URBAN BLOW FLIES (DIPTERA: CALLIPHORIDAE) IN FOUR CITIES OF THE COLOMBIAN CARIBBEAN COAST

CALIFÓRIDOS URBANOS (DIPTERA: CALLIPHORIDAE) EN CUATRO CIUDADES DE LA COSTA CARIBE COLOMBIANA

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ABSTRACT

The purpose of this study was to evaluate the species composition of the family Calliphoridae from samples collected in four different cities in the colombian Caribbean coast. Van Someren-Rydon traps were used baited with human faeces, rotten fish and fermented fruit were used. Six traps were placed in each city (two traps per type of bait), for a total of 24 traps. They were left for 72 hours in each site and samples were collected every 12 hours (day and night). 5654 individuals were identified, belonging to the subfamilies Chrysomyinae and Luciliinae. The identified species were *Cochliomyia macellaria, Chrysomya albiceps, Chrysomya megacephala, Lucilia eximia, Lucilia sericata* and *Chloroprocta idioidea,* expanding the range of distribution for the last two species. The best bait was the rotten fish and the best time to collect these species was during daylight.

KEY WORDS: preferred bait, *Lucilia sericata, Chloroprocta idioidea,* circadian cycle

RESUMEN

El propósito de este estudio fue evaluar la composición de las especies de la familia Calliphoridae recolectadas en cuatro diferentes ciudades de la costa Caribe colombiana. Se utilizaron trampas Van Someren-Rydon cebadas con heces humanas, pescado descompuesto y fruta fermentada. Seis trampas fueron colocadas en cada ciudad (dos trampas por cebo), para un total de 24 trampas. Estas se dejaron durante 72 horas en cada sitio y se recogieron muestras cada 12 horas (día y noche). Se identificaron 5654 individuos, pertenecientes a las subfamilias Chrysomyinae y Luciliinae. Las especies identificadas fueron *Cochliomyia macellaria, Chrysomya albiceps, Chrysomya megacephala, Lucilia eximia, Lucilia sericata* y *Chloroprocta idioidea,* ampliando el rango de distribución de las dos últimas especies. El cebo más efectivo fue el pescado descompuesto y el mejor momento para recolectar estas especies fue durante el día.

PALABRAS CLAVES: preferencia de cebo, *Lucilia sericata, Chloroprocta idioidea,* ciclo circadiano

INTRODUCTION

One of the main groups of insects with the greatest impact on human society is dipterans, which represent 12 % of known animal species (Pape and Evenhuis, 2013). The Calliphoridae family includes flies that are mostly of bright metallic colors (blue or green) and are generally decomposers, although there are also sarcosaprophagous, coprophagous (Amat et al., 2008), necrophagus, predators and parasitoid species (Amat, 2009); also the fact that they live in unhealthy urban settlements allows them to be mechanical propagators of human enteropathogens (Graczyk et al., 2005). The group plays an important role in the process of decomposition of organic matter, because of its high predominance and complex ecological communities (Hanski, 1987; Shewell, 1987).

There are few studies on the family Calliphoridae in the north area of South America, some are limited to type

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localities or to individuals collected by professionals from other countries (Amat, 2009). In Colombia there are 29 species and 12 genera grouped into 3 subfamilies: Calliphorinae, Chrysomyinae and Toxotarsinae (Amat et al., 2008).

In the past few years, some studies of forensic importance have been carried out on Calliphoridae in Colombia. Calliphoridae is the first group of insects that colonize corpses, enabling scientists to determine the post-mortem interval. However, there are no specific revisions about the species found in the Colombian Caribbean. There are reports of the species *Lucilia eximia* in the departments of Bolívar and Magdalena; *Chrysomya megacephala* in the departments of Sucre, Bolívar and Magdalena; *Cochliomyia macellaria* in all regions up to 2.500 meters high; *Chloroprocta idioidea* in the department of Sucre and Bolívar; *Lucilia sericata* in the departments of Sucre and La Guajira; *Chrysomya albiceps* in the departments of Sucre and Magdalena; and *Roraimomusca roraima, Blepharignema splendens, Eumensembrinella quadrilineata* and *Hemilucilia* sp. in the Sierra Nevada of Santa Marta (SNSM) (Pape et al., 2004; Amat and Wolff, 2007; Amat, 2009; Wolff et al., 2010a; Giraldo et al., 2011; Solano et al., 2013).

Due to the Calliphoridae's medical and sanitary importance as being transmitters of pathogens, their close location to urban settlements, and their usefulness as a tool in forensic studies, it is necessary to have baseline information about this family in every region of the country. The objective of this study was to evaluate the species composition of blowflies collected in four cities of the colombian Caribbean coast and to describe their preferences in bait and dial behavior in order to increase knowledge of the ecology of this family.

MATERIALS AND METHODS

Study Area

The samples were collected in the colombian Caribbean between July 24 and August 29, 2010. The study area corresponded to the "zonobioma subxerofitico tropical" which has a temperature between 25 and 38 °C and an annual rainfall of less than 2000 mm. This can be considered a transitional biome between the "zonobioma subxerofitico tropical" and the "zonobiomadesértico tropical" (Hernández and Sánchez, 1992). The region has an arid and semi-arid climate with low precipitation both in the summer and in the rainy season. "Unimodal-Biestacional" and "Bimodal-Tetraestacional" rainfall regime are common in this area (Rangel-Ch and Carvajal-Cogollo, 2012). The vegetation of this zonobiome has structural adaptations such as the presence of compound leaves, small leaflets, and thorns (IAVH, 1995). Canopy height ranges from 15 to 25 m and are presented as four vegetative strata including the herbaceous stratum (IAVH, 1998). Four coastal localities were selected (Figure 1):
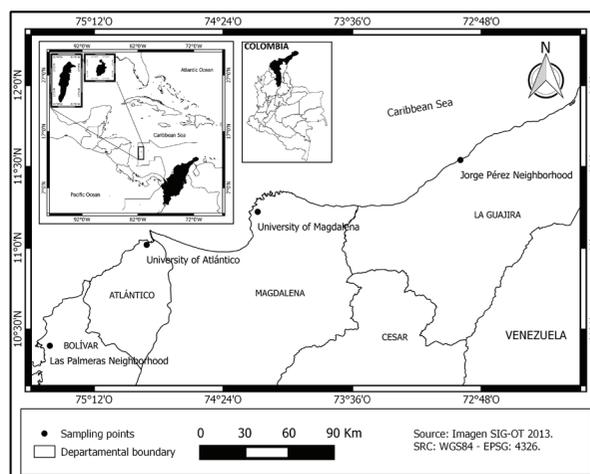

Figure 1. Partial map of the colombian Caribbean coast specifying the sampling locations.

The University of Magdalena (11º13'18.36"N, 74º11'10.89"W, 20 meters above sea level) in the District of Santa Marta, department of Magdalena. Sampling was conducted in the experimental farm of the university, within the dry forest plot (2 ha), a secondary forest in state of succession, bordered by grassland area of crops and fish ponds. This area is located 100 m from settlements (Strewe et al., 2009).

The Jorge Pérez neighborhood (11º32'25.02"N, 72º55'47.45"W, 10 meters above sea level) in Riohacha city, department of La Guajira. It is a peri-urban neighborhood, located in the city limits, bordering indigenous and displaced settlements. The main activity is fishing as it is located 500 m from the coastal area El Faro.

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The University of Atlántico (11°01'07.58"N, 74°52'28.19"W, 48 meters above sea level) in the municipality of Puerto Colombia, Metropolitan Area of Barranquilla, department of Atlántico. Located approximately 3 km from the Caribbean sea, close to the lakes El Cisne and Caujaral. Vegetation of tropical dry forest is observed and in the driest areas, grasslands and cactus. It is situated in the greater urban and academicals zone of Barranquilla and the collect was done in the surrounding of gardens, cafeterias and classrooms.

The neighborhood Las Palmeras (10°23'51.04"N, 75°28'28.29"W, 6 meters above sea level) in the District of Cartagena, department of Bolivar. It is located in the commune 7, to the northwestern of the city and 7 km from the Caribbean Sea. It has a low socioeconomic status but all its basic needs are covered. The traps were placed in the backyard of a private residence surrounded by mango trees.

Sampling Method

Six Van Someren-Rydon (Vsr) traps were placed along a linear 300 m transect in the different sampling sites, with a distance between traps of 50 m. Three types of bait were used to attract the flies: 1). Mix of fermented pineapple with banana and beer (fruit), 2). Rotten fish (fish) and 3). Human faeces, obtaining a total of two samples of the same bait in each transect. Sampling was conducted for 72 hours in a continuous way, to get two populations (day and night) by collecting samples every 12 hours (06:00h and 18:00h).

Preservation and Identification

The material was separated, quantified and identified following the taxonomic keys provided by Whitworth (2006), Amat et al. (2008) and Vargas and Wood (2010) and were compared with the specimens identified in the collection of this family deposited in the Colección de Entomología de la Universidad de Antioquia (CEUA). Identification, mounting and preservation of insects were conducted in the installations of the CEUA, where the specimens were stored.

Data Analysis

For the analysis of bait preference a correspondence analysis (CA) was performed using the statistical environment R, version 2.15.3 and abundance of species data (Nenadic and Greenacre, 2007).

RESULTS

A total of 5654 individuals of Calliphoridae were identified, 2192 males and 3462 females, distributed in 4 genera and 6 species belonging to the subfamilies Luciliinae and Chrysomyinae. The most abundant species was *C. megacephala* (Fabricius, 1794) with a relative abundance (RA) of 82%, followed by *C. idiodea* (Robineau-Desvoidy, 1830), *L. eximia* (Wiedemann, 1819), *C. albiceps* (Wiedemann, 1819), *C. macellaria* (Fabricius, 1775) and finally *L. sericata* (Meigen, 1826). The distributional range of *C. idioidea* was extended to the departments of La Guajira, Magdalena and Atlántico, and of *L. sericata* to the department of Bolivar (Table 1).

Table 1. Main species of *Calliphoridae* found in urban areas of the Colombian Caribbean region, captured with Van Someren-Rydon (Vsr) traps (Ma = Magdalena, Bo = Bolívar, At = Atlántico, Gu = La Guajira, Fru = fruit, Fs = fish, Hf = human faeces)

Taxa	Departaments	Bait	Abundance
Calliphoridae			5654
Chrysomya megacephala	At, Bo, Ma, Gu	Fru, Fs, Hf	4643
Chloroprocta idioidea	At, Bo, Ma, Gu	Fru, Fs, Hf	322
Lucilia eximia	At, Bo, Ma, Gu	Fru, Fs, Hf	294
Chrysomya albiceps	At, Bo, Ma, Gu	Fru, Fs, Hf	220
Cochliomyia macellaria	At, Bo, Ma, Gu	Fru, Fs, Hf	158
Lucilia sericata	Bo, Gu	Fru, Fs, Hf	17

The collected individuals showed mainly diurnal activity in general. Females were more abundant throughout the sampling in all locations (Table 1). Most individuals were collected in the Department of Magdalena and they showed strong preference for the fish bait. The same pattern was observed in all departments except La Guajira, where the fruit bait was more successful.

L. sericata was the species with the lowest abundance throughout the study (RA 0.30 %) (Table 1), with only 17 individuals captured, all females. It was distributed in the departments of La Guajira and Bolivar (Table 2), and was moderately attracted by the fruit bait with a relative

frequency (RF) of 70.58 % (Figure 2). The preferred baits for *C. idioidea* were fruit and fish species and were collected in daylight hours, particularly in the department of Magdalena (Table 2). Its relative abundance was 5.69 % (Table 1).

Table 2. Abundance of female and male captured in daylight (D) and at night (N) in each locality.

Species	Riohacha				Cartagena				Santa Marta				Barranquilla			
	D	N	♂	♀	D	N	♂	♀	D	N	♂	♀	D	N	♂	♀
L. eximia	54	9	20	43	67	38	54	51	76	18	20	74	18	14	15	17
C. albiceps	15	3	4	14	8	1	2	7	119	22	20	121	42	10	8	44
C. idioidea	14	31	2	43	1	0	1	0	156	77	99	134	35	8	24	19
C. megacephala	571	218	421	368	556	234	327	463	2615	434	1109	1940	11	4	8	7
C. macellaria	46	8	21	33	8	4	4	8	81	8	32	57	3	0	1	2
L. sericata	11	1	0	12	2	3	0	5	0	0	0	0	0	0	0	0

The species *C. megacephala* had the highest abundance, with 82.11 % (Table 1). It was mainly found in the department of Magdalena, preferentially drawn from the human faeces (RF 39.06 %) and fish baits (RF 49.98%) (Figure 2). Its activity was greatly associated with daytime hours (Table 2). Alike, *L. eximia* showed greater preference for the human faeces bait with RF of 48.9 %, with fruit bait in second place (Figure 2) and most individuals of this species were captured in the department of Magdalena. They showed higher activity in the daytime, were generally females, (Table 2) and showed a RF of 5.19% (Table 1). On the other hand, *C. albiceps* was found with a RF of 3.89% (Table 1); unlike the two latter, this species was strongly attracted to the fish bait (RF 91.81 %) (Figure 2). It was found especially in the departments of Magdalena and Atlántico, with diurnal habits basically, and over 50% were females (Table 2). Ultimately, *C. macellaria* showed a RF of 2.79% (Table 1). Most individuals were attracted by the fish bait (RF 55.06 %), with human faeces bait in second place (RF 32.27 %) (Figure 2). The species showed higher abundance in the department of Magdalena and had generally diurnal habits (Table 2).
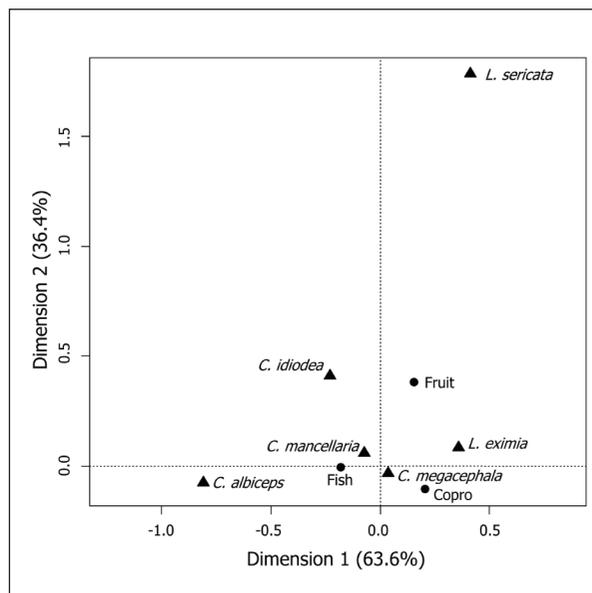

Figure 2. Correspondence analysis (CA) showing the trend of the six species of the family Calliphoridae in the Colombian Caribbean Coast Region with respect to the type of bait.

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DISCUSSION

There were found 6 of the 29 species, and 4 of the 12 genus described for Colombia. On the other hand, almost all the species which are reported for the colombian Caribbean were captured, except for *Roraimomusca roraima, Blepharignema splendens, Eumensembrinella quadrilineata* and *Hemilucilia* sp., reported in the SNSM. This could be because all sampling locations were below 50 meters above sea level. The species recorded with higher abundance are species with strong preference for human settlements (Montoya et al., 2009).

Most individuals had a daytime activity although species such as *C. megacephala* have nocturnal oviposition (Singh and Bharti, 2001). This might be explained by the fact that the flies detect the bait by smell and observing at close range, although the latter may be limited at night by the lack of light, as with drosophilids the sleep cycle of calliphorids can be affected by artificial light (Amendt et al., 2008). This study was conducted in urban areas, so the amount of light may affect the hours of activity of the studied species. Therefore, more studies are needed to help determine circadian cycles of species of blowflies.

L. sericata was the only one of the six species that was not present in all the departments sampled, being found only in La Guajira and Bolivar. This is a new record of this species for the department of Bolivar, since it was previously reported only in the departments of Cundinamarca (Pape et al., 2004; Camacho, 2005; Yusseff, 2006; Echeverry et al., 2009; Salazar, 2010; Segura et al., 2010), Antioquia (Pape et al., 2004; Salazar, 2010; Ramirez et al., 2012), and Santander and Sucre (Pape et al., 2004), although Wolff (2010) described this species with wide distribution in Colombia. The other five species were found in all departments. Individuals of *L. sericata* showed preferences for traps baited with fruit (Figure 2); however, some studies reported it as a ghoul species (Echeverry et al., 2009; Pinilla et al., 2010; Grassberg and Reiter, 2011). Only 17 individuals of this species were collected in this study; therefore, this is not a representative sample to determine the preference of bait.

The second new record for the area was the species *C. idioidea,* which had been reported in the department of Antioquia (Amat 2009; Montoya et al., 2009; Salazar, 2010), in the colombian Amazon (Amat, 2009; 2010), in the departments of Caldas, Meta, Risaralda and Vichada (Amat, 2009) and reported by Wolff (2010) in warm

regions and downs. The results of Amat (2009) and Montoya et al. (2009) are consistent with this study, describing the species with a high preference for the fish attractant.

C. megacephala was the most abundant introduced species. This result is similar to the ones reported by Buitrago and Bermudez (2010) in Panama, Mello et al. (2004) in Brazil and Pérez et al. (2005) and Yusseff (2006) in Colombia. Its abundance in urban areas is consistent with Mello et al. (2004), Montoya et al. (2009) and Rodrigues-Guimarães et al. (2008), who described it as a synanthropic species. In this study, most individuals were diurnal, as was found by Montoya et al. (2009).

L. eximia was captured mostly in the attractive human faeces (Figure 2), contrary to what is recorded in other studies in which the main attractant was carrion (Wolff et al., 2004; Gião and Godoy, 2006; Wolff et al., 2010b; Beltran and Villa, 2011), although Gião and Godoy (2006) also suggested preferences for excrement. This species was reported by Wolff et al. (2010b) and Beltran and Villa (2011) with synanthropic features.

C. albiceps is a species that was described as synanthropic by Mello et al. (2004) and Rodrigues–Guimarães et al. (2008). They also reported this species as the second most abundant in their studies, which agree the study by Ramos and Wolff (2011). Nevertheless, it was not very abundant in this work. In the collection of this species, females were present in greater quantity than males, as it is shown in the results of the studies of Rodrigues-Guimarães et al. (2008).

Montoya et al. (2009) described *C. macellaria* primarily as a diurnal species, which is consistent with this study. They also reported this species as one of the most abundant; however, in our study *C. macellaria* was one of the species with lower abundance, which can be explained by the presence of *C. albiceps,* an introduced species which in its larval stage feeds on others larvae of flies, principally *C. macellaria,* significantly reducing their populations (Rosa et al., 2006).

The blowflies in this study were found mostly in the traps baited with fish, in second place with human faeces and at last with fruit (Figure 2). This behavior is consistent to the fact that animal tissues have higher percentage of fat and protein, necessary for the development of the early larval stages, consequently the most captured individuals were females (Stevens, 2003; Montoya et al., 2009; Charabidze et al., 2011; Rabelo et

al., 2011; Battán et al., 2012). Human faeces and fruit baits probably provide a lesser amount of these nutrients than necessary for the development of larvae.

CONCLUSIONS

In the sampled departments genera *Cochliomyia, Chrysomya, Lucilia* and *Chloroprocta* were reported. These genera belong to the Chrysomyinae and Luciliinae subfamilies. The most abundant species in this study was *C. megacephala,* corroborating the fact that this species has a high synanthropy, hence a medical and public health importance, useful in studies of forensic entomology in the examined localities. In addition the range of distribution of *L. sericata* was extended to the department of Bolivar and *C. idioidea* to the departments of La Guajira, Magdalena, Bolívar and Atlántico. It would necessary a longer lasting study to determine if external factors are affecting the abundance of species of the Calliphoridae family in these locations.

In the colombian Caribbean coast there are no exhaustive studies in relation to the taxonomy and ecology of the species of the family Calliphoridae. For this reason, this study constitutes a significant contribution to the knowledge of this family in the north of Colombia.

ACKNOWLEDGEMENTS

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