CAP LTER Plant Species Diversity Responds to Land Use and Landscape Aesthetics

Julie Ripplinger[1], Janet Franklin[1,2]

[1]School of Life Sciences, [2]School of Geographical Sciences and Urban Planning, Arizona State University, Tempe, Arizona 85287

Background

- Increasing our knowledge of the effects of urbanization on plant communities is fundamental to understanding the value of urban ecosystems in providing vital services to residents, such as clean air and mitigation of the urban heat island effect.
- Our research builds on the findings of previous land use and plant diversity research at CAP LTER (Hope et al. 2003, 2006, Walker et al. 2009) and aims to improve our understanding of the interactions of human activities and the environment by examining variability in plant community patterns across time and landcover types.

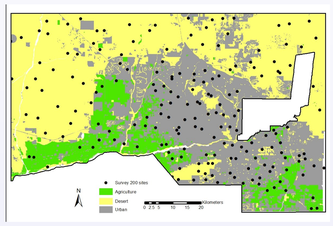

Figure 1. Sites of CAP LTER Survey 200.

Research Question -- How do CAP LTER vegetation spatial patterns vary from 2005 to 2010
- Among landcover types?
- At fine- and coarse-scales?

- We expected that spatial vegetation patterns in Phoenix metropolitan might have been affected by the recent housing crisis (that resulted in a stunning 48% decrease in assessed real estate value in the Phoenix area between 2008 and 2011!).

Methods

- *Sampling methods* -- The Survey 200 is a core CAP LTER legacy data set that was first collected in 2000, and again in 2005 and 2010. The survey's 204 plots were randomly located in order to acquire a representative and unbiased sample of the LTER's ecological characteristics and are resampled every five years (Fig 1).
- Each site was classified in a coarse regional land-use category (urban, agriculture, desert, transportation, and mixed use)

Figure 2. Regional land-use types , (a) urban, (b) desert, and (c) agriculture.

Methods cont.

- *Sampling methods cont.* -- Then finer-scale within-urban residential land-use categories were used to define residential landscapes as mesic, xeric, or oasis.

  - **Mesic** plots primarily consisted of extensive irrigated lawn, high water-use plants, and lacked gravel swaths.
  - **Xeric** plots typically consisted of drip-irrigated desert-adapted plants, usually covered in gravel mulch, and lacked irrigated lawn.
  - **Oasis** plots consisted of a combination of xeric and mesic components; such as high and low water plants and some lawn.

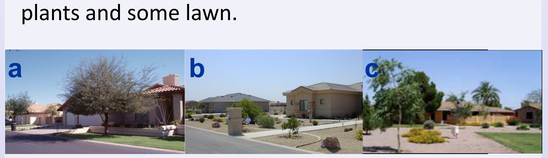

Figure 3. Examples of residential land-use, (a) mesic, (b) xeric, and (c) oasis.

- *Analysis methods* –To compare 2010 Survey 200 spatial patterns to those observed in 2005, we duplicated several of the analyses conducted by Walker et al. (2009), specifically non-metric multidimensional scaling (NMDS), and plant species richness, by land-use type at coarse and fine scales.

Results

- *Course-Scale Analysis* -- As found for 2005 (Fig 4b), in 2010 plant species richness varied by regional land-use and decreased significantly from desert to urban to agriculture (Fig 4a).
- Land-use also affected community composition, though unlike in 2005 (Fig 5b), the 2010 species composition of desert sites was unique while there was a great deal of overlap in species composition of urban and agriculture sites (Fig 5a).

Regional Composition and Diversity (Coarse)

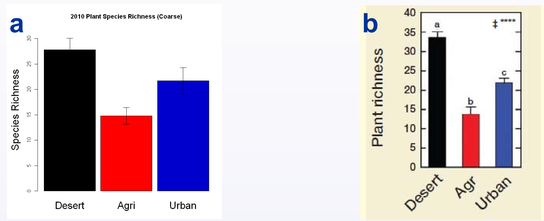

Figure 4. Plant species richness on CAP LTER by regional land use type for the years (a) 2010 and (b) 2005 (from Walker et al. 2009).

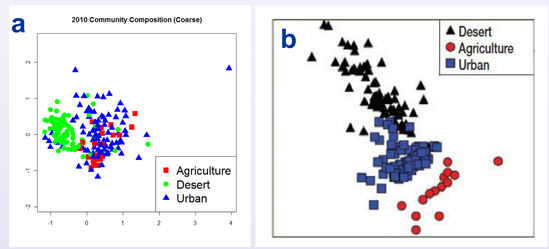

Figure 5. Plant community composition by regional land use type for the years (a) 2010 and (b) 2005 (from Walker et al. 2009).

Results cont.

- As found for 2005 (Fig 7b), we found that plant species richness varied among landscape aesthetic land-use types (Fig 7a). 2010 plant species richness increased from mesic to oasis to xeric, though the differences were not statistically significant. Walker and colleagues partitioned native and non-native species for this analysis and we did not, so this may account for the lack of significance in 2010.
- In contrast to the course-scale regional land-use of 2010 (Fig 5a) and to the 2005 residential land-use analysis (Fig 8b), ordination of the 2010 plant species does not reveal distinct plant communities at the residential level (Fig 8a).

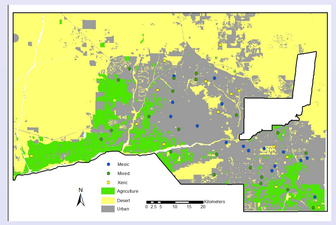

Figure 6. Residential subset of CAP LTER Survey 200 sites.

Residential Composition and Diversity (Fine)

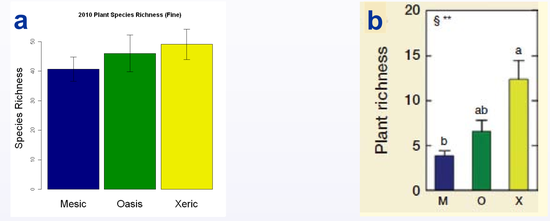

Figure 7. Plant species richness on CAP LTER by residential land use type for the years (a) 2010 and (b) 2005 (from Walker et al. 2009).

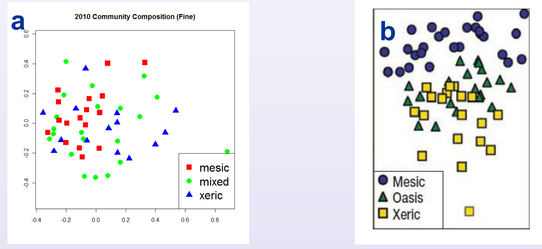

Figure 8. Plant community composition by residential land use type for the years (a) 2010 and (b) 2005 (from Walker et al. 2009).

Preliminary Conclusions

- These aberrations in community composition between 2005 and 2010 suggest a shift in social-ecological processes driving plant community patterns. Future work includes refined comparisons of 2005-2010 data and investigation into drivers of this change between survey years.
- We expect the drivers of this shift to be related to the 2008 housing and economic crisis, which had a particularly severe impact on the growing economy of Phoenix metropolitan area. However, thus far the differences found are not great, and there may not have been sufficient time for the socioeconomic factors to affect urban vegetation.

Acknowledgements

Many thanks to our cooperators and funding sources:

VALE Vegetation and Landscape Ecology Lab

Central Arizona-Phoenix Long-Term Ecological Research CAP LTER

NSF

ASU School of Life Sciences

ASU School of Geographical Sciences & Urban Planning