Species Richness of Mammals and Terrestrial Birds Across a Gradient of Urbanization in Central Arizona

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Introduction

- Urban ecosystems provide unique opportunities and challenges for the management of wildlife species. However, current wildlife management approaches in cities are often reactive, rather than proactive.
- Proactive management requires information on the social and ecological factors that drive the dynamics of urban wildlife communities. This knowledge is particularly limited in arid systems.
- The imperfect detection of many wildlife species further complicates our understanding of urban habitat relationships.

Research Question

How does a community of mammals and ground-dwelling birds respond to urbanization in the desert context of Arizona's Phoenix metropolitan area?

Hypotheses: species presence and detection will decrease with higher urbanization and increase with greater productivity.

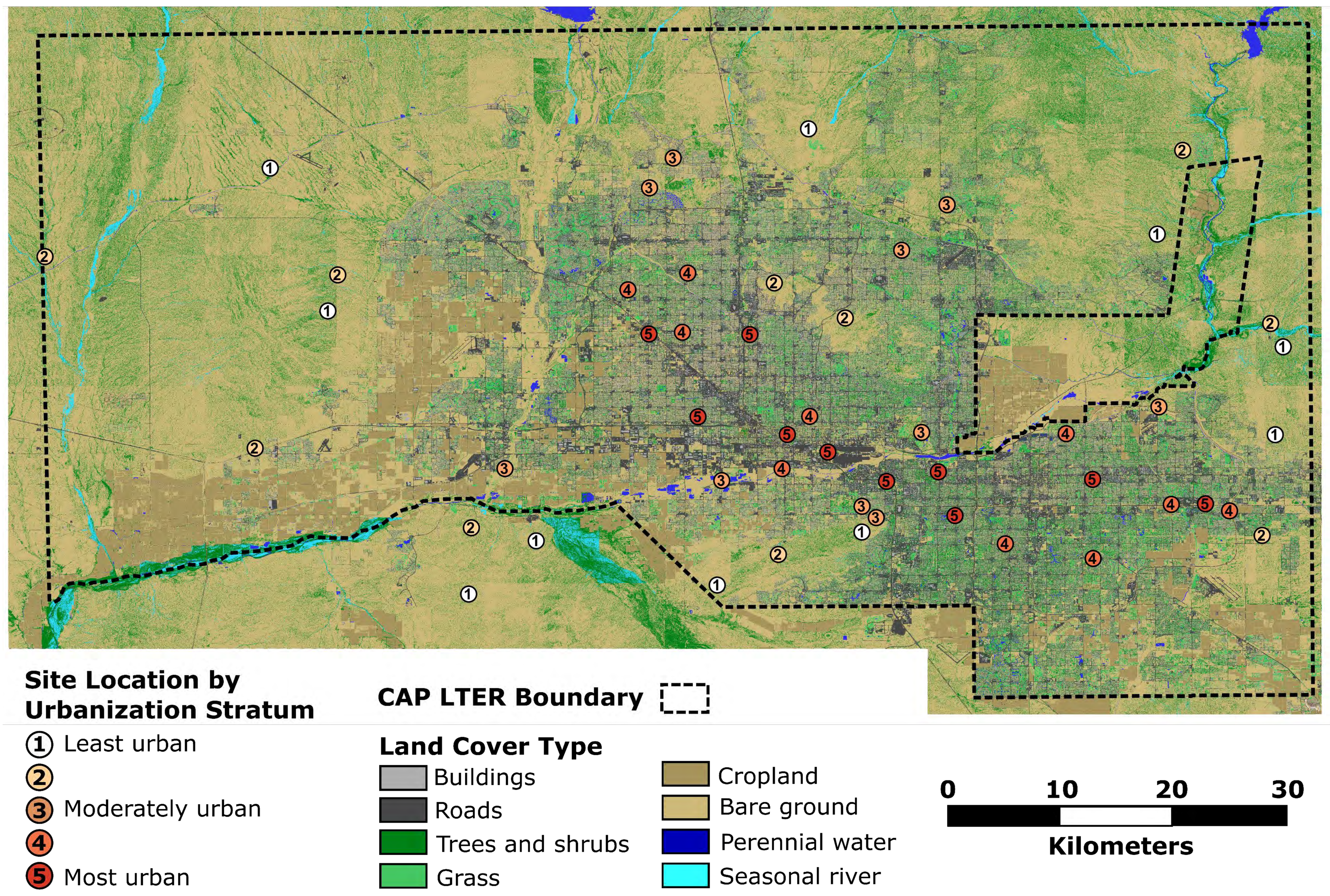
Methods

- 50 camera traps have been set across the Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER) study area since March 2019 (Figure 1).
- Two key environmental gradients were evaluated in Google Earth Engine within five distance buffers (100, 500, 1000, 2000, 4000 m)
  1. Urban land cover (CAP LTER 2010 NAIP-based Land Cover)
  2. Vegetation productivity (MODIS NDVI)
- Two types of analyses were conducted:
  1. Poisson GLMs for observed species richness
  2. Multi-species occupancy modeling (Bayesian)
- Optimal scale of urban land cover and productivity in Poisson GLMs was chosen using model selection approach based on AIC.






Figure 1. Locations of 50 wildlife camera sites and land cover within the CAP LTER study area. Land cover data and types are based on a 2010 classification of NAIP aerial imagery. Sites were placed into each of the five urbanization strata based on the proportion of urban land cover types (buildings and roads) within 1000 m








Results

- 16 species were observed across 34 sites during April 2019
- Observed species richness declined with greater urbanization ($p < 0.01$) and showed no significant relationship with productivity (Figure 2).

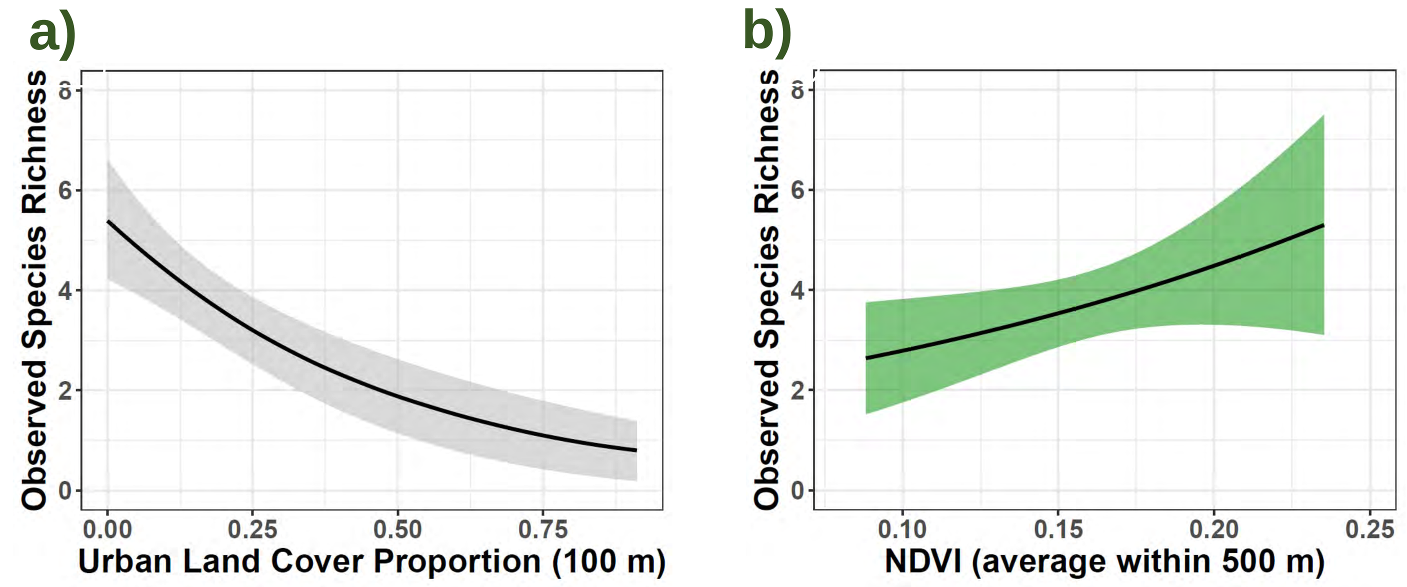


Figure 2. Predicted responses of observed species richness across gradients of (a) urban land cover and (b) NDVI, based on Poisson GLMs

- The occupancy and detection probability of the average species decreases with greater urbanization but does not change with NDVI (Table 1).

Table 1. Effects of covariates on community-level hyperparameters of from multi-species occupancy modeling

Parameter	Covariate	Mean Beta	95% CRI
Occupancy	Urban Land Cover (100 m)	**-4.554**	**-6.941 to -2.239**
Occupancy	Mean NDVI (500 m)	-0.616	-4.444 to 5.159
Detection Probability	Urban Land Cover (100 m)	**-1.607**	**-2.930 to -0.316**
Detection Probability	Mean NDVI (500 m)	-1.501	-5.725 to 2.395

Discussion

- Urbanization had a stronger influence on species presence and detection than did vegetation productivity. Why the apparent disconnect in our system?
- Accounting for imperfect detection of rare species can influence estimated patterns of wildlife diversity.
- What about the influence of additional landscape characteristics and those at different scales?
- How might these relationships vary between seasons and in other cities?

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