AN ANALYSIS OF BIRD AND TREE DIVERSITY IN EDMANDS PARK, NEWTON, MA

Maureen Bowman, Seth Heckman, and David Krauss*
Department of Biology, Boston College,
140 Commonwealth Ave. Chestnut Hill MA02467
*To whom correspondence should be addressed.

ABSTRACT

Edmands Park is a small town park in Newton, MA. It is primarily a mixed hardwood forest with a small meadow area and a stream forming a small marshy area. In order to help develop a coherent management plan for the park, bird and tree populations were studied for patterns of biodiversity.

Tree censuses were conducted at twenty-three random plots throughout the park. The information collected, including the distribution of the three most populous species, density, and diversity were plotted on a topographical map of the park and analyzed. In order to census the park's bird populations a transect was designed to cover the park and intersect with the tree plots. Bird censuses were conducted twice a week. The bird data were then plotted and compared with the tree data. Correlation analyses were performed to analyze the patterns that emerged.

Negative correlations were discovered between tree density and bird diversity, Red/Black Oak density (the most common tree type) and bird diversity, and Hickory density and bird diversity. Tree diversity and bird diversity did not show a significant relationship. Instead bird diversity appears to be more closely dependent on the understory vegetation. These data have helped to identify concentrations of biodiversity and point towards better management strategies for the park's ecosystem.

INTRODUCTION

Many different groups have studied the biodiversity in various settings, such as wildlife reserves, agricultural areas, rainforests, etc. to determine how steps can be taken to aid in biological conservation. Such projects are usually done on one or more different levels based on geography, patch size, and configuration (Richter et. al., 2000). Incorporating these ideas of study design, we chose to investigate the biodiversity of birds and trees in Edmands Park in Newton, MA, adjacent to the Boston College law campus. The park is 190 meters in its North-South dimension and 90 meters in its East-West dimension, surrounded by suburban homes. There is a stream that enters the park from the east at about the midpoint and then runs north through the center of the park. At the northern end of the park the stream widens, forming a small marsh at the park's northern boundary. The southern half of the park is mostly dry and elevated. In the southeastern corner of the park, there is a flat, low, wet area.

In the earlier half of the twentieth century, Edmands Park was used primarily as a public ice skating rink. The present broad stream bed area in the northern end of the park used to be a flooded man-made pond for ice skating. There are remnants of old stone chimneys around the flat area where fires were maintained for the comfort of skaters. One can still see the remnants of an old dam that used to block up the water flow at the northern end of the park. During the latter half of the twentieth century, these facilities have been disused and nature has reclaimed much of the park. Dog walking has become the dominant activity in the park. In spite of its small size, Edmands Park encompasses several different communities and patterns of human use, making it an interesting study site.

The goal of our study was to obtain data concerning the diversity of the species of birds and the tree populations within the park in order to understand the relationships between use patterns, invasive species (primarily focusing on oriental bittersweet and Norway maple as they are the species most likely to be problematic in the park (Weatherbee, 1998)), and biodiversity to determine if there are any correlations. The patterns discerned from this study should be useful in helping the park commission to formulate plans to aid in the conservation of biodiversity in the park.

METHODS

In order to study the biodiversity of birds in Edmands Park, a transect through the park was designed to sample the three different communities within the park. The first portion of the transect was through the marshy community which contained a dense understory and few mature trees. The second portion was through the community overlooking the stream, which consisted of mostly mature oak trees and a sparse understory. The final portion contained little surface water, sparse understory, and mixed woodland. A bird census was conducted along this transect twice a week during the fall semester of 2000. Birds were observed with a pair of Nikon 8x23 binoculars and identified according to Peterson (1980). In addition to the census; temperature, time and weather were also noted.

In order to gain a coherent idea of tree distribution in Edmands Park each tree was counted according to its species. Sample plots of 20 meters in radius were selected through the imposition of an artificial grid over the park. A random number generator (Microsoft Excel) was then used to compute grid references. All trees within the plots were identified according to Petrides (1972) and counted. This method was based on the work of several authors who have developed strategies for surveying forest communities (Crawley and Harrel, 2001; Fuchs and Krannitz, 2000, Kolbe and Buongiorno, 1999; Mainelli and Krauss, 1999). Twenty-three points were determined to be an appropriate sample size for a park of this size. Plots were delineated by locating the point on the map determined by the random number generator and using a 20 meter length of rope to describe a circle around the point. Only trees with a DBH of 5 cm or greater were counted, smaller trees being considered part of the shrub community (Kolbe and Buongiorno, 1999; McCarthy et al. 2001).

Regression analyses were performed using Statview *5* in order to determine whether or not there were any factors affecting biodiversity in the park. Cluster analyses using a Ward's clustering method were conducted with JMP *5* statistical software, in order to look for patterns and relationships in the data.

RESULTS

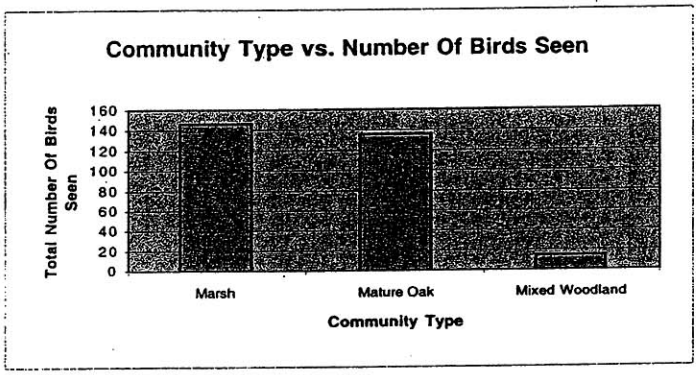

Figure 1 shows the effect of community type on the total number of birds seen over the course of the study.

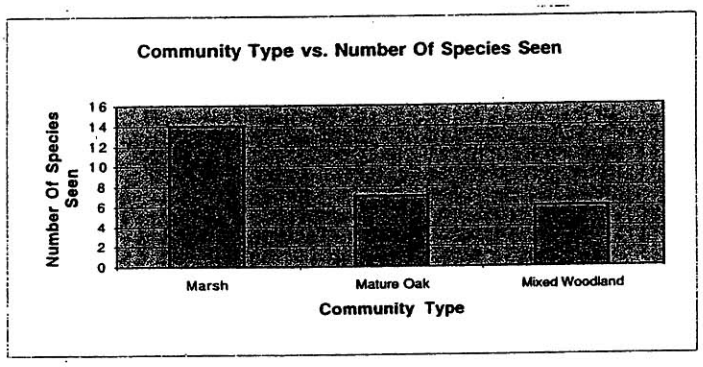

Figure 2 shows the effect of community type on the bird species seen over the course of the study.

It was found that there was a relationship between the number of birds seen and the community type (Figure 1) as well as the number of species seen and the community type (Figure 2). In both of these cases, the marshy community was the most populous and diverse; whereas, the mixed woodland community was the least populous and diverse.

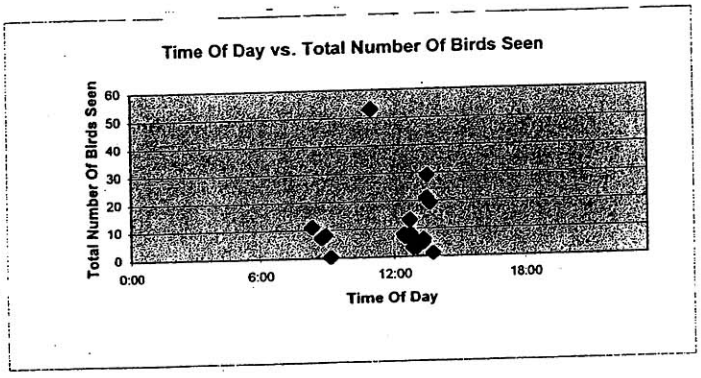

Figure 3 shows the effects of the time of day on the total number of birds seen in the park.

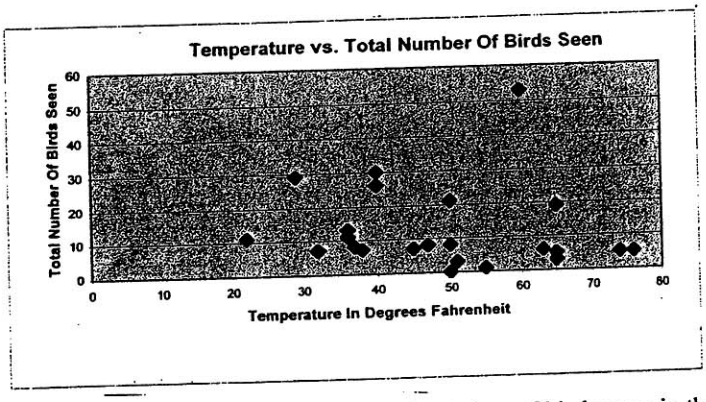

Figure 4 shows the effects of temperature on the total number of birds seen in the park.

Some of the transects were performed after the peak hours of 5 to 9 A.M. (Ralph et al., 1993). Therefore, in order to determine whether our sampling methods were affecting our observances, we conducted correlation analyses between bird diversity and time of day (Figure 3) and between bird diversity and temperature (Figure 4). No such correlations were found.

A summary of the tree data collected in Edmands Park, including data for species of interest is presented in Table 1. The average number of trees counted in each sample plot was 92, with a maximum of 139 and a minimum count of 47. Tress of the Black/Red Oak complex (*Quercus velutina-rubra*) were the most abundant throughout the park, being found in 22 plots. The least common tree found was the Scarlet Oak (*Quercus coccinea*), with a total count of 3 trees found in plot 2. There was an invasive tree species, the Norway Maple (*Acer platanoides*), which was found in 13 plots, totaling 195 individual trees, making it the third most populous tree found in the park. There was an invasive vine, Oriental Bittersweet (*Celastrus orbiculata*) found in 9 plots. To determine whether the plots containing invasive bittersweet were different from those without it we

constructed a dendrogram using Ward's clustering method. Figure 6 shows that there is no distinct pattern to the presence of bittersweet.

Table 1

Category	Value
Total Trees Counted	2205 trees counted
Plots Surveyed	23 plots surveyed
Avg. Trees per plot	92 trees per plot
Avg. square feet per plot	11,309 $ft.^2$ per plot
Max. # Trees per plot	Section A6 (139 trees counted)
Mm. # Trees per plot	Section B1 (47 trees counted)
Avg. # Tree Species per plot	9.478
Max. # Tree Species per plot	13 tree species (plot A8)
Min # Tree Species per plot	7 tree species (plots B3, D6, C7, B8, B9)
Most Common Tree	Black/Red Oak (912 total, found in 22 plots)
Least Common Tree	Scarlet Oak (3 total, found in 2 plots)
Invasive Tree	Norway Maple (195 total, found in 13 plots), third most populous tree
Native Competitor of Invasive	Sugar Maple (16 total, found in 6 plots)
Invasive Vine	Oriental Bittersweet (found in 9 plots)

Summary data of tree diversity at Edmands Park, Newton, MA. Average values for important aspects of the park's biodiversity and data for species of special interest are recorded.

Oaks were the most common species found and it was determined that there was a significant decline in bird diversity in plots with a high proportion of oaks (Figure 7). It was found that there was a significant increase in bird diversity in plots with high proportions of invasive Norway Maple (Figure 8). It was also found that while the number of species of birds was not correlated with the number of species of birds in a plot it was correlated with the Shannon-Weaver index for trees (Figure 9). The number of species of birds was strongly negatively correlated with tree density, measured as the number of trees per plot (Figure 10).

Dendrogram Showing Community cohesion and the presence of Oriental Bittersweet

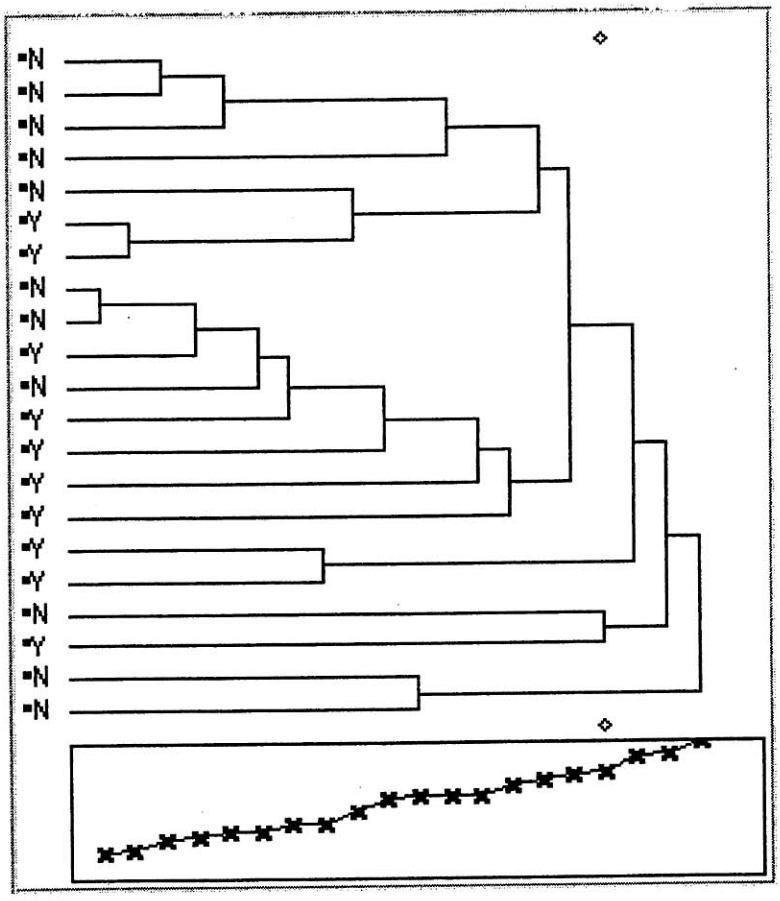

Figure 6. The labels Y and N in this dendrogram reflect the presence or absence (respectively) of oriental bittersweet in tree plots. The lack of a pattern is interpreted as evidence that the presence of oriental bittersweet is not influencing community structure.

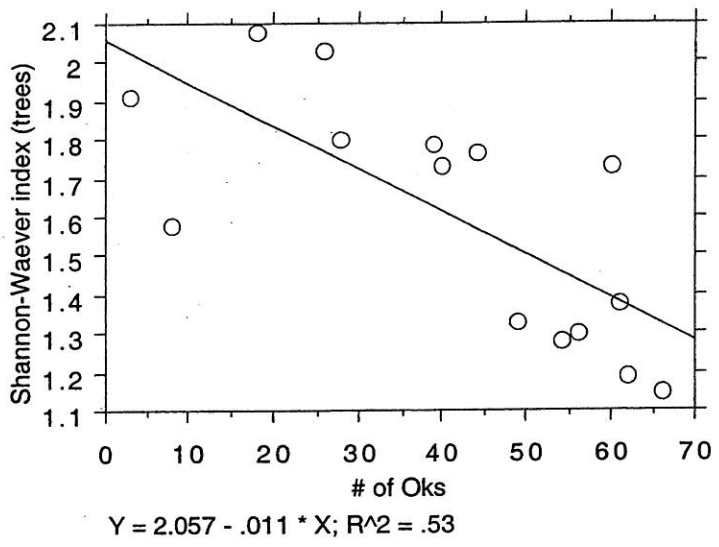

Figure 7. In tree plots with a high density of oak trees it was observed that tree diversity (as measured by the Shannon-Weaver index) declined significantly.

DISCUSSION

Our study was performed from the late summer till early spring. As the seasons progressed, more birds were found in the predominantly in the understory layer. This observation is likely due to the diversity of vegetation and wide variety of food sources and cover in this layer. Doherty and Grubbs (2000) found a similar correlation between the presence of chickadees and the amount of shrub cover. In Edmands Park it seems likely that the negative correlation between tree density and bird diversity was due to the increased density of the understory in areas with fewer trees. Future studies will investigate this pattern further.

Trees Diversity as a Function of Norway Maple Density

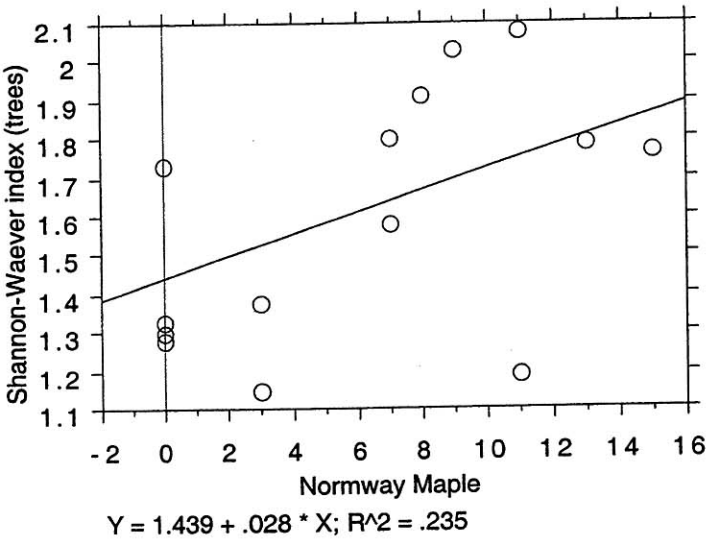

Figure 8. In tree plots with a high density of Norway Maples it was observed that tree diversity (as measured by the Shannon-Weaver index) increased significantly.

Bird Diversity as a Function of tree Diversity

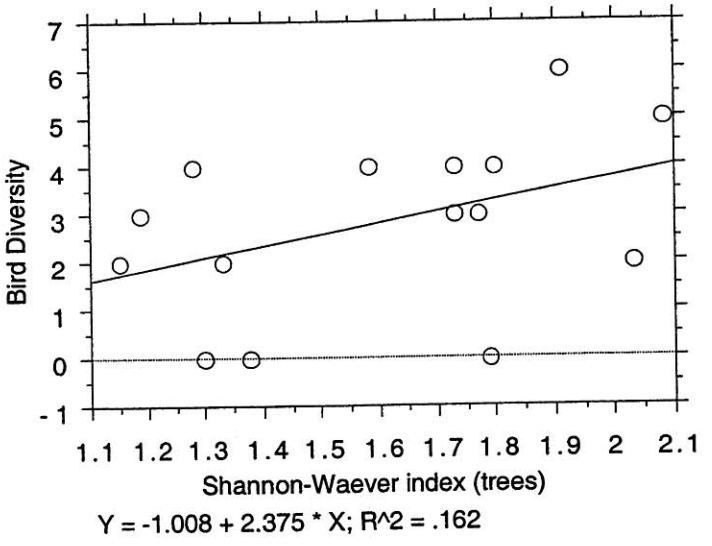

Figure 9. It was found that in areas with a high Shannon-Weaver index for trees bird diversity tended to increase.

Bird Diversity as a Function of Tree Density

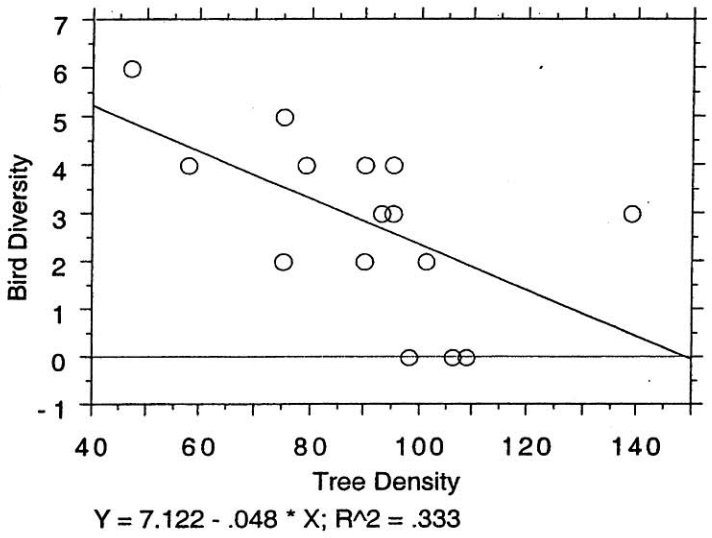

Figure 10. In areas of dense tree growth we tended to observe fewer bird species, perhaps due to the sparser undergrowth in these areas.

American Crows *(Corvus brachyrhynchos)* were an exception to this pattern. The crows tended to be found in mature oak trees. Crows were observed to spend much more time traveling between communities within the park and between the park and other areas. Their wide foraging patterns and complex social structure probably account for the observed differences.

A cluster analysis of tree populations showed that there was no significant grouping which contained all plots with the presence of the Oriental Bittersweet. Thus, the cluster diagram shows that the presence of the invasive Oriental Bittersweet had no impact on the diversity of the trees in areas where it grew.

The dominance of oaks in many regions of the park presents a classic example of a conservation dilemma. The areas of the park with the highest biodiversity are those with the disturbed edge areas. In order to conserve the dominant native community a reduction in biodiversity will most likely result in the park. It seems that, if carefully managed, the current pattern of high use areas and relatively isolated spots are an ideal combination.

Although the population of Norway Maple is not excessive in Edmands Park it is an important component of the park's ecosystem. It proliferated in 13 plots whereas its native competitor, the Sugar Maple (Weatherbee and Somers, 1998) was only found in 6 plots. 195 Norway Maples were found while only 16 Sugar Maples were found. The correlation between Norway Maple numbers and tree diversity suggests that they are

moving into disturbed areas rather than the regions where oaks are dominant. Avoiding disturbance will probably help to restrict the number of Norway Maple in the future. The recommended practice for dealing with the threat of Norway Maples is to hand- pull saplings and cut down larger ones (Weatherbee and Somers, 1998; McCarthy et al., 2001).

Of all the areas in Edmands Park, it was clear from our study that the marshy area at the north end of the park was particularly important, having both the highest density and diversity of birds. This is probably due to the variety of cover and abundance of different food sources in this region. This information should be considered in future management plans for the park and an effort should be made to maintain this area as a haven for wildlife.

ACKNOWLEDGEMENTS

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