The shadowing of avian density: scalar effects of vegetation on bird abundance

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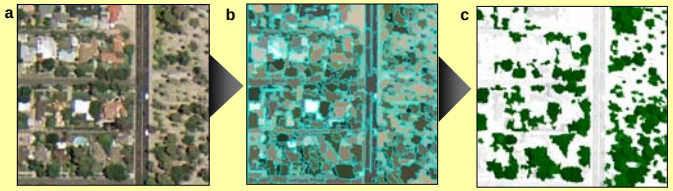
Abstract

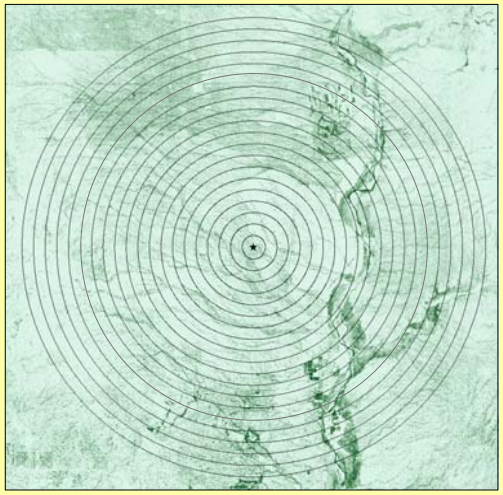
In this study we analyzed the scalar effects of vegetation coverage on avian density across the CAP LTER study region, encompassing desert and urban ecosystems. We expect based on our preliminary work that there is a specific scale that birds are more likely to exploit vegetation abundance. Bird diversity and density were surveyed at 40 sites quarterly during 2003. We compiled overall bird count estimates in order to estimate general avian density. Buffers were constructed to around these points, each with increasing radius of 0.5km. Within these buffers, vegetation coverage was extracted by an object-oriented remote sensing classification scheme conducted on high-resolution (0.6m²) aerial photography captured in April 2003. This classification was subset at a variety of scales in order to determine which scale of vegetation best determines avian density. Findings from the analysis suggest: (1) there is a significant relationship between vegetation coverage and avian density at all scales and; (2) birds react to vegetation coverage at localized more so than regionalized scales.

Urban Forest Classification Scheme



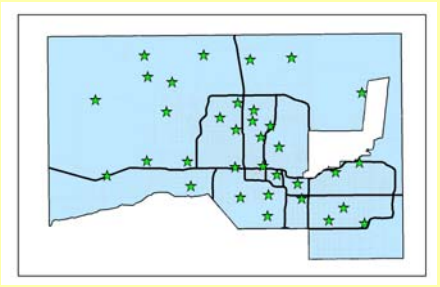
We employed an object-oriented approach to classify urban vegetation through a hybrid of image segmentation and rule-based classification. To more accurately estimate real world objects, the image was apportioned into basic units for analysis at the object-appropriate scale before classification can occur through a process of segmentation (b). Segmentation was conducted based on contextual information (i.e. within-pixel spectra values and patch texture) as well as neighborhood characteristics making possible the extraction of real-world objects, proper in shape, as the basic units for analysis. Following segmentation, the objects were subjected to an urban forest classification scheme (c) developed for high-resolution (0.61m), true-color (red, green, blue), aerial photography. The outset of this procedure produces a binary matrix where the entire raster set is classified highlighting the elements of the urban forest for the specified areas. To determine the accuracy of the classification, an extensive groundtruthing campaign was conducted. Subsequent analysis of commission errors indicated a user's accuracy of woody vegetation of 0.96, indicating that 96% of the objects identified as woody vegetation were, indeed, trees or shrubs.

Buffer Extraction



We applied the Urban Forest Classification scheme to the largest buffer at 10 meters and then subset the remaining buffers in increments of 0.5 kilometers. The twenty scales ranged from 0.5 to 10.0 kilometers. This resulted in proportion of vegetation per area.

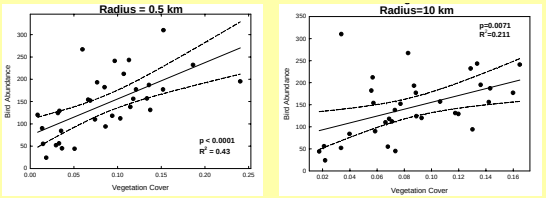
Bird Counts



Since Fall 2002, seasonal bird counts have been conducted by three observers per site, including winter (January), spring migration (April), summer breeding (July), and fall migration (October). Thus, over a calendar year, each of the 40 sites is visited 12 times (3 observers by 4 seasons). Observers employ 15 minute open-radius point counts, noting all bird species seen or heard as well as their estimated distance from the observer. In this analysis, we aggregated results of counts for all bird species across 4 seasons, occupying 1 full calendar year which corresponded to the year in which the imagery was acquired (2003).

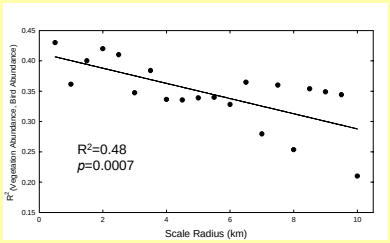
Analysis

Multiple Simple Regression



Simple regression comparing the relationship between vegetation coverage and bird abundance was performed on a multiple series of scales at a variety of radii from the bird count point (i.e. 0.5, 1.0, 1.5,…,10.0 km). From the twenty simple regressions conducted the above figures represent two examples. *Note: all regressions were significant α=0.01.*

Scalar Analysis



The figure above demonstrates a declining correlation between bird abundance and vegetation with increasing scales. This suggests that birds react to vegetation coverage at localized more so than regionalized scales.

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