Statistical Analysis of Point Count Bird Surveys and Measuring Biodiversity

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Abstract

Point Count Bird Surveys have been conducted at Brookhaven National Laboratory over six different transects for thirty years (April through September annually). Within the last two years (2010-2011), the 200 acre solar farm has been added to the landscape and an additional transect was added in 2010 to document effects of this feature on bird populations. There have been 122 different bird species identified. The large data set of more than 13,000 entries was analyzed statistically by looking at the different variations among different bird species and by identifying variation from transects to transect. In the large data set, it will allow us to find different trends by species and different trends by transect. Indices that were used to measure biodiversity were Simpson Index and Shannon-Wiener Index. Point Count Surveys are continuing in 2012, but have been reduced to 4 months/May-August) from six (April-September) to focus more on migratory species.

Introduction

Bird surveys have been conducted at Brookhaven National Laboratory to detect the various bird species present and their relative abundance at specific locations across the 5,265 acre site. Point Count Surveys were started in the year 2000 and are continuing in 2012, but have been reduced to 4/months from six. Therefore, an abundance of data has been recorded over the last thirteen years. Based on a survey by U.S. Fish and Wildlife Service, 51.3 million Americans watch birds. There are about 9,865 species of birds found worldwide. At Brookhaven National Laboratory, 122 different species have been detected across seven transects (Biological Fields, Peconic River, East Trenches, North Transect, South Transect, Z-Path, and Long Island Solar Farm). Each transect varies in the number and abundance of individual species found. This allows for calculation of species diversity and specific variations within species, and within and across transects. In order to record data, one has to recognize the various bird calls of each species.

Materials & Methods

More than 1,956 points were sampled throughout the seven transects at Brookhaven National Laboratory. From 2000-2001, there were 20 transect points surveyed (240 points). From 2000-2009, there were 28 transect points surveyed (344 points), and from 2010-2011 there were 31 transect points (372 points). The last two years the number of transect points increased due to the addition of a 200 acre solar farm to the landscape and an additional transect was added to document effects of this feature on bird populations. The same exact points were surveyed annually over a six month period to obtain statistically sound analysis of the data. Point Count Surveys were initially conducted from March through October, but were reduced to April the last two years due to migration patterns. Analysis conducted included calculation of the average number of birds, standard deviation, and developing a weighted average for each species. The weighted average normalizes the bird species for easier comparison of species and to help identify differences in populations, if any. To calculate the weighted average, W

W = \sum_{i=1}^{n} \frac{S_i}{N} \times \log \left( \sum_{i=1}^{n} \frac{S_i}{N} \right)

These tests helped standardize the population to help identify and compare transects and individual species. Based on the large data set, two tests were conducted using the Simpson Index (D), a measurement that accounts for the richness and the percent of each species from a biodiversity survey. Simpson Index is shown in 2012, but has been reduced to 4/months from six (April-September) to focus more on migratory species.

Discussion

Results

Figure 1 (left): 21 individual birds make up 80% of the population and serve as the core subset of birds. To display what is happening over time, a Pareto Analysis was conducted to visually display the results (Figure 1). The scale on the right tells us the percentages of defects, which means the AMRO (American Robin) and Blue Jay were combined; the two individual species make up about 25% of the total population. Overall looking at the Pareto Chart, the core subset seems to be the American Robin and Blue Jay. When we look at measures of different species are relatively similar.

Table 1 (below): Measures of Biodiversity using Simpson’s Diversity Index & Shannon-Wiener Index

Table 1 displays measures of biodiversity using Simpson’s Diversity Index and Shannon-Wiener Index for the twelve years of data. Species richness is accounted for by the122 different bird species. Simpson’s Index D describes the randomly selected individuals that belong to the same subspecies. Simpson’s Index D calculated is closer to zero; therefore Simpson’s Diversity Index (Figure 3) tells us that the individual species are independent of the others. The results for Shannon-Wiener Diversity index, the numbers calculated for evenness are closer to one which concludes that the there are similar proportions of all subspecies and tells us how similar the different species are throughout the population.

Figure 2 (right): Species Richness (S): Total Number of Individual Species per transect (Biological Fields (BF), Peconic River (PRB), Z-Path (ZP), North Transect (NT), South Transect (ST), and East Trenches (ET)). Comparing the species richness among all transects, the number of species are very diverse. The transect with the highest diversity is the Biological Fields which also has the highest species richness.

Figure 3 (left): Simpson’s Diversity Index (Simpson’s Diversity Index tells us that the individual species belong to different subspecies. The closer to 100%, the more diverse each transect is.

Figure 4 (right): American Robin (Linear Impression) Robins represent the most prevalent bird found on the landscape where the rate of change (slope) is -0.0295. This fact allows us to look at the Brookhaven National Laboratory and the SULI program for providing me with this wonderful opportunity.

Figure 5 (left): The figure to the left is an example control chart for individuals (I-Chart). The center represents the average. Upper Control Limit (UCL) and Lower Control Limit (LCL) represent the average of the moving range of two observations. Blue Jay’s in control, since none of the plotted points fall outside either the UCL or LCL.