Urbanization Contributes to Simplified Riparian Bird Communities

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Central Arizona–Phoenix
Long-Term Ecological Research

ASU Arizona State University

GRRO: Greater Road Runner

Introduction

- Riparian zones are biodiversity hotspots, particularly in arid landscapes where they provide resources for wildlife, including migratory bird species.
- Urbanization affects bird habitat at both the site-level and landscape-level. Environmental changes may lead to riparian zones that foster altered biotic communities.
- Shifts in bird communities may take place over long temporal scales. However, such shifts have rarely been documented in urban areas.

KILL: Killdeer

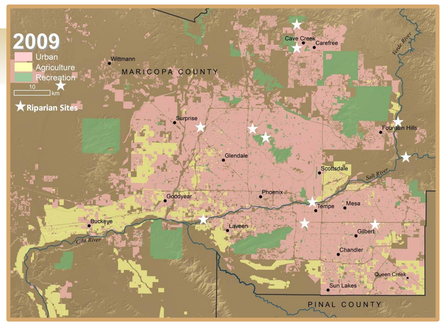
SOSP: Song Sparrow

Questions:

1. How does bird species composition differ between engineered and natural riparian areas?
2. Which environmental variables explain variation in bird community composition across riparian sites?
3. How has bird community composition and abundance at riparian sites changed over time?

Methods: Study Sites

- Central Arizona–Phoenix Long-Term Ecological Research (CAP LTER) project has been monitoring bird populations since 2001 at 12 riparian long-term monitoring sites.
- Sites are located in a natural or engineered setting, and their water feature is ephemeral or perennial (4 riparian habitat categories).



Methods: Data and Analyses

Riparian Bird Community

- Since 2001, 15-minute point count surveys were conducted annually at the 12 riparian sites, 3 times per season (spring and winter).
- We used unconstrained ordinations (non-metric multidimensional scaling (NMDS)) to evaluate riparian habitat and bird communities compositional differences across 4 riparian habitat categories.
- We built a Bayesian model to describe differences in bird abundance across riparian habitats, and to quantify abundance temporal trends.
- We used diversity profiles (Renyi index) to investigate temporal change in diversity.

Environmental Variables

- In spring 2013, site variables were quantified within 40m of bird points.
- Landscape variables were quantified within 1-km radius of bird points using remote sensing images from 2010.

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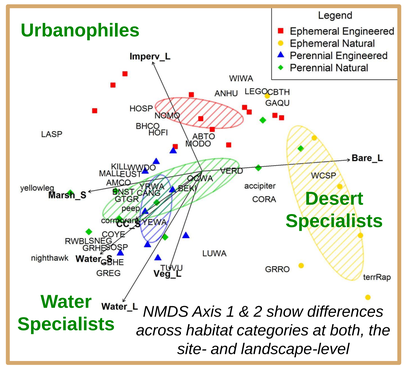
Photo Credits: Mélanie J. Banville

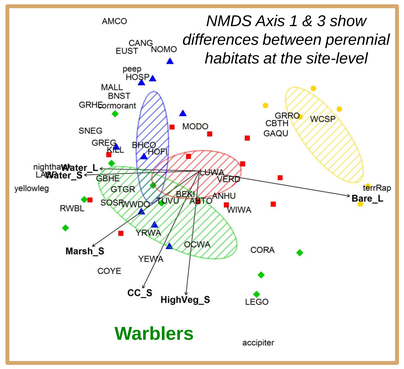
Results: Environmental Variables & Bird Community

- Spring bird community NMDS (2011 to 2013) show bird communities compositional differences across riparian habitat categories.
- Eight site- and landscape-level environmental variables are significant in explaining environmental variation of riparian habitat categories.
- Engineered habitats support more urban-adapted species; natural habitats support more specialists.
- Compared to perennial engineered habitats, perennial natural habitats have more tall vegetation at the site-level and support more spring migrants such as warblers.



Significant Environmental Variables

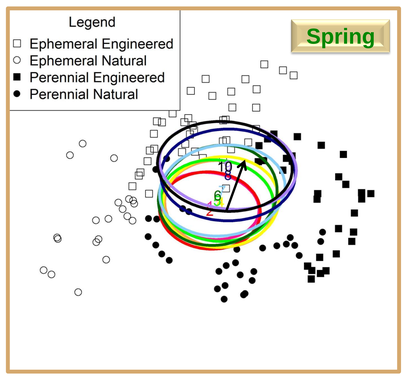
Site-level	Graph Name
% Marsh	Marsh_S
% Water	Water_S
% High Vegetation (>1.5m)	HighVeg_S
% Canopy Cover	CC_S
Landscape-level	**Graph Name**
% Impervious Surface	Imperv_L
% Bare Ground	Bare_L
% Water	Water_L
% Vegetation	Veg_L

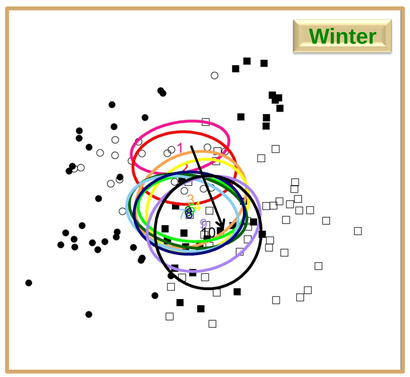


Results: Temporal Bird Community Change

Compositional Shift

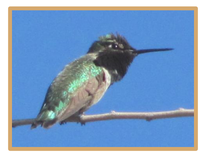
- Ellipses 1 to 10 represent bird community composition from 2001 to 2013.
- Moving average NMDS shows overall bird community shifting toward a composition found at sites with less water and more impervious surface.



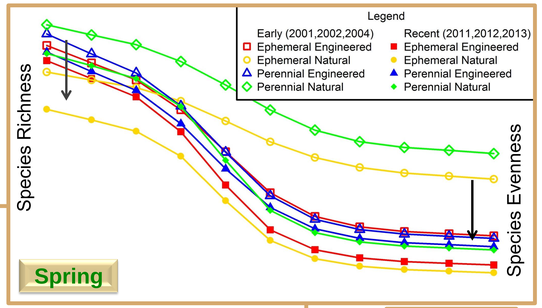


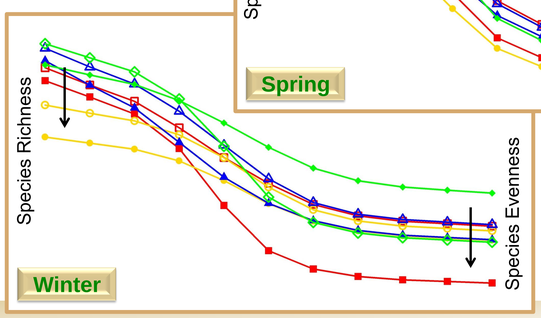
Diversity Shift

- Diversity profiles (Renyi index) show overall decreases in diversity.



ANHU: Anna's Hummingbird





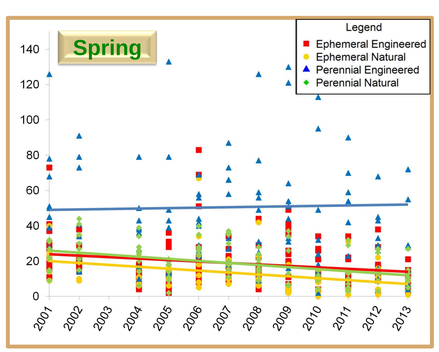
NOMO: Northern Mockingbird

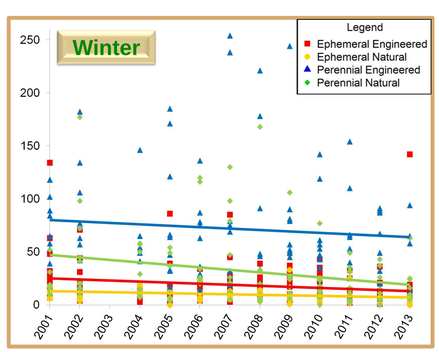
Results: Temporal Abundance Trends

Bayesian model $R^2 = 0.41$

Abundance % change

	Spring		Winter	
Ephemeral Engineered	-4.1/yr	-39.6/12 yrs	-5.2/yr	-47.3/12 yrs
Perennial Engineered	not significant		-1.9/yr	-20.6/12 yrs
Perennial Natural	-5.9/yr	-51.9/12 yrs	-7.4/yr	-60.2/12 yrs
Ephemeral Natural	-8.4/yr	-65.1/12 yrs	-5.4/yr	-48.6/12 yrs





Conclusions

- Diversity is declining across all riparian sites, and communities are becoming more urban-like.
- Natural riparian sites seem to be changing the most, as contrasted with engineered ones. These natural sites may be important reservoirs for specialists as urbanization progresses.
- Resource managers could design restoration sites to resemble the natural sites (i.e., encourage tall vegetation with dense canopies).

Future Direction

- Build a Bayesian model to describe species richness differences across riparian habitats, and to quantify temporal trends.
- Get environmental data such as land cover and normalized difference vegetation index (NDVI) from 2001 to the present and correlate with bird community compositional change.