Johns Hopkins University

Master of Science in Environmental Science and Policy

Independent Graduate Project Proposal for Summer Semester 2010

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5/10/2010
Statement of Purpose
The purpose of my research is to 1) evaluate the site selection decisions of the Important Bird Areas (IBA) program as implemented by Audubon Society’s Maryland-DC chapter to protect habitat deemed important to the long-term viability of at-risk native bird populations in the area, and 2) to uncover relevant landscape features predictive of species abundance to guide future IBA decisions and possibly modify existing ones. To that end, I will perform a spatial analysis of the presence and persistence of bird species within and outside of the IBA’s in the region, using Bird Breeding Atlas survey data at two points in time 20 years apart.

Introduction
With continued human development encroaching upon and degrading natural bird habitats, many bird species are declining in numbers. Species most at risk are those that specialize in particular habitat types, are already rare, and those that congregate in large areas. To curb these declines and help provide for the long-term habitat needs of these at risk birds, the Audubon Society has joined with Birdlife International to establish the Important Bird Areas Program here in the US. The program is part of an international initiative started by Birdlife International in Europe in the 1980’s, which has now spread to over 150 countries and 46 states the US. The goal of the program is to scientifically identify the areas most essential for sustaining native bird populations, and then to focus conservation efforts on these places. Typically, the selected sites will stand out from the surrounding area in some identifiable manner and may lie on either public or privately owned lands.

I plan to direct my research toward Audubon’s Maryland-DC IBA program efforts, which has identified 33 IBA’s in the area as of spring 2010. At least one of three criteria must be met for a land area to be selected as an IBA by this program:

1. it is considered important habitat to at-risk native bird species in general
2. it contains representative, rare, or unique habitat supportive of certain native bird species
3. native bird species congregate on the site for breeding or migratory purposes

By proactively selecting IBA’s based on this criteria, important habitat can be identified and protected before the native bird species that rely on it become endangered.

**Project Goals/Hypothesis Testing**

For this project, I will focus on the first two criteria (important habitat to at-risk native bird species and representative/rare/unique habitat supportive of native bird species) in evaluating the site selections of Audubon’s IBA program - comparing levels of presence and persistence of bird species found on those sites to the same measures on non-selected areas in the region. The third criterion implies a seasonality that won’t be captured in the Bird Breeding Atlas survey data. Statistically significant higher values in the IBA sites will validate the appropriateness of their selection. Though my expectation is that it only will be necessary to compare against areas of similar human population density and degree of land development, I will explicitly test the hypothesis that those two factors are negatively correlated with bird species presence and persistence, and therefore need to be taken into account. Assuming that bears out, the hypotheses I test to evaluate each site will depend on the criterion used for its selection as an IBA site. The parenthetical clauses below refer to sites selected based on the second criterion targeting habitat specialists:

- At-risk bird species (habitat specialist native bird species associated with the site’s habitat type) appear in greater abundance on IBA sites than on non-selected areas of similar human population density and land development (and habitat type).
- At-risk bird species (habitat specialist native bird species associated with the site’s habitat type) persist at a greater rate over the 20 year period on IBA sites than on non-selected areas of similar human population density and land development (and habitat type for habitat specialists). [The Bird Breeding Atlas survey data captures bird species presence in two five year periods – 1983-87 and 2002-06.]
- For species assemblages of habitat specialists (e.g., Forest Interior Dwelling Species) this hypothesis translates into: “Mean species richness per atlas block for that assemblage declined less (or increased more) from the 1st atlas project to the 2nd atlas project in blocks of their required habitat type within IBAs than in blocks outside IBAs of similar human population density and land development and habitat type.

- For individual species, this hypothesis translates into: “The block occupancy rate for the species declined less from the 1st atlas project to the 2nd atlas project in blocks within IBAs than in blocks outside IBAs of similar human population density and land development (and habitat type for habitat specialists).”

Habitat specialist species to be considered are: Forest Interior Dwelling Species (FIDS), Mountain Peatland, Shrubland and Early Successional, Grassland, Freshwater Marsh, Salt Marsh, and Coastal Beach and Dune.

If data availability and time permits, I will extend this part of the analysis to Maryland’s GreenPrint program, intended to identify ecologically valuable lands, though not specifically for at-risk native bird species.

To uncover the natural and anthropogenic landscape features related to bird species abundance, I will perform a multivariate statistical analysis with those attributes as explanatory covariates in the models to predict the number of species present in a defined area. While not an exhaustive list, features for consideration will include: land cover, surface topography; patch metrics, such as size, edge amount, and connectedness; and human impacts, such as population density, land development, and road networks, in the immediate and surrounding areas. For the habitat specialists requiring specific land cover types (e.g., forest, marshland, grassland), I will examine the additional factors that potentially enhance or detract bird assemblage within each of these land cover types. The results of this analysis should shed light on the combination of attributes most supportive of at-risk and habitat specialist bird species viability.
In addition to the two overarching goals of site evaluation and uncovering landscape attributes explanatory of bird presence, there are several hypotheses related to the IBA program and at-risk bird species presence and persistence that I plan to examine:

- There are meaningful differences in presence and persistence among native bird species as well as among broader categorizations of them based on attributes such as habitat requirement, home range area, IBA program risk assessment, and others.
- Initial species abundance, as measured in the first survey, is predictive of both persistence and later species abundance as measured in the second survey.
- Spatial interactions exist among species (i.e. the presence of one species increases/decreases the probability of the presence of another).

**Methodology**

This will largely be a GIS-based project, with spatial and statistical techniques employed to test the hypotheses I’ve defined above and to investigate meaningful relationships between landscape attributes and bird species presence, directed toward informing best conservation practices for bird populations. I will use ArcGIS 9.3.1 as the GIS platform and SAS 9.1 for the statistical analysis. In addition to the value of the visual display of the data ArcGIS provides, the data elements I develop there (e.g., landscape characteristics, geographical distributions of species populations, changes in land cover over time) will be leveraged in my statistical analysis using SAS. I may employ additional software packages, such as FRAGSTATS to generate patch metrics, if the need arises, which would then also be imported into SAS for analysis.

The data will include:

- bird species presence distributions from the Bird Breeding Atlas survey data
- identification of IBA’s from the Audubon Society
- land cover data from the USGS
- digital elevation model (DEM) data for elevations, slopes, and aspects
- possibly other sources yet to be determined
I will import each of these data sources for the MD/DC area into ArcGIS as individual data layers, where I’ll be able to 1) display bird species population distributions over the IBA and non-IBA regions and other landscape characteristics, and 2) generate new data elements that quantify and relate relevant aspects of the underlying data for hypothesis testing and investigation.

While I can’t say at this time the specific statistical techniques I’ll employ to analyze the data, I expect them to include significance testing of mean differences between IBA and non-IBA areas (e.g., species persistence measures in each), along with linear, logistic and/or geographically weighted regression modeling to collaboratively relate landscape features to at risk native bird species abundance.

Anticipated Results
I anticipate generally or possibly entirely validating the IBA site selections in the MD/DC area based on the rationales for their selection into the program. I do expect, however, that differences in abundance and persistence among the species on IBA’s, and with other landscapes in the area, will meaningfully inform the IBA site selection process for the MD/DC chapter of the Audubon Society and other organizations in the US and internationally seeking the protection of habitat to ensure the long-term viability of bird species native to the locale.

Project Steps
Review literature – Review literature about native bird species ecology and relevant to the IBA and related bird conservation programs.
Obtain data – Obtain bird survey and landscape GIS data.
Load data into GIS – Load data layers into ArcGIS for processing and analysis.
Create additional attributes/transformations – Create additional data elements (e.g. site areas) off of the loaded data layers.
Perform spatial analysis – Apply spatial analytic techniques as needed.
Import data into SAS – Import enhanced data into SAS from ArcGIS.
Perform statistical analysis – Perform statistical tests and multivariate analysis in SAS.
Create draft of final write-up
Revise draft and turn in final write-up

Working Bibliography


