Ground Arthropod Diversity at North Desert Village

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Abstract

While many studies have shown that urbanization and land-use type significantly impact species richness and evenness, few studies have investigated the mechanisms by which these changes occur. A residential neighborhood at ASU-Polytechnic Campus has been designed with 4 different neighborhood landscape regimes and provides the ideal opportunity to explore how local neighborhood landscaping affects biodiversity and food web structure and function of arthropod communities. Species richness, abundance and evenness were compared for ground dwelling arthropods before and after the installation of the North Desert Village (NDV) landscape treatments. This study can provide insights and understanding into the fundamental processes of how local landscaping practices alter diversity, relative abundances, and trophic structure of biological communities.

Introduction

Urbanization is an intense human activity that can radically alter species richness, evenness and composition relative to wildlands (McKinney 2002). Whereas the patterns of changes in biodiversity in urbanized areas have been increasingly documented, the underlying processes and causes for these changes are virtually unknown (Faeth et al. 2005, Shochat et al. 2006). Recent studies in the CAP-LTER region using the native Sonoran desert plant, brittlebush (*Encelia farinosa*) have found that urban habitats exhibit a reduction in species diversity and altered species composition. Investigations of regional scale effects in the CAP-LTER region of residential, industrial, agricultural and desert remnant areas on ground arthropod communities have also found that community composition varied among land use types (McIntyre et al. 2001, Cook and Faeth 2006, Schochat et al. 2004) Consequently, urbanization results in changing the food web structure and dynamics in urban areas.

Understanding these changes is critical to management of habitats, species diversity, and invasive species in rapidly expanding urban areas. Here we investigate **how local neighborhood landscaping affects biodiversity and food web structure and function of ground-dwelling arthropod communities**. In this study we compare ground arthropod data from before and after the establishment of the four landscape types. We will test for differences in richness, abundances and trophic structure between these two desert landscapes. If these differ significantly, then this would suggest that not only is productivity essential in determining relative abundances, diversity and trophic structure, but also that reconstructed xeric habitats differ fundamentally by the identity of the vegetation.

Methods

North Desert Village

Five neighborhoods of different landscape regimes (native, xeric, mesic, oasis and control) have been established at North Desert Village, a residential community located at Arizona State University, Polytechnic Campus. Each neighborhood consists of 6 single-family homes arranged in a horseshoe shape surrounding a central common area. The native treatment consists of plants native to the Sonoran Desert, the xeric treatment has low water-use non-native plants, the mesic treatment has a lawn landscape supplemented with high water-use trees and the oasis is a combination of the xeric and oasis treatments (see Fig. 1). Finally, the control neighborhood has been left unmanipulated and the common area remains a section of unmaintained grass.

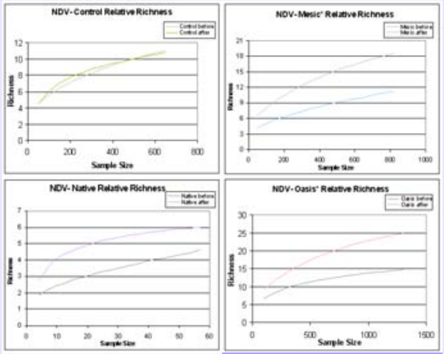
Pitfall Traps

Arthropods were sampled using pitfall traps installed in each of the four neighborhoods before the installation of the new landscape regime. Twelve pitfall traps (half in the common area and one in the yard of each house) were set in each neighborhood and remained open for 72 hours. Before the landscape installation, traps were set in January, March, May, June, August and November of 2004. The after landscape installation sampling occurred in December of 2005 and February, April, August and October of 2006. Specimens were sorted, counted and identified to family level and classified to trophic guild (predator, herbivore, omnivore, detritivore or parasite).

Statistical Analyses

Species richness, evenness and abundance were assessed and the distribution of trophic guilds were compared. Rarefaction curves were constructed using EcoSim Version 7 and Non-metric Multidimensional Scaling was used to construct a diagram of the community relationships, clustering those communities which are most similar.

Figure 1.From top clockwise: Mesic, Native, Xeric and Oasis neighborhoods. North Desert Village Study Area



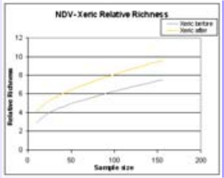
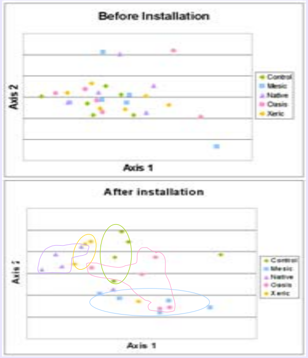


Figure 2. (above) Rarefaction curves for before and after NDV treatment installation. Curves show the number of taxa found in each treatment type given a similar sample size.

Figure 4. (below) Nonmetric Multi-dimensional Scaling for pre and post-treatment sampling (n=6 and n=5, respectively)



Results

Species abundance as well as species richness differed greatly before and after treatment installation. Rarefaction analyses showed that all of the treatments differed in species richness before and after the installation of the treatments (Fig. 2), with the exception of the control. Species richness in the xeric and native treatments also significantly differed after the installation of the landscape regimes. The trophic guild structure also differed between treatments (Fig. 3). NMDS revealed that arthropod communities formed fairly distinct clusters according to landscape type (Fig. 4). While the native and non-native xeric treatments were more similar to one another than any other treatment, the mesic treatment was most different than any other and the oasis treatment, as expected fell in between these two distinct types of landscape management.

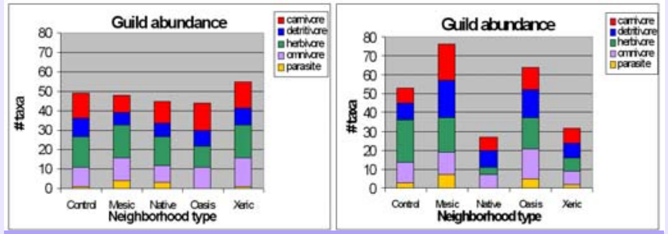


Figure 3. Total number of taxa per treatment type before and after NDV installation. Before n=6, After n=5

Discussion

As expected, greater arthropod abundances were found in the oasis treatment compared to the native and xeric treatments and an even greater abundance in the mesic treatment. This supports the hypothesis that says trophic dynamics are mediated by bottom-up resources and as productivity increases, species abundance also increases (Lindeman 1942). This was the opposite pattern found for species richness. Species richness was greater in the less productive treatments. Other studies in the Sonoran Desert have also found similar patterns for ground arthropod abundances. McIntyre et al. (2001) and Shochat et al (2004) found that arthropod abundances were higher in mesic residential treatments and species richness was lower compared to less productive treatments. Notable differences were also found between the two least productive treatments where the main distinction is plant diversity. A significant difference was found between arthropod species richness in the xeric and native landscape regimes. Furthermore, differences were also found in the distribution of the trophic guilds in these treatments. These analyses tell us that while species abundance in non-native vegetated xeriscapes mimics that found in xeriscapes with native vegetation, they may differ fundamentally in community structure.

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