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DIVERSITY OF NECROPHAGOUS BLOWFLY (DIPTERA: CALLIPHORIDAE) OF MEDICAL AND VETERINARY IMPORTANCE IN URBAN ENVIRONMENTS IN CÓRDOBA (ARGENTINA)

Diversidad de moscas necrófagas (Diptera: Calliphoridae) de importancia médica y veterinaria en ambientes urbanos en Córdoba (Argentina)

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ABSTRACT

The complex nature of urban environments can have different effects on species diversity and composition. The aim of this work was to characterize the assemblage of Calliphoridae regarding its richness, abundance, and synanthropy in Córdoba City, Argentina. Three sampling sites differing in their distance to the border of the city and degree of urbanization were selected. In each site, collections were carried out with 12 traps baited with cow liver (200 g per trap) that were operated for five consecutive days during three different times of the year, in April, June and August 2013. A total of 341 adult calliphorids from nine species, *Lucilia sericata* (Meigen), *L. eximia* (Wiedemann), *L. cuprina* (Wiedemann), *L. cluvia* (Walker), *Calliphora vicina* Robineau-Desvoidy, *Sarconesia chlorogaster* (Wiedemann), *Chrysomya albiceps* (Wiedemann), *C. megacephala* (Fabricius) and *C. chloropyga* (Wiedemann) were collected. *Lucilia sericata* was the most abundant species followed by *C. vicina*. Species diversity, composition and abundance changed between sites, richness being lowest at the most urbanized site. All species are cosmopolitan except *Sarconesia chlorogaster*, whose distribution is restricted to South America. These results are consistent with a homogenization of the fauna in urban environments.

Key words. Diptera, Calliphoridae, urban landscape, diversity.

RESUMEN

La complejidad de los entornos urbanos puede tener diferentes efectos en la diversidad y la composición de especies. El objetivo de este trabajo fue caracterizar el conjunto de Calliphoridae en cuanto a su riqueza, abundancia y sinantropía en la ciudad de Córdoba, Argentina. Se seleccionaron tres sitios de muestreo que difieren tanto en la distancia al borde o límite de la ciudad como en la intensidad de la urbanización. En cada sitio se colocaron 12 trampas cebadas con hígado de vaca (200 g por trampa) que permanecieron durante cinco días consecutivos durante tres momentos diferentes del año, en abril, junio y agosto de 2013. Se recolectó un total de 341 califóridas adultos pertenecientes a nueve especies, *Lucilia sericata* (Meigen), *L. eximia* (Wiedemann), *L. cuprina* (Wiedemann), *L. cluvia* (Walker), *Calliphora vicina* Robineau-Desvoidy, *Sarconesia chlorogaster* (Wiedemann), *Chrysomya albiceps* (Wiedemann), *C. megacephala* (Fabricius) y *C. chloropyga* (Wiedemann). *Lucilia sericata* fue la especie más abundante, seguida de *C. vicina*. La diversidad, la composición y la abundancia de especies cambiaron entre los sitios, observándose una disminución en la riqueza del sitio más urbanizado. Todas las especies son cosmopolitas, excepto *Sarconesia chlorogaster*, cuya distribución está restringida a Sudamérica. Estos resultados son consistentes con una homogeneización de la fauna en entornos urbanos.

Palabras clave. Diptera, Calliphoridae, paisaje urbano, diversidad.

INTRODUCTION

The process of urbanization affects the structure of the insect communities. Urban environments can have different effects on local species diversity, leading to a marked dominance of those more adapted to human environments and their activities (McKinney 2002, 2006, Mulieri *et al*. 2011). Alternatively, urbanization can promote an increase in biodiversity, usually by the incorporation of exotic species that may even replace native species or because urban environments offer a high diversity of resources which can be used by a larger variety of species (McKinney 2002, 2006). Researches on biotic responses to urbanization have shown widely varying results. For example, a meta-analysis of results from carabid studies showed a clear reduction in species richness in urban green areas compared with equivalent rural sites (Martinson & Raupp 2013). In Buenos Aires, Argentina, Sarcophagidae species that were able to exploit dead or moribund invertebrates were collected almost exclusively in rural and not in urban environments, suggesting that the urban landscape could reduce the abundance and richness of potential prey or dead insects (Mulieri *et al*. 2011). On the other hand, both the urban and suburban samples were dominated by native coprophilous species; this success is due to exploiting the feces of domestic animals, a larval substrate commonly available in cities (Mulieri *et al*. 2011).

Several studies have described the detrimental impact of urbanization on abundance, species richness, and community composition in different groups of insects (for example, Gibb & Hochuli 2002, Mulieri *et al*. 2011, Martinson & Raupp 2013, Greco *et al*. 2014). Some of these works have particularly focused on necrophagous Diptera, especially on species of the family Calliphoridae, which are important in the degradation of organic matter (for example, Figueroa-Roa & Linhares 2002, Patitucci *et al*. 2011, De Souza & Zuben 2012, Pinilla Beltran *et al*. 2012). These flies have medical and veterinary relevance as they can be mechanical vectors of biological pathogens (Cadavid-Sanchez *et al*. 2015), and some species cause myiasis to humans and other vertebrates (Greenberg 1973, Guimarães & Papavero 1999). Blowflies are common inhabitants of the urban ecosystem and require a temporally and spatially random ephemeral resource (e.g., carrion, dung, animal decaying organic matter) to complete development. Therefore, these dipterous may display a different response to urbanization compared with insects that feed and/or reproduce on more constant and uniformly distributed food sources. Recent studies indicate that species composition and relative abundance of Calliphoridae may be strongly influenced by human intervention on natural environments, especially when urbanization processes are involved (Patitucci *et al*. 2011).

The association of calliphorid species with human settlements has been studied for some regions of South America, in Brazil (Linhares 1981a, Carvalho *et al*. 1984, Viana *et al*.

1998), Chile (Figueroa & Linhares 2002) and Colombia (Pinilla Beltran *et al.* 2012). Comparative studies on the diversity of blowflies in relation to gradients of urbanization have been conducted in some geographic locations in Argentina. In the southeast of Patagonia, Mariluis *et al.* (2008) reported a higher prevalence in urban areas of the exotic species *Calliphora vicina* and *Lucilia sericata* over the natives *Compsomyops fulvicrura* (Robineau-Desvoidy) and *Sarconesia chlorogaster*, which showed a strong preference for either uninhabited or less influenced area. This region of Patagonia has cold semidesertic climate and is mainly represented by a shrubby steppe of xeric shrubs accompanied by coarse grasses. Centeno *et al.* (2004), in the "Pampa" biome near Buenos Aires characterized by predominantly grassland vegetation and a temperate-humid to subhumid climate, observed the highest levels of diversity in natural and rural areas compared to urban sites. In a rural area of Córdoba, a temperate-semidry area, Battán Horenstein *et al.* (2007, 2010) carried out a study on pig carcasses detecting seasonal and insolation condition (shade or sunlight) differences in species composition of the Calliphoridae family. In that study, seven calliphorid species were collected, and *Chrysomya albiceps* was the dominant species in summer, autumn and spring, being replaced in winter by *C. vicina*, *S. chlorogaster* and *L. sericata*. *Calliphora vicina* showed a strong preference for carcasses in the shade.

As far as we know, the effect of urbanization on blowfly communities in the central region of Argentina, an eco-climatically different region from Buenos Aires and Patagonia, has not yet been explored. The aim of this work was to characterize the assemblage of calliphorid regarding its richness, abundance, and synanthropy (urbanization intensity) in Córdoba City, Argentina. Our final goal is to contribute to the knowledge of how human modification of the natural environment affects the diversity of ecological communities and may have health implications through facilitating the proliferation of species of medical and veterinary importance.

MATERIALS AND METHODS

Field sites and blowfly collections

The study was carried out in the city of Córdoba, which is situated in the center of Argentina (31° 200′ S, 64° 100′ W, elevation 440 m a s l). The climate is temperate, mesothermal, with average temperatures ranging from 11° C in the winter to 24° C in the summer. Average annual rainfall is 800 mm, and rainfalls prevail during October to December and in March (Jarsun *et al.* 2003). The city is located within the Espinal phytogeographic province, a thorny deciduous shrubland forest (Fund 2014), but has been historically subjected to intense modifications, including deforestation, urbanization and agriculture. These anthropogenic influences have resulted in a landscape characterized by a highly developed urban core and a trend toward diminishing impervious surfaces at the periphery. Three sampling sites differing in their distance to the border of the city and degree of urbanization were selected (Fig. 1). Site I (in the center of the city) is densely built (22 houses per hectare; 85% impervious surfaces), with a predominance of backyards and small or no front yards; it includes park areas (approximately 1 ha) and commercial buildings. Site II (closer to the hilly range) has a lower (8 houses per hectare, 45% impervious surfaces) construction density with bigger gardens, more trees but fewer recreational areas. Large areas are used for agriculture, plant nurseries, and industrial activities, and other commercial activities are limited. Site III (near to the crops area), although still suburban, has more isolated housing (4 houses per hectare, 15% impervious surfaces) in close proximity to agriculture and pig and poultry farms. Since the rainy season is concentrated during October to March (Jarsun *et al.* 2003), the collections of flies were carried out during the drier months of April, June and August of 2013. In each site and month 12 traps baited with cow liver (200 g per trap) were installed for 5 consecutive days. Traps adapted from Hwang and Turner (2005) consisted of two plastic bottles (500 ml and 1000 ml), one pushed inside the other forming two parts, the upper collection chamber and the lower bait chamber. The collection chamber was made from the top parts of two bottles. The bait chamber was the bottom part of a bottle. Entry holes were made by cutting the plastic with an X shape and folding back the triangular portions to form a square hole with four inner vanes restricting escape of flies. Within each site, traps were separated by a minimum of 150 m and a maximum of 500 m. Adult flies were collected and stored in 80% ethanol for taxonomic identification to species level based on morphological characters (Mariluis & Schnack 2002). The specimens are deposited at the entomological collection of Instituto de Diversidad y Ecología Animal (CONICET-UNC; Moira Battán Horenstein).

Data analysis

To estimate overall species richness and verify the completeness of the calliphorid blowfly inventory, first, species data collected from all traps from a site along the sampling period were pooled. Then, a species accumulation curve was generated for each site, using sample-based interpolation (rarefaction) from the reference samples using the multinomial model (S(est)) (Colwell *et al*. 2012) in EstimateS software (Colwell 2013) (i.e., the expected number of species represented among m samples, given the reference sample). Three traps from sites I and II that collected no flies were excluded from the analysis. Richness estimates, standard errors, and 95% confidence intervals were calculated.

Two estimators of total species richness were calculated: The non-parametric estimator ACE (Abundance-based Coverage Estimator) of Chao & Lee (1992) that separates the observed species as rare and abundant groups, and only uses the rare group to estimate the

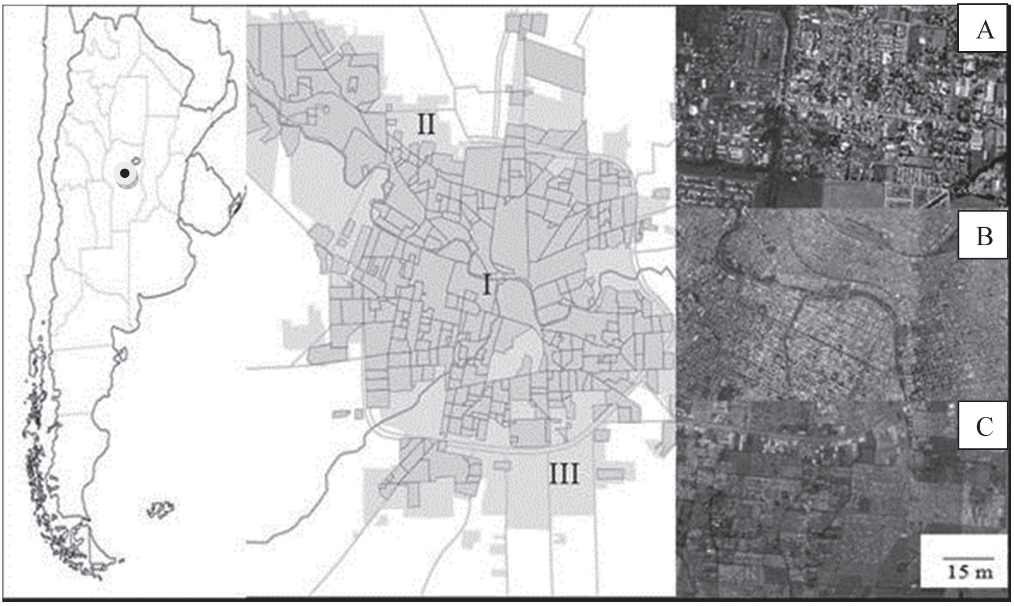

Figure 1. Location of Córdoba city in Argentina (black circle) and study sites (I, II and III). In each study site (Photos A, B and C).

number of missing species, and Chao1-bc, a bias-corrected form for Chao1 (Chao 2005). This approach uses the numbers of singletons and doubletons to estimate the number of missing species because missing species information is mostly concentrated on those low frequency counts. The estimated CV is used to characterize the degree of heterogeneity among species discovery probabilities. A CV = 0 would mean that all species have equal detection probabilities in the community.

Shannon index and its effective number of species (diversity of order 1, or Shannon diversity), were calculated based on Horvitz-Thompson estimator and sample coverage method (Chao & Shen 2003), and its estimated standard error was based on a bootstrap method in SPADE software (Chao & Shen 2010).

The effects of site on fly abundance (data transformed to ln (n+1)) and diversity were evaluated using one way analysis of variance (ANOVA) (Infostat, Di Rienzo *et al*. 2014). For all tests, a p value <0.05 was considered to represent significant differences. Least significant difference (LSD) Fisher test was used for post hoc analyses. Throughout the text, the results are presented as the adjusted mean plus/minus the standard error.

To assess the similarity in species composition between areas or dates, Sorensen qualitative index was estimated (Magurran 2004):
Sørensen = $2C / (S_A + S_B)$.

Where C = number of species common to areas A and B; S_A or S_B = total number of species of area A or B, respectively.

To test for differences in species composition between sampling sites considering relative abundance, a non-parametric multivariate analysis of variance (PERMANOVA) based on Bray-Curtis distances was used, with 10,000 permutations. To visualize differences in multivariate patterns among observations, non-metric multidimensional scaling (nMDS) was performed on the Bray-Curtis distances (Past software, Hammer *et al*. 2001). Where these groups differed, similarity percentages (SIMPER) were calculated using ln (n+1) transformed data to determine which species made the largest contribution to the dissimilarities (Clarke & Warwick 2001). Also, a principal components analysis (PCA) was used to explore the relationships between assemblages of species abundance and site.

We also calculated the indicator value (IndVal) index (Dufrene & Legendre 1997) to find species significantly associated with a particular urbanization level (or site typology) following the equation: $IndVal_{ij}=A_{ij} \times B_{ij} \times 100$. Where $IndVal_{ij}$ is the indicator value for species i in site j; A_{ij}, is the mean abundance of species i in site j compared to the species abundance in all sites in the study. B_{ij} is the proportion of traps within site j where the species i is present. Final multiplication by 100 produces percentages. An IndVal = 100 % shows that a species is a perfect indicator for a given site typology (for details, see Dufrene & Legendre 1997). Indicator values were tested for significance with a Monte Carlo randomization procedure (Quinn & Keough 2002).

RESULTS

A total of 341 adult calliphorids from nine species, *Lucilia sericata*, *L. eximia*, *L. cuprina*, *L. cluvia*, *C. vicina*, *S. chlorogaster* *C. albiceps*, *C. megacephala* and *C. chloropyga* were collected. *Lucilia sericata* was the most frequent species followed by *C. vicina*. Species and abundances of flies observed in each site are shown in Table 1. *Chrysomya albiceps*, *C. megacephala* and *C. chloropyga* were collected in fewer than three specimens each and were not included in the tables or abundance analysis. Rarefaction curves indicated that total richness was overall well estimated, because they reached a sill for sites I and III (Fig. 2). Also, for sites I and III the number of species observed matched expected species richness based on Chao1-bc and ACE estimates, and sample coverage was 1 (or close to 1), meaning that the probability of finding additional species with further sampling was less than 1%, while for site II 70% of expected species richness was detected (Table 2). CV values close to one indicate that discovery probabilities are not homogeneous among species.

Table 1. Composition, total number, average abundance (± standard errors; data transformed to ln (n+1)) of adult Calliphoridae collected each site (I, II and III) and percentage (%) number of specimens per species from the total sample.

Species	**I**	**II**	**III**	**%**
Lucilia sericata	**34** (0.94 ± 0.43^{a})	**66** (1.83 ± 0.43^{a})	**20** (0.56 ± 0.43^{a})	**35.61**
Lucilia eximia	**1** (0.03 ± 0.07^{a})	**7** (0.19 ± 0.07^{ab})	**9** (0.28 ± 0.07^{b})	**5.04**
Lucilia cuprina	**8** (0.22 ± 0.18^{a})	**14** (0.36 ± 0.18^{a})	**10** (0.25 ± 0.18^{a})	**9.5**
*Lucilia cluvia**	-	**3** (0.05 ± 0.21)	-	**0.89**
Calliphora vicina	**24** (0.67± 0.48^{a})	**75** (2.14 ± 0.48^{b})	**18** (0.53 ± 0.48^{a})	**34.72**
Sarconesia chlorogaster	**3** (0.08 ± 0.26^{a})	**8** (0.22 ± 0.26^{a})	**37** (1.03 ± 0.26^{b})	**14.24**

Different letters (a,b) indicate significant differences in adult abundance between sampling sites.* No statistical assessments were carried out due to low number of flies.

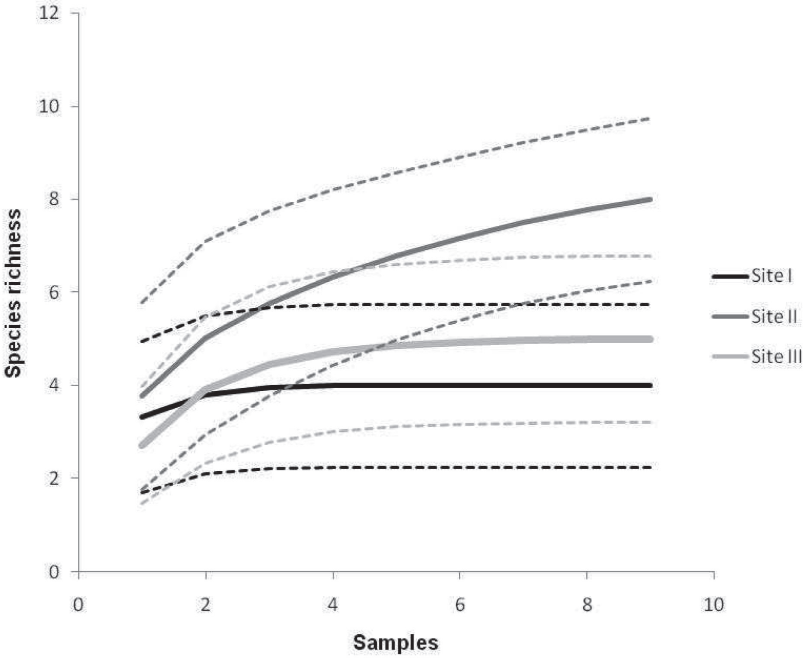

Figure 2. Rarefaction curves for each of the three sites sampled in Córdoba city (continuous lines). Dashed lines indicate 50% confidence intervals.

Table 2. Richness estimates of adult flies per site in Córdoba city, Argentina (bootstrap mean± standard error).

	Site I	Site II	Site III
Nº observed individuals	70	177	96
Nº observed species	5	9	6
Estimated sample coverage	0.99	0.98	0.99
Estimated CV	0.91	1.43	0.69
Chao1-bc	5.0±0.4	12.0±4.5	6.0±0.5
ACE	5.9±1.8	12.6±4.7	6.5±1.3

Abbreviations: Estimated CV= Estimated Coefficient of variation; Chao1-bc= a bias-corrected form for the Chao1 richness estimator (Chao 2005); ACE = Abundance-based Coverage Estimator (Chao and Lee, 1992).

Rarefaction curves were compared between pairs of sites at 9 samples (the total number of positive traps per site). Following the conservative no overlap criterion proposed by Colwell *et al*. (2012) it was inferred that species richness of site II was significantly higher than species richness of site I. Sites II and III overlapped 8.26% (Fig. 2). Both Shannon diversity index ($F_{2,26}$= 3.84, p = 0.03) and its effective number of species ($F_{2,26}$= 3.36, p = 0.05) were higher for sites II and III compared to site I (Table 3).

Total fly abundance tended to differ between sites ($F_{2,26}$= 2.95, p = 0.07), flies being more abundant in site II. For individual species (Table 2), *C. vicina* was mainly collected at site II ($F_{2,26}$= 4.39, p = 0.02), while *S. chlorogaster* was the dominant species at site III ($F_{2,26}$= 4.36, p = 0.02), where *L. sericata* collections were lowest ($F_{2,26}$= 3.66, p = 0.04).

Table 3. Diversity estimates of adult flies per site in Córdoba city, Argentina (mean± standard error).

	Site I	Site II	Site III
Shannon index	0.33±0.18^a	1.00±0.18^b	0.87±0.16^b
Exp. Shannon	1.59±0.40^a	2.98±0.41^b	2.76±0.37^b

Different letters (a,b) indicate significant differences between sampling sites.

Species composition changed between sites. Sites I and II, I and III shared 88% and 83% of species, respectively. Areas II and III that are farthest spatially from each other were 64% similar in species composition. Considering relative abundance, species composition also significantly differed between sites (F = 2.69; p = 0.01) using PERMANOVA. Site II significantly differed from site III (P = 0.002), while differences between sites I and III were close to significant (P = 0.08). Collections from traps on site II separated from site III traps in two dimensional ordination space when species abundances from different sites were analyzed using NMDS; traps from site II grouped mostly to the top left side of the graph while site III were more widely spread towards the right side of the graph (Fig. 3). SIMPER between Site II and site III traps consistently showed *Ch. vicinia, L. sericata* and *S. chlorogaster* as the species making the largest contribution to the dissimilarities (each contributing >10%) (Table 4). The first two species were more abundant in site II while *S. chlorogaster* was more frequent on site III. A similar pattern was also observed with a PCA, where *C. vicina* and *L. sericata* cluster with site II while *S. chlorogaster* with site III (Fig. 4).

Table 4. Percentage contribution of each Calliphoridae species to the observed dissimilarities between sites II and III.

Taxon	Contribution	Cumulative %	Abundance (ln)	
			Site II	Site III
Calliphora vicina	18.14	26.60	1.83	0.59
Lucilia sericata	17.92	52.89	1.86	0.76
Sarconesia chlorogaster	12.38	71.05	0.40	1.07
Lucilia cuprina	8.76	83.90	0.69	0.39
Lucilia eximia	6.25	93.07	0.44	0.52
Lucilia cluvia	1.84	95.77	0.20	0
Chrysomya albiceps	1.81	98.43	0.08	0.06
Chrysomya chloropyga	0.54	99.21	0.08	0
Chrysomya megacephala	0.54	100.00	0.08	0

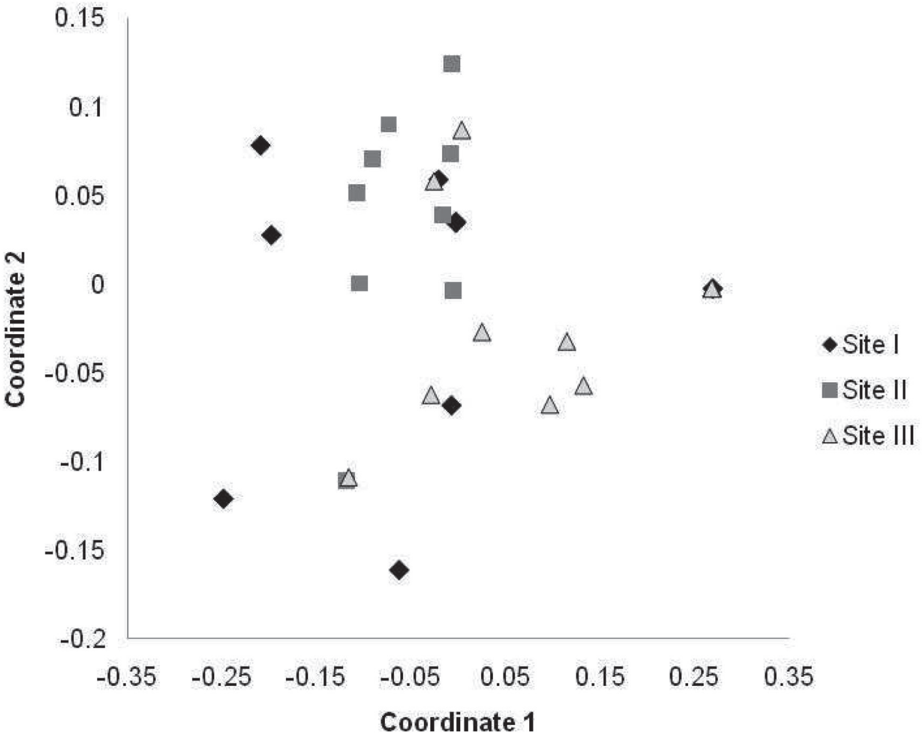

Figure 3. Non-parametric multidimensional scaling plot of 6 calliphorid species collected at three sites in Córdoba city, Argentina. Stress is 0.16, indicating a good representation of the data in the two-dimensional ordination plot.

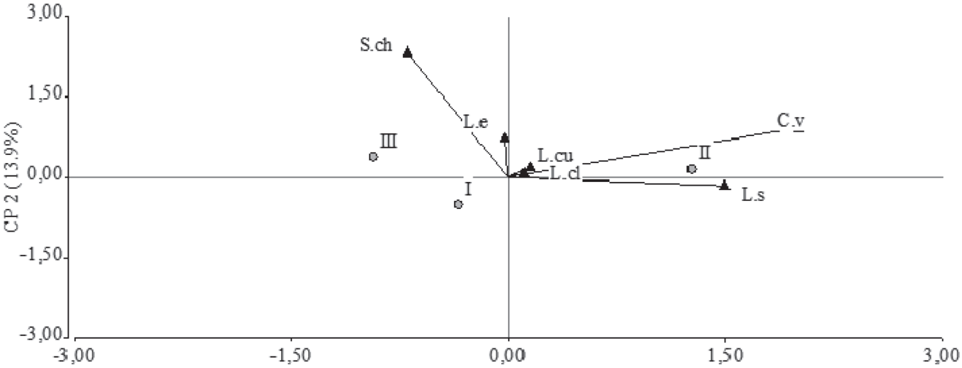

Figure 4. Principal components analysis (PCA) showing association between species abundances and sites I, II and III. Abbreviations: L.s (*Lucilia sericata*), L.e (*L. eximia*), L.cu (*L. cuprina*), L.cl (*L. cluvia*), C.v (*Calliphora vicina*), S.ch (*Sarconesia chlorogaster*). Circles represent sites I, II and III.

In the indicator species analysis three calliphorid species were selected as significant indicators of a particular site type. *Sarconesia chlorogaster* was closely associated with site III, *L. sericata* and *C. vicina* with site II, and no species were significantly associated with site I (Table 5).

Table 5. Indicator species analysis showing Calliphoridae species associated with the different sites.

Site	Species	IV (%)	*P* value
II	*Lucilia sericata**	22.9	0.03
	Lucilia cuprina	6.9	0.57
	Lucilia cluvia	5.6	0.34
	*Calliphora vicina**	23.2	0.03
III	*Lucilia eximia*	9.3	0.29
	*Sarconesia chlorogaster**	32.1	0.001

(*) Best indicator species

DISCUSSION

It has been observed that responses to urbanization differ depending on the insect species. In this study the assemblage of blowfly species showed some variations between the three sampling sites. Species richness was highest at the intermediate urbanized site (site II), being twice as diverse as site I (based on effective numbers) but only 10% more diverse than the more rural site III, as would be expected from intermediate disturbance hypothesis (Connell 1978). In contrast, Mulieri *et al*. (2012) found a negative relation between urbanization level and richness of Sarcophagidae species, more in tune with the increasing disturbance hypothesis proposed by Gray (1989).

At the species level, the two most abundant were *Lucilia sericata* and *Calliphora vicina.* Both species are originally from the Holarctic region but are now widely spread throughout the world (Greenberg 1973). Patitucci *et al.* (2011) defined them as urban exploiters, consistent with the observations of other authors (Hwang & Turner 2005 in England, Kavazos 2012 in Australia).

Lucilia sericata is considered a thermophilic and heliophilic species, while *C. vicina* is typical of cold and shaded environments. Studies in Córdoba (Battan-Horenstein *et al*. 2007) and Buenos Aires (Mariluis & Schnack 1989) indicate that these species are temporally segregated, *L. sericata* peaking in the summer and *C. vicina* in the winter. The fact that both species were very abundant in the present study may be explained by the sampling period, which was mostly in the fall, a transitional period in terms of temperature conditions.

In this study *L. sericata* and *C. vicina* species were dominant in the site II which has an intermediate density of houses, and showed lower abundances in the most urbanized site (I). Both species were the indicators of site II as shown by the IndVal index. Still, due to their high abundance they can be characterized as urban, as proposed by Patitucci *et al*. (2011). *Sarconesia chlorogaster* has an exclusively South American distribution, with records for Brazil, Argentina, Uruguay, Peru and Chile (Bonatto & Carvalho 1996). This species was collected in the three sites but was mainly abundant in the rural environment, where it had been previously recorded by Battán-Horenstein *et al*. (2007, 2010) on pig carcasses. Other authors have observed *S. chlorogaster* associated with rural or more natural environments; for example, in southeast Patagonia it showed a strong preference for sites with little or no influence from human activities (Mariluis *et al*. 2008).

In most cities, there is usually no simple linear decrease in the level of urbanization from the city center to rural sites (McIntyre 2000). The high flying ability of the blowflies could contribute to the homogenization of the environment in terms of species composition.

Species turnover was similar for the different sites. The increasing distance between sites (II and III were the furthest apart) contributes most clearly to changes in beta diversity. Considering species composition, sites that are closer were more similar. When species relative abundances were included in the analysis, sites II and III were the least similar. These results may indicate that, although the sites share a high number of same species, the proportion of the species varies. This may be related to a combination of different degrees of urbanization and probably habitat heterogeneity. Site II showed an intermediate level of urbanization with moderately to highly built patches alternating with open green spaces, while agricultural landscape was more prevalent on site III.

Biotic homogenization is a process by which species similarity across space increases over time as a combined result of species invasions and extinctions (Olden 2006). The establishment of cosmopolitan species, together with reductions of endemic species, increases the phylogenetic similarity, a process referred to as taxonomic homogenization. Most species detected in the present study were exotic and considered either eusynanthropic or hemisynanthropic (Labud *et al*. 2003), supporting the homogenization of the blowfly fauna in urban environments, as has been observed in other bioclimatic regions (Mariluis *et al*. 2008, Patitucci *et al*. 2011, Labud *et al*. 2003). *Lucilia eximia* and *L. cluvia* are a Nearctic and a Neotropical species, respectively, frequently found in rural and urban sites and that breed primarily in carcasses but also in rotten fruit and urban garbage (Madeira *et al*. 1989). The three species of *Chrysomya* were introduced to Brazil from Africa about four decades ago, quickly spreading through Peru, Bolivia, Paraguay and Argentina (Mariluis 1983, Peris 1986). Several authors (Linhares, 1981, Ferreira & Barbola, 1998) determined the synanthropic indexes for *C. albiceps* and classified it as hemisynantropic and with positive heliophily. It is important to note that Battan-Horenstein *et al.* (2007), working in the same region using a pig carcass as bait during the Autumn of 2004, collected this species in high abundance. The low percentage of *C. albiceps* in the present work can be attributed to the size of the bait used. Apparently, *C. albiceps* is attracted to larger animals, such as pig carcasses, to oviposit. Similar results were obtained by Souza and Linhares (1997). *Lucilia cuprina* is a species originally from Afrotropical and Oriental regions, but that now is widely distributed throughout the world (Greenberg 1973).

Several of the species detected in this study are considered relevant from a medical and/or veterinary perspective for their role as mechanical vectors of pathogens. For example, *Lucilia sericata* and other species of the genus have been shown to transmit *Salmonella enteritidis* and *Klepsiella oxytoca* (Mian *et al*. 2002, Cadavid-Sanchez *et al*. 2015). Other species such as *C. vicina, L. sericata, L. cluvia* and *S. chlorogaster* can cause myasis due their larvae feeding on dead tissue or decaying organic matter (Mariluis & Schnack, 1996). Most of the species were collected at the three sites, except *L. cluvia* which was restricted to site II, but was actually a rare species, represented by only three specimens. The widespread occurrence of these species in anthropic environments implies potential health risk and thus their populations should be monitored.

In conclusion, we contributed to the characterization of the assemblage of Calliphoride in a temperate city of South America, detecting mostly cosmopolitan species, a clear indication of biotic homogeneization. Urbanization intensity affected calliphorid assemblages because species richness, diversity and abundance were higher at intermediate compared to high or low urbanization levels. Although we had good estimates of species richness, the sampling method implied that mostly species attracted to small decaying animal bait were collected. Further surveys with other attractants are underway for a more complete assessment of Calliphoridae fauna.

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