Docosia adusta sp. nov. (Diptera: Mycetophilidae) from the Colombian Andes: a Holarctic element in northwestern South America

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Abstract—A third Neotropical species of the genus *Docosia* Winnertz is described from the Colombian Andes. Three males and four females of *D. adusta* **sp. nov.** from Cundinamarca, Colombia, collected at 3600 m elevation were examined. Detailed illustrations of the male and female terminalia are presented and morphological differences in relation to those of other species of the genus are discussed. The relationships between Holarctic and Neotropical species within *Docosia* are discussed and overlap of circumantarctic, tropical, and Nearctic elements in the northern Andes is considered.

Résumé—Nous décrivons une troisième espèce néotropicale du genre *Docosia* Winnertz des Andes de Colombie à l'examen de trois mâles et quatre femelles de *D. adusta* **sp. nov.** de Cundinamarca, Colombie, récoltés à 3600 m. Nous présentons des illustrations détaillées des derniers segments abdominaux du mâle et de la femelle et discutons des différences morphologiques avec les autres espèces du genre. Nous traitons des relations entre les espèces holarctiques et néotropicales au sein de *Docosia*, en particulier du chevauchement des éléments circumantarctiques, tropicaux et néarctiques dans le nord des Andes.

[Traduit par la Rédaction]

Introduction

Fungus gnats are one of the most species-rich dipteran families, Mycetophilidae (Diptera), in the Neotropical Region. Although the monophyly of Mycetophilidae is a consensus (Søli 1997; Amorim and Rindal 2007; Rindal *et al*. 2009), a robust phylogeny of this family is still wanting. Seven subfamilies are recognized for Mycetophilidae s.s.: Sciophilinae, Gnoristinae, Mycomyinae, Leiinae, Manotinae, Allactoneurinae, and Mycetophilinae (*e.g*., Väisänen 1984; Matile 1989; Rindal *et al.* 2009). However, the monophyly of Sciophilinae, Gnoristinae, and Leiinae is still questionable. Subfamilial rank has been given to the tribe Metanepsiini (Väisänen 1984; Ševčík and Hippa 2010) of Gnoristinae, but this clade would almost certainly make the rest of Gnoristinae paraphyletic (Kallweit 1998).

The present diversity of Leiinae comprises 32 recent genera and almost 550 recent species worldwide. Leiinae are well represented in the fossil record (Evenhuis 1994; Blagoderov and Grimaldi 2004), with 54 species. Particularly noteworthy are 8 genera currently assigned to Leiinae in Cretaceous amber (some of these genera may belong elsewhere). The recurrent discussion about the monophyly of Leiinae (*e.g*., Søli *et al*. 2000; Hippa *et al*. 2005; Jaschhof and Kallweit 2009; Rindal *et al.* 2009) reflects the problems in establishing subfamily limits. Two characters (short R_1 and longitudinal r-m) were used by Edwards (1925) to define Leiinae. These features are indeed met by most leiine genera, but there are

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a number of exceptions (Jaschhof and Kallweit 2009). The sinuous vein CuA has more recently been considered a synapomorphy for Leiinae (Baxter and Poinar 1994; Jaschhof and Kallweit 2009), but this actually delimits only a smaller clade, without solving the problem of placing various genera in this clade or Gnoristinae.

Docosia Winnertz is a distinctive genus, possibly close to *Tetragoneura* Winnertz (Edwards 1925). Väisänen (1986) suggested that *Tetragoneura* plus *Ectrepesthoneura* Enderlein should be treated as gnoristines. *Docosia* has CuA more or less straight and, even considering that this condition is plesiomophic, it could fit together with *Tetragoneura* (whatever its placement). Some other features could suggest the placement of the genus in Leiinae, but molecular analysis (Rindal *et al.* 2009) suggests that *Docosia* should be assigned to Gnoristinae.

Docosia presently comprises 65 described extant species worldwide of which 46 are Palaearctic (*e.g.*, Chandler *et al.* 2006; Kurina 2006, 2008; Laštovka and Ševčík 2006; Ševčík 2006*b*; Ševčík and Laštovka 2008; Xu *et al.* 2003), 16 are Nearctic (*e.g.*, Garrett 1925; Van Duzee 1928), 1 is Oriental (Ševčík 2010), and 2 are Neotropical (Edwards 1933). Information on the biology of *Docosia* has been provided mainly through the contributions of Chandler (2010), Ševčík (2006*a*), and Rulik and Kallweit (2006).

In this paper we describe a new Neotropical species of *Docosia* from Colombia and compare features shared by this species with the remaining species of the genus. Comments are made on the implications of the relationship of this species with other species of the genus for understanding the biogeography of the Neotropical Region.

Material and methods

The specimens examined in this study belong to the Diptera collection of the Instituto de Investigación de Recursos Biológicos Alexander von Humboldt (IAvH), Bogotá, Colombia. The holotype and some of the paratypes are deposited in IAvH. One male and one female paratype have been placed in the Diptera collection of the Museu de Zoologia da Universidade de São Paulo (MZUSP).

Head, thorax, wing, and terminalia were drawn after dissection. Soft parts were cleared in 10% KOH at 40 °C for 4–6 h, neutralized in acetic acid, and mounted on permanent slides with Canada balsam. Some specimens were mounted temporarily in glycerin or in jelly with phenol (modified from Zandler 2003) on depression slides. Photographs were taken using a Leica DC camera attached to a Leica MZ16 stereomicroscope and a DM2500 transmission microscope. Photographs were prepared using AutoMontage software and edited with Adobe Photoshop CS. Drawings were prepared using a *camera lucida* and redrawn using Adobe Illustrator 11.0. Morphological terms follow Søli (1997), except for wing venation, which follows Amorim and Rindal (2007).

Docosia Winnertz

Docosia Winnertz, 1863: 802.

Type species: *Mycetophila sciarina* Meigen (Johannsen 1909: 92).

Diagnosis

Three ocelli, lateral ones close to eye margin. Sc ending free or in R; R_1 obviously longer than r-m; point of furcation of M very basal in the wing, r-m nearly horizontal, M_{1+2} shorter than r-m. Wing may be darkened, but without markings and without macrotrichia on the membrane. Male cerci with combs of blackish spines. Long apical setae on T9.

Docosia adusta sp. nov.

(Figs. 1–7)

Diagnosis

Lateral ocelli not touching eye margin. Laterotergite with a group of 9–12 setae of different lengths on posterior third. Legs and halteres dark. Wing membrane brownish, mainly along anterior margin; Sc without macrotrichia; strong medial and cubital

Fig. 1. *Docosia adusta*. Female paratype, habitus. Scale bar = 1 mm.

veins. Gonocoxite setose fused to each other ventrally, with a pair of distal mesal extensions, gonocoxal bridge well produced; gonostylus simple, short, with a single apical long seta and 2 small subapical setae; T9 more or less rectangular, longer than wide.

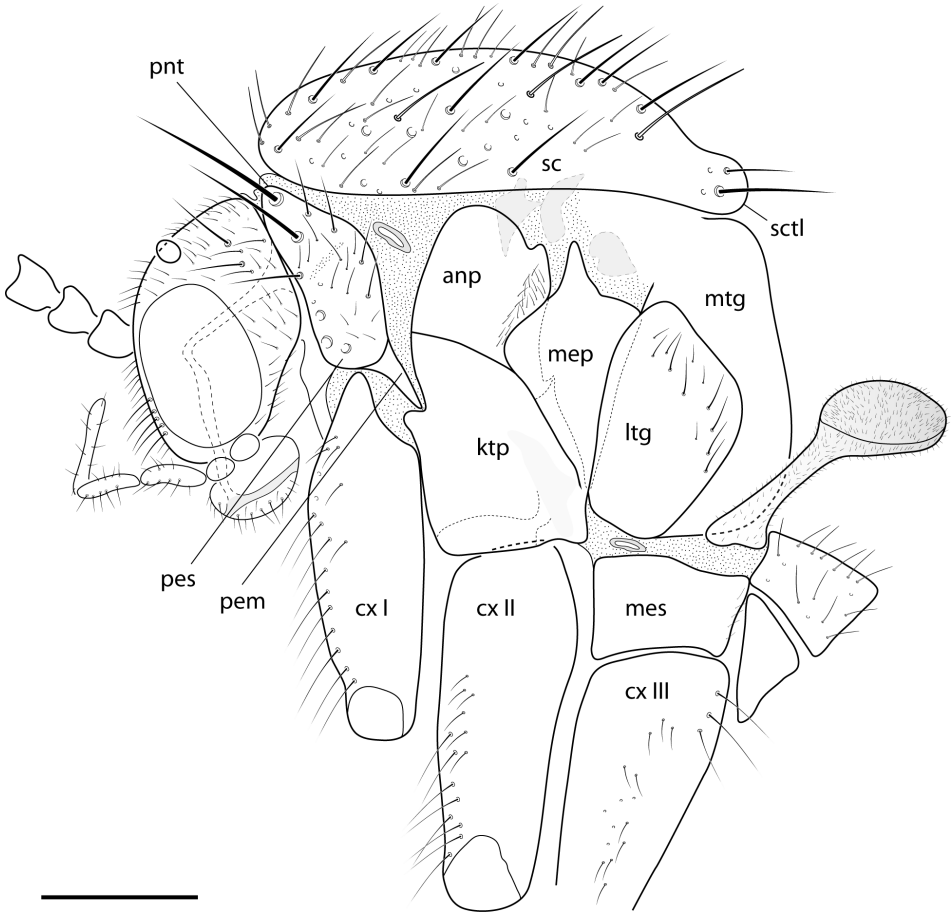
Material examined

Holotype ♂: labelled "COLOMBIA, Cundinamarca, PNN [Parque Nacional Natural] Chingaza Alto de La Bandera, Malaise trap, 04°31′N, 73°45′W, 3,600 m, 15.xi–01.xii.2001, L. Cifluentes leg., M. 2600 [Malaise trap # 2600]". **Paratypes**: 2 ♂, 4 ♀, same data as holotype.

Description

Male (Figs. 2, 4–6). Wing length 4.1 mm, wing width 1.7 mm. ***Head*** (Fig. 2). Vertex dark brown, with scattered setae. Three ocelli approximately aligned, mid-ocellus smaller than lateral ones, lateral ocelli separated from mid-ocellus by about 2.0 times its width and from eye margin by about its own diameter. Occiput dark brown. Eyes setose. Antennal scape and pedicel quite short, brown, with longer setae dorsally along distal margin; 14 brown flagellomeres, first slightly longer than second, flagellomeres 2–14 same length, almost 1.5 times longer than wide, with scattered setae and a short basal neck. Frons and clypeus brown, covered with short setae; labella light brown, proximal article brown; maxillary palpus brownish, lighter towards apex, five palpomeres, first and second palpomere rounded, apical ones increasingly longer, fourth as long as third, last palpomere 1.5 times penultimate one. ***Thorax*** (Fig. 2). Scutum, scutellum, and pleural sclerites dark brown. Pleural membrane brown. Scutum moderately arched, covered with small scattered setae and stronger supra-alar, dorsocentral, and acrostichal setae. Scutellum with eight scutellar bristles, four of them twice length of remaining four, plus many additional setulae. Pronotum with 2 strong setae and some additional setae. Anespisternum with many setulae along posterior margin, katepisternum more or less square ventrally. Mesepimeron not reaching ventral margin of thorax, bare. Laterotergite only slightly projecting, with a group of 9–12 setae of different lengths on posterior third. Mediotergite slightly curved in profile, bare. Metepisternum with five setulae posteriorly. Haltere pedicel brownish, knob light brown, setulae on pedicel, knob more densely setulose. Legs brown. First tarsomere more than twice length of second tarsomere; mid and hind tibiae with long erect darker bristles, in midtibia dorsally and ventrally, in hind tibia more conspicuously dorsally. Tibial spurs 1:2:2, brown, almost 3 times tibial width at apex, internal spurs shorter. Tarsal claws with small basal tooth. ***Wing.*** Membrane homogeneously light brown, darker along anterior margin; membrane densely covered with microtrichia in all cells. R_1, R_5, and r-m with macrotrichia dorsally and ventrally; M_1, M_2, M_4, CuA, and A_1 with macrotrichia only dorsally. Sc short, ending free, vanishing to apex, without macrotrichia. C ending much before wing apex, extending about one-sixth of distance between R_5 and M_1. First sector of Rs perfectly transverse, devoid of macrotrichia. R_1 long, reaching C on apical third of wing; R_5 short, reaching C quite before wing apex, well sclerotized, slightly sinuous at apex; r-m almost perfectly longitudinal, slightly

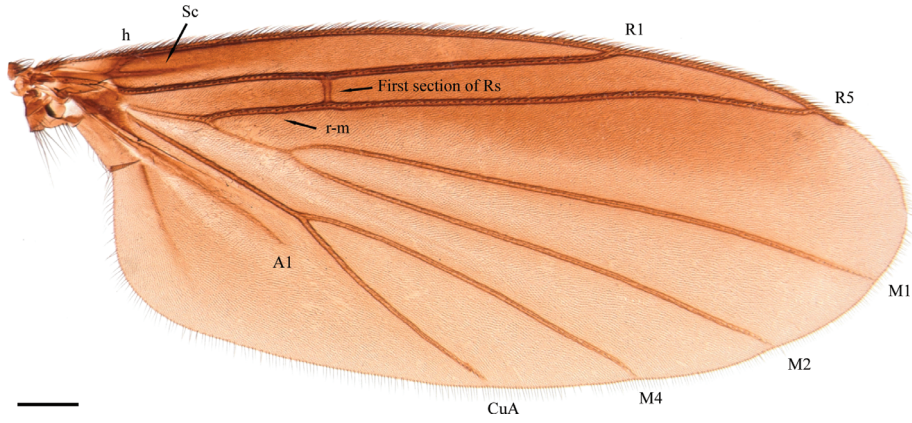
Fig. 2. *Docosia adusta*. Male paratype, thorax, lateral view (anp, anepisternum; *cx I*, fore coxa; *cx II*, midcoxa; *cx III*, hind coxa; *ktp*, katepisternum; *ltg*, laterotergite; *mes*, metepisternum; *mep*, mesepimeron; *mtg*, mediotergite; *pem*, proepimeron; *pes*, proepisternum; *pnt*, pronotum; *sctl*, scutellum). Scale bar = 0.3 mm.



curved at basal end, well sclerotized, more than 4 times length of r-m. M_{1+2} short, bare, strongly displaced to wing base; medial fork complete, 7 times length of M_{1+2}, M_1 and M_2 only slightly divergent towards apex; M_4 basally well produced, distally reaching wing margin, M_4 and CuA only slightly divergent along their length; first sector of CuA slightly shorter than second sector of CuA. A_1 incomplete, not produced on apical half. ***Abdomen.*** Abdomen brown, setose, lateral margins of tergites and sternites with slender, less sclerotized band. T8 short and wide, S8 longer than wide. Terminalia brown, conspicuous, not particularly elongate. ***Terminalia*** (Figs. 4–6). Gonocoxite setose, elongate, fused to each other ventrally, with a pair of distal mesal extensions, gonocoxal bridge well produced; gonostylus short, simple, elongate, slightly curved mesally, with single long apical seta and 2 subapical setae on rounded apex; aedeagus distinctively sclerotized, filiform, trifid basally; T9 more or less rectangular, longer than wide, setose, with four pairs of longer, curved setae on distal margin; cercus very developed, with two rings of distinctively sclerotized spines.

Female (Figs. 1, 3, 7). As in male, except for following features. ***Wing*** (Fig. 3). Length 4.4 mm, width 1.7 mm. ***Head*** (Fig. 1). Antennal flagellomeres not as elongate as in male, flagellomeres closer to each other. ***Terminalia***

Fig. 3. *Docosia adusta*. Female paratype, wing. Scale bar = 0.3 mm.



(Fig. 7). Yellowish. S8 weakly sclerotized, with mesal distal projection covered with scattered microtrichia; T8 wide, very short mesally, setae only at lateral margins; S9 (genital fork) weakly sclerotized, wide at anterior end; T9 almost divided in two separate lateral sclerites, with some long setae along distal margin; Ce1 weakly sclerotized, mostly covered by T9, Ce2 more or less cylindrical, weakly sclerotized, devoid of microtrichia, 1 longer seta and 1 shorter seta on basal third and 2 longer subapical setae (one dorsal and one ventral), besides 1–2 additional short setae.

Etymology

The species epithet is feminine, derived from the Latin *adustus*, for "brown", and referring to the brown wing membrane (especially along the anterior margin) and the general body color.

Comments

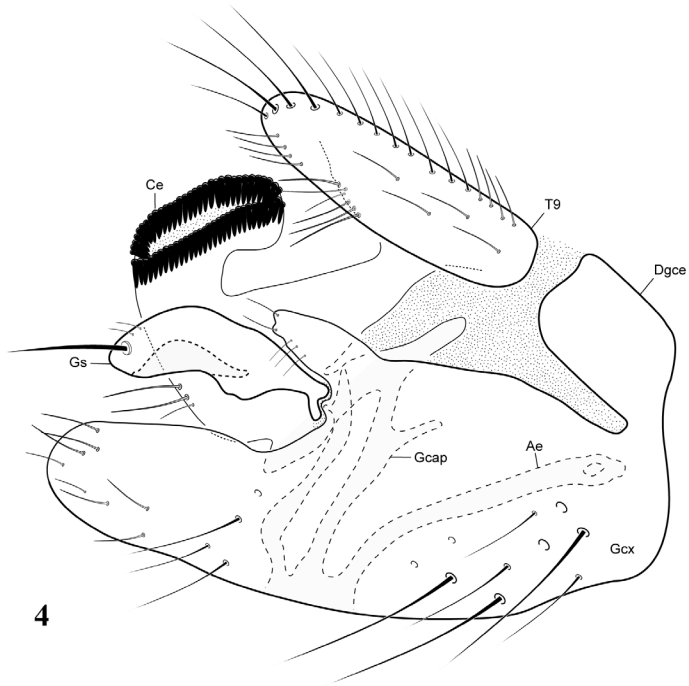
The males of this species have the terminalia rotated to some degree. Edwards (1941: 71) considered that the pair of dorsal sclerites in the male terminalia of *Docosia gilvipes* (Walker) correspond to T9 divided into two separate plates by a transverse suture. This actually does not seem to be the case in *D. adusta* sp. nov. The basal sclerites are entirely bare and clearly correspond to the dorsal fusion of lateral extensions of the gonocoxites, resulting in a complete ring anteriorly in the terminalia. This feature is also present in most other species of the *gilvipes* group (*e.g.*, *D. pseudogilvipes* Kurina (Kurina 2008, fig. 11)). In the female terminalia the shape of sternite 8 is unusual in relation to that of other genera of Mycetophilidae, in the sense that this sclerite has a single median distal extension, ending acuminate. This is also seen in other species of the genus, like *D. gilvipes* (Laštovka and Ševčík 2006, fig. 17b). Tergite 9 also has a deep incision distally, which almost divides the plate into two separate lateral sclerites. A single conspicuous cercomere is visible, but this is actually Ce2, the basal cercomere being weakly sclerotized and partially covered by T9.

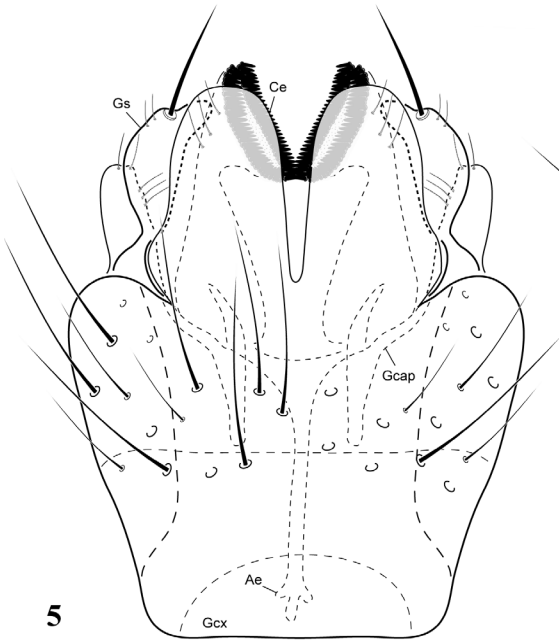
Discussion

Docosia adusta is different from the two other Neotropical species of the genus, *D. pammela* Edwards and *D. cuzcoensis* Edwards, in many respects. The other Neotropical species are small (3 mm long), entirely black, and with the posterior wing veins weakly sclerotized; *D. adusta* is much larger, dark brown, and with a darkened wing membrane.

A detailed study of the relationships within *Docosia* is outside the scope of this paper. Nevertheless, it is obvious that *D. adusta* is not directly connected with the two known Neotropical species. The features shared by *D. adusta*, *D. pammela*, and *D. cuzcoensis* are

Figs. 4–6. *Docosia adusta*. Male paratype, terminalia. 4, Lateral view; 5, ventral view, without tergite 9; 6, tergite 9, dorsal view (Ae, aedeagus; Ce, cercus; Dgce, dorsal extension of gonocoxite; Gcap, gonocoxal apodeme; Gcx, gonocoxite; Gs, gonostyle; T, tergite). Scale bar = 0.1 mm.





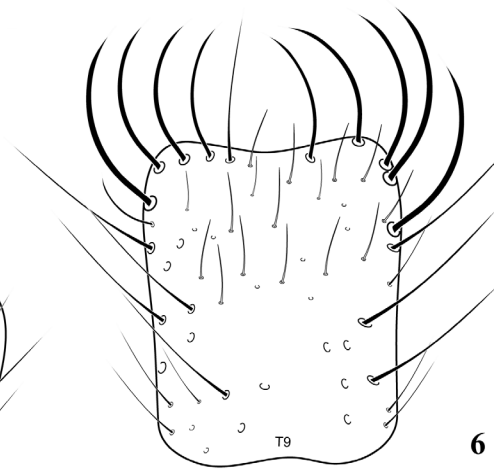
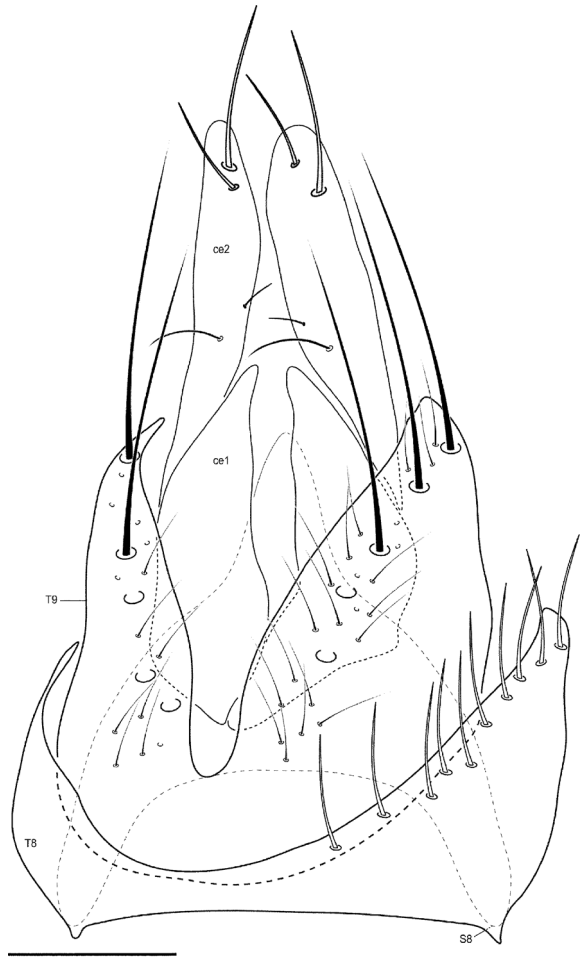


Fig. 7. *Docosia adusta*. Female paratype, terminalia, laterodorsal view (ce, cercus; S, sternite; T, tergite). Scale bar = 0.1 mm.



of wider distribution in *Docosia* and do not correspond to shared exclusive apomorphies. This includes Sc ending free, anespisternum setose, gonocoxites connected to each other dorsally, aedeagus filiform, T9 with some stronger setae along the distal margin, and cerci with rows of black spines.

Docosia adusta seems to be more closely related to the Palaearctic species *D. gilvipes* and *D. pseudogilvipes*, the morphology of whose male terminalia was carefully described and illustrated by Kurina (2008). A close relationship is suggested by the shape of the cercus with two pairs of rather long rows of spines, the more or less simplified gonostyle, and the distal extension of the syngonocoxite ventrally. From this perspective, *D. adusta* is considerably different from *D. carbonaria* Edwards, *D. cephaloniae* Chandler *et al*., *D. chandleri* Ševčík and Laštovka, *D. enos* Chandler, Bechev, and Caspers, *D. expectata* Laštovka and Ševčík, *D. flavicoxa* Strobl, *D. fumosa* Edwards, *D. fuscipes* (von Roser), *D. helveola* Chandler, and *D. lastovkai* Chandler. Laštovka and Ševčík (2006) and Kurina (2008) suggested that *D. gilvipes* could have an isolated position within the genus and could be placed in a separate subgenus or genus (along with *D. pseudogilvipes* (Kurina 2008)). Some undescribed Nearctic species of *Docosia* also belong to this group (J. Ševčík, personal communication).

With reference to a revision of the Palaearctic species of *Docosia*, Petr Laštovka has commented that relationships within the Nearctic portion of the genus are complex (P.J. Chandler, personal communication). He recognized about 50 species with "interesting phyletic relations" and that there are Nearctic species from the *gilvipes* group "more numerous than those with Sc bare and ending in R_1 (apart from distinct features of terminalia)".

Independently of the question of the rank of this clade (species group, genus, or subgenus), if the association of *D. adusta* with this Holarctic group of species within the genus is correct, the presence of this species in Colombia corresponds to a secondary extension of a Nearctic clade to the south, reaching northeastern South America. This pattern is actually not restricted to *Docosia* within the Mycetophilidae. Two undescribed species of *Cordyla* Meigen (Mycetophilidae: Mycetophilinae) show this pattern as well, one reported from Costa Rica (Vockeroth 2009), the other reaching Colombia (Oliveira *et al*. 2007).

The overlap of different biogeographic elements in Colombia is actually even more complex. Besides the presence of elements of Nearctic origin higher in the Andes, close to localities with elements of tropical origin in the Neotropical Region, areas of higher altitude in Colombia also have a number of typical circum-antarctic elements, such as species of *Neoaphelomera* Miller, *Allocotocera* Mik, *Parvicellula* Marshall, *Austrosynapha* Tonnoir, *Paraleia* Tonnoir, and *Procycloneura* Edwards (Oliveira *et al*. 2007). Further studies of the diversity of *Docosia* and its phylogenetic connections would contribute to a better understanding of the biogeographic history of the genus and, hence, the biogeographic evolution of the region.

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