

# Statistical Variations in Bird Survey

## Data From 2000 to 2007

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Ovenbird (*Seiurus aurocapillus*).  
Photo taken by Toucan10000, Member of NYC Audubon PhotoSIG Forum.



Brown-headed cowbird (*Molothrus ater*).  
Photograph from Breeding Bird Survey, Patuxent Wildlife Research Center.



### ABSTRACT

Since 2000, the Environmental & Waste Management Services (EWMS) Division at Brookhaven National Laboratory (BNL) has conducted monthly bird surveys from March through October using a point-count method. The purpose of these surveys is to identify new species in the area; monitor changes in species populations, as well as changes in parasitic species populations; create accurate habitat models; and evaluate the effect of land management on various species.

To accomplish this, statistical analysis of the data collected from 2000 through 2007 was performed using Statistix 9, an analytical statistics program. The data were organized into smaller files by year, family, and species. Biodiversity indices were calculated for each year. Next, descriptive statistics files, such as scatter plots and pie charts were created to gain a visual perspective of how the number of birds observed varied with respect to weather and temporal variables, as well as how biodiversity indices varied by year. A one-way analysis of variance (ANOVA) test and/or a Kruskal-Wallis nonparametric ANOVA test was then performed on selected data sets to determine the significance of any variation from the mean. Finally, a Geographical Information System was used to identify any correlation between species population variations and habitat availability.

The results showed that the brown-headed cowbird (*Molothrus ater*) and the ovenbird (*Seiurus aurocapillus*) experienced population changes during the 2000-2007 period ( $\alpha = 0.05$ ). Both increases and decreases in the total sum of birds and bird species observed with respect to season were determined. ANOVA testing also showed that the diversity of the Biology Fields and Peconic River transects was greater than that of the South and Z-Path transects ( $\alpha = 0.05$ ). According to the Pearson correlation test, a strong correlation of 0.6581 exists between the species richness of a transect and vegetation type representing more than 30 percent of the station area.

Using these results, the EWMS division at BNL can make informed management decisions concerning the experimental design of the survey method and the oversight of bird species populations and habitats.

### INTRODUCTION



Bird species populations play a significant role in defining the ecological character of an ecosystem. Statistical variations in the populations are often good indicators of less obvious changes in other factors affecting the ecosystem. They also provide a relatively accurate source of data from which to determine the biodiversity of the ecosystem.

The United States Geographical Survey (USGS) has recognized the importance of bird populations to American ecosystems<sup>1</sup>. Subsequently, in the early 1960's, the USGS began organizing regular surveys of breeding birds along established survey routes. These surveys are conducted mostly by qualified birdwatchers using the point-count method to identify the species and number of the birds observed.

In May 2000, Timothy Green, of the Environmental & Waste Management Services (EWMS) division at the Brookhaven National Laboratory (BNL), began conducting similar bird surveys on a monthly basis from the spring through the fall of each year. The purpose of the surveys was to identify new species in the area; monitor changes in species populations, as well as changes in parasitic species populations; create accurate habitat models; and evaluate the effect of land management on various species. Statistical analysis was required to assist in accurately evaluating the data collected from these surveys, and in making informed management decisions concerning the results.

### DISCUSSION & FUTURE WORK



The goal of this project was to identify statistical variations in bird survey data collected over an eight-year period at BNL. The results of statistical analysis performed on the data with reference to population and habitat revealed that the bird species population is relatively stable and diverse, and that species richness has a strong positive correlation to wetland areas. Future work should focus on the adaptation of the survey method to include density estimation during observation<sup>2</sup>, and the use of such methods as time series analysis and combining variables during analysis to increase the ability of the analysis results to accurately predict future trends.



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### METHOD OF ANALYSIS



The bird surveys were conducted using a point count method. Six transects, or permanent point count survey routes, were established throughout varying habitats on the BNL site. Throughout these transects, 28 point count locations, or stations, were spaced approximately 1000 ft. apart to ensure that no observation would be repeated at an adjacent location. Each transect was regularly visited during the last week of the month from March through October initially (2000-2002), then from April through September (2003-2007). Each station was visited for a 5-minute count period during which all birds identified by call or by sight were recorded by all observers (usually two).

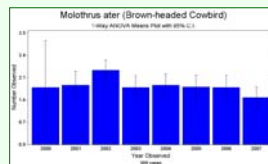
The analysis was primarily conducted using a statistical analysis program, Statistix 9. The data were imported from Excel into Statistix 9, and smaller data files were created to isolate observations within a particular group, i.e., species, family, or year.

For population analysis, all species with 50 or more observations were separated for investigation. To determine if the mean number of birds per observation had changed significantly over the eight-year period, an analysis of variance (ANOVA) test was performed for each species. To determine if population statistics would support the general monthly behavior of breeding birds in the northern American states, a one-way ANOVA test was performed on the mean total number of birds per observation with respect to month.

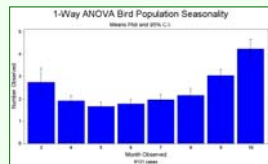
For biodiversity and habitat analysis, a Geographical Information System (GIS) was used to identify the types of vegetation within the 500-foot boundary of each transect. Six biodiversity indices were calculated for each transect station. These data were grouped by transect, and a one-way ANOVA test was performed for each biodiversity index with respect to transect. A Pearson correlation test was performed to determine the strength of the correlation between the types of vegetation within a transect station and the station's species richness (sum of species observed during the eight year period).



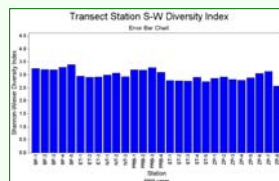
### ANALYSIS RESULTS



**Figure 1:** This plot gives a visual representation of the significant decrease in the number of brown-headed cowbirds per observation from 2002 to 2007,  $\alpha = 0.05$ . Since this species is parasitic, a decrease in population is desired.



**Figure 2:** This plot compares the total mean number of birds per observation by month. Since more birds are seen during migratory periods (March and October), and less during nesting periods (May and June), this plot displays an expected trend.



**Figure 3:** From a brief perusal of this data, a trend in both the diversity and the evenness of a transect station can be hypothesized. The stations situated in the Biology Fields and the Peconic River transects appear to be the most diverse, while the South and Z-Path transects appear to be the least diverse. The results of the respective ANOVA test verified this hypothesis.



### LITERATURE

#### CITED

- Purpose Statement. United States Geographical Survey <http://usgs.gov>
- Statistical Approaches to the Analysis of Point Count Data: A Little Extra Information Can Go a Long Way. Farnsworth et al. USDA Forest Service Gen. Tech. Rep. PSW-GTR-191. 2005.

