Landscape design and bird community structure in Phoenix, Arizona: Management implications.

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URBANIZATION…

as it transforms natural biotic systems into human-dominated landscapes, has become recognized as one of the greatest threats to bird diversity throughout the world.

Urban patterns in bird communities:

- decrease in diversity
- increase in density
- shift in community composition
- human commensals replace native species.

Urban development:

- alters the natural landscape
- creates a mosaic pattern
- has varying landscape designs and vegetation structures

HOWEVER…There is HOPE!

Some urban areas may resemble key features of native habitats
AND…
Certain landscape designs may provide mini refugia within urban areas, enabling the persistence of a natural bird community.

STUDY SITE: Phoenix, Arizona

- Arizona = 2nd fastest growing state in the USA
- Population in Phoenix has doubled 2 times in 35 years

Residential landscape design in Phoenix, AZ:

1. MESIC (turf, water-loving) yards (**Figure 1**)
2. XERIC (gravel, desert-like) yards (**Figure 1**)

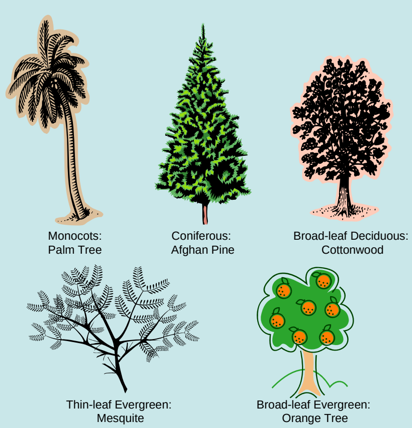

Figure 2. Examples of different leaf structures and corresponding trees.

RESEARCH QUESTIONS

1. Does the fine scaled vegetation structure within the residential yards differ between mesic and xeric designs?
2. How do birds respond to different vegetation structures?
3. Does bird community structure differ between mesic and xeric design?

MESIC YARDS

XERIC YARDS

Figure 1. Examples of residential landscapes in Phoenix, Arizona.

METHODS

- Quantify vegetation in residential landscapes: 150m X 40m transects around 26 bird monitoring sites at the Central Arizona-Phoenix (CAP) LTER.
- Classify transects: MESIC (grass present) VS. XERIC (gravel / dirt present).
- Record abundance of trees according to 5 types of leaf structure (**Figure 2**) and 3 height classes.
- Compare bird distributions from the bird monitoring locations with different vegetation structure and designs.

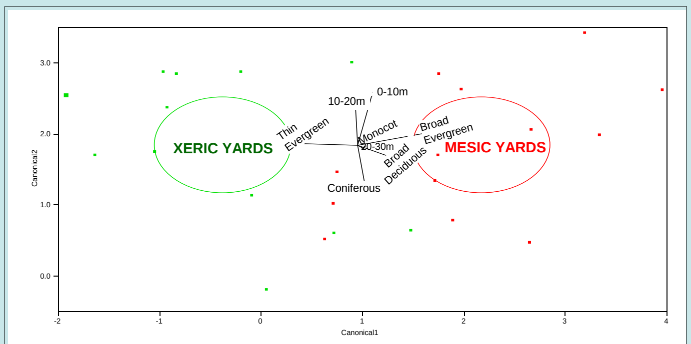

Figure 3. Discriminant Analysis classified **Mesic** transects (red squares) as dominated by broad-leafed deciduous and broad-leafed evergreen trees (predominantly non-native or with high water dependence), and to a lesser degree, monocots and trees taller than 20m. **Xeric** transects (green squares) were dominated by thin-leafed evergreen trees (predominantly native or drought-tolerant).

RESULTS

Vegetation Structure in Residential Landscapes

- We ran a *Discriminant Analysis* to partition the fine scaled vegetatation structure in mesic and xeric designs. Drought tolerant trees aligned with xeric yards and broad-leafed and dense canopy trees aligned with mesic yards with a 12% misclassification rate (Figure 3).

Bird Community

- We applied *Nonmetric Multidimensional Scaling (NMDS)* to display vegetation associations with the bird community. Desert species demonstrated strong associations with drought-tolerant trees while opportunistic and alien species demonstrated strong associations with water-dependent trees (**Figure 4**).

Habitat Preference

Eight bird species exhibited significant preferences for particular vegetation structures ($p<0.10$). For example:

- The Verdin, a desert specialist, had a preference for neighborhoods with thin-leafed evergreen trees (Linear Regression, $p=0.08$) (**Figure 5**).
- The Great-tailed Grackle, an opportunistic species, shows a positive relationship with conifers (Linear Regression, $p=0.01$) (**Figure 5**).

HOWEVER…only two species (Gila Woodpecker and Cactus Wren) demonstrated a significant difference between Mesic and Xeric landscape design (ANOVA, $p=0.09$ and $p=0.08$, respectively).

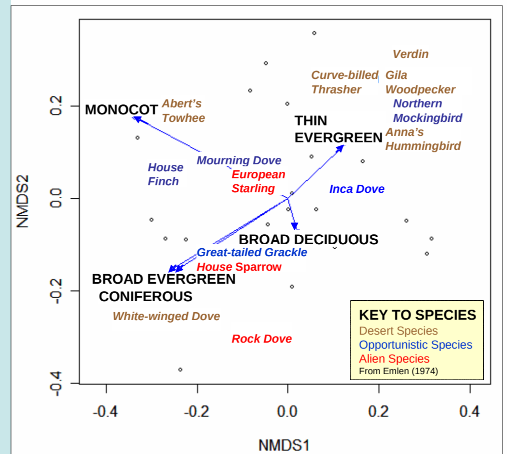

Figure 4. Nonmetric Multidimensional Scaling ordination diagram of 14 bird species to explore bird community structure and associations with vegetation structure. **Desert species** (native birds with limited distribution) are clustered around Thin Evergreen trees while **Opportunistic species** (native birds with broad distributions) and the **Alien species**, exhibited a more generalized pattern, utilizing a broad range of vegetation structures.

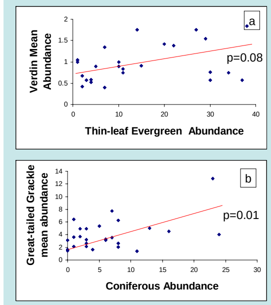

Figure 5. Habitat preferences for the different vegetation structures. (a) The Verdin, a desert specialist, shows a preferance for neighborhoods with thin-leafed evergreen trees. (b) The Great-tailed Grackle, an opportunistic species, shows a positive relationship with conifers.

CONCLUSION AND FUTURE RESEARCH

Opportunistic and alien species appear to inhabit novel urban environments broadly and may out compete desert species for resources. For example, the dense canopy of the coniferous trees might provide opportune habitat for generalist species such as the Great-tailed Grackle, whereas desert specialists such as the Verdin, might be unable to adapt to the foreign vegetation structure.

Future studies aim to address the mechanisms and behavioral cues responsible for the distinct bird assemblages within the different human-dominated landscapes. If particular landscape designs and vegetation structures support a higher proportion of native bird communities, then development plans could incorporate these designs in future projects.

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