Effects of urbanization on avian species richness in the Phoenix metropolitan area: Patterns in vegetation remnants

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Integrating Pattern, Process, Scale and Hierarchy

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Background

Habitat loss and fragmentation are important causes of loss of biodiversity. Urbanization is an important driver of these changes in habitat quantity, quality and configuration. Birds are ideal study organisms for estimating the effects of urbanization on species richness due to their mobility. If habitat loss and fragmentation are limiting the avifauna community, it is likely that less mobile organisms, with similar habitat requirements, are being affected as well. Since Phoenix has such a unique polycentric structure with many urban mountain preserves with remnant native vegetation, it provides an ideal area for this type of investigation. Overall, this research seeks to examine the relationship between the size and spatial configuration of native vegetation remnants in the Phoenix area and the species richness and community composition of the bird communities that reside within them.

Typically, communities in habitat fragments that are all derived from one, once unfragmented, community will show a nested pattern (Atmar and Patterson 1995). A nested community is indicative of fragments being truly isolated by a hostile matrix, since, if individuals were moving between fragments, one would expect the communities in fragments to be evenly mixed (Ganzhorn and Eisenbeiszlig 2001). Preliminary analysis of nestedness results are presented here.

Figure 1. A curve-billed thrasher, one of the most commonly observed birds in the study, at the Buttes Resort.

Sampling Design

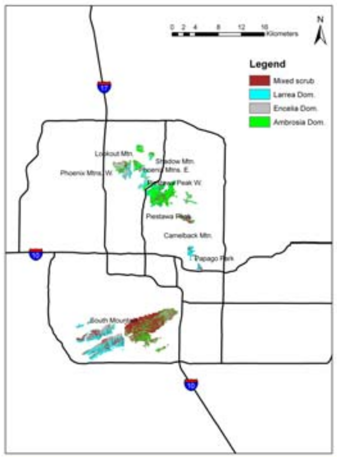

Figure 2. Stiles (2006) mapped dominant vegetation types in many native vegetation remnants in the Phoenix metropolitan area using remotely sensed data. Four dominant vegetation classes were used – Larrea dominant, Ambrosia dominant, Encelia dominant and mixed scrub

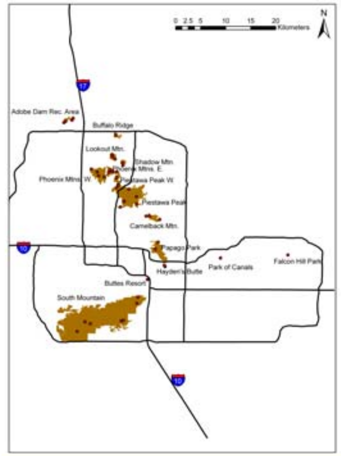

Figure 3. Shown above are the polygons used for input into Hawth's Spatial Ecology Tools and the final sampling points.

A stratified random sampling approach was taken to assess avian species richness in native vegetation remnants. Stiles (2006) mapped many of these areas based upon the dominant vegetation (Figure 2). Using Hawth's Tools in ArcGIS, we placed random points within the boundaries of each remnant and randomly chose one point to represent each vegetation type mapped within the remnant. For smaller areas, the same basic method was used, but the number and location of dominant vegetation types were determined at the site. This method produced 45 points in 16 native vegetation remnants (Figure 3). At each point, point counts are conducted using CAP-LTER protocol.

Preliminary Analysis of Nestedness

➢Are bird communities in native vegetation remnants in the Phoenix metropolitan area nested subsets of each other?

➢**Hypothesis 1:** Bird communities in native vegetation remnants are nested subsets of each other because they originated from the same, once unfragmented community, and the matrix is too hostile to allow movement between fragments.

➢**Hypothesis 2:** Bird communities in native vegetation remnants are nested subsets of each other because they originated from the same, once unfragmented community, and only certain fragments provide adequate resources for certain species to breed.

➢**Hypothesis 3:** Bird communities in native vegetation remnants do not show a nested pattern because there is mobility between remnants and each remnant has equally adequate resources.

The Maximally Packed Matrix

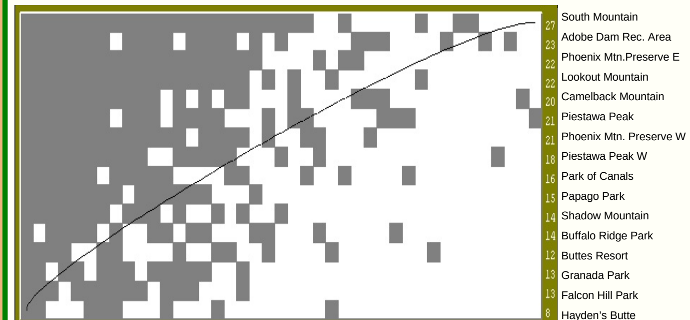

Figure 4. The maximally packed matrix shows the order in which the remnants show the most nested pattern. Species are in columns, remnants in rows. Numbers to the right represent the cumulative species richness of each remnant (Atmar and Patterson 1995).

➢The data used to populate this matrix are preliminary data from the first breeding season of field sampling (April/May 2007). Further data may be required to overcome possible passive sampling effects and obtain an unbiased picture of species presence-absence.

➢ System temperature (minimum 0°, maximum 100°) is a measure of the disorder in the nested pattern of the matrix. A cold matrix shows a high degree of order, while a hot matrix shows disorder (Atmar and Patterson 1995). The temperature of the present matrix is 26.54°.

➢The Monte Carlo derived probability (500 runs) that the matrix would be randomly generated with a temperature of less than 26.54° is 1.37e-18.

➢If this general pattern holds as future data are added to the analysis, hypothesis 1 will be supported. If it holds only for breeding season data, but no nested pattern is observed for winter season data, hypothesis 2 will be supported.

Proposed Future Research

➢One winter season (Dec. 2007/ Jan. 2008) and one more breeding season (April/ May 2008) of data will be collected.

➢Further analyses of the data including quantitative spatial analysis of the effect of the size and isolation of remnants, as well as analysis of the effect of surrounding land use at multiple scales are planned.

References and Acknowledgements

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