 f# IAvH); *idem* 2600 m[eters], 31.VIII–16.IX.2001 (1 f# IAvH); *idem* 10–28.VI.2001, P. Reina leg. M1836 (1 f# IAvH); *idem* Qda.[Quebrada] Carrizal, 3360 m[eters], 04–21.dic[XII].2000, M1078 (1 f# IAvH); *idem* Cabaña Carrizal, 2855 m[eters], 01–23.Sep[IX].2000, M614 (1 f# IAvH); *idem* 2850 m[eters], 02–22.VIII.2001,

M2026 (1 f# IAvH); *idem* Cabaña Chaina, 2600 m[eters], 31.VIII–16.ix.2001, A. Roberto. M2066 (2 f# IAvH); *idem* Cerro Pan de Azúcar, 3300 m[eters], Malaise, 2–22.VIII.2001, P. Reina leg. M2023 (1 f# IAvH); *idem* La Planada, 5º25'12"N/73º27'24"W, 2975 m[eters], 01–19.IV.2000, Malaise 8 (1 f# IAvH); *idem* Lagunillas, 3380 m[eters], 09–24.Feb[II].2001, M1272 (1 f# IAvH); *idem* 3360 m[eters], 25.jun[VI] –13.jul[VII].2000, Malaise 4 (1 f# IAvH); *idem* 09–18.III.2001, M1511 (1 f# IAvH); *idem* La Planada, 2850 m[eters], 02–19.apr[IV].2000, M32 (1 f# IAvH); *idem* 21.I.–07.II.2001, M1249 (1 f# IAvH); *idem* Cundinamarca, PNN[Parque Nacional Natural] Chingaza, Valle del Frailejón, 04º31"N/73º45'W, 3170 m[eters], 20.dec[XII].2000–05.jan[I].2001, L. Cifuentes, M1220 (1 f# IAvH); *idem* Huila, PNN[Parque Nacional Natural] Cueva de los Guacharos, 01º38"N/76º06'W, 1980 m[eters], 02–05.XII.2001, D. Campos Leg. M2535 (1 f#, IAvH); *idem* Magdalena, PNN[Parque Nacional Natural] Santa Marta, El Ramo, 10º48'N/73º39'W, 2500 m[eters], 21–29.dic[XII].2000, J. Cantillo "M1047" (2 f# IAvH); *idem* 01–15.jul[VII].2000, M365 (2 f# IAvH); *idem* 16–31.aug[VIII].2000, M602 (1 f# IAvH); *idem* 2400 m[eters], 10–24.jun[VI].2000, M1 (1 f# IAvH); *idem* La Estación, 10º48'40"N/73º39'32"W, 15–31.jul[VII].2000, J. Cantillo, M369 (1 f# IAvH); *idem* PNN[Parque Nacional Natural] Tayrona, 11º20'N/74º02"W, 60 m[eters], 23.sep[IX]–17.oct[X].2000, R. Henriquez M793 (1 f# IAvH); *idem* Nariño**,** RN[Reserva Natural] La Planada, Parcela Olga, 1º15'N/78º15"W, 1850 m[eters], 02–16.sep[IX].2000, G. Oliva Leg. M883 (1 f# IAvH); *idem* 16.VI.–02.VII.2001, M2384 (1 f# IAvH); *idem* Valle del Cauca, PNN[Parque Nacional Natural] Farallones de Cali, Alto Anchicaya, 03º26'N/76º48"W, 650 m[eters], 02–16.jan[I].2001, S. Sarria, M1544 (1 f# IAvH); *idem* Vichada, PNN[Parque Nacional Natural] Tuparro, Centro Administrativo, 140 m[eters], 19–29.jun[VI].2000, W. Villaba, Malaise 17 (1 f# IAvH).

Key to males of the Neotropical species of *Chalarus* [modified from Rafael (1990)].

1 Cell r_1 closed (Fig. 37) … ***C. connexus*** Rafael, 1988.

\- Cell r_1 open (Figs 5, 16, 26, 48) … 2

2 Legs and antennae yellow … ***C. xanthopodus*** Rafael, 1990.

\- Legs and antennae brown to black … 3

3 Frons with 1–3 pair of setae … ***C. latifrons*** Hardy, 1943

\- Frons without setae … 4

4 Apex of phallic guide with subapical processes (Figs 10a, 21a, 31a) … 5

- Apex of phallic guide without subapical processes (Figs 42, 53) … 11

5 Apex of phallic guide with subapical processes symmetrical (Figs 21a) … 6

- Apex of phallic guide with subapical processes asymmetrical (Figs 10a, 31a) … 9

6 Subapical processes of phallic guide with seta conspicuous, long, and aristiform [Fig. 21a and see figures 5, 6 in Rafael (1988)] … 7

- Subapical processes of phallic guide bare, short, and flattened dorsoventrally [see figure 13 in 1990; figures 2a, b in Rodríguez *et al*. (2012)] … 8

7 Pedicel with two setae dorsally and two ventrally (Fig. 14); apex of phallic guide with tip acute (Fig. 21a); right gonopod thickened medially, thin apically, with apex slightly acute when seen in lateral view (Fig. 20) … ***C. boyacensis*** **sp. nov.**

- Pedicel with three setae dorsally and four ventrally [see figure 1 in Rafael (1988)]; apex of phallic guide truncated [see figure 5 in Rafael (1988)]; right gonopod thickened medially and apically, with apex rounded when seen in lateral view (see figure 4 in Rafael (1988)] … ***C. chilensis*** Collin, 1931

8 Right surstylus with apex slightly truncated in lateral view [see figure 3b in Rodríguez *et al*. (2012)] … ***C. tani*** Rodríguez *et al*. 2012

- Right surstylus with apex rounded in lateral view [see figure 12 in Rafael (1990)] … ***C. lenkoi*** Rafael, 1990

9 One subapical process very short, about 1/4 to 1/5 the length of the other [see figures 10 and 11 in Rafael (1988)] … ***C. amazonensis*** Rafael, 1988

- All subapical processes equal in length (Fig. 31a) or one about 1/2 the length of the other (Fig. 10a) … 10

10 All subapical processes equal in length, one thinner than the other (Fig. 31a); right gonopod with apex slightly acute when seen in lateral view (Fig. 30); ejaculatory apodeme pin-shaped (Fig. 32) … ***C. chairensis*** **sp. nov.**

- One subapical process about 1/2 the length of other (Fig. 10a); right gonopod with apex rounded when seen in lateral view (Fig. 9); ejaculatory apodeme parasol-shaped (Fig. 11) … ***C. absonus*** Rafael, 1990

11 Surstyli with sinus at junction with epandrium in lateral view [see figure 14 in Rafael (1990)]; right surstylus with apex truncated in lateral view [see figure 15 in Rafael (1990)]; right gonopod with apex slightly rounded in lateral view [see figure 15 in Rafael (1990)]; phallus with lateral ejaculatory ducts long beyond the membranous area in dorsal view [see figure 15 in Rafael (1990)] … ***C. triramosus*** Rafael, 1990

- Surstyli without sinus at junction with epandrium in lateral view [Figs 51–52 and see figure 7 in Rafael (1990)]; right surstylus with apex rounded in lateral view [Fig. 52 and see figure 7 in Rafael (1990)]; phallus with lateral ejaculatory ducts short not exceeding the membranous area in dorsal view [Fig. 53b and see figure 9 in Rafael (1990)] … ***C. delicatus*** Rafael, 1990

Acknowledgments

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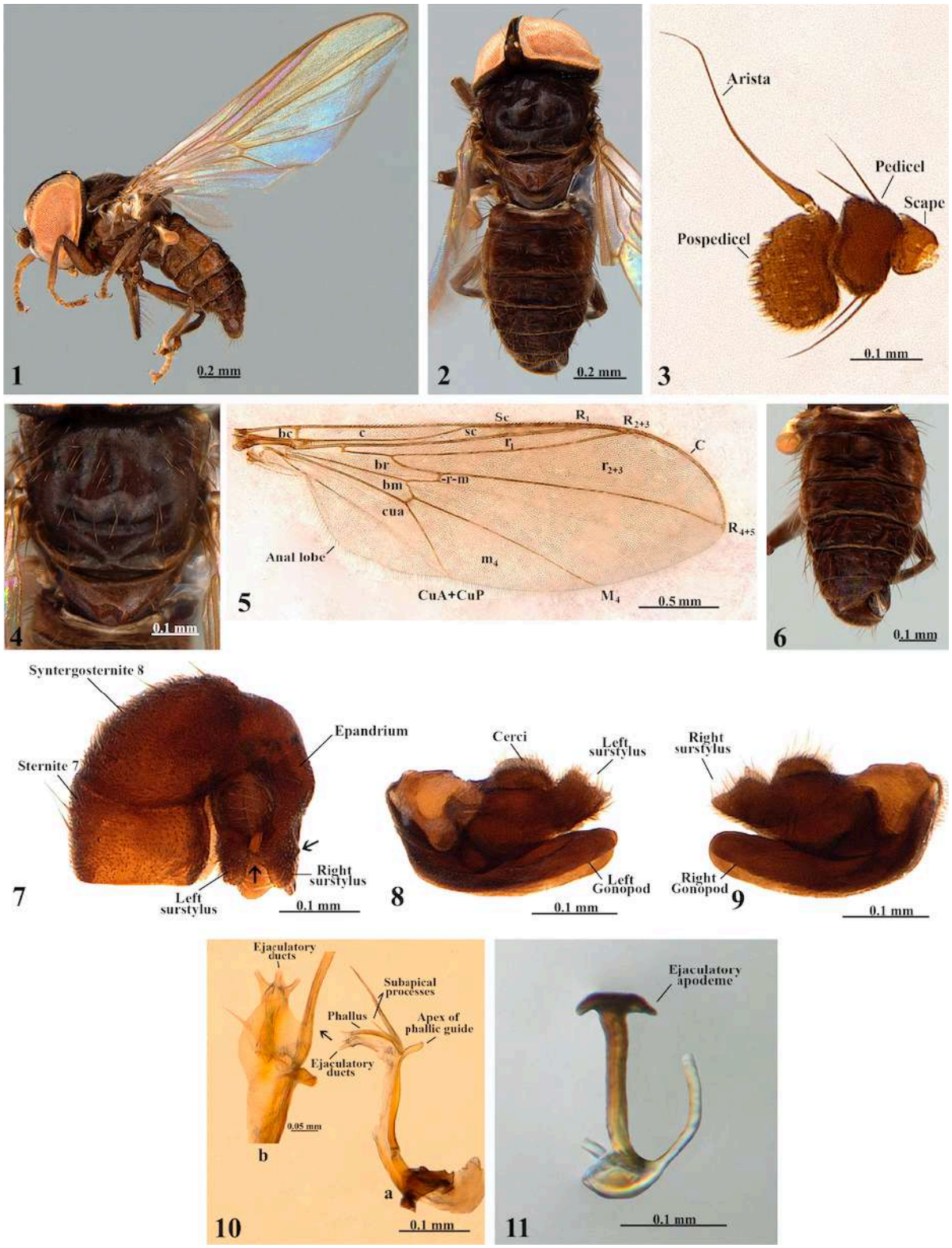
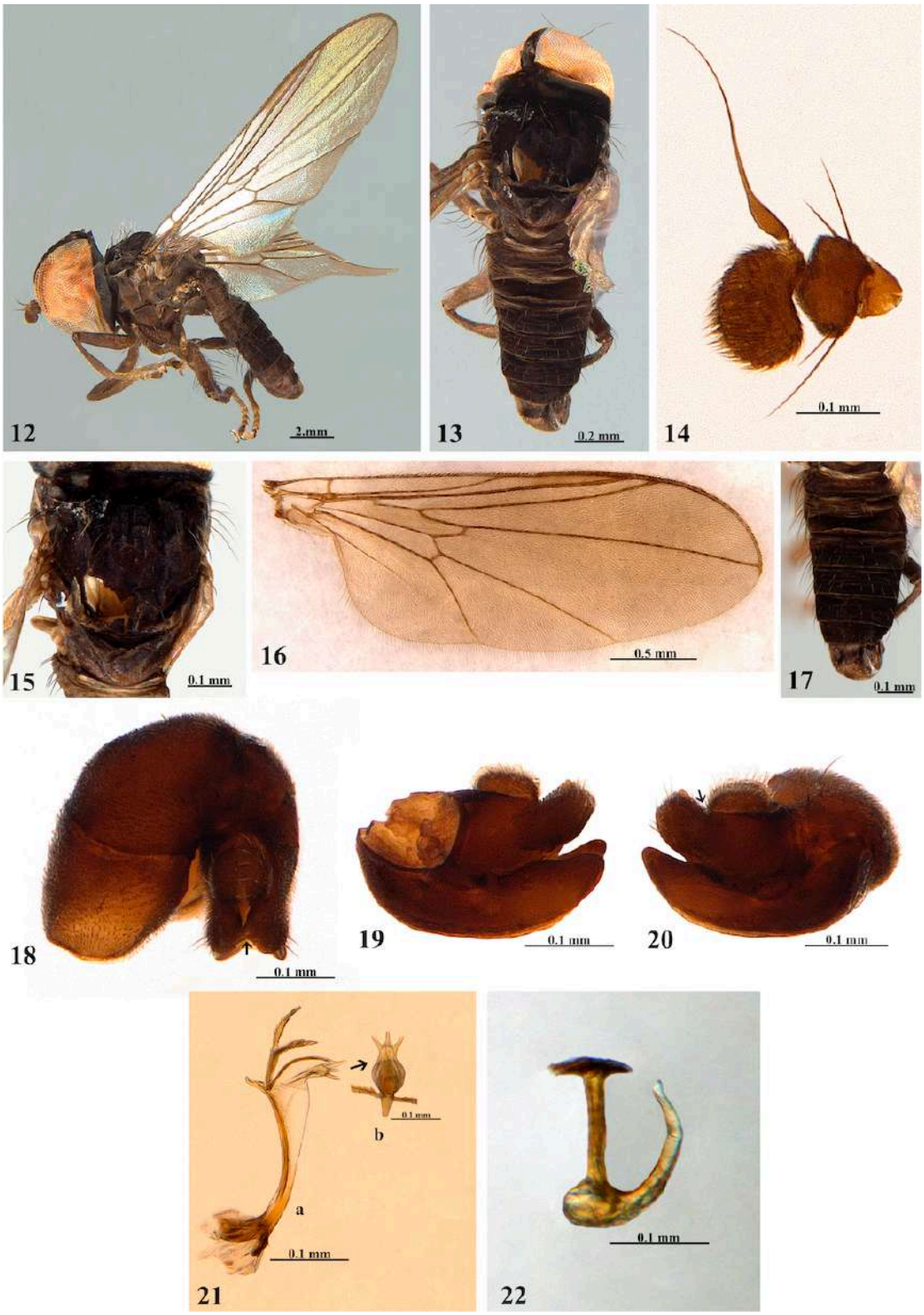
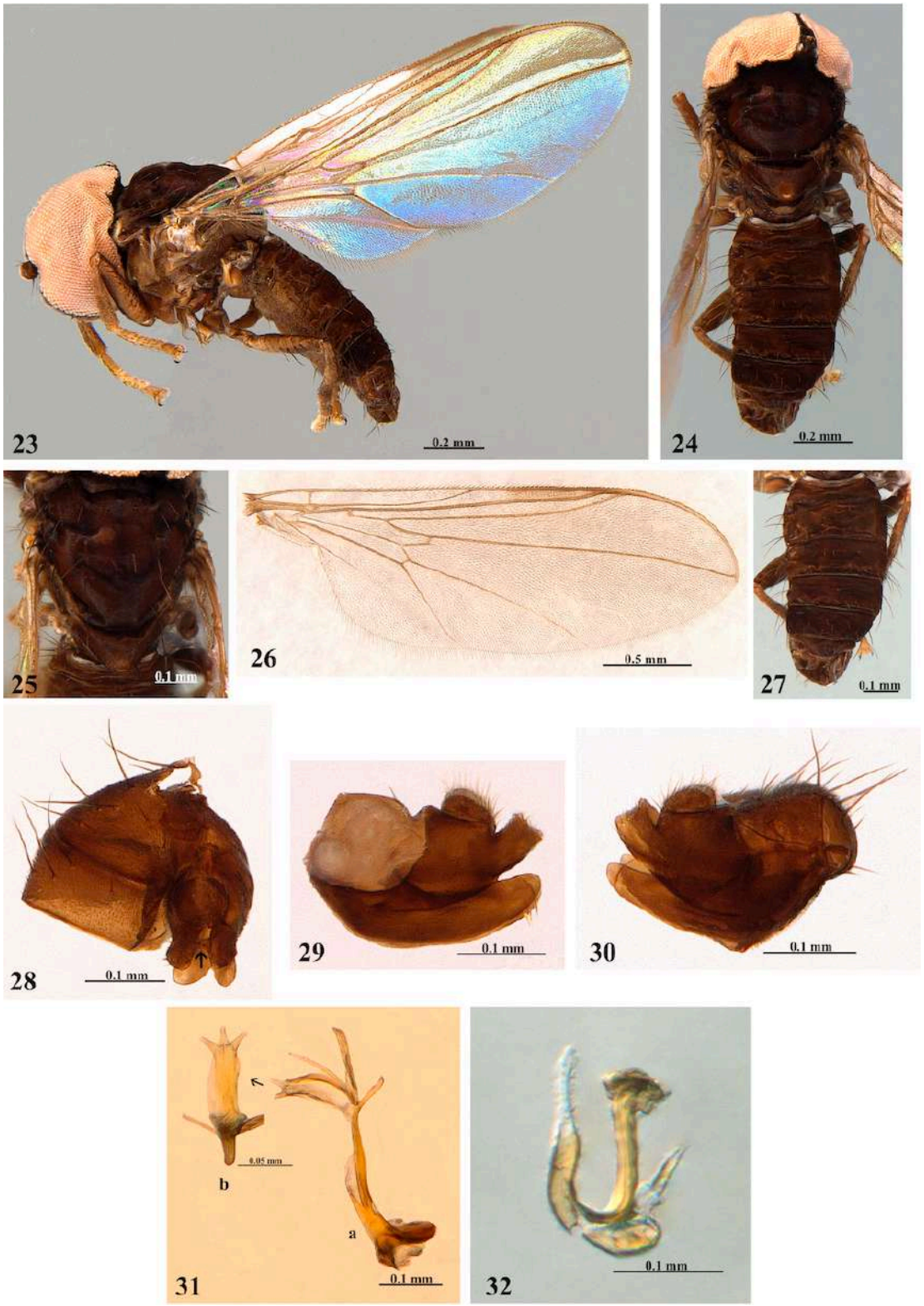


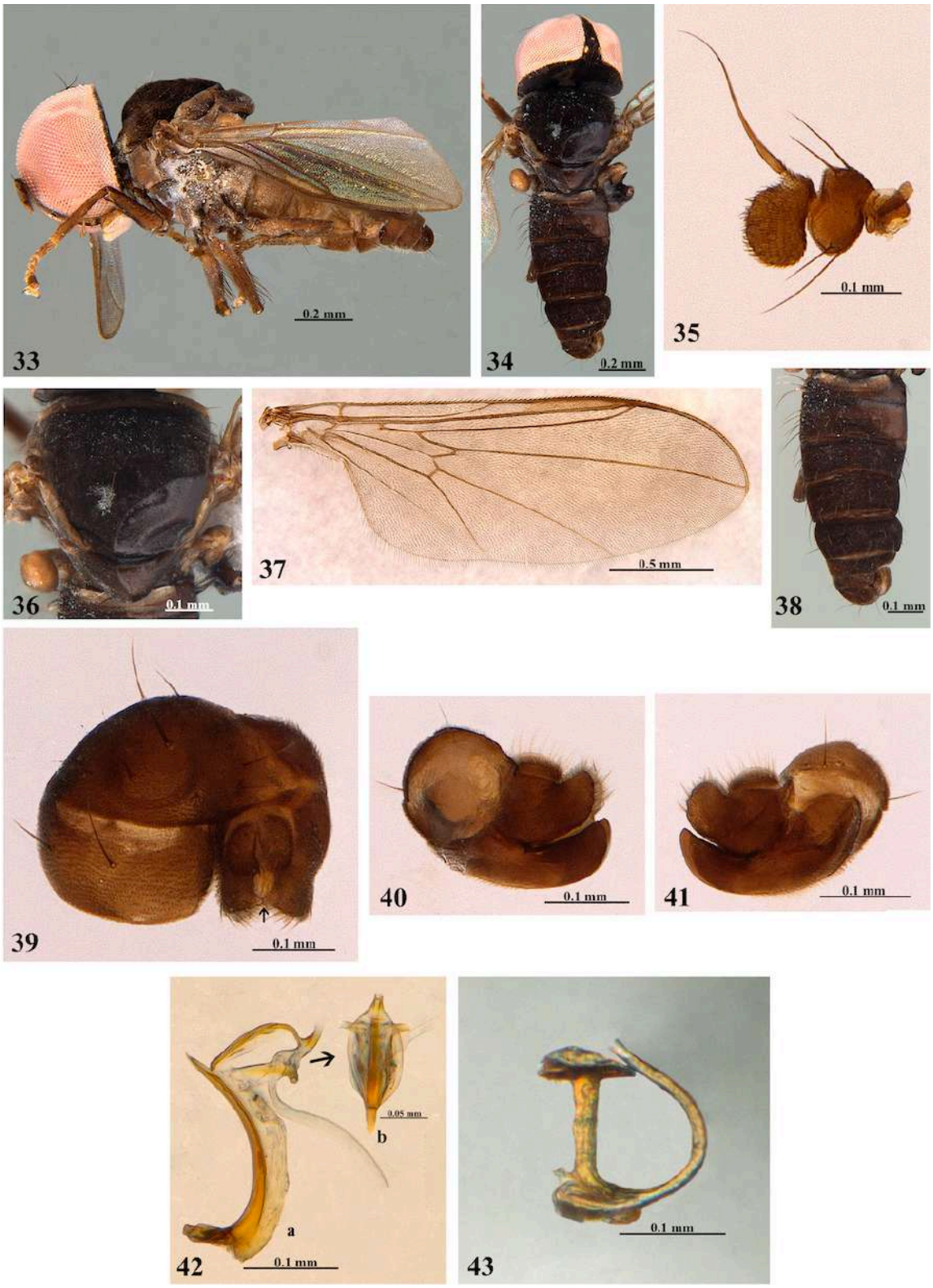
FIGURES 2 - 11. *Chalarus absonus* Rafael, 1990 (IAvH–M1271). Male. **1**, Habitus, left lateral view; **2**, Habitus, dorsal view; **3**, Antenna; **4**, Thorax, dorsal view; **5**, Wing; **6**, Abdomen, dorsal view; **7**, Terminalia, dorsal view; **8**, Left surstylus and gonopod, lateral view; **9**, Right surstylus and gonopod, lateral view; **10**, **a**: Phallic guide, subapical processes and phallus, right lateral view, **b**: Phallus dorsal view, **11**, Ejaculatory apodeme.



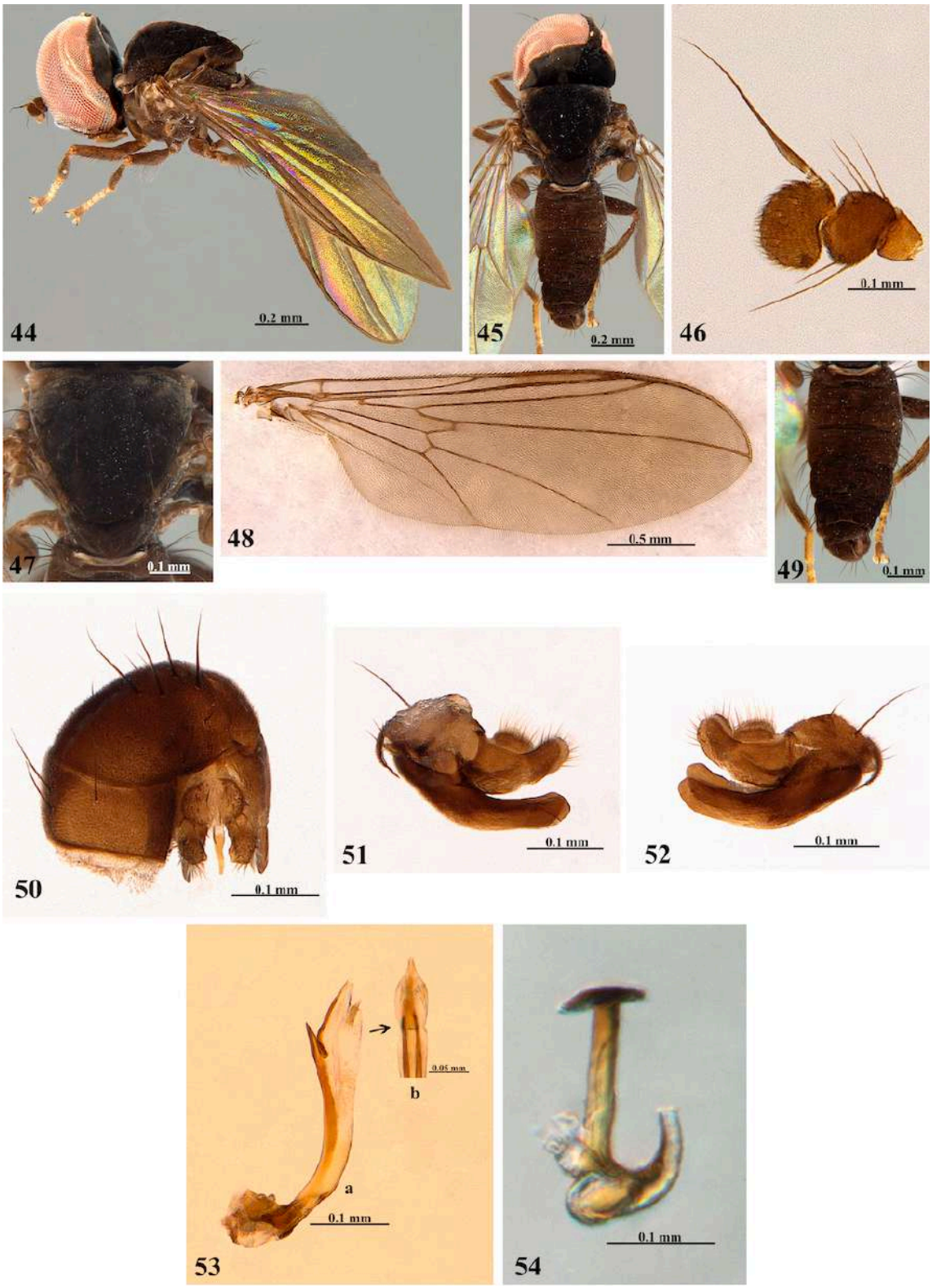
FIGURES 12–22. *Chalarus boyacensis* **sp. nov.** (IAvH–M1271). Holotype male. 12, Habitus, left lateral view; 13, Habitus, dorsal view; 14, Antenna; 15, Thorax, dorsal view; 16, Wing; 17, Abdomen, dorsal view; 18, Terminalia, dorsal view; 19, Left surstylus and gonopod, lateral view; **20**, Right surstylus and gonopod, lateral view; **21**, **a**: Phallic guide, subapical processes and phallus, left lateral view, **b**: Phallus dorsal view, **22**, Ejaculatory apodeme.



FIGURES 23–32. *Chalarus chairensis* **sp. nov.** (LEUA–00000049759). Holotype male. 23, Habitus, left lateral view; 24, Habitus, dorsal view; 25, Thorax, dorsal view; 26, Wing; 27, Abdomen, dorsal view; 28, Terminalia, dorsal view; 29, Left surstylus and gonopod, lateral view; **30**, Right surstylus and gonopod, lateral view; **31**, **a**: Phallic guide, subapical processes and phallus, right lateral view, **b**: Phallus dorsal view, **32**, Ejaculatory apodeme.



FIGURES 33–43. *Chalarus connexus* Rafael, 1988 (LEUA–00000049808). Male. 33, Habitus, left lateral view; 34, Habitus, dorsal view; 35, Antenna; 36, Thorax, dorsal view; 37, Wing; 38, Abdomen, dorsal view; 39, Terminalia, dorsal view; 40, Left surstylus and gonopod, lateral view; **41**, Right surstylus and gonopod, lateral view; **42**, **a**: Phallic guide, subapical processes and phallus, left lateral view, **b**: Phallus dorsal view, **43**, Ejaculatory apodeme.



FIGURES 44–54. *Chalarus delicatus* Rafael, 1990 (LEUA–00000049809). Male. 44, Habitus, left lateral view; 45, Habitus, dorsal view; 46, Antenna; 47, Thorax, dorsal view; 48, Wing; 49, Abdomen, dorsal view; 50, Terminalia, dorsal view; 51, Left surstylus and gonopod, lateral view; **52**, Right surstylus and gonopod, lateral view; **53**, **a**: Phallic guide, subapical processes and phallus, left lateral view, **b**: Phallus dorsal view, **54**, Ejaculatory apodeme.

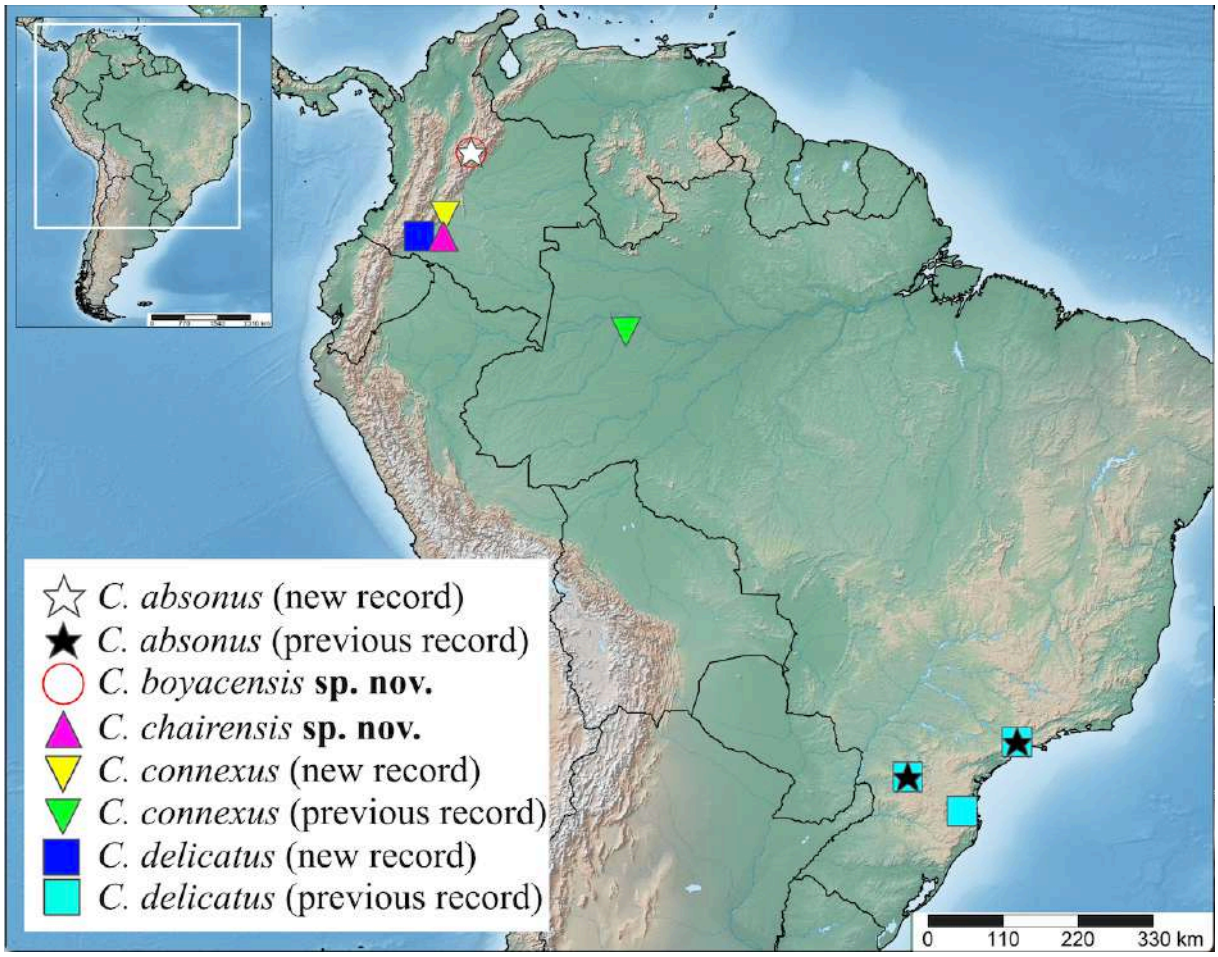


FIGURE 55. Geographical records of *Chalarus* species in Colombia. *Chalarus absonus* Rafael, 1990, *C. boyacensis* **sp. nov.**, *C. chairensis* **sp. nov.**, *C. connexus* Rafael, 1988, and *C. delicatus* Rafael, 1990.

Subfamília: Pipunculinae Walker, 1834
Tribo: Tomosvaryellini Hardy, 1943
Gênero: *Clistoabdominalis* Skevington, 1939

CAPÍTULO 2

Ramos-Pastrana, Y. *Clistoabdominalis* Skevington, 2001 (Diptera: Pipunculidae) of Colombia, with description of a new species and an updated key to males of the Neotropical species.

Manuscrito em preparação para a revista Zootaxa.

***Clistoabdominalis* Skevington, 2001 (Diptera: Pipunculidae) of Colombia, with description of a new species and updated key to males of the Neotropical species**

Abstract

Clistoabdominalis Skevington, 2001 has a cosmopolitan distribution and is a poorly studied genus in the Neotropical region, completely unknown in Colombia. One new species is described from protected areas and conflict territories of limited access in Colombia, namely *Clistoabdominalis lucyae* **sp. nov.** (type-locality: Parque Nacional Natural Tayrona). *Clistoabdominalis spinitibialis* (Hardy, 1954) is recorded for the first time in Colombia, with an amended diagnosis. Illustrations and a dichotomic key to the Neotropical species are also presented.

Key words: big-headed fly, diversity, Pipunculinae, Tomosvarylini, taxonomy

Introduction

Clistoabdominalis Skevington, 2001 (Pipunculinae: Tomosvaryellini) is a cosmopolitan genus with 75 world species (Skevington & Yeates 2001; Kehlmaier 2005a; Földvári 2013; Kazerani & Kehlmaier 2018; Marques *et al*. 2019a: Motamedinia *et al*. 2020). The genus was created by Skevington (2001) to include the type species *Pipunculus helluo* Perkins, 1905 and 11 other *Eudorylas* Aczél, 1940 species were combined into this genus (Skevington & Yeates 2001).

Skevington & Yeates (2001) considered *Clistoabdominalis* monophyletic, the sister group of *Eudorylas* within the tribe Eudorylini. In the recent phylogenetic analyses carried out by Motamedinia *et al*. (2021), Eudorylini was found to be paraphyletic, with *Tomosvaryella* Aczél, 1939 as sister to *Eudorylas* + *Clistoabdominalis*. Given the well-supported paraphyly, Eudorylini was synonymized with Tomosvaryellini and in the molecular analyses presented by these authors, *Clistoabdominalis* was not recovered monophyletic, with three species (*C. doczkali*, *C. ruralis,* and one undescribed species from Malagasy) strongly supported within the *Eudorylas* clade. Additionally, these authors affirm that *Eudorylas* and *Clistoabdominalis* due to their paraphyletic condition require redefinition rather than synonymy, and the type species for *Clistoabdominalis*, *C. helluo* (Perkins, 1905) found out closely related to *C. beneficiens* (Skevington & Yeates, 2001) so there is little doubt that the main clade of *Clistoabdominalis* includes the type species. Finally, they propose that *C. ruralis* Meigen, 1824 and *C. doczkali*

Kehlmaier, 2005b are both moved back into *Eudorylas* and that *Eudorylas vineti* Dempewolf, 1996 and *E. fusculus* Zetterstedt, 1844 both be transferred to *Clistoabdominalis*.

Skevington (2001) revised 29 Australian species of *Clistoabdominalis* and proposed 23 species. Földvári (2003; 2013) described two species and proposed one combination for the Afrotropical region. Kozánek & Kehlmaier (2004) and Kehlmaier (2005a; 2005b) studied the fauna of the Palearctic/Oriental region, describing one species and proposing 10 combinations. Marques *et al*. (2019a) described one species for the Neotropical region. Additionally, other authors made keys to male and/or female species (Skevington 2001, Kehlmaier 2005b, Földvári 2013).

Currently, in the Neotropical region occur two species, *Clistoabdominalis spinitibialis* (Hardy, 1954) and *C. mitarakensis* Marques & Rafael, 2019a, but none are recorded from Colombia. The objective of this paper was to study the species of *Clistoabdominalis* from Colombia, describe and illustrate all the species found in the country as well as provide a new identification key to the males of all the Neotropical species.

Material and methods

This study is based on pinned specimens deposited in the following collections: Colección del Laboratorio de Entomología Universidad de la Amazonia (LEUA), Florencia, Caquetá, Colombia and Colección del Instituto de Investigación de Recursos Biológicos Alexander von Humboldt (IAvH), Villa de Leyva, Boyacá, Colombia; Invertebrate Collection of Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil.

The total length of a specimen was measured in lateral view by summing the distances from the frons (antenna excluded) to the scutellum apex and from the scutellum apex to the abdomen apex. To study the internal characteristics of the male genitalia, the abdomen apex was cut off at the third tergite, placed into lactic acid (85%), and heated at 150º C over a Thermo Scientific Cimarec plate for approximately 1 hour, prior to the dissection of the genital pieces. The pieces were dissected and photographed in dehydrated glycerin using an excavated slide. After study, the pieces were stored in microvials containing glycerin. The wings were mounted on microslides with Canada balsam. The holotype specimens were pinned, mounted, and deposited in their original collections. The microvial and microslide were pinned along with the respective specimen.

The morphological terminology follows Cumming & Wood (2017). The measurements (in millimeters) that refer to the head, antenna, and wing were made as proposed by Kehlmaier

(2005b), Marques *et al*. (2019b) and Ramos-Pastrana & Rafael (2021): F, length of frons; EM, length of eye contiguity; V, length of vertex; LW/ MWW, ratio between length and maximum width of the wing; LTC/LFC, ratio between length of third costal section by length of fourth costal section of the wing; LPP/WPP, ratio between length and maximum width of the postpedicel.

The following measurements of the ovipositor follow Skevington (2005): ovipositor length (OL), measured over a straight line from the tip of the piercer to the point where the base of the ovipositor articulates with sternite 6 dorsally; piercer length (PL), measured over a straight line from the proximal edge of the cerci to the tip of the piercer; length ovipositor's base (B), measured over a straight line from the proximal end of the cerci to the point where the base of the ovipositor articulates with sternite 6 dorsally.

Photographs were taken with a Leica digital camera DFC450 coupled to a stereomicroscope Leica M205A and connected to a computer with Leica Application Suite software, with automatic mounting module (synchronization software) (http://www.syncroscopy.com/syncroscopy/). The maps showing species' geographic records were plotted using the SimpleMappr software (Shorthouse 2010).

In the list of examined material, label data are given as presented on the labels. The square brackets ([]) are used to indicate complementary data that are not present in the specimen labels. New records for the country are included within each species and mentioned as a "new record" in geographical distribution. Data for specimens with identical data were simplified with *idem* and only the data that differ from the anterior labels were written.

Results

Clistoabdominalis Skevington, 2001

Dorylas (*Eudorylas*) Hardy, 1954: 1 (partim).

Eudorylas Aczél, 1952: 242 (partim).

Pipunculus (*Eudorylas*) Walker, 1849: 639 (partim); Perkins, 1905: 145 (partim); Hardy, 1954: 44, Figs 21a–c (partim); 1965a: 187 (partim); 1965b; 1 (partim); 1968: 461, Figs 29a–e (partim); Scarbrough & Knutson, 1989: 533, Figs 16a–c, 17 (partim).

Eudorylas Rafael, 1995: 793 (partim); De Meyer, 1997: 426, 434, Figs 2, 13b, 7 (partim).

Clistoabdominalis Skevington, 2001 *in* Skevington & Yeates, 2001: 345, Figs 1e, 1f, 3d, 4f, 5b, 5g, 5i, 6d, 7d, 8i, 8j, 8k. Type species *Pipunculus hellou* Perkins, 1905 (original designation); Skevington, 2001: 695, Figs 1–38; Kehlmaier, 2005a: 23, 8a–l, 9a–d, 10a–

k, 11a–g; Földvári, 2013: 17, Figs 5a–5e, 5f–5k, 6a–6f, 6g, 6l, 39n–o, 40e–j; Kazerani & Kehlmaier, 2018: 583, 2a–f, 3a–f; Marques *et al*. 2019a: 254, Figs 3a–j; Motamedinia *et al*. 2020: 561, Figs 1a–e, 2a–f, 3a–e, 4a–e, 5a–e, 6a–e, 7a–e, 8a–e, 9a–e, 10a–e, 11a–e, 12; Motamedinia *et al*. 2021: 14.

Diagnosis [adapted from Skevington (2001)]. Postpedicel usually with short setae. Pterostigma usually present. Tergite 1 with lateral setae reduced or absent; male tergite 5 asymmetric; tergite 6 not visible dorsally and generally with protuberance laterally; syntergosternite 8 inflated (rarely not inflated); membranous area usually absent. Apex of phallic guide distinctive, curving, concave medially. Phallus usually trifid, with ejaculatory ducts separated only to 1/3 distal (rarely unbranched). Ejaculatory apodeme usually funnel-shaped.

Clistoabdominalis species from Colombia

Clistoabdominalis lucyae sp. nov.

Figs 1–13, 30

Diagnosis. Male. Postpronotal lobe brownish yellow. Syntergosternite 8 without membranous area. Surstyli asymmetrical. Apex of phallic guide thickened basally, thin apically, with a lobe dorsally with apex forward-directed. Phallus thickened, with apex slightly truncated, frontal margin sinuous.

Description. MALE (holotype). Body length 4 mm. ***Head*** (Figs 1–2). Eyes contiguous for 18 facets. F, EM, V (mm) = 0.3, 0.4, 0.2. Frontal triangle dark brown, gray-brown pruinose. Occiput brown, gray pruinose ventrally and laterally, brown pruinose dorsally. Antenna (Fig. 3) with scape dark brown, with one yellow seta dorsally; pedicel dark brown, with three setae dorsally and two setae ventrally; postpedicel brown, with acuminate apex. LPP/WPP = 2.7. ***Thorax*** (Figs 2, 4). Postpronotal lobe brownish yellow. Scutum dark brown, brown pruinose. Notopleuron brown, gray-brown pruinose. Scutellum concolor with scutum, dark brown, brown pruinose. Mesopleuron concolor with notopleuron, gray-brown pruinose. Mediotergite concolor with mesopleuron, gray-brown pruinose. ***Wing*** (Fig. 5). Length 3.9 mm. LW/MWW = 3.5; LTC/LFC = 0.4. Membrane slightly brown infuscated; vein r-m located after basal third of cell dm; anal lobe large. Halter stem beige with base and apex brown, knob dark brown. ***Legs*** (Fig. 1). Coxae dark brown, gray-brown pruinose; trochanters dark brown, gray-brown pruinose; femora dark brown with apices yellow, gray-brown pruinose, with a row long setae

posterolaterally; fore tibia brown, with bases yellow; mid tibia brown, with 1/3 basally yellow; hind tibia brown, with base yellow and discoloration dark brown medially; tarsomeres 1–4 brown, 5 dark brown; pulvilli brown. ***Abdomen*** (Figs 1–2, 6). Ground color velvety dark brown, with inconspicuous scattered setae; tergite 1 with a row of yellow and inconspicuous setae laterally, brown pruinose basally, gray pruinose distally and laterally; tergites 1–3 brown pruinose dorsally and gray pruinose posterolaterally; tergite 5 brown pruinose, with a band gray pruinose in distal margin, interrupted medially; tergites and sternites 6 and 7 as in Fig. 7. Syntergosternite 8 dark brown, brown pruinose, almost 1/2 times as larger than tergite 5, without membranous area apically (Figs 6, 8). ***Terminalia*** (Figs 7–13). Epandrium dark brown; surstyli brown (Fig. 8). Surstyli (Figs 8–10) asymmetrical, shorter than epandrium length, completely setose, with long setae apically; left surstylus slightly square-shape, slightly longer than right, with inner margin with apex acute and outer margin with apex subrounded; right surstylus slightly triangle-shaped, inner margin with an acute lobe; both surstyli with apex downward-directed (Fig. 8); both surstyli with apices truncated and forward-directed when seen in lateral view (Figs 9–10). Gonopods subsymmetrical, with apices slightly rounded; right gonopod higher than left (Fig. 11). Apex of phallic guide thickened basally, thin apically, with acute apex upwards-directed and lobe dorsally with apex forward-directed (Fig. 12). Ejaculatory apodeme funnel-shaped (Fig. 13). Phallus unbranched, thickened, with apex slightly truncated, upwards-directed and frontal margin sinuous (Fig. 12).

FEMALE. Unknown.

Type material. (2 m#). HOLOTYPE. Male: COLOMBIA, **Magdalena**, PNN[Parque Nacional Natural] Tayrona, Palangana, 11º20'N/74º02'W, 30 m[eters], 15–30.XI.2001, Malaise, R. Rodriguez Leg. M2570 (1 m# IAvH) (photographed specimen). PARATYPE. *idem* 15–30.XI.2001, M2567 (1 m# LEUA).

Etymology. The new species is named after Lucy Yolanda Pastrana, the mother of the author, in gratitude to her dedication, to the effort made to give more importance to her children than to herself, thanks for the upbringing and the love given.

Geographical distribution. Colombia (Magdalena) (Fig. 30).

Habitat. The specimens were collected in the reserve Parque Nacional Natural Tayrona, this area has mainly thorny bushes and dry tropical forests typical of the Caribbean region of Colombia.

Taxonomic notes. Based on males *C. lucyae* **sp. nov.** is similar in appearance to *C. spinitibialis* (Hardy, 1954). It differs from *C. spinitibialis* by having the fore tibia brown, with

base yellow (*versus* fore tibia yellow ventrally, brown dorsally, with apex entirely yellow); mid tibia brown, with basal 1/3 yellow (*versus* mid tibia brown, with apices yellow); hind tibia brown, with base yellow and discoloration dark brown medially (*versus* hind tibia brown with apices yellow); tergites 2 brown pruinose dorsally and gray pruinose posterolaterally (*versus* tergite 2 gray pruinose, except by a brown pruinose spot dorsocentrally); tergite 5 brown pruinose, with a band gray pruinose in distal margin, interrupted medially (Fig. 6) [*versus* tergite 5 brow, with gray pruinosity scattered (Fig. 19)]. Other differentiation characters can be seen in the key below.

***Clistoabdominalis spinitibialis* (Hardy, 1954)**

Figs 14–26, 30

Clistoabdominalis spinitibialis Skevington & Yeates, 2001: 435; Rodríguez & Rafael, 2012: 17.

Eudorylas spinitibialis Rafael, 1995: 827, Figs 158–161, 219; De Meyer, 1996: 69.

Pipunculus (*Eudorylas*) *ventosus* Hardy, 1965b: 57, Fig. 21d.

Pipunculus (*Eudorylas*) *spinitibialis* Hardy, 1965a: 224, Figs 9b–d; 1965b: 52, Fig. 19d; 1966: 6.

Dorylas (*Eudorylas*) *ventosus* Hardy, 1954: 47, Figs 23a–b; Hardy, 1965a: 224 (synonymy).

Dorylas (*Eudorylas*) *spinitibialis* Hardy, 1954: 44, Figs 21a–c.

Diagnosis. Antenna brown to black; postpedicel with acuminate apex. Postpronotal lobe yellow. Legs predominantly black, fore and hind femora with small ventral ctenidia. Fore and mid tibia with long seta apically. Third section of the costal vein shorter than the length of the fourth. Tergite 1 without long setae laterally. Syntergosternite 8 inflated, almost 1.5 times longer than the length of tergite 5, with a small membranous area. Surstyli subsymmetrical. Apex of phallic guide thickened basally, thin, with acute apex upwards-directed. Phallus unbranched, thin, with acute apex.

Intraspecific variability. Hardy (1954) and Rafael (1995) provided a complete description and illustrations of the Brazilian holotype; we provide a comparison of the variations between the Colombian and Argentine, Bolivian, and Brazilian specimens (between parenthesis, when comparable). MALE. Body length 3 mm (*versus* 3.3 mm in the holotype). ***Head*** (Figs 14–15). Frontal triangle gray-brown pruinose. Occiput brown, gray pruinose, ventrally and laterally, brown pruinose dorsally (*versus* Occiput black, black pruinose dorsally).

Antenna (Fig. 16) with scape and pedicel dark brown, scape with one seta dorsally; pedicel with three setae dorsally and two setae ventrally; postpedicel brown with acuminate apex (*versus* antenna brown; postpedicel with tinge yellow). ***Thorax*** (Figs 14–15, 17). Postpronotal lobe light brown, gray-brown pruinose (*versus* postpronotal yellow). Scutum velvety dark brown, brown pruinose, with two pruinose gray spots between the postpronotal lobes. Notopleuron dark brown, gray-brown pruinose. Scutellum brown, gray-brown pruinose. Mesopleuron brown, gray-brown pruinose. Mediotergite dark brown, gray-brown pruinose. ***Wing*** (Fig. 18). Membrane brown infuscated; vein r-m located after basal third of cell dm. Halter stem beige, with bases and apices brown, knob brown (*versus* halter entirely brown). ***Legs*** (Fig. 14). Coxae brown, gray-brown pruinose (*versus* coxae black); trochanters brown, gray-brown pruinose (*versus* trochanters black); femora brown, with apices yellow, gray-brown pruinose; ventral ctenidia, in hind femur more reduced, and a row of long and fine yellow setae posterolaterally (*versus* femora black, fore and hind femora with ventral ctenidia inconspicuous); fore tibia yellow ventrally, brown dorsally, with apex entirely yellow; mid and hind tibia brown with apices yellow; fore and mid tibiae with long setae apically (*versus* all tibiae black); tarsomeres 1–4 brown, 5 dark brown (*versus* tarsomeres 1–4 yellow, 5 brown to black); pulvilli light brown. ***Abdomen*** (Figs 14–15, 19). Ground color velvety dark brown (*versus* abdomen black), with conspicuous scattered setae; tergite 1 with a row of yellow and inconspicuous setae laterally, brown pruinose in basal half, gray pruinose in distal half; tergite 2 gray pruinose, except by a spot brown pruinose dorsocentrally anterolaterally; tergites 3–5 brow, with gray pruinosity scattered; tergites and sternites 6 and 7 as in Fig. 20. Syntergosternite 8 dark brown, brown pruinose, almost 1/2 times as larger than tergite 5, with membranous area apically (Fig. 21). ***Terminalia*** (Figs 20–26). Epandrium and surstyli brown (Fig. 21). Surstyli (Figs 21–23) subsymmetrical, shorter than epandrium length, completely setose; left surstylus with apex slightly acute rounded and slightly inward-directed; right surstylus with apex slightly truncated and slightly downward-directed (Fig. 21); both surstyli with apices slightly rounded and margins sinuous when seen in lateral view (Figs 22–23). Gonopods subsymmetrical, with apices acute; left gonopod higher than right (Fig. 24). Apex of phallic guide thickened basally, thin, with acute apex upwards-directed (Fig. 25). Ejaculatory apodeme funnel-shaped (Fig. 26). Phallus unbranched, thin, with acute apex (Fig. 25). FEMALE (Figs 27–29). Body length 3.5 mm (*versus* body length 3 mm in the allotype); wing length 3.8 mm (*versus* wing length 3.7 mm). Ovipositor base brown, grayish-pruinose (Fig. 28) (*versus* ovipositor base brownish red);

piercer subopaque yellow, except the base brown, apex shiny (Fig. 29) (*versus* piercer yellowish).

Examined material. (42 m#). COLOMBIA, Caquetá, Florencia, Vda.[Vereda] Paraiso, Fca.[Finca] Paraiso, 01º44'51.4"N/75º37'46.8"W, 663 m[eters], 09–23.XI.2016, Y. Ramos-Pastrana, (*Saccharum officinarum*), (1 m# LEUA–42958) (photographed specimen); *idem* (1 m# LEUA–42959); *idem* (1 m# LEUA–42960); *idem* (1 m# LEUA–42961); *idem* 07–21.XII.2016; *idem* (1 m# LEUA–42962); *idem* 26.X–09.XI.2016 (1 f# LEUA–42963) (photographed specimen); *idem* 21.XII.2016–04.I.2017 (1 m# LEUA–42964); *idem* (1 m# LEUA–42965); *idem* (1 m# LEUA–42966); *idem* (1 m# LEUA–42967); *idem* (1 m# LEUA–42968); *idem* 26.X.–09.XI.2016 (1 f# LEUA–42969; *idem* (1 f# LEUA–42970); *idem* 09–23.XI.2016 (1 f# LEUA–42971); *idem* 04–18.I.2017 (1 m# LEUA–42972); *idem* (1 m# LEUA–42973); *idem* (1 m# LEUA–42974); *idem* 18.I–01.II.2017 (1 m# LEUA–42975); *idem* (1 m LEUA–42976); *idem* 01–15.II.2017 (1 m# LEUA–42977); *idem* (1 m# LEUA–42978); *idem* (1 m# LEUA–42979); *idem* 15.II–01.III.2017 (1 m# LEUA–42980); *idem* 01–15.III.2017 (1 m# LEUA–42981); *idem* (1 m# LEUA–42982); *idem* (1 f# LEUA–42983); *idem* 15–29.III.2017 (1 m# LEUA–42984); *idem* (1 m# LEUA–42985); *idem* 29.III–12.IV.2017 (1 m# LEUA–42986); *idem* (1 m# LEUA–42987); *idem* (1 m# LEUA–42988); *idem* (1 m# LEUA–42989); *idem* (1 f# LEUA–42990); *idem* Vda.[Vereda] San Pacho, Fca.[Finca] El Recreo, 01º42'24.3"N/75º36'36.6"W, 643 m[eters], 01–15.III.2017 (1 m# LEUA–42991); *idem* 15.II–01.III.2017 (1 f# LEUA–42992); *idem* Vda.[Vereda] La Viciosa, Fca.[Finca] Macagual, 01º30'32.2"N/75º40'28.3"W, 253 m[eters], 23.XI–07.XII.2016 (1 m# LEUA–42993); *idem* San José del Fragua, Vda.[Vereda] Bellavista, Fca.[Finca] Mi Ranchito, 01º18'23"N/76º00'33"W, 265 m[eters], 01–15.II.2017 (1 f# LEUA–42994)"; *idem* 18.I–01.II.2017 (1 m# LEUA–42995); *idem* Bosque Piso, 15.II–01.III.2017 (1 m# LEUA–42996); *idem* Puerto Rico, Vda.[Vereda] La Soledad, Fca.[Finca] Borinquen, Bosque dosel, 01º55'30"N/75º08'33.2"W, 308 m[eters], 09–23.XI.2016 (1 f# LEUA–42997); *idem* Amazonas, PNN[Parque Nacional Natural] Amacayacu, Matamata, 3º41'S/70º15'W, 150 m[eters], 8.VII.2000, Red, A. Parente Leg., M3546 (1 m# IAvH); *idem* Bolivar, SFF[Santuario de Fauna y Flora] Los Colorados, 09º54'N/75º07'W, 180 m[eters], 14–30.XI.2001, Malaise, E. Deulofue Leg., M2627 (1 f# IAvH)".

Geographical distribution. Argentina (Tucumán), Bolivia (Beni), Brazil (Amazonas, Mato Grosso, Bahia, Rio de Janeiro, São Paulo, Paraná, Santa Catarina), Colombia (new record) (Amazonas, Bolívar, Caquetá) (Fig. 30).

Habitat. The specimens were collected in several habitats including plantation, humid and dry tropical forests in Colombia. Plantation included Sugar cane (*Saccharum officinarum*). Humid tropical forests were located in Caquetá and Parque Nacional Natural Amacayacu in Amazonas. Tropical dry forest was located in the Caribbean region and Santuario de Fauna y Flora Los Colorados in Bolivar, Colombia.

Key to males of the Neotropical species of *Clistoabdominalis*

1 Syntergosternite 8 without membranous area (Fig. 8); surstyli asymmetrical (Fig. 8); apex of phallic guide thickened basally, thin apically, with a lobe dorsally with apex forward-directed (Fig. 12); phallus thickened, with apex slightly truncated frontal and margin sinuous (Fig. 12) … ***C. lucyae* sp. nov.**

- Syntergosternite 8 with membranous area [Fig. 21 and see figure 3f in Marques *et al.* (2019a)]; surstyli symmetrical or subsymmetrical [Fig. 21 and see figure 3e in Marques *et al.* (2019a)]; apex of phallic guide completely thin, without dorsal lobe [Fig. 25 and see figure 3j in Marques *et al.* (2019a)]; phallus thin with apex acute (Fig. 25) or trifid [see figure 3j in Marques *et al.* (2019a)] … 2

2 Postpronotal lobe yellow to light brown (Fig. 14); fore and mid tibiae with long setae apically; susrtyli subsymmetrical, left surstylus with acute apex slightly inward-directed, right surstylus with apex slightly truncated downward-directed (Fig. 21); ejaculatory apodeme funnel-shaped (Fig. 26); phallus unbranched, with apex acute (Fig. 25) … ***C. spinitibialis*** (Hardy, 1954)

- Postpronotal lobe brown [see figure 3a in Marques *et al.* (2019a)]; fore and mid tibiae without long setae apically; surstyli symmetrical, both surstyli with apex acute inward-directed [see figure 3e in Marques *et al.* (2019a)]; ejaculatory apodeme conical-shaped [see figure 3i in Marques *et al.* (2019a)]; phallus trifid [see figure 3j in Marques *et al.* (2019a)] … ***C. mitarakensis*** Marques & Rafael, 2019

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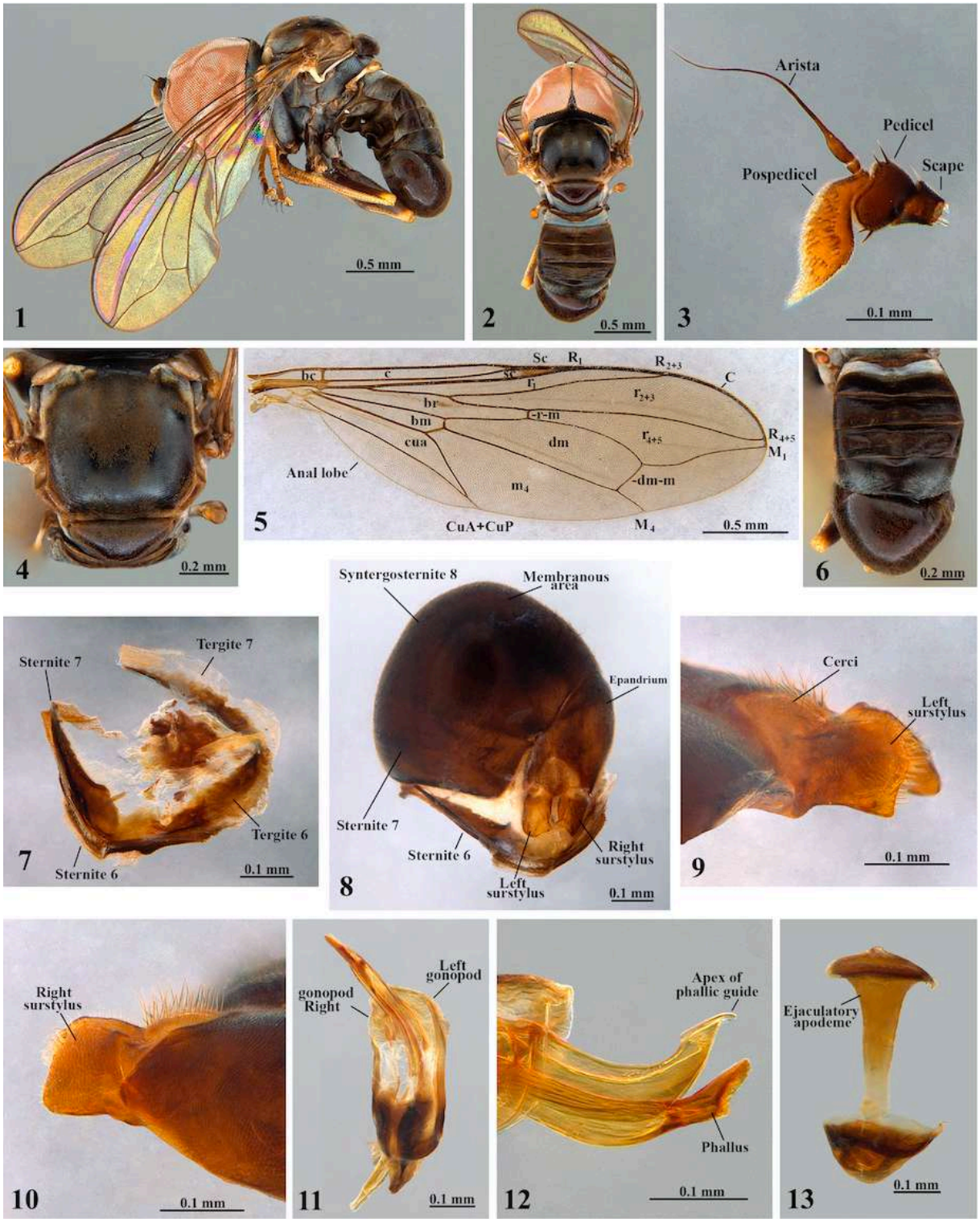
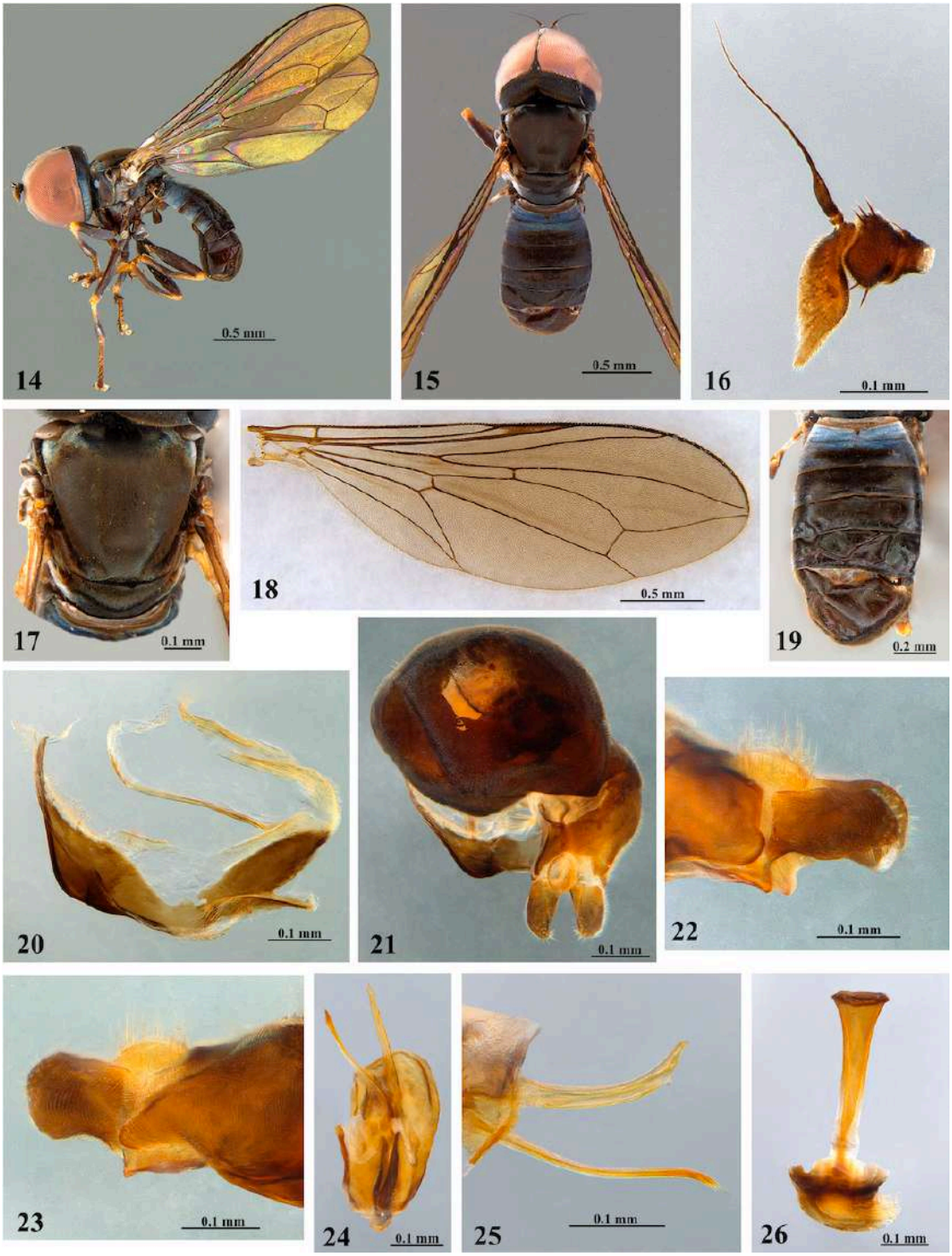
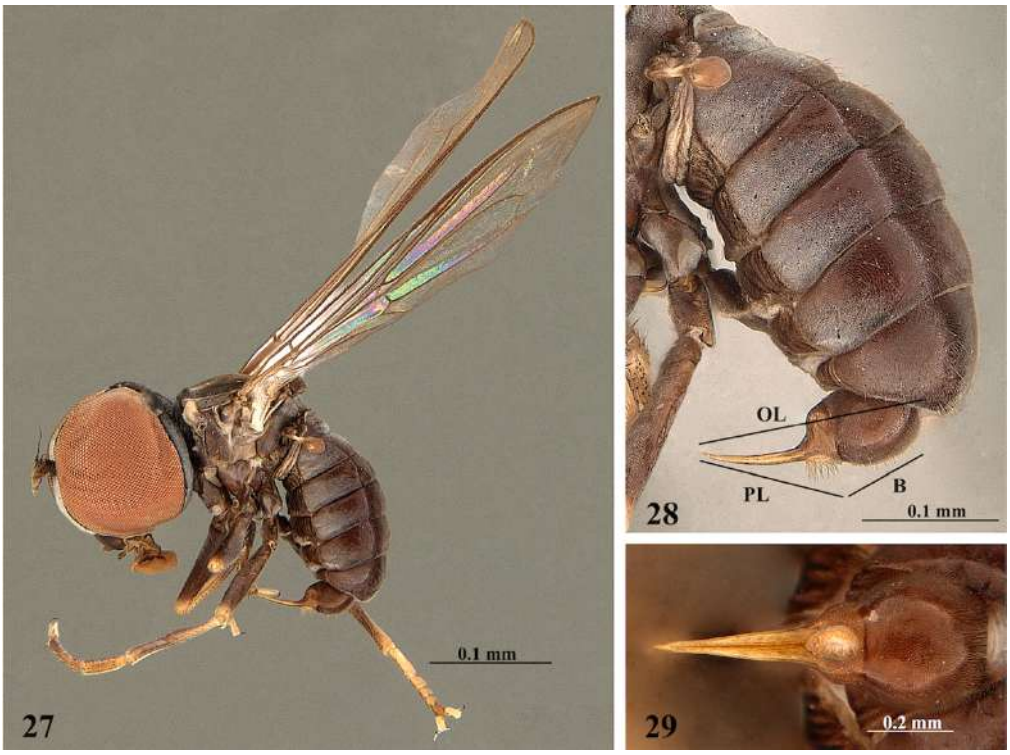


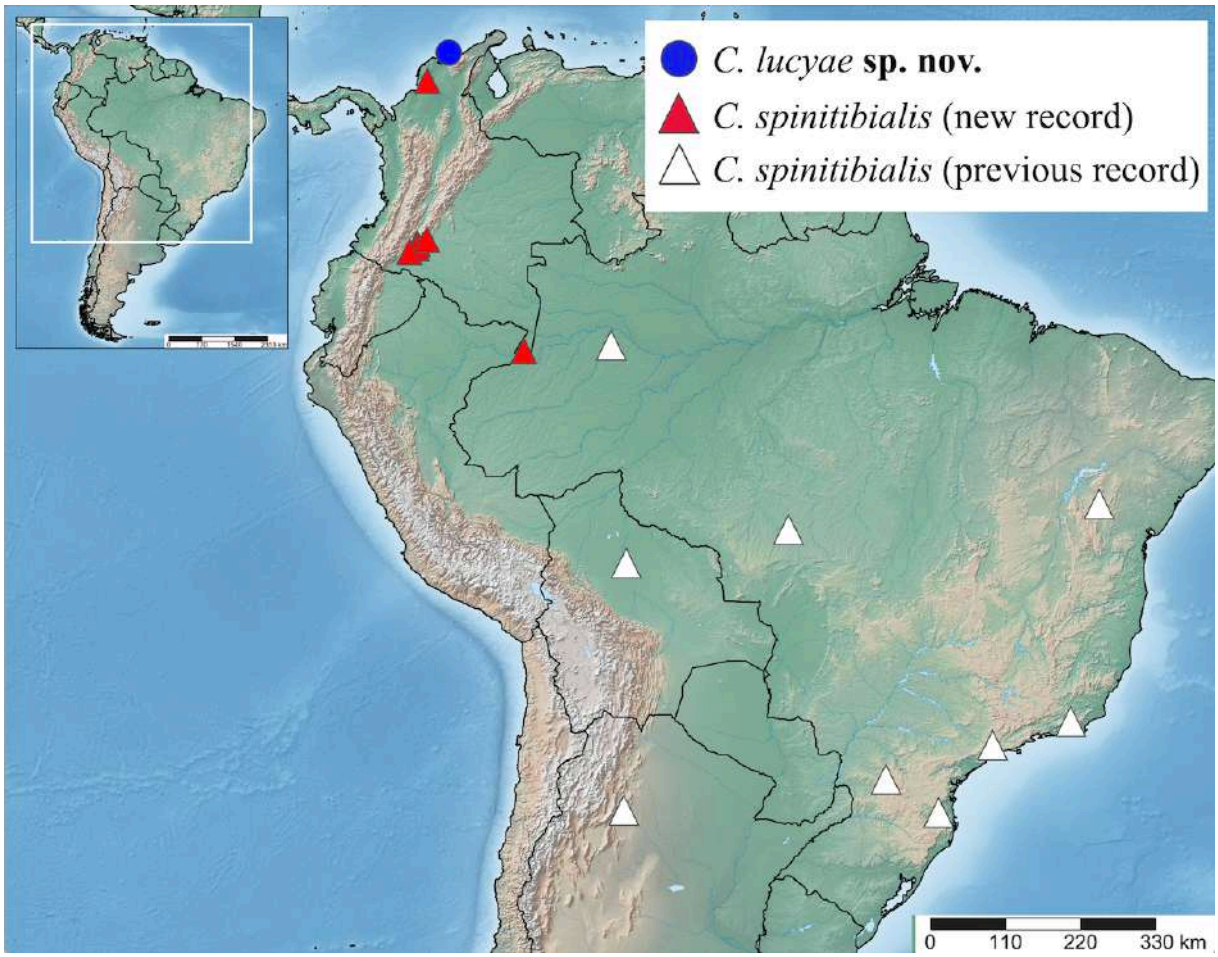
FIGURES 1-13. *Clistoabdominalis lucyae* **sp. nov.** (IAvH–M2570). Holotype male. **1**, Habitus, left lateral view; **2**, Habitus, dorsal view; **3**, Antenna; **4**, Thorax, dorsal view; **5**, Wing; **6**, Abdomen, dorsal view; **7**, Tergites and sternites 6 and 7, ventral view; **8**, Terminalia, dorsal view; **9**, Left surstylus, lateral view; **10**, Right surstylus, lateral view; **11**, Hypandrium and gonopods, ventral view, **12**, Phallic guide and phallus, left lateral view; **13**, Ejaculatory apodeme.



FIGURES 14-26. *Clistoabdominalis spinitibialis* (Hardy, 1954) (LEUA–42958). Male. **14**, Habitus, left lateral view; **15**, Habitus, dorsal view; **16**, Antenna; **17**, Thorax, dorsal view; **18**, Wing; **19**, Abdomen, dorsal view; **20**, Tergites and sternites 6 and 7, ventral view; **21**, Terminalia, dorsal view; **22**, Left surstylus, lateral view; **23**, Right surstylus, lateral view; **24**, Hypandrium and gonopods, ventral view, **25**, Phallic guide and phallus, left lateral view; **26**, Ejaculatory apodeme.



FIGURES 27-29. *Clistoabdominalis spinitibialis* (Hardy, 1954) (LEUA–42963). Female. **27**, Habitus, left lateral view; **28**, Abdomen, right lateral view; **29**, Piercer, ventral view.



FIGURES 30. Geographical records of *Clistoabdominalis* species in Colombia. *Clistoabdominalis lucyae* **sp. nov.** and *C. spinitibialis* (Hardy, 1954).

Subfamília: Pipunculinae Walker, 1834

Tribo: Tomosvaryellini Hardy, 1943

Gênero: *Dasydorylas* Skevington, 2001

CAPÍTULO 3

Ramos-Pastrana, Y. *Dasydorylas* Skevington, 2001 (Diptera: Pipunculidae) of Colombia, with description of three new species and an updated key to males of the Neotropical species.

Manuscrito em preparação para a revista Zootaxa.

***Dasydorylas* Skevington, 2001 (Diptera: Pipunculidae) of Colombia, with description of three new species and an updated key to males of the Neotropical species**

Abstract

The pipunculid genus *Dasydorylas* Skevington, 2001 has a cosmopolitan distribution. This genus has just a few species known from the Neotropical Region and is completely unknown to Colombia. Three new species of *Dasydorylas* are described from protected areas and conflict territories of limited access in Colombia, namely *Dasydorylas colombensis* **sp. nov.** (type locality: Santuario de Fauna y Flora Iguaque, Boyacá), *D. gibbera* **sp. nov.** (type locality: Santuario de Fauna y Flora Iguaque, Boyacá), and *D. santainensis* **sp. nov.** (type locality: Páramo de Santa Inés, Belmira, Antioquia). *Dasydorylas nigellus* (Rafael, 1991) is recorded for the first time from Colombia and an amended diagnosis is provided. A dichotomic key to all Neotropical species is presented. With this paper, the number of Neotropical *Dasydorylas* species is increased from six to nine.

Key words: big-headed fly, diversity, Pipunculinae, Tomosvaryellini, taxonomy

Introduction

Dasydorylas Skevington, 2001 (Pipunculinae: Tomosvaryellini) is a cosmopolitan pipunculid genus, with 32 species worldwide (Motamedinia *et al*. 2020). *Pipunculus horridus* (Becker, 1897) and *P. discoidalis* (Becker, 1897) were the first described species in the genus. Later, Becker (1908), Banks (1915), Hardy (1950; 1954; 1961; 1968; 1972), Koizumi (1959), and Kuznetzov (1994) described other *Dasydorylas* species under the genera *Pipunculus*, *Dorilas*, and *Eudorylas*.

Banks (1915) described *Pipunculus cinctus*, but later it was transferred by Hardy (1943) to *Dorilas* (*Eudorylas*). Curran (1928) described *Dasydorylas regalis* under *Pipunculus*. Hardy (1943) described *Dasydorylas cinctus subtilis* under *Dorilas*. Hardy (1954) described *Dasydorylas eremita* and *D. nigripides* under *Dorilas* (*Eudorylas*). Rafael (1991) described *D. nigellus* under *Eudorylas*. Rafael & Ale-Rocha (2004) described *D. vulcanus* and proposed four new combinations, transferring *Dorilas* and *Pipunculus* species to *Dasydorylas*. Földvári (2013) revised the Afrotropical species of *Dasydorylas* and listed eight species, of which two were described as new. Motamedinia *et al*. (2017) revised the Iranian species of *Dasydorylas*

and proposed two new species and one new combination, additionally, the species were characterized morphologically and molecularly by using DNA barcoding of the mitochondrial COI gene. Motamedinia *et al*. (2020) revised four of the Middle East species of *Dasydorylas* and proposed three species.

Skevington & Yeates (2001) considered *Dasydorylas* as sister to a large clade including *Amazunculus* Rafael, 1986, *Elmohardyia* Rafael, 1987a, *Basileunculus* Rafael, 1987b, *Allomethus* Hardy, 1943 and *Claraeola* Aczél, 1940, placed within the tribe Eudorylini. In the recent phylogenetic analyses carried out by Motamedinia *et al*. (2021), *Dasydorylas* was recovered as related to *Dorylomorpha* + at least one undescribed genus within Tomosvaryellini.

Currently, in the Neotropical Region, seven species of *Dasydorylas* are known from Argentina, Brazil, Costa Rica, Mexico, Nicaragua, and Peru, however, none have been registered in Colombia. The objective of this paper was to study the species of *Dasydorylas* from Colombia, describe and illustrate all the species found in the country as well as provide a new identification key to the males of all the Neotropical species.

Material and methods

This study is based on pinned specimens deposited in the following collections: Colección del Laboratorio de Entomología Universidad de la Amazonia (LEUA), Florencia, Caquetá, Colombia; Colección del Instituto de Investigación de Recursos Biológicos Alexander von Humboldt (IAvH), Villa de Leyva, Boyacá, Colombia; Colección Entomológica Universidad de Antioquia (CEUA), Medellín, Antioquia, Colombia; Invertebrate Collection of Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil.

The total length of a specimen was measured in lateral view by summing the distances from the frons (antenna excluded) to the scutellum apex and from the scutellum apex to the abdomen apex. To study the internal characteristics of the male genitalia, the abdomen apex was cut off at the third tergite, placed into lactic acid (85%), and heated at 150º C over a Thermo Scientific Cimarec plate for approximately 1 hour, prior to the dissection of the genital pieces. The pieces were dissected and photographed in dehydrated glycerin using an excavated slide. After study, the pieces were stored in microvials containing glycerin. The wings were mounted on microslides with Canada balsam. The holotype specimens were pinned, mounted, and deposited in their original collections. The microvial and microslide were pinned along with the respective specimen.

The morphological terminology follows Cumming & Wood (2017). The measurements (in millimeters) that refer to the head, antenna, and wing were made as proposed by Kehlmaier (2005), Marques *et al*. (2019) and Ramos-Pastrana & Rafael (2021): F, length of frons; EM, length of eye contiguity; V, length of vertex; LW/ MWW, ratio between length and maximum width of the wing; LTC/LFC, ratio between length of third costal section by length of fourth costal section of the wing; LPP/WPP, ratio between length and maximum width of the postpedicel.

The following measurements of the ovipositor follow Skevington (2005): ovipositor length (OL), measured over a straight line from the tip of the piercer to the point where the base of the ovipositor articulates with sternite 6 dorsally; piercer length (PL), measured over a straight line from the proximal edge of the cerci to the tip of the piercer; length ovipositor's base (B), measured over a straight line from the proximal end of the cerci to the point where the base of the ovipositor articulates with sternite 6 dorsally.

Photographs were taken with a Leica digital camera DFC450 coupled to a stereomicroscope Leica M205A and connected to a computer with Leica Application Suite software, with automatic mounting module (synchronization software) (http://www.syncroscopy.com/syncroscopy/). The maps showing species' geographic records were plotted using the Simple Mappr software (Shorthouse 2010).

In the list of examined material, label data are given as presented on the labels. The square brackets ([]) are used to indicate complementary data that are not present in the specimen labels. New records for the country are included within each species and mentioned as a "new record" in geographical distribution. Data for specimens with identical data were simplified with '*idem*' and only the data differing from the previous labels were written.

Results

Dasydorylas Skevington, 2001

Dasydorylas Skevington, 2001: 435. Type species *Pipunculus eucalypti* Perkins, 1905 (original designation); Rafael & Ale-Rocha, 2004: figs 33–37; Földvári, 2013: 23; Motamedinia *et al.* 2017; 2020.

Eudorylas Rafael, 1991: 156, figs 12–16, 37; 159, figs 21–28, 39 (partim).

Dorilas (*Eudorylas*) Hardy, 1954: 21 figs 7a–b, 32 figs 14a–c (partim);

Dorilas Hardy, 1943: 84, plate 6, figs 36a–b (partim).

Pipunculus Banks, 1915: 169 (partim); Curran, 1928: 43 (partim); Hardy, 1943: 83 (partim); Aczél, 1948: 28 (partim); 1952: 247 (partim); Arnau & Owen, 1981 (Curran types) (partim).

Diagnosis [adapted from Skevington (2001)]. In the Neotropical Region, small to medium size specimens (2.5–4.8 mm). Eyes holoptic in males, dichoptic in females. Postpedicel with acuminate apex. Notopleuron usually with dense tuft of long setae. Scutum with dorsocentral setae conspicuous. Femora with ventral ctenidia and row of long setae posterodorsally. Hind tibia with one or more erected anterior spines on median part, fore and mid tibiae with distinct apical spines. Tegula usually with a cluster of setae. Wing with pterostigma. Abdomen ovate with conspicuous scattered setae (rarely inconspicuous) ground color dark; tergites 2–4 usually with posterior margin brown, gray, or yellowish brown pruinose. Syntergosternite 8 with a membranous area. Apex of phallic guide stout, with apex hook-shaped. Ejaculatory apodeme parasol-shaped (rarely funnel-shaped). Phallus thin and trifid (rarely bifid).

Dasydorylas species from Colombia

Dasydorylas colombensis sp. nov.

Figs 1–13, 53

Diagnosis. Postpedicel with aristiform apex. Tergite 1–5 brown, brown pruinose, with distal margin gray pruinose dorsolaterally, interrupted medially. Surstyli subsymmetrical, slightly shorter than epandrium; both surstyli thickened basally and medially, thin apically, with inner margins slightly straight, outer margin curved, and apices acute inward-directed; left surstylus with apex sinuous, right surstylus with apex truncated when seen in lateral view. Apex of phallic guide with upper margin slightly sinuous and a tuff of small setae centrally. Phallus trifid, with ejaculatory ducts distinctly separated only in distal half.

Description. MALE (holotype). Body length 3.4 mm. ***Head*** (Figs 1–2). Eyes contiguous for 19 facets. F, EM, V (mm) = 0.3, 0.4, 0.1. Frontal triangle dark brown, brown pruinose, with callus shiny dark brown. Occiput dark brown, gray pruinose ventrally and laterally, brown pruinose dorsally. Antenna (Fig. 3) scape and pedicel dark brown, pedicel with three setae dorsally and two ventrally; postpedicel with aristiform apex. LPP/WPP = 5.1. ***Thorax*** (Figs 1–2, 4). Postpronotal lobe brown, brown pruinose, with six long setae along upper

margin. Scutum, ground color brown, brown pruinose, with two gray pruinose spots anterolaterally; dorsocentral setae conspicuous. Notopleuron brown, gray-brown pruinose. Scutellum brown, brown pruinose. Mesopleuron and mediotergite concolorous with notopleuron. ***Wing*** (Fig. 5). Length 4.9 mm. LW/MWW = 3.1; LTC/LFC = 5.6. Membrane brown infuscated; vein M_1 slightly curved upward. Halter stem and knob completely beige ventrally, brown dorsally, except beige in medial third of stem. ***Legs*** (Fig. 1). Coxae dark brown, gray-brown pruinose; trochanters brown, gray-brown pruinose; femora brown, gray-brown pruinose, except yellowish brown apices; tibiae brown, except yellowish brown in basal third; tarsomeres 1–4 brown, 5 dark brown; pulvilli yellowish brown. ***Abdomen*** (Figs 1–2, 6). Ground color velvety brown, with conspicuous scattered setae; tergite 1–5 brown, brown pruinose, with distal margin gray pruinose dorsolaterally, interrupted medially; tergite 1 with five black and long setae laterally; tergites and sternites 6 and 7 as in Fig. 7. Syntergosternite 8 dark brown, gray-brown pruinose, shorter than tergite 5, with a membranous area apically (Fig. 6). ***Terminalia*** (Figs 7–13). Epandrium and surstyli brown (Fig. 8). Surstyli (Figs 8–10) subsymmetrical, slightly shorter than epandrium, with some differentiated black setae scattered dorsally. Both surstyli thickened basally and medially, thin apically, with inner margins slightly straight, outer margin curved, and apices acute inward-directed; right surstylus slightly shorter than left (Fig. 8); left surstylus with apex sinuous, right surstylus with apex truncated when seen in lateral view (Figs 9–10). Gonopods asymmetrical, right gonopod slightly thicker than left (Fig. 11). Apex of phallic guide stout, with apex hook-shaped, upper margin slightly sinuous, with a tuff of small setae dorsocentrally (Fig. 12). Ejaculatory apodeme parasol-shaped (Fig. 13). Phallus trifid, thin, with ejaculatory ducts distinctly separated only in distal half (Figs 11–12).

FEMALE. Unknown.

Type material. (7 m#). HOLOTYPE. Male: COLOMBIA, Boyacá, SFF[Santuario de Fauna y Flora] Iguaque, Cab.[Cabaña] Mamaramos, 05º25'N/73º27'W, 2855 m[eters], 13.Nov[XI]–04.Dic[XII].2001, P. Reina leg., M1063 (1 m#, IAvH) (photographed specimen). PARATYPES. *idem* 05º25'N/73º26'W, 23.Sep[iIX]–11.Oct.[X].2000 (2 m#, IAvH); *idem* 01–17.Aug[VIII].2000 (1 m#, IAvH); *idem* 04–21.Dec[X].2001 M1080 (1 m#, IAvH); *idem* 05º25'12"N/73º27'24"W, Malaise4, 01–19.IV.2000 (2 m#, IAvH). Holotype with left wing mounted on microslide with Canada balsam. Left antenna and terminalia placed in a microvial with glycerin, both pinned along with the specimen.

Etymology. The specific name refers to Colombia.

Geographical distribution. Colombia (Boyacá) (Fig. 53).

Habitat. The specimens were collected in the Santuario de Fauna y Flora Iguaque reserve, where the vegetation is composed of cloud Andean forests of the cordillera of the Northeast region of Colombia.

Taxonomic notes. Based on males and due to the shape of the surstyli, *D. colombensis* **sp. nov.** (Fig. 8) is similar in appearance to *D. gibbera* **sp. nov.** (Fig. 21). It differs from *D. gibbera* **sp. nov.** by having the tergites 1–5 brown, brown pruinose, with distal margin gray pruinose dorsolaterally, slightly interrupted medially (Figs 1–2, 6) [*versus* tergite 1 completely brown pruinose; tergite 2–4 with distal margins yellowish brown pruinose; tergite 5 dark brown, brown pruinose dorsally, yellowish brown pruinose laterally in *D. gibbera* **sp. nov.** (Figs 1–15, 19)]; left surstylus with apex sinuous in lateral view (Fig. 9) [*versus* left surstylus with apex slightly rounded in lateral view (Fig. 22)]; apex of phallic guide with upper margin slightly sinuous and tuff of small setae dorsocentrally (Fig. 12) [*versus* apex of phallic guide with a translucid lobes lateroapically and a stout rigid lobe dorsally (Fig. 25)]; phallus with ejaculatory ducts distinctly separated only in distal half (Fig. 12) [*versus* phallus with ejaculatory ducts distinctly separated only in distal fifth (Fig. 25)].

***Dasydorylas gibbera* sp. nov.**

Figs 14–26, 53

Diagnosis. Postpedicel with aristiform apex. Tergite 2–4 with distal margins yellowish brown pruinose; tergite 5 dark brown, brown pruinose dorsally, yellowish brown pruinose laterally. Surstyli subsymmetrical, equal to epandrium length; both surstyli thickened basally and medially, thin apically, with inner margins slightly straight, outer margins curved; right surstylus with apex truncated and left surstylus with apex slightly rounded when seen in lateral view. Apex of phallic guide with stout and rigid lobe dorsally and translucid lobes lateroapically. Phallus trifid, with ejaculatory ducts distinctly separated only in distal fifth.

Description. MALE (holotype). Body length 4.8 mm. ***Head*** (Figs 14–15). Eyes contiguous for 19 facets. F, EM, V (mm) = 0.4, 0.4, 0.2. Frontal triangle dark brown, brown pruinose, with callus shiny dark brown. Occiput brown, brown pruinose. Antenna (Fig. 16) scape brown, with one seta dorsally; pedicel dark brown, with four setae dorsally and two ventrally; postpedicel with aristiform apex. LPP/WPP = 5.6. ***Thorax*** (Figs 15, 17). Postpronotal lobe dark brown, brown pruinose, with four long setae along upper margin. Scutum, ground

color brown, brown pruinose, with one spot black anteriorly and dorsocentral setae conspicuous. Notopleuron brown, gray-brown pruinose. Scutellum concolorous with scutum. Mesopleuron and mediotergite concolorous with notopleuron. ***Wing*** (Fig. 18). Length 5.8 mm. LW/MWW = 3.2; LTC/LFC = 0,8. Membrane brown infuscated, vein M_1 slightly curved upward. Halter stem and knob completely beige ventrally, brown dorsally, except beige medial third of stem. ***Legs*** (Fig. 14–15). Coxae dark brown, gray-brown pruinose; fore trochanter brown; mid and hind trochanters brown, except brownish yellow distal third; femora dark brown, gray-brown pruinose, except brownish yellow apices; tibiae dark brown, with bases and apices brownish yellow; tarsomeres 1–5 yellowish brown; pulvilli brownish yellow. ***Abdomen*** (Figs 14–15, 19). Ground color velvety dark brown, with conspicuous scattered setae; tergite 1 completely brown pruinose, with four black and long setae laterally; tergite 2–4 with distal margins yellowish brown pruinose; tergite 5 dark brown, brown pruinose dorsally, yellowish brown pruinose laterally; tergites and sternites 6 and 7 as in Fig. 20. Syntergosternite 8 brown, gray-brown pruinose, slightly shorter than tergite 5, with a membranous area apically (Fig. 19). ***Terminalia*** (Figs 20–26). Epandrium and surstyli yellowish brown (Fig. 21). Surstyli (Figs 21–23) subsymmetrical, equal to epandrium length. Both surstyli thickened basally and medially, thin apically, with inner margins slightly straight, and outer margins curved; right surstylus thicker than left, with apex truncated; left surstylus with apex rounded (Fig. 21); right surstylus with apex truncated; left surstylus with apex slightly rounded when seen in lateral view (Figs 22–23). Gonopods asymmetrical, right gonopod thicker than left (Fig. 24). Apex of phallic guide stout, with apex hook-shaped, with stout and rigid lobe dorsally and translucid lobes lateroapically (Fig. 25). Ejaculatory apodeme parasol-shaped (Fig. 26). Phallus trifid, thin, with ejaculatory ducts distinctly separated only in distal fifth (Fig. 25).

FEMALE. Unknown.

Type material. (1 m#). HOLOTYPE. Male: COLOMBIA, Boyacá, SFF[Santuario de Fauna y Flora] Iguaque, Cab.[Cabaña] Mamaramos, 05º25'N/73º27'W, 2855 m[eters], 23.May[V]–08.Jun[VI].2000, P. Reina leg., (1 m#, IAvH). Holotype with left wing mounted on microslide with Canada balsam. Left antenna and terminalia placed in a microvial with glycerin, both pinned along with the specimen.

Etymology. From the Latin *gibbus* (= hump), the name refers to the shape of the lobe in dorsal margin of the phallic guide in the male genitalia.

Geographical distribution. Colombia (Boyacá) (Fig. 53).

Habitat. The specimen was collected in the Santuario de Fauna y Flora Iguaque reserve, where the vegetation is composed of cloud Andean forests of the cordillera of the Northeast region of Colombia.

Taxonomic notes. Based on males and due to the shape of surstyli, *D. gibbera* **sp. nov.** (Fig. 21) is similar in appearance to *D. colombensis* **sp. nov.** (Fig. 8). It differs from *D. colombensis* **sp. nov.** by having the tergite 1 completely brown pruinose, with four black and long setae laterally; tergite 2–4 with distal margins yellowish brown pruinose, tergite 5 dark brown, brown pruinose dorsally, yellowish brown pruinose laterally (Figs 14–15, 19) [*versus* tergite 1–5 brown, brown pruinose, with distal margin gray pruinose dorsolaterally, interrupted medially, in *D. colombensis* **sp. nov.** (Figs 1–2, 6)]; left surstylus with apex slightly rounded when seen in lateral view (Fig. 22) [*versus* left surstylus with apex sinuous when seen in lateral view (Fig. 9)]; apex of phallic guide with a translucid lobes lateroapically and a stout rigid lobe dorsally (Fig. 25) [*versus* apex of phallic guide with upper margin slightly sinuous and a tuff of small setae centrally (Fig. 12)]; phallus with ejaculatory ducts distinctly separated only in distal fifth (Fig. 25) [*versus* phallus with ejaculatory ducts distinctly separated only in distal half (Fig. 12)].

Dasydorylas nigellus (Rafael, 1991)
Figs 27–39, 53

Dasydorylas nigellus, (n. comb.) by subsequent designation, Rafael & Ale-Rocha, 2004: 12.
Eudorylas nigellus Rafael, 1991: 156, figs 12–16, 37.

Diagnosis. Male. Postpedicel with acuminate apex. Vein M_1 straight. Fore and mid femora with conspicuous ventral ctenidia; hind femur without ventral ctenidia. Tergite 1 completely covered by brown pruinosity, with spot dark brown pruinose dorsocentrally and six black and long setae laterally; tergites 2–4 with posterior thin margins brown pruinose; tergite 5 with posterior wide margin gray-brown pruinose. Surstyli equal to epandrium length. Both surstyli thickened in basal half, thin in distal half, with apices outwards-directed; both surstyli with tips downward-directed and rounded apex when seen in lateral view. Apex of phallic guide stout, with margin slightly straight. Ejaculatory apodeme funnel-shaped. Phallus trifid, thin, with ducts distinctly separated only in the apex.

Intraspecific variability. Rafael (1991) provided a complete description and illustrations of the Brazilian holotype; however, we found variations in the Colombian specimens, therefore, we provide a comparison of the variations between the Colombian and Peruvian specimens (between parenthesis, when comparable). MALE. ***Head*** (Figs 27–28). Eyes contiguous for 20 facets. F, EM, V (mm) = 0.3, 0.5, 0.1. Frontal triangle dark brown, gray-brown pruinose, with callus shiny dark brown (*versus* frontal triangle opaque black, with callus shiny black in the holotype). Occiput brown, gray-brown pruinose. Antenna (Fig. 29) brown, pedicel with two setae dorsally, three ventrally; postpedicel with acuminate apex [*versus* antenna black, pedicel with three setae dorsally and four setae ventrally, see figure 12, presented by Rafael, (1991)]. LPP/WPP = 2.9. ***Thorax*** (Figs 27–28, 30). Postpronotal lobe dark brown, brown pruinose, with four long setae along upper margin (*versus* postpronotal lobe opaque black). Scutum dark brown, gray-brown pruinose, with dorsocentral setae conspicuous (*versus* scutum opaque black, brown pruinose). Notopleuron concolorous with scutum (*versus* notopleuron opaque black, brown pruinose). Scutellum concolorous with scutum (*versus* opaque black, brown pruinose). Mesopleuron and mediotergite brown, gray-brown pruinose (*versus* mesopleuron and mediotergite black, brown pruinose). ***Wing*** (Fig. 31). Length 5.9 mm. LW/MWW = 3.9; LTC/LFC = 1.9. Membrane brown infuscated, vein M_1 straight. Halter stem dark brown, except beige third medial, knob dark brown. ***Legs*** (Fig. 27). Coxae dark brown, gray-brown pruinose (*versus* coxae black); trochanters brown, brown pruinose (*versus* trochanters black); femora dark brown, gray-brown pruinose, except brown apices (*versus* femora black); tibiae dark brown, gray-brown pruinose, except basal quarter; tarsomeres 1–4 brown, 5 brown; pulvilli yellowish brown. ***Abdomen*** (Figs 28, 32). Ground color velvety dark brown, with inconspicuous scattered setae; tergite 1 completely covered by brown pruinosity, with spot dark brown pruinose dorsocentrally (*versus* abdomen opaque black, gray pruinose) and six black and long setae laterally; tergites 2–4 with posterior thin margins brown pruinose; tergite 5 with posterior wide margin gray-brown pruinose; tergites and sternites 6 and 7 as in Fig. 33. Syntergosternite 8 dark brown, gray-brown pruinose, shorter than tergite 5, with a membranous area apically (Fig. 32) [*versus* Syntergosternite 8 acuminate, larger than tergite 5 see figure 13, presented by Rafael (1991)]. ***Terminalia*** (Figs 33–39). Epandrium and surstyli dark brown (Fig. 34). Surstyli (Figs 34–36) subsymmetrical, equal to epandrium length, setose marginally. Both surstyli thickened in basal half, thin in distal half, with apices outwards-directed (Fig. 34); left surstylus slightly thinner than right (Fig. 34) [*versus* surstylus long, see figure 15, presented by Rafael (1991)], both surstyli with tips downward-directed and rounded

apex when seen in lateral view (Figs 35–36). Gonopods asymmetrical; right gonopod slightly thicker than left (Fig. 37). Apex of phallic guide stout, with apex hook-shaped and upper margin slightly straight (Fig. 37, 38). Ejaculatory apodeme funnel-shaped (Fig. 39). Phallus trifid, thin, with ducts distinctly separated only in distal quarter (Figs 37–38).

FEMALE. Unknown.

Examined material. (1 m#). COLOMBIA, Boyacá, SFF [Santuario de Fauna y Flora] Iguaque, Cab. [Cabaña] Mamaramos, 06º26'N/73º27'W, 2855 m[eters], 13–30.jul[VII].2000, P. Reina leg. M380 (1 m# IAvH) (photographed specimen).

Geographical distribution. Colombia (Boyacá) (new record), Peru (Huánuco) (Fig. 53).

Habitat. The specimen was collected in the Santuario de Fauna y Flora Iguaque reserve, where the vegetation is composed of cloud Andean forests of the cordillera of the Northeast region of Colombia.

***Dasydorylas santainensis* sp. nov.**

Figs 40–52, 53

Diagnosis. Postpedicel with aristiform apex. Tergite 1 brown pruinose dorsally, yellowish brown pruinose laterally. Tergite 2–4 with distal margins yellowish brown pruinose. Tergite 5 with distal third gray-brown pruinose. Surstyli subsymmetrical, slightly longer than epandrium. Both surstyli more thickened medially than basally and apically, with inner and outer margins sinuous and apices slightly rounded and inward-directed; both surstyli with apices slightly rounded when seen in lateral view. Apex of phallic guide with an upper margin with a tuff of small setae basally, and translucid lobes lateroapically. Phallus trifid, with ejaculatory ducts distinctly separated only in distal seventh.

Description. MALE (holotype). Body length 4.2 mm. ***Head*** (Figs 40–41). Eyes contiguous for 19 facets. F, EM, V (mm) = 0.5, 0.4, 0.1. Frontal triangle dark brown, brown pruinose, with callus shiny dark brown. Occiput dark brown, gray pruinose ventrally and laterally, brown pruinose dorsally. Antenna (Fig. 42) dark brown; scape with one seta dorsally, pedicel with four setae dorsally and three ventrally; postpedicel with aristiform apex. LPP/WPP = 5. ***Thorax*** (Figs 41, 43). Postpronotal lobe brown, brown pruinose, with four long setae along upper margin. Scutum, ground color brown, brown pruinose, with one spot black anteriorly; dorsocentral setae conspicuous. Notopleuron brown, gray-brown pruinose. Scutellum

concolorous with scutum. Mesopleuron and mediotergite concolorous with notopleuron. ***Wing*** (Fig. 44). Length 6.7 mm. LW/MWW = 5.6; LTC/LFC = 1. Membrane brown infuscated, vein M_1 slightly curved upward. Halter beige ventrally, brown dorsally. ***Legs*** (Fig. 40–41). Coxae dark brown, gray-brown pruinose; fore and mid trochanters brown, gray-brown pruinose, except brownish yellow anterolaterally, hind trochanters completely dark brown; femora dark brown, gray-brown pruinose, except brownish yellow apices; tibiae dark brown, with bases and apices brownish yellow; tarsomeres 1–5 yellowish brown; pulvilli brownish yellow. ***Abdomen*** (Figs 40–41, 45). Ground color velvety dark brown, with conspicuous scattered setae; tergite 1 brown pruinose dorsally, yellowish brown pruinose laterally, with five black and long setae laterally; tergite 2–4 with distal margins yellowish brown pruinose; tergite 5 with distal third gray-brown pruinose; tergites and sternites 6 and 7 as in Fig. 46. Syntergosternite 8 brown, gray-brown pruinose, slightly shorter than tergite 5, with a membranous area apically (Fig. 45). ***Terminalia*** (Figs 46–52). Epandrium and surstyli dark brown (Fig. 47). Surstyli (Figs 47–49) subsymmetrical, and slightly longer than epandrium. Both surstyli more thickened medially than basally and apically, with inner and outer margins sinuous and apices slightly rounded and inward-directed; right surstylus slightly shorter and thicker than left (Fig. 47); both surstyli with apices slightly rounded when seen in lateral view (Figs 48–49). Gonopods subsymmetrical, right gonopod slightly thicker than left (Fig. 50). Apex of phallic guide stout, with apex hook-shaped, upper margin slightly curved upward, with a tuff of small setae basally, and a translucid lobe lateroapically (Fig. 51). Ejaculatory apodeme parasol-shaped (Fig. 52). Phallus trifid, thin, with ducts distinctly separated only in distal seventh (Fig. 51).

FEMALE. Unknown.

Type material. (3 m#). HOLOTYPE. Male: COLOMBIA, Antioquia, Belmira, Páramo de Sta[Santa] Inés, El Morro, 06º38'3"N/75º38'28"W, 3100–3300 m[eters], Red entomológica, 21–30.Junio[VI].2017, Proy.[Proyecto] moscas de las flores. A.L. Montoya, C. Rodríguez, J.P. Carmona leg., (1 m#, CEUA–101599) (photographed specimen). PARATYPES. *idem* 06º39'28"N/75º40'17"W, T.[Trampa] Malaise suelo, 4–14.dic[XII].2016 (1 m#, CEUA–101564); *idem* Boyacá, SFF[Santuario de Fauna y Flora] Iguaque, 05º25'12"N/73º27'24"W, 2855 m[eters], Malaise4, 01–19.IV.2000, P. Reina leg., (1 m#, IAvH). Holotype with left wing mounted on microslide with Canada balsam. Left antenna and terminalia placed in a microvial with glycerin, both pinned along with the specimen.

Etymology. The specific epithet refers to the type locality, Paramo of Santa Inés, Belmira, Colombia.

Geographical distribution. Colombia (Antioquia, Boyacá) (Fig. 53).

Habitat. The specimens were collected in the Páramo Santa Inés, with areas of very humid premontane forest of the Oriental and Central cordillera of Northwest Colombia and Santuario de Fauna y Flora Iguaque reserve, where the vegetation is composed of cloud Andean forests of the cordillera of Northeast Colombia.

Taxonomic notes. Based on males and due to the shape of the phallus, *D. santainensis* **sp. nov.** (Fig. 51) is similar in appearance to *D. gibbera* **sp. nov.** (Fig. 25). It differs from *D. gibbera* **sp. nov.** by having both surstyli more thickened medially than basally and apically, with inner and outer margins sinuous, apices slightly rounded inward-directed; right surstylus slightly shorter and thicker than left (Fig. 47) [*versus* both surstyli thickened basally and medially, thin apically with inner margins slightly straight, outer margins curved; right surstylus thicker than left, with apex truncated; left surstylus with apex rounded in *D. gibbera* **sp. nov.** (Fig. 21)]; gonopods subsymmetrical (Fig. 50) [*versus* gonopods asymmetrical (Fig. 24)]; upper margin of apex of phallic guide with a tuff of small setae basally (Fig. 51) [*versus* apex of phallic with a stout and rigid lobe dorsally (Fig. 25)].

Unidentified females of Dasydorylas

25 females of *Dasydorylas*, distributed in nine morphospecies could not be associated with males.

Material examined. (25 f#). COLOMBIA, Boyacá, SFF[Santuario de Fauna y Flora] Iguaque, Cab.[Cabaña] Mamaramos, 05º25'N/73º27'W, 2855 m[eters], 13.nov[XI]–04.dic[XII].2000, P. Reina leg., M1064 (3 f# IAvH); *idem* 13–30.jul[VII].2000, M380 (2 f# IAvH); *idem* 23.Sep.[IX]–11.Oct[x].2000 (1 f# IAvH); *idem* 1–17.Aug.[VIII].2000 (3 f# IAvH); *idem* Cabaña Carrizal, 1–23.sep.[IX].2000 M614 (3 f# IAvH); *idem* Malaise 4, 1–19.IV.2000 M614 (1 f# IAvH); *idem* El Níspero, 05º38'N/73º31'W, 2730 m[eters], 3–18.II.2002, M3068 (1 f# IAvH); *idem* Qda.[Quabrada] Los Francos, 05º25'N/73º27'W, 2850 m[eters], 7–24.feb[II].2001, M1270 (1 f# IAvH); *idem* Cab.[Cabaña] Mamaramos, 05º25'12"N/73º27'24"W, 2855 m[eters], 17.VIII–01.IX.2000 (3 f# IAvH); *idem* Malaise 4, 25.Jun[VI]–13.Jul[VII].2000 (4 f# IAvH); *idem* 01–19.IV.2000 (1 f# IAvH); *idem* Cundinamarca, PNN[Parque Nacional Natural] Chingaza, Sendero Suasie, 04º31'N/73º45'W, 3100 m[eters], 08–22.dic[XII].2000, E. Niño Leg., M1032 (1 f# IAvH).

Key to males of the Neotropical species of *Dasydorylas*

1 Postpedicel with acuminate apex [Fig. 29 and see figure 35a in Hardy (1943); figure 21 in Rafael (1991) and figures 51, 99 in Rafael (1995)]; vein M_1 slightly straight or clearly straight [Fig. 31 and see figure 35b in Hardy (1943); figure 39 in Rafael (1991) and figures 194, 205 in Rafael (1995)] … 2

- Postpedicel with aristiform apex (Figs 3, 16, 42); vein M_1 slightly to clearly upward curved (Figs 5, 18, 44) … 7

3 Phallus bifid [see figure 36 in Rafael (2004)] … ***D. vulcanus*** Rafael, 2004

- Phallus trifid [Figs 12, 25, 51 and see figure 26 in Rafael (1991) and figure 54 in Rafael (1995)] ... 3

4 Both surstyli with bases slightly thicker than apices [see figure 25 in Rafael (1991)]; third costal section slightly equal to length of fourth [see figure 39 in Rafael (1991)] … ***D. regalis*** (Rafael, 1991)

- Both surstyli with bases clearly thicker than apices [Fig. 34 and see figure 35c in Hardy (1943); figures 53, 100 in Rafael (1995)]; third costal section slightly longer than the length of fourth [Fig. 31 and see figure 35b in Hardy (1943) and figures 194, 205 in Rafael (1995)] … 4

5 Left surstylus left-directed and right surstylus clearly down-directed, when seen in frontal view [see figure 35c in Hardy (1943)] … ***D. cinctus*** (Banks, 1915)

- Both surstyli slightly sideways-directed [see figure 100 in Rafael (1995)] or clearly sideways-directed [Fig. 34 and see figure 53 in Rafael (1995)] … 5

6 Phallic guide with a tuff of small setae dorsally [see figure 101 in Rafael (1995)]; junction of ventral and frontal margin forming an angle of about 110 degrees [see figure 101 in Rafael (1995)]; phallus trifid, with ejaculatory ducts not distinctly separated [see figure 101 in Rafael (1995)] … ***D. nigripedes*** (Hardy, 1954)

- Phallic guide without tuff of setae dorsally [Fig. 38 and see figure 54 in Rafael (1995)]; junction of ventral and frontal margin of phallic guide curved, not forming an angle [Fig. 38 and see figure 54 in Rafael (1995)]; phallus trifid, with ejaculatory ducts distinctly separated only in distal seventh [Fig. 38 and see figure 54 in Rafael (1995)] … 6

7 Both surstyli thickened basally and medially, thin apically, with outer margins sinuous not forming an angle [see figure 54 in Rafael (1995)]; phallic guide with dorsal margin

curved upward in distal half [see figure 54 in Rafael (1995)] … ***D. eremita*** (Hardy, 1954)

- Both surstyli with basally half thickened, and distal half thin, with outer margin forming an angle [Fig. 34 and see figure 14 in Rafael (1991)]; phallic guide straight, slightly curved upward only in distal third [Fig. 38 and see figure 14 in Rafael (1991)] … ***D. nigellus*** (Rafael, 1991)

8 Both surstyli more thickened medially than basally and apically, with inner margins sinuous (Fig. 47); phallic guide with upper margin straight and a tuff of small setae basally (Fig. 51) … ***D. santainensis*** **sp. nov.**

- Both surstyli thickened basally and medially, thin apically, with inner margins straight and outer margins curved (Figs 8, 21); phallic guide with upper margin sinuous and a tuff of small setae centrally (Fig. 12) or with stout and rigid lobe dorsally (Fig. 25) … 8

8 Both surstyli with acute apex (Fig 8); phallic guide with upper margins sinuous and a tuff of small setae centrally (Fig. 12); phallus trifid with ejaculatory ducts distinctly separated only in distal quarter … ***D. colombensis*** **sp. nov.**

- Left surstylus with rounded apex, right surstylus with truncated apex (Fig. 21); phallic guide with a stout and rigid lobe dorsally (Fig. 25); phallus trifid with ejaculatory ducts distinctly separated only in distal ninths … ***D. gibbera*** **sp. nov.**

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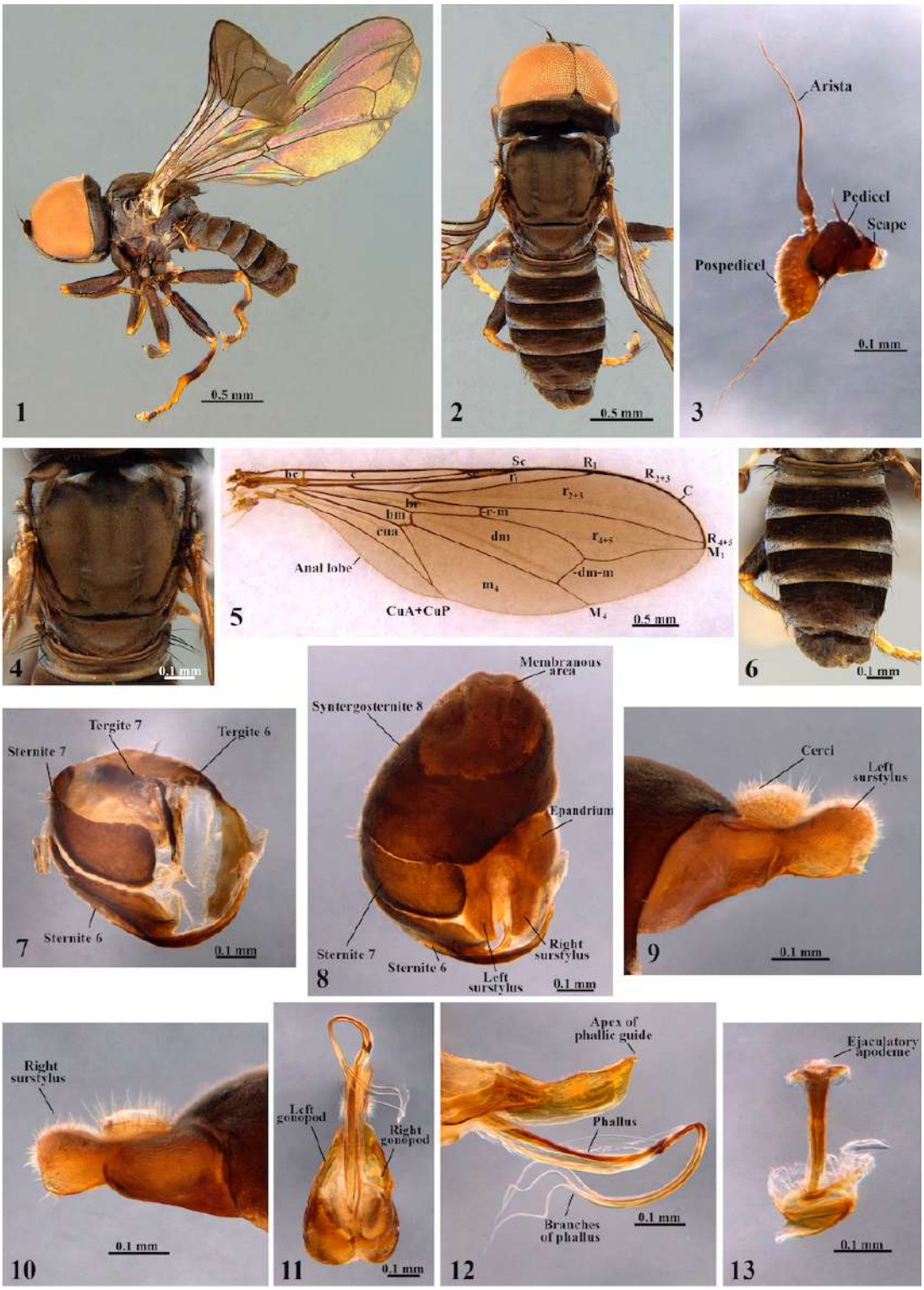
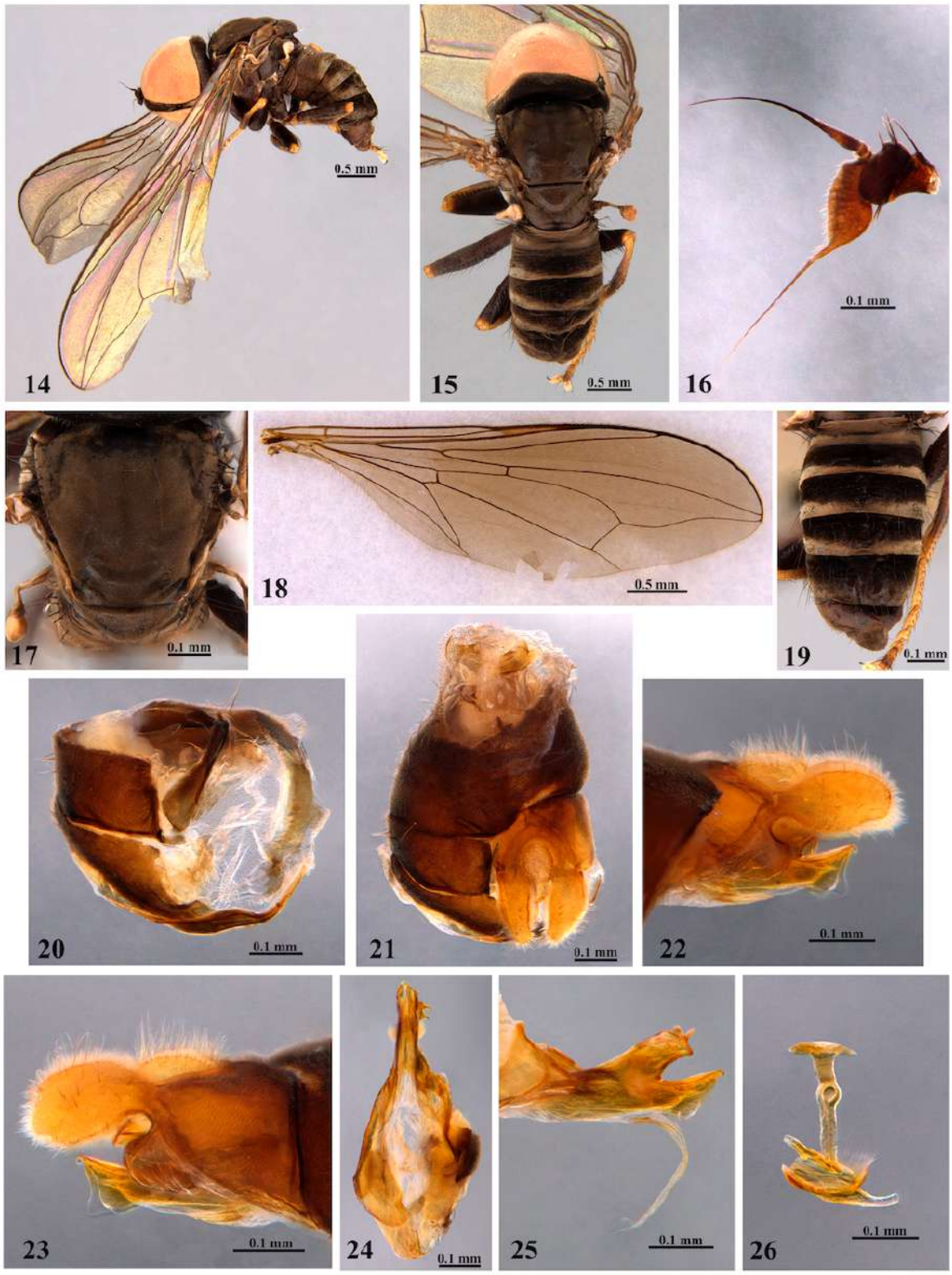
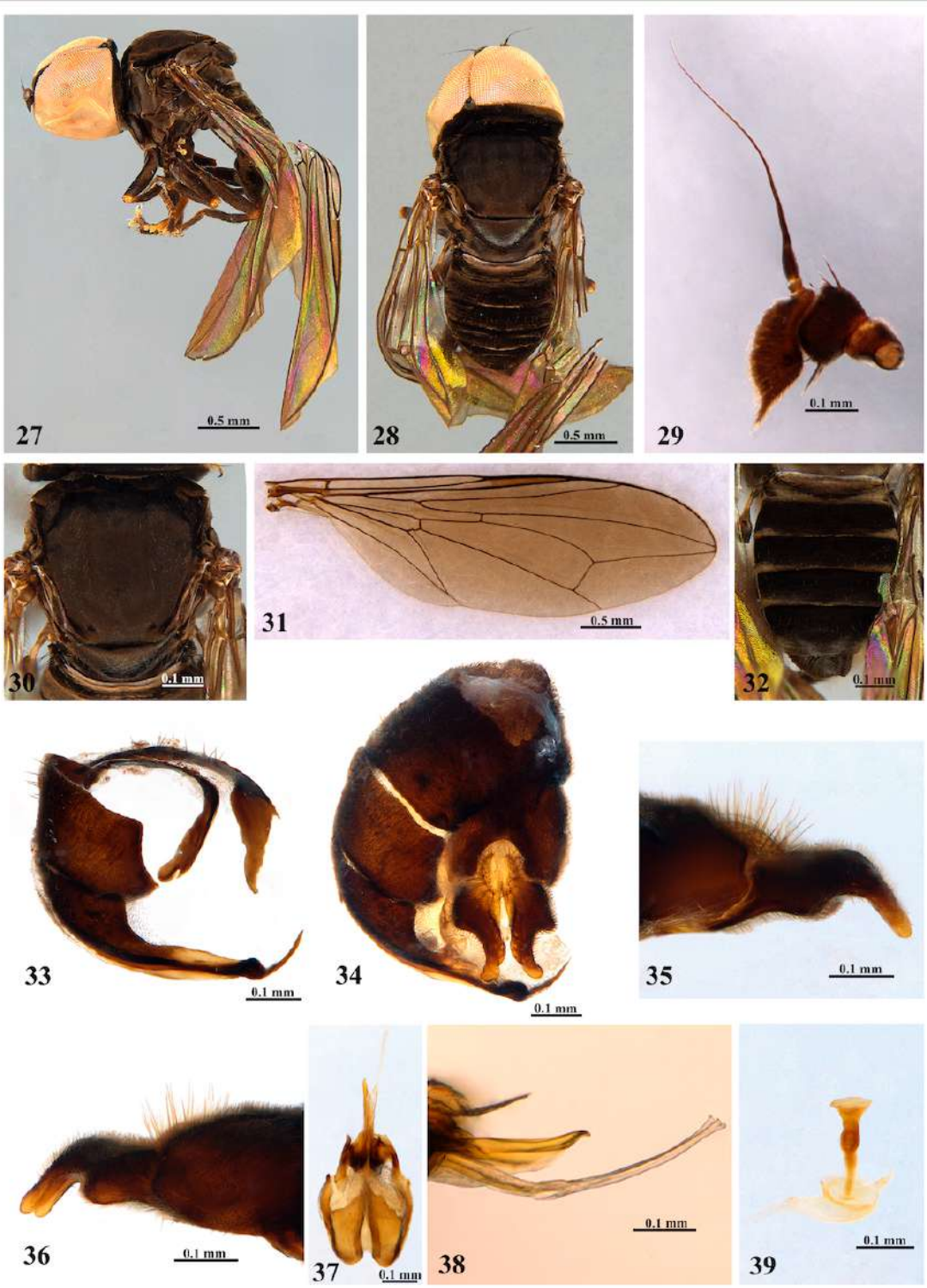


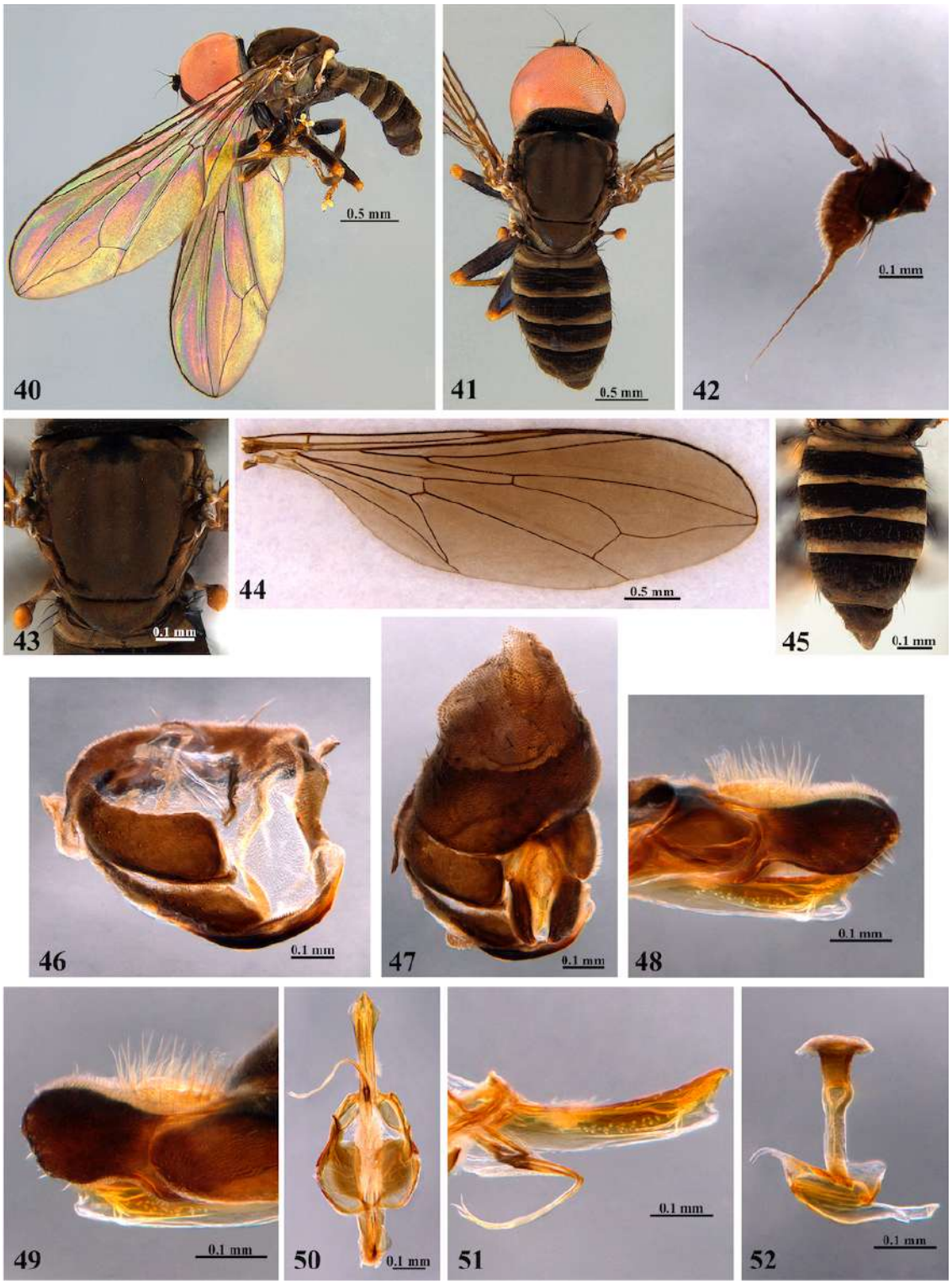
FIGURES 1-13. *Dasydorylas colombensis* **sp. nov.** (IAvH–M1063). Holotype male. **1**, Habitus, left lateral view; **2**, Habitus, dorsal view; **3**, Antenna; **4**, Thorax, dorsal view; **5**, Wing; **6**, Abdomen, dorsal view; **7**, Tergites and sternites 6 and 7, ventral view; **8**, Terminalia, dorsal view; **9**, Left surstylus, lateral view; **10**, Right surstylus, lateral view; **11**, Hypandrium and gonopods, ventral view, **12**, Phallic guide and phallus, left lateral view; **13**, Ejaculatory apodeme.



FIGURES 14-26. *Dasydorylas gibbera* **sp. nov.** Holotype male. **14**, Habitus, left lateral view; **15**, Habitus, dorsal view; **16**, Antenna; **17**, Thorax, dorsal view; **18**, Wing; **19**, Abdomen, dorsal view; **20**, Tergites and sternites 6 and 7, ventral view; **21**, Terminalia, dorsal view; **22**, Left surstylus, lateral view; **23**, Right surstylus, lateral view; **24**, Hypandrium and gonopods, ventral view, **25**, Phallic guide and phallus, left lateral view; **26**, Ejaculatory apodeme.



FIGURES 27-39. *Dasydorylas nigellus* (Rafael, 1991) (IAvH–M380). Male. **27**, Habitus, left lateral view; **28**, Habitus, dorsal view; **29**, Antenna; **30**, Thorax, dorsal view; **31**, Wing; **32**, Abdomen, dorsal view; **33**, Tergites and sternites 6 and 7, ventral view; **34**, Terminalia, dorsal view; **35**, Left surstylus, lateral view; **36**, Right surstylus, lateral view; **37**, Hypandrium and gonopods, ventral view, **38**, Phallic guide and phallus, left lateral view; **39**, Ejaculatory apodeme.



FIGURES 40-52. *Dasydorylas santainensis* **sp. nov.** (CEUA–M101599). Holotype male. **40**, Habitus, left lateral view; **41**, Habitus, dorsal view; **42**, Antenna; **43**, Thorax, dorsal view; **44**, Wing; **45**, Abdomen, dorsal view; **46**, Tergites and sternites 6 and 7, ventral view; **47**, Terminalia, dorsal view; **48**, Left surstylus, lateral view; **49**, Right surstylus, lateral view; **50**, Hypandrium and gonopods, ventral view, **51**, Phallic guide and phallus, left lateral view; **52**, Ejaculatory apodeme.

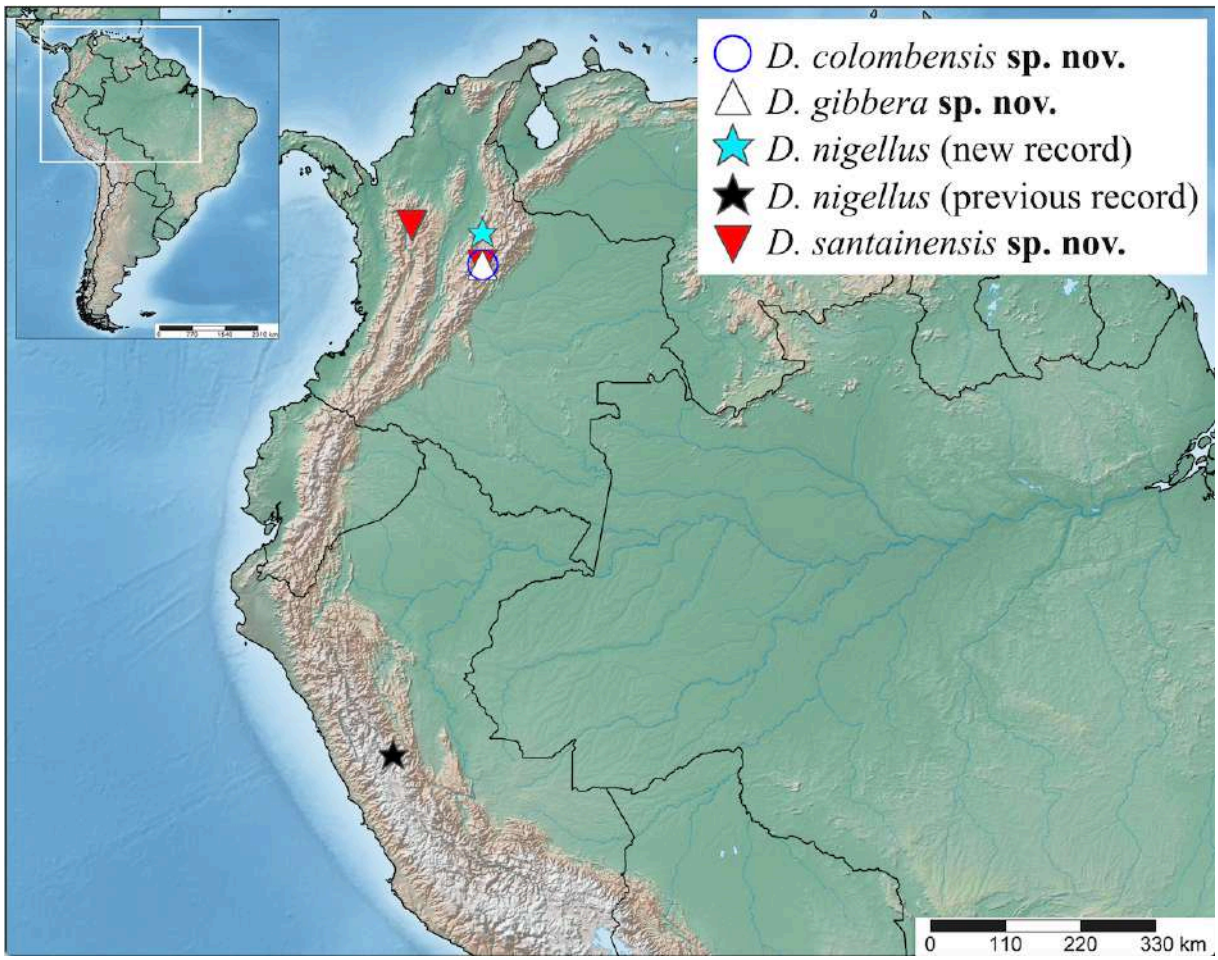


FIGURE 53. Geographical records of *Dasydorylas* species in Colombia. *Dasydorylas colombensis* **sp. nov.**, *D. gibbera* **sp. nov.**, *D. nigellus* and *D. santainensis* **sp. nov.**

Subfamília: Pipunculinae Walker, 1834
Tribo: Pipunculini Walker, 1834
Gênero: *Pipunculus* Latreille, 1802

CAPÍTULO 4

Ramos-Pastrana, Y. *Pipunculus* Latreille, 1802 (Diptera: Pipunculidae) of Colombia, with description of three new species and an updated key to males of the Neotropical species.

Manuscrito em preparação para a revista Zootaxa.

***Pipunculus* Latreille, 1802 (Diptera: Pipunculidae) of Colombia, with description of three new species and an updated key to males of the Neotropical species**

Abstract

Pipunculus Latreille, 1802 is a cosmopolitan genus, with nine known species in the Neotropical region, but completely unknown in Colombia. Three new species of *Pipunculus* are described from Colombia, namely *Pipunculus caeruleus* **sp. nov.** (type-locality: Páramo de Santa Inés, Belmira), *P. chiminiguagua* **sp. nov.** (type-locality: Cabaña Chaina, Santuario de Fauna y Flora Iguaque) and *P. planus* **sp. nov.** (type-locality: Los Mudos, Santuario de Fauna y Flora Iguaque). Illustrations and a new dichotomic key to the Neotropical species are presented.

Key words: big-headed fly, diversity, Pipunculinae, Pipunculini, taxonomy

Introduction

Pipunculus Latreille, 1802 (Pipunculinae: Pipunculini) has had a long and highly controversial taxonomic history. *Dorilas* (Meigen, 1800) was the first described genus in the family and it remained the type of the family until Meigen's (1800) names were suppressed by the International Commission on Zoological Nomenclature (Opinion 678), therefore, *Pipunculus* became the type of Pipunculidae (Skevington & Marshall 1998).

Pipunculus has been divided into several subgenera, Hardy (1966) considered two: the nominal, *Pipunculus* (*Cephalosphaera*) Enderlein, 1936, and *P*. (*Eudorylas*) Aczél, 1940 (Rafael 1991). Hardy (1972) revalidated *Cephalops* Fallén, 1810, which was synonymized with *P*. (*Pipunculus*) and treated as subgenus. Thus, most of the Neotropical species included in the nominal subgenus *Pipunculus* by Hardy (1966), were transferred to *Cephalops* by Rafael (1990) giving it the genus status (Rafael 1991). Hardy (1975; 1980; 1989) considered *Cephalops*, *Eudorylas*, *Pipunculus* s.s., and *Cephalosphaera* as subgenera of *Pipunculus* s.l. Posteriorly, Collin (1956), Coe (1966), Bankowska (1972), Lauterer & Kozánek (1987), De Meyer (1989), and Morakote & Hirashima (1990) considered *Cephalops*, *Eudorylas*, and *Pipunculus* as separated genera (Skevington & Marshall 1998). Rafael & De Meyer (1992) and De Meyer (1994) agree with the latter interpretation, differing only in removing the *Cephalosphaera* from *Cephalops* synonymy and recognizing *Parapipunculus* Rafael, 1986 as a separate genus.

The Neotropical species of *Pipunculus* were revised by Rafael (1991). In his revision, *Pipunculus ferepauculus* Hardy, 1965a, and *P. xanthopodus* (Williston, 1892) remained in *Pipunculus*, describing *P. hardyi* Rafael, 1991. However, as this name was preoccupied by Yang & Xu, 1989, the new replacement name *Pipunculus rafaeli* was proposed by Skevington (1998) to avoid violation of the principle of homonymy (ICZN 1999, Art. 67.8). Skevington (1998) recorded for the first time the species *P. fuscus nitidiventris* Loew, 1866 for Mexico, including also a key for the known species.

Rafael & De Meyer (1992) considered *Pipunculus* as a monophyletic group sister to *Parapipunculus* within the tribe Pipunculini. Skevington & Marshall (1998) produced a morphological phylogeny for the new world *Pipunculus*. *Parapipunculus* was synonymized under *Pipunculus* based on evidence that the inclusion of *P. tibialis* (Hardy, 1943) (the type species of the latter) recovered *Pipunculus* as a paraphyletic group. In the recent phylogenetic analyses carried out by Motamedinia *et al*. (2021), *Pipunculus* was found monophyletic, meanwhile, Cephalopsini was paraphyletic, with *Cephalops s.s*. considered either as sister to *Pipunculus* or sister to *Cephalops* (*Beckerias*) Aczél, 1939 + *Pipunculus*. Given the well-supported paraphyly, Cephalopsini was synonymized with Pipunculini by the authors. Therefore, Pipunculini was redefined to include *Pipunculus* and all taxa included in the former Cephalopsini plus *Claraeola cyclohirta* Skevington, 2002, and *Claraeola anorhaeba* Hardy, 1968.

Pipunculus has a cosmopolitan distribution, with eight recognized species in the Neotropics (Argentina, Brazil, Costa Rican, Guatemala, and Mexico) (Skevington & Marshall 1998), but none recorded in Colombia. The objective of this work is to study the *Pipunculus* species from Colombia, describe and illustrate all the species and develop an updated identification key to the Neotropical species.

Material and methods

This study is based on pinned material deposited in the following collections: Colección Entomológica Universidad de Antioquia (CEUA), Medellín, Antioquia, Colombia; Instituto de Investigación de Recursos Biológicos Alexander von Humboldt (IAvH), Villa de Leyva, Boyacá, Colombia; Invertebrate Collection of Instituto Nacional de Pesquisas da Amazônia (INPA), Manaus, Amazonas, Brazil and Laboratorio de Entomología Universidad de la Amazonia (LEUA), Florencia, Caquetá, Colombia.

The total length of the specimens was measured in lateral view by summing the distances from the front of the head (antenna excluded) to the apex of the scutellum and from there to the apex of the abdomen. To study the male genitalia, the apex of the abdomen was cut off at the tergite 3, placed into lactic acid (85%), and heated at 150ºC over a Thermo Scientific Cimarec plate for approximately 1 hour prior to the dissection of the genital pieces. The pieces were dissected and photographed in dehydrated glycerin using an excavated slide, and preserved in a microvial in glycerin. The wings were separated and mounted on microslides with Canada balsam. The holotypes were pinned, mounted, and deposited in their original collections. The microvial and microslide were pinned along with the respective specimen.

The morphological terminology follows Cumming & Wood (2017). The measurements (in millimeters) that refer to the head, antenna, and wing were made according Kehlmaier (2005), Ramos-Pastrana & Rafael (2021) and Ramos-Pastrana & Rafael (2022): F, EM, V— single values of F, length of frons, EM, length of eye contiguity and V, length of vertex; LW/MWW— ratio between length and maximum width of the wing; LTC/LFC—ratio between length of third costal section by length of fourth costal section of the wing; LPP/WPP—ratio between length and maximum width of the postpedicel.

The following measurements of the ovipositor were taken, as proposed by Skevington (2005): ovipositor length (OL), measured over a straight line from the tip of the piercer to the point where the base of the ovipositor articulates with sternite 6 dorsally; piercer length (PL), measured over a straight line from the proximal edge of the cerci to the tip of the piercer; length ovipositor's base (B), measured over a straight line from the proximal end of the cerci to the point where the base of the ovipositor articulates with sternite 6 dorsally.

Photographs were taken with a Leica digital camera DFC450 coupled to a stereomicroscope Leica M205A and connected to a computer with Leica Application Suite software, with automatic mounting module (synchronization software) (http://www.syncroscopy.com/syncroscopy/).

The maps showing species' geographic records were plotted using the SimpleMappr software (Shorthouse 2010).

Label data are given as presented on the labels. The square brackets ([]) are used to indicate complementary data that are not present in the specimen labels. New records for the country are included within each species and mentioned as a "new record" in geographical distribution. Data for specimens with identical data were simplified with (*"idem"*) and only the data that differs from the other labels is written.

Results

Pipunculus Latreille, 1802

Dorilas Meigen, 1800: 31. Type species *Pipunculus campestris* Latreille, 1802 (subs. des. of Coquillett, 1910: 535); Sack, 1935; 15,44 (groups V and VI) (partim); Aczél, 1939: 20 (partim); 1940: 151 (partim); 1948: 74 (partim); 1952: 240 (partim); Hardy, 1943: 54 (partim). Suppressed by ICZN, 1963: 339 (Opinion 678).

Pipunculus Latreille, 1802: 463. Type species *Pipunculus campestris* Latreille, 1802, (monotype); Becker 1897: 36 group II (partim); 1900: 226 (partim); Verral, 1901 groups II and III (partim); Creason, 1911: 296 group II (partim); Rafael, 1991; De Meyer, 1996: 21; Motamedinia *et al*. 2021: 14.

Microcera Meigen, 1803: 273. Type species. *Pipunculus campestris* Latreille, 1802 (subs. des. of Coquillett, 1910: 569).

Dorilas (*Dorilas*) Hardy, 1950; 13 (partim).

Pipunculus (*Pipunculus*) Hardy, 1965b: 230 (partim); 1965c: 552 (partim); 1966: 6 (partim); 1972: 10; 1975: 297; 1980: 486.

Diagnosis [adapted from Skevington & Marshall (1998)]. Small to medium-sized (3.2–6.0 mm). Eyes holoptic in males, dichoptic in females. Pospedicel obtuse, acute or acuminate. Ocellar setae absent. Wing with vein M_2 absent. Proepisternum with fan of setae. At least the anterior third of scutum and all abdominal segments covered with dense setae. Pterostigma present. Abdominal tergites with at least some brownish or grayish pruinosity. Syntergosternite 8 with a membranous area. Surstyli symmetrical to subsymmetrical (rarely asymmetrical), covered with many conspicuous setae (rarely with inconspicuous setae). Apex of phallic guide with tip thin hook-shaped and lobes apically and ventrally (rarely absent). Ejaculatory apodeme fan-shaped, parasol-shaped wide or narrow (rarely bottle-shaped). Phallus trifid, simple or coiled.

Species of *Pipunculus* from Colombia

Pipunculus caeruleus sp. nov.

Figs 1–13, 40

Diagnosis. Male. Antenna brown; postpedicel with acuminate apex. Wing with anal lobe narrowed. Coxae opaque dark brown. All tibiae without distinct apical spines and outstanding setae anteromedially. Abdomen velvety dark blue, gray-brown pruinose. Syntergosternite 8 brown with a large membranous area. Surstyli subsymmetrical, with inner margins sinuous, apices slightly truncated and downwards directed. Apex of phallic guide stout and shorter. Ejaculatory apodeme narrowed, needle-shaped. Phallus with ejaculatory ducts coiled, completely separated.

Description. MALE (holotype). Body length 4 mm. ***Head*** (Figs 1–2). Eyes contiguous for 17 facets. F, EM, V (mm) = 0.3, 0.4, 0.2. Frontal triangle gray-brown pruinose, with conspicuous dark brown callus. Occiput brown, brown pruinose dorsally and upper half laterally, gray pruinose in lower half laterally and ventrally. Antenna (Fig. 3) brown; scape with one seta dorsally; pedicel with two setae dorsally and three ventrally; postpedicel with acuminate apex. LPP/WPP = 2.6. ***Thorax*** (Figs 1–2, 4). Postpronotal lobe brown, gray-brown pruinose. Scutum dark brown, gray-brown pruinose, with dorsocentral setae; long and brown setae covering basal third. Notopleuron brown, gray pruinose. Scutellum concolorous with scutum. Mesopleuron concolorous with notopleuron. Mediotergite concolorous with mesopleuron. ***Wing*** (Fig. 5). Length 6.1 mm. LW/MWW = 3.8; LTC/LFC = 1.3. Membrane brown infuscated; anal lobe narrowed. Halter dark brown. ***Legs*** (Fig. 1). Coxae opaque dark brown, with apices yellowish brown; fore and hind coxae gray pruinose; mid coxa gray-brown pruinose; trochanters opaque dark brown, gray-brown pruinose; femora opaque dark brown, gray-brown pruinose, with apices yellowish brown, ventral ctenidia and a row of long and fine yellow setae posterolaterally; tibiae opaque dark brown, with bases yellowish brown, without distinct apical spines and outstanding setae anteromedially; fore and hind tibiae with a patch of short and fine setae yellow, giving fluffy appearance in distal two thirds posteriorly; hind tibia without an acute process posteroapically; tarsomeres 1–5 dark brown; pulvilli brownish yellow. ***Abdomen*** (Figs 1–2, 6). Ground color velvety dark blue, gray-brown pruinose, with few inconspicuous setae scattered dorsally and laterally, equal in length; tergite 1 gray-brown pruinose dorsally and laterally; tergites 2–5 dark blue, brown pruinose in basal third; tergites and sternites 6 and 7 as in Fig. 7. Syntergosternite 8 brown, gray-brown pruinose, clearly longer than tergite 5, with the membranous area large (Fig. 8). ***Terminalia*** (Figs 7–1). Epandrium and surstyli brown (Fig. 8). Surstyli (Figs 8–10) subsymmetrical, slightly shorter than epandrium, with short setae in outer margins. Both surstyli thickened basally, thin apically, with inner margins sinuous, apex slightly truncated and downwards directed (Fig. 8); left surstylus slightly

thinner than right, left surstylus with outer margin slightly straight, right surstylus with outer margin slightly sinuous (Fig. 8); both surstyli with upper margin sinuous and acute apex; left surstylus with lower margin slightly straight; right surstylus with lower margin slightly sinuous when seen in lateral view (Figs 8–10). Gonopods asymmetrical; left gonopod thinner and shorter than right (Fig. 11). Apex of phallic guide stout and shorter, with tip thin slightly hook-shaped (Fig. 12). Ejaculatory apodeme narrowed, needle-shaped (Fig. 13). Phallus trifid, coiled, with ejaculatory ducts completely separated (Fig. 12).

FEMALE. Unknown.

Type material. (3 m#). HOLOTYPE. Male: COLOMBIA, Antioquia, Belmira, Páramo de Sta.[Santa] Inés, El Morro, 06º37'57.5"N/75º38'42.9"W, 3100–3300 m[eters], 25.III–05.IV.2017, Proyecto moscas de las flores, A.L. Montoya, C. Rodríguez, JP. Carmona Leg., (1 m#, CEUA–101617) (photographed specimen). PARATYPES. *idem* Boyacá, Cab.[Cabaña] Chaina, 05º25'N/73º27'W, 2550 m[eters], 01–14.feb.[II].2001, A. Roberto Leg., M1271 (1 m#, IAvH); *idem* 2600 m[eters], M2662 (1 m#, LEUA). Holotype with left wing mounted on a microslide with Canada balsam. Left antenna and terminalia placed in a microvial with glycerin, both pinned along the specimen.

Etymology. From the Latin '*caeruleum*' (= blue) and refers to the predominant color in tergites of the males.

Geographical distribution. Colombia (Antioquia, Boyacá) (Fig. 40).

Habitat. The specimens were collected in the Páramo Santa Inés, with areas of very humid premontane forest of the Oriental and Central cordillera of the Northwest region of Colombia and Santuario de Fauna y Flora Iguaque reserve, where the vegetation is composed of cloud Andean forests of the cordillera of the Northeast region of Colombia.

Taxonomic notes. *Pipunculus caeruleus* **sp. nov.** runs to *P. abnormis* Skevington, 1998 in couplet 10 of the key presented by Skevington & Marshall (1998). It differs from *P. abnormis* by having body length 4 mm (*versus* body length 3.2–3.7 mm in the holotype); postpedicel with acuminate apex (Fig. 3) (*versus* postpedicel with obtuse apex [see figure 1, presented by Skevington & Marshall (1998)]; frontal triangle gray-brown pruinose (*versus* frontal triangle silver-gray pruinose); Occiput brown, brown pruinose dorsally and upper half laterally, gray pruinose in lower half laterally and ventrally (*versus* Occiput entirely silver-grey pruinose, except for small brown pruinose region near ocellar); postpronotal lobe brown, gray-brown pruinose (*versus* postpronotal lobe light brown to yellowish brown); scutum and scutellum dark brown, gray-brown pruinose (*versus* scutum and scutellum blackish brown, gray pruinose);

coxae opaque dark brown, with apices yellowish brown; fore and hind coxae gray pruinose; mid coxa gray-brown pruinose (Fig. 1) (*versus* all coxae entirely dark brown, gray pruinose); trochanters opaque dark brown, gray-brown pruinose (Fig. 1) (*versus* trochanters entirely yellow); tibiae opaque dark brown, with bases yellowish brown (Fig. 1) (*versus* tibiae entirely yellow); abdomen velvety dark blue, gray-brown pruinose; tergite 1 gray-brown pruinose dorsally and laterally; tergites 2–5 dark blue, brown pruinose in basal third (Figs 1–2, 6) (*versus* tergite 1 entirely gray pruinose to bare anterodorsally; tergites 2–3 brown pruinose to not pruinose anterolaterally; tergites 4–5 gray pruinose posterolaterally, not pruinose dorsally); both surstyli with apices downwards directed (Fig. 8) (*versus* both surstyli with apices clearly outwards directed [see figure 18e, presented by Skevington & Marshall (1998)]; apex of phallic guide without lobe apically (Fig. 12) (*versus* apex of phallic guide with lobe with tip hook shape apically [see figure 18f, presented by Skevington & Marshall (1998)]; ejaculatory apodeme needle-shaped (Fig. 13) (*versus* ejaculatory apodeme fan-shaped [see figure 18d, presented by Skevington & Marshall (1998)]; phallus with ejaculatory ducts coiled (Fig. 12) (*versus* phallus with ejaculatory ducts not coiled [see figure 18g, presented by Skevington & Marshall (1998)].

***Pipunculus chiminiguagua* sp. nov.**

Figs 14–26, 40

Diagnosis. Male. Antenna brown; postpedicel with acuminate apex. Wing with anal lobe narrowed basally. Coxae opaque dark brown. Fore and mid tibiae with distinct apical spines; hind tibia without an acute process posteroapically and outstanding setae anteromedially. Abdomen dark brown, gray-brown pruinose, with many conspicuous setae scattered dorsally and laterally equal in length. Syntergosternite 8 with membranous area apically. Surstyli subsymmetrical, with inner margins slightly straight, outer margin sinuous, and apices rounded downwards directed. Apex of phallic guide with rounded and translucent lobe ventrally. Ejaculatory apodeme fan-shaped. Phallus with ejaculatory ducts not coiled, completely separated.

Description. MALE (holotype). Body length 4.2. mm. ***Head*** (Figs 14–15). Eyes contiguous for 18 facets. F, EM, V (mm) = 0.3, 0.4, 0.1. Frontal triangle gray-brown pruinose, with conspicuous dark brown callus. Occiput brown, brown pruinose dorsally and upper half laterally, gray pruinose in lower half laterally and ventrally. Antenna (Fig. 16) brown; scape with one seta dorsally; pedicel with three setae dorsally and three ventrally; postpedicel with acuminate apex. LPP/WPP = 2.5. ***Thorax*** (Figs 14–15, 17). Postpronotal lobe brown, gray-

brown pruinose. Scutum dark brown, gray-brown pruinose, with dorsocentral setae, long and brown setae covering basal third. Notopleuron brown, gray pruinose. Scutellum concolorous with scutum. Mesopleuron concolorous with notopleuron. Mediotergite concolorous with mesopleuron. ***Wing*** (Fig. 18). Length 6 mm. LW/MWW = 3.6; LTC/LFC = 0.3. Membrane brown infuscated; anal lobe narrowed basally. Halter dark brown. ***Legs*** (Figs 14–15). Coxae opaque dark brown, with apices yellowish brown; fore and hind coxae gray pruinose; mid coxa gray-brown pruinose; trochanters yellowish brown; femora shiny dark brown to black, with basal third and apices yellowish brown, ventral ctenidia and a row of long and fine yellow setae posterolaterally; tibiae yellowish brown; fore and mid tibiae with distinct apical spines; fore and hind tibiae with a patch of short and fine setae yellow, giving fluffy appearance in distal two thirds posteriorly; hind tibia without an acute process posteroapically and outstanding setae anteromedially; tarsomeres 1–3 yellowish brown; tarsomeres 4–5 dark brown; pulvilli yellowish brown. ***Abdomen*** (Figs 14–15, 19). Ground color dark brown, gray-brown pruinose, with many conspicuous setae scattered dorsally and laterally equal in length; tergite 1 completely covered by gray-brown pruinosity; tergites 2–4 shiny dark brown dorsally, with a spot in I-shaped centrally brown pruinose; tergites and sternites 6 and 7 as in Fig. 20. Syntergosternite 8 brown, gray-brown pruinose, clearly shorter than tergite 5, with membranous area apically (Fig. 21). ***Terminalia*** (Figs 20–26). Epandrium and surstyli dark brown (Fig. 21). Surstyli (Figs 21–23) subsymmetrical, slightly equal to epandrium length, with short setae in inner and outer margins. Both surstyli thickened basally and medially, thin apically, with inner margins slightly straight and outer margin sinuous, apices rounded downwards directed (Fig. 21); both surstyli with upper and lower margin sinuous and apices rounded downwards directed when seen in lateral view (Figs 22–23). Gonopods subsymmetrical, left gonopod longer than right (Fig. 24). Apex of phallic guide stout, with tip hook-shaped and rounded and translucent lobe ventrally (Fig. 25). Ejaculatory apodeme fan-shaped (Fig. 26). Phallus trifid, not coiled, ejaculatory ducts completely separated (Fig. 25).

FEMALE. Unknown.

Type material. (4 m#). HOLOTYPE. Male: COLOMBIA, Boyacá, SFF[Santuario de Fauna y Flora] Iguaque, Cab.[Cabaña] Chaina, 05º25'N/73º27'W, 2600 m[eters], 14.II–05.III.2001, P. Reina Leg., Malaise, M1359 (1 m#, IAvH) (photographed specimen). PARATYPES. *idem* (1 m#, IAvH); *idem* 01–16.XII.2001, P. Roberto Leg., M2682 (1 m#, INPA); *idem* Qda.[Quebrada] Los Mudos, 05º44'N/73º26'W, 2840 m[eters], 27.II–17.III.2003, P. Reina Leg., Malaise, M3563 (1 m#, LEUA). Holotype with left wing mounted on a

microslide with Canada balsam. Left antenna and terminalia placed in a microvial with glycerin, both pinned along the specimen.

Etymology. The name '*chiminiguagua*' is derived from the indigenous idiom "Chibcha", the indigenous people that inhabited the type locality '*Chiminiguagua*' (= supreme god, creator), very important to their culture. The name is to be treated as a noun apposition

Geographical distribution. Colombia (Boyacá) (Fig. 40).

Habitat. The specimens were collected in the Santuario de Fauna y Flora Iguaque reserve, where the vegetation is composed of cloud Andean forests of the cordillera of the Northeast region of Colombia.

Taxonomic notes. Based on males *Pipunculus chiminiguagua* **sp. nov.** is similar in appearance to *P. ferepauculus* Hardy, 1965. It differs from *P. ferepauculus* by having postpedicel with acuminate apex (*versus* postpedicel with obtuse apex); frontal triangle gray-brown pruinose (*versus* frontal triangle black, not pruinose); Occiput brown, brown pruinose dorsally and upper half laterally, gray pruinose in lower half laterally and ventrally (*versus* Occiput silver-grey pruinose ventrally and laterally, not pruinose dorsally); postpronotal lobe brown, gray-brown pruinose (*versus* postpronotal lobe blackish brown); scutum and scutellum dark brown, gray-brown pruinose (Fig. 17) (*versus* scutum and scutellum blackish brown, brown pruinose); coxae opaque dark brown, with apices yellowish brown (Fig. 14) (*versus* coxae entirely blackish brown); femora shiny dark brown to black, with basal third and apices yellowish brown (Figs 14–15) (*versus* femora brownish black with yellow apices); fore and mid tibiae with distinct apical spines (*versus* all tibiae without distinct apical spines); abdomen dark brown, gray-brown (Figs 15, 19) (*versus* abdomen blackish brown, brown pruinose); Surstyli subsymmetrical (Fig. 21) (*versus* surstyli asymmetrical [see figure 4, presented by Rafael (1991)]; apex of phallic guide with rounded and translucent lobe ventrally and without lobe apically (Fig. 25) (*versus* apex of phallic guide with triangular lobe ventrally and long, stout and rounded lobe apically [see figure 5, presented by Rafael (1991)].

***Pipunculus planus* sp. nov.**

Figs 27–39, 40

Diagnosis. Male. Antenna dark brown; postpedicel with acute apex. Wing with anal lobe large. Coxae shiny dark brown. Mid tibia with distinct apical spines; hind tibia with an acute process posteroapically and outstanding setae anteromedially. Abdomen velvety dark brown, brown

pruinose dorsally, giving the appearance of longitudinal bands dorsally. Syntergosternite 8 with membranous area large. Surstyli subsymmetrical, with inner and outer margins curved, apices rounded and slightly inward directed. Apex of phallic guide with translucent and distinct lobe and one row of inconspicuous setae laterally. Ejaculatory apodeme narrowed, bottle-shaped. Phallus with ejaculatory ducts coiled, distinctly separated in distal half.

Description. MALE (holotype). Body length 4.5 mm. ***Head*** (Figs 27–28). Eyes contiguous for 18 facets. F, EM, V (mm) = 0.4, 0.4, 0.1. Frontal triangle brown pruinose, with conspicuous dark brown callus. Occiput brown, brown pruinose dorsally and upper half laterally, gray pruinose in lower half laterally and ventrally. Antenna (Fig. 29) dark brown; scape with one seta dorsally; pedicel with three setae dorsally and two ventrally; postpedicel with acute apex. LPP/WPP = 2.2. ***Thorax*** (Figs 27–28, 30). Postpronotal lobe brown, brown pruinose. Scutum dark brown, brown pruinose, with dorsocentral setae; long and brown setae covering basal third. Notopleuron concolorous with scutum. Scutellum concolorous with scutum. Mesopleuron brown, gray-brown pruinose. Mediotergite brown, brown pruinose. ***Wing*** (Fig. 31). Length 5.8 mm. LW/MWW = 3.5; LTC/LFC = 1.3. Membrane brown infuscated; anal lobe large. Halter stem brown; knob yellowish brown. ***Legs*** (Fig. 27). Coxae shiny dark brown, gray-brown pruinose, with apices yellowish brown; trochanters shiny brown, brown pruinose; femora shiny dark brown, with apices yellowish brown, ventral ctenidia and a row of long and fine yellow setae posterolaterally; tibiae shiny dark brown, with bases yellowish brown; fore and hind tibiae with a patch of short and fine setae yellow, giving fluffy appearance in distal two thirds posteriorly; fore tibia without distinct apical spines; mid tibia with distinct apical spines; hind tibia with a process acute posteroapically and outstanding setae anteromedially; tarsomeres 1–4 brown, 5 dark brown; pulvilli yellowish brown. ***Abdomen*** (Figs 27–28, 32). Ground color velvety dark brown, brown pruinose dorsally, giving the appearance of longitudinal bands dorsally, shiny posterolaterally, with inconspicuous setae scattered dorsally and long and fine setae brownish yellow laterally, about 3 times longer than dorsal seta; tergites and sternites 6 and 7 as in Fig. 33. Syntergosternite 8 dark brown, brown pruinose, slightly shorter than tergite 5, with membranous area large (Fig. 34). ***Terminalia*** (Figs 33–39). Epandrium and surstyli dark brown (Fig. 34). Surstyli (Figs 34–36) subsymmetrical, shorter than length of epandrium, with long setae in outer margins. Both surstyli thickened basally and medially, thin apically, with inner and outer margins curved, apex rounded, and slightly inward directed (Fig. 34); left surstylus slightly thinner than right (Fig. 34); both surstyli with apices forward directed, left surstylus with apex rounded, right surstylus with an acute apex when seen

in lateral view (Figs 35–36). Gonopods asymmetrical; left gonopod thicker than right (Fig. 37). Apex of phallic guide stout, with tip thin hook-shaped, translucent distinct lobe and one row of inconspicuous setae laterally (Fig. 38). Ejaculatory apodeme narrowed, bottle-shaped (Fig. 39). Phallus trifid, with ejaculatory ducts coiled, distinctly separated in distal half (Fig. 38).

FEMALE. Unknown.

Type material. (5 m#). HOLOTYPE. Male: COLOMBIA, Boyacá, SFF[Santuario de Fauna y Flora] Iguaque, Qda.[Quebrada] Los Mudos, Malaise, 05º44'N/73º26'W, 2840 m[eters], 14.II–14.III.2003, P. Reina Leg., M3637 (1 m#, IAvH) (photographed specimen). PARATYPES. *idem* Cab.[Cabaña] Chaina, 05º25'N/73º27'W, 2550 m[eters], 01–14.feb.[II].2001, A. Roberto Leg., M1271 (2 m#, LEUA); *idem* (1 m#, LEUA); *idem* (1 m#, INPA). Holotype with left wing mounted on a microslide with Canada balsam. Left antenna and terminalia placed in a microvial with glycerin, both pinned along the specimen.

Etymology. From the Latin '*planus*' (= flat), and refers to the dorsoventral flattening of the ejaculatory ducts of the phallus in the male terminalia.

Geographical distribution. Colombia (Boyacá) (Fig. 40).

Habitat. The specimens were collected in the Santuario de Fauna y Flora Iguaque reserve, where the vegetation is composed of cloud Andean forests of the cordillera of the Northeast region of Colombia.

Taxonomic notes. Based on males *Pipunculus planus* **sp. nov.** is similar in appearance to *P. kotaneni* Skevington, 1998. It differs from *P. kotaneni* by having postpedicel with acute apex (*versus* postpedicel with obtuse apex); frontal triangle brown pruinose (*versus* frontal triangle silver grey pruinose); Occiput brown pruinose dorsally and upper half laterally, gray pruinose in lower half laterally and ventrally (*versus* Occiput silver-grey pruinose ventrally and laterally, not pruinose dorsally); postpronotal lobe brown, brown pruinose (*versus* postpronotal lobe black, silver pruinose); scutum and scutellum dark brown, brown pruinose (Fig. 30) (*versus* scutum and scutellum black, gray pruinose anterolaterally and brown pruinose medially); coxae shiny dark brown, with apices yellowish brown (Fig. 27) (*versus* coxae entirely black); trochanters shiny brown, brown pruinose (Fig. 27) trochanters entirely black); femora shiny dark brown, with apices yellowish brown (Fig. 27) (*versus* femora entirely black); tibiae shiny dark brown, with bases yellowish brown (Fig. 27) (*versus* tibiae brownish black); mid tibia with distinct apical spines (*versus* mid tibiae without distinct apical spines); hind tibia without distinct apical spines (*versus* hind tibia with distinct apical spines); abdomen dark brown, brown pruinose dorsally, shiny posterolaterally (Figs 27–28, 32) (*versus* abdomen

black, brown pruinose dorsally, sparsely gray pruinose laterally); both surstyli with inner margins curved and apices slightly inward directed (Fig. 34) (*versus* both surstyli with inner margins sinuous and apices clearly inward directed [see figure 33e, presented by Skevington & Marshall (1998)]; apex of phallic guide with translucent lobe and one row of inconspicuous setae laterally (Fig. 38) (*versus* apex of phallic guide without translucent lobe laterally and with tuff of setae apically [see figure 33f, presented by Skevington & Marshall (1998)].

Unidentified females

Four female specimens belonging to three morphospecies could not be associated with males.

Material examined. (4 f#). COLOMBIA, Boyacá, Qda.[Quebrada] Los Mudos, 05º44'N/73º26'W, 2840 m[eters], 14.II–14.III.2003, P. Reina Leg., M3637 (2 f#, IAvH); *idem* Cabaña Chaina, 05º25'N/73º27'W, 2600 m[eters], 16–30.XI.2001, M2583 (1 f#, IAvH); *idem* 10–28.VI.2001, M1836 (2 f#, IAvH); *idem* Magdalena, PNN[Parque Nacional Natural] Santa Marta, Bella Vista, 10º48'N/73º39'W, 1500 m[eters], 3–24.II.2002, J. Cantillo Leg., M3029 (1 f#, IAvH).

Key to males of the Neotropical species of *Pipunculus*

1 At least one tibia with distinct apical spines … 2

- All tibiae without distinct apical spines … 3

2 Mid tibia with distinct apical spines; hind tibia without distinct apical spines and with a process acute posteroapically; both surstyli with apices slightly downward directed (Fig. 34); apex of phallic guide with a translucent lobe and one row of inconspicuous setae laterally (Fig. 38) … ***P. planus* sp. nov.**

- Mid tibia without distinct apical spines; hind tibia with distinct apical spines and without process acute posteroapically; both surstyli with apices clearly inward directed [see figure 33e in Skevington & Marshall (1998)]; apex of phallic guide without translucent lobe laterally and with a tuff of conspicuous seta apically [see figure 33f in Skevington & Marshall (1998)] … ***P. kotaneni*** Skevington, 1998

3 Phallic guide with sinus apically [see figures 27h, 45g in Skevington & Marshall (1998)] … 4

- Phallic guide without sinus apically [Figs 12, 25 and see figures 18f, 24f, 28f, 31f, 40g and figure 5 in Rafael (1991)] … 5

4 Both surstyli with inner margins straight and apices slightly inward directed [see figure 27d in Skevington & Marshall (1998)]; ejaculatory apodeme narrowed parasol-shaped [see figure 27f in Skevington & Marshall (1998)]; ejaculatory ducts of phallus short, broad and blunt [see figure 27e in Skevington & Marshall (1998)] … ***P. elegantulus*** Williston, 1892

- Both surstyli with inner margins curved and apices strongly inward directed [see figure 45e in Skevington & Marshall (1998)]; ejaculatory apodeme strongly fan-shaped [see figure 45d in Skevington & Marshall (1998)]; ejaculatory ducts of phallus long, thin and acute [see figure 45f in Skevington & Marshall (1998)] … ***P. xanthopodus*** Williston, 1892

5 Both surstyli with apices clearly outwards directed [see figure 18e in Skevington & Marshall (1998)]; apex of phallic guide with lobe with tip hook shape apically, very similar to the shape of the apex [see figure 18f in Skevington & Marshall (1998)] … ***P. abnormis*** Skevington, 1998

- Both surstyli with apices never outwards directed [Figs 8, 21, and see figures 24e, 28e 31e, 40e in Skevington & Marshall (1998) and figure 4 in Rafael (1991)]; apex of phallic guide with lobe with tip never hook shaped apically, never similar to the shape of the apex [see figures 28f, 31f, 40g in Skevington & Marshall (1998) and figure 5 in Rafael (1991)] or without lobe ventrally [see figure 24f in Skevington & Marshall (1998)] … 6

6 Apex of phallic guide with lobe apically [see figures 28f, 31f, 40g in Skevington & Marshall (1998) and figure 5 in Rafael (1991)] … 7

- Apex of phallic guide without lobe apically [Figs. 12, 25, and see figure 24f in Skevington & Marshall (1998)] … 10

7 Ejaculatory ducts of phallus coiled [see figures 31g, 40f in Skevington & Marshall (1998)] … 8

- Ejaculatory ducts of phallus not coiled [see figures 28g in Skevington & Marshall (1998) and figure 5 Rafael (1991)] … 9

8 Both surstyli with inner margins sinuous [see figure 40e in Skevington & Marshall (1998)]; apex of phallic guide with acute lobe apically [see figure 40g in Skevington & Marshall (1998)]; ejaculatory apodeme with side margins rounded [see figure 40d in Skevington & Marshall (1998)] … ***P. rafaeli*** Skevington, 1998

- Both surstyli with inner margins slightly straight [see figure 31e in Skevington & Marshall (1998)]; apex of phallic guide with rounded lobe apically [see figure 31f in Skevington & Marshall (1998)]; ejaculatory apodeme with side margins acute [see figure 31b in Skevington & Marshall (1998)] … ***P. horvathi*** Kertés, 1907

9 Susrtyli subsymmetric with long setae dorsally and apically [see figure 28d in Skevington & Marshall (1998)]; apex of phallic guide with rounded lobe ventrally and short, thin, and acute lobe apically [see figure 28f in Skevington & Marshall (1998)] … ***P. fuscus*** Loew, 1866

- Surstyli asymmetrical with short and fine setae laterally and apically [see figure 4 in Rafael (1991)]; apex of phallic guide with triangular lobe ventrally and long, stout and rounded lobe apically [see figure 5 in Rafael (1991)] … ***P. ferepauculus*** Hardy, 1965

10 Both surstyli with apices forward directed (Fig. 8); apex of phallic guide without lobe ventrally (Fig. 12); ejaculatory ducts of phallus coiled (Fig. 12) … ***P. caeruleus*** **sp. nov.**

- Both surstyli with apices downward directed [Fig. 21, and see figure 24a in Skevington & Marshall (1998)]; apex of phallic guide with lobe ventrally [Fig. 25, and see figure 24f in Skevington & Marshall (1998)]; ejaculatory ducts of phallus not coiled [Fig. 25, and see figure 24g in Skevington & Marshall (1998)] … 11

11 Membranous area large, extending over most of the length of syntergosternite 8 [see figure 24c in Skevington & Marshall (1998)]; left surstylus with apex inward directed [see figure 24e in Skevington & Marshall (1998)]; apex of phallic guide with short lobe ventrally [see figure 24f in Skevington & Marshall (1998)]; ejaculatory apodeme narrowed needle-shaped [see figure 24d in Skevington & Marshall (1998)] … ***P. cingulatus*** Loew, 1866

- Membranous area short, only in apical area of syntergosternite 8 (Fig. 21); left surstylus with apex downward directed (Fig. 22); apex of phallic guide with large lobe ventrally (Fig. 25); ejaculatory apodeme wide fan-shaped (Fig. 26) … ***P. chiminiguagua*** **sp. nov.**

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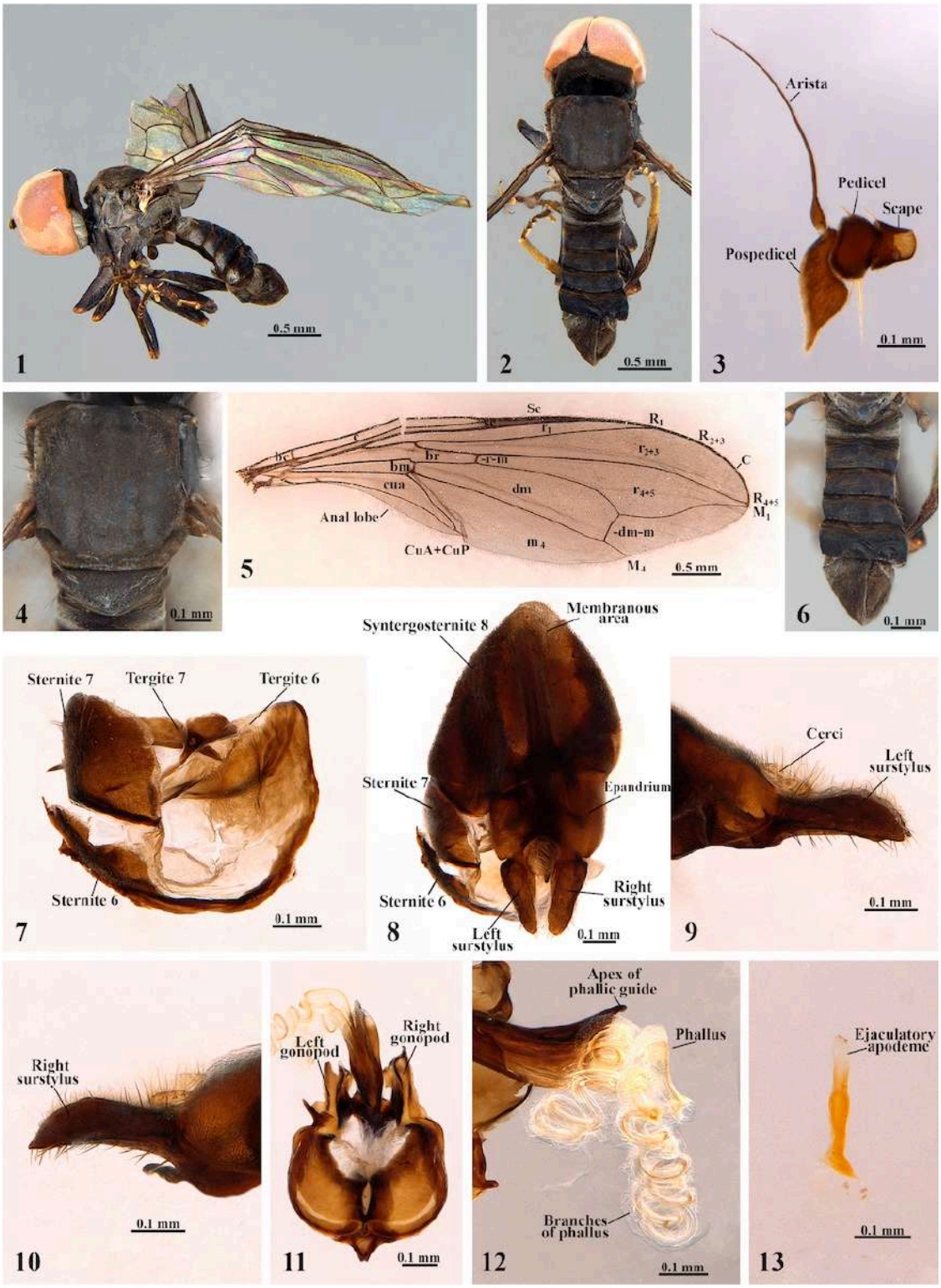
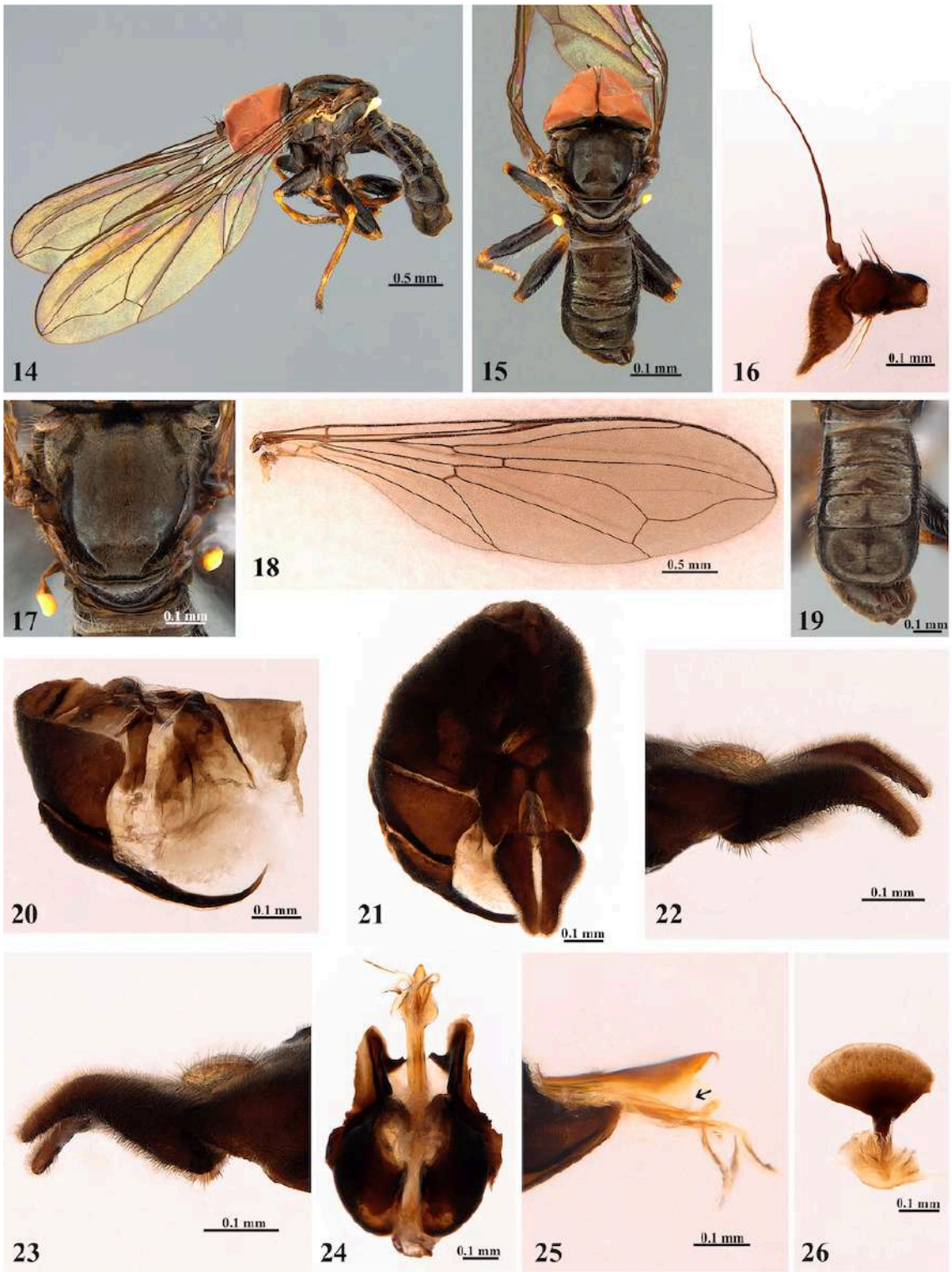
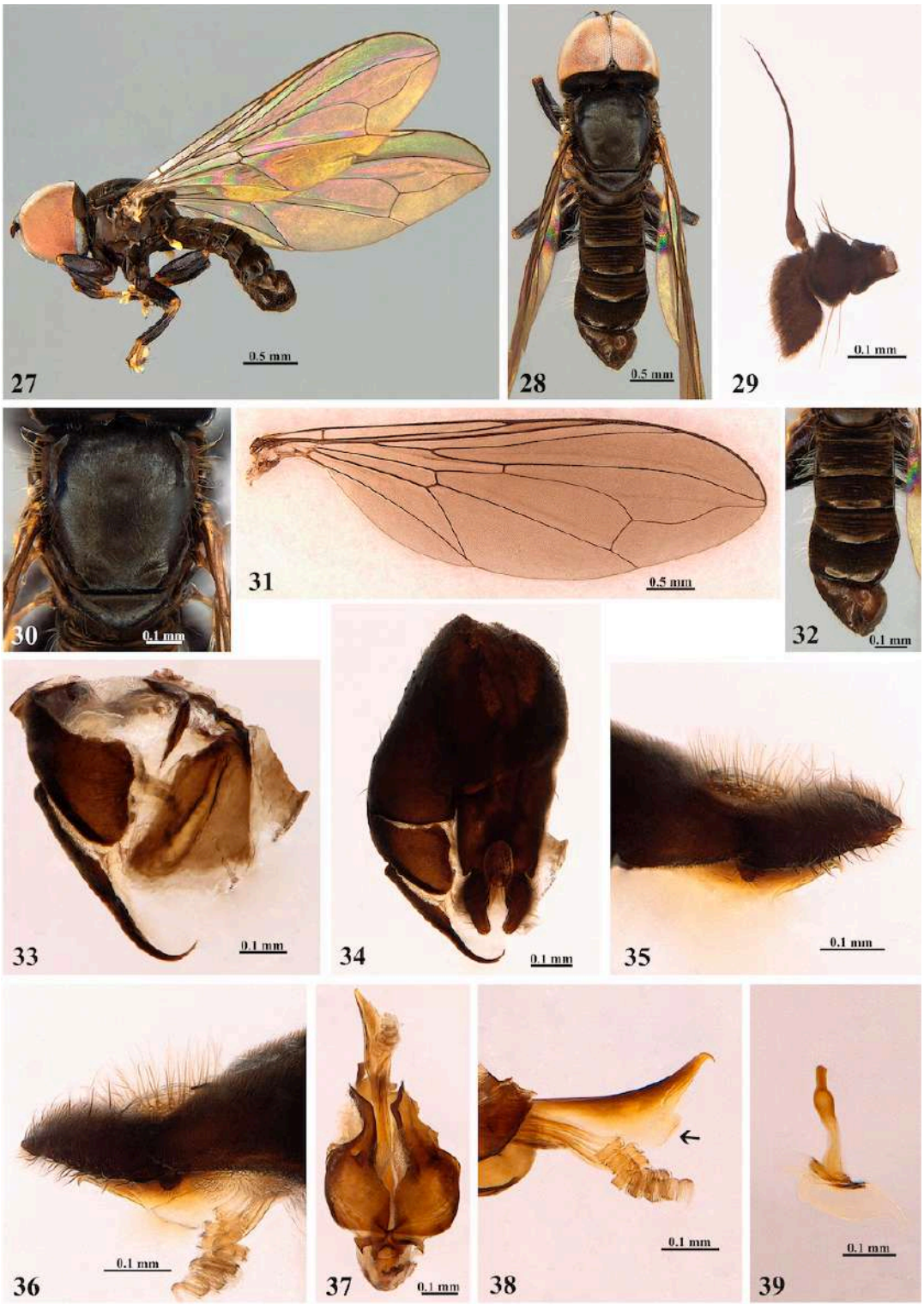


FIGURES 1-13. *Pipunculus caeruleus* **sp. nov.** (CEUA–101617). Holotype male. **1**, Habitus, left lateral view; **2**, Habitus, dorsal view; **3**, Antenna; **4**, Thorax, dorsal view; **5**, Wing; **6**, Abdomen, dorsal view; **7**, Tergites and sternites 6 and 7, ventral view; **8**, Terminalia, dorsal view; **9**, Left surstylus, lateral view; **10**, Right surstylus, lateral view; **11**, Hypandrium and gonopods, ventral view, **12**, Phallic guide and phallus, left lateral view; **13**, Ejaculatory apodeme.



FIGURES 14-26. *Pipunculus chiminiguagua* **sp. nov.** (IAvH–M1359) Holotype male. **14**, Habitus, left lateral view; **15**, Habitus, dorsal view; **16**, Antenna; **17**, Thorax, dorsal view; **18**, Wing; **19**, Abdomen, dorsal view; **20**, Tergites and sternites 6 and 7, ventral view; **21**, Terminalia, dorsal view; **22**, Left surstylus, lateral view; **23**, Right surstylus, lateral view; **24**, Hypandrium and gonopods, ventral view, **25**, Phallic guide and phallus, left lateral view; **26**, Ejaculatory apodeme.



FIGURES 27-39. *Pipunculus planus* **sp. nov.** (IAvH–M3637). Holotype male. **27**, Habitus, left lateral view; **28**, Habitus, dorsal view; **29**, Antenna; **30**, Thorax, dorsal view; **31**, Wing; **32**, Abdomen, dorsal view; **33**, Tergites and sternites 6 and 7, ventral view; **34**, Terminalia, dorsal view; **35**, Left surstylus, lateral view; **36**, Right surstylus, lateral view; **37**, Hypandrium and gonopods, ventral view; **38**, Phallic guide and phallus, left lateral view; **39**, Ejaculatory apodeme.

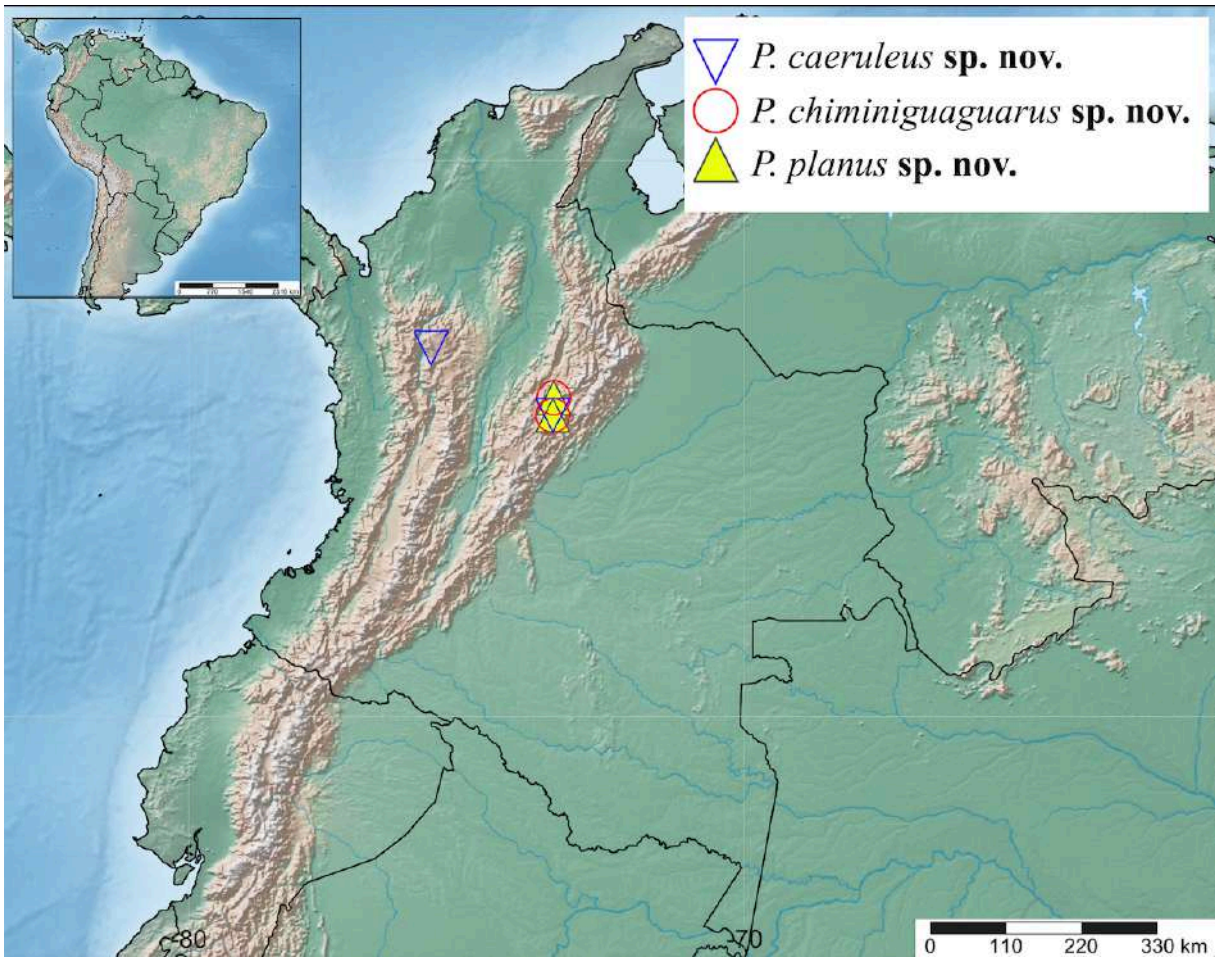


FIGURE 40. Geographical records of *Pipunculus* species in Colombia. *P. caeruleus* **sp. nov.**, *P. chiminiguagua* **sp. nov.** and *P. planus* **sp. nov.**

Subfamília: Pipunculinae Walker, 1834

Tribo: Tomosvaryellini Hardy, 1943

Gênero: *Basileunculus* Rafael, 1987

ANEXO 1

Ramos-Pastrana, Y., Marques, D.W.A. & Rafael, J.A. 2022. *Basileunculus* Rafael, 1987 (Diptera: Pipunculidae) of Colombia, with description of three new species and an updated key to males of the Neotropical species. *Neotropical Entomology*, 51: 691–704. https://doi.org/101007/s13744-022-00983-6

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SYSTEMATICS, MORPHOLOGY AND PHYSIOLOGY

Basileunculus Rafael, 1987 (Diptera: Pipunculidae) of Colombia, with Description of Three New Species and an Updated Key to Males of the Neotropical Species

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Abstract
Basileunculus Rafael, 1987 is exclusive of the Neotropical region and is a poorly studied group, completely unknown in Colombia. Three new species of *Basileunculus* are described from Colombia, namely *Basileunculus elieceri* **sp. nov.** (type-locality: Cabaña Chaina, Santuario de Fauna y Flora Iguaque), *B. elongatus* **sp. nov.** (type-locality: Santuario de Fauna y Flora Iguaque), and *B. tayronensis* **sp. nov.** (type-locality: Parque Nacional Natural Tayrona). *Basileunculus rex* Curran, 1934 is recorded for the first time in Colombia, with an amended diagnosis. Descriptions, illustrations, diagnosis, distribution maps of new species, and a dichotomic key for all of the Neotropical species are presented.

Keywords Big-headed fly · Pipunculinae · Taxonomy · Tomosvaryellini

Introduction

Basileunculus Rafael 1987 is exclusive to the Neotropical region (Rafael 1987); however, according to Rafael and Menezes (1999), it probably occurs in the Nearctic Region. Rafael and De Meyer (1992) and Skevington and Yeates (2001) considered *Basileunculus* as a monophyletic group and positioned this genus as the sister group of *Allomethus* Hardy, 1943 + *Claraeola* Aczél 1940, all of them grouped within the tribe Eudorylini. In the recent phylogenetic analyses carried out by Motamedinia et al. (2021), *Basileunculus* was recovered as the sister-group of *Amazunculus* Rafael 1986 + *Elmohardyia* Rafael 1986. Furthermore, the authors synonymized Eudorylini under Tomosvaryellini, because the latter was found to be not monophyletic, with *Tomosvaryella* Aczél, 1939, hypothesized as the sister group to *Eudorylas* Aczél 1940 + *Clistoabdominalis* Skevington 2001 in the analyses.

The species currently included in *Basileunculus* were previously treated by Malloch (1912) and Curran (1934) under *Pipunculus* Latreille 1802. Later, Hardy (1948, 1954) and Aczél (1952) treated them under *Dorilas* (*Eudorylas*) Aczél, 1940, and Hardy (1966) treated them under *Pipunculus* (*Eudorylas*) Latreille 1802.

Basileunculus is easily recognizable by the combination of the following characters: pedicel with several dorsal and ventral setae; postpedicel with subrounded apex (rarely with acuminate apex); proepisternum bare; vein M_2 absent; abdomen ground color velvety brown to dark brown, with conspicuous scattered setae and gray pruinose bands on posterior margins, sometimes interrupted medially; surstyli symmetrical to subsymmetrical, with distinctive setae; phallic guide simple, thickened basally, thinner apically, with apex acute hook-shaped; ejaculatory apodeme racket-shaped and phallus unbranched.

Currently, the genus includes three species, *Basileunculus rex* (Curran 1934) (Brazil, Guiana), *B. interruptus* (Malloch 1912) (El Salvador, Panama), and *B. aliceae* Rafael 1987 (Brazil, Dominican Republic) (Rafael 1987, 1996), but none have been recorded from Colombia. The objective of this

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Subfamília: Pipunculinae Walker, 1834

Tribo: Pipunculini Walker, 1834

Gênero: *Cephalops* Fallén, 1810

Gênero: *Semicephalops* De Meyer, 1994

ANEXO 2

Ramos-Pastrana, Y., Marques, D.W.A. & Rafael, J.A. 2022. *Cephalops* Fallén and *Semicephalops* De Meyer (Diptera: Pipunculidae) of Colombia, with description of five new species and an updated key to males of the Neotropical species. *Zootaxa*, 5141 (3): 201–084. https://doi.org/10.11646/zootaxa.5141.3.1

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Cephalops Fallén and *Semicephalops* De Meyer (Diptera: Pipunculidae) of Colombia, with description of five new species and an updated key to males of the Neotropical species

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Abstract

The pipunculid genera *Cephalops* Fallén, 1810 and *Semicephalops* De Meyer, 1994 are cosmopolitan in distribution. These two genera have just a few species known from the Neotropical Region and they were completely unknown to Colombia. Four new species of *Cephalops* and one species of *Semicephalops* are described from protected areas and conflict-territories of limited access in Colombia, namely *Cephalops acutus* **sp. nov.** (type locality: Cañaveral, Magdalena), *C. gracilis* **sp. nov.** (type locality: El Níspero, Boyacá), *C. klinsmanni* **sp. nov.** (type locality: Las Brisas, Caquetá), *C. lobatus* **sp. nov.** (type locality: El Níspero, Boyacá) and *Semicephalops folium* **sp. nov.** (type locality: Quebrada Carrizal, Boyacá). With this paper, the number of *Cephalops* species from the Neotropical Region increase from 13 to 17 and that of *Semicephalops* from five to six. *Cephalops amapaensis* Rafael, 1990 and *Semicephalops inpaganus* Rafael, 1990 are recorded for the first time from Colombia, and amended diagnosis are provided for both. A dichotomic key to the Neotropical species of both genera is presented.

Key words: big-headed fly, diversity, Pipunculinae, Pipunculini, taxonomy

Introduction

Cephalops Fallén, 1810 is a cosmopolitan pipunculid genus with 178 species worldwide (Skevington 2005). Hardy (1943) treated the species of *Cephalops* under the genus *Dorilas* Meigen, 1800 but later on, included them both under *Pipunculus* (*Pipunculus*) Latreille, 1802 (Hardy 1965a) and *Pipunculus* (*Cephalops*) Fallén, 1800 (Hardy 1972). Several European authors treated *Cephalops* as a distinct genus (Collin 1956; Coe 1966; Albrecht 1979; Kozánek 1981; Kozánek & Lauterer 1987). De Meyer (1989a) described *Microcephalops* for a species group before treated under the genus *Cephalops*. Rafael (1990) transferred most of the Neotropical species treated in the subgenus *Pipunculus* (*Pipunculus*) by Hardy (1966) to *Cephalops* and he divided them into three species groups: *Cephalops brasiliensis* group, *C. callistus* group, and *C. latifrons* group and additionally he proposed a new key with illustrations for all the Neotropical species of *Cephalops*.

De Meyer (1994) divided *Cephalops* into four subgenera: *Cephalops* (*Cephalops*) Fallén, *Cephalops* (*Semicephalops*) De Meyer, *Cephalops* (*Parabeckerias*) De Meyer, and *Cephalops* (*Beckerias*) Aczél (previously with rank of genus), with only *Cephalops* (*Cephalops*) and *Cephalops* (*Semicephalops*) occurring in the neotropics. Later on, Rafael (1996) transferred the five species treated in the *C. latifrons* group to the genus *Microcephalops* De Meyer, 1989a. In the phylogenetic analysis carried out by Motamedinia *et al.* (2021), *Beckerias* Aczél, 1939, *Cephalops* s.s. Fallén, *Parabeckerias* De Meyer, 1994 and *Semicephalops* De Meyer, 1994 were raised to genus rank. In the Neotropical Region, there are currently 13 species of *Cephalops*, from Brazil, Dominican Republic and Mexico, and five of *Semicephalops*, from Argentina, Brazil and Jamaica (De Meyer 1996; Rafael & Rodríguez

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Subfamília: Pipunculinae Walker, 1834

Tribo: Pipunculini Walker, 1834

Gênero: *Cephalosphaera* Enderlein, 1936

Gênero: *Neocephalosphaera* De Meyer, 1994

ANEXO 3

Ramos-Pastrana, Y., Marques, D.W.A. & Rafael, J.A. 2022. *Cephalosphaera* Enderlein and *Neocephalosphaera* De Meyer (Diptera: Pipunculidae) of Colombia, with description of nine new species and an updated key to their Neotropical species. *Zootaxa*, 5178 (4): 301–303.
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Cephalosphaera Enderlein and *Neocephalosphaera* De Meyer (Diptera: Pipunculidae) of Colombia, with description of nine new species and an updated key to their Neotropical species

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Abstract

Cephalosphaera Enderlein, 1936 and *Neocephalosphaera* De Meyer, 1994 have a cosmopolitan distribution and they include a few studied species in the Neotropical region. Both genera are entirely unknown in Colombia. One new species of *Cephalosphaera* and eight of *Neocephalosphaera* are described from protected areas and from conflict-territories of limited access in Colombia, namely, *Cephalosphaera munchiquensis* **sp. nov.** (type locality: Parque Nacional Natural Munchique, La Romelia, Cauca, 2640 m), *Neocephalosphaera carinae* **sp. nov.** (type locality: Santuario de Fauna y Flora Iguaque, Cabaña Mamarramos, Boyacá, 2855 m), *N. grisea* **sp. nov.** (type locality: Santuario de Fauna y Flora Iguaque, Quebrada Los Mudos, Boyacá, 2840 m), *N. iguaquensis* **sp. nov.** (type locality: Santuario de Fauna y Flora Iguaque, El Nispero, Boyacá, 2730 m), *N. muisca* **sp. nov.** (type locality: Santuario de Fauna y Flora Iguaque, Boyacá, 2855 m), *N. paolae* **sp. nov.** (type locality: San José del Fragua, Caquetá, 1270 m), *N. spinifera* **sp. nov.** (type locality: Santuario de Fauna y Flora Los Colorados, Alto El Mirador, Bolívar, 400 m), *N. spiralis* **sp. nov.** (type locality: Santuario de Fauna y Flora Iguaque, Quebrada Carrizal, Boyacá, 3350 m) and *N. sumapazensis* **sp. nov.** (type locality: Parque Nacional Natural Sumapaz, Cabaña Las Mirias, Meta, 735 m). Illustrations and a dichotomic key to the Neotropical species of these two genera are presented.

Key words: big-headed fly, Pipunculinae, Pipunculini, taxonomy, South America

Introduction

Cephalosphaera Enderlein, 1936 was treated as a subgenus of *Pipunculus* Latreille, 1802 in the catalogue of Neotropical Diptera (Hardy 1966), and seven species were listed. Later, Rafael (1986) transferred *Pipunculus elegantulus* Williston, 1892 to the genus *Parapipunculus* Rafael, 1986, which is currently considered as the junior synonym of *Pipunculus* Latreille, 1802 (Skevington & Marshall 1998).

Rafael (1992) considered *Cephalosphaera* as a monophyletic group, based on the point of origin for the M_2 vein, which is closer to the wing margin; and by the hypandrium possessing a distinct muscular fagot which surrounds the base of the phallus dorsally and affixes in the inner part ventrally and mentioned that its phylogenetic position is probably between *Pipunculus* and *Cephalops* Fallén, 1810. Although the monophyly of *Cephalosphaera* continued to be controversial, Rafael & De Meyer (1992) and De Meyer (1994) positioned this genus as sister group of *Cephalops*, within the tribe Cephalopsini. In the recent phylogenetic analyses carried out by Motamedinia *et al.* (2021), Cephalopsini was found to be paraphyletic, with *Cephalops* s.s. either as sister to *Pipunculus* or *Cephalops* s.s. and as sister to *Cephalops* (*Beckerias*) + *Pipunculus*. Given the well supported paraphyly, Cephalopsini was synonymized with Pipunculini by the authors.

Cephalosphaera is cosmopolitan in distribution. It was divided by De Meyer (1994) into two subgenera: *C.* (*Cephalosphaera*) Enderlein and *C.* (*Neocephalosphaera*) De Meyer. In the molecular analyses carried out by Mo-

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Subfamília: Pipunculinae Walker, 1834

Tribo: Tomosvaryellini Hardy, 1943

Gênero: *Tomosvaryella* Aczél, 1939

ANEXO 4

Ramos-Pastrana, Y. & Rafael, J.A. 2021. *Tomosvaryella* Aczél (Diptera: Pipunculidae) of Colombia, with description of two new species. *Zootaxa*, 4985 (1): 037–068. https://doi.org/10.11646/zootaxa.4985.1.2

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Tomosvaryella Aczél (Diptera: Pipunculidae) of Colombia, with description of two new species

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Abstract

Tomosvaryella Aczél, 1939 has a cosmopolitan distribution and is a genus well studied in general in the Neotropical Region. However, in Colombia only three species were recorded. Two new species of *Tomosvaryella* are described from protected areas and from conflict territories of limited access in Colombia, namely: *Tomosvaryella macarenensis* **sp. nov.** (type-locality: Serrania Macarena, Meta) and *T. martae* **sp. nov.** (type-locality: San Vicente del Caguan, Caquetá). The female of *T. tuberculata* Hardy, 1948 is described. *Tomosvaryella similis* (Hough, 1899) is new to South America (Colombia) and *T. galapagensis* (Curran, 1934), *T. lynchi* (Shannon, 1927), *T. mexicanensis* Ale-Rocha & Rafael, 1995, *T. similis*, *T. tuberculata* and *T. venezuelana* Ale-Rocha, 1993 are reported for the first time in Colombia. Illustrations and a dichotomic key to Colombian species of *Tomosvaryella* are presented. Furthermore, the diagnosis of all species recorded in Colombia are amended. The *Tomosvaryella* fauna is increased from three to 11 species in Colombia.

Key words: big-headed fly, new records, Pipunculinae, Tomosvaryellini, taxonomy

Resumen

Tomosvaryella Aczél, 1939 es de distribución cosmopolita y está bien estudiado, en general, en la región neotropical. Sin embargo, en Colombia, solo se tenía registro de tres especies. Dos nuevas especies de *Tomosvaryella* son descritas de áreas protegidas y de territorios de difícil acceso por causa del conflicto interno de Colombia: *Tomosvaryella macarenensis* **sp. nov.** (localidad tipo: Serranía Macarena, Meta) y *T. martae* **sp. nov.** (localidad tipo: San Vicente del Caguan, Caquetá). Se describe la hembra de *T. tuberculata* Hardy, 1948. *Tomosvaryella similis* (Hough, 1899) es nueva para América del Sur (Colombia) y *T. galapagensis* (Curran, 1934), *T. lynchi* (Shannon, 1927), *T. mexicanensis* Ale-Rocha & Rafael, 1995, *T. similis*, *T. tuberculata* y *T. venezuelana* Ale-Rocha, 1993 se registran por primera vez en Colombia. Se presentan ilustraciones y una clave dicotómica para todas las especies de *Tomosvaryella* de Colombia. Además, se modifica la diagnosis de todas las especies registradas en Colombia. La fauna de *Tomosvaryella* se incrementa de tres a 11 especies.

Palabras clave: moscas cabezonas, nuevos registros, Pipunculinae, Tomosvaryellini, Taxonomía

Resumo

Tomosvaryella Aczél, 1939 tem distribuição cosmopolita, é um grupo geralmente bem estudado na região Neotropical, porém na Colômbia apenas três espécies foram registradas. Duas espécies de *Tomosvaryella* são descritas de áreas protegidas e territórios de difícil acesso devido aos conflitos internos na Colômbia. *Tomosvaryella macarenensis* **sp. nov.** (localidade-tipo: Serrania Macarena, Meta) e *T. martae* **sp. nov.** (localidade-tipo: San Vicente del Caguan, Caquetá). A fêmea de *T. tuberculata* Hardy, 1948 é descrita pela primeira vez. *Tomosvaryella similis* (Hough, 1899) é um novo registro para a América do Sul (Colômbia) e *T. galapagensis* (Curran, 1934), *T. lynchi* (Shannon, 1927), *T. mexicanensis* Ale-Rocha & Rafael, 1995, *T. similis*, *T. tuberculata* e *T. venezuelana* Ale-Rocha, 1993 são registrados pela primeira vez na Colômbia. São apresentadas ilustrações e chave dicotômica para as espécies da Colômbia. Além disso as diagnoses

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SÍNTESE

Antes do presente estudo, apenas cinco gêneros e 10 espécies de Pipunculidae tinham sido registrados para a Colômbia. Neste estudo foram analisados nove gêneros sem registro prévio para o país (*Basileunculus*, *Cephalops*, *Cephalosphaera*, *Chalarus*, *Clistoabdominalis*, *Dasydorylas*, *Neocephalosphaera*, *Pipunculus* e *Semicephalops*) mais *Tomosvaryella* que já tinha registro; dentro desses gêneros foram descritas 28 espécies novas e 14 novos registros foram feitos para a Colômbia. Com a adição dos resultados deste estudo, a Colômbia passou de ter registrada uma subfamília, cinco tribos, cinco gêneros e 10 espécies a ter duas subfamílias, três tribos, 14 gêneros e 52 espécies de Pipunculidae conhecidos (Tabela 1). Outro resultado importante é a reformulação das diagnoses dos gêneros estudados, pois alguns espécimes colombianos possuem características que não foram incluídas em suas diagnoses originais. Além disso, as diagnoses e descrições para as espécies conhecidas foram atualizadas, incluindo a descrição mais detalhada dos caracteres das genitálias masculinas. Agora *Tomosvaryella* tem uma chave dicotômica ilustrada para as espécies colombianas, os outros gêneros estudados têm uma chave dicotômica ilustrada e atualizada para a identificação das espécies da região Neotropical, as quais facilitarão que novos estudos com esses grupos sejam realizados e que essa padronização das características diagnósticas e descrições continue sendo utilizada. A informação sobre os habitats e microhabitats de ocorrência das espécies na Colômbia é importante, pois a literatura atual carece de informações sobre o local de coleta dos espécimes estudados até o momento. Além disso, esses dados podem ser usados para planejar estratégias de conservação para algumas áreas de importância ecológica e distribuição de espécies de Pipunculidae em áreas de endemismo.

Tabela 1. Lista de verificação de Pipunculidae da Colômbia. Novos registros são indicados com um asterisco (*), novas espécies já publicadas derivadas desta tese com dois asteriscos (**) e novas espécies ainda não publicadas com três asteriscos (***).

Subfamília	Tribo	Gênero	Espécie	Autor
Chalarinae Hardy, 1965*		*Chalarus* Walker, 1834*	*absonus**	Rafael, 1990
			*boyacensis****	Ramos-Pastrana
			*chairensis****	Ramos-Pastrana
			*connexus**	Rafael, 1988
			*delicatus**	Rafael, 1990
Pipunculinae Walker, 1834	Microcephalopsini Aczél, 1940	*Microcephalops* De Meyer, 1989	*williamsi*	(Hardy, 1954)
	Pipunculini Walker, 1834*	*Cephalops* Fallén, 1810*	*acutus***	Ramos-Pastrana, Marques & Rafael, 2022
			*amapaensis**	Rafael, 1990
			*gracilis***	Ramos-Pastrana, Marques & Rafael, 2022
			*klinsmanni***	Ramos-Pastrana, Marques & Rafael, 2022
			*lobatus***	Ramos-Pastrana, Marques & Rafael, 2022
		Cephalosphaera Enderlein, 1936*	*munchiquensis***	Ramos-Pastrana, Marques & Rafael, 2022
		Neocephalosphaera De Meyer, 1994*	*carinae***	Ramos-Pastrana, Marques & Rafael, 2022
			*grisea***	Ramos-Pastrana, Marques & Rafael, 2022
			*iguaquensis***	Ramos-Pastrana, Marques & Rafael, 2022
			*muisca***	Ramos-Pastrana, Marques & Rafael, 2022
			*paolae***	Ramos-Pastrana, Marques & Rafael, 2022
			*spinifera***	Ramos-Pastrana, Marques & Rafael, 2022
			*spiralis***	Ramos-Pastrana, Marques & Rafael, 2022
			*sumapazensis***	Ramos-Pastrana, Marques & Rafael, 2022

Tabela 1. Continuação

Subfamília	Tribo	Gênero	Espécie	Autor
Pipunculinae Walker, 1834	Tomosvaryellini Hardy, 1943	*Pipunculus* Latreille, 1802*	*caeruleus****	Ramos-Pastrana
			*chiminiguagua***	Ramos-Pastrana
			*planus****	Ramos-Pastrana
		Semicephalops De Meyer, 1994*	*folium***	Ramos-Pastrana, Marques & Rafael, 2022
			*inpaganus**	Rafael, 1990
		Amazunculus Rafael, 1986	*cordigaster*	Galinkin & Rafael, 2008
		Basileunculus Rafael, 1987*	*elieceri***	Ramos-Pastrana, Marques & Rafael, 2022
			*elongatus***	Ramos-Pastrana, Marques & Rafael, 2022
			*rex**	Curran, 1934
			*tayronensis***	Ramos-Pastrana, Marques & Rafael, 2022
		Clistoabdominalis Skevington, 2001*	*lucyae****	Ramos-Pastrana
			*spinitibialis**	(Hardy, 1954)
		Dasydorylas Skevington, 2001*	*colombensis****	Ramos-Pastrana
			*gibbera****	Ramos-Pastrana
			*nigellus**	(Rafael, 1991)
			*santainensis****	Ramos-Pastrana
		Dorylomorpha Aczél, 1939	*reveloi*	Hardy, 1963
		Eudorylas Aczél, 1940	*absonditus*	(Hardy, 1954)
			dumicolus	(Hardy, 1963)
			spinosus	(Hardy, 1948)
			subopacus	(Loew, 1866)

Tabela 1. Continuação

Subfamília	Tribo	Gênero	Espécie	Autor
Pipunculinae Walker, 1834	Tomosvaryellini Hardy, 1943	*Tomosvaryella* Aczél, 1939	*galapagensis**	(Curran, 1934)
			*lynchi**	(Shannon, 1927)
			*macarenensis***	Ramos-Pastrana & Rafael, 2021
			*martae***	Ramos-Pastrana & Rafael, 2021
			*mexicanensis**	Ale-Rocha & Rafael, 1995
			prostata	Hardy, 1963
			scopulata	Hardy, 1963
			*similis**	Ale-Rocha & Rafael, 1995
			subvirescens	(Loew, 1872)
			*tuberculata**	Ale-Rocha & Rafael, 1995
			*venezuelana**	Ale-Rocha & Rafael, 1995