Food web Dynamics in Aboveground Desert Remnant and Xeric Residential Landscapes

Bony Ahmed, Kathleen A. Lohse, Ryan A. Sponseller, and Nancy B. Grimm

Arizona State University - Global Institute of Sustainability and School of Life Sciences

Introduction

Urban ecosystems are generally recognized as areas under profound and constant local human activity, being composed of high-density human habitation, industrial and commercial centers, and remnants of indigenous habitat. In 1990s, population of Central Arizona Phoenix grew at an unprecedented rate. Being located on a desert, water is a critical resource for the Phoenix region. Thus, the intense rate of growth prompted the Environmental Protection agency to launce several water conservation campaigns. One result of these campaigns was the transformation of residential landscapes. Many Phoenicians switched from mesic landscapes, which need much water to sustain, to xeric landscapes, which need little water to sustain because of their resemblance to the "pristine" desert (EPA 2002). Although the structure of xeric landscapes is similar to undisturbed desert landscape, several human management factors such as plant watering and fertilization make it unclear as to whether or not these landscapes differ functionally.

Questions and Hypotheses

Q: How do desert and xeric landscapes ecosystems differ in terms of aboveground foodwebs?

H1: Xeric landscapes have greater abundance of herbivores than desert landscapes because xeric landscapes have greater nutrient (N,P) and water availability.

P1: If nutrient availability is higher in xeric landscape ecosystems than desert ecosystems, then C:N and C:P ratios in foliar tissues will be lower in the xeric versus desert sites

P2: If water availability is higher in xeric landscape ecosystem than desert ecosystems, then soil moisture will be higher in the xeric sites than the desert sites

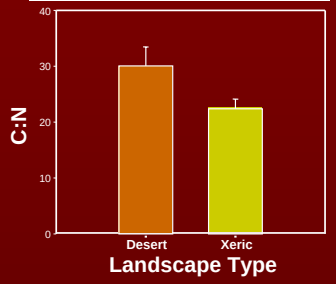
P3: If nutrient or water availability is higher in xeric landscape ecosystem than desert ecosystems, then insect abundance will be greater in the xeric sites than the desert sites

Methods

Eight sites were examined throughout the Phoenix Metro area, four desert and four xeric. Xeric residential yards were defined as single family homes, that have no turf, comprising mostly of gravel and brittlebush. Desert remnant sites were defined as lacking built structures and abundant with Sonoran Desert vegetation. Insects were collected by vacuum from two plants per site; foliar tissue from each plant was harvested for nutrient analysis. Carbon and nitrogen content of ground leaf material were measured on a Perkin-Elmer 2400 CHN analyzer (Perkin Elmer Inc., Wellesley, MA). Phosphorous content was measured on ground leaves by persulphate and sulphuric acid digestion followed by colorimetric analysis. Soil moisture data was collected by

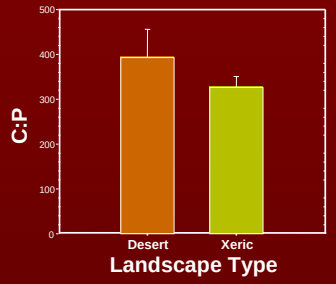
Resources

Foliar C:N in Desert vs. Xeric



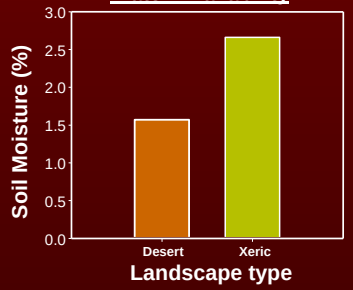
Desert landscape sites had higher C:N ratios than xeric residential landscapes sites. This difference was only marginally significant (F = 4.0566, P = 0.0906).

Foliar C:P in Desert vs. Xeric



Desert landscapes had higher C:P ratios than xeric sites, however the differences were not significant (F = 0.9658, P = 0.3637).

Water Availability



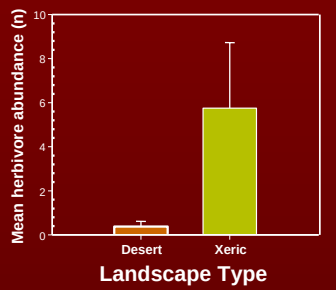
Xeric residential sites also had higher soil water content than desert sites. However, there were not enough data from all the sites to perform a thorough statistical analysis.

Discussion and Future Research

- There was generally lower C:N, C:P and greater soil moisture in xeric landscapes compared to desert sites. This suggest that human activities in xeric landscapes alters the aboveground resource availability.
- Insect herbivores feeding upon nutrient rich plants were also affected, there were significantly more herbivores in xeric sites than the desert sites.
- Future research involving more sites and plants will further confirm or reject the suggested hypotheses.
- Further research comparing whether nutrient availability or water availability leads to abundance and/or biodiversity is being conducted.

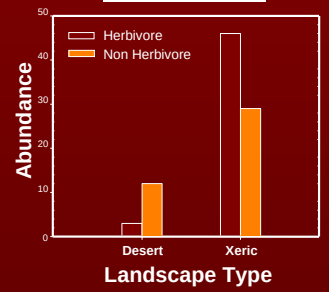
Herbivore Abundance

Herbivore Abundance Per Site



Herbivores were far more abundant in xeric residential sites than in the desert remnants. A one way test revealed significant differences in rank sums of herbivores (Chi-Square 3.606, 0.0575).

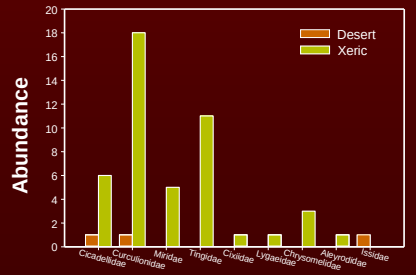
Site Differences



Xeric sites outnumbered desert sites in both herbivores and non herbivores. There were greater herbivores (47) and less non herbivores (29) in xeric sites, while less herbivores (3) and more non herbivores (12) were present in desert sites.

Biodiversity

Diversity of Herbivores vs. Site Type



Different types of herbivore taxa were found in contrasting landscape types. Xeric sites had 8 different taxa as opposed to 3 taxa found in desert sites. The most abundant group was the weevil (*Curcullionidae*; order: Coleoptera).

Contanct: Bony.Ahmed@asu.edu