Tree Species Composition and Density in Former Pastured and Plowed Sites

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BI/ES 430 Forest Ecology

Introduction

Since settlement by Europeans, New England has experienced major landscape alterations due to agriculture and development. In the 1800's, settlers cleared many forested areas to accommodate the large number of sheep pouring into the region due to a dramatic increase in sheep farming (Foster, et al. 2004). Eventually, many of these farmers abandoned their farms and traveled west in search of more fertile land. My study investigated possible differences in relative abundance and tree density between pastured and plowed areas at the ice storm damage site (red trail) and the Kimball farm site (blue trail). Results of this study can contribute to our understanding of the impact of human disturbance on forests. Different types of disturbances (such as pasture vs. cultivation) might have different long term impacts on forest growth.

The questions this study focused on answering were: What is the difference in species composition between the plowed and pastured areas? What is the difference in average tree density between the two sites?

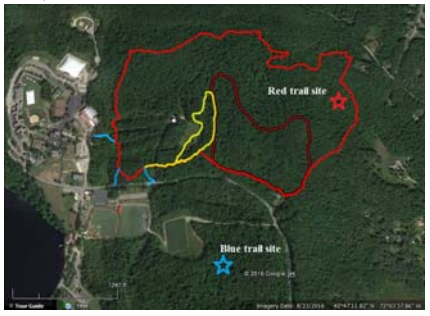

Figure 1. Map showing the ice storm damage site (red star) and the Kimball farm site (blue star).

Methods

This study was conducted on the Franklin Pierce University campus at two different sites. The first day of data collection took place on October 18, 2016 at the ice storm damage site located off of the red trail. Each site was sampled using four transects. The starting point for each transect was 10 paces from the rock wall that separated the plowed and pastured areas. Using the point and quarter method, I ran transects directly west for the plowed site and directly east for the pastured site. There were 4 sampling points along each transect which were 10 paces apart. At each sampling point, the four nearest trees $\geq$ 2m in height in four quadrants (NE, SE, SW, NW) were identified and distance to each tree was recorded. The same process was used for the Kimball farm site located off of the blue trail. The data for the Kimball farm site were collected on November 1, 2016. After the data were recorded on data sheets, they were transferred into Microsoft Excel. Then, the data were analyzed using relative abundance graphs, scatterplots, t-tests, and chi-square analyses.

Figure 2. Photograph of the ice storm damage site looking at the rock wall from the pasture side.

Results

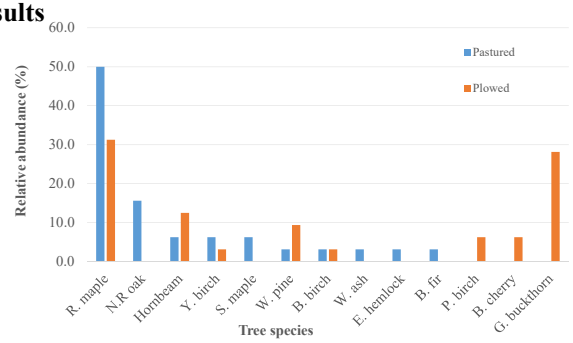

Figure 3. Bar graph comparing the relative abundance of tree species in the pastured and plowed areas of the ice storm damage site. At this site, the pastured side had more red maple, northern red oak, sugar maple, white ash, hemlock, and balsam fir than the plowed side. The plowed side had many more shade intolerant species such as buckthorn, white pine, black cherry, and paper birch. The chi-square analysis (Table 1) showed a p-value of 0.095 which means there is no significant difference in species composition between the pastured and plowed sides.

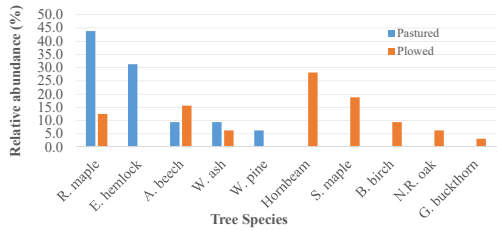

Figure 4. Bar graph comparing the relative abundance of tree species in the pastured and plowed areas of the Kimball farm site. At this site, the pastured side had more red maple, hemlock, white ash, and white pine than the plowed side. The plowed side had more hornbeam, sugar maple, black birch, northern red oak, and buckthorn. The chi-squared analysis (Table 2) showed a p-value of 0.014 which means the difference in species composition between the pastured and plowed side is statistically significant.

Discussion

This study was focused on comparing the species composition and tree density between formerly pastured and plowed fields on campus. Relative abundance bar graphs showed that there are some differences in species composition between pastured and plowed areas, however only the comparison at the Kimball farm site was statistically significant with a p-value of 0.014 (Table 2). A possible ecological explanation is that there has been enough time for tree seeds to colonize both sides of the rock wall. Earlier after abandonment, there could have been a greater difference in species composition, however over time seeds could have migrated on both sides of the wall. Another possibility is that there was not a large enough sample size with only 2 transects on each side of the rock wall to detect meaningful differences. The other aspect of the study compared tree density between the pastured and plowed sides. The t-test showed that there was no significant difference between the pastured and plowed areas at both sites. Similar tree densities are consistent with the fact that all forests are of similar age.

Additional Photos and Results

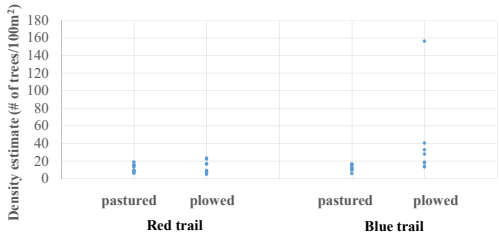

Figure 5. Scatterplot comparing the density estimates of pastured and plowed fields at both the ice storm damage site (red trail) and the Kimball farm site (blue trail). The pastured and plowed fields at the red trail have very similar density estimates. At the blue trail site, the plowed site has bigger range of densities and has an outlier at 156.2 trees/100m^2. The t-Tests comparing mean densities resulted in p-values of 0.62 and 0.13 indicating no significant differences.

Table 3. T-test comparing the mean density estimates for the pastured and plowed areas of the ice storm damage (Red trail) site

	Pastured	Plowed
Mean	11.83	13.37
Variance	20.79	52.29
Observations	8	8
df	14	
p-value	0.62	

Table 4. T-test comparing the mean density estimates for the pastured and plowed areas of the Kimball farm (Blue trail) site

	Pastured	Plowed
Mean	12.26	40.01
Variance	14.53	2297.93
Observations	8	8
df	14	
p-value	0.13	

Figure 6. Photograph of the ice storm damage site looking at the plowed side.

Works cited

Fuller, J., Foster, D., Motzkin, G., McLachlan, J., & Barry, S. (2004). Broadscale Forest Response to Land Use and Climate Climate. In D. R. Foster, & J. D. Aber, *Forests in Time: The Environmental Consequences of 1,000 years of Change in New England* (pp. 101-124). Yale University.