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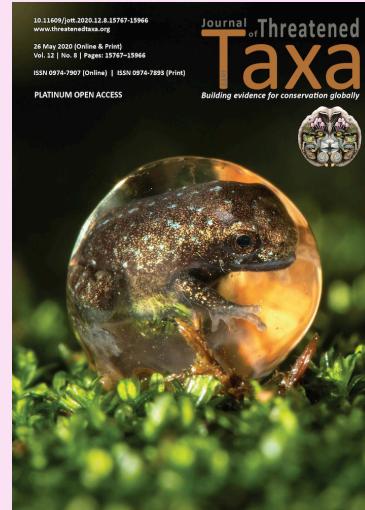
## COMMUNICATION

### DIVERSITY AND SYNANTHROPY OF FLIES (DIPTERA: CALYPTRATAE) FROM ECUADOR, WITH NEW RECORDS FOR THE COUNTRY

Karen Blacio, Jonathan Liria & Ana Soto-Vivas

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## Diversity and synanthropy of flies (Diptera: Calyptratae) from Ecuador, with new records for the country

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**Abstract:** The Calyptratae are one of the most diverse groups of Diptera. Some species have immature states involved in the decomposition of organic matter of animal origin (i.e., they are sarcosaprophagous). In this study, we examined the diversity and synanthropy of sarcosaprophagous calyprates in several environmental zones of the Ecuadorian Andes. Captures were performed in an urban zone located in the Tocachi community with monocultures (MC) and polycultures (PC), a rural zone with an agroecological farming system (AFS), and a forest zone with a montane forest located in the Parque Arqueológico Cochasquí (PAC) and the Cochasquí montane forest (CMF). A total of 2,925 specimens of Calyptratae were collected, representing 38 morphotypes and 17 species. Four are new reports for Ecuador: *Dolichophaonia trigona* (Shannon & Del Ponte), *Phaonia trispila* (Bigot), *Compsomyiops melloi* Dear, and *Calliphora lopesi* Mello. CMF and PAC presented high abundance and richness, followed by AFS, MC, and PC; PAC showed the highest diversity, in contrast to lowest in MC; the evenness decreased from forest to urban zones. Species that exhibited a preference for human settlements (positive synanthropic index) included *Limnophora marginata* Stein, *Phaonia trispila*, *Lucilia cuprina* (Wiedemann), *Calliphora lopesi*, *Compsomyiops melloi*, and *Calliphora nigribasis* Macquart. Those with a preference for uninhabited areas (negative index) included *Tricharaea* sp1, *Sarconesiopsis magellanica* (Le Guillou), and *Sarconesiopsis chlorogaster* (Wiedemann).

**Keywords:** Blow flies, Calliphoridae, flesh flies, Muscidae, Sarcophagidae.

**Resumen:** Calyptratae es uno de los grupos más diverso de Diptera. Algunas larvas están implicados en la descomposición de la materia orgánica de origen animal (es decir, son sarcosaprófagas). En este estudio, examinamos la diversidad y la sinantropía de los calipratos sarcosaprófagos en varios ambientes de los Andes ecuatorianos. Las capturas se realizaron en una zona urbana ubicada en la comunidad de Tocachi, en áreas de monocultivos (MC) y policultivos (PC), una zona rural con un sistema de agricultura agroecológica (AFS) y una zona forestal con un bosque montano ubicado en el Parque Arqueológico Cochasquí (PA) y el bosque montano de Cochasquí (CMF). Se recolectaron un total de 2.925 especímenes de Calyptratae, que representan 38 morfotipos y 17 especies. Cuatro son nuevos reportes para Ecuador: *Dolichophaonia trigona* (Shannon y Del Ponte), *Phaonia trispila* (Bigot), *Compsomyiops melloi* Dear y *Calliphora lopesi* Mello. CMF y PAC presentaron alta abundancia y riqueza, seguidos de AFS, MC y PC; PAC mostró la mayor diversidad, en contraste con la más baja en MC; la equidad disminuyó de bosque a zonas urbanas. Las especies que mostraron preferencia por los asentamientos humanos (índice sinantrópico positivo) fueron *Limnophora marginata* Stein, *Phaonia trispila*, *Lucilia cuprina* (Wiedemann), *Calliphora lopesi*, *Compsomyiops melloi* y *Calliphora nigribasis* Macquart. Aquellas con preferencia por áreas deshabitadas (índice negativo) incluyeron *Tricharaea* sp1, *Sarconesiopsis magellanica* (Le Guillou) y *Sarconesiopsis chlorogaster* (Wiedemann).

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**Author contribution:** KB and ASV conducted the Diptera identification and wrote the first manuscript draft. KB and ASV conducted the specimens collections. ASV and JL wrote the final manuscript. ASV prepared the specimen photographs. All authors elaborated the data analysis.

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## INTRODUCTION

The highly diverse Dipteran infraorder Calyptratae has members that widely distributed through most biogeographic regions (Wiegmann et al. 2011; Lambkin et al. 2013). These insects are characterized by a high capacity for decomposing organic matter, where their larvae play an important role in nutrient recycling (Byrd & Castner 2001; Kimberly et al. 2005). Some species are important as disease vectors and feature in medico-legal investigations (Catts & Mullen 2002; Benecke et al. 2004; Magaña et al. 2006). Several Calyptratae are well adapted to human-perturbed habitats, forming an anthropo-biocenosis (Polvoný 1971). This taxon is highly specialized in some feeding habits: Saprofagous, coprophagous, necrophagous, hematophagous and pollen feeders (Hernández & Dzul 2008).

In Ecuador, calyptate species have been recorded in Muscidae (77 species), Calliphoridae (23 species), Sarcophagidae (18 species), and Fanniidae (4 species) (Löwenberg-Neto & Carvalho 2013; Whitworth 2014; Salazar & Donoso 2015). Ecological investigations in sarcosaprophagous dipterans are scarce. Torres (2016) studied blowfly diversity in different types of human-modified and wild environments, and noted that diversity decreased and species dominance increased in human environments (urban and rural), in contrast to wild habitats.

This study aimed to describe the diversity and synanthropy in Calyptratae from a protected forest in the Archaeological Cochasquí Park, and in human environments in the Tocachi parish, Pedro Moncayo canton. This investigation was authorized with permission Nº 007-2018-RIC-FLO-FAU-DPAP-MA and collection Nº 007-2019-DPAP-MA.

## MATERIAL AND METHODS

### Study area

The study was undertaken in the Pedro Moncayo canton, north-west of Pichincha province, on the southern slope of Nudo de Mojanda. The total area comprises 339.10km<sup>2</sup> with four life zones in the High Andino zoogeographic level (1,730–2,952 m): lower montane dry forest, montane moist forest, lower montane moist forest, and montane wet forest (Albuja et al. 1980; PDOT 2015). In this area, three types of environment (urban, rural, and forest) were identified: (i) urban zone located in the Tocachi community (-0.0352S & 78.282W), characterized by basic services, with

paved streets, a school area, a housing yard consisting of monocultures (MC) and polycultures (PC); (ii) rural zone located 1km away from the community (-0.048S & 78.290W), characterized by a small human population (< 30 permanent inhabitants) without basic services in an agro-ecological farming system (AFS); (iii) forest zone corresponding to low human disturbance, with a lower montane forest located in the Parque Arqueológico Cochasquí (PAC) (-0.059S & 78.304W) and the Cochasquí montane forest (CMF) (-0.058S & 78.304W).

### Sampling

Flies were captured with Morón & Terrón (1984) modified necrotraps made of two transparent plastic soup containers, with an internal funnel formed from a foam container. Traps were baited with fish viscera and beef, placed 1m above the ground (Uribe-M et al. 2010; Moreno et al. 2016); 100 traps separated by 30m each following transects in each site (MC, PC, AFS, PAC and CMF) for a period of 48 hours each month from May to November 2017. Trapped specimens were separated into morphotypes, mounted and identified using taxonomic keys (Mc Alpine et al. 1981; Carvalho 2002; Toro 2007; Amat et al. 2008; Carvalho & Mello 2008; Buenaventura et al. 2009; Marshall et al. 2011; Vairo et al. 2011; Patitucci et al. 2013a).

### Data analysis

We evaluated the local diversity using Hill numbers (Hill 1973; Moreno 2001) for site diversity estimation ( $N_0 = S$ ,  $N_1 = e^{-H'}$  and  $N_2 = 1 / \lambda$ ; where  $S$  corresponds to species richness,  $H'$  Shannon-Wiener index and  $\lambda$  Simpson index); for evenness the  $E_{2,1}$  Alatalo index (Heip et al. 1998) was calculated using the formula:  $N_1 - 1 / N_2 - 1$ . The diversity between sites was evaluated using the Jaccard (quantitative) similarity index. All analyses were made using PAST (Hammer et al. 2001) and EstimateS (Colwell 2019) software.

The synanthropic index (SI) was calculated according to Nuorteva (1963):  $SI = (2a+b-2c)/2$ , where "a" corresponds to the percentage of individuals of each species collected in the urban zone, "b" the percentage of the same species collected in the rural zone, and "c" the percentage of the same species collected in the forest zone. The SI fluctuates between +100 to -100, where a value of +100 indicates a strong species preference for densely populated urban areas, -100 indicates a complete avoidance of human settlements and intermediate values indicate differential degrees of synanthropy. For this analysis, only those species with 10 or more individuals were considered.

## RESULTS

A total of 2,925 specimens of Calyptratae were collected, representing 38 morphotypes and 17 species; four of these are new reports for Ecuador (Table 1). Muscidae and Sarcophagidae representing 39.6% and 24.7% abundance, respectively. In Muscidae, the most common taxa were *Limnophora marginata* Stein, 1904, followed by *Phaonia trispila* (Bigot, 1885), *Dolichophaonia trigona* (Shannon & Del Ponte, 1926), *Phaonia* sp1, and *Dolichophaonia* sp1. Sarcophagidae was commonly represented by *Tricharea* sp1 and *Peckia* (*Sarcodexia*) sp1. In Calliphoridae, the most abundant species were: *Sarconesiopsis magellanica* (Le Guillou, 1842), *Calliphora nigribasis* Macquart, 1851, and *Lucilia cuprina* (Wiedemann, 1830). Finally, Tachinidae comprises a high number of morphotypes (25) and two species: *Eulasiopalpus* nr. *niveus* Townsend, 1914 and *Eulasiopalpus* nr. *vittatus* Curran, 1947.

Concerning the abundance and species composition between sites, CMF and PAC presented high abundance and richness, followed by AFS, MC, and PC. The PAC presented the highest  $N_1$  and  $N_2$  Hill diversity index, in contrast to MC which showed the lowest; PC presented intermediate diversity values. On the other hand, evenness  $F_{2,1}$  index decreased from forest to urban sites: PAC-CMF > AFS > PC > MC. Figure 1 shows the dendrogram based on Jaccard index similarity; PAC is separated from the other sites, and CMF and AFS form a cluster separated from the crops group (MC and PC).

The synanthropic index was calculated for the most

common species (10 individuals or more). In this study, the species and morphotypes that exhibited positive synanthropic index values were (Table 2): *Limnophora marginata* Stein, 1904 (+86.62) showing strong preference for human settlements, *Peckia* (*Sarcodexia*) sp1 (+8.60), *Phaonia trispila* (+6.24), *Lucilia cuprina* (Wiedemann, 1830) (+5.48), *Calliphora lopesi* Mello, 1962 and *Compsomyiops melloi* Dear, 1985 with (+2.98), and *Calliphora nigribasis* (+2.57), all with a preference for human settlements. The values for the other species and morphotypes were negative (showing preference for uninhabited areas): *Fannidae* sp1 (-40.89), *Tricharaea* sp1 (-14.94), *Sarconesiopsis magellanica* (-5.55), Scatophagidae sp1 (-3.12), *Sarconesia chlorogaster* (Wiedemann, 1831) (-1.75), Sarcophagidae sp1 (-1.36), and *Boettcheria* sp1 (-0.11).

The list of new records with diagnostic characters and distribution is given below:

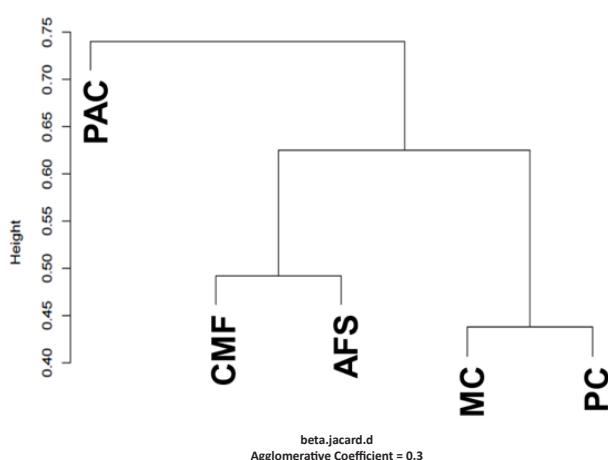
### Family Calliphoridae

#### Subfamily Calliphorinae

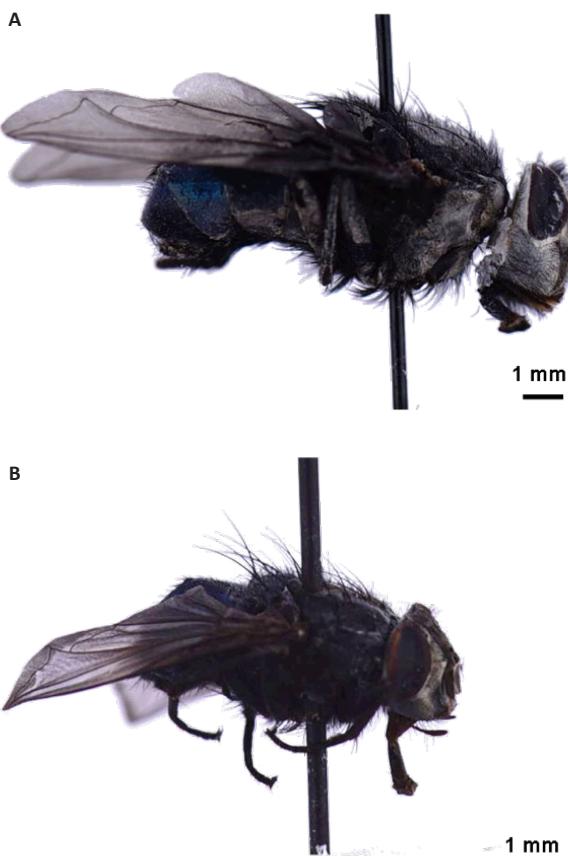
##### *Calliphora lopesi* Mello, 1962 (Image 1A)

This species of *Calliphora* can be distinguished by its bare stem vein, lower calypter setose above, bare suprasquamal ridge, thorax dull grey with whitish microtomentum, and abdomen subshining metallic blue with more or less whitish microtomentum. Other characters include a robust orange palpus with stout black setae; parafacial black to brown, lower half sometimes reddish to orange; parafacial with one or two changeable spots in both sexes, females also with a changeable spot midway on fronto-orbital plate when viewed from above; gena usually brown or black, genal groove black in *C. nigribasis*. Thorax with typical chaetotaxy; normally two postsutural intra-alars. Base of wing infuscated along costa to apex of costal cell, angling back to anterior edge of basal medial and posterior cubital cells, intensity and extent of area with color somewhat variable; and fringe of lower calypter normally brown *C. nigribasis*, rim and fringe are usually white or pale in the remaining four in *C. lopesi*.

Diagnostic characters: Differ from *C. nigribasis* by the reddish genal groove (black in *C. nigribasis*); rim and fringe of lower calypter white (dark reddish-brown in *C. nigribasis*); male frons narrower (related to head width), averaging 0.066 (0.06–0.07/5) (whereas averaging 0.102 (0.09–0.12/5) in *C. nigribasis*); male surstyli and cercus slender (whereas shorter and more stout in *C. nigribasis*); ST5 normal (exceptionally broad in *C. nigribasis*); female T5 without incision (T5 with incision in *C. nigribasis*) (Whitworth & Rognes, 2012).



**Figure 1.** Dendrogram based on the Jaccard coefficient index showing the similarity in the composition of Calyptratae species in the sites sampled. Parque Arqueológico Cochásquí (PAC), Cochásquí montane forest (CMF), agroecological farming system (AFS), polyculture (PC), and monoculture (MC).



**Image 1.** Lateral views of Calliphoridae new records species collected at Pedro Moncayo canton in the Pichincha province: A—*Calliphora lopesi* | B—*Compsomyiops melloi*. © Yesenia Tovar & Ana Soto-Vivas

Material examined: MECN-EN-DIP-4862, 17.xi.2017, 1 female, polyculture in urban zone located in the Tocachi community, Pichincha, -0.035S & 78.282W, 2,816m, coll.

Blacio & Soto-Vivas.

Distribution (Whitworth & Rognes 2012; Kosmann et al. 2013): Brazil, Uruguay.

#### Subfamily Chrysomyinae

##### *Compsomyiops melloi* Dear, 1985 (Image 1B)

*Compsomyiops* species can be distinguished by the haired parafacials, pubescent greater ampulla and normal sized palpi (Dear 1985).

Diagnostic characters: Differs from *C. fulvicrura* (Robineau-Desvoidy, 1830) frons 0.40 of the head width; frontal vitta broader than a fronto-orbital plate measured at lunula; parafacial hairs dark and proclinate; genae silvery-yellow dusted anteriorly; frontal vitta orange-brown dusted; calypters pale brown (Dear 1985).

Material examined: MECN-EN-DIP-4861, MECN-EN-DIP-4865, MECN-EN-DIP-4866, MECN-EN-DIP-4867, MECN-EN-DIP-4868, 22.x.2017, 5 females, polyculture in

urban zone located in the Tocachi community, Pichincha, -0.035S & 78.282W, 2,816m, coll. Blacio & Soto-Vivas.

Distribution (Dear 1985; Amat 2009; Kosmann et al. 2013): Colombia, Mexico.

#### Family Muscidae

##### Subfamily Phaoniinae

##### *Dolichophaonia trigona* (Shannon & Del Ponte, 1926) (Image 2A)

*Dolichophaonia* species are characterized by eye with short cilia, arista plumose, presutural acrostichals often differentiated, dorsocentral setae 2:3-4, prealar present, except in *D. vockerothi* (Carvalho, 1983), shorter than notopleural anterior seta, katepisternals 1:2, meron haired or not; wing veins bare, vein M parallel or very slightly forward-curved apically, calcar present, about twice as long as the basal width of hind tibia; female: clypeus, in lateral view, with a strong, hook-shaped anterior tip, posteriorly with a prominent sclerotization, ovipositor with large tergites and sternites (Carvalho & Couri 2002).

Diagnostic characters: One prepimeral setae development; mid tibia often with 2 median posterior setae; female palpus more dilated than in male; sternite 1 bare; pre-alar present, shorter than noto-pleural anterior seta; two intra-alars post-sutural setae; wing with two conspicuous clouds on cross-veins dm-cu; upper calypter yellowish with dark brown margins; wing with costal margin yellowish; dorso-central setae 2:3-4 (Carvalho & Couri 2002).

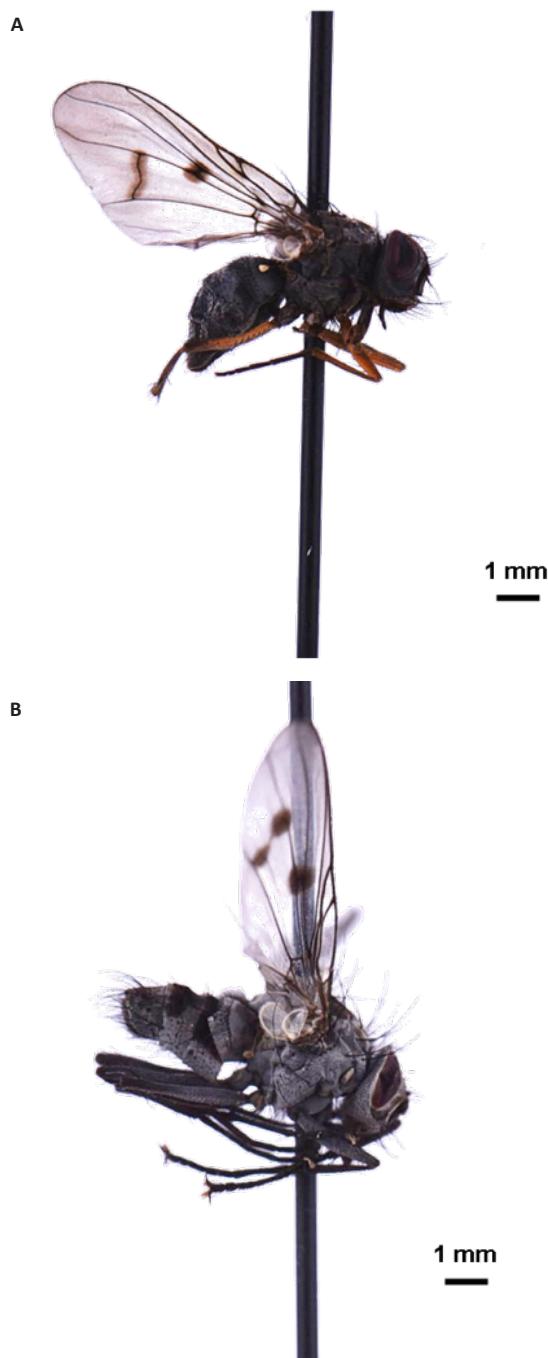
Material examined: MECN-EN-DIP-4859, MECN-EN-DIP-4869, MECN-EN-DIP-4870, 22.ix.2017, 3 females, Cochasquí

montane forest, Pichincha, -0.058969S & 78.304351W, 3052m, coll. Blacio & Soto-Vivas. MECN-EN-DIP-4871, MECN-EN-DIP-4872, 22.ix.2017, 2 females, monoculture in urban zone located in the Tocachi community, Pichincha, -0.035S & 78.282W, 2,816m, coll. Blacio & Soto-Vivas.

Distribution (Löwenberg-Neto & Carvalho 2013): Argentina, Brazil, Uruguay.

##### *Phaonia trispila* (Bigot, 1885) (Image 2B)

*Phaonia* species are characterized by: eyes ciliated, arista plumose, dorsocentral setae 1–2:3–4, notopleuron with covering setulae and with two setae, the posterior one weaker; pre-alar seta present (absent in *P. lentiginosa* Snyder), lower calypter glossiform, *Phaonia* type, Rs node bare or ciliated, vein M usually curved forward apically, hind tibia on postero-dorsal surface with the calcar about as long as the width of the tibia at calcar



**Image 2.** Lateral views of Muscidae new records species collected at Pedro Moncayo canton in the Pichincha province: A—*Dolichophaonia trigona* | B—*Phaonia trispila*. © Yesenia Tovar & Ana Soto-Vivas

insertion; female: ovipositor elongated, tubular, tergites narrow; sternite 8 reduced to two sclerites, microtrichia usually well-developed only on the membrane, cerci free (Carvalho & Couri 2002).

Diagnostic characters: General coloration black; scutellum with a yellowish-brown apex; wing with dark

brown macules in the anterior and posterior transverse veins and a slight spot at the end of the Sc vein; posterior spiracle on the PV margin without setae. Male: Paramere without concavity on the ventral surface; gonopod with the anterior region not exceeding the paramere width; ventral face curved. Female: proboscis in lateral view, with the clypeus, in the anterior region, with a strong tip; dorsal and basal haustellum sclerites with many setae (Coelho 2000).

Material examined: MECN-EN-DIP-4864, MECN-EN-DIP-4860, 22.ix.2017, 2 females, Cochasquí montane forest, Pichincha, -0.058S & 78.304W, 3,052m, coll. Blacio & Soto-Vivas. MECN-EN-DIP-4857, 22.ix.2017, 1 female, monoculture in urban zone located in the Tocachi community, Pichincha, -0.035S & 78.282W, 2,816m, coll. Blacio & Soto-Vivas. MECN-EN-DIP-4858, 17.xi.2017, 1 female, polyculture in urban zone located in the Tocachi community, Pichincha, -0.035S & 78.282W, 2,816m, coll. Blacio & Soto-Vivas. MECN-EN-DIP-4863, 22.x.2017, 1 female, agroecological farming system 1km away from the Tocachi community, Pichincha, -0.048S & 78.290W, 3,000m, coll. Blacio & Soto-Vivas.

Distribution (Löwenberg-Neto & Carvalho 2013): Argentina, Brazil, Venezuela, Uruguay.

## DISCUSSION

The most abundant and diverse Calyptratae community was observed in the wild environment (Cochasquí Archaeological Park). This suggests that the species share the available resources, from pollen to organic matter in animal and plant decay (Baumgartner & Greenberg 1985; Carson & Schnitzer 2008). In contrast to the urban area (mono- and polycultures) where the richness was lower, possibly due to anthropogenic modifications such as garbage and drains which support flies adapted to these environments (Carvalho et al. 1984; Souza et al. 2014). On the other hand, the dipteran community similarity found between urban areas and the montane forest and agro-ecological farming system could be associated with the fact that Tocachi rural and urban environments are partially preserved, due to the agricultural practices that are carried out in some areas.

Muscidae were the most abundant taxa in this study; adults can be predatory, hematophagous, saprophagous or necrophagous, living in varied habitats, such as dung, decomposing organic vegetable or animal matter, wood, fungi, nests, and dens, among others (Couri & Carvalho 2005). These flies are relatively common at high altitude regions, where they are important as pollinators and

**Table 1.** Absolute frequency of Calyptratae in five sites in Pedro Moncayo canton, Ecuador from May to November 2017. \* New report from Ecuador.

Family	Species / morphotype	PAC	CMF	AFS	PC	MC	Total
Calliphoridae	<i>Calliphora lopesi</i> Mello, 1962*	0	0	0	10	0	10
	<i>Calliphora nigribasis</i> Macquart, 1851	9	1	10	10	2	32
	<i>Chlorobrachycoma splendida</i> Townsend, 1918	2	0	0	2	0	4
	<i>Chrysomya albiceps</i> (Wiedemann, 1819)	1	0	0	0	1	2
	<i>Cochliomyia hominivorax</i> (Coquerel, 1858)	7	0	0	0	0	7
	<i>Cochliomyia macellaria</i> (Fabricius, 1775)	1	0	0	0	0	1
	<i>Compsomyiops melloi</i> Dear, 1985*	0	0	0	10	0	10
	<i>Lucilia cuprina</i> (Wiedemann, 1830)	1	0	0	19	0	20
	<i>Lucilia eximia</i> (Wiedemann, 1819)	0	0	0	3	0	3
	<i>Lucilia sericata</i> (Meigen, 1826)	0	0	0	0	5	5
	<i>Sarconesia chlorogaster</i> (Wiedemann, 1831)	10	0	0	0	0	10
	<i>Sarconesiopsis magellanica</i> (Le Guillou, 1842)	87	67	28	17	35	234
	<i>Roraimomusca roraima</i> Townsend, 1935	2	0	0	0	0	2
	Rhiniinae sp1	0	0	0	2	0	2
Sarcophagidae	<i>Blaesoxiphia</i> sp1	0	0	1	0	0	1
	<i>Boettcheria</i> sp1	11	7	8	2	5	33
	<i>Peckia</i> sp1	0	0	0	1	0	1
	<i>Peckia</i> ( <i>Sarcodexia</i> ) sp1	61	59	97	25	40	282
	<i>Tricharaea</i> sp1	189	44	82	38	20	373
	Sarcophagidae sp1	16	1	10	0	3	30
	Sarcophagidae sp2	0	0	0	0	1	1
Muscidae	<i>Dolichophaonia</i> sp1	0	1	0	0	3	4
	<i>Dolichophaonia trigona</i> (Shannon & Del Ponte, 1926)*	0	4	0	0	4	8
	<i>Phaonia trispila</i> (Bigot, 1885)*	1	13	15	16	7	52
	<i>Phaonia</i> sp1	0	0	7	0	1	8
	<i>Limnophora marginata</i> Stein, 1904	43	333	336	158	210	1080
Fanniidae	Fanniidae sp1	64	413	60	14	17	568
Scatophagidae	Scatophagidae sp1	51	10	24	8	10	103
Tachinidae	<i>Eulasiopalpus</i> nr. <i>niveus</i> Townsend, 1914	0	1	0	0	0	1
	<i>Eulasiopalpus</i> nr. <i>vittatus</i> Curran, 1947	0	0	1	0	0	1
	<i>Adejeania</i> sp1	0	0	4	0	0	4
	Tachinidae sp1	1	0	0	0	0	1
	Tachinidae sp2	1	0	0	0	0	1
	Tachinidae sp3	1	0	0	0	0	1
	Tachinidae sp4	1	0	0	0	0	1
	Tachinidae sp5	1	0	0	0	0	1
	Tachinidae sp6	1	0	0	0	0	1
	Tachinidae sp7	4	0	0	0	0	4
	Tachinidae sp8	5	0	0	0	0	5
	Tachinidae sp9	0	1	0	0	0	1
	Tachinidae sp10	0	1	0	0	0	1
	Tachinidae sp11	0	1	0	0	0	1
	Tachinidae sp13	0	1	0	0	0	1

Family	Species / morphotype	PAC	CMF	AFS	PC	MC	Total
	Tachinidae sp14	0	1	0	0	0	1
	Tachinidae sp15	0	1	0	0	0	1
	Tachinidae sp16	0	1	0	0	0	1
	Tachinidae sp17	0	1	0	0	0	1
	Tachinidae sp18	0	1	0	0	0	1
	Tachinidae sp19	0	1	0	0	0	1
	Tachinidae sp20	0	0	0	0	1	1
	Tachinidae sp21	0	0	0	0	1	1
	Tachinidae sp22	0	0	0	0	1	1
	Tachinidae sp23	0	0	3	0	0	3
	Tachinidae sp26	0	0	1	0	0	1
	Tachinidae sp27	0	0	0	1	0	1
	Hill $N_0 (=S)$	25	23	16	17	19	
	$N_1 (e^{\mu})$	8.51	4.44	5.63	7.07	5.10	
	$N_2 (1/\lambda)$	5.80	3.19	3.51	3.96	2.81	
	Alatalo $E_{2,1} (N_1 \cdot 1/N_2 \cdot 1)$	0.64	0.64	0.54	0.49	0.44	

PAC—Parque Arqueológico Cochasquí | CMF—Cochasquí montane forest | AFS—Agroecological farming system | PC—Polyculture | MC—Monoculture.

floral visitors and account for a high proportion of fauna (Proctor et al. 1996; Carvalho et al. 2005; Pérez & Wolff 2011). The most common species were *L. marginata*, *D. trigona* and *P. trispila*, the last two species have not been collected previously in Ecuador; *D. trigona* is reported in Argentina, Brazil, and Uruguay, and *P. trispila* has been registered in Argentina, Brazil, Venezuela and Uruguay (Löwenberg-Neto & Carvalho 2013). In this study, *L. marginata* showed a highly positive synanthropic index, suggesting strong preference for human settlements, in contrast to *P. trispila* that showed a low positive synanthropic index, indicating a mild preference for human settlements. Patitucci et al. (2013b) studied the ecological assemblages of saprophagous muscids in three sites with different urbanization levels. Particularly, *P. trispila* showed high abundance in rural areas, and a negative synanthropic index associated with complete avoidance of human settlements. Sarcophagidae was mainly represented by *Tricharaea* sp1, *Peckia (Sarcodexia)* sp1 and *Boettcheria* sp1; this family have a wide variety of habits, some species being scavengers, coprophages, hosts of ant and termite nests, some cause myiasis to amphibians and mammals, others are predators on arachnid eggs, butterfly larvae and bee pupae (Pape et al. 2004). Yepes-Guarisas et al. (2013) investigated the ecology and synanthropy of Sarcophagidae from Antioquia-Colombia. These authors found that *Tricharaea* spp. and *Peckia (Sarcodexia) lambens* (Wiedemann, 1830),

showed a positive synanthropic index. Pinilla et al. (2012) studied the synanthropy of Calliphoridae and Sarcophagidae in three zones in Bogotá-Colombia. They reported a *Boettcheria* morphotype associated mainly in the forest but also represented in rural areas.

With Calliphoridae, most species are sarcosaprophagous, but there are also predators and parasitoids. Souza et al. (2014) point out that this family is associated with regenerating forest, due to certain species colonizing at some stages. Also, studies with different degrees of urbanization showed that calliphorids prefer baits of animal origin (D'Almeida & Almeida 1998). This taxon is one of the most important families representative of synanthropic species (Souza & Zuben 2012). In the present study, the Calliphoridae species had a greater relationship in wild and rural environments, however, they are also present in the urban environment; this could be due to small vegetation patches and the association with domestic or farm animals. *S. magellanica* was the most abundant species and demonstrated a preference for uninhabited areas; Figueroa & Linhares (2002) and Pinilla et al. (2012) stated that this species was abundant in rural and wild areas. In concordance with our results, *S. chlorogaster* was reported by Schnack et al. (1989) in Argentina and Vianna et al. (1998) in Brazil, as a species with independence from human settlements. *L. cuprina* was found to be widely distributed in rural and urban areas on Pedro Moncayo canton, in particular, densely

**Table 2. Synanthropic index of Calyptratae in five sites in Pedro Moncayo canton, Ecuador from May to November 2017 from those species with a number equal or higher to 10 individuals.**

Species / morphotype	PAC	%	CMF	%	AFS	%	PC	%	MC	%	Total	SI
<i>Sarcoesiopsis magellanica</i> (Le Guillou, 1842)	87	15.24	67	6.95	28	4.08	17	5.06	35	9.54	234	-5,55
<i>Sarcosia chlorogaster</i> (Wiedemann, 1831)	10	1.75	0		0		0		0		10	-1,75
<i>Calliphora nigribasis</i> Macquart, 1851	9	1.58	1	0.10	10	1.46	10	2.98	2	0.54	32	2,57
<i>Calliphora lopesi</i> Mello, 1962	0		0		0		10	2.98	0		10	2,98
<i>Compsomyops melloi</i> (Wiedemann, 1819)	0		0		0		10	2.98	0		10	2,98
<i>Lucilia cuprina</i> (Wiedemann, 1830)	1	0.18	0		0		19	5.65	0		20	5,48
<i>Tricharaea</i> sp1	189	33.10	44	4.56	82	11.94	38	11.31	20	5.45	373	-14,94
<i>Peckia</i> ( <i>Sarcodexia</i> ) sp1	61	10.68	59	6.12	97	14.12	25	7.44	40	10.90	282	8,60
<i>Boettcheria</i> sp1	11	1.93	7	0.73	8	1.16	2	0.60	5	1.36	33	-0,11
<i>Sarcophagidae</i> sp1	16	2.80	1	0.10	10	1.46	0		3	0.82	30	-1,36
<i>Phaonia trispila</i> (Bigot, 1885)	1	0.18	13	1.35	15	2.18	16	4.76	7	1.91	52	6,24
<i>Limnophora marginata</i> Stein, 1904	43	7.53	333	34.54	336	48.91	158	47.02	210	57.22	1080	86,62
<i>Fannidae</i> sp1	64	11.21	413	42.84	60	8.73	14	4.17	17	4.63	568	-40,89
<i>Scatopagidae</i> sp1	51	8.93	10	1.04	24	3.49	8	2.38	10	2.72	103	-3,12

PAC—Parque Arqueológico Cochasquí | CMF—Cochasquí montane forest | AFS—Agroecological farming system | PC—Polyculture | MC—Monoculture | SI—Synanthropic Index.

inhabited areas. Several authors associate *L. cuprina* with densely populated areas and due to this, this species is considered to be a medical-veterinary important species because it is associated with the transmission of pathogenic micro-organisms and primary myiasis in sheep and humans (Vianna et al. 1998; Souza & Zuben 2012). *C. melloi* and *C. lopesi* were collected for the first time in Ecuador in this study. Dear (1985), Amat (2009) and Kosmann et al. (2013) recorded *C. melloi* in Mexico and Colombia, and Whitworth & Rognes (2012), and Kosmann et al. (2013) reported *C. lopesi* in Brazil and Uruguay. Finally, *C. lopesi* and *C. nigribasis* showed independence from human settlements; similar findings to those reported by Vianna et al. (1998) and Pinilla et al. (2012), in Brazil and Colombia, respectively.

Finally, Tachinidae presented a high number of morphotypes and two species *Eulasiopalpus* nr. *niveus* and *Eulasiopalpus* nr. *vittatus*. This family is extremely diverse in the Neotropics, a common taxon at middle elevations (1,000–2,000 m) along the mountain chains of tropical Central and South America (Stireman et al. 2006; Stireman 2007). Only a fraction of Neotropical Tachinidae have been described, and for most of those that have been described, the life history host associations, or behavior are poorly known (Guimarães 1977; Toma 2012). The tachinid species provide various ecosystem services in the Andean forests, their value as pest controllers and pollinators, favors the variability of the forest flora as well as maintaining the balance of

the ecosystem by regulating populations (Ssymank et al. 2008; Quintero et al. 2017).

Urbanization processes cause an ecosystem negative impact by decreasing the proportion of native species, while introduced species usually occupy urbanized environments due to pre-adaptation processes (McKinney 2002; 2008). Several authors affirm that the introduced species proportion increases as it approaches large heavily urbanized sectors; in contrast to those native species that are more abundant in less modified sectors. In sacer-saprophagous dipterans, the environmental colonization success depends on their morphology, flexibility in the use of different resources, as well as on life history (Vianna et al. 1998; Uribe-M et al. 2010; Mulieri et al. 2011; Pinilla et al. 2012).

## REFERENCES

- Albuja, L., M. Ibarra, J. Urgiles & R. Barriga (1980). Estudio preliminar de los vertebrados ecuatorianos. 1ra ed. Quito, Ecuador. Departamento de Ciencias Biológicas. Escuela Politécnica Nacional, 131pp. Accessed online on 18 October 2019; <https://bibdigital.epn.edu.ec/handle/15000/4798>
- Amat, E. (2009). Contribución al conocimiento de las Chrysomyinae y Toxotarsinae (Diptera: Calliphoridae) de Colombia. *Revista Mexicana de Biodiversidad* 80: 693–708. <https://doi.org/10.22201/ib.20078706e.2009.003.166>
- Amat, E., M. Vélez & M. Wolff (2008). Clave ilustrada para la identificación de los géneros y las especies de califóridos (Diptera: Calliphoridae) de Colombia. *Caldasia* 30: 231–244.
- Baumgartner, D. & B. Greenberg (1985). Distribution and Medical Ecology of the Blow Flies (Diptera: Calliphoridae) of Peru. *Annals*

- of the Entomological Society of America 78: 565–587. <https://doi.org/10.1093/aesa/78.5.565>
- Benecke, M., J. Eberhard & R. Zweihoff (2004).** Neglect of the elderly: forensic entomology cases and considerations. *Forensic Science International* 146S: 195–199. <https://doi.org/10.1016/j.forsciint.2004.09.061>
- Buenaventura, E., G. Camacho, A. García & M. Wolff (2009).** Sarcophagidae (Diptera) de importancia forense en Colombia: claves taxonómicas, notas sobre su biología y distribución. *Revista Colombiana de Entomología* 35: 189–196.
- Byrd, J.H. & J.L. Castner (2001).** Forensic Entomology: The utility of arthropods in legal investigations. 1st edition, Boca Raton, CRC Press, 418pp.
- Carson, W. & S. Schnitzer (2008).** Tropical Forest Community Ecology. Wiley-Blackwell, USA. 536pp.
- Carvalho, C.J.B. (2002).** Muscidae (Diptera) of the Neotropical Region: taxonomy. Editora Universidade Federal do Paraná, Curitiba. Brasil. 287pp.
- Carvalho, C.J.B. & M.S. Couri (2002).** Part I. Basal groups. pp. 17–132. In: Carvalho, C.J.B. de (Ed.), *Muscidae (Diptera) of the Neotropical Region: Taxonomy*. Editora Universidade Federal do Paraná, Curitiba.
- Carvalho, C.J.B. & P. Mello (2008).** Key to the adults of the most common forensic species of Diptera in South America *Revista Brasileira de Entomologia* 52: 390–406. <https://doi.org/10.1590/S0085-56262008000300012>
- Carvalho, C.J.B., M.S. Couri, A.C. Pont, D. Pamplona & S.M. Lopes (2005).** A Catalogue of the Muscidae (Diptera) of the Neotropical Region. *Zootaxa* 860: 1–282. <https://doi.org/10.11646/zootaxa.860.1.1>
- Carvalho, C.J.B., J. De Almeida & C. Jesús (1984).** Dípteros sinantrópicos de Curitiba e arredores (Paraná, Brasil). I. Muscidae. *Revista Brasileira de Entomologia* 28: 551–560.
- Catts, E.P. & G.R. Mullen (2002).** Myiasis (Muscoidea and Oestroidea), pp. 317–348. In: Mullen, G. & L. Durden. (eds.). *Medical and Veterinary Entomology*. Academic Press, San Diego, CA.
- Couri, M. & C.J.B. Carvalho (2005).** Diptera muscidae do estado do Rio de Janeiro (Brasil). *Biota Neotropica* 5: 205–222. <https://doi.org/10.1590/S1676-06032005000300015>
- Colwell, R. (2019).** EstimateS: Statistical estimation of species Richness and Shared Species from Sample. Version 9.1. Available in: <https://viceroy.eeb.uconn.edu/estimates/EstimateSPages/AboutEstimateS.htm>
- Coelho, S. (2000).** Phaonia Robineau-Desvoidy (Diptera, Muscidae, Phaoniinae): II: revisão das espécies. *Revista Brasileira de Zoologia* 17: 795–875. <https://doi.org/10.1590/S0101-81752000000300023>
- Dear, J. (1985).** A revision of the New World Chrysomyini (Diptera: Calliphoridae). *Revista Brasileira de Zoologia* 3: 109–169. <https://doi.org/10.1590/S0101-81751985000300001>
- D'Almeida, J. & J. Almeida (1998).** Nichos tróficos en dípteros caliptrados, no Rio de Janeiro, RJ. *Revista Brasileira de Biología* 54: 563–570. <https://doi.org/10.1590/S0034-71081998000400004>
- Figueroa, L. & A. Linhares (2002).** Sinantrópia de los Calliphoridae (Diptera) de Valdivia, Chile. *Neotropical Entomology* 31: 233–239. <https://doi.org/10.1590/S1519-566X2002000200009>
- Guimarães, J.H. (1977).** Host-parasite and parasite-host catalogue of South American Tachinidae (Diptera). *Arquivos de Zoologia* 28: 1–131.
- Hammer, O., D. Harper & P. Ryan (2001).** PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Palaeontology Electronica* 4: 9.
- Hernández, V. & J. Dzul (2008).** Moscas (Insecta: Diptera), pp: 95–105. In: Manson, R., V. Hernández, S. Gallina & K. Mehltreter. *Agroecosistemas cafetaleros de Veracruz: biodiversidad, manejo y conservación*. Instituto de Ecología A.C. (INECOL) e Instituto Nacional de Ecología (INE-SEMARNAT), México.
- Heip, C., P. Herman & K. Soetaert (1998).** Indices of diversity and evenness. *Océanis* 24: 61–87.
- Hill, M. (1973).** Diversity and evenness: a unifying notation and its consequences. *Ecology* 54: 427–432.
- Kimberly, L., R. Fell & C. Brewster (2005).** Insect fauna visiting carrion in Southwest Virginia. *Forensic Science International* 150: 73–80. <https://doi.org/10.1016/j.forsciint.2004.06.041>
- Kosmann, C., R. Pinto de Mello, E. Sevilha & R. Pujol-Luz (2013).** A list of current valid blow fly names (Diptera: Calliphoridae) in the Americas South of Mexico with key to the Brazilian species. *Entomo Brasilis* 6: 74–85. <https://doi.org/10.12741/ebrazilis.v6i1.266>
- Lambkin, C., T. Pape, B.J. Sinclair, G.W. Courtney, J.H. Skevington, R. Meier, D.K. Yeates, V. Blagoderov & B.M. Wiegmann (2013).** The phylogenetic relationships among infraorders and superfamilies of Diptera based on morphological evidence. *Systematic Entomology* 38: 164–179. <https://doi.org/10.1111/j.1365-3113.2012.00652.x>
- Löwenberg-Neto, P. & C.J.B. Carvalho (2013).** Muscidae (Insecta: Diptera) of Latin America and the Caribbean: geographic distribution and check-list by country. *Zootaxa* 3650: 001–147. <https://doi.org/10.11646/zootaxa.3650.1.1>
- Magaña, C., Andara, C., Contreras, M., Coronado, A., Guerrero, E., Hernández, D., Herrera, M., Jiménez, M., Liendo, C., Limongi, J., Liria, J., Mavárez, M., Oviedo, M., Piñango, J., Rodríguez, I., Soto, A., Sandoval, M., Sánchez, J., Seijas, N., Tiape, Z. & Y. Velásquez. (2006).** Estudio preliminar de la fauna de insectos asociada a cadáveres en Maracay, Venezuela. *Entomotropica* 21: 53–59.
- Marshall, S., T. Whitworth & L. Roscoe (2011).** Blow flies (Diptera: Calliphoridae) of eastern Canada with a key to Calliphoridae subfamilies and genera of eastern North America, and a key to the eastern Canadian species of Calliphorinae, Luciliinae and Chrysomyiinae. *Canadian Journal of Arthropod Identification* 1–93. <https://doi.org/10.3752/cjai.2011.11>
- McKinney, M. (2002).** Urbanization, Biodiversity and Conservation. *BioScience* 52: 883–890. [https://doi.org/10.1641/0006-3568\(2002\)052\[0883:UBAC\]2.0.CO;2](https://doi.org/10.1641/0006-3568(2002)052[0883:UBAC]2.0.CO;2)
- McKinney, M. (2008).** Effects of urbanization on species richness: A review of plants and animals. *Urban Ecosystems* 11: 161–176. <https://doi.org/10.1007/s11252-007-0045-4>
- Mc Alpine, J., B. Peterson, G. Shewell, H. Teskey & D. Wood (1981).** Manual of Nearctic-Diptera Volume I. Biosystematics Research Institute. Ottawa. Ontario. Research Branch. Agriculture Canada. Monograph No. 27. 121: 90–104.
- Moreno, A., J. Moreno, M. Vasquez & J. Liria (2016).** New records of blowflies (Diptera: Calliphoridae) from Amazonian Venezuela. *Advances in Environmental Biology* 10: 1–7.
- Moreno, C.E. (2001).** Métodos para medir la biodiversidad. M&T, Manuales y Tesis SEA 1: 84pp.
- Morón, M. & R. Terrón (1984).** Distribución estacional y altitudinal de los insectos necrófilos de la sierra norte de Hidalgo, Mexico. *Acta Zoológica Mexicana* 3: 1–47.
- Mulieri, P., L. Patitucci, J. Schnack & J. Mariluis (2011).** Diversity and seasonal dynamics of an assemblage of sarcophagid Diptera in a gradient of urbanization, *Journal of Insect Science* 11(1): 1–15. <https://doi.org/10.1673/031.011.9101>
- Nuorteva, P. (1963).** Synanthropy of blowflies (Diptera: Calliphoridae) in Finland. *Annales Entomologica Fenniae* 29: 1–49. <https://doi.org/10.1093/aesa/49.1.29>
- Pape, T., M. Wolff & E. Amat (2004).** Los califóridos, éstridos, rinofóridos y sarcofágidos (Diptera: Calliphoridae, Oestridae, Rhinophoridae y Sarcophagidae) de Colombia. *Biota Colombiana* 5: 201–208.
- Pérez, S. & M. Wolff (2011).** Muscidae (Insecta, Diptera): Importancia y diversidad para Colombia. *Boletín del Museo Entomológico Francisco Luis Gallego* 3: 13–22.
- Patitucci, L., P. Mulieri, M. Olea & J. Mariluis (2013a).** Muscidae (Insecta: Diptera) of Argentina: revision of Buenos Aires province fauna, with a pictorial key to species. *Zootaxa* 3702: 301–347. <https://doi.org/10.11646/zootaxa.3702.4.1>
- Patitucci, L., P. Mulieri, M. Olea, J. Schnack & J. Mariluis (2013b).** Assemblages of saprophagous muscids (Diptera: Muscidae) in three urban sites of temperate Argentina. *Revista Colombiana de Entomología* 39: 291–300.
- PDOT (2015).** Plan de Ordenamiento y Desarrollo Cantonal,

- Actualización 2015–2025. Available online 18 October 2019. <https://docplayer.es/31843475-Plan-de-ordenamiento-y-desarrollo-cantonal-actualizacion.html>
- Pinilla, Y., N. Segura & F. Bello (2012).** Synanthropy of Calliphoridae and Sarcophagidae (Diptera) in Bogotá, Colombia. *Neotropical Entomology* 41: 237–242. <https://doi.org/10.1007/s13744-012-0036-x>
- Polovón, D. (1971).** Synanthropy, p. 17–54. In: Greenberg, B. *Flies and Disease: Ecology, classification, and biotic associations*. Vol. 1. New Jersey, Princeton University Press.
- Proctor, M., P. Yeo & A. Lack (1996).** The Natural History of Pollination. Timber Press, Portland.
- Quintero, E., A. Benavides, N. Moreno & S. González (2017).** Bosques Andinos, estado actual y retos para su conservación en Antioquia. Medellín, Colombia: Fundación Jardín Botánico de Medellín Joaquín Antonio Uribe Programa Bosques Andinos (COSUDE). 1 Ed – Medellín, 2018. 542pp.
- Salazar, F. & D.A. Donoso (2015).** Catálogo de insectos con valor forense en el Ecuador. *Revista Ecuatoriana de Medicina y Ciencias Biológicas* 36: 49–59.
- Schnack, J., J. Marilus, J. Muzon & G. Spinelli (1989).** Synanthropy of Calliphoridae. A first approach in Argentina (Insecta, Diptera). *EOS* 65: 271–280.
- Souza, C.R. & C.J.V. Zuben (2012).** Diversity and Synanthropy of Calliphoridae (Diptera) in the Region of Rio Claro, SP, Brazil. *Neotropical Entomology* 41: 243–248. <https://doi.org/10.1007/s13744-012-0037-9>
- Souza de Pereira, J., M. Esposito, F. Carvalho & L. Juen (2014).** The Potential Uses of Sarcosaprophagous Flesh Flies and Blowflies for the Evaluation of the Regeneration and Conservation of Forest Clearings: A Case Study in the Amazon Forest. *Journal of Insect Science* 14: 215. <https://doi.org/10.1093/jisesa/ieu077>
- Ssymank, A., C. Kearns, T. Pape & F. Thompson (2008).** Pollinating Flies (Diptera): A major contribution to plant diversity and agricultural production. *Biodiversity* 9: 86–89. <https://doi.org/10.1080/14888386.2008.9712892>
- Stireman, J. (2007).** Preliminary notes on Tachinidae reared from Lepidoptera in the Ecuadorian Andes. *The Tachinid Times* 20: 4–8.
- Stireman, J., J. O'Hara & D. Wood. (2006).** Tachinidae: Evolution, Behavior, and Ecology. *Annual Review of Entomology* 51: 525–55. <https://doi.org/10.1146/annurev.ento.51.110104.151133>
- Toma, R. (2012).** Tachinidae: una discusión sobre el problema de la identificación de los taxones de la Región Neotropical. *Entomotropica* 27: 145–152.
- Torres, A. (2016).** Diversidad de moscas de la familia Calliphoridae (Diptera, Oestroidea) en tres ambientes con diferentes grados de antropización en siete localidades adyacentes a la ciudad de Quito, Pichincha. Trabajo de Grado presentado como requisito parcial para optar al Título Licenciado en Biología. Facultad de Biología. Universidad Pontificia Universidad Católica del Ecuador. Quito, Ecuador.
- Toro, M. (2007).** Contribución al conocimiento de géneros pertenecientes a la antigua Tribu Dejeaniini (Diptera: Tachinidae) en Los Andes Ecuatorianos. Trabajo de Grado presentado como requisito parcial para optar al Título Licenciado en Biología. Facultad de Ciencias Naturales. Universidad de Guayaquil. Guayaquil, Ecuador.
- Uribe-M.N., M. Wolff & C.J.B. Carvalho (2010).** Synanthropy and ecological aspects of Muscidae (Diptera) in a tropical dry forest ecosystem in Colombia. *Revista Brasileira de Entomologia* 54: 462–470. <https://doi.org/10.1590/S0085-56262010000300018>
- Vairo, K., C. Mello-Patiu & C.J.B. Carvalho (2011).** Pictorial identification key for species of Sarcophagidae (Diptera) of potential forensic importance in southern Brazil. *Revista Brasileira de Entomologia* 55: 333–347. <https://doi.org/10.1590/S0085-56262011005000033>
- Vianna, E., J. Brum, P. Ribeiro, M. Berne & J. Silveira (1998).** Synanthropy of Calliphoridae (Diptera) in Pelotas, Rio Grande do Sul State, Brazil. *Revista Brasileira de Parasitologia Veterinária* 7: 141–147.
- Whitworth, T.L. (2014).** A revision of the Neotropical species of *Lucilia* Robineau-Desvoidy (Diptera: Calliphoridae). *Zootaxa* 3810: 1–76. <https://doi.org/10.11646/zootaxa.3810.1.1>
- Whitworth, T. & K. Rognes. (2012).** Identification of Neotropical blow flies of the genus *Calliphora* Robineau-Desvoidy (Diptera: Calliphoridae) with the description of a new species. *Zootaxa* 3209: 1–27. <https://doi.org/10.11646/zootaxa.3209.1.1>
- Wiegmann, B.M., M.D. Trautwein, I.S. Winkler, N.B. Barr, J.W. Kin, C. Lambkin, M.A. Bertone, B. Cassel, K.M. Bayless, A.M. Heimberg, B.M. Wheeler, K.J. Peterson, T. Pape, B.J. Sinclair, J.H. Skevington, V. Blagoderov, J. Caravas, S.N. Kutty, U. Schmidt-Ott, G.E. Kampmeier, F.C. Thompson, D.A. Grimaldi, A.T. Beckenbach, G.W. Courtney, M. Friedrich, R. Meier & D.K. Yeates (2011).** Episodic radiations in the fly tree of life. *Proceedings of the National Academy of Sciences* 108: 5690–5695. <https://doi.org/10.1073/pnas.1012675108>
- Yepes-Gaurisas, D., J.D. Sánchez-Rodríguez, C. Mello-Patiu & M. Wolff (2013).** Synanthropy of Sarcophagidae (Diptera) in La Pintada, Antioquia-Colombia. *Revista de Biología Tropical* 61: 1275–1287.





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