Birds, habitat, an urban gradient, and socioeconomic factors: Exploring the relationships in a residential landscape.

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INTRODUCTION

Residential landscapes represent a large percentage of urban land cover (Martin et al. 2003). Managing these landscapes for **native birds** and other wildlife could potentially reduce the negative impacts of urbanization on biodiversity (Warren et al. 2008) by providing mini refugia within urban areas. Birds demonstrate a strong association with vegetation composition (Chace and Walsh 2006).

In urban landscapes, humans modify plant conditions and in essence, have created entirely novel plant communities (Whitney and Adams 1980). Therefore, to fully understand how birds respond to residential landscapes, we propose a conceptual model that integrates socioeconomic factors that influence landscaping decisions and thus drive urban bird community patterns (Fig 1).

RESIDENTIAL LANDSCAPE DESIGNS: (Fig. 2)

- Vary in vegetation composition and configuration
- Some designs include novel and foreign vegetation (**MESIC**)
- Some designs mimic the wildlands being replaced (**XERIC**)
- Traditional determinants of plant communities (soil, climate, and elevation) have little influence on plant distribution in urban landscapes.
- Socioeconomic factors drive landscaping decisions (Grove et al. 2006).

XERIC YARDS **MESIC YARDS**

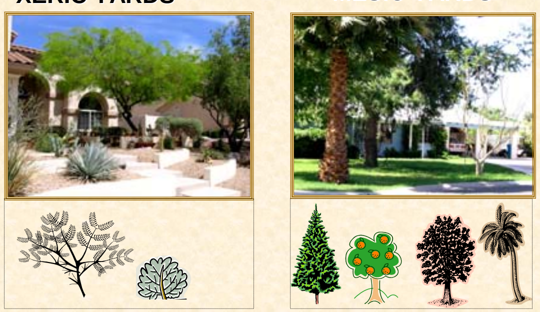

Figure 2. Examples of residential landscapes in Phoenix, Arizona with corresponding typical vegetation. From left to right, including abbreviations used for analysis and species example: Thin-leaf evergreens (**TE**, mesquite), **SHRUB**, Conifers (**CON**; Afghan pine), Broad-leaf evergreen (**BE**; citrus spp), Broad-leaf deciduous (**BD**; cottonwood), Monocot (**MON**; palm tree)

REFERENCES

Chace, J. F., and J. J. Walsh. 2006. Urban effects on native avifauna: a review. Landscape and Urban Planning **74**:46-69.

Grove, J. M., A. R. Troy, J. P. M. O'Neil-Dunne, W. R. Burch, M. L. Cadenasso, and S. T. A. Pickett. 2006. Characterization of households and its implications for the vegetation of urban ecosystems. Ecosystems **9**:578-597.

Martin, C. A., K. A. Peterson, and L. B. Stabler. 2003. Residential landscaping in Phoenix, Arizona, U.S.: practices and preferences relative to covenants, codes, and restrictions. Journal of Arboriculture **29**:9-17.

Warren, P. S., S. B. Lerman, and N. D. Charney. 2008. Plants of a feather: Spatial autocorrelation of gardening practices in suburban neighborhoods. Biological Conservation **141**:3-4.

Whitney, G. G., and S. D. Adams. 1980. Man as a Maker of New Plant-Communities. Journal of Applied Ecology **17**:431-448.

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CONCEPTUAL MODEL OF BIRD, HABITAT, URBAN GRADIENTS, AND SOCIOECONOMIC VARIABLES IN RESIDENTIAL LANDSCAPES

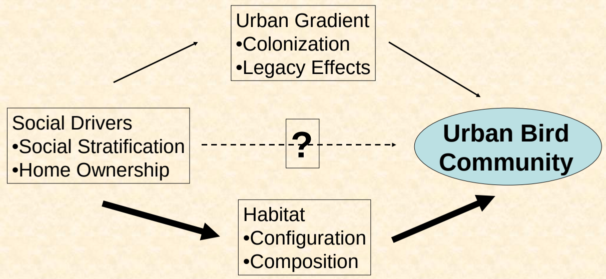
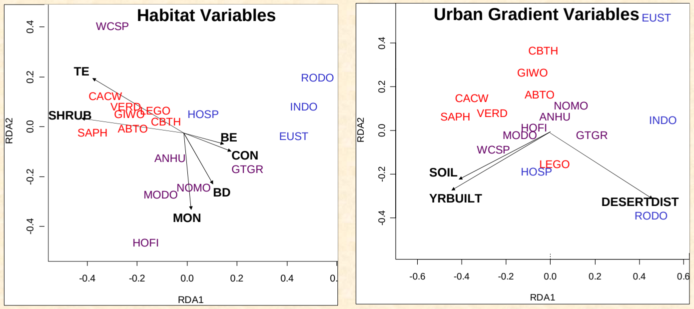
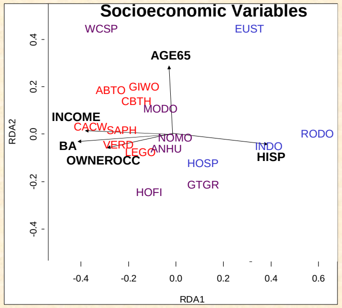


Figure 1. We propose social drivers (e.g. income and education) as processes driving the urban bird community structure. These social drivers have a large influence on landscaping decisions (habitat for birds) and correlate with urban gradient measures (distance from urban center; i.e. ability for native birds to colonize urban landscapes. Additional factors might be driving the urban community such as behavior by birds (e.g. a few urban specialist species excluding or out-competing native birds) and resources (e.g. bird feeders, swimming pools, and garbage).





INTERPRETING THE ORDINATION TRIPLOTS:

Black Arrows: the environmental vectors
•Length= importance of the variable to ordination
•Direction= arrow points towards increase in value

Species: locations on the plot indicate the species' distributional similarity with each other

**Ignore axis labeled 'RDA1' and 'RDA2'

Figure 3. Constrained Ordination (Redundancy Analysis) diagram of 17 bird species to explore bird community structure and associations with habitat, an urban gradient, and socioeconomic variables.

RESEARCH QUESTION

How do **socioeconomic**, **habitat**, and **urban gradient** measures influence bird distribution in residential landscapes?

METHODS

Compare bird distributions from the **PASS** bird monitoring locations with habitat structure variables, urban gradient variables, and socioeconomic variables

ANALYSIS:
- Correlation analysis between socioeconomic and habitat variables
- Conduct an ordination: Redundancy Analysis (RDA) to explore the relationship between the three sets of variables and bird community.

RESULTS

All five socioeconomic variables correlated with at least two habitat variables. For example:

- **positive** relationship between **INCOME** and **Thin-evergreen Trees** (TE) and **education** (BA) and TE (Linear Regression, F=22.0685, r^2=0.37, P<0.0001, and F=19.8633, r^2=0.34 P<0.0001)
- **negative** relationship between % **Hispanic** and **Shrubs** (F=10.1599, r^2=0.21 P=0.0029).

The ordination (redundancy analysis) for the **habitat** and **urban gradient** variables were **significant**: the proportion of variation in the bird community explained by the environmental variables is greater than expected by chance (**ANOVA, F=0.9273, p=0.0225, F=0.8793, p=0.0492**).

The **socioeconomic** variables were **not significant** (**ANOVA, F=0.6336, p=0.33**).

The triplots (Figure 3) suggest native bird species align closely with xeric landscaping, and areas closer to remnant desert patches. Although not significant, the census variables suggest a trend towards native birds aligning with higher income neighborhoods, college educated and owner occupied residents.

CONCLUSIONS

Correlation analyses show how socioeconomic variables influence landscaping decisions in residential landscapes. The triplots support our conceptual model where the habitat and urban gradient variables significantly explain the variation in the urban bird community. By including socioeconomic variables in the analysis, we gain a greater understanding of the driving factors behind the urban bird community. Our results also suggest racial and economic inequalities in regards to biodiversity where Hispanic and poor neighborhoods have fewer native birds.

KEY TO BIRD CODES

DESERT BIRDS native birds with limited distribution
- ABTO = Aberts Towhee
- CACW = Cactus Wren
- CBTH = Curve-billed Thrasher
- GIWO = Gila Woodpecker
- LEGO = Lesser Goldfinch
- SAPH = Say's Phoebe
- VERD = Verdin

GENERALISTS native birds with broad distributions
- ANHU = Anna's Hummingbird
- GTGR = Great-tailed Grackle
- HOFI = House Finch
- MODO = Mourning Dove
- NOMO = Northern Mockingbird
- WCSP = White-crowned Sparrow

INVASIVES cosmopolitan species
- EUST = European Starling
- HOSP = House Sparrow
- INDO = Inca Dove
- RODO = Rock Dove

KEY TO HABITAT CODES

SHRUB = # Shrubs <1m
TE = Thin Evergreen Trees
MON= Monocots
BE = Broad Evergreen Trees
BD = Broad Deciduous Trees
CON = Coniferous Trees

KEY TO URBAN GRADIENT CODES

SOIL= Amt. of bare soil within 1km radius
YRBUILT= Age of housing
DESERTDIST = Distance to desert

KEY TO SOCIOECONOMIC CODES

AGE65 = Percent older than 65
BA = Percent with a Bachelor's degree
HISP = Percent Hispanic
INCOME = Income level
OWNEROCC = Percent owner occupied