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POPULATION DYNAMICS OF CICADELLIDAE AND DELPHACIDAE (HEMIPTERA) IN AN URBAN ENVIRONMENT OF THE RIO DE JANEIRO CITY

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RESUMO

DINÂMICA POPULACIONAL DE CICADELLIDAE E DELPHACIDAE (HEMIPTERA) EM UM AMBIENTE URBANO DA CIDADE DO RIO DE JANEIRO

Com base em coletas de insetos atraídos por fonte luminosa, foi feita uma amostragem dos Auchenorrhyncha, entre maio de 2014 e abril de 2015. Foram registradas duas famílias, Delphacidae e Cicadellidae, sendo que a última foi bem mais abundante. Nebulosidade e umidade relative foram correlacionadas significativamente com as densidades de Cicadellidae. Para os Delphacidae, evaporação, precipitação e temperatura (do mês anterior) foram correlacionadas significativamente aos dados populacionais. Considerando o total de Auchenorrhyncha, os valores foram significativamente correlacionados a umidade relativa, precipitação, nebulosidade e evaporação.

Palavras-chave: Auchenorrhyncha; Brasil; flutuações.

ABSTRACT

Based on insect collections attracted by light source, samplings of Auchenorrhyncha were collected monthly from May 2014 to April 2015. Two families, Delphacidae and Cicadellidae, were recorded the latter attaining higher abundance. Cloudiness and relative humidity were significantly correlated to Cicadellidae densities. For Delphacidae, evaporation, precipitation and temperature (the previous month) were significantly correlated to population data. Considering the total of Auchenorrhyncha, the densities were significantly correlated to relative humidity, precipitation, cloudiness and evaporation.

Keywords: Auchenorrhyncha; Brazil; fluctuations.

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INTRODUCTION

The urban environment is a result of environmental, biological and socio-economic factors interactions, within the space built by men predominating on the natural environment, causing major changes (BRUN *et al.*, 2007; TORRES, 2015). However, urban areas are not occupied exclusively by humans. Despite being poorly studied compared to preserved ecosystems, they host a great amount of animals, including insects. According to TORRES (2015), because of urbanization, such environments have fragments of different vegetation types, with different sizes and shapes, usually composed by opportunistic or exotic plant species (the parks, squares, lakes, gardens and buildings of a city). Many of these locations are used as a shelter by a variety of animals, enabling even colonization by new species, who have learned to take advantage of such urbanized habitats.

The urban insect fauna is quite diverse, sampling members of Diptera, Lepidoptera, Hymenoptera, Hemiptera, Blattodea, Orthoptera, and Zygentoma orders, occurring, basically, in all substrates. Insects have a great adaptive capacity, as they can inhabit almost every location, such as residences, factories, or sewage (MELIC, 1997; ALCARAZ *et al.*, 2006; ISHIKAWA *et al.*, 2015). Afforestation and urban lighting can have direct influence on the number of species as a whole.

Among the Hemiptera, Auchenorrhyncha represents a diverse group of phytophagous insects, with a large number of species distributed in several taxa, occurring in a variety of ecosystems. Many species are abundant in agricultural crops and can cause significant damage by feeding on the sap and, thus transmitting pathogens (GIUSTOLIN *et al.*, 2009). Cicadellidae and Delphacidae are widely distributed in the world, including the Americas. Many species of these families are vectors of phytopathogenic virus and mollicutes, which cause severe symptoms in several plant hosts (DE OLIVEIRA *et al.*, 2013).

OBJECTIVES

The present studying aimed to evaluate the population dynamics of auchenorrhynchous insects of the Cicadellidae and Delphacidae families in a residential building in the northern zone of Rio de Janeiro, southeastern Brazil.

AREA OF STUDY

The climate of Rio de Janeiro favors the occurrence of insects, primarily because of its rainfall volume and high temperatures. The metropolitan region has, predominantly, a semi-humid tropical climate, with heavy rainfall in the summer, when temperatures can easily reach forty degrees Celsius.

In contrast, the weather is much more mild and dry in the winter. The average temperature during the year ranges from 22º to 24º Celsius and rainfall tends to be in between 1,000 to 1,500 millimeters annually. The rainy season is in the summer, while winter is drier. The proximity of the sea and the sharp and diverse relief of the metropolitan region of Rio de Janeiro contribute to the great spatial variability and meteorological features. The urbanization process also changes the atmospheric conditions, since they influence thermal properties of the surface, decreasing the wind intensity and soil humidity (cf. KALNAY & CAI, 2003).

MATERIAL AND METHODS

Population dynamics of auchenorrhynchous insects of the Cicadellidae and Delphacidae families were studied using monthly quantitative samples, carried out from May 2014 to April 2015, one sample per month, in a residential building of the northern zone of Rio de Janeiro (Figure 1), and were correlated with meteorological data (obtained from Instituto Nacional de Meteorologia – INMET) through Pearson Correlation. Two types of calculation were performed, the first one comparing the population values to environmental data from the same month of the collected samples, and the other correlating population values to the environmental data of the previous month.

Multiple regression was applied to values of abundance of Auchenorrhyncha and variables appointed as significantly correlated with the monthly variation of insects, namely: evaporation, cloud cover, precipitation and relative humidity. For the correlation that resulted in the most significant value (in this case, the population variation of Auchenorrhyncha and monthly average relative humidity data – see below), was drawn the linear regression line. The statistical program used was PAST, version 3.

The organisms were collected in a chandelier, illuminated by two fifteen watts white-fluorescent lamps. Many insects are positively phototrophic and the use of light traps produce valuable faunistic data. This data can be considered as a biodiversity parameter of the concerned vicinity (DADMAL & KHADAKKAR, 2014). The specimens were collected, sorted, counted and deposited in the José Alfredo Pinheiro Dutra Collection, from Instituto de Biologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil.

RESULTS AND DISCUSSION

Various insects respond to abiotic factors like humidity, temperature, light and resources in different ways. These abiotic factors not only affect the behavior of insects but also disturb the physiological mechanism (KHALIQ et al., 2014). In this study, the different groups responded significantly to evaporation, precipitation, cloudiness, temperature and relative humidity.

Figure 1. Collection point, a residential building located in a strictly urban area of Cachambi neighbourhood, north zone of the city of Rio de Janeiro. Map of the city of Rio de Janeiro (above) and Cachambi and neighboring districts (below). Source: Google Maps.

Overall, 148 specimens of Auchenorrhyncha were collected, 136 of the Cicadellidae family and 12 belonging to Delphacidae family. Part of the taxa identified is in Figure 2. During the sampling period, Auchenorrhyncha presented three population peaks, the most prominent one in June-July, other in November and another in March-April (Figure 3). The Cicadellidae members, which represent the vast majority of the group, maintained such default values. Delphacidae, the less numerous members, had the greatest population values in February-March, followed by June (Figure 4).

The peaks of Cicadellidae population were observed in April and June (22 and 21 specimens, respectively). Cloud cover ($t = 0.61132$; $p<0.05$) and relative humidity ($t=0.81865$, $p<0.01$) were significantly correlated to the population data. For Delphacidae, evaporation ($t=0.68246$, $p<0.05$), precipitation ($K = t=0.68133$; $p<0.05$), maximum temperature of the last month ($t=0.609$; $p<0.05$), and medium temperature of the last month ($t=0.57687$; $p<0.05$) were significantly correlated to the population increases. Considering the total of Auchenorrhyncha, population values were significantly correlated to relative humidity ($t=0.82575$; $p<0.01$), precipitation ($t=0.59906$; $p<0.01$), cloudiness

(t=0.63612; p<0.05) and evaporation (t=0.61364; p<0.05).

Multiple regression showed significant influence of the independent factors (evaporation, cloud cover, precipitation and relative humidity) in population biology Auchenorrhyncha (multiple R=0.83875; multiple R^2= 0.7035; multiple R^2 adj = 0.53407; ANOVA F=4,1522; p<0.05). The environmental factor most significantly correlated to the Auchenorrhyncha is relative humidity. Simple linear regression showed the influence of this factor in population dynamics, as shown in Figure 6. The line of regression was calculated (slope a = 1.6098, std. error a = 0,34771, intercept b = -102,49, std. error b = 24,836). The most distant points of the line were those relating to the months of May and June, which had exeptionally high population densities.

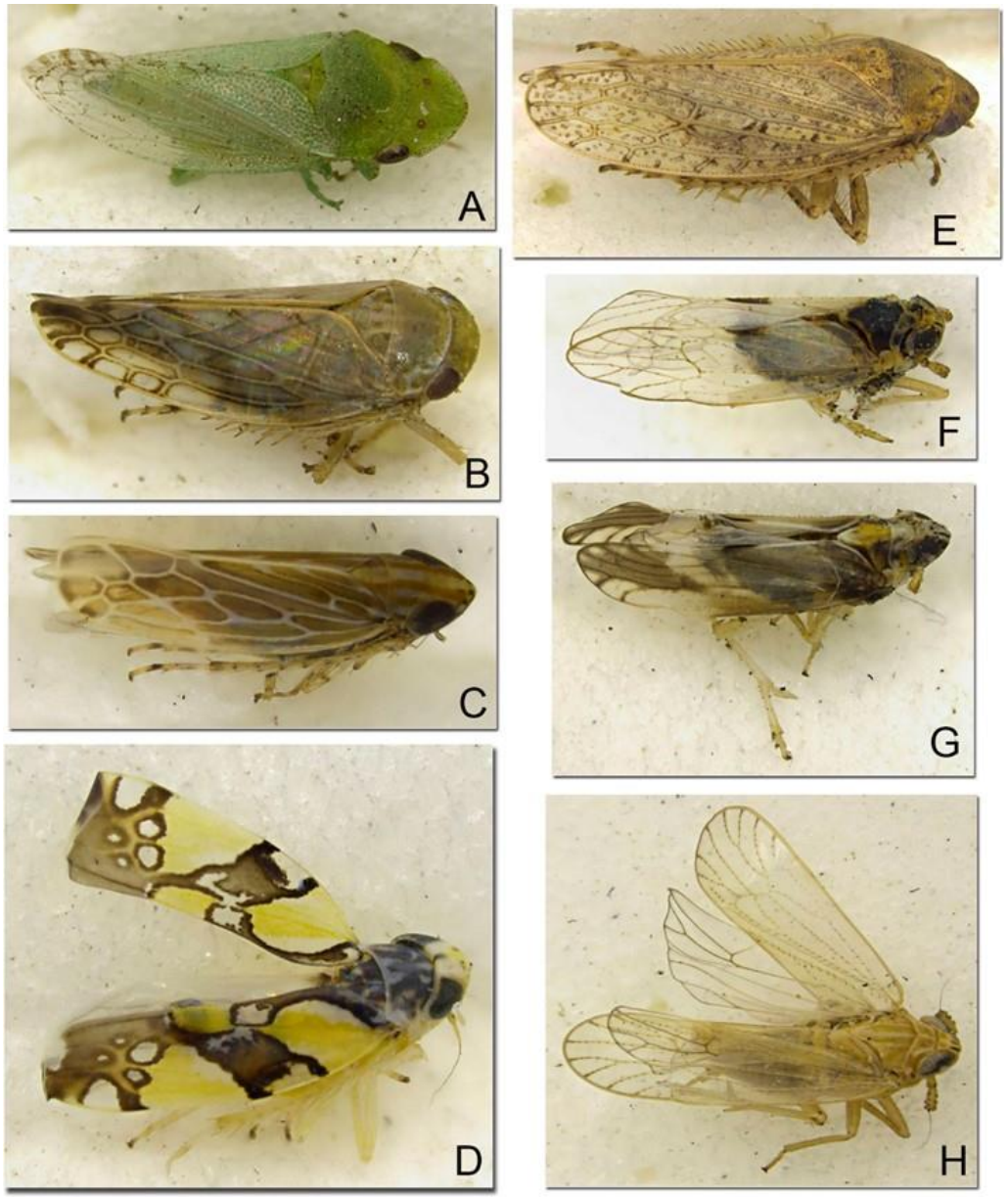

Figure 2. Specimens of Auchenorrhyncha collected in a residential building located in a strictly urban área of Cachambi neighbourhood, North Zone of the city of Rio de Janeiro. Cicadellidae: (A) *Xerophloea viridis* (Fabricius, 1794); (B) *Acinopterus* sp; (C) *Haldorus* sp; (D) *Protalebrella brasiliensis* (Baker, 1899); (E) *Curtara samera* DeLong & Freytag, 1972. Delphacidae: (F) *Delphacodes* sp; (G) *Tagosodes* sp; (H) *Metadelphax*(?) sp.

OTT & CARVALHO (2001), studying the Leafhopper community of a field in the State of Rio Grande do Sul, observed that the lower population values were obtained in periods of low rainfall. According to these authors, periods of exceptional drought can lead adults to enter a reproductive diapause or move to favorable locations, as lower layers of vegetation or adjacent wetter areas. From samples collected with a light trap held in Viçosa, State of Minas Gerais, COELHO & DA-SILVA (2003) observed there were significant positive correlation between the values of *Agallia incongrua* Oman, 1938 leafhopper population and the average temperature. LARA *et al.* (2007) noted that in June, the beginning of the dry period of the year, there is reduction in the number of leafhoppers. The progressive increase in the number of insects occurred from December, during summer, characterized by the onset of the rainy season and high temperatures. On the other hand, SANTA-CECILIA *et al.* (2002) found a significant positive correlation between population values of *Oncometopia fascialis* (Signoret, 1854) leafhopper with temperature and relative humidity, not with the rainfall. SARTOR *et al.* (2009), inventorying the species of insects of the municipality of Viamão, State of Paraná, observed that in the month of November was registered the largest number of specimens, coinciding with high values of relative humidity and rainfall. Still related to rainfall, the immediately preceding month (October) had the largest amount of precipitation sampling period. The month showing the lowest population, May, was also the one who had the lowest rates of precipitation and maximum temperature in the period. FABRIN *et al.* (2014) studied the population variation of leafhoppers in the State of Rio Grande do Sul, noting four population peaks, occurring in the months of August, October, December and February. According to them, the population of leafhoppers grows after the onset of spring rains, reaches peak in summer and autumn and decreases significantly in the winter. REHMAN *et al.* (2015) studied the population biology of the leafhopper *Amrasca biguttula* (Ishida, 1912) in Pakistan, correlating to the relative humidity, at certain times of the day.

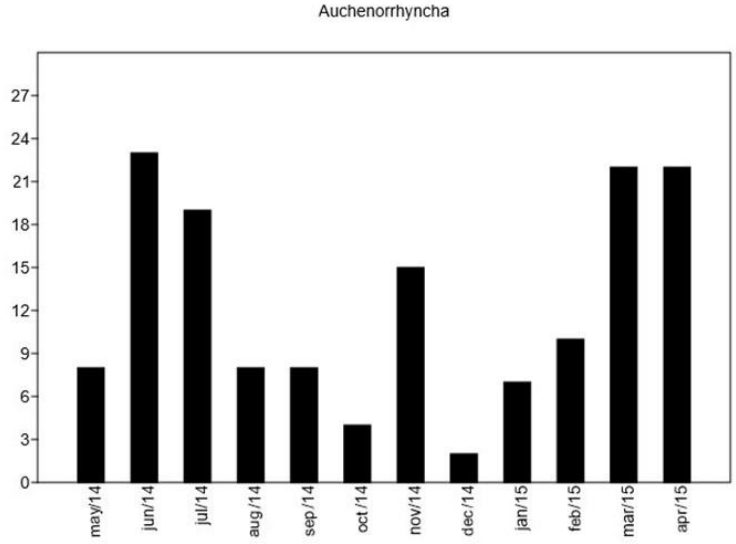

Figure 3. Monthly fluctuation of the abundance of Auchenorrhyncha in a residential building of the municipality of Rio de Janeiro, may 2014 to April 2015.

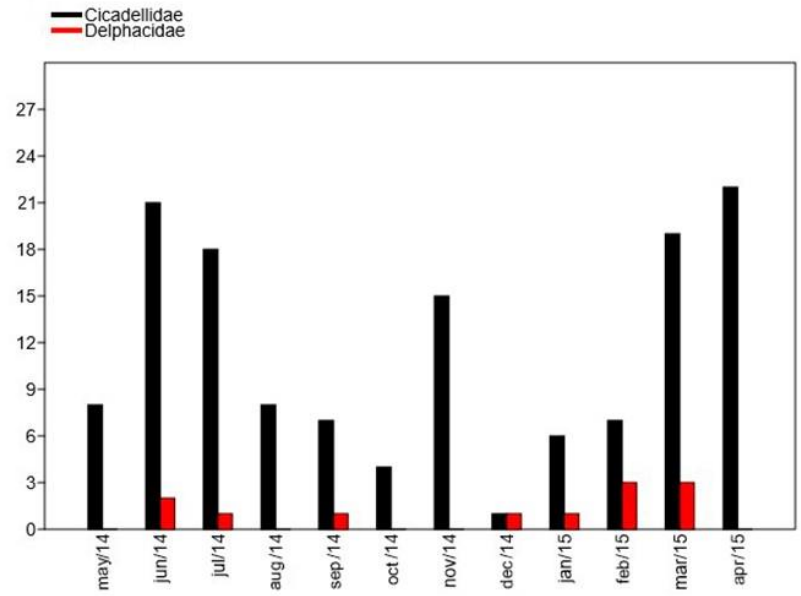

Figure 4. Monthly fluctuation of the abundance of Cicadellidae and Delphacidae in a residential building of the municipality of Rio de Janeiro, may 2014 to April 2015.

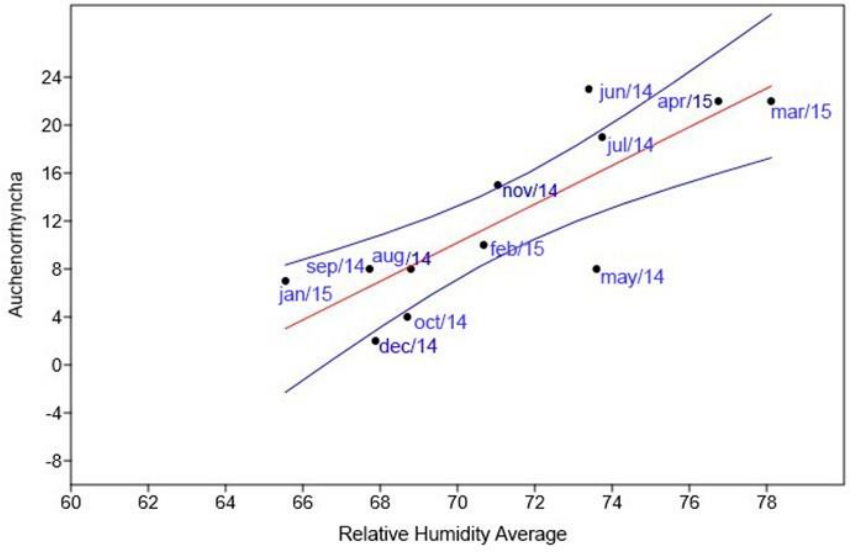

Figure 5. Linear regression line between the monthly variation of the abundance of Auchenorrhyncha and monthly average values of relative humidity, obtained in a residential building of the municipality of Rio de Janeiro, may 2014 to April 2015.

The comparison between the seasons (spring/summer on one side, fall/winter on the other), in the case of Auchenorrhyncha (t = 2.7043; p 0.05) and in the case of Cicadellidae (t = 2.8972; p = 0.05), indicated the existence of significant seasonal variation (Figure 6). With respect to Delphacidae, there was no difference in population number between stations, possibly by the low abundance values found.

While certain Auchenorrhyncha are active throughout the year, others seem to have a distinct seasonal distribution. This seasonal activity is correlated with the start of the wet season and the resulting production of new plant growth (WOLDA, 1978). In one of the few urban studies of the group, CORDEIRO & SILVA (2012) analyzed the Hemiptera (Heteroptera and Auchenorrhyncha) of a hill of

Sulacap, West Zone of Rio de Janeiro. They found that most taxa and specimens occurred, significantly, in the rainy season. In the present study, maybe because the sampling period have occurred into an exceptionally dry year, population difference was not detected between stations. However, grouping up spring with summer and autumn with winter, the difference was statistically significant, indicating a seasonal pattern for the group.

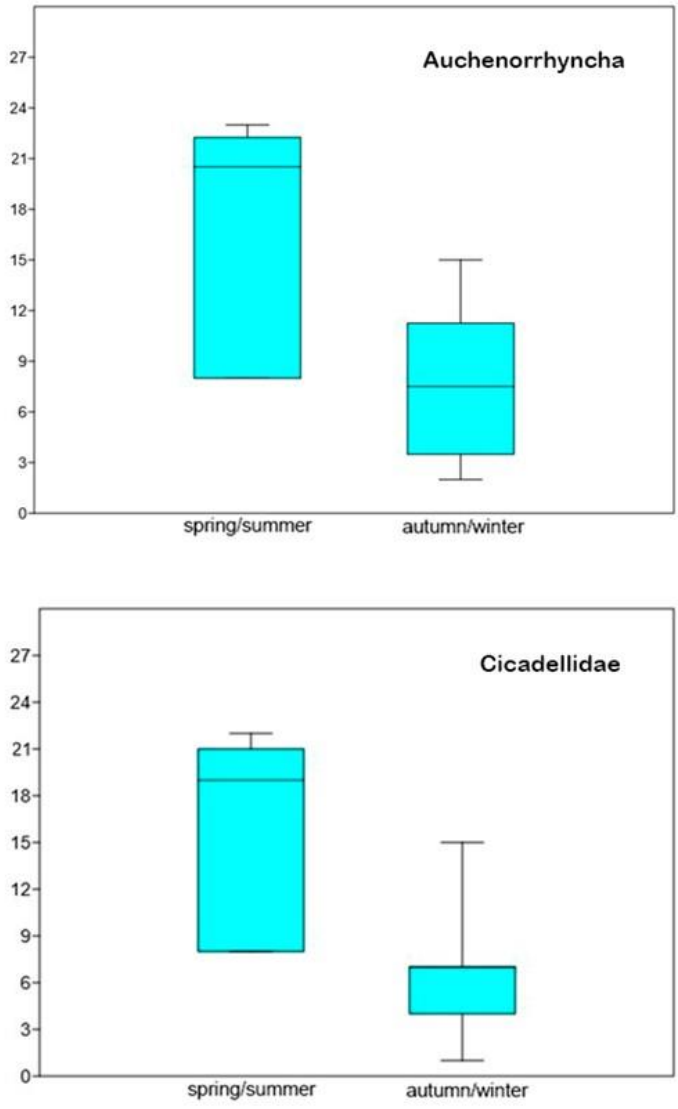

Figure 6. Box-plot comparing the values of abundance of Auchenorrhyncha and Cicadellidae in the different seasons.

FINAL CONSIDERATIONS

The urban ecology is a relatively new area of research and the urban environment, therefore, is a still little-known ecosystem (JAPYASSÚ & BRESCOVIT, 1999). In this way, urbanization, since preserving portions of the original coverage, seems to favour a surprisingly high number of species, and not just those introduced.

The groups obtained in this research can be relict fauna from Atlantic Forest remains within the city of Rio de Janeiro, besides eventually introduced species from works of landscape architecture. Further studies are needed for detailing the dynamics of occupation of urban areas by these Auchenorrhyncha and to assess the impact of these animals throughout the urban community. One factor that was not considered here is the possible influence of the development cycle of these insects, it is not known how many generations occur each year and even if adults are present throughout the year. To elucidate this question, it would be necessary to carry out biological studies with the species.

We must further highlight that the collection type used in this study (inspection of chandelier in a residential building) can function as an alternative option to light common traps. This procedure is suitable not only for inventories of taxa, as well as for ecological oriented studies. Respecting properly the interval between the dates of collection, the material obtained is perfectly suitable to studies of population biology and seasonality.

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