Synanthropy of Sarcophagidae (Diptera) in La Pintada, Antioquia-Colombia

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Abstract: Sinantropía de Sarcophagidae (Diptera) en La Pintada, Antioquia-Colombia. Recently, populations of flies have increased in numbers given the elevated levels of organic matter waste produced by anthropic activities and domestication of animals. Such increase represents a worldwide health concern, since flies can be vectors of human diseases. The great variety of feeding and developmental habits of flies of the family Sarcophagidae taking place on animal corpses, feces and decomposed organic matter make them potential vectors of pathogens. Herein, we evaluated the synanthropic index (SI), as well as other ecological aspects of this family, through simultaneous monthly samplings in three areas with different degrees of human disturbance (urban, rural and forest). Each area had four van Someren Rydon traps, each one with a different bait (i.e., human feces, chicken viscera, fish and decomposing onion). Traps were active during 48 hours each month, and specimen collection was made every 12 hours. A total of 7 446 Sarcophagidae individuals were collected (1 275 males and 6 171 females), belonging to 27 species and nine genera. *Tricharaea* (*Sarcophagula*) *canuta* (SI=+96.67), *Oxysarcodexia taitensis* (SI=+93.85), *Peckia* (*Peckia*) *chrysostoma* (SI=+90.00) and *Tricharaea* (*Sarcophagula*) *occidua* (SI=+88.76) exhibited the highest values of synanthropy index, revealing a strong preference for human settlements. The most abundant species were *Oxysarcodexia conclausa* (21.80%), *Ravinia effrenata* (18.67%), *Oxysarcodexia bakeri* (11.45%) and *Oxysarcodexia taitensis* (10.20%), all of which exhibited preference for urban environments. Additionally, we are reporting seven new records of Sarcophagid flies for Colombia: *Oxysarcodexia angrensis*, *Oxysarcodexia bakeri*, *Oxysarcodexia diana*, *Oxysarcodexia similata*, *Oxysarcodexia timida*, *Peckia* (*Peckia*) *pexata* and *Titanogrypa* (*Cucullomyia*) *placida*. Rev. Biol. Trop. 61 (3): 1275-1287. Epub 2013 September 01.

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The Sarcophagidae Hagen, 1881, are a family of Calyptratae flies present in all geographic regions of the world, from which nearly 2 600 species have been described. They are distributed in three subfamilies: Miltogramminae, Paramacronychiinae and Sarcophaginae (Pape 1996). Sarcophagidae show the highest richness in the Neotropical region and it is strongly dominated by Sarcophaginae, with few members of the other subfamilies (Pape & Dahlem 2010). In Colombia, there are 78 species reported: six Miltogramminae and 72 Sarcophaginae, the latter grouped in 24 genera, with some of the most notorious being: *Oxysarcodexia* Townsend, 1917, *Peckia* Robineau-Desvoidy, 1830, *Ravinia* Robineau-Desvoidy, 1863 and *Lepidodexia* Brauer & Bergenstamm, 1891 (Pape *et al.* 2004).

Sarcophaginae have a wide variety of habits, some species being scavengers, coprophages, hosts of ant and termite nests, some cause myasis to amphibians and mammals, others are predators on arachnid eggs, butterfly larvae and bee pupae. They can even be highly specialized parasitoids in other arthropods (Pape *et al*. 2004). This variety of habits is what

allows several species to be associated with human environments and domestic animals, becoming a great threat to public health, due to their capacity to become vectors of pathogenic organisms such as protozoa, helminthes, bacteria and virus (Greenberg 1973).

The transformation of natural environments into urban and rural areas, radically changes local fauna and flora, however, some species of flies can adapt to these new conditions; this association is called synanthropy and can be calculated for different ecological regions according to the formula proposed by Nuorteva (Ferreira 1979, Linhares 1981, Dias *et al.* 1984, D'Almeida 1984, Ferreira & Lacerda 1993, Gomes & Von Zuben 2005, Montoya *et al.* 2009, Uribe *et al.* 2010), who considers synanthropy as "the capacity of some animals to make use of favorable conditions created by men" (Nuorteva 1963).

Calculation of synanthropy index (SI) is based on the comparison of flies species collected in urban, rural and forest areas. This index ranges from -100 and +100; positive values show a preference for areas with human settlements and negative values show intolerance to ecological changes resulting from urbanization. The degree and nature in which synanthropy occurs is different depending on the species, the geographical and weather conditions of the place, and the characteristics of the human groups that modify the habitat in a determined way, with their culture, traditions and habits (Nuorteva 1963). Furthermore, the environmental impact caused by a poor management of residuals, increases densities of synanthropic flies populations, and in consequence, the potential of disease transmissions (Paraluppi & Castellón 1994, Lomônaco & Almeida 1995, Ferreira & Barbola 1998).

Sarcophagidae are an important component of synanthropic fauna in South America, however, there are few works done under this perspective, which have been developed mainly in some regions of Brazil as Curitiba (Ferreira 1979), Campinas (Linhares 1981), Belo Horizonte (Dias *et al*. 1984), Rio de Janeiro (D'Almeida 1984) and Goiânia (Ferreira & Lacerda 1993). In Colombia, there are only two studies on synanthropy, one for the family Calliphoridae (Montoya *et al.* 2009) and another for Muscidae (Uribe *et al.* 2010) with none on Sarcophagidae associated to anthropic environments. This way, the present work is a contribution to the ecology, natural history and general knowledge of the Sarcophagidae.

MATERIALS AND METHODS

Study site: La Pintada is located in the Southwest of the department of Antioquia, Colombia, at 5º44' N - 75º36' W at an average altitude of 600masl. Annual average temperature is 27°C, relative humidity is 76% and average annual precipitation is 1 000mm, the latter having a bimodal distribution characterized by two wet periods (April-May and September-November) and two with less precipitation (December-March and June-August). The municipality has an area of 55km^2 with a population of 10 450 inhabitants and an urban area of 6.5km^2 (Velásquez *et al*. 2006). All sampling areas belong to Tropical Dry Forest (T-df) (Holdridge 1967).

Sampling: The study was simultaneously done in three areas with different ecological characteristics: 1. Urban area: located in the village (5º44'48" N - 75º36'34" W) at an altitude of 610masl. There are drinkable water, sewerage system and periodical waste collection. 2. Rural area: grasslands located 5km away from the urban area (5º43'25" N - 75º37'26" W) at an altitude of 770masl. Drinkable water is collected from a spring, it also has a septic tank and waste is burned. The site provides ecotourism services with approximately 150 visitors each month and holds four permanent residents, beef cattle and horses. 3. Forest area: it is characterized by low human intervention, located in Farallón de la Paz (5º43'24" N - 75º37'15" W) 5.5km away from the urban area and at an altitude of 850masl.

Four van Someren Rydon traps (Villareal *et al*. 2004) were installed in each area, placed one meter high from the ground and separated

from each other by a distance of 50m. Each trap was baited with about 150g of a bait type: human faeces, fish, chicken viscera or rotting onion. The traps were left for 48 hours each month, and obtained material was collected in Falcon vials containing 70% ethanol every 12 hours (06:00 and 18:00h). Samples were taken every month for a total period of six months, from February to July 2007. The total sampling effort in each area was 1 152 hours. Precipitation data were provided by the Colombian Meteorogical Institute (Instituto de Hidrología, Meteorología y Estudios Ambientales de Colombia-IDEAM).

Preservation and identification: Only the males were identified, since there are not descriptions and keys for the females; nonetheless these were considered for some analyses. Males were set in entomological pins with their external genitalia exposed, in order to observe the structures that allow species identification. They were identified following the keys of Carvalho & Mello-Patiu (2008), Buenaventura *et al.* (2009) and Pape & Dahlem (2010), the catalogue by Pape (1996), some descriptions and redescriptions (e.g. Lopes 1946, 1962, 1975, Leite & Lopes 1989, Lopes & Leite 1991, Lopes & Tibana 1991, Guimarães 2004, Giroux *et al*. 2010) and through the revision of the Sarcophagidae reference collection deposited in the Entomological Collection of University of Antioquia (Colección de Entomología de la Universidad de Antioquia - CEUA), identified by Thomas Pape and Cátia Antunes de Mello-Patiu, specialists on this family. The nomenclature adopted was from Pape (1996). All material was deposited in the Entomological Collection of University of Antioquia (CEUA, Collection National Register No.036).

The SI was calculated according to the formula by Nuorteva (1963), SI=(2a+b-2c)/2, where a. is the percentage of individuals of a given species collected in the urban area, b. is the percentage of the same species collected in the rural area, and c. the percentage of the same collected in the forest. For this analysis, only species with a number equal or higher to 15 individuals were considered.

RESULTS

A total of 7 446 individuals were collected (1 275 males and 6 171 females). Males were 17.1% of the sample, distributed in nine genera and 27 species. *Oxysarcodexia* and *Peckia* were the most diverse genera with 11 and six species respectively, *Ravinia* and *Tricharaea* with two species, and *Argoravinia*, *Helicobia*, *Sarcodexia*, *Sarcofahrtiopsis* and *Titanogrypa* were represented by only one species (Fig. 1). The complete results for all species are in the appendix section.

From all the species found, only *Peckia* (*Squamatodes*) *ingens* (Walker, 1849) were reported for Antioquia; the remaining species are new records for this department, and seven of them were also new records for Colombia: *Oxysarcodexia angrensis* (Lopes, 1933), *O. bakeri* (Aldrich, 1916), *O. diana* (Lopes, 1933), *O. similata* (Lopes & Tibana, 1987), *O. timida* (Aldrich, 1916), *P.* (*Peckia*) *pexata* (Wulp, 1895) and *Titanogrypa* (*Cucullomyia*) *placida* (Aldrich, 1925), which totalizes 85 species for the country (Fig. 1).

Oxysarcodexia conclausa (Walker, 1861), *Ravinia effrenata* (Walker, 1861), *O. bakeri* and *Oxysarcodexia taitensis* (Schiner, 1868) were the most abundant species respectively, representing 62.07% of the total number of males collected (Fig. 1). These species were scarcely found in the forest area. Consequently, the urban and rural areas had the highest proportions of individuals: 71.69% and 23.22% respectively (including all the species found) (Fig. 2, 3).

Titanogrypa placida, *Oxysarcodexia cyaniforceps* (Hall, 1933), *O. diana*, *Peckia pexata* and *Sarcofahrtiopsis cuneata* (Townsend, 1935) were the most scarce species with only two individuals for *T. placida* and one individual for each of the remaining species; however, three of these species were new records for Colombia (Appendix).

Most of the collected individuals were found in May, which coincides with the wettest

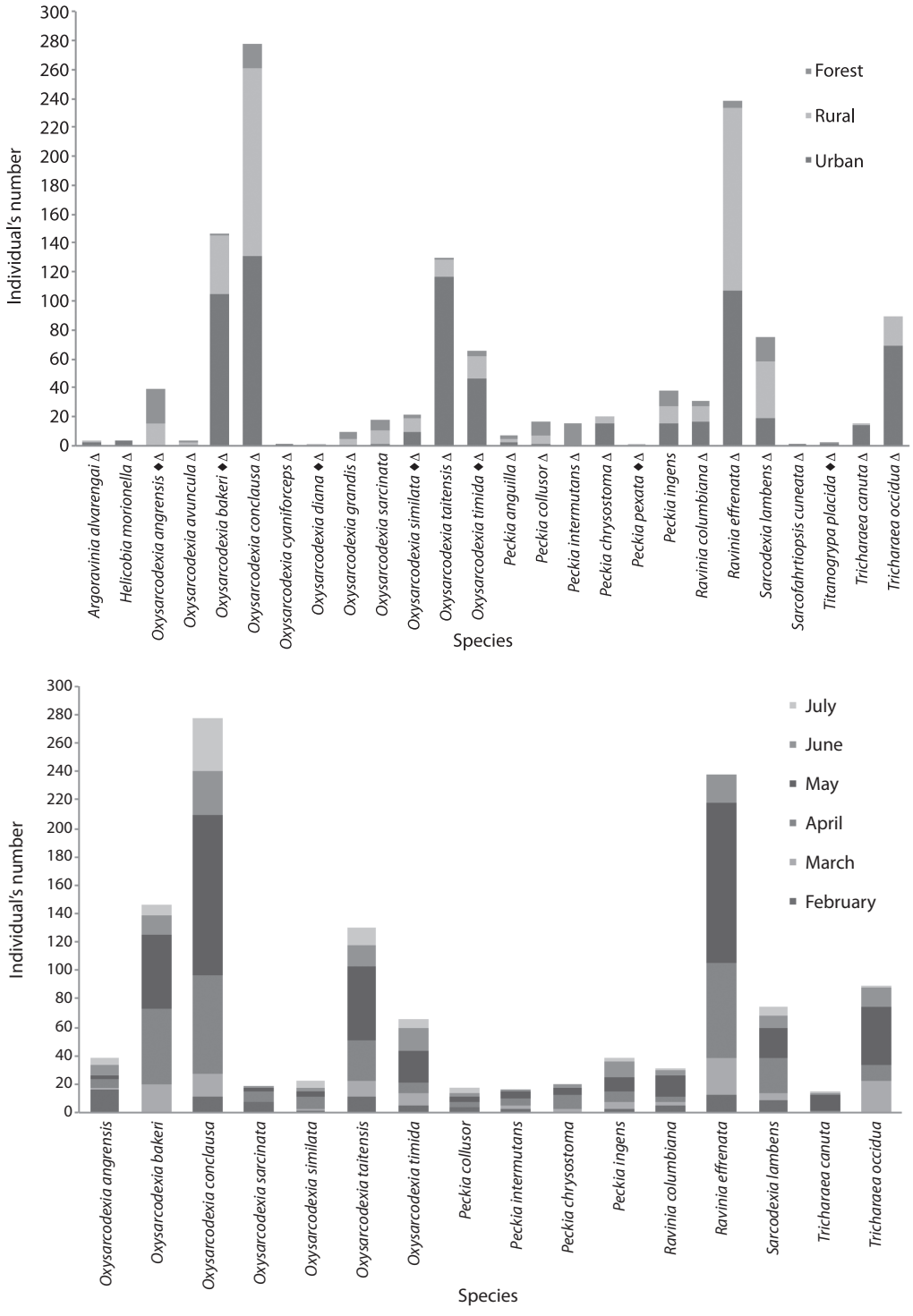

Fig. 2. Monthly distribution of Sarcophagidae species with 15 or more individuals, collected in La Pintada, Antioquia-Colombia from February to July, 2007.

month; on the other hand, the least number of sarcophagid flies were collected during February when the precipitation was very low. Therefore the monthly species abundance was possibly related to rainfall (Figs. 2, 4).

Chicken viscera was the most effective bait in all three areas (41.82%), followed by fish (39.86%), human faeces (16.47%) and onion (1.85%) (Fig. 3). However, a difference was found between the preference of males and females for the baits, being chicken viscera the most effective to capture males (33.80%) (Fig. 5), and fish and viscera had a very similar effect in females (41.11% and 39.88% respectively).

The species with the highest synanthropic indices were *Tricharaea* (*Sarcophagula*) *canuta* (Wulp, 1896) and *Oxysarcodexia taitensis* with 96.67 and 93.85 respectively, showing a

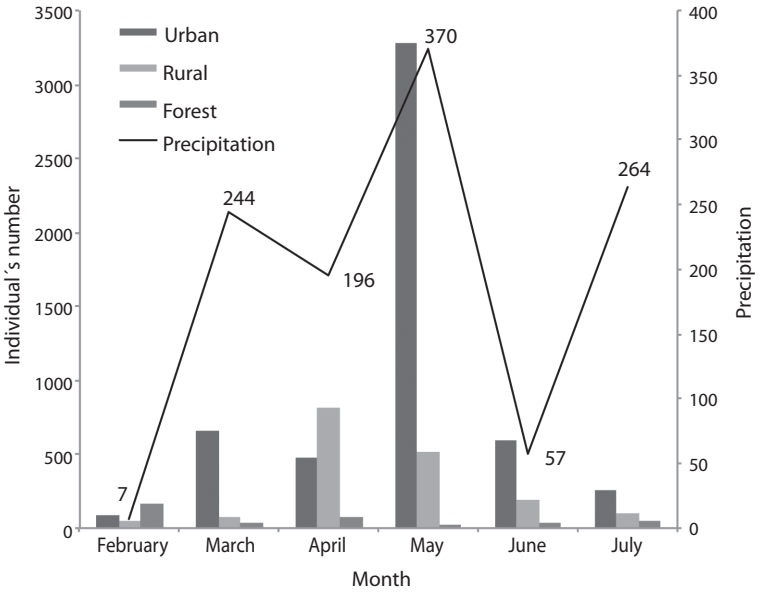

Fig. 3. Monthly frequencies of Sarcophagidae individuals collected in each of the sampling areas and precipitations through the months of February to July, 2007 in La Pintada, Antioquia-Colombia.

very strong preference for human settlements. In contrast, *Oxysarcodexia angrensis* and *Peckia* (*Pattonella*) *intermutans* (Walker, 1861) with -42.31 and -100.00 respectively, were not found in urban areas and *P. intermutans* was found exclusively in the forest area, showing a complete avoidance for human settlements. The remaining species showed different degrees of association with human settlements, most of them preferring habited areas (Table 1 and Appendix).

DISCUSSION

With this study we have reported seven new records for Colombia, many of them previously recorded for other countries in the Neotropical and Neartic regions (Lopes 1975, Lopes & Tibana 1991, Pape 1996, Oliveira *et al.* 2002, Pape *et al.* 2004). These results allow us to resume a total of 85 species of this family for Colombia.

The most abundant genus in this study was *Oxysarcodexia*, represented mainly by *O. conclausa*, which was observed throughout the study showing a preference for human settlements and exhibited a strong necrophagous behavior.

Tricharaea canuta was the most eusynanthropic species with a strong preference for dense human settlements, it was mainly attracted by human faeces, for which it

TABLE 1
Synanthropic index (SI) for Sarcophagidae species

Species*	SI	Significance of the value of the index †	Value limit	
Tricharaea canuta	96.67	Strong preference for dense human settlements	100	90
Oxysarcodexia taitensis	93.85	Strong preference for dense human settlements	100	90
Peckia chrysostoma	90.00	Strong preference for human settlements	90	65
Tricharaea occidua	88.76	Strong preference for human settlements	90	65
Oxysarcodexia bakeri	84.93	Strong preference for human settlements	90	65
Oxysarcodexia timida	75.76	Strong preference for human settlements	90	65
Ravinia effrenata	69.96	Strong preference for human settlements	90	65
Oxysarcodexia conclausa	64.39	Preference for human settlements	65	20
Ravinia columbiana	62.90	Preference for human settlements	65	20
Oxysarcodexia similata	52.27	Preference for human settlements	65	20
Sarcodexia lambens	30.67	Preference for human settlements	65	20
Peckia ingens	27.63	Preference for human settlements	65	20
Oxysarcodexia sarcinata	-5.56	Preference for uninhabited areas	0	-40
Peckia collusor	-35.29	Preference for uninhabited areas	0	-40
Oxysarcodexia angrensis	-42.31	Complete avoidance for human settlements	-40	-100
Peckia intermutans	-100.00	Complete avoidance for human settlements	-40	-100

* Species with 15 or more individuals.
† Significance of the value of the index follows Nuorteva (1963).
Samples were collected in La Pintada, Antioquia-Colombia from February to July, 2007.

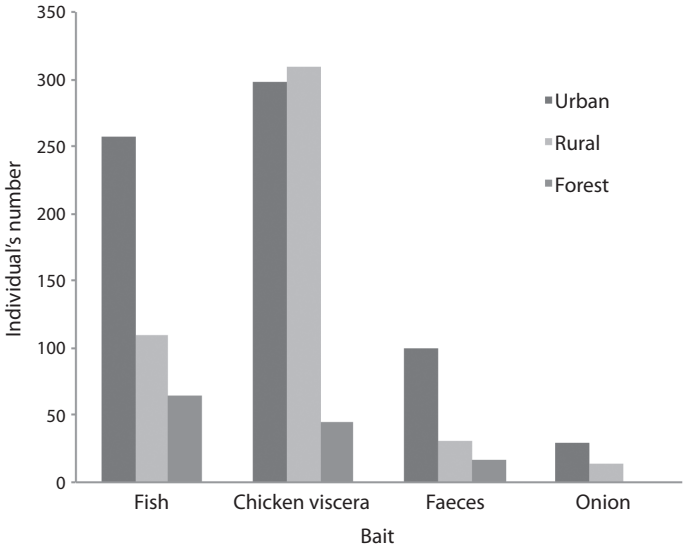

Fig. 4. Number of Sarcophagidae individuals collected at each bait in the sampling areas of La Pintada, Antioquia-Colombia, through the months of February to July, 2007.

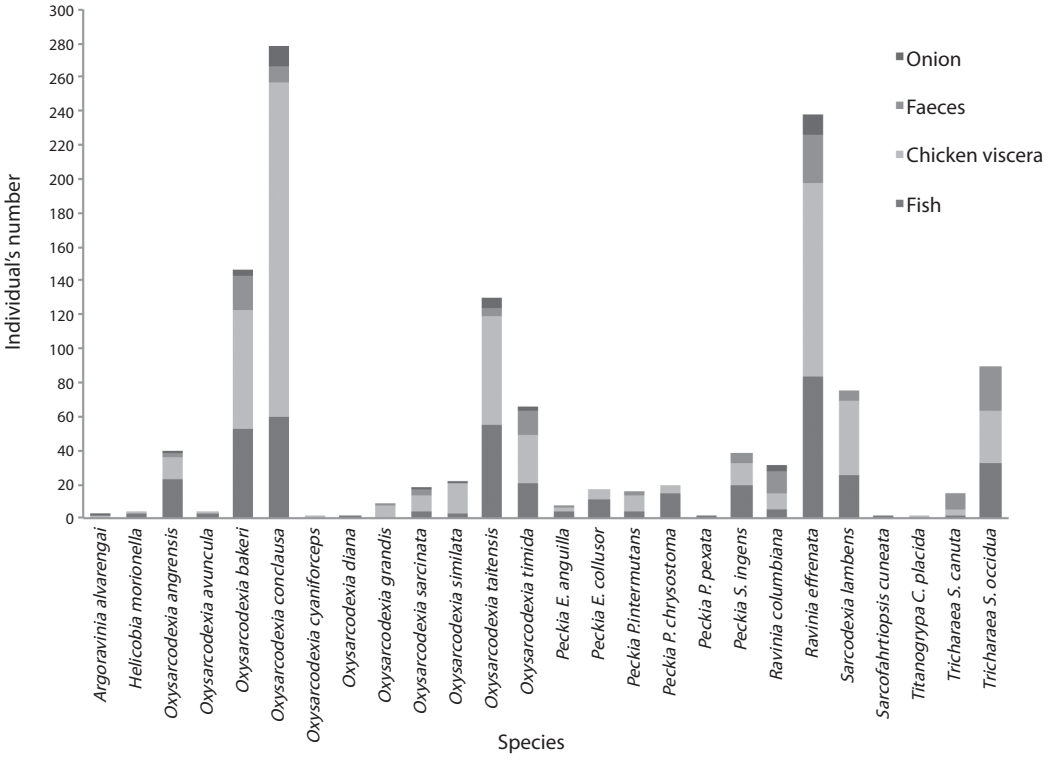

Fig. 5. Sarcophagidae species collected with each bait in La Pintada, Antioquia-Colombia from February to July, 2007.

could be considered as a potential vector of pathogens to humans.

Peckia (*Peckia*) *chrysostoma* (Wiedemann, 1830), *Tricharaea* (*Sarcophagula*) *occidua* (Fabricius, 1794), *O. bakeri* and *O. timida* showed a strong preference for human settlements, having high synanthropic indexes (from 90 to 65). *Tricharaea occidua* was collected in chicken viscera, fish and human faeces in similar proportions, and therefore it could be considered a potential vector of human diseases, it has also been registered in previous studies as one of the most abundant species in corpses (Barros *et al*. 2008). *Peckia chrysostoma* was mainly found in the urban area and being absent in forests; this coincides with observations in Rio de Janeiro, where it was commonly found inside houses, SI=60.97 (D'Almeida 1984), while in Belo Horizonte it was more common in uninhabited areas, SI=-32.4 (Dias *et al*. 1984) and in Campinas it showed independence of human settlements, SI=13.90 (Linhares 1981). This species revealed a necrophagous behavior, also evidenced in Rio de Janeiro and Campinas, in a similar way (Linhares 1981, D'Almeida 1984). It has been collected in decomposing fish (Leandro *et al*. 2005), pig corpses (Barros *et al*. 2008, Barbosa *et al.* 2009) and human corpses (Oliveira-Costa *et al.* 2001) in Brazil, where is of great forensic importance.

Oxysarcodexia similata, Sarcodexia lambens (Wiedemann, 1830) and *P. ingens* revealed a preference for human settlements, being present in all three sampling areas, with a similar abundance in urban and rural areas. *Sarcodexia lambens* showed a strong attraction for fish and chicken viscera, in accordance to other studies where this species has been found in a large proportion in corpses (Barros *et al*. 2008). However, it is an opportunistic species and it has been attracted by a variety of substrata,

such as pig and human corpses (Oliveira-Costa *et al.* 2001, Barros *et al*. 2008, Barbosa *et al.* 2009), and even causing myasis in humans (Queiroz de Leão *et al.* 1996, Fernandes *et al*. 2009) and frogs (Hagman *et al*. 2005).

Linhares (1981) reported *Helicobia morionella* (Aldrich, 1930) attracted by chicken viscera, mouse corpses and human faeces, showed the highest abundance in the latter; it also resulted in a synanthropic index that reveals a complete rejection for human settlements. These results contrast with those found in this study, since the few individuals collected of this species were caught in the urban area being attracted by fish and chicken viscera, with no individuals in human faeces.

Peckia pexata and *P.* (*Euboettcheria*) *anguilla* (Curran & Walley, 1934) were considered an asynanthropic species by Dias *et al* (1984), differing from the herein presented results, since *P. anguilla* showed its highest abundance in the rural area, also being present in the urban and forest areas. However, both species exhibit necrophagous habits and have been previously associated to corpses' decomposition (Barros *et al*. 2008). *Peckia pexata* is represented in this study by only one individual collected in the rural area, for this reason, nothing could yet be concluded. In Brazil, this species has been recorded as one of the most abundant in corpses in the Cerrado biome being present in several phases of decomposition, and therefore, having forensic importance (Barros *et al*. 2008).

Oxysarcodexia avuncula showed dominance in the forest of Belo Horizonte (Dias *et al*. 1984), while in the present study it was found in the rural area and the forest in equal proportions, being collected in fish and chicken viscera. This species has been attracted by corpses in Brazil (Barros *et al*. 2008), and in this study 75.0% of its individuals were attracted by fish and the other 25.0% by chicken viscera.

The species that showed preference for uninhabited areas were *Oxysarcodexia sarcinata* (Lopes, 1953) and *Peckia* (*Euboettcheria*) *collusor* (Curran & Walley, 1934). The latter showed complete rejection for human settlements in Campinas, SI=-71.10 (Linhares 1981), Belo Horizonte, SI=-93.00 (Dias *et al*. 1984) and Rio de Janeiro, SI=-80.99 (D'Almeida 1984), with most individuals collected in the forest, it was classified as an asynanthropic species. In La Pintada, it showed a necrophagous behavior being attracted in a larger proportion by fish and chicken viscera, what coincides with the other studies (D'Almeida 1984, Barros *et al*. 2008, D'Almeida & Lima 1994), while in Campinas it has been also reported in human faeces (Linhares 1981).

Oxysarcodexia angrensis was collected in all baits, being fish the most successful. This species exhibited a very low synanthropic index (-42.31) indicating a complete rejection for human settlements, which is in accordance to observations in Campinas where it was present in chicken viscera, mouse carcass and human faeces, SI=-58.90 (Linhares 1981).

Peckia intermutans presented the lowest synanthropic index (-100.00), since this species was recorded only in the forest, showing a complete rejection for urbanized areas, which make it an asynanthropic species. This result is similar to the behavior found in Campinas, SI=-94.30 (Linhares 1981) and Rio de Janeiro, SI=-60.1 (D'Almeida 1984); but it significantly differs from the results of Belo Horizonte, SI=4.2 (Dias *et al*. 1984) where *P. intermutans* showed independence from inhabited areas and was found in the three areas, with a lower proportion in the urban area. This species showed a necrophagous behavior, also exhibited in other studies (Linhares 1981, D'Almeida 1984, D'Almeida & Lima 1994), for this reason several taxonomists have remarked its importance in forensic entomology (Carvalho *et al*. 2000, Oliveira *et al*. 2002, Barros *et al*. 2008).

The great abundance of females in each environment can be explained by the need of appropriate substrata for laying larvae, being necrophagy the most abundant habit, while onion did not have a significant importance as bait. A deeper knowledge on the ecology of Sarcophagidae will help to better understand the dynamics of its species and their effect on

the ecosystem, which in turn opens the possibility to use the asynanthropic species as indicators of healthy environments, and even synanthropic species could be implemented in the forensic entomology field in Colombia.

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RESUMEN

La población de moscas se ha visto incrementada recientemente por la proliferación de residuos de materia orgánica proveniente de la actividad antrópica, así como por la domesticación de animales. Este aumento constituye una gran alerta de salud a nivel mundial, ya que algunas moscas son vectores de enfermedades al humano. Los Sarcophagidae cuentan con una gran variedad de hábitos de alimentación y desarrollo, los cuales tienen lugar en cadáveres de animales, excrementos y materia orgánica en descomposición; haciéndolos posibles vectores de patógenos. En este estudio se evaluó el índice de sinantropía, al igual que otros aspectos ecológicos de esta familia mediante muestreos mensuales simultáneos en tres zonas (urbana, rural y bosque), usando trampas van Someren Rydon cebadas con excremento humano, vísceras de pollo, pescado y cebolla en descomposición. En cada zona se instalaron cuatro trampas (una por atrayente), durante 48 horas cada mes, realizando recolectas cada 12 horas. Se recolectaron 7 446 individuos de Sarcophagidae (1 275 machos y 6 171 hembras), de 27 especies y nueve géneros. *Tricharaea* (*Sarcophagula*) *canuta* (+96.67), *Oxysarcodexia taitensis* (+93.85), *Peckia* (*Peckia*) *chrysostoma* (+90.00) y *Tricharaea* (*Sarcophagula*) *occidua* (+88.76) presentaron los índices de sinantropía más altos del estudio, lo que refleja una fuerte preferencia por asentamientos humanos. Las especies más abundantes fueron: *Oxysarcodexia conclausa* (21.80%), *Ravinia effrenata* (18.67%), *Oxysarcodexia bakeri* (11.45%) y *Oxysarcodexia taitensis* (10.20%), todas exhibiendo preferencia por ambientes urbanizados. Se reportan siete nuevos registros para Colombia: *Oxysarcodexia angrensis*, *Oxysarcodexia bakeri*, *Oxysarcodexia diana*, *Oxysarcodexia similata*, *Oxysarcodexia timida*, *Peckia* (*Peckia*) *pexata* y *Titanogrypa* (*Cucullomyia*) *placida*.

Palabras clave: índice de sinantropía, Sarcofágidos, ecología, bosque seco tropical, biodiversidad, historia de vida.

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APPENDIX

Oxysarcodexia conclausa: It was the most common species, corresponding to 21.80% of males, it was found in equal proportion in the urban and rural areas, and poorly represented in the forest area (Fig. 1). A significant abundance was found in May revealing a strong attraction for chicken viscera (Figs. 2 and 5). The synanthropic index for this species was +64.39, showing a preference for human settlements (Table 1).

Ravinia effrenata: It was the second most common species in the study, representing 18.67% of males, with its higher proportion in the rural area (53.4%) (Fig. 1). Number of captures increased as precipitation rose (Fig. 2 and Fig. 3). This species showed attraction for chicken viscera and fish (Fig. 5). Its synanthropic index was +69.96, indicating a strong preference for human settlements (Table 1).

Oxysarcodexia bakeri: This represents the first record of this species for Colombia. We observed a total number of 146 individuals that represented the 11.45% of the sample (Fig. 1). Its highest abundance was obtained in April and May in equal proportions (Fig. 2 and Fig. 3). It showed attraction for chicken viscera and fish (Fig. 4 and Fig. 5). Synanthropic index for this species was +84.93, revealing a strong preference for human settlements and being almost absent in the forest (Table 1).

Oxysarcodexia taitensis: Represented 10.20% of the total number of individuals (Fig. 1) and its monthly frequency increased with the rain (Fig. 2 and Fig. 3). It showed preference for chicken viscera and fish in similar proportions (Fig. 4 and Fig. 5). Its synanthropy index was the second highest in the study (+93.85), indicating a marked preference for dense human settlements (Table 1).

Tricharaea (*Sarcophagula*) *occidua* (Fabricius, 1794): Represented 6.98% of the total number of males found in the urban and rural areas, with a higher abundance in the first (Fig. 1). It was collected in chicken viscera, fish and human faeces in very similar proportions, and was absent in onion (Fig. 5). This was the most abundant species in May, with 47.19% of the individuals (Fig. 2). Its synanthropic index was +88.76, indicating a strong preference for human settlements (Table 1).

Sarcodexia lambens (Wiedemann, 1830): Represented 5.88% of the sample (Fig. 1). Its capture was directly related to rainfall, and increased in those months with the most frequent rainfalls (Fig. 2 and Fig. 3). It was mainly attracted by chicken viscera and fish (Fig. 5). Its synanthropic index was +30.67, indicating a slight preference to human settlements (Table 1), since it was more abundant in the rural area, followed by the urban (Fig. 1).

Oxysarcodexia timida (Aldrich, 1916): This study represents the first record of this species for Colombia. It was present during the six months of the study, with a higher abundance in May (34.85%) (Fig. 2); it represented the 5.18% of the total number of individuals (Fig. 1). It showed a higher preference for chicken viscera (42.4%) (Fig. 5). This species was largely found in the urban area, with few captures in the forest, proved by its synanthropic index of +75.76, indicating a strong preference for human settlements (Table 1).

Oxysarcodexia angrensis (Lopes, 1933): It is recorded for the first time in Colombia in this study, representing 3.06% of the sample (Fig. 1). It was attracted by all baits, showing a strong affinity for fish (Fig. 5). It showed a different behavior when compared to the previously described species: it exhibited a higher abundance during the dry season, with 41.03% of all individuals (Fig. 2 and Fig. 3). It was collected in a larger proportion in the forest, being absent in the urban area, which

was corroborated by its synanthropic index of -42.31%, that indicated complete rejection for human settlements (Table 1).

Peckia (*Squamatodes*) *ingens* (Walker, 1849): Its highest abundance was recorded in May and June showing strong attraction for fish (Figs. 2 and 5). It was numerous in the urban area (42.1%) and found in equal proportions in the rural area and the forest (28.9%) (Fig. 1). Its synanthropic index +27.63, revealed a slight preference for human settlements (Table 1).

Ravinia columbiana (Lopes, 1962): Presented its highest abundance in May with 48.39% of all individuals (Fig. 2). It was mainly attracted by human faeces (41.9%), followed by chicken viscera (32.3%) (Fig. 5). Its synanthropic index was +62.90, since it was found in all areas but with a larger proportion in the urban (Fig. 1); therefore showing preference for human settlements (Table 1).

Oxysarcodexia similata (Lopes & Tibana, 1987): This study represents the first record of this species for Colombia. Represents 1.73% of the total number of males (Fig. 1), with the highest abundance in April (Fig. 2) and a strong attraction for chicken viscera (81.8%), no individuals were collected in human faeces (Fig. 5). It was found similarly in the urban and rural areas, with few captures in the forest (Fig. 1). The synanthropic index was +52.27, showing preference for human settlements (Table 1).

Peckia (*Peckia*) *chrysostoma* (Wiedemann, 1830): Its highest abundance was recorded in April (Fig. 2 and Fig. 3) and it was mainly attracted by fish (75.0%), followed by chicken viscera, and absent in the other baits (Fig. 5). The 80.0% of individuals were collected in the urban area (Fig. 1), resulting in a synanthropic index of +90.00, which indicates a strong preference for human settlements (Table 1).

Oxysarcodexia sarcinata (Lopes, 1953): Its highest abundance occurred in April (44.44%), being absent in March and July (Fig. 2). This species was found in all baits, with a higher proportion in chicken viscera (Fig. 5). Its synanthropic index was-5.56, indicating a preference for uninhabited areas (Table 1).

Peckia (*Euboettcheria*) *collusor* (Curran & Walley, 1934): Represented 1.33% of the total, with 17 individuals recorded (Fig. 1); it was mainly attracted by fish (Fig. 5). Its monthly abundance was very similar during all months (Fig. 2). A total of 58.8% of all individuals were found in the forest, resulting in a synanthropic index of-35.29, indicating a preference for uninhabited areas (Table 1).

Peckia (*Pattonella*) *intermutans* (Walker, 1861): Constituted 1.25% of the total (Fig. 1), with the highest abundance in the wet months and absent in the beginning of the dry season (Fig. 2 and Fig. 3). It was mainly attracted by chicken viscera (Fig. 5). It represented the lowest synanthropic index of all the study (-100.00), indicating a complete rejection for human settlements and being present only in the forest (Fig. 1 and Table 1).

Tricharaea (*Sarcophagula*) *canuta* (Wulp, 1896): It was found in a larger proportion in May (73.33%) and it was absent during the first months of sampling (Fig. 2). It showed its highest abundance in the urban area (93.3%) (Fig. 1), having 66.7% of all individuals attracted by human faeces (Fig. 5). Its synathropic index was the highest in all the study (+96.67), showing a strong preference for dense human settlements (Table 1).

Oxysarcodexia grandis (Lopes, 1946): It was infrequent in the study, with just nine individuals collected in the rural and forest area, in a proportion of 55.6% and 44.4% respectively (Fig. 1). It was mainly attracted by chicken viscera (Fig. 5).

Peckia (*Euboettcheria*) *anguilla* (Curran & Walley, 1934): Represented 0.55% of the total, with just seven captures, found in a larger proportion in the rural area and with

similar proportions in the urban area and the forest (Fig. 1). Presented a strong attraction for fish (Fig. 5).

Oxysarcodexia avuncula (Lopes, 1933): It was scarce in the study, with just four individuals were collected in both rural and forest areas in equal proportions (Fig. 1). A total of 75.0% of the individuals were attracted by fish and the other 25.0% by chicken viscera; no individuals were found in other baits (Fig. 5).

Helicobia morionella (Aldrich, 1930): It was uncommon in the study, represented by only four individuals in the urban area (Fig. 1). It was mainly attracted by fish (Fig. 5).

Argoravinia alvarengai (Lopes, 1976): Represented 0.24% of the total, its highest abundance was recorded in the urban area with no records in the forest (Fig. 1). It showed equal attraction by chicken viscera, fish and onion baits, while no organisms were found in human faeces (Fig. 5).

Titanogrypa (*Cucullomyia*) *placida* (Aldrich, 1925): This study represents the first record of this species in Colombia. It was scarce, with only two individuals, one collected in the urban area and the other in the forest (Fig. 1). It showed attraction for fish and chicken viscera (Fig. 5).

Oxysarcodexia cyaniforceps (Hall, 1933): With only one individual collected in the urban area in chicken viscera (Figs. 1 and 5).

Oxysarcodexia diana (Lopes, 1933): Recorded for the first time in Colombia, it was represented by one individual collected in the rural area. It was attracted by fish (Figs. 1 and 5).

Peckia (*Peckia*) *pexata* (Wulp, 1895): This study represents the first record of this species for Colombia, and was represented by one individual collected with fish bait in the rural area (Figs. 1 and 5).

Sarcofahrtiopsis cuneata (Townsend, 1935): This species was represented by one individual in the urban area and was attracted by fish (Figs. 1 and 5).