



**AN ASSESMENT OF THE ANT COMMUNITY IN A
NEOTROPICAL URBAN AREA WITH DIFFERENT LEVELS
OF DISTURBANCE**

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ABSTRACT

Traditionally, urban areas have been described as sites inhabited by a reduced number of animal species. However, the new spaces created represent a new niche that some species take advantage of. This work characterized the ant community in four different microhabitats in an urban area of Costa Rica. Bait sampling of ants revealed a total of 22 species, 20 of which are native species. Four adjacent areas were sampled: the interior of a building, two green areas, and an ecological reserve. Comparing these four areas, the two green areas showed the greatest similarity, while the building interior was the least similar. The results suggest that urban green areas can serve as reservoirs for native biodiversity.

KEYWORDS

Bait sampling, Costa Rica, Formicidae, similarity indices, urban ecology

**EVALUACIÓN DE LA COMUNIDAD DE HORMIGAS EN UNA
ZONA URBANA NEOTROPICAL CON DIFERENTES
NIVELES DE PERTURBACIÓN**

RESUMEN

Tradicionalmente, las áreas urbanas han sido descritas como sitios habitados por un número reducido de especies animales. Sin embargo, los nuevos espacios creados podrían representar un nuevo nicho que algunas especies podrían aprovechar. Se caracterizó la comunidad de hormigas en cuatro diferentes microambientes en un área urbana de Costa Rica. Muestreos con cebos para hormigas muestran un total de 22 especies, de las cuales 20 son especies nativas. Se muestrearon cuatro áreas adyacentes: el interior de un edificio, dos jardines y una reserva ecológica. La comparación entre estas áreas, arroja que los dos jardines presentan la mayor similitud, mientras el interior del edificio es el menos similar. Los resultados sugieren que las áreas verdes en zonas urbanas pueden funcionar como reservorios para especies nativas de hormigas y posiblemente de algunos otros grupos.

PALABRAS CLAVE

Muestreo con cebos, Costa Rica, Formicidae, índices de similitud, ecología urbana

INTRODUCTION

Urbanization is one of the most important factors modifying natural landscapes, generating significant changes in the dynamics of ecosystems (Cleargeau *et al.*, 2001). Increasing construction leads to a restructuring of plant and animal communities, including interactions between native species and those that accompany human settlements (Rizali *et al.*, 2008; Sumasgutner *et al.*, 2014). The new spaces created offer a variety of new interspecific relations as well as new resources due to human activity, offering a wide range of possibilities for some species and limitations for others (Suarez *et al.*, 1998; Wetterer 1998; Bolger *et al.*, 2000).

The ecological effects of anthropogenic fragmentation on arthropod communities can be complex and diverse since they can occur at different levels, especially those associated with food resources and nesting sites (Philpott *et al.*, 2010). In ants it has been suggested that changes in habitat are strongly correlated with rapid changes in community structure of the altered zone (Rizali *et al.*, 2008). Tropical

urban environments can provide favorable conditions for the foraging and nesting of some ant species, which then become more abundant and potentially displace the native myrmecofauna (Delabie *et al.*, 1995). However, ants display a wide variety of habits and interactions with plants and other animals, so the presence of forest remnants in urban areas could protect part of the native myrmecofauna (Holway *et al.*, 2002). This in turn could generate a mosaic between native and introduced species, a subject that has been little studied in urban areas.

Because of the potential heterogeneity of the myrmecofauna in urban areas, the aim of our research was to evaluate the composition of the ant community present in an urban area where there is a small protected woodland immersed in a larger area of managed green areas (mowed grass with trees and shrubs) and buildings. Due to the gradient between areas with lower and higher degrees of alteration, it was expected that the level of disturbance would directly influence the composition of the ant community, due to changes in food resources and nesting sites (Suarez *et al.*, 1998).

METHODS

We conducted the study between October and December 2015 in the main campus of the University of Costa Rica located in Montes de Oca, San Jose, Costa Rica (9°56'09"N, 84°03'07"W, 1200 m above sea level).

We collected ants in four areas categorized according to the level of disturbance. The first area was located inside the building of the School of Biology ("Building interior") which was considered the most altered due to the constant cleaning and waste collection, as well as the occasional use of baited boric acid for cockroach control. There is no cafeteria or other obvious food source in the building, and ant baits

(see below) were placed on the floor no farther than three meters from the exterior. The second area was a green area on the south side of the Biology building ("Biology green area"), located between one and ten meters from the building. This grassy area is frequently mowed, and has some trees and ornamental plants. The third area was a slightly less altered green area located southwest of the Chemistry building ("Chemistry green area"). This grassy area adjoins a small creek (Quebrada Los Negritos), receives less movement of people, and is less frequently maintained. Finally, we categorized the Reserva Ecológica Leonelo Oviedo ("Ecological reserve") as a zone with only minor alteration because it is a secondary woodland with about 40 years of growth located west of the Biology building (Nishida *et al.*, 2009).

Ants were collected using baits as described by Bestelmeyer *et al.* (2000), with pieces of pecan shortbread cookies (Keebler Sandies[®]) serving as baits. Twenty baits were placed throughout each of the four areas, approximately one to two meters apart, for two hours, and ant specimens were collected every half hour. We considered the 20 baits per two-hour period as a sampling event. For each area, we collected every two weeks to complete a total of four events per site. All collected ants were preserved 95% ethanol.

Identifications were carried out using a list of potential ant species occurring in the Central Valley of Costa Rica, which was supplied by John Longino and Philip Ward (pers. comm., 2015). We used AntWeb (2015) as well as the relevant taxonomic keys (Longino, 2003, 2006; Wilson, 2003) to identify the ants that were collected. Voucher specimens are deposited in the entomology collection in the Museum of Zoology at the University of Costa Rica.

We applied two non-metric multidimensional scale analyses (nMDS) to determine whether the structure of the ant community varies according to the four areas, one using the Jaccard similarity index and

the other using the Morisita similarity index. We used a Chi-Square test of Independence to determine whether the number of native and introduced species is independent of the collection site. All statistical analyses were done using PAST 3.11 (Hammer *et al.*, 2001).

RESULTS AND DISCUSSION

We found a total 22 species of ants, of which 20 are native species (Table 1). The presence of native versus introduced species was not related to the collection site ($\chi^2=0.32$, $df=3$, $p=0.96$). Both nMDS analyses grouped the Chemistry and Biology green areas as the sites with greater similarity and the Building interior as the area with a very low similarity, compared to the other three areas (Figure 1).

The low number of ant species found in the Building interior was probably due to the scarcity of potential food sources as well as the presence of boric acid baits. At least some of the ants found in the Building interior probably nest outside the building. Our evidence for this supposition is the low activity of ants observed during the sampling events, as well as the observations of individuals entering from outside the building through the windows.

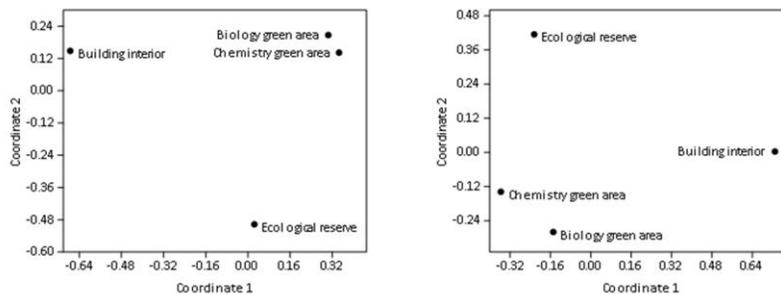


Figure 1. Results of non-metric multidimensional scale analysis using Jacard (left, stress level= 0, $R^2= 0.93$) and Morisita (right, stress level= 0, $R^2= 0.75$) similarity index

Table 1. Ant species collected at four sites on the University of Costa Rica campus. See text for description of sites. * = species not native to Costa Rica.

Ant species	Building interior	Biology green area	Chemistry green area	Ecological reserve
<i>Cardiocondyla obscurior</i> *		X		
<i>Crematogaster nigropilosa</i>				X
<i>Cyphomyrmex rimosus</i>		X	X	X
<i>Linepithema angulatum</i>			X	
<i>Linepithema neotropicum</i>			X	
<i>Myrmelachista zeledoni</i>				X
<i>Nylanderia</i> sp. JTL-001		X	X	
<i>Nylanderia steinheili</i>		X	X	
<i>Odontomachus bauri</i>		X	X	X
<i>Pachycondyla impressa</i>		X		
<i>Pheidole absurda</i>		X	X	X
<i>Pheidole megacephala</i> *			X	X
<i>Pheidole pubiventris</i>			X	
<i>Pheidole pugnax</i>		X	X	
<i>Pheidole punctatissima</i>	X	X	X	X
<i>Pheidole subarmata</i>		X		
<i>Pheidole susannae</i>		X	X	X
<i>Pheidole synanthropica</i>		X	X	
<i>Solenopsis bicolor</i>			X	
<i>Solenopsis picea</i>		X	X	
<i>Tapinoma ramulorum</i>	X	X	X	X
<i>Wasmannia auropunctata</i>			X	X

Our results suggest that urban green areas can serve as reservoirs for native biodiversity. Although urban areas are generally thought to be dominated by introduced species, the vast majority of ants collected in our study are native species. Nonetheless, most of the species we collected are generalist feeders, which agrees with previous studies on other groups of animals that inhabit urban areas (Gibb & Hochuli, 2002), and is probably a result of the type of bait that was used. More varied sampling techniques are necessary to better understand the diversity of ant feeding habits in urban areas, for example the potential presence of specialised predators. We found more species in the two managed green areas than in the ecological reserve (Table 1), although this probably reflects our sampling methodology, which favors species adapted to disturbed areas. Litter samples, for example, could reveal a greater number of species in the reserve.

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