

Monitoring the bird population at Brookhaven National Laboratory by using point count bird surveys

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Abstract

Since 2000, Point count bird surveys have been conducted by the Environmental and Waste Management Services Division to monitor the bird population change at Brookhaven National Laboratory (BNL). The bird count survey points are located in these seven transects: Biology Field (BF), East Trenches (ET), North Transect (NT), Peconic River (PRB), South Transect (ST), Z-Path (ZP), and Solar Farm (SF). The Solar Farm transect was added in 2010. The data of point count bird survey is recorded in Microsoft Excel® and analyzed by using statistical software Minitab® 16. Statistical variations in bird population are often good indicators of changes in other factors affecting the ecosystems; conducting point count bird surveys at BNL is used to monitor the changes in bird species and annual fluctuations in bird populations. The purpose of this paper is to find the different variations of bird population during thirteen years observations at different transects in BNL. When we compared the point count bird survey conducted in BNL to the Breeding Bird Survey conducted in New York State (NYS) to measure biodiversity, the Simpson's index of diversity, and the Shannon-Wiener Evenness index for BNL and NYS, we found that point count bird surveys at both BNL and NYS share similar characteristics. The result of Pareto analysis supports that the Shannon-Wiener Evenness index shows the bird species in BNL and NYS are moderately even. The nonparametric Mann-Whitney Test and Kruskal-Wallis Test were performed to demonstrate that the presence of surface water and habitat with different layers of shrub and plant make a significant difference in bird population distributed across over different transects ($\alpha=0.05$). The transect locations presented with surface water and more layer of shrub and plant attract more birds than the other transect locations. Consequently, the work provides a statistical sound foundation for making decisions for continuing managing and protecting the natural resource at Brookhaven National Laboratory.

Introduction

Bird species populations play a significant role in ecosystems.

- ❖ Birds occupy many levels of trophic webs in ecosystems, from mid-level consumers to top predators. Birds help maintain sustainable population levels with other native organisms service as prey or predator species ("Ecological roles of birds").
- ❖ Birds help plants reproduction through pollination and seed dispersal. These behaviors increase not only the seeds' survival rate, but also species diversity by spreading seeds to colonize new areas ("How do animals help plant reproduction?").
- ❖ Changing of bird species and populations can indicate the less obvious factors affecting the ecosystem. Scientists from the United States Geographical Survey National Wildlife Health Center (NWHC) indicate that birds are the natural hosts for the West Nile Virus (WNV). WNV can be transmitted from infected birds to humans and other animals through the bites of mosquitoes("Wild Birds Help Scientists Understand West Nile Virus"). Scientists found out that infection in bird species within the family Corvidae (e.g., crows and jays) is a particularly important indicator of WNV activity. In 2001, the dead bird test of WNV surveillance shows that the WNV infection is significant higher in crows than all other birds (53% versus 9%). In 238 (66%) counties, dead crows were the first indicators of WNV activity. According to these result, CDC suggests that state and local health department surveillance programs should continue to emphasize the collection and testing of dead corvids (O'Leary, Nasci, Cambell, and Marfin, 50: 617-619).

The United States Geographical Survey (USGS) (<http://www.usgs.gov>), established different routes across over the United States to conducted regular breeding bird survey in 1966.

- ❖ The surveys are conducted by birdwatchers using a point count method.
- ❖ By Hostettler and Main (1-5), the birdwatcher stands in a specific transect point, a circle of a certain radius, and counts individual birds (of each species) by sight and birds' call in certain time period. In most cases, transect, observing time period and radius size should be consistent. Point counts are used to sample bird species and populations in order to estimate trends in populations over regional areas, assess habitat preferences, and monitor the population (Johnson, 117-123).

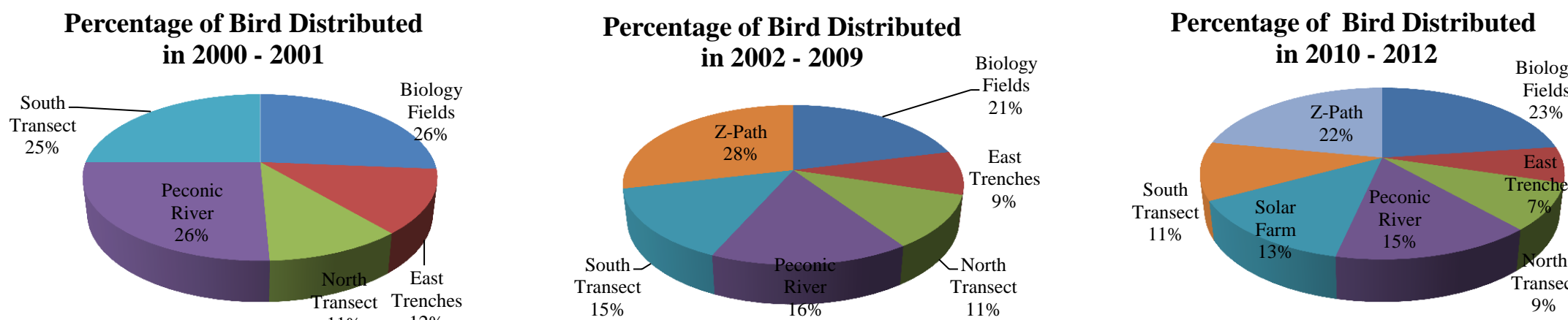
Method of Sampling

The point count method has been applied in monitoring bird populations by Tim Green and Ernie Lewis at Brookhaven National Laboratory (BNL) annually from 2000.

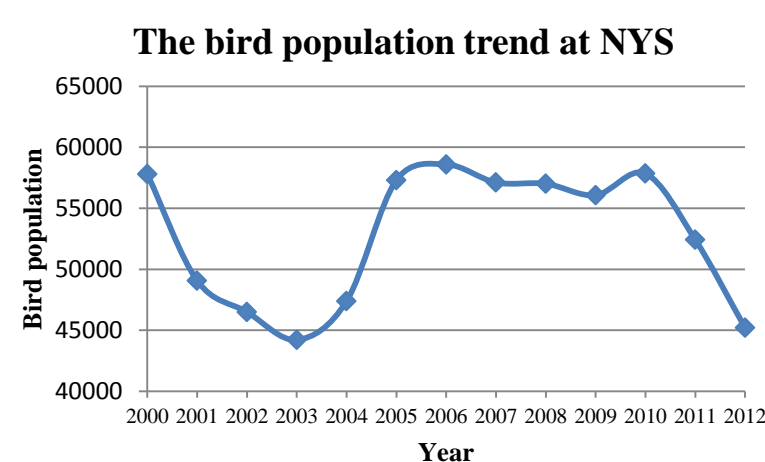
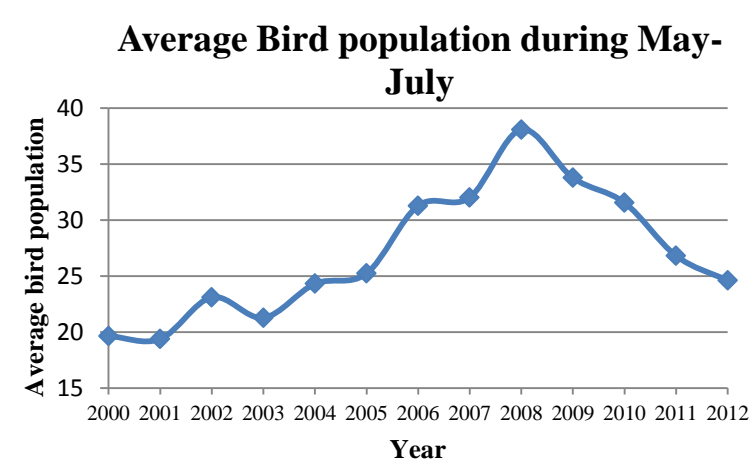
- ❖ Transect: Biology Fields, East Trenches, North Transect, Peconic River, South Transect, Z-Path (added at 2002), Solar Farm (added at 2010)
- ❖ All birds seen or heard during 5-minute time period were recorded.
- ❖ The radius of every transect location point is approximately 150 meters to ensure that there is enough space for observation, but no two transect location points are adjacent .
- ❖ The Kestral 4000 portable weather station was applied during the survey. The data recorded includes start and stop time, start and stop temperature, dew point, relative humidity, wind speed, and wind direction.
- ❖ All survey data was recorded into a Microsoft Excel® spreadsheet for analysis.

Data Analysis and Discussion

- ❖ Descriptive and summary statistics of bird population distributed in different transects during April to September from 2000 to 2012 .

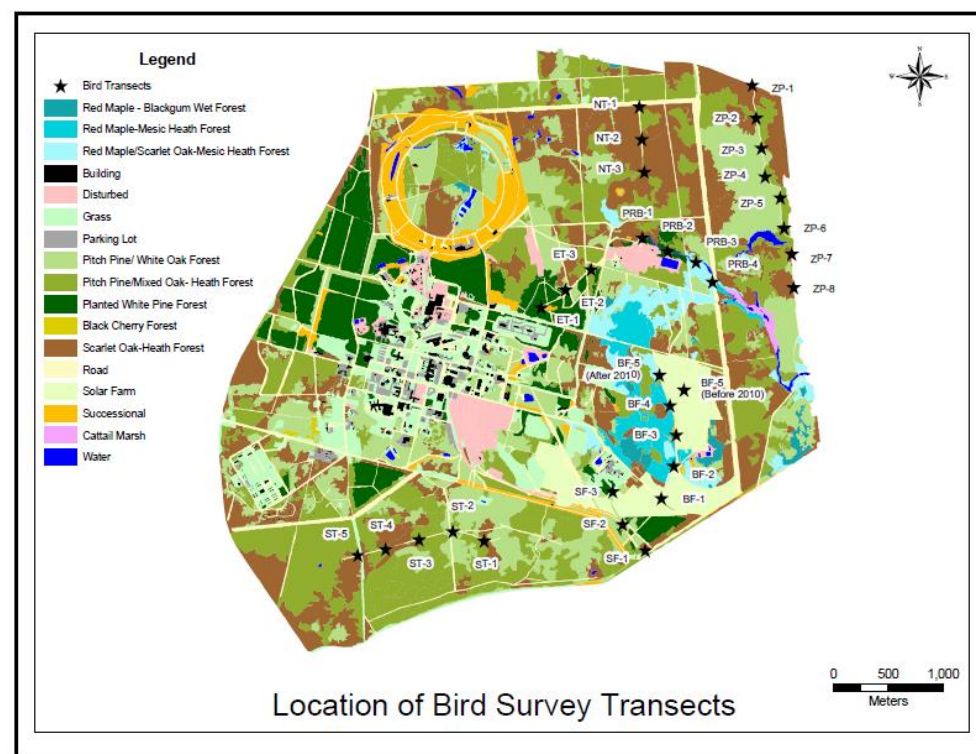


- ❖ During the breeding season, the average of bird population in BNL is decreasing since 2008. The New York State(NYS) Breeding Bird Survey shows that the bird population in NYS is decreasing as well since 2010. The decreasing rate is approximately 10% per year in both BNL and NYS.

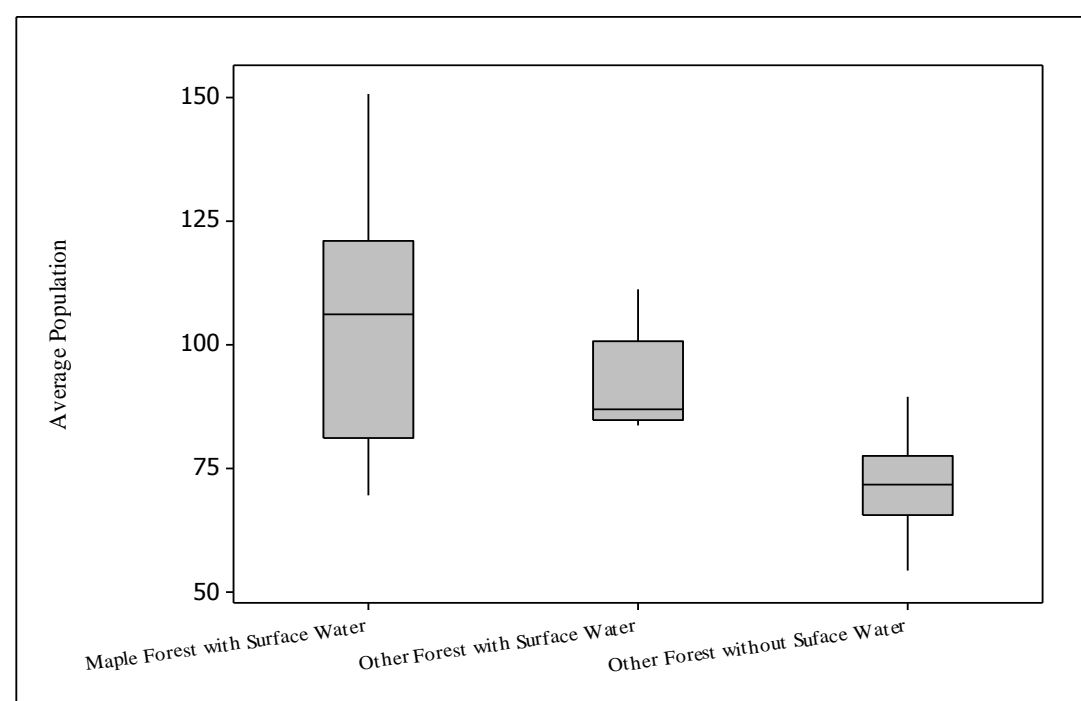
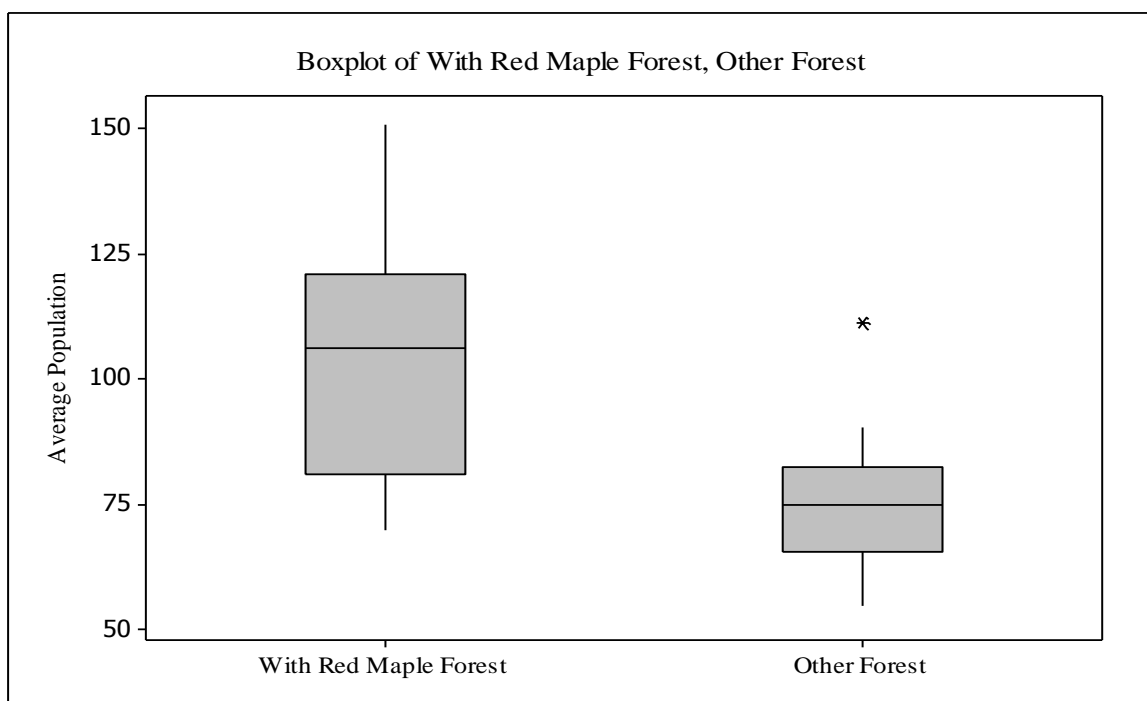
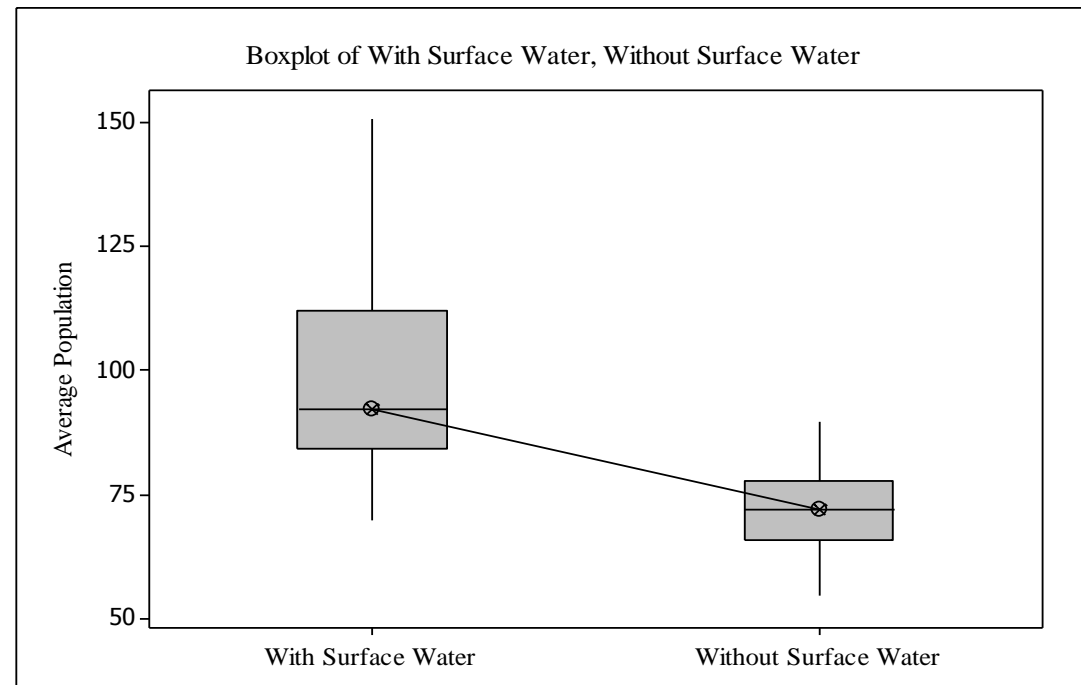


Data Analysis and Discussion (Count')

- ❖ Pareto analysis is used in this paper. The Pareto principle (Chen, Chong, and Yong, 61-80) states that, in many cases, approximately 20 percent of the causes accounts for 80 percent of the results. We found that at both BNL and NYS, approximately 20% of bird species accounts for 80% bird populations by each year.
- ❖ For Biodiversity analysis, we used methods introduced by Brower, Zar and Ende (177) and Raytheon Employees Wildlife Habitat Committee (3pp), two tests were conducted using the Species Richness (S), the Simpson Index (D) and the Shannon-Wiener index (H) to estimate the variation of biodiversity of both bird surveys in BNL and New York State (NYS) by years. NYS breeding bird survey data was obtain from North American Breeding Bird Survey in USGS website (<https://www.pwrc.usgs.gov/BBS/PublicDataInterface/index.cfm>). The result shows that the biodiversity indices of both bird populations in BNL and NYS is relatively diverse.
- ❖ Zacchei, Battisti, and Carpaneto (281-286) point out that the diversity index and species richness is increased in wetland. The nonparametric Mann-Whitney Test ($\alpha = 0.05$) and Boxplot were performed for the transect locations present with/without surface water. The result ($p = 0.0001$) reveals that the median of average population in transect location point presence with surface water is significant greater than the transect location point presence without surface water.
- ❖ During conducting point count bird survey, we found that the Biology Field, PRB-3 and PRB- 4 have more layers of plant and shrub than the other bird survey transects. Since vegetation in Biology Field, PRB-3, and PRB-4 mainly consist of red maple forest. We perform the nonparametric Mann-Whitney Test ($\alpha = 0.05$) and Boxplot. The result ($p = 0.0071$) reveals that the median of average population in Biology Field, PRB-3, and PRB-4 is greater than the rest transect location point.
- ❖ The nonparametric Kruskal-Wallis Test ($\alpha = 0.05$) and Boxplot were performed. The data ($p = 0.001$) shows that the red maple forest presents of surface water attract more birds than other transect locations.



* This figure is provided by Jennifer Higbie from BNL.



Conclusion

The goal of this study is to monitor the bird population trend using point count bird survey conducted over thirteen years period at BNL. The result of statistical analysis reveals that the bird population recorded at BNL is decreasing annually by about 10% since 2008. The biodiversity indices show that the bird species are relatively diverse at BNL and NYS. Since there is more diverse vegetation in NYS, the biodiversity indices at NYS is higher than at BNL which is expected. Biology Field has most of the bird population in thirteen years of observation. The species richness index and Simpson's diversity index at Biology Field are greater than other 7 transects at BNL. The result of the nonparametric Mann-Whitney Test and Kruskal-Wallis Test indicate that red-maple forest mix with scarlet oak forest/mesic heath forest and presence of surface water are the significant factors that affects the bird population distributed in different transects at BNL.

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