The Effect of Prior Land Use on Biomass Growth Rates in the Black Rock Forest

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Abstract

Biomass growth in forests recovering from clearing or agriculture could be a significant sink for atmospheric CO_2. Determining whether or not the growth rate of trees on agricultural land is different from that of woodlot lands is important to determine if the regrowth of forests on former agricultural lands is a feasible method for carbon sequestration. The growth rate of trees on sites in the Black Rock Forest that were either agricultural or woodlots was determined. Three species of trees were used, red maple, red oak, and white oak. The average ages of the trees on both agricultural and woodlot plots were similar, however there was a trend that the diameter of the trees and the growth rates were larger on the agricultural plot for all species sampled. This result is unexpected given that the working hypothesis is that the agricultural land would have more nutrient depletion and slower growth rate as an effect. The woodlot land however had a higher tree density and total biomass. The cause of the higher growth rate but lower tree density on the agricultural site is more likely to have been caused by recent management practices as opposed to the agricultural practices.

Table of Contents

List of Figures……………………………………………………………….………………4
List of Tables……………………………………………………………..……………….5
Introduction…………………………………………..…………………………6
Background…………………………………………………………..………………7
History of the Black Rock Forest……………………………………………..………7
Site History……………………………………………………………………...9
Variables regarding the effect of agriculture on an area……………….……………10
Effect of agriculture on future growth…………………………………………11
Approach and Methods……………………………………………………………..12
Site Selection…….…….….….….…….….……….….….……….….….12
Sampling……………………………………………………………………..14
Biomass Growth Calculations………………………………………………..15
Soil Sampling………………………………………………………….....……15
Historical Records Review…………………………..…………………………16
Results…………………………………..……………………………………..16
Discussion……………………………...…………………...………………23
Conclusions……………………………………………………………...………26
Implications and future research……………………………………………….....27
Acknowledgements…………………………………………………………………28
References……………………………………………………………………………..28
Appendices…………………………………………………………………………….30
Agricultural site data…………………………………………………………………30
Tree diameter……………………………………………………………………30
Age and annual growth………………………………………………….…31
Tree density, basal area, and aboveground biomass…………………………..…38
Slope…………………………………………………………………………..39
Woodlot site data……………………………………………………………………40
Tree diameter……………………………………………………………….……40
Age and annual growth……………………………………………….……..41
Tree density, basal area, and aboveground biomass……………………………..48
Slope………………………………………………………………………….…49

List of Figures

Timeline of Black Rock Forest Region……………………………………………………...9

Map of woodlot site…………………………………………………………………...17

Map of agricultural site………………………………………………………………..17

Average diameter of trees on woodlot and agricultural plots……………………………18

Average age of trees on woodlot and agricultural plots…………………………………19

Average annual growth of trees on woodlot and agricultural plots………..……………20

Summary compartment maps from Black Rock Forest Archives…………….………22

List of Tables

Statistical significance table for annual tree growth……………………………………20

Tree density, aboveground biomass, and basal area……………………………………20

Agricultural and woodlot site slope and aspect…………………………………………21

Introduction

Throughout the 1700's and 1800's a large percentage of the forested land in the northeastern United States was cleared for multiple purposes. In fact, in some states up to 70 percent of the forested lands were cleared for agriculture or lumber (Foster 1995). The largest amount of clearing occurred in the late 1800's and since then 60-80% of the former cleared land has regrown (Foster 1995). After agricultural abandonment, at least in the northeast, forest will invade former farmlands relatively quickly (Hooker and Compton 2003). There is significant growth of forests and biomass accumulation during the first 100 years after abandonment and the amount of biomass can return to levels near those of undisturbed forest (Hooker and Compton 2003). The biomass in trees is contained in the wood of the trunk and the branches. Because the CO_2 from the atmosphere is absorbed by the trees and by photosynthesis converted into the biomass of the tree, the increase of tree biomass could be a major sink of carbon to be utilized in the future. However, productivity and carbon sequestration rates may differ between lands continuously forested and those developed on abandoned agricultural lands. An understanding of the changes in these sinks could lead to strategies for the efficient use of different types of land for carbon sequestration.

I plan to determine if trees in areas of the Black Rock Forest that have different former land uses have a significant difference in their biomass growth rates. The land use types studied are former agricultural lands and woodlots. Because of the effects that agricultural processes can have on the land, namely depletion of soil nutrients and organic matter, I suspect that the biomass growth rate in areas that were formerly agricultural lands should be lower than in areas that were woodlots.

Background

History of the Black Rock Forest Region

The Black Rock Forest is located in the Hudson Highlands region of New York State, a mountainous area along the Hudson River approximately 50 miles north of New York City. This region was first settled by Europeans in 1684 and has since undergone four major stages of the patterns of land use (see timeline, figure 1) (Maher 1999). Small subsistence farmers first settled the area. Because of the hilly nature of the land, the settlers were only able to clear small areas of land and start small farms. These farms supported the families throughout the year by providing multiple crops, such as peas, corn, squash, and rye, all for the consumption by the family (Maher 1996).

As New York City grew, the demand for food production rose in the region. The Hudson Highlands region gradually shifted from subsistence farms, which only provided for the individual family, to larger commercial grain farms producing a single cash crop to be shipped downriver (Maher 1996). This trend occurred between the years of 1790-1925 when the Hudson Highlands played a major role in the supply of food to New York City.

Following the opening of the Erie Canal in 1825, agriculture changed in nearly the entire northeast. The canal connected Buffalo, in western New York, and New York City and provided rapid and inexpensive transport of goods. The length of time required to travel from Buffalo to New York City decreased from 20 to 10 days and the price of shipping per ton decreased by nearly 95 % (Hedrick 1933). Agricultural products that previously would not have lasted the journey, or that were too difficult to ship were now easy to transport. In addition, not only were the areas of western New York more accessible, but the agricultural productivity, and quality of the land in those areas was much greater. Grain products could then be produced in greater quantity and very inexpensively. As a result, nearly all of the commercial agriculture shifted from coastal areas to farther inland (Hedrick 1933). As grain production no longer remained economically viable in the east, the agriculture shifted to perishable goods like vegetables and fruits that would not last the journey from the fields farther west. Additionally, dairying increased in the region to supplement the perishables being shipped south to the city (Maher 1996). Perishable production and dairy farming remained important to the regional economy until the 1890's when the amounts of farmland began declining as the local economy began to promote the Hudson Highlands region as a tourist attraction drawing wealthy New Yorkers out of the city (Maher 1996).

As farming decreased in the area, the amount of lumber that was harvested from the forests increased. The timber was used for wood products, lumber and railroad ties, as well as fuel for the railroads. The other main use of the resource was to supply energy. The wood was used in several industries in the area, iron, lime, and brick making, the production of charcoal, as well as fuel for heating homes (Hedrick 1933). Although in the Black Rock Forest only 7.5 % of the area was cleared specifically for agriculture, at least 50 % of the area was cleared for lumber at some point in the area's history (Maher 1999). Some of these areas were clear cut several times for lumber (Tryon 1930).

The Black Rock Forest was established by the Stillman family as a preserve and as an experimental forest in 1928. It became part of the Harvard University Forest System from 1949 to 1989. It has been operated as a research and education field station by the Black Rock Forest Consortium since 1989 and currently consists of 3785 acres (Maher 1996).

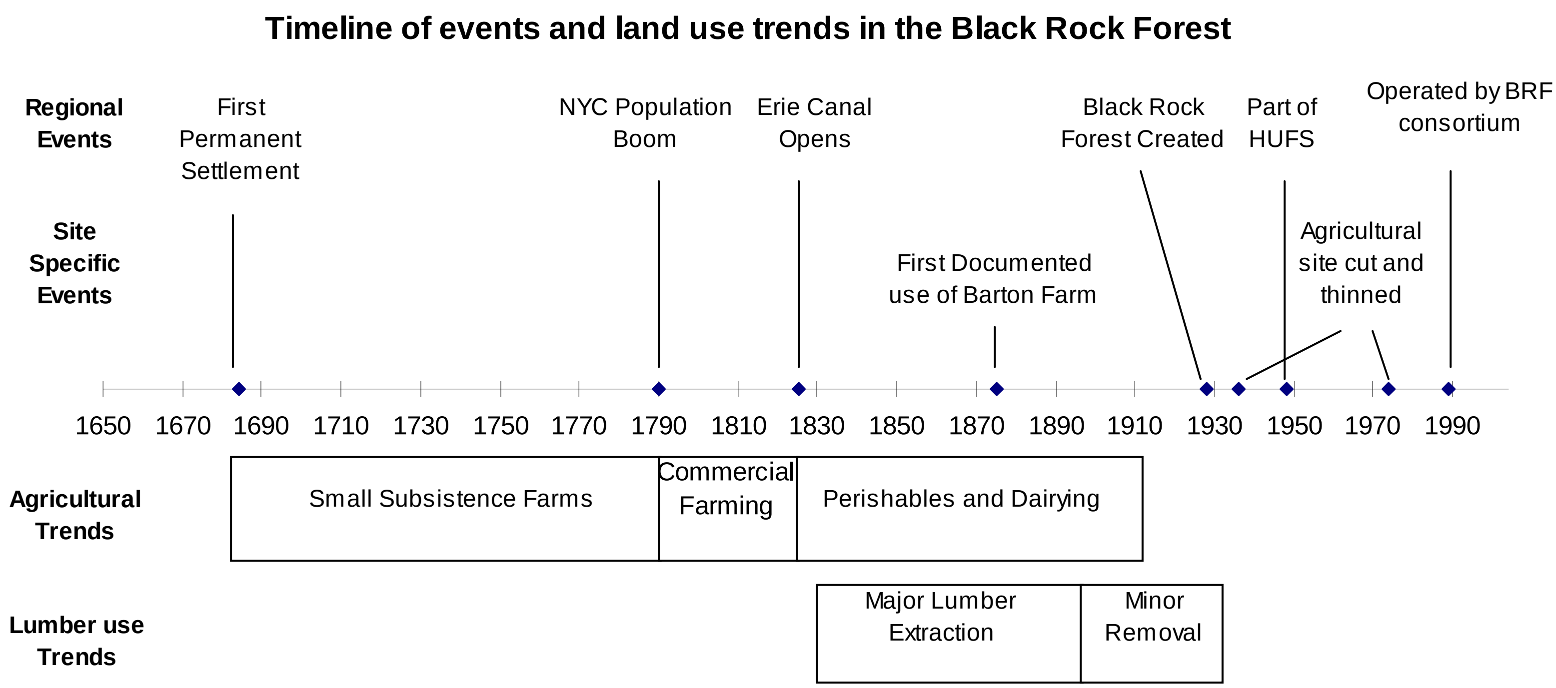

Figure 1: A timeline of the major regional and local events in the Black Rock Forest, as well as the changes in land use as a result of these events. (Modified from Maher 1999)

Site History

Within the Black Rock Forest there have been seventeen individual properties identified. The properties vary in size and length of time occupied. One of these properties is the site of the Barton Farm, which was chosen for the site of the study. There is evidence to show that the Barton family was living on the study site within the Black Rock Forest by at least 1875. However, due to the extensiveness of the rock walls it is likely that the area was farmed for several years before this time (Maher 1996). Additionally, the Barton farm is near the Old West Point Road, a main thoroughfare connecting the towns of Cornwall and West Point. This increases likelihood that the area was inhabited and farmed for several generations.

Variables regarding the effect of agriculture on an area

The effects of agriculture on certain areas are dependant on several initial factors. These are the initial fertility of the soil, the nutrients present, and the complexity of the ecosystem. These factors that influence how the agricultural processes will affect a location and how that area will change in the future.

Initial soil fertility can impact how an area will recover after disturbance. Areas of low soil fertility that are cleared grow back with lower biomass than areas with higher fertility. Thus variations in soil fertility can account for some of the variations in biomass between areas that have been cleared and that have not been cleared (Laurance et al. 1999).

The complexity of the ecosystem before agricultural disturbance also impacts the processes of recovery and the length of time required for recovery. In highly complex ecosystems it can take up to 200 years for biomass to return to the pre-disturbance amount (Laurance et al. 1999). Examples of these complex ecosystems are tropical rain forests. In less complex ecosystems, levels of biomass different from those of uncleared areas can only be detected between 40 to 60 years after the disturbance (Compton et al. 1998). Pine and oak forests in New England are examples of these types of ecosystems. Because of the length of time from agricultural abandonment is at least since 1928, the establishment of the Black Rock Forest, the biomass may have returned to pre-disturbance levels, but the growth rates may still be lower.

The effect of agriculture on future growth

Agricultural disturbance can have several effects on the land that may impact future growth or recovery on that land. Carbon is stored in the soil through leaf litter fall from trees, and through root inputs (Entry et al. 2002). The processes of agriculture can remove carbon from the soil by up to 30 % (Compton et al. 1998). Any soil degradation that comes about due to the agricultural processes could slow the growth rate for future biomass (Laurance et al. 1999). Degradation could include soil nutrient loss as well as increased erosion or soil loss (Entry et al. 2002). The recovery time for the soil can, however, take longer than the biomass recovery (Hooker and Compton 2003).

Furthermore, the length of agricultural use on a given area, or the intensity, may impact the future recovery of the land. In some cases long-term agriculture has been shown to affect the species diversity of an area even over an extended time scale (Dupouey et al. 2002). This may or may not impact the biomass of an area. Any biomass changes will depend on the species in each case. After agricultural processes, the nitrogen availability for forest regrowth also depends on the intensity of the agriculture (Compton et al. 1998). Additionally, the vegetation patterns that arise after disturbance in an area are somewhat dependant on the prior land use in that area (Compton et al. 1998).

The type of agriculture is also an important factor controlling the soil quality. The methods of agriculture for intensive removal of crops and using the land for pasture are very different. Intensive cropping and tillage of the land depletes the soil nutrients more and can increase erosion and nutrient leaching. Less intensive modes of agriculture can decrease erosion and soil nutrient depletion (Drinkwater et al. 2000). The intensity of agriculture on the site chosen may not have been extremely high, but it is likely that the length of time it was farmed was significant.

Approach/methods

Site Selection

There are extensive historical data on the Black Rock Forest at its inception from the writings of Henry Tryon, the first forester of the Black Rock Forest. Writings of Tryon's indicate the approximate age of many of the stands of trees in the forest (Tryon 1930). He also indicates that near the Upper Reservoir there were both some young stands as well as older stands of trees. It is likely that these areas belonged to the former Barton farm because it was the only farm in that area. Using additional information about the area around the Upper Reservoir in more detail from Maher, as well as physical evidence, two comparable plots were selected. One of the plots is former agricultural land, and the other plot is a former wood lot.

There are several different physical parameters used to distinguish former agricultural lands from wood lot lands. The lack of rocks at the ground surface indicates that the area was likely to have been plowed and the rocks removed. This is especially true in areas like the Black Rock Forest that are naturally rocky. The presence of low stone walls is also key to the determining if an area was used for agricultural purposes. Often times the stones removed from the ground from plowing were made into the stone walls that surround the fields. Additionally, it is unlikely that lands surrounded by only low stone walls were pasture fields because low walls would not keep the animals in. Maher indicated that the stone walls around the Barton site were relatively extensive revealing that the site was farmed for at least a few generations (Maher 1996). On the other hand, wood lot areas are characterized by the presence of many rocks at the surface and a lack of stone walls in the area, because the land did not need to be cleared for plowing, and in fact the presence of many stones on the surface indicate that the land could not have been used for intensive agriculture because it could not have been plowed.

In the areas identified as former wood lot and former agricultural land, trees were selected and marked for the length of the study. By far the dominant species in the two plots selected were red oak and red maple, as in much of the Black Rock Forest. The three species of trees selected for this study are the dominant red maple and red oak, as well as the white oak. There are other species of trees in the plot such as birch, beech, ash, and other species of oak; however the numbers of these are too few to allow an adequate comparison between the two sites. On each plot 10 red maples and 10 red oaks were identified for the study. However, the number of white oaks on the plots was not as large and only 3 and 6 were identified on the wood lot plot and agricultural land plot, respectively.

All of the trees selected were canopy trees, ensuring that crowns of the trees all received direct sunlight from above. By only selecting canopy trees the amount of sunlight that the trees receive does not become an additional complicating variable.

Sampling

Each tree selected for the study was measured to determine the biomass growth per tree. The diameter-at-breast-height (DBH) was measured for each tree. DBH is the standard measure for comparing tree size and dominance and is defined as the diameter of the trunk 1.3 m above the ground. The measurement for DBH was taken with a tape measure in units of cm/π to express the diameter.

Following the DBH measurement, each tree had a core sample taken to determine the age of the tree. The core was also taken at breast height to correspond with the diameter measurement. The age of the tree obtained from the core sample will approximate the total age of the tree, however the total age of the tree will be somewhat greater because it takes each tree a variable number of years to grow to at least 1.3 m. The diameter and the age will correspond because they are taken at the same height.

Additional measurements included taking the average slope of the land in the plot, the density of trees, and the basal area in each plot. Three measurements of slope and aspect of the land were taken randomly throughout each plot. The slope measurement will indicate if the erosion rates are the same, areas with larger slopes may erode faster than areas with smaller slopes. The density of trees is the number of trees per area; this will show differences in total tree numbers in each plot. The basal area is the cross-sectional area of the tree, measured at-breast-height. The total amount of basal area per stand is measured as m^2/ha. To determine the basal area, a 20m x 20m sub-plot of each site were randomly selected. The diameter and species of all trees with a DBH greater than 1-inch was recorded. The measure of basal area will aid in the comparison of amount of tree cover in each plot.

Biomass Growth Calculation

The average annual growth rate for each tree was calculated from the diameter and the age of the tree, and is being defined as the trunk growth in millimeters per year. These values will be averaged for all of the trees per species to give an average growth rate per year for the three species. The significance of differences in growth rate depending on prior land use type is determined by performing a t-test on the data. Total above ground biomass for each tree will also be estimated using allometric equations that have been developed for these species based on diameter. Results will be examined for differences between site and species and compared among different tree ages.

Soil Sampling

Within each 20m x 20m sub-plot soil samples were taken to determine nutrient levels of the soils. Five soil samples were collected from each sub-plot, each divided into topsoil and sub-soil layers. The topsoil was the top 2-3 inches of the soil, beneath the humus layer; the sub-soil was the underlying layer. These sub-samples of the soil layers were then mixed together and a bulk sample was taken to determine the average soil nutrient levels per plot. The soil samples were sent to Cornell Soil Lab, where they were tested using the Morgan procedure. The Morgan test does not give a total value of nutrients, but it determines the biologically available nutrients in the soil.

Historical Records Review

The Black Rock Forest records contain the logging history of the forest from after it was established as an experimental forest to the present. The logging data could help to verify the age of the tree stand as well as determine how often the area was cut. The files were reviewed to determine what type of forest maintenance, if any occurred in the areas of the forest under study.

Results

Initial selection of trees around the former Barton Farm occurred on November 3rd 2003. All of the trees to be sampled at both sites were identified. Figures 2 and 3 are schematic maps of the wood lot site and the agricultural land site, respectively. The maps show the locations of the trees and their species identification. The sites are located along the Swamp Trail. The woodlot site is located approximately 100 meters farther along the trail from the trailhead than the agricultural site.

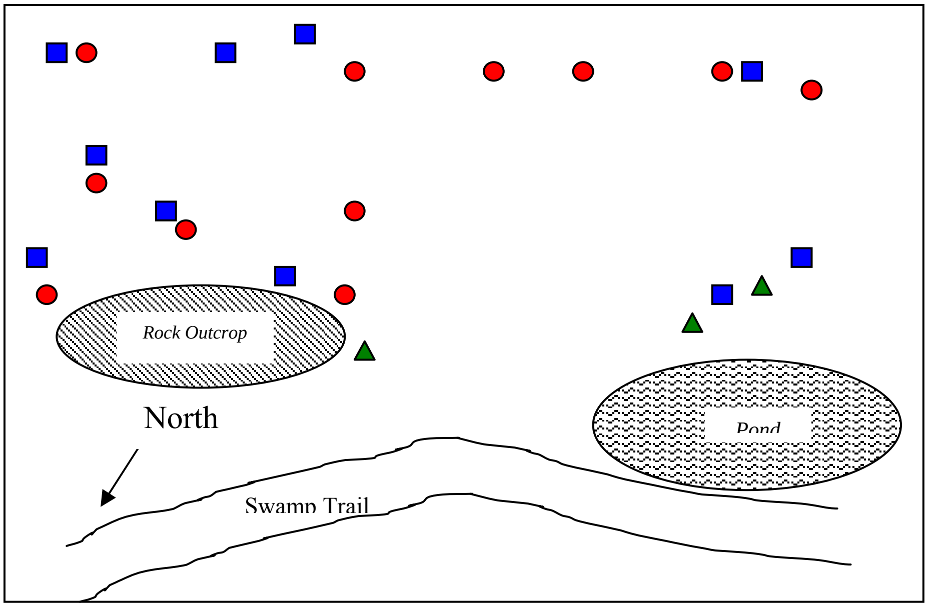

Figure 2: Schematic map of former wood lot. Key: ● -Red Maple, ■ -Red Oak, ▲ -White Oak

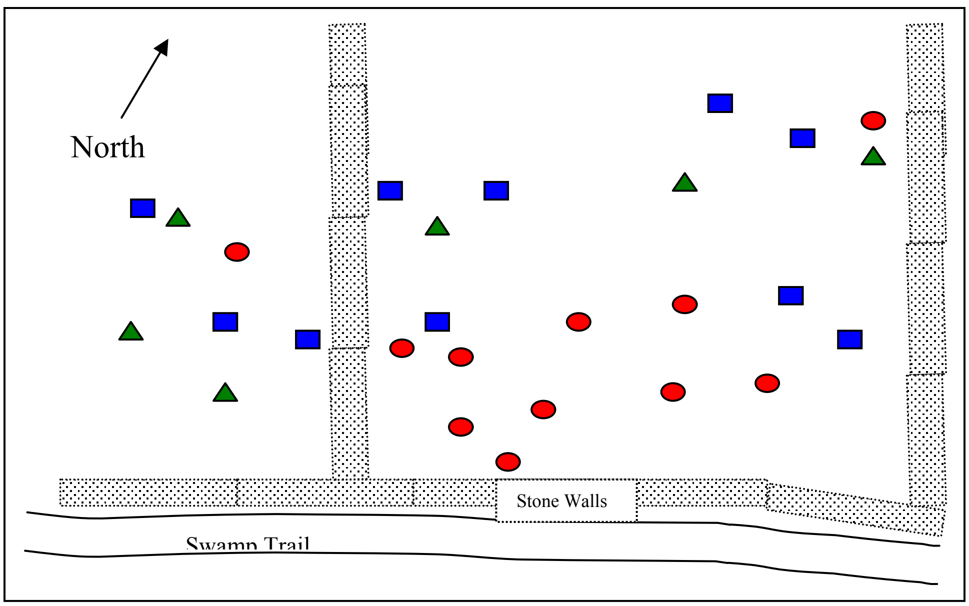

Figure 3: Schematic map of former agricultural site. Key: ● -Red Maple, ■ -Red Oak, ▲ -White Oak

After initial identification of the trees the diameters of all of the trees were measured. The data collected from those measurements are presented in figure 4, which consists of the average tree diameter for each of the species in each plot. The tree diameters on the woodlot site were all greater than those on the agricultural site. The agricultural site trees were on average 5 cm greater in diameter.

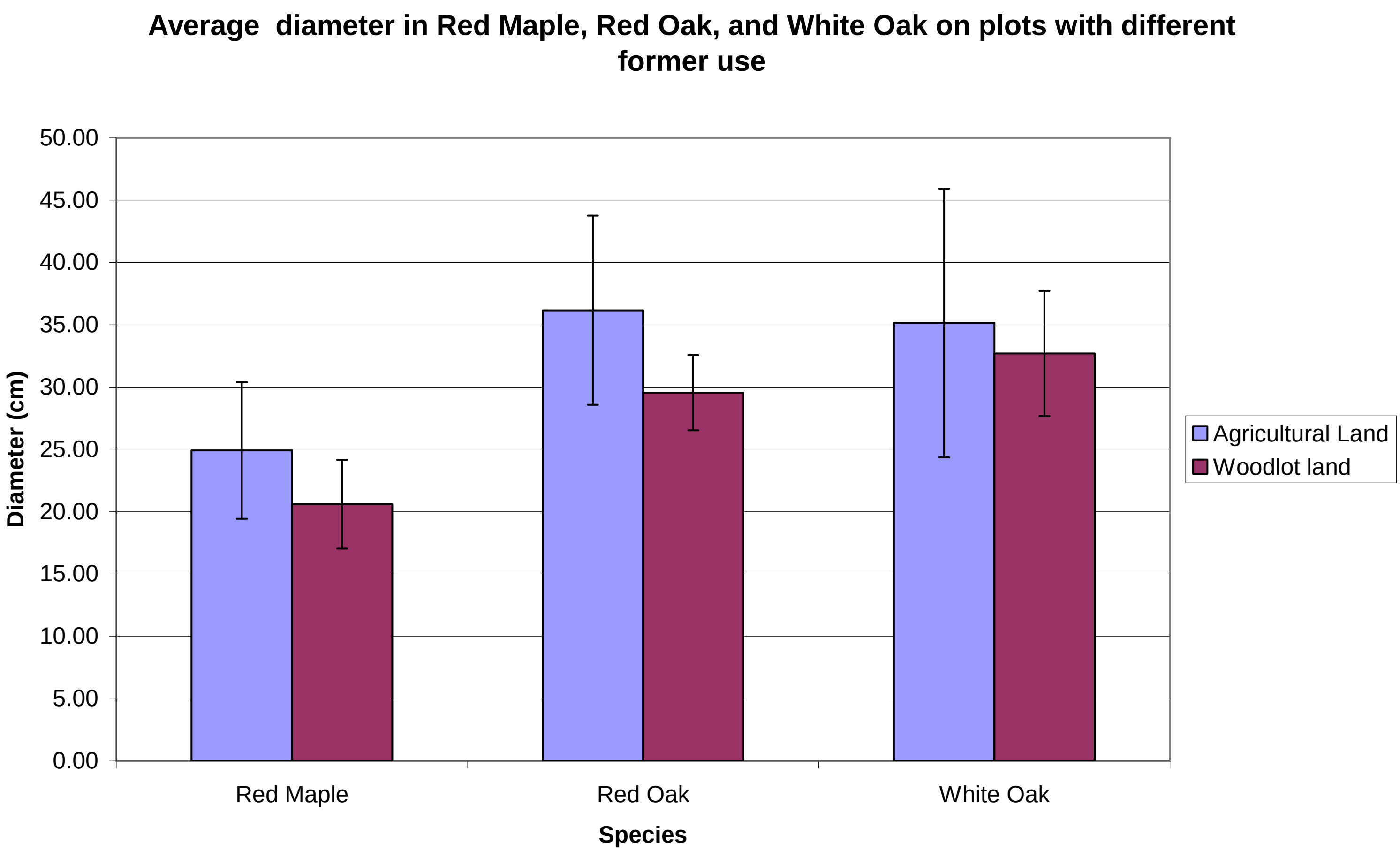

Figure 4: Average tree diameter in centimeters for red oak, red maple, and white oak in both former agricultural land and former woodlot. Error bars represent standard deviation.

Tree ring core samples were taken for all of the trees in the plots. The cores were analyzed using the computer program MeasureJ2X, which measures the growth for every year beginning from the last year of growth, the 2003 growing season. The age of each tree was determined, as well as the growth per year. The average age of the trees in each plot is presented in figure 5 and the average annual growth per tree is in figure 6.

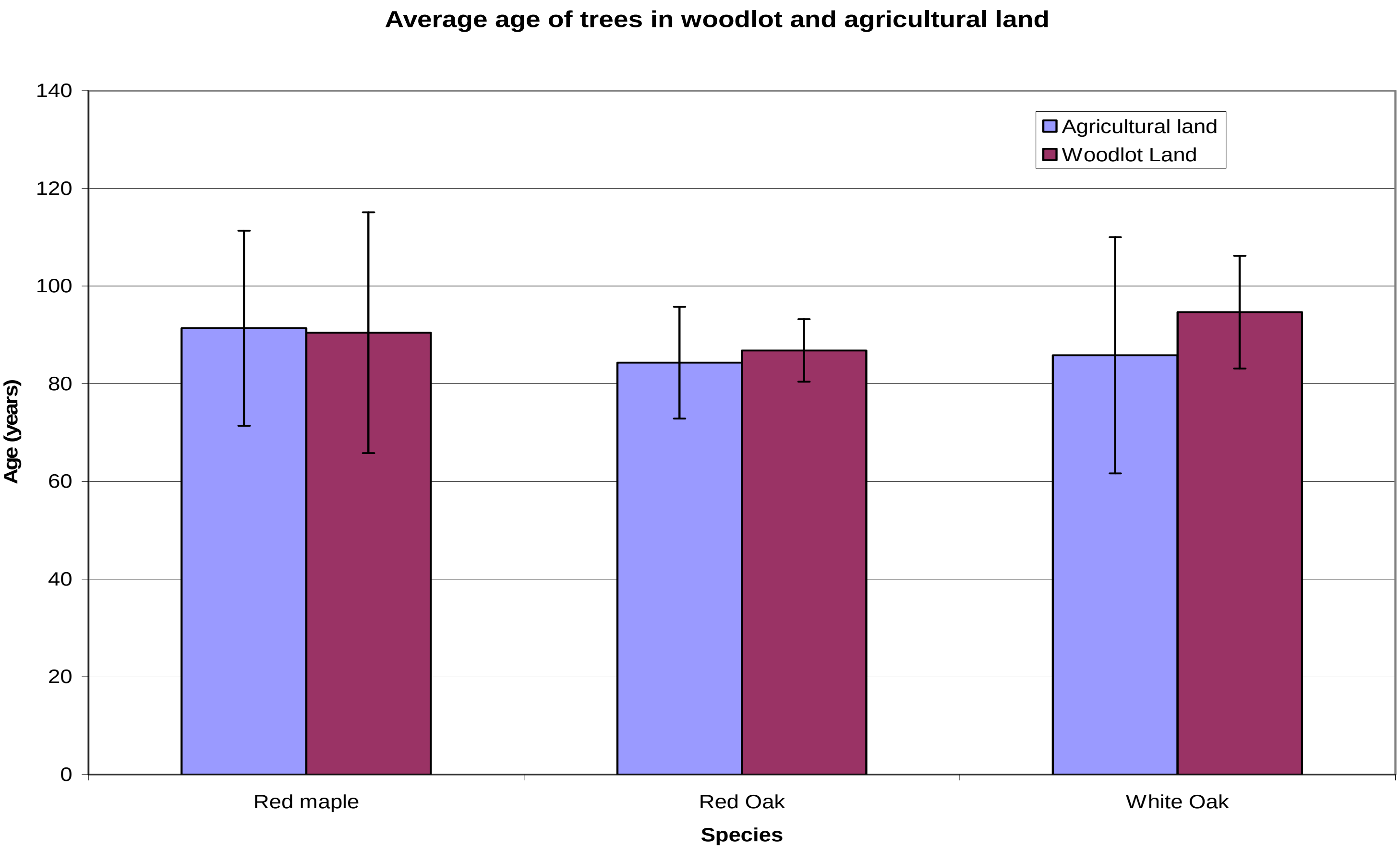

Figure 5: Average age of Red maple, red oak, and white oak in the wood lot and agricultural land sites. Error bars indicate standard deviation of the ages.

The age of the red oak and white oak trees in the wood lot plot are larger than those of the agricultural plot, however, the red maple trees are on average older on the agricultural land. There is variation of ages, but all of the ages of the trees are very similar, and neither area has significantly older trees.

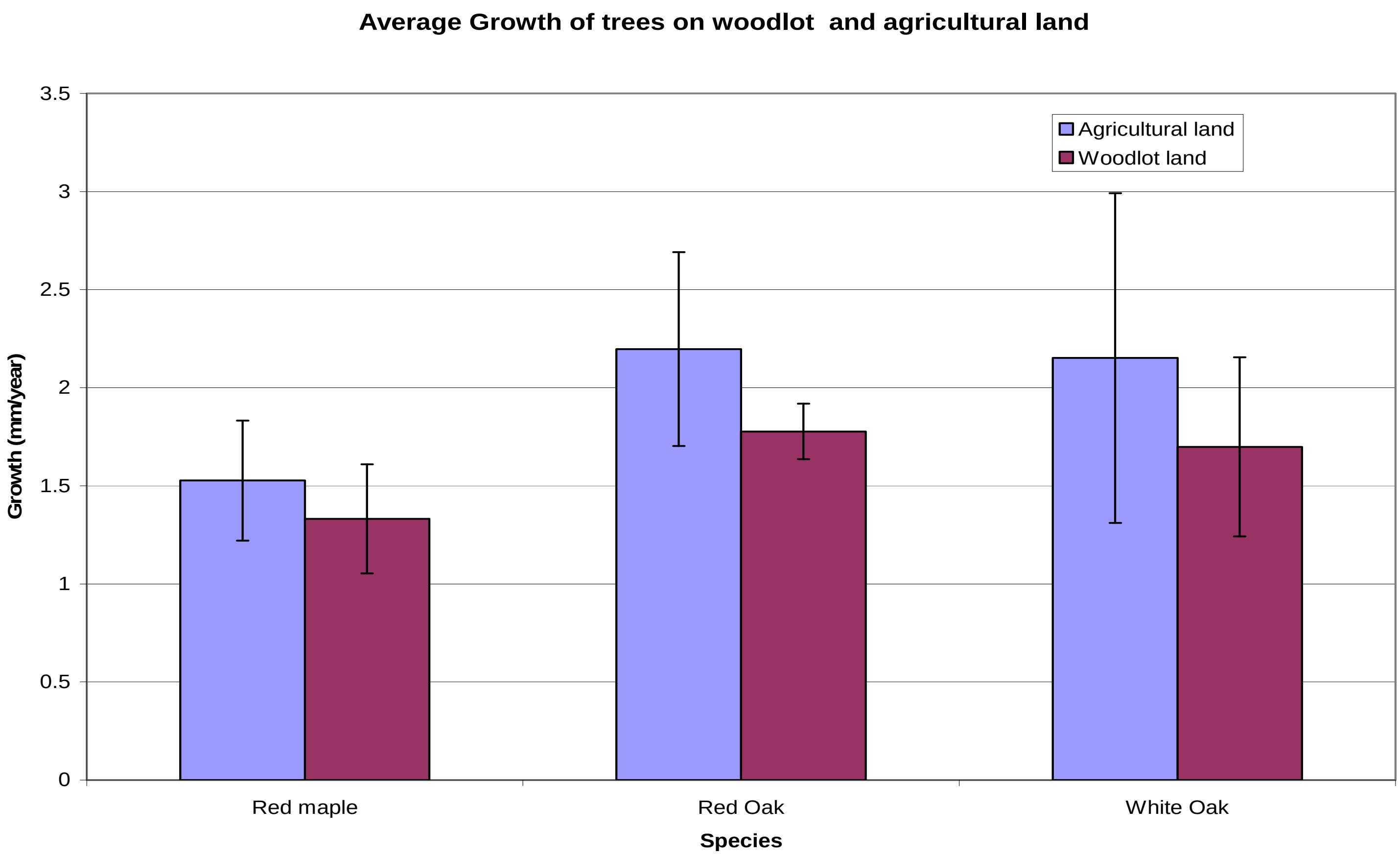

Figure 6: Average growth in millimeters per year at-breast-height for red maple, red oak, and white oak in the wood lot and agricultural land sites. Error bars indicate standard deviation of the growth rate.

There is a larger average growth of trees on the agricultural site than on the woodlot site, however the variation from the mean is also larger on the agricultural site as opposed to the woodlot site. In both cases there are large deviations around the means for annual growth rate, therefore while there is a trend for higher growth rates in the agricultural site those results are not statistically significant. See table 1.

Table 1: Statistical summary table average annual growth rates using a two-tailed T test. None of the results had significance greater than 0.05, but the red maple was significant to $p>0.2$, $T_{0.2\ df=1} = 3.078$.

	Mean annual growth	**Standard Deviation**	**Standard Error**	**T**	**$T_{0.05,\ df=1}$**	**Significant**
Red Oak						
Agricultural	2.20	0.49	0.51	0.82	12.706	No
Woodlot	1.78	0.14				
Red Maple						
Agricultural	1.53	0.31	0.41	3.70	12.706	No
Woodlot	1.33	0.28				
White Oak						
Agricultural	2.15	0.84	0.96	0.47	12.706	No
Woodlot	1.70	0.46				

The tree density in the woodlot site is greater than that in the agricultural site. This results in a higher estimated aboveground biomass and a greater basal area. There is a greater number of trees per hectare on the woodlot site, and even though these trees may be smaller, their total cover, the basal area, and the total dry biomass is greater (see table 2). The tree densities in the woodlot site is normal, the agricultural site is slightly low.

Table 2: Tree density in trees per hectare, aboveground biomass in metric tons per hectare, and basal area meters^2 per hectare. All of the values are larger on the woodlot site.

	Agricultural Site	Wood lot site
Tree Density (trees/ha)	500	650
Aboveground Biomass (t/ha)	220	241
Basal Area (m^2/ha)	28.4	28.8

The average slopes of the sites were measured. The wood lot site is very level, with an average slope down to the north and west at 6%. The agricultural site is more sloped than that of the woodlot site. The slope on this site is down to the east and south at 15% (see table 3).

Table 3: Average slope, aspect and direction of the agricultural and woodlot sites.

	Agricultural Site	Wood lot site
Slope (%)	-15	-6
Aspect (degrees)	115	321
Direction	East south east	North west

The historical logging records showed the sites fell within Black Rock Forest compartments VI and XVI. There were two logging and thinning events in compartment VI. The logging and thinning consisted of cutting some trees and removal of dead and dying trees. The cuttings occurred in 1936 and 1974, and they both included the area of the agricultural site. See figure 7. However, there was no visual evidence, stumps, in or around the agricultural site.

The results of the soil samples sent to Cornell were not obtained at this time. The will most likely show that the nutrients are similar in both sites.

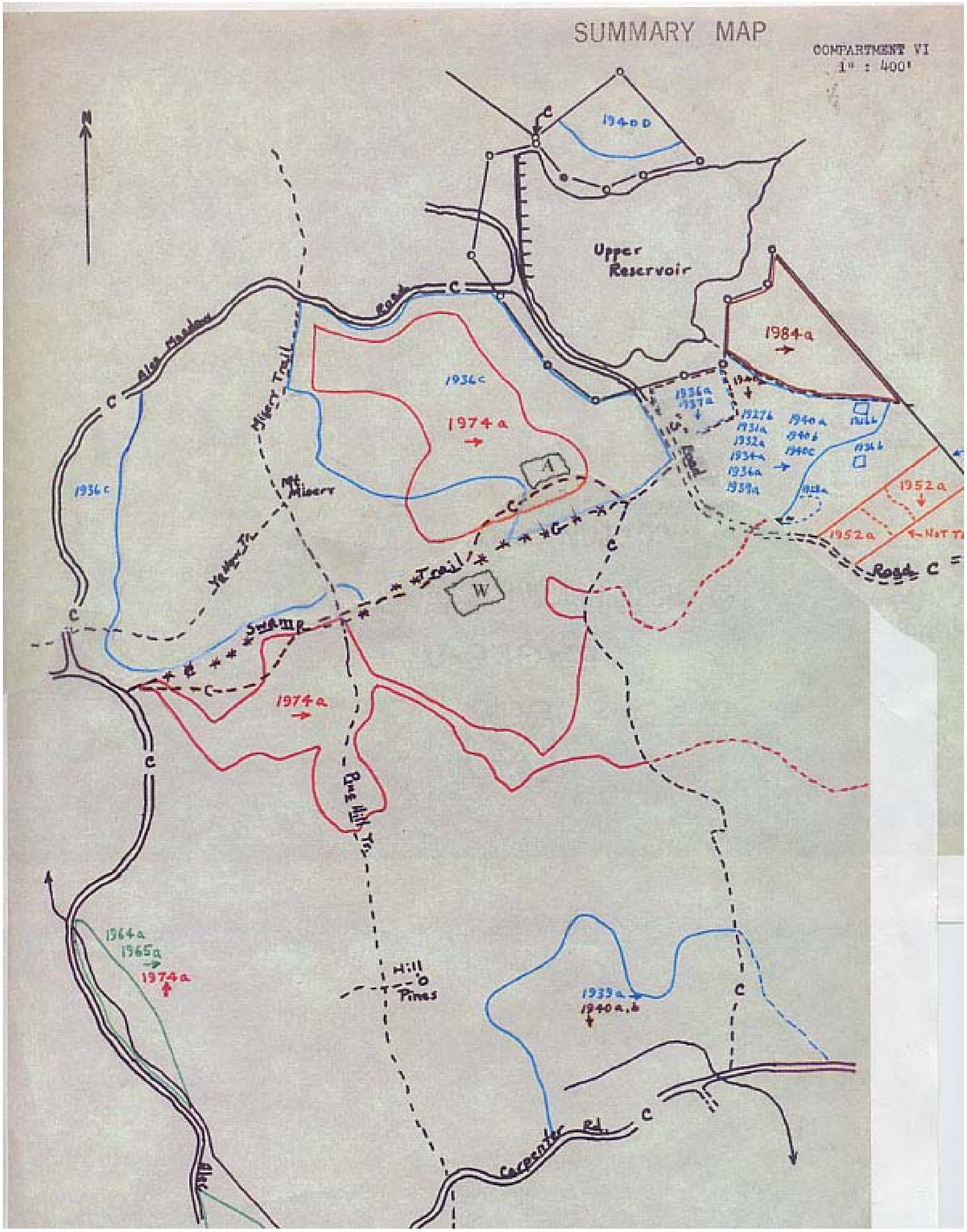

Figure 7: A combination of summary maps for compartments VI and XVI. The different plots are marked on the map, A indicates the agricultural site, and W indicates the woodlot site. The locations of thinning are also on the map with the year in which they occurred. The agricultural site falls within the boundary of the 1936c and the 1974a thinning. (Black Rock Forest)

Discussion

There is a trend for larger tree growth in the agricultural site, but because the differences in annual tree growth between the two sites are not statistically significant it is possible that the length of time the land was used for agriculture was not long enough to impact the soil. It is also possible that if there were any effect on the soil, such as nutrient depletion, it is minimal. If this were the case, the difference may only be detectable in the soil, and not measurable in the tree growth. Finally, if there were an impact on the soil from agriculture, it may be long enough time since agricultural abandonment for the soil to recover.

There were however, a significantly greater number of trees on the woodlot site than on the agricultural site. This decrease in density is evidence that the thinning events impacted the site. It is possible that even though there is a trend towards a higher per tree growth rate on the agricultural site that there may actually be a greater relative growth rate on the woodlot site. It is likely that the cause of the increased growth rate on the agricultural site is the thinning. The thinning removed some but not all of the trees from the site. The remaining trees would have less competition for water, nutrients, space, and sunlight allowing for them to grow faster.

It is unlikely that the differences in slope affected the results obtained, with regards to erosion. The slope of the agricultural site is larger than that of the wood lot site, and that would cause higher erosion rates, which would remove additional soil nutrients. This does not seem to be the case, as the growth rate is higher in the agricultural site. However, the slope may have impacted the growth rate if the agricultural plot received more direct sunlight, or had a longer day length due to direction of slope. If this is the case, it could be the cause of the increased growth on the agricultural site. The farmers may have chosen that site to specifically receive the benefits of better sunlight even though erosion may have been a problem.

An additional issue concerning the plots is the baseline quality of the soil before any type of land usage occurred. Generally, farmers chose the best lands for their fields, the most fertile, the flattest, and best drained. The farmers also left the poorer quality lands for other purposes. This would mean that the agricultural fields would have higher baseline fertility than the woodlot site. If the growth rate is actually determined to be greater in the former agricultural land plot, we may not be able to determine if the increased fertility is from the agricultural processes or from the baseline fertility inherent in the soil. In the case of the Barton farm this may not be as big an issue as with some other areas in the Black Rock Forest. Several other heavily farmed areas in the forest are located in the low-lying areas surrounding streams, and in these locations the former agricultural fields would definitely have a higher baseline fertility that the surrounding areas that were not used for fields. The Barton farm however is located away from major streams and therefore this dichotomy between baseline fertility of agricultural and woodlot areas may not be as pronounced.

Finally, an issue that cannot be easily resolved is the fact that there is a lack of untouched forest to which the growth rates that will be obtained from the plots can be compared. Because the growth rates of the two plots show no statistical difference, only a trend, it can only be said that in this case there is no difference between woodlot land

and agricultural land. No conclusion can be drawn regarding the differences in growth rates between untouched and disturbed forests. Because of the extensive logging that occurred in the Black Rock Forest it would be very difficult to find a plot that is completely untouched, and if one could be found it is likely that it would be quite a distance from the other two plots and therefore not have similar physical properties.

Conclusions

There is a non-significant trend towards higher growth rates in the agricultural site, but there is a significantly higher density in the woodlot. It is possible that the length of time the agricultural land was used for farming was not sufficient to cause drastic decreases in soil fertility and thereby decreases in tree growth. It is also possible that because farmers generally chose higher quality lands, if the land was not intensely farmed, the higher nutrient levels in the soil may have been maintained. However, more likely it is the more recent management practices of the forest, the thinning, are the cause of the increased growth rate and the decreased density on the agricultural site. The trees on the agricultural site would have experienced less competition after thinning, allowing them to grow faster.

To clarify and continue this work, more detailed accounting for total biomass in the sites should be performed. This may indicate that there is more biomass stored in other sinks of the forest ecosystem, such as detritus. Other sites could be analyzed to see if similar patterns hold up, this would also increase the chances of finding a statistical difference. Additionally, the results of the soil samples should be reviewed to determine if the soil in the agricultural land has been depleted, but the effect is not detectable in the tree growth, or to determine if the sites equally recovered and the biomass difference are in fact from the clearing.   Finally, the tree density effects the calculation of total growth per plot because the growth rates from the agricultural site may seem higher when in fact the rate difference is due to the different number of trees per plot. The wood lot site may have a lower per tree growth rate while at the same time have a higher total growth rate. To account for the discrepancy between total numbers of trees on each plot the data should be normalized to the total number of trees. The relative growth rate, or kg new biomass per existing kg of biomass, should found to determine the growth without the impact of tree density.

Implications of research

There has been significant regrowth of forests of the eastern United States since the large scale abandonment of agricultural fields and the decline of logging. In fact, 9 million acres of forest regrew in New England alone from agricultural abandonment between 1850-1900(Foster 1995). Because nearly 90% of the terrestrial biomass of carbon is located in forests (Armentano and Ralston 1980) these growing forests could be a significant sink for CO_2 in the future (Hooker and Compton 2003). Understanding the rates of regeneration and growth, in relation to different sites within the forest, and how the total biomass changes over time may help determine how long these growing forests will be an active sink and assist prediction of the amount of carbon they will be able to absorb. At this time there is not a significant difference in the sink of CO_2 in woodlot versus agricultural land, however because of the thinning that occurred after agricultural abandonment it cannot be said if the one site could support a higher biomass.

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Appendices

Agricultural Land Data

Tree Diameter:

Tree Species	Sample ID	Diameter (cm)	dia (in)
Red Oak	AG-RO-1	42.60	16.77196
	AG-RO-2	25.45	10.01987
	AG-RO-3	30.35	11.94903
	AG-RO-4	37.40	14.72467
	AG-RO-5	39.50	15.55146
	AG-RO-6	24.90	9.803326
	AG-RO-7	36.80	14.48845
	AG-RO-8	34.50	13.58292
	AG-RO-9	48.70	19.17357
	AG-RO-10	41.45	16.31919
	mean	36.17	14.24
	standard dev	7.59	2.99
Red Maple	AG-RM-1	16.00	6.299326
	AG-RM-2	21.65	8.523775
	AG-RM-3	35.00	13.77978
	AG-RM-4	22.90	9.01591
	AG-RM-5	25.50	10.03955
	AG-RM-6	24.30	9.567101
	AG-RM-7	29.20	11.49627
	AG-RM-8	21.50	8.464719
	AG-RM-9	31.10	12.24431
	AG-RM-10	27.40	10.7876
	AG-RM-11	19.55	7.696989
	mean	24.92	9.81
	standard dev	5.48	2.16
White Oak	AG-WO-1	24.00	9.448989
	AG-WO-2	30.80	12.1262
	AG-WO-3	48.90	19.25232
	AG-WO-4	44.20	17.40189
	AG-WO-5	39.85	15.68926
	AG-WO-6	23.15	9.114337
	mean	35.15	13.84
	standard dev	10.77	4.24

Age and Annual Growth:

Red Oak Tree ID	Year of first column growth	Ring Size (m^{-7})									
AGRO1	1945	48920	38786	29845	23724	17069					
AGRO1	1950	32537	47854	38836	41478	30963	41935	31979	23343	31572	30023
AGRO1	1960	28473	24181	19609	19913	27204	23774	16256	13741	24994	31953
AGRO1	1970	25451	15646	23267	23749	42443	36119	46076	51562	31445	44678
AGRO1	1980	46533	22378	42240	24079	36932	27051	25425	33934	30785	30582
AGRO1	1990	31242	24790	34747	31496	23673	12446	20320	18288	18364	17907
AGRO1	2000	25172	26492	20269	10084						
AGRO2	1913	23368	21539	19431	15647	15291	6553	8306			
AGRO2	1920	5080	6172	5258	4089	3810	3454	4344	6909	11912	6579
AGRO2	1930	9245	11938	6731	6935	9245	13691	15697	14173	11633	16129
AGRO2	1940	17958	11354	23800	18186	17602	15748	6884	17018	15189	14935
AGRO2	1950	17729	15774	14122	16053	12548	21259	10389	9576	10922	8331
AGRO2	1960	14249	19304	18847	15723	13335	22606	22784	14605	5638	5690
AGRO2	1970	5918	9220	13793	15087	21768	17755	16941	22683	12598	19355
AGRO2	1980	20091	20828	29464	18695	22301	28067	20980	26238	26924	27686
AGRO2	1990	25832	31445	26340	31877	29490	29489	27584	30887	19812	15011
AGRO2	2000	16028	11582	17704	21285						
AGRO3	1916	20295	19660	16560	17399						
AGRO3	1920	23495	17704	13386	17424	15240	19508	18313	18999	10262	7442
AGRO3	1930	9703	6655	7188	10617	9931	10668	7824	5105	4699	5486
AGRO3	1940	11557	12243	12675	18745	17424	15088	16967	16282	19050	16840
AGRO3	1950	8864	16866	20015	17501	26848	20548	20193	18949	16129	24409
AGRO3	1960	15469	15671	14047	8534	8331	13335	12903	12751	15596	19050
AGRO3	1970	25501	18720	11456	11938	10236	13563	22860	32817	28372	20726
AGRO3	1980	22048	20904	11227	19913	20879	25578	24638	19558	21234	22276
AGRO3	1990	22098	29083	21438	27254	30581	31700	25958	29236	32309	31953
AGRO3	2000	27889	39624	46406	38430						
AGRO4	1919	35737									
AGRO4	1920	36576	23038	19203	18211	17704	11049	11659	10414	9677	9779
AGRO4	1930	16764	13691	15265	13538	8509	6198	12548	19608	21387	21666

AGRO4	1940	32487	20803	26822	24943	23215	29007	22251	12979	26314	25604
AGRO4	1950	26238	29946	21997	22657	25908	21640	28169	26264	23571	23139
AGRO4	1960	11557	17501	30607	21895	17449	29210	30760	34341	23317	10820
AGRO4	1970	17679	13106	27864	35255	33782	26746	29363	30302	42189	19482
AGRO4	1980	32639	30175	40462	27432	23902	23876	23647	29413	26924	25527
AGRO4	1990	36830	30049	36830	32131	24917	10338	10490	28956	20066	29185
AGRO4	2000	29692	18415	9144	17196						

AGRO5	1921	22885	22403	17323	13690	6757	8839	33477	14961	13792	
AGRO5	1930	12801	8459	10744	16967	11049	11913	15443	30200	26086	28905
AGRO5	1940	36297	39345	41376	35535	42824	36043	40691	33578	22302	30861
AGRO5	1950	33070	40767	46889	37592	43739	38684	26213	29591	24638	23596
AGRO5	1960	22530	13919	17221	25121	16256	13919	12446	24232	26213	17551
AGRO5	1970	13767	13208	14224	21209	27686	28778	23825	24689	22911	28981
AGRO5	1980	18187	25120	24156	30226	29921	24130	30429	35712	42622	47752
AGRO5	1990	44119	55144	42113	52019	46127	39903	17805	13996	38252	22403
AGRO5	2000	39599	41376	31039	27178						

AGRO6	1913	27686	25299	31775	19761	26238	23572	24384			
AGRO6	1920	18770	14758	6426	11303	8966	9296	6579	5283	4648	8408
AGRO6	1930	7950	11836	10618	10820	6782	4191	4800	9652	10897	12421
AGRO6	1940	12522	20574	22022	18770	20701	17374	20396	13233	8205	13665
AGRO6	1950	16307	13411	18593	12547	15850	12979	10211	15088	8585	5816
AGRO6	1960	5665	6070	10567	7442	13106	13538	13996	14427	16078	17145
AGRO6	1970	10668	17882	7544	11379	25882	26366	24561	22937	17449	18949
AGRO6	1980	8255	20294	20828	21133	17501	13970	17932	16688	14453	18542
AGRO6	1990	17957	24664	20040	24207	24790	24257	17755	18999	16916	18415
AGRO6	2000	15113	10008	24181	21996						

AGRO7	1918	11761	6781								
AGRO7	1920	11938	25832	14554	21743	15291	13284	14706	17806	15748	13360
AGRO7	1930	11430	13513	13386	10338	16052	19457	21361	16536	12192	12877
AGRO7	1940	16307	12472	17272	26619	31039	22682	27610	33451	34519	29515
AGRO7	1950	15214	25019	30150	31090	40259	23393	27559	30785	18567	28525
AGRO7	1960	21717	19405	11379	9094	14274	25756	14757	14707	15596	13004
AGRO7	1970	16739	12471	15215	10363	17171	21666	19380	25425	23267	25578
AGRO7	1980	24282	11455	17120	18212	19609	18923	13792	18974	16611	19076
AGRO7	1990	20497	14605	19660	23419	18008	18339	20473	15798	17755	14326
AGRO7	2000	23749	23317	16561	10693						

AGRO8	1920	32284	22301	18059	23165	17374	13411	9880	7976	12344	14326
AGRO8	1930	10795	10185	15164	16688	22606	16739	10083	10770	15519	26086
AGRO8	1940	21590	21717	30683	24943	27356	25425	32893	33630	28880	12624
AGRO8	1950	16840	23698	19431	20726	16714	16256	15722	13488	16408	14351
AGRO8	1960	15062	11354	9550	9627	16256	16789	14605	15977	23114	24714
AGRO8	1970	18110	9525	9957	9170	11023	22378	23088	23267	21818	19177
AGRO8	1980	22759	12674	20549	21996	21666	22098	18263	22936	19177	19838
AGRO8	1990	21336	22301	23927	21234	21768	21082	22606	16840	16840	16409
AGRO8	2000	18338	17806	16357	15469						

AGRO9	1899	45822									
AGRO9	1900	37922	16510	20955	13690	21133	25603	23953	26898	23038	27915
AGRO9	1910	29565	24791	29133	28296	31191	30099	23470	29591	30200	18695
AGRO9	1920	10719	9779	8763	7112	7543	7849	7061	7925	7188	6528
AGRO9	1930	5385	7061	6756	6935	11963	15773	20524	29845	21564	19431
AGRO9	1940	13513	10236	16205	21032	29337	41452	36272	42189	34265	22834
AGRO9	1950	28601	21590	16713	11125	9550	10186	13767	11938	13411	9982
AGRO9	1960	10490	15012	15621	10439	14275	12979	18618	38939	40259	35763
AGRO9	1970	35103	34010	42977	21336	32182	33909	33909	33325	35179	43586
AGRO9	1980	44628	42164	36322	35890	42748	48108	44323	20371	13538	16713
AGRO9	1990	29566	23901	25425	15190	21640	16536	19812	15087	19101	18263
AGRO9	2000	42494	16866	24231	34976						

AGRO10	1923	54991	29997	42266	23672	34189	18745	20066			
AGRO10	1930	28905	28880	25933	14021	12040	10287	12166	13335	12599	9296
AGRO10	1940	21362	23291	22251	17602	12929	17348	8636	6147	11353	9094
AGRO10	1950	9702	8763	7595	10973	12928	15012	12928	11380	8991	18872
AGRO10	1960	17323	19863	38481	24841	23927	27305	33655	44145	34849	15646
AGRO10	1970	22479	15850	27864	49784	47726	49327	38913	36906	43942	22327
AGRO10	1980	30937	39040	29743	30277	26619	45009	37516	34341	43002	55600
AGRO10	1990	47346	43866	40335	51994	54127	40031	34899	32436	41707	28295
AGRO10	2000	19685	35992	23571	12421						

Red Maple

Tree ID	year of first column growth	Ring Size (m^{-7})									
AGRM1	1886	14834	9829	9017	7747						
AGRM1	1890	19127	23114	18491	25222	21692	12217	8230	8712	9169	7747
AGRM1	1900	4572	14453	8687	7645	6960	5156	5639	5486	7137	11151
AGRM1	1910	8738	16027	13005	11404	5995	7798	13766	5436	7772	6985
AGRM1	1920	4420	3404	6451	9068	5105	7341	14300	15596	45390	16687
AGRM1	1930	23114	17272	11761	9652	6400	7849	3581	6503	3226	2082
AGRM1	1940	7468	9601	6884	3022	2616	8535	6502	6528	2667	6731
AGRM1	1950	2565	5614	8001	11633	13284	7163	2515	4953	6350	7620
AGRM1	1960	8585	3200	8027	12065	9423	12116	13335	16713	26746	15901
AGRM1	1970	22885	22022	7950	11354	18847	30607	24003	26517	30785	34925
AGRM1	1980	25908	22123	28575	29718	27763	30632	21539	31344	8331	11024
AGRM1	1990	8737	18237	15367	10084	10211	7341	7239	6578	6147	8179
AGRM1	2000	8636	8077	2591	9474						
AGRM2	1934	17272	14376	13996	12420	8255	10313				
AGRM2	1940	11328	11176	27991	18136	22199	20473	23368	23114	13436	18669
AGRM2	1950	15901	12573	21590	22352	21285	17069	15722	16256	15647	7467
AGRM2	1960	10567	10236	9068	17348	8001	16180	15290	7087	11354	9906
AGRM2	1970	13233	17044	19024	10846	16866	12725	25959	24993	15240	19101
AGRM2	1980	18796	15418	12167	7442	9957	13512	21159	12623	10618	14046
AGRM2	1990	12420	15621	17399	16434	19660	16434	19913	13691	12573	23393
AGRM2	2000	21260	16459	23597	10871						
AGRM3	1909	40919									
AGRM3	1910	34138	36449	38278	27635	31140	25299	23317	9322	14300	13233
AGRM3	1920	21590	43307	15621	19609	12852	17450	15824	29718	17984	22783
AGRM3	1930	9500	15367	20676	19024	16688	27483	12801	23394	20802	19939
AGRM3	1940	18796	32462	12928	15291	24206	21412	26620	13665	20294	22556
AGRM3	1950	17526	26797	9626	21463	16561	10211	28295	9779	32639	21997
AGRM3	1960	13436	35078	23876	14529	11480	15952	29235	20777	51080	32639
AGRM3	1970	42189	19609	32055	27381	21895	11506	10998	12344	16155	15011
AGRM3	1980	14072	35280	23699	14935	17018	15418	19481	16104	12954	12649
AGRM3	1990	20879	10338	12522	20269	13919	15494	11405	5359	10872	9017
AGRM3	2000	7772	9068	2819	1702						
AGRM4	1874	32156	21844	17856	15240	28118	13767				
AGRM4	1880	15951	11938	7087	13132	6451	5207	6960	5461	6147	9271
AGRM4	1890	6146	10694	5410	6756	7062	9017	8102	7773	8686	8433
AGRM4	1900	5360	11607	11481	20219	11125	8356	8103	9906	5258	10820

AGRM4	1910	9373	8102	11329	5232	7265	7696	5283	4877	4597	4318
AGRM4	1920	5334	4115	4445	2972	4572	4318	2895	4191	4725	5867
AGRM4	1930	4674	11354	7950	3988	3276	4496	6528	6807	7315	5461
AGRM4	1940	3963	3683	2616	6299	9398	9042	5665	3962	9322	8788
AGRM4	1950	5614	7975	6223	5741	5156	5969	2616	2515	5613	6909
AGRM4	1960	8483	8332	3860	7697	4673	5715	11049	8077	11253	19888
AGRM4	1970	15418	20777	24739	20473	13970	24892	18288	12954	11938	8280
AGRM4	1980	11252	9221	8966	4877	8686	12523	12649	22809	9881	9728
AGRM4	1990	10185	13716	12243	6553	5842	14173	3607	4572	3455	2870
AGRM4	2000	3530	3582	7290	6883						

AGRM5	1917	79019	28245	24968							
AGRM5	1920	25832	32944	20701	16637	11278	13309	17958	13005	8483	11303
AGRM5	1930	10922	2744	6807	19583	5614	26619	24511	3048	19050	20650
AGRM5	1940	22327	27559	33426	16840	18771	21031	14427	5969	5080	7036
AGRM5	1950	10439	10516	8331	8204	14910	13640	17831	15113	14071	31268
AGRM5	1960	26695	26492	12446	12345	12700	20447	5664	8407	7392	32715
AGRM5	1970	27229	28626	15519	19964	14275	35535	27432	9220	21793	15748
AGRM5	1980	10592	22708	23444	13563	12599	6578	7366	14580	7645	6528
AGRM5	1990	6655	7315	9754	8458	13284	12116	17399	26238	5461	8535
AGRM5	2000	7594	5893	5232	3150						

AGRM6	1928	22326	32131								
AGRM6	1930	23470	31826	20955	20295	23266	10033	12065	10440	14884	9093
AGRM6	1940	9500	15138	17831	19406	14325	15367	17120	15341	14758	12954
AGRM6	1950	13182	9551	13005	18770	24257	28499	22428	20473	37287	13970
AGRM6	1960	11963	19101	16231	13843	28397	27838	10084	17983	28728	19024
AGRM6	1970	15139	23952	10414	8712	11303	16840	18517	9550	13869	21767
AGRM6	1980	5893	2312	15900	18364	17679	10998	18821	12599	22758	8788
AGRM6	1990	4852	9677	11633	4344	7848	13640	5512	3835	3429	3785
AGRM6	2000	4801	5308	5537	2261						

AGRM7	1902	28956	22124	22631	23648	20472	10008	14732	14097		
AGRM7	1910	9144	16408	23825	330	13183	23139	18669	13412	12852	11633
AGRM7	1920	16536	10261	17450	21336	18263	31800	25324	8535	6604	5334
AGRM7	1930	19304	17500	18288	11252	2337	21946	13995	13488	20599	21996
AGRM7	1940	30912	33223	25578	23521	34569	13691	20751	21082	28855	34214
AGRM7	1950	16357	14148	40310	30835	22683	20116	25502	23343	17449	13259
AGRM7	1960	12268	14453	9652	12395	8027	26517	21666	12497	15316	9424
AGRM7	1970	24130	3175	6020	18897	17272	13437	11303	8483	7671	8509
AGRM7	1980	3861	11074	12726	13005	11836	5715	11430	6985	3835	4445
AGRM7	1990	2464	4496	5563	5740	11405	6680	5664	6807	4013	3683
AGRM7	2000	2464	6274	9119	6629						

AGRM8	1916	3759	11837	4470	15621						
AGRM8	1920	19838	11506	15926	12192	14020	11176	11811	11634	15671	15317
AGRM8	1930	13436	13132	12116	16637	18085	13766	15545	7747	6858	5207
AGRM8	1940	7011	5969	8737	18263	21310	15291	12395	9627	10668	9220
AGRM8	1950	7798	10592	16357	14021	20244	23546	22199	26848	23267	10007
AGRM8	1960	22352	32360	31470	23826	25831	22911	30201	30327	24232	22428
AGRM8	1970	21895	18593	23165	18618	16307	21691	14427	14631	14249	7138
AGRM8	1980	3784	4496	5512	4521	3785	5537	6909	4470	5893	4496
AGRM8	1990	6400	4115	3099	6858	3785	1778	3175	1524	2946	3912
AGRM8	2000	1625	2794	1270	1067						

AGRM9	1908	8941	10236								
AGRM9	1910	10135	13360	8153	8357	10414	9144	39776	26924	27712	30353
AGRM9	1920	27533	29820	23774	15621	6630	14275	15036	24562	26823	21590
AGRM9	1930	22961	20269	19000	19888	23977	22276	15291	12725	10592	10236
AGRM9	1940	10821	15875	25451	31496	26263	18314	16916	20168	16764	18237
AGRM9	1950	18135	17526	17857	16738	27991	27102	18212	23926	30658	25984
AGRM9	1960	35103	22759	23317	34290	38303	28702	35357	30683	29769	27686
AGRM9	1970	26187	25807	26797	17881	23648	16433	13132	10719	8814	6782
AGRM9	1980	9271	5384	4471	4013	5867	7773	9626	8357	10338	13106
AGRM9	1990	8027	7366	6807	5740	1372	4775	5690	1168	1295	3429
AGRM9	2000	2058	4724	1042	2311						

AGRM10	1911	55728	50876	40843	26848	28042	25755	51105	40691	30429	
AGRM10	1920	30963	27609	23267	35357	37693	30633	15011	17475	16942	15748
AGRM10	1930	20218	25654	21463	26848	19939	16688	14351	10973	15367	15570
AGRM10	1940	20549	37160	22682	9144	5715	8433	6985	10388	5411	7010
AGRM10	1950	12370	7696	6248	9754	13894	15646	15951	13640	14504	11049
AGRM10	1960	3302	2159	2413	3530	2362	3277	2896	4699	4673	10363
AGRM10	1970	8027	10617	5690	11379	18212	17754	14631	12877	14224	15012
AGRM10	1980	9195	8940	5893	12827	12802	6502	5233	8001	8737	9119
AGRM10	1990	11938	11227	12674	8712	7747	9805	4927	6147	9754	6629
AGRM10	2000	4090	4267	2692	3988						

AGRM11	1943	17526	12624	10541	6909	15545	10820	8281			
	1950	3098	4242	4623	12370	7925	9448	14656	24816	17374	19431
	1960	18110	11404	11964	16129	28321	32893	44551	54737	46457	44069
	1970	53035	41986	38126	21463	12344	16332	26137	21819	31978	6122
	1980	4699	15189	14960	17526	20752	8331	5690	7163	9322	9194
	1990	13208	9957	13640	17678	21565	5715	13030	18441	21615	37109
	2000	12065	14428	10464	14326						

White Oak Tree ID	Year of first column growth	Ring Size (m^{-7})									
AGWO1	1870	28271	16637	14579	8255	7544	7315	5918	8001	5487	8661
AGWO1	1880	8331	9906	8814	8052	5715	14630	13869	17373	17577	13132
AGWO1	1890	11227	10312	3709	7772	4267	4217	4673	2667	4166	5943
AGWO1	1900	7011	7671	5435	5791	6401	6833	6680	2870	5258	3353
AGWO1	1910	3454	3632	3887	3429	5308	7417	8763	12776	11837	13487
AGWO1	1920	16256	13538	15596	17373	21997	10312	12091	15316	15951	19837
AGWO1	1930	20320	17171	19380	14021	19151	13767	12903	13183	10338	9322
AGWO1	1940	9296	6121	8052	14224	9043	6654	7519	6934	8026	8738
AGWO1	1950	5817	6019	4242	8509	5893	8712	9474	7824	6654	7087
AGWO1	1960	4750	4826	4089	5461	7188	8890	6147	5537	5055	4801
AGWO1	1970	4165	4725	4140	7137	5233	8813	11938	12142	9271	14554
AGWO1	1980	12573	13360	5766	6045	7214	8433	12903	12751	9093	9753
AGWO1	1990	6554	9728	8229	14097	9703	8916	11353	7443	6883	8788
AGWO1	2000	5538	7264	7671	6934						
AGWO2	1922	19482	49174	52121	38963	38126	20167	22632	27914		
AGWO2	1930	18111	17907	16103	8382	14173	7900	5816	10897	12395	21565
AGWO2	1940	9957	13360	15189	9246	6604	8534	11125	7265	12547	12065
AGWO2	1950	10872	11658	10236	14936	13487	12268	18644	9169	14504	9829
AGWO2	1960	10186	10109	17221	19584	16510	13258	13361	21590	30378	22276
AGWO2	1970	16916	7798	23978	13614	24765	22708	22377	21920	24943	9068
AGWO2	1980	19253	22682	20981	36779	27686	20828	22809	19558	27407	25425
AGWO2	1990	32436	20041	21005	24384	17171	21285	22504	23114	22606	28220
AGWO2	2000	17373	15926	6376	22758						
AGWO3	1918	21946	29413								
AGWO3	1920	54635	23825	32893	22784	28829	29261	34976	35052	33960	23164
AGWO3	1930	19736	31877	36602	25704	30150	23089	24841	24943	26009	30988
AGWO3	1940	36678	23546	14757	24765	26619	26696	24790	36043	41148	30480
AGWO3	1950	26213	21767	23445	22352	22021	25883	18034	28423	28270	23596
AGWO3	1960	31242	22759	30200	22911	32741	38760	34239	32741	25121	20802
AGWO3	1970	21209	39878	40564	44933	48234	46584	51282	44501	37694	32918
AGWO3	1980	33122	29591	46380	16129	41301	30505	48997	55295	51842	29032
AGWO3	1990	43383	33122	37516	26568	41072	26517	33122	29210	29261	21615
AGWO3	2000	30937	17603	40309	29566						

AGWO4	1928	61823	54356								
AGWO4	1930	41834	45492	37973	28981	30302	33122	32359	33528	28575	21946
AGWO4	1940	24816	23520	27788	26873	35433	41732	43587	52578	46278	37643
AGWO4	1950	44044	34188	28372	32029	28220	26314	21031	15799	22657	16358
AGWO4	1960	18745	12827	14097	17043	20346	14884	11430	7849	11785	11024
AGWO4	1970	12141	12344	12548	11913	17119	12802	18669	13970	19202	17831
AGWO4	1980	19685	11100	14198	15469	16993	17195	18568	16891	15367	13563
AGWO4	1990	21387	14046	16028	15113	17069	15748	13360	12979	12370	13208
AGWO4	2000	16993	13817	14123	9347						

AGWO5	1938	71146	71171								
AGWO5	1940	53975	53213	62407	54153	38456	47701	24816	33883	45771	35611
AGWO5	1950	37135	46710	28804	31217	33375	24181	31852	38176	22987	33477
AGWO5	1960	26873	31166	22327	24765	32842	26695	16180	15316	20498	11887
AGWO5	1970	20346	16484	17272	25476	29134	35255	39269	41935	26365	32792
AGWO5	1980	28753	33883	11735	27686	20422	23698	31420	29895	23724	23470
AGWO5	1990	19634	21361	14453	20625	13614	17170	12142	12649	15037	17576
AGWO5	2000	12929	19025	11963	0						

AGWO6	1926	38049	47498	32462	22174						
AGWO6	1930	40538	60503	53543	49860	45136	37414	19838	25273	26746	28956
AGWO6	1940	33960	30607	34747	31166	28067	22631	22098	21082	24435	17932
AGWO6	1950	17196	21463	16358	16764	17348	14300	12065	10262	7417	10566
AGWO6	1960	6604	4902	6376	6858	7569	7493	7442	5842	6477	3200
AGWO6	1970	6808	4572	5892	6655	7239	8230	6553	6934	7290	6883
AGWO6	1980	5385	4699	5080	3861	5359	5360	6731	9855	6477	6071
AGWO6	1990	7239	8915	5156	10668	12548	11963	15113	8738	11811	14605
AGWO6	2000	7823	7747	10465	5791						

Tree density, basal area, and aboveground biomass:

Agricultural Plot		DBH	Basal area	Biomass			
1	BB	3.1	0.00486699	15.2228632	agricultural plot has a slightly low density of 500 trees per hectare.		
2	BB	2.59	0.00339732	9.43636595	agricultural plot shows red maple as most numerous, followed by black birch and red oaks		
3	RO	24.75	0.31023265	2715.16561	agricultural plot shows healthy biomass of 220 t/ha		
4	RM	4.58	0.01062351	50.1126499	agricultural plot biomass is dominated by red oak followed by black birch and red maple		
5	BB	4.22	0.00901907	34.5848367		% density	Biomass (kg)
6	RM	2.37	0.00284468	7.44484175	red maple	40	34243

7	WA	17.5	0.1551005	1295.58932	red oak	15	111733	
8	RM	4.61	0.01076314	50.9668935	black birch	35	37203	
9	BB	11.96	0.0724435	552.829232	hop hornbeam	5	4596	
10	HH	7.58	0.02909883	183.824182	white ash	5	32390	
11	RM	8.51	0.0366772	224.750359			220163	
12	RM	9.09	0.04184705	261.230058				
13	RM	7.87	0.03136798	187.69263				
14	RM	13.06	0.08638204	584.859317				
15	RO	6.75	0.02307516	146.612403				
16	BB	13.73	0.09547247	798.115332				
17	BB	4.04	0.00826608	30.7976573				
18	BB	4.74	0.01137873	47.1145751				
19	RM	1.75	0.001551	2.65608106				
20	RO	19.35	0.1896265	1607.52577				
	avg DBH	**8.6**	**28.4**	**Basal Area**	**Density**	**500**	**220163**	**Biomass (kg)**

Ground slope:

	slope (%)	aspect (deg)
	-17	115
	-20	133
	-8	111
	-14	105
average	-14.75	116
direction	ESE	

Wood Lot Data

Tree Diameter:

Tree Species	Sample ID	Diameter (cm)	dia (in)
Red Oak	N-RO-1	29.20	11.49627
	N-RO-2	28.45	11.20099
	N-RO-3	34.90	13.7404
	N-RO-4	33.10	13.03173
	N-RO-5	29.05	11.43721
	N-RO-6	26.90	10.59074
	N-RO-7	32.60	12.83488
	N-RO-8	28.90	11.37816
	N-RO-9	26.25	10.33483
	N-RO-10	26.15	10.29546
	mean	29.55	
	standard dev	3.02	
Red Maple	N-RM-1	24.30	9.567101
	N-RM-2	20.60	8.110382
	N-RM-3	23.70	9.330877
	N-RM-4	15.30	6.02373
	N-RM-5	18.60	7.322966
	N-RM-6	16.60	6.535551
	N-RM-7	16.70	6.574921
	N-RM-8	21.75	8.563146
	N-RM-9	26.35	10.3742
	N-RM-10	19.80	7.795416
	N-RM-11	22.85	8.996225
	mean	20.60	
	standard dev	3.56	
White Oak	N-WO-1	32.85	12.9333
	N-WO-2	27.60	10.86634
	N-WO-3	37.65	14.8231
	mean	32.70	
	standard dev	5.03	

Age and Annual Growth:

Red Oak Tree ID	Year of first column growth	Ring Size (m^{-7})									
NRO1	1916	54153	34366	32080	30404						
NRO1	1920	34036	36703	30048	24638	21209	17450	16358	11963	12090	7747
NRO1	1930	8332	9347	8941	16764	14351	11531	13564	9118	12091	13360
NRO1	1940	13157	10872	14224	19710	32944	23647	26137	26949	30480	26848
NRO1	1950	15316	21158	20651	18796	23672	20092	22606	21768	14020	19711
NRO1	1960	13970	16662	15291	11303	17374	20574	14452	11506	9221	13131
NRO1	1970	19101	13183	10084	9601	8839	13995	17577	21565	18618	18796
NRO1	1980	18745	17602	10795	15875	18415	14326	15342	13589	12420	13589
NRO1	1990	14224	13081	9246	12649	11709	12827	9246	9246	17119	9449
NRO1	2000	13843	16637	14427	17323						
NRO2	1926	33909	27839	23012	23825						
NRO2	1930	14605	12370	13665	12675	12293	22759	16230	16536	14351	10312
NRO2	1940	18872	16815	19355	12040	18135	21285	25553	25451	30556	25628
NRO2	1950	21768	13538	11811	16256	24816	23114	29159	16002	21311	19075
NRO2	1960	16764	19863	13843	13665	12446	8027	8839	12979	13539	15849
NRO2	1970	12040	19761	20396	14732	12878	7087	9017	11404	25984	28194
NRO2	1980	26188	23927	24815	16104	21895	17805	14351	11049	18949	20497
NRO2	1990	10491	9982	18262	10338	21057	9804	10084	10363	9703	14249
NRO2	2000	21489	10414	11608	21742						
NRO3	1914	52629	38404	39675	37516	32918	24689				
NRO3	1920	16993	17246	16358	9906	10211	14224	9347	9449	18135	13488
NRO3	1930	13081	13309	10008	14275	10084	14249	13411	19050	24562	22504
NRO3	1940	21514	20981	21082	25882	24232	16891	22504	21997	22174	25146
NRO3	1950	22301	25324	21488	20498	27229	23063	22657	17500	9576	13335
NRO3	1960	17323	16358	13055	10287	14250	18694	16332	13818	17119	11151
NRO3	1970	16281	22276	23698	22683	25679	28321	29616	12167	22327	21310
NRO3	1980	18110	18263	13335	15850	21107	14732	21209	17120	23596	19736
NRO3	1990	20726	23699	13411	14249	6325	13538	12903	10287	9754	16688
NRO3	2000	6578	6960	11938	12268						

NRO4	1911	34697	54483	33121	45924	41960	35891	36779	39827	48184	
NRO4	1920	39700	32131	20676	21767	17501	20701	14986	11709	13310	10338
NRO4	1930	9982	5334	7366	5055	5232	3912	4902	4165	3709	5181
NRO4	1940	5715	11176	9271	9652	11049	14250	18516	17526	11354	13843
NRO4	1950	16713	16714	24409	18263	24688	20346	16281	21768	17704	19761
NRO4	1960	13843	9779	10058	12624	12700	11557	10846	15113	19863	17043
NRO4	1970	13996	16306	11786	17374	21488	29693	25857	31470	25197	28575
NRO4	1980	15037	23292	20599	21031	24740	18999	21793	23978	18415	27229
NRO4	1990	21056	28372	17374	6451	29160	31826	23342	22556	20116	22429
NRO4	2000	29286	22326	20955	23216						

NRO5	1920	57302	48463	29490	23088	20930	13437	13741	8585	7188	10795
NRO5	1930	8281	9728	7976	8458	10033	8712	8941	8712	11125	15418
NRO5	1940	18415	13106	13412	16281	11430	10185	11126	18567	11328	21057
NRO5	1950	18313	16333	11455	9144	17094	11303	10440	8686	6274	6020
NRO5	1960	12878	10007	7316	8356	18415	19076	12014	10185	7874	5563
NRO5	1970	8407	18669	22200	23165	29641	22149	27432	43409	35331	39319
NRO5	1980	39929	27585	30607	34620	21996	29896	27000	33325	33249	40259
NRO5	1990	33477	14656	12268	30302	28245	28067	15265	18466	20625	13944
NRO5	2000	12345	22149	16002	17297						

NRO6	1922	81331	63703	44653	31775	33097	25349	26162	21666		
NRO6	1930	14351	13487	11913	14275	9449	15316	11481	9499	5842	5461
NRO6	1940	8255	19711	9118	14681	24943	25476	24918	13055	8179	10592
NRO6	1950	13716	15570	20473	13893	18009	17602	10262	19228	17373	15672
NRO6	1960	12141	7925	7442	12548	10795	11227	10388	12700	21387	11379
NRO6	1970	4674	4851	6147	5867	15037	14910	21692	22301	24308	25958
NRO6	1980	14402	21285	23292	18187	20345	11913	18110	17704	13893	16917
NRO6	1990	19786	23699	26771	22403	23825	18263	14071	13869	15849	18517
NRO6	2000	24892	11227	8864	20422						

NRO7	1903	57378	30480	22860	16637	28321	41301	17373			
NRO7	1910	17780	16307	26035	26238	32766	44704	42367	39878	43333	35890
NRO7	1920	40361	37592	29108	22403	17627	18847	23724	16027	12243	15138
NRO7	1930	11278	11811	16078	13208	13615	9017	10058	10236	9373	9245
NRO7	1940	8662	7137	10668	10109	14732	15698	17526	16256	12471	8509
NRO7	1950	15240	20650	17704	21006	17526	20675	21997	15316	21869	15748
NRO7	1960	20676	15443	11278	10109	13183	12852	16078	13132	17704	16942
NRO7	1970	13639	8763	6427	6400	7316	8534	8407	9602	9067	8078
NRO7	1980	7569	6832	12243	11430	11303	11024	7874	12344	13234	9906
NRO7	1990	14833	13996	20320	19989	16231	14707	18973	18136	17551	16053
NRO7	2000	21489	23825	18694	18085						

NRO8	1915	26137	36474	45771	32817	24841					
NRO8	1920	22936	24613	26492	24384	15824	10719	8027	8636	8813	4979
NRO8	1930	4292	5030	6121	5232	7163	6934	4166	3429	3607	2895
NRO8	1940	2159	3048	2794	3074	8661	7087	11582	11964	10769	6757
NRO8	1950	9931	14326	8737	16028	13817	18415	16332	9983	18491	12141
NRO8	1960	19761	16383	16459	21108	27686	20955	16434	14757	19456	21082
NRO8	1970	18187	13335	21793	14935	32385	34900	30581	27509	31038	29490
NRO8	1980	29616	13589	25857	22124	18643	24562	17145	19152	15113	11963
NRO8	1990	19965	13258	24461	19304	17754	22276	20498	18745	18745	16713
NRO8	2000	23343	24765	14834	13233						

NRO9	1915	66421	29514	28423	28092	33909					
NRO9	1920	26416	25223	19507	19786	17628	19431	17755	15773	16434	13157
NRO9	1930	14681	13005	11506	11303	14681	14224	16282	16434	18313	12471
NRO9	1940	14275	17196	19558	21387	21107	21641	22708	20066	12750	18923
NRO9	1950	18492	19329	25171	17933	20828	18440	16205	20092	16992	17679
NRO9	1960	13030	7214	8331	11989	9601	9880	9805	11100	14173	13284
NRO9	1970	9881	10261	6452	11277	12192	15825	16789	15443	13030	17450
NRO9	1980	7112	16078	14529	14275	14554	14427	15037	13742	14300	23292
NRO9	1990	21386	23876	22632	20701	20777	18161	18339	15875	14656	15290
NRO9	2000	8840	14478	11887	14046						

NRO10	1920	48336	39015	40208	16738	26493	32943	23597	26187	21184	23038
NRO10	1930	21920	19837	25223	25577	26061	24308	27000	36906	38202	26492
NRO10	1940	19659	25019	23724	11582	10237	22453	16434	15138	16104	6325
NRO10	1950	6248	5893	5562	6376	7036	6858	9372	9932	5994	8661
NRO10	1960	6630	9550	9754	7569	12141	9373	9017	10769	10821	8839
NRO10	1970	9906	9601	10719	14757	13843	11405	14199	9880	10998	11659
NRO10	1980	8052	14478	5918	5334	4953	6020	7010	6579	6578	6477
NRO10	1990	7112	7519	8052	9017	8534	12294	5257	7036	10694	16611
NRO10	2000	8458	5563	8179	13538						

Red Maple

Tree ID	Year of first column growth	Ring Size (m^{-7})									
NRM1	1919	7569									
NRM1	1920	6909	21742	23216	18770	17374	11608	18973	21387	15291	17247
NRM1	1930	12827	16992	17704	17069	21006	26111	27940	11963	15520	13233
NRM1	1940	8661	13437	15875	16637	20244	26746	18974	25324	27686	18415
NRM1	1950	21463	21971	21285	26873	11786	11557	18999	24968	22784	11811
NRM1	1960	11658	27915	21946	23952	17754	16815	18720	15367	11100	13894
NRM1	1970	12725	33325	26187	28550	34823	16129	13411	14174	21132	8840
NRM1	1980	10795	11709	19964	15571	12471	6375	10313	8026	5868	9779
NRM1	1990	9194	8484	3912	5715	3606	6020	5512	9246	6324	3455
NRM1	2000	5486	4724	5284	5105						
NRM2	1914	14198	5538	12801	9195	7899	7874				
NRM2	1920	1956	3023	4673	8586	6527	9957	11710	6908	9500	10439
NRM2	1930	11049	21768	20092	15113	12395	10236	6731	6579	3657	6680
NRM2	1940	22733	17095	14960	9576	9576	7544	10769	20523	9449	8890
NRM2	1950	3175	6503	8382	6807	14986	16662	9627	14579	9703	4902
NRM2	1960	2236	3556	4165	5664	10465	2947	18237	12903	10846	9677
NRM2	1970	10262	19913	22733	16510	12446	22073	18237	16155	19278	15951
NRM2	1980	7239	10084	9373	14427	12370	5740	3632	9830	10313	5080
NRM2	1990	8915	9931	11176	15596	24130	7849	7950	13563	7163	2388
NRM2	2000	1295	5309	10820	6782						
NRM3	1933	23673	7340	10059	26517	20498	16789	9983			
NRM3	1940	15087	14097	10719	12522	18085	26568	33020	17780	25604	16865
NRM3	1950	11278	7544	11607	15469	18339	41529	15646	10592	21285	36398
NRM3	1960	41428	32563	13817	19736	14630	11481	24460	19457	21895	19735
NRM3	1970	15139	27610	17703	6427	9956	17806	33274	23800	22860	53797
NRM3	1980	47955	57582	27965	17094	27204	51333	33452	21590	13945	11277
NRM3	1990	15977	14173	4953	3759	7798	2819	3023	1499	2616	5461
NRM3	2000	5766	4699	3175	5105						
NRM4	1922	12242	14326	9957	7061	4394	4090	2260	1600		
NRM4	1930	9500	8001	3226	2565	8408	10160	10464	8967	7137	1499
NRM4	1940	1320	4090	7975	2972	2159	2566	5664	13030	19355	18415
NRM4	1950	5994	7163	9449	7264	7442	5995	4115	5054	5283	7036
NRM4	1960	3810	5283	9068	16993	19126	24282	14682	21437	33096	20346
NRM4	1970	18593	33756	31014	41935	29972	16434	15189	17882	5664	6578
NRM4	1980	7595	9576	21691	25223	23317	15951	24587	17780	16561	11887
NRM4	1990	8052	15443	8458	9119	7544	7010	6249	1397	4292	3582

NRM4	2000	3479	4725	2743	5588						
NRM5	1938	16408	16129								
NRM5	1940	15164	10693	8712	5563	3353	1422	991	1244	1575	2007
NRM5	1950	2768	3480	3175	1702	3175	2210	1143	2819	1880	3302
NRM5	1960	2311	2566	1447	3734	6452	3175	7239	5283	6706	12674
NRM5	1970	3023	12090	12522	8001	7671	9830	7518	6833	7671	15087
NRM5	1980	29185	24181	22352	24079	27762	32258	26416	46457	14529	15494
NRM5	1990	21717	9017	33477	26390	18339	15799	31775	14732	14936	16230
NRM5	2000	12167	10820	11481	8509						
NRM6	1929	58115									
NRM6	1930	28524	19304	14503	14631	14503	13742	17068	19431	24080	18237
NRM6	1940	14021	12090	10744	12624	8280	14377	21564	19990	19965	20142
NRM6	1950	15697	12598	11811	11989	7798	8103	2743	4165	5766	10313
NRM6	1960	3759	13284	8788	17349	18516	9728	8738	2997	6960	4902
NRM6	1970	2489	4750	7620	12751	8204	9754	11099	9805	1143	1854
NRM6	1980	6502	13488	16078	14986	9754	6019	4598	6375	5868	4140
NRM6	1990	6223	5410	1194	2591	1320	1474	7594	2108	2515	3175
NRM6	2000	2489	1346	1753	889						
NRM7	1890	24664	25171	23266	10313	7518	11506	11684	14326	9042	10008
NRM7	1900	7061	6807	7392	10719	7340	6630	9906	4495	18111	6400
NRM7	1910	8255	16587	8102	16739	13157	19939	14072	13589	22910	19381
NRM7	1920	3429	9956	10973	10135	9474	11608	9728	7645	11481	11151
NRM7	1930	3734	3403	4140	7341	9296	5766	6807	11659	11735	12141
NRM7	1940	11887	10643	13157	8382	10998	18745	12624	19406	20320	15748
NRM7	1950	18567	17882	29007	17449	14199	13360	10770	11963	7443	8356
NRM7	1960	13716	13665	5995	11862	9525	8712	7518	8281	15595	5487
NRM7	1970	7137	10008	11633	23825	13818	18542	15519	22123	21438	14580
NRM7	1980	20142	13843	11252	12700	9144	6274	6172	4775	7519	5308
NRM7	1990	3861	9347	7290	5029	2820	4114	5055	10058	5944	10770
NRM7	2000	6502	2743	6376	9296						
NRM8	1931		14097	16738	15774	19100	24105	22276	11201	14300	10033
NRM8	1940	8459	10210	5995	8814	11531	13869	11303	17627	11075	9271
NRM8	1950	19405	12802	12827	19964	13107	11607	17704	20904	22378	20548
NRM8	1960	20168	20447	18161	12878	15316	9982	10414	9297	13487	23190
NRM8	1970	24791	13792	12065	10998	27661	22733	12649	27025	25451	24994
NRM8	1980	21056	9424	27229	18186	11405	8940	10186	7137	3048	5334
NRM8	1990	10465	4674	26339	24867	11430	8560	8331	18009	11557	6883
NRM8	2000	8382	6579	3962	5715						

NRM9	1875	17678	11455	17577	20422	19151					
NRM9	1880	18847	16307	12192	11100	7086	6300	6527	7976	10287	9195
NRM9	1890	9398	17678	17348	11710	6629	6299	11761	14909	12370	15520
NRM9	1900	19075	15342	21437	10846	12294	13335	19177	11049	13665	5461
NRM9	1910	3226	6756	13741	16815	13411	6274	17679	18846	14809	8839
NRM9	1920	7594	17145	17526	20625	17780	20219	12725	6731	6782	14478
NRM9	1930	21590	18389	14732	14402	12472	11404	11532	6985	11125	12624
NRM9	1940	15697	17653	19634	24308	20625	19558	16383	18669	21641	17297
NRM9	1950	13716	23749	30429	35611	41478	29185	36398	33909	18567	20473
NRM9	1960	18135	24003	29693	33045	45593	28372	12776	11151	15316	22936
NRM9	1970	19685	14072	22911	26136	24918	21412	25857	19812	18263	14046
NRM9	1980	13589	19812	8331	12903	18339	21590	14148	12522	12192	9754
NRM9	1990	10363	9144	7874	9246	8280	8484	4597	5918	3074	3327
NRM9	2000	4572	10211	8712	6223						

NRM10	1865	10185	13183	10007	16409	14122					
NRM10	1870	10058	13285	10363	8864	9297	5105	2413	5614	4572	8407
NRM10	1880	10084	10515	7468	7925	3759	4496	5410	4826	9906	10262
NRM10	1890	8712	15113	9296	12141	9017	17628	9449	12674	12523	18821
NRM10	1900	19685	15469	7620	10693	16688	18364	40157	19584	12116	17145
NRM10	1910	15849	27153	32436	16687	16536	11023	8967	18567	24486	22834
NRM10	1920	12751	14859	9931	13996	15291	15697	12751	18821	11633	13792
NRM10	1930	10364	6324	6223	4953	5588	11252	8205	11938	10134	9474
NRM10	1940	5004	6045	5131	7925	9017	8585	10592	13208	11455	10440
NRM10	1950	9728	6553	8865	5385	5842	7747	5562	4572	2972	3912
NRM10	1960	5384	5055	4242	5689	5639	8738	9474	6985	9576	12065
NRM10	1970	9804	11379	10821	19786	23673	15393	7543	8230	9703	15976
NRM10	1980	18644	8433	7823	9804	6376	8128	6324	7316	13614	10439
NRM10	1990	9373	8814	20117	17729	9042	9881	10947	9881	11785	10618
NRM10	2000	15824	14605	16383	7950						

NRM11	1922	47956	34721	20676	28067	21996	15698	14630	12395		
NRM11	1930	12624	10414	9042	20803	16053	20167	16104	19609	13716	14122
NRM11	1940	18695	19304	15341	22327	13208	9855	15773	18314	15595	18263
NRM11	1950	13030	16307	13360	8840	12700	9169	9906	6756	9449	11735
NRM11	1960	18110	10338	10846	10287	18440	16510	9500	1422	18466	17145
NRM11	1970	11786	15367	21005	17857	9067	12980	18643	25477	9855	7950
NRM11	1980	14427	25654	18161	13843	8535	3530	3607	4343	8941	7163
NRM11	1990	12294	10083	10567	9271	11633	6452	13512	8941	5131	9550
NRM11	2000	8941	6274	15037	9220						

Tree ID	**Year of first column growth**	**Ring Size (m^{-7})**									
NWO1	1895	11379	11405	11912	14961	11709					
NWO1	1900	7544	8509	13335	8839	9602	14732	10718	11024	9855	9627
NWO1	1910	7798	5638	9246	17958	20396	18593	17272	19685	19380	18567
NWO1	1920	22378	22682	19126	13513	16180	16688	20193	20497	19965	19939
NWO1	1930	17602	20422	20142	14071	13691	15011	13488	12065	14579	11710
NWO1	1940	17348	21641	15722	12675	12141	11125	9348	10795	15113	12293
NWO1	1950	11075	17424	17729	16586	18238	13868	11735	11887	10516	12674
NWO1	1960	12776	12523	11150	10567	11633	10236	9296	5919	6197	6858
NWO1	1970	6223	9119	7086	7951	9474	9499	9170	9296	8560	10668
NWO1	1980	11328	10160	8992	7747	7214	7543	9729	10414	10210	8306
NWO1	1990	7773	7670	7366	9475	7467	7823	5665	5384	4750	6045
NWO1	2000	6173	8382	8966	7696						
NWO2	1915	13208	6756	16612	14757	12040					
NWO2	1920	13538	10338	14402	10541	30124	24409	18263	14224	18491	21844
NWO2	1930	17247	24714	22733	24054	18034	25070	31369	21082	27000	26543
NWO2	1940	24054	27228	27661	26467	28956	29057	26543	15647	16662	20828
NWO2	1950	20346	18110	19278	15926	18390	12547	12675	13259	10363	15646
NWO2	1960	7697	10871	14859	18415	11481	7620	9093	7086	13920	16052
NWO2	1970	16409	30937	22784	22149	22123	19075	18136	12217	14605	14174
NWO2	1980	4292	11430	9093	9881	21082	15748	13284	12345	11938	21869
NWO2	1990	18745	21971	13107	14147	20600	11658	14859	15698	15163	15266
NWO2	2000	5004	14732	19558	12852						
NWO3	1915	54178	30455	37109	23368	30887					
NWO3	1920	24409	28854	20270	21615	25425	20397	22047	23850	34316	35331
NWO3	1930	27305	31826	31420	30048	21438	38862	38989	8179	21361	20473
NWO3	1940	32689	33833	38811	24918	31978	31496	37313	36271	19990	25857
NWO3	1950	24029	19939	21717	18364	21234	22251	15748	23850	20473	28092
NWO3	1960	14656	10388	14097	14377	13182	14402	16993	10719	16433	8840
NWO3	1970	9220	19990	16306	28626	29947	17221	22250	25426	19837	16358
NWO3	1980	5359	19279	12751	19405	17374	18669	10896	10211	9652	14199
NWO3	1990	8229	18212	10008	9474	8560	10795	10109	13132	12827	13817
NWO3	2000	13437	14757	14631	10363						

Tree density, basal area, and aboveground biomass:

TREE #	SPECIES	DBH	Basal area	biomass		% density	Biomass	
1	RM	8.16	0.03372232	204.068985	red maple	54	42895	
2	RM	6.91	0.02418205	138.392724	red oak	23	57513	
3	CO	19.62	0.19495532	2361.24474	black birch	4	21578	
4	RM	2.08	0.00219111	4.8132475	chestnut oak	12	114769	
5	RM	10.35	0.05425225	349.968027	pignut hickory	8	4610	
6	RO	10.3	0.05372934	399.057557		100	241366	
7	RM	2.08	0.00219111	4.8132475	woodlot has a typical forest density of 650 trees per hectare.			
8	RO	3.24	0.00531652	19.7761469	woodlot shows red maple as most numerous, followed by red and chestnut oaks			
9	RM	10.36	0.05435714	350.724276	woodlot shows healthy biomass of 241 t/ha			
10	PH	3.64	0.00671027	27.758014	woodlot biomass is dominated by chestnut oak followed by red oak and red maple			
11	RM	2.37	0.00284468	7.44484175				
12	PH	7.02	0.02495809	156.659239				
13	CO	16.22	0.13324128	1405.10863				
14	CO	13.34	0.09012572	824.423273				
15	RO	7.19	0.02618152	171.122252				
16	RM	3.48	0.00613332	23.8778545				
17	RM	6.39	0.02067944	114.838501				
18	RO	11.42	0.06604946	504.613913				
19	RM	4.64	0.01090368	51.8285043				
20	RO	13.42	0.09120993	724.020706				
21	RM	6.23	0.01965682	108.036354				
22	RO	11.19	0.06341577	481.923066				
23	BB	14.14	0.10125953	863.107959				
24	RM	6.35	0.02042135	113.118318				
25	RM	6.04	0.01847613	100.230983				
26	RM	7.02	0.02495809	143.658986				
	avg DBH	**8.2**	**28.8**	**Basal Area**	**Density**	**650**	**241366**	**Biomass (kg)**

Ground Slope:

	Slope (%)	Aspect (deg)
	-7	306
	-6	325
	-5	333
Average	-6	321.3333
Direction	nw	