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Vegetation and Land Use Effects on Bird Richness: A Cambridge Perspective

Nathan Coney

Dani McDonald

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2016 Community of Scholars Day

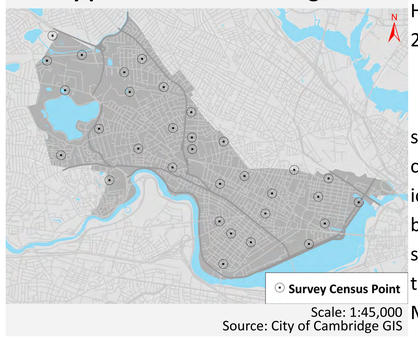
Urbanization has an important ecological effect, development of urban environments has been increasing globally and has shown significant impact on animal life. The behavioral traits of living organisms, including avifauna, adapt to these new urban environments.

Bird-monitoring surveys produced from city-like environments are important to understand both adverse and beneficial effects on the bird population's health. They also are useful when comparing the avifauna of different cities and the similarities in the effects of these urban environments . Urban environments can disturb regimes including: light conditions, predation, habitat distribution, and the composition of species. Non-natural food and habitat resources, along with traffic and disease risk of a city setting has a high negative risk for wildlife species. However, urban surroundings provide fairly predictable and stable food supplies, as well as higher temperatures with less variation due to the heat-island effect . City residents, property owners, officials, planners, developers and designers are capable of shaping the habitat of urban avifauna

Study Area

Our study area, the City of Cambridge is across the river to Boston Massachusetts, and well known for higher education. According to the 2013 US Census Bureau, Cambridge contains about 107, 289 inhabitants and a population density of 16,685.7/sq. mi. . From the late 19th c. to the early 20th c. Cambridge grew rapidly with industrialization from 26, 000 in 1860 to over 120, 000 in 1950. The area transformed from rural farmland to the inner core of Boston's metropolitan area. The 2009 Cambridge GIS data reports a canopy layer of about 30%, 494.5 hectares. Around 200 hectares, approximately 11%, of Cambridge is open space for the public. While landscape changes have also been infrequently documented, Cambridge conveniently has been the research site for avifauna surveys spanning over the past 150 years. An example of this includes a study measuring breeding pair species on a small plot in West Cambridge, documenting 26 species in 1860, 9 species in the 1950's and 12 species currently. This reduction then rebound is assumed to be from the introduction of invasive species, the application and reduction of pesticides and the effects of urbanization (Strobach, Hrycyna & Warren, 2014)

Survey points within Cambridge



Scale: 1:45,000
Source: City of Cambridge GIS

Background research provides some context into the historical development of bird richness in an small area within the city of Cambridge, Massachusetts. Few studies looked to examine and understand bird richness on a citywide perspective. To begin to place this in context, we chose to examine the how bird richness interacts with land use and vegetation richness within Cambridge. Hopefully, this is the first of many studies within the Cambridge area to create an understanding of avifauna on a citywide scale, investigating the effects of other urban factors. (Nilon, Warren, & Wolf, 2011, Tryjanowski et al, 2015, Lepcyzk & Warren, 2012)

Methodology

Following an preexisting bird census conducted by Dr. Morimoto in May of 2013, two separate investigations were done to begin to understand local correlations between bird richness and environmental factors. The earlier census surveyed 32 different points along 100 meter transects throughout the city of Cambridge, investigating a cross-section of the city's urban environments.

Field Investigation

The field investigation revisited the earlier census points, conducting similar 100 meter transects identifying the parcels and their land use it ran through. Modeled after a similar investigation conducted in Baltimore, MD (Nilon et al, 2009), it also identified visible vegetation – specifically the number of individuals and species of trees and shrubs along each side of the transect. Overall, this identified 17 different factors at each site.

A look at field sampling

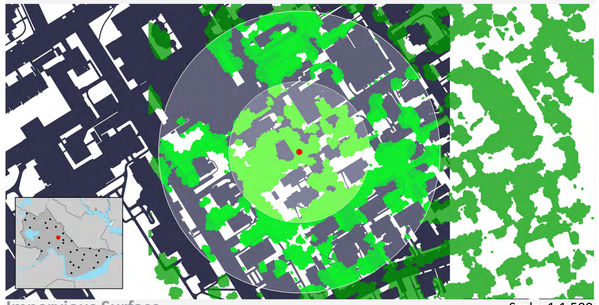
100 m transects, originated from the 2013 Census points, identified land use and vegetation richness

Scale: 1:1,500
Source: City of Cambridge GIS

GIS

GIS (geographic information systems) allowed for geospatial analysis of the immediate area around each of these points. Using publically available data from the city of Cambridge of both local tree canopy cover (the area of trees visible from aerial imagery) and impervious surface (the total amount of surface that does not allow water to percolate into it), we identified this area at an 50 and 100 meter radius around each of the census points. A value was calculated for each of these as a percentage of the whole radius. The spatial analysis defined 6 different factors at each of the survey sites.

A look on the GIS analysis



Scale: 1:1,500
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Results

The 2013 census identified 36 different species throughout the survey points. Of these, only 7 showed up at a majority of sites. (11 were found at less than 10% of sites). 9 variables were derived from this survey.

The 2015 surveys identified 23 different vegetation and land use factors to compare to earlier findings at the same points.

Analysis

207 Pearson correlation tests were run between the 23 vegetation / land use values and 9 bird census values. Of these, 38.65% (80) were found to have a 95+% confidence interval. Some common trends found among the correlations can be seen in the table on the right.

This data as a whole confirms much of the current understandings around the urban ecology of birds— area with a lower vegetation richness will observe fewer bird species and individuals, and an increase in non-niche species that can dominate within the niches of an urban setting.

Further Investigation

Future studies could easily be conducted within Cambridge as an concise study area with a relatively similar land development.

- The existing data could easily lend itself to multi-variable analysis, to isolate combinations of values that indicate a larger correlation.
- Future studies could investigate land usage and other environmental GIS data published by Cambridge GIS and MassGIS.
- Bird or vegetation values identified could easily connected to SES indicators , mirroring similar studies in other cities.
- Effort was done to organize the data in a clean format to repeat these transects in the future, identifying other values of interest within Cambridge's setting.

	Correlates with	r	P
% Imp. Surface (50m)	Non-migrating spp.	-0.59	99.98%
	Resident spp.	-0.53	99.91%
	Non-resident spp.	-0.59	99.85%
	Non-migrating indiv.	-0.30	95.17%
	Non-resident indiv.	-0.55	99.95%
	House Sparrows, indiv.	0.32	96.32%
% Canopy Cover (50m)	Non-migrating spp.	0.56	99.96%
	Resident spp.	0.51	99.85%
	Non-resident spp.	0.51	99.84%
	Non-migrating indiv.	0.32	96.49%
	Non-resident indiv.	0.56	99.76%
	House Sparrows, indiv.	-0.32	96.11%
Individual Trees	Non-migrating spp.	0.55	99.95%
	Non-resident spp.	0.70	99.99%
	Non-resident indiv.	0.37	98.11%
	Common indiv.	-0.51	99.85%
	Resident indiv.	-0.46	99.59
	House Sparrows, indiv.	-0.57	99.96%
Open Space (parcels)	Non-migrating spp.	0.43	99.32%
	Non-resident spp.	0.49	99.76%
	Non-resident indiv.	0.47	99.66%
	Common indiv.	-0.44	99.42%
	Resident indiv.	-0.39	98.55
	House Sparrows, indiv.	-0.52	99.89%

Several of the vegetation and land use factors (found on the left side of the table) significantly expressed both positive and negative correlations (r). These relationships corroborate similar findings in other studies of urban –avian interactions.

A future study lends itself to improve upon some of this one's shortcomings—a relatively small sample size, and bird data collection over a greater time period, through incorporating citizen science efforts. These would require researchers to train and organize this volunteer efforts, but would allow for a much more complete data set.

References

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WORKING DOCUMENTS

Questions?
Comments?

I'll be here for 5-6 another session

or nconey@lesley.edu

- Nathan Coney

Cambridge Neighborhood Bird Survey Vegetation Data Sheet

Date:
Observer:
Site ID #:
Location
Vegetation Data
Birds
Field Procedure:
Data Definitions:
Other Notes

Davis 10/27

COTTAGE ST
WATSON ST
UPTON ST
PERRY ST
LOPEZ ST
LAUREL ST
KELLY RD
ROCKWELL ST
CHALK ST
DECATUR ST
FAIRMONT ST
VALENTINE ST
BROOKLINE ST
ERIE ST
HAMILTON ST
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

ER DESIGN

ETATION AND LAND USE EFFECTS ON BIRD RICHNESS:
A CAMBRIDGE PERSPECTIVE
Dani McDonald and Nathan Coney
CNSCI 4550: Directed Research Capstone: Science
Lesley University
Introduction
Methodology
Analysis
Further Investigation
Citations
Results

METHODOLOGY MAPS

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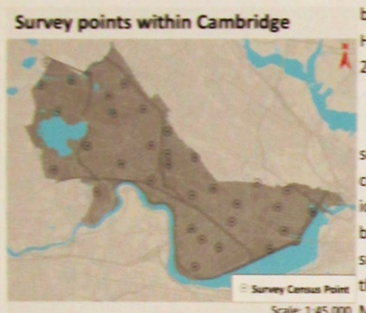

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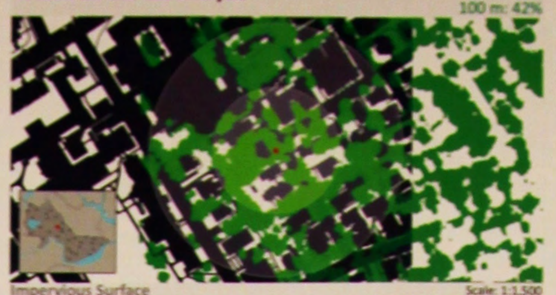

Canopy Cover
50 m: 51%
100 m: 42%

Impervious Surface
50 m: 54%
100 m: 60%

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