Spatiotemporal patterns of dominant plant species in CAP LTER

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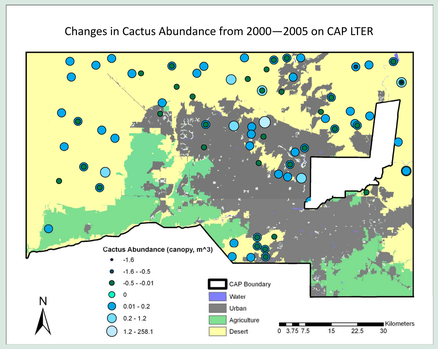
Introduction

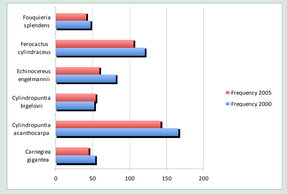
We are exploring spatiotemporal dynamics of plant communities in urban and surrounding desert sites of the rapidly urbanizing Phoenix metropolitan area. Our efforts build on theoretical work developed primarily in 'natural' systems as well as considerable efforts by Central-Arizona Phoenix Long Term Ecological Research (CAP LTER) projects. Data for the CAP LTER Survey 200 project was collected at 204 randomly located sample plots. Previous analyses of these data detected associations between both environmental and socioeconomic factors (e.g. land use) and plant diversity and composition based on single survey years. We have detected changes in species frequency and abundance between 2000 and 2005. For example, dominant cactus species decrease in frequency from 2000 to 2005, while frequency of dominant tree and shrub species remain relatively constant. We hypothesize that changes in relationships are related to environmental and socioeconomic factors but that their relative impact differs between urban, desert, and agricultural sites. This work is a preliminary step to identifying thresholds of change and discerning the applicability of ecological resilience theory in urban landscapes, which will contribute to our understanding of threshold behaviors in coupled human-natural systems.

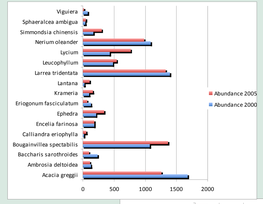
Phoenix, Water, and Resilience

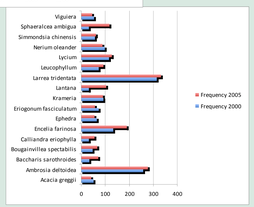
Phoenix, Arizona is one of the fastest growing metropolitan areas in the United States. It lies in Central Arizona, which is a desert system reliant upon a reservoir system for collecting and distributing surface runoff, as well as groundwater which is being consumed faster than it is being recharged (Ellis et al. 2008). Accordingly, population and economic stressors on freshwater supplies will increase as >100 000 residents move to the area annually. Water supply and demand will shift as time goes on, and freshwater availability will become more vulnerable as it is influenced by interactions among global change, surface water hydrology, and societal adaptations to water scarcity (Vorosmarty et al. 2000).

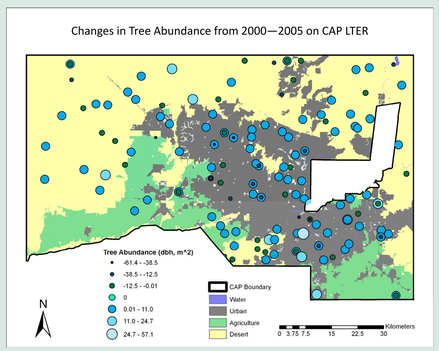
Changing water supplies affect natural vegetation patterns in addition to vegetation aesthetics in horticultural applications. Additionally, the scientific community recognizes that 'natural' drought-tolerant plant communities are more resilient to water shortages, but we have yet to understand how drought disturbances and decreasing access to water resources will affect resilience of urban vegetation and landscaping aesthetics or how the influence of increasing human populations will affect spatiotemporal vegetation patterns.

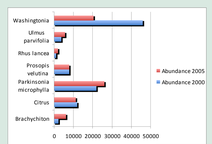


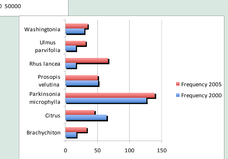












Results

Cactus--

The frequency of all cactus species decreased from 2000 to 2005, suggesting decreases in recruitment for cactus species across the CAP LTER. This is in contrast to the increased frequency ("recruitment") among many native shrubs. With present results, we find that dominant cactus species do not occur in the urban core or in the agricultural area, but rather on the periphery of the built regions and in the surrounding desert.

Shrubs--

The dominant desert shrubs *Larrea* and *Ambrosia* both increased in frequency but decreased in abundance from 2000 to 2005. This suggests recruitment of small individuals contributing to frequency, in addition to death or canopy dieback of larger individuals. This might suggest natural dynamics of the community in response to wet and dry years.

There is also an increase in frequency in *Baccharis sarothroides* (decreased in abundance), *Encelia farinosa* (no change in abundance) and *Sphaeralcea ambigua* (increased in abundance). These are subshrubs that are fast-growing and shade-intolerant and probably recruit in response to disturbance and/or available moisture (wet years). These subshrubs are likely responding to local community dynamics and available canopy cover.

In contrast with this general pattern of increasing frequency and recruitment for native shrubs, *Acacia greggii* and *Viguiera* (sunflower) decreased in both frequency and abundance.

Trees--

Washingtonia (fan palm), although native to the Sonoran Desert, is used in landscaping and probably mainly urban in this dataset. It increased slightly in frequency but decreased greatly in abundance. This suggests that either big trees were replaced by small trees or a change in how abundance was measured.

Prosopis velutina (velvet mesquite) and *Parkinsonia microphylla* (palo verde) are native desert plants, although also used in landscaping both in yards, along freeways and malls, etc. *Parkinsonia* increased in frequency and abundance while *Prosopis* did not change much.

Acknowledgements

Many thanks to our cooperators and funding sources:

VALE Vegetation and Landscape Ecology Lab

Central Arizona-Phoenix Long-Term Ecological Research CAP LTER

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