The influence of environmental values & neighborhood context on household-level biodiversity

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Introduction

Urbanization & land use changes often alter plant biodiversity. Residential landscapes—as highly managed ecosystems that cover a considerable proportion of cities—may significantly impact urban biodiversity. Both homeowners' decisions & property characteristics influence the structure of these landscapes & sub/urban environments. To-date, most urban biodiversity studies focus on regional scale analyses, with few addressing household-level decisions & associated social-ecological outcomes. **We therefore examine plant biodiversity & groundcover at the household scale in Phoenix, AZ by exploring both agency-based drivers (residents' values) & structural factors (property characteristics) as possible explanations for urban biodiversity patterns across diverse neighborhoods.**

Research Questions

1) How does biodiversity differ across diverse neighborhoods & in relation to common groundcover types (grass vs. rock)?

2) How do residents' values & property characteristics explain biodiversity at the household & neighborhood scales?

Landscape Gradient ➔ Common Phoenix, AZ Yard Structures

Mesic: Grass Lawn | Oasis: Mixed Grass & Rock | Xeric: Rock Yard

Integrative Methods

• Combining a social survey (n = 121) & observational field survey (n = 428) in 4 Phoenix neighborhoods (Fig. 1) we examined residents' values & front-yard plant composition & groundcover, respectively.

Biodiversity: Plant taxa were identified to species or genus. *Richness* (# of plant species) & *evenness* (no single species dominates) were calculated using PAST 2.04 (Hammer et al. 2001). Turfgrass species were excluded from measures.

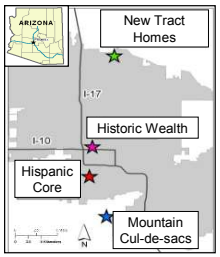
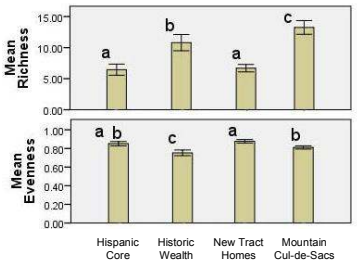


Fig. 1: City of Phoenix & four case study neighborhoods.

• **Structural Property Characteristics**: Property age & value were obtained from 2008 county tax assessor data. Yard area was manually digitized from high resolution satellite imagery in Arc GIS.

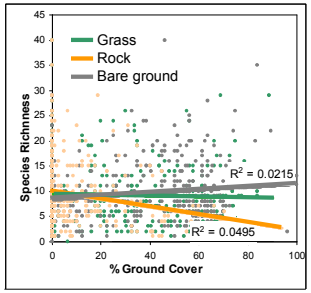
• **Resident Values**: Values are core beliefs that are important to a person. Social survey variables were averaged into composite indices & tested for reliability (Cronbach's alpha) to create 2 value measures that influence groundcover choices & yard inputs (Larson et al. 2010): *Environmental Practicality*, reflecting easy-to-maintain yards with low environmental impact as a specific landscaping priority, & *Ecological Orientation*, reflecting a biocentric worldview broadly.

Fig. 2: Richness & Evenness by Neighborhood



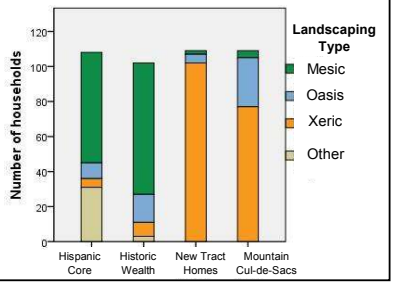
Different letters indicate statistical differences between means given: Kruskal-Wallis one way ANOVA at p<0.001, & Mann-Whitney U for pair-wise tests with a Bonferroni adjustment using $\alpha = 0.05$.

Fig. 3: Richness vs. Ground Cover



Lines with R^2 labeled indicate significant Spearman's rho values at p<0.05. Results for evenness are similar, but inverted, and thus not shown.

Fig. 4: Neighborhood Landscaping

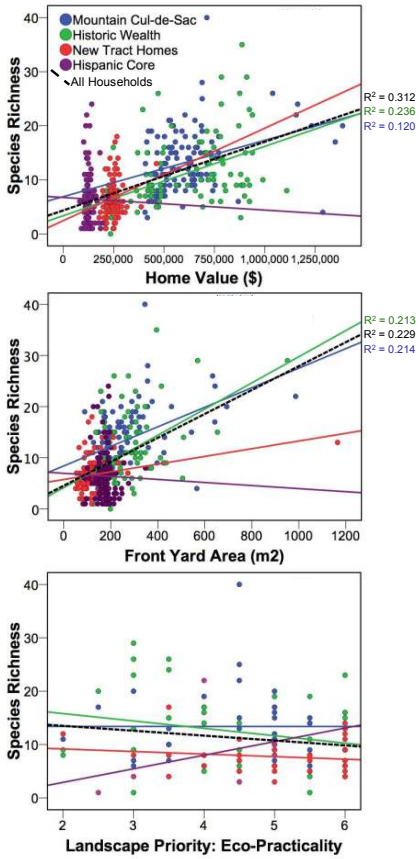


FINDINGS:

• Biodiversity differs across yards (Fig.2) but, this is likely not driven by ground cover as correlations are weak (Fig. 3).

• Furthermore, we find that diversity can be the same between xeric and mesic yards and different between neighborhoods with similar yard types (compare patterns in Fig. 2 & 4).

Fig. 5: Biodiversity by Property Attributes & Resident Values



Correlations by neighborhood for richness (y) & property value, yard area and resident values. Lines with R^2 labeled indicate significant Spearman's rho values at p<0.05. Environmental orientation was not significant & therefore is not shown here.

FINDINGS:

•Structural and property characteristics (area and property value in $) are better predictors of diversity than residents' values.

Key Finding: Relationship between yard area & biodiversity

In non-managed ecosystems, biodiversity is positively related to land area. Sampling corrections (e.g. rarefaction) are commonly used, assuming that recorded taxa will increase as sampling effort increases. However, our unit of analysis—the yard—was fully surveyed & further sampling would not turn up additional species. Thus, we treat area as an independent variable in our study. While diversity largely does correlate with area, **we show that diversity does not always relate to area in the urban setting** (Fig. 5). The Hispanic Core & New Tract Homes have similar plant diversity (Fig. 2), yet diversity in the former is not correlated to area & diversity in the latter is correlated to area. Further studies should seek to prove or refute this possibility.

Conclusions & Next Steps

• Weak correlations between diversity and values imply that conservation programs should consider urban structure, rather than residents' values, in encouraging landscaping practices.

• Biodiversity is quite different across similar yard types (e.g. mesic & xeric) (Fig. 2, 3 & 4). Thus, we need to know more about what constitutes these yard types & derive better classification schemes for them. See next steps below.

• Further studies should assess if biodiversity drivers, like area, exhibit different relationships among neighborhoods as we have anecdotally seen here. Biodiversity drivers may thus, be context dependent.

• **Our next steps** involve 1) regression analysis to further understand the possible drivers of yard biodiversity in multivariate models, and 2) cluster techniques to create a yard typology based on realistic depictions of mesic, oasis, & xeric yards. In developing a landscape typology considering groundcover, biodiversity, and other factors, we will link ecosystem services to common plant assemblages in varying types of yards allowing us to better understand our urban environment.

Acknowledgements

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