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Diversity of Calliphoridae (Insecta: Diptera) in Hudson, Argentina

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RESUMO - As moscas Calliphoridae têm a importância sanitária e forense, e níveis diferentes de associação com os ambientes humanos (sinantropia). Conseqüentemente, as variações da diversidade específica em cada área poderiam ser usadas como um indicador do impacto antrópico. Neste estudo, a comunidade de Calliphoridae em Hudson (Argentina) foi coletada em três areas com graus diferentes de Sinantropia (natural, rural e urbana). As moscas foram atraídas com iscas e capturadas com rede entomológica. Doze coletas foram feitas em cada área e os índices de diversidade de Simpson e de Shannon foram calculados. A área natural foi a mais diversa. As outras duas áreas não mostraram nenhuma diferença significativa entre si. A diversidade foi mais elevada no meio da primavera e no fim do verão, e mais baixa no fim de primavera e no começo do verão. As alterações devido aos ambientes humanos afetam a diversidade, diminuindo a abundância de algumas espécies.

PALAVRAS-CHAVE: Calliphoridae, comunidade, diversidade específica, sinantropia, Buenos Aires

ABSTRACT - Blowflies have sanitary and forensic importance, and different levels of association with human settlements (synanthropy). Therefore, specific diversity changes in each site could be used as an indicator of the anthropic impact. In this study, the community of Calliphoridae in Hudson (Argentina) was sampled in three sites with different degrees of Synanthropy (natural, rural and urban). Flies were attracted with bait and collected with an insect net. Twelve samples were collected in each site and both Simpson and Shannon diversity indexes were calculated. The Natural area was the most diverse. The other two areas showed no significant differences between them. The diversity was higher in the middle of spring and in late summer, and lower at the end of spring and in the beginning of summer. Alterations due to human settlements affect diversity by decreasing the abundance of some species.

KEY WORDS: Blowfly, community, species diversity, synanthropy, Buenos Aires

The Calliphoridae (Diptera) are sarcosaprophagous flies and breed in carrion, excrement or other types of organic matter. They can be vectors of several animal and human diseases (Greenberg 1971, Mariluis *et al*. 1989, Fischer *et al*. 2001), and they can cause myiasis in the cattle or man (Guimarães *et al.* 1983). Some species are more associated with human settlements (eusynanthropy) whereas others avoid them (asynanthropy) or live in ecotones or zones of transition (hemisynanthropy) (Nuorteva 1963; Ferreira 1978, 1983; Linhares 1981; Schnack *et al*. 1995). Due to the these facts those species can be of sanitary importance (Maldonado & Centeno 2003).

On the other hand, the diversity of each community could be an indicator of the degree of anthropic influence over a natural area caused by the human settlements and the activities associated with them. The specific diversity can experience modifications both in time and space and those changes are used to evaluate the effects of the environment contamination (Hayek & Buzas 1997, Legendre & Legendre 1998). The knowledge of these variations in areas with different degrees of human influence allows a diversity of indexes to be used as indicators of degradation of natural areas by human activity (Legendre & Legendre 1998). Decease of insect diversity caused by human disturbance (agriculture, grazing, burning, mining) has been reported (Folgarait 1998, Kearns 2001).

Previous works on the Calliphoridae community in Argentina are very few in the literature (Schnack *et al*. 1995). Therefore, the goal of this work was to study the changes in diversity of Calliphoridae at human settlements with different degrees of development and to determine wether diversity differences could be used as indicators of human influence on the environment.

Material and Methods

The present study was carried out in Hudson, Argentina (34º 45' S, 58º 25' W). Three different areas with different degrees of human impact were evaluated between 1993 and 1995: urban area, with houses, gardens and constant human action; a natural habitat, a neighbouring forest area without human settlements, (distant 1,5 km from the town) and the rural site, situated between the two previous sites, with empty lands, shrubs, grasses, the ground partially without vegetation and some dispersed houses; in this place the human action was sporadic with garbage disposal. Twelve samples were collected simultaneously in each area, three in each season. For each sample, a bait made of 500 g of decomposing lung was exposed on the ground for 15 min. Flies visiting the bait were collected with an insect net. The sampling was repeated hourly between 12.00h and 14.00h. The captured flies were taken to the laboratory and identified.

The diversity was determined using the indexes of Shannon and Simpson, and significant differences were further analysed with the concept of (h,f)-entropy of Salicrú *et al.* (1993), and with tests developed using the theory of information by Pardo *et al.* (1992).

Results

The collected species were: *Calliphora nigribasis* Macquart, *Calliphora vicina* Robineau-Desvoidy, *Chrysomya albiceps* (Wiedemann), *Chrysomya megacephala* (Fabricius), *Chrysomya putoria* (Wiedemann), *Cochliomyia hominivorax* (Coquerel), *Cochliomyia macellaria* (Fabricius), *Paralucilia pseudolyrcea* (Mello), *Sarconesia chlorogaster* (Wiedemann), *Phaenicia cuprina* (Wiedemann), *Phaenicia cluvia* (Walker) and *Phaenicia sericata* (Meigen). Species of the genus *Phaenicia* were identified according to Mariluis (2002). However, many authors include these species into the *Lucilia* genus.

Table 1 shows the values of Shannon and Simpson diversity indexes, for each area and date of sampling and the significant differences among the samples obtained. In winter, only a few individuals were collected and hence, indexes were calculated for only one sample. Natural area was the most diverse area showing significant statistical differences between urban and rural areas. The table also shows significant differences between seasons. Diversity increases in spring to the middle of the season and decreasing at the end. The summer began with a very low diversity, increasing along the season. During fall, very important values of diversity were obtained. No values were recorded during winter. In the Table also are showed the significant differences between samples in the natural area when both indices are used.

Discussion

The diversity of Calliphoridae have been studied only in some of its aspects (Hanski & Kuusela 1980, Baumgartner & Greenberg 1985, Ives 1991) and the specific diversity of blowfly communities in Argentina was studied only in Santa Catalina, Province of Buenos Aires (Schnack *et al*. 1995). In that study the natural and the rural areas had the most diversity, although they only used the Shannon diversity index without to establish a level of significance.

In the present analysis, the natural area showed the highest significance of the specific diversity indexes, both fully and seasonally. The highest diversity in this area could be explained by the increment in the participation of the *C. nigribasis*, *P. cluvia* and *P. pseudolyrcea* together with the dominant species *C. macellaria* and *C. albiceps*. According to Ives (1991), the patchily distributed resources in the environment and the intraspecific aggregation, determine that some patches are available for the rare species. In the natural

Table 1.Values of Simpson and Shannon indexes and significant differences among samples for the natural area[1]

			U	0.4629	0.0506	0.0876	0.5363	0.6474	0.6097	---	0.7189	0.6644	0.5456
			R	0.6234	0.0795	0.1081	0.5125	0.3353	---	0.6021	0.6682	0.4929	0.5456
			N	0.5803	0.1765	0.0804	0.7000	0.6384	0.7200	0.1919	0.7481	0.7076	0.5456
Shannon index ↓ Simpson index ↑			Date	09-93	12-93	01-94	02-94	03-94	05-94	09-94	11-94	02-95	0.5456
U	R	N											
0.8653	1.1107	1.1256	09-93	---	***	***	***	ns	***	***	***	***	ns
0.1333	0.2115	0.4316	12-93	***	---	***	***	***	***	ns	***	***	***
0.2068	0.2875	0.2221	01-94	***	***	---	***	***	***	**	***	***	***
1.0306	0.8385	1.4632	02-94	***	***	***	---	**	ns	***	*	ns	**
1.2395	0.7396	1.3059	03-94	**	***	***	**	---	*	***	***	**	ns
1.0901	---	1.3230	02-94	*	***	***	ns	ns	---	***	ns	ns	**
---	1.1244	0.4076	09-94	***	ns	**	***	***	***	---	***	***	***
1.5472	1.4042	1.6521	11-94	***	***	***	**	***	***	***	---	ns	***
1.3261	1.0455	1.4294	02-95	***	***	***	ns	ns	ns	***	**	---	***
1.7093	0.9901	1.0398	04-95	ns	***	***	***	**	**	***	***	***	---

Significant differences among samples obtained with the Shannon index (down the diagonal) and with the Simpson index (upper the diagonal) to natural area.

[1]The significance level is denoted by: *** if significant difference at 0.01; ** at 0.05; * at 0.10 or ns when no significant difference

U = urban area; R = rural area; N = natural area

area the structure of the vegetation, mainly trees and shrubs, would increase the available number of patches, by means of the more trophic/reproductive resources and available refuges, so these reasons could be the causes of the increment of asynanthropic species.

The rural area did not significantly differ from the urban area if all the samples are considered. In the analysis of the seasons, most of the cases showed the rural area as less diverse than the other areas, and by this reason it cannot be considered as an ecotone or transitional area, where the diversity increases by the contribution of the species from the neighbouring areas to the richness. In this site the different vegetation, more scarce than the rural area, and the higher degradation caused by human activities, could be a cause of the loss of species. The characteristic species in this area was *C. albiceps*.

The urban and the rural areas were no different. Nevertheless in some of the samples the diversity was higher than in the other areas. Most of them were no significantly different, or the diversity was lower. In an urban area, with only a little ground surface with vegetation and available organic matter, *P. sericata* was the characteristic species, and the occurrence of asynanthropic species could decrease. However, during several periods of the year, with relative abundance at the maximum, asynanthropic species occurred in the urban area, increasing their diversity.

With respect to the inconsistency of the diversity indexes in the ordering of the dates for two of the three areas studied, as discussed by Kempton (1979) and Hulbert (1971), there were no significant differences. Inconsistency in the ordering were caused by the different weights given by each index for the species with a small number of individuals, as mentioned by Samways (1984).

We conclude that the highest diversity during one season is reached when there is enough time to establish the community. When it happened, the rare or not very frequent species increased their presence, as observed during spring and summer.

At the beginning of the spring, the dominance of *C. nigribasis* determined lesser diversity in the natural area than in the rural area, where this species occurred in a lower proportion. On the other hand, in the middle of the season (6-11-94) the highest diversity was registered when rare species occurred with few individuals (*C. chloropyga, S. chlorogaster*, *C. megacephala*) and when the abundance of asynanthropic species (*P. cluvia* and *P. pseudolyrcea*) increased. Diversity decreased at the beginning of the summer, because a new dominant species, *C. macellaria,* appeared massively, reaching several orders of magnitude higher than other species. In late summer the *C. macellaria* dominance decreased for the *C. albiceps* abundance modulating effect. Their larvae III foraged on others larvae and the *C. macellaria* abundance decreased (Wells 1992). The annual variation of the diversity defines in this way, two periods of high diversity: the spring and summer seasons, while the autumn showed lower values, except for of 18-4-95, where the low abundance of individuals was the cause of the artificial index increment.

The human impact on the taxocoenoses of the Calliphoridae is remarkable. The diversity decreases in an environment with human settlements and with effects of the human actions, as registered for the rural and urban areas. The natural area has showed high diversity; the asynanthropic species like *P. pseudolyrcea*, *P. cluvia* and *C. nigribasis* could be used as indicators of the human influence when their abundance decreases, and increase the presence of the eusynanthropic species like *P. sericata* increases. Therefore, the diversity index in the comparison of communities could be a suitable indicator of the environmental degradation and human impact.

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