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ENV 200-02
Biomass Lab Report

ABSTRACT

This lab report aims to make connections between Coopers Woods as a carbon sink linked to its own land use history based primarily on agriculture. Ever since the 1700s, numerous projects have been created to maintain reforestation and recovery towards improved soil productivity and carbon-storing abilities. Anthropological influence, and specifically recent urbanisation has resulted in an offset in carbon emissions and maintaining these new forests requires data from individual land use histories. A better understanding of conservation efforts that cater to specific histories will provide insight towards carbon sequestration and climate change issues regarding carbon storage. Students collected data from three separate plots in Coopers Woods, the oldest forest succession, conifer, and young, measuring radius, dbh, how many trees within each plot, etc.; using this data, we found average biomass per hectare, per forest type, and average basal area for the three plots. Total carbon stored in Coopers Woods (907353.6418) was calculated from the sum of these averages; several other data sets were used to make these calculations. As hypothesized, the oldest forest succession trumped the conifer and young successions in the three averages mentioned previously.

INTRODUCTION

Due to Cooper's Woods, and a large extent of New England forests, originally serving as agricultural resources, their land use history and modern urbanization has had a significant impact on future forest successions. Once markets were established in the 1700s, economies were farming based and depended on small-scale commercial activity which in turn required greater amounts of transportation and created a demand in agricultural products (Whitlock, et al, 2018). Consequently, forests were cleared for farming and other similar industries; the land was transformed into pasture for cattle or became timber, fuelwood, etc. Following the boom of the agricultural industries in New England, and more extensively in Europe, rural farming areas were abandoned for opportunities in the more urban parts of the country, allowing for forest regrowth. The deceleration and lowered intensity of human impact on the health of the ecosystem allowed areas to become carbon sinks and offer greater long term benefits. This land history can pertain to several subcategories, of which are farm development, logging history, post-agricultural vegetation development, and the pattern and rate of land abandonment. Whitlock et al. argues that "over the past 250 years there have been few periods of stability in which even the extent of forest vs. open land was relatively constant" with great variability between "population density, the agricultural, forestry and industrial practices, and the geographical pattern of land use" (Whitlock, et al, 2018). Throughout time, each use of the land, whether it was for timber, pasture, or housing, prompted vegetational changes and influenced its potential productivity or abandonment for greener pastures, so to speak.

Establishing forests as carbon sinks has proven to be a driving force in lowering global emissions, as significant forest loss through deforestation has been linked to net emissions, and the greenhouse gas effect and its anthropogenic causes (Woodall, 2015). Forest recovery/ afforestation began after a long period of land disturbance, with rapid recovery moving towards carbon sequestration and decarbonized economies. However the balance between current emissions and the ability of ecosystems to "regrow and adapt to higher levels of CO_2 and N deposition" must be taken into account regarding the productivity of our carbon sinks; carbon emissions continue to rise alongside reforestation projects (Felzer, et al, 2023). The timing and intensity of past disturbances affect individual forests' nutrient levels and growth rates, respectively, and projects must be based on this history. Moreover, previous agricultural land may be high in nutrients but demonstrates an inability to regrow at a rate that can nullify current net emissions.

METHODS

Site description

Data from this lab was collected from Coopers Woods, 27 acres of forest provided by HWS Trustees Edward and Robin Cooper as a teaching and learning resource, and recreational area for our college community and general public. It's located next to the arts campus, spanning from Jay Street to the Glenwood Cemetery, and contains a multitude of biodiversity, serving as a significant carbon sink with recent projects re-establishing the forest. Students explored the area's three successions: the oldest site has become the most forested of the three over the years, the second succession was originally farmed and has been reclaimed with planted trees, and the youngest successive site has been allowed to regrow the most of the three. Since 1938, Cooper's Woods has been recovering and growing (thanks in large part to the Colleges) from its agricultural origins; environmental factors such as invasive species and the like have influenced the area, but ultimately, regrowth and productivity have been on the rise.

Measurement Collection

In groups of three, students were given the following materials: five orange flags to mark the plots, a measuring tape to calculate distances from the center flag, creating the circular plot, and a smaller measuring tape to calculate the diameter of the trees. Groups first collected data from a plot within the first area of Cooper's Woods, the youngest trees and latest succession. Far apart, groups would "chuck" a single flag, as instructed by Professor Brubaker, in the general area of their preferred plot; this flag would serve as a center, from which four other flags would be placed 7.9 meters away from (using the longer tape measure), creating a circular plot roughly 200 square meters; plots with 10-20 trees were preferred to plots with less than 10. Within the plot, each (live) tree with a diameter greater than 10cm was recorded by wrapping the second taping measure around the trunk at chest height, with the tape pulled over the “0” on the end and the hook wedged between the tree bark; along with DBH (diameter, rest, height), Professor Brubaker would also identify the tree species for each group. These steps were repeated once within each succession of Cooper’s Woods, generating three separate plots. On the datasheet, students should have for each plot the plot number, habitat type, tree number and corresponding name/description and DBH.

RESULTS

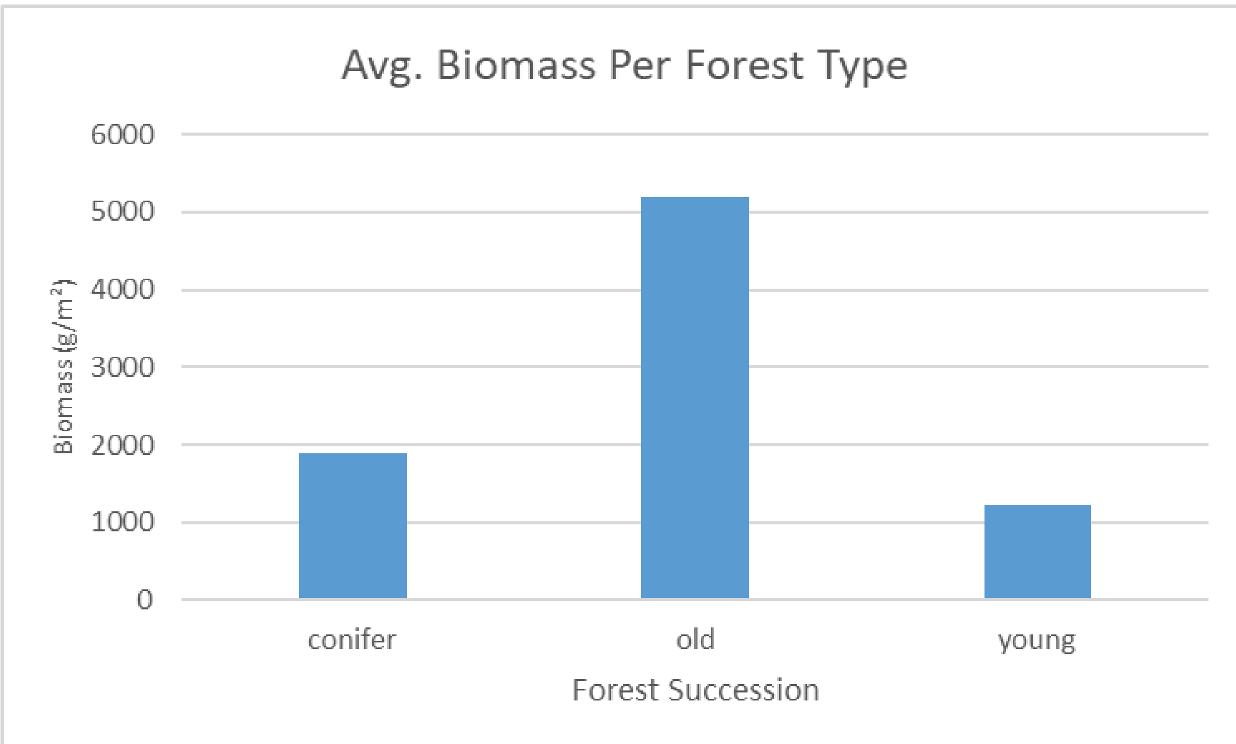

Figure 1: Average Biomass per forest type of Conifer, old, and young forest successions within Coopers Woods

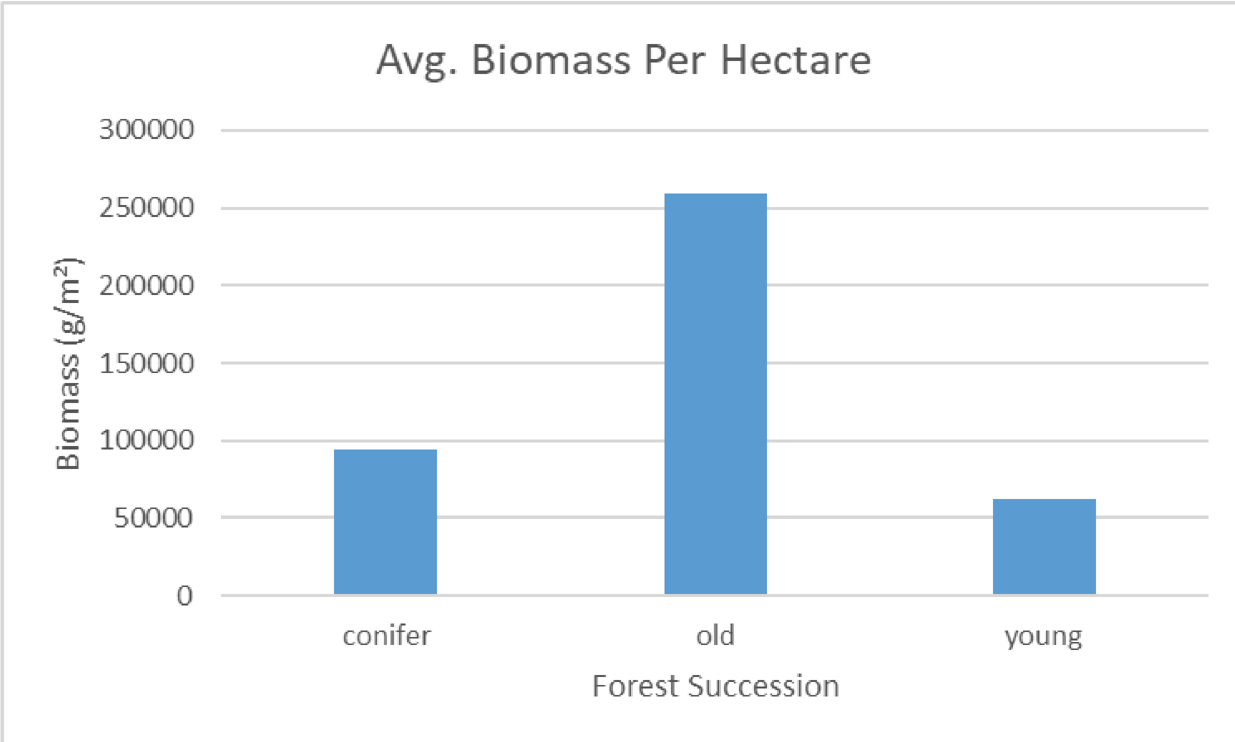

Figure 2: Average biomass per hectare of Conifer, old, and young forest successions within Coopers Woods

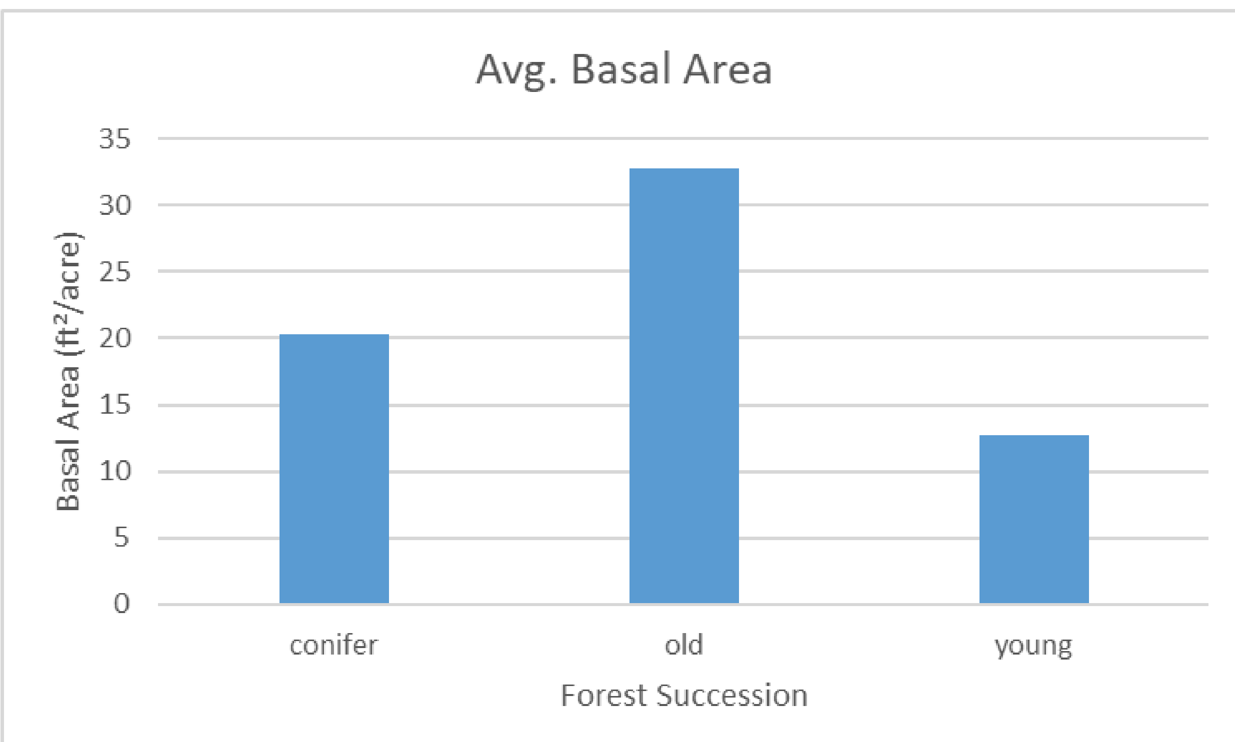

Figure 3: Average Basal Area of Conifer, old, and young forest successions within Coopers Woods.

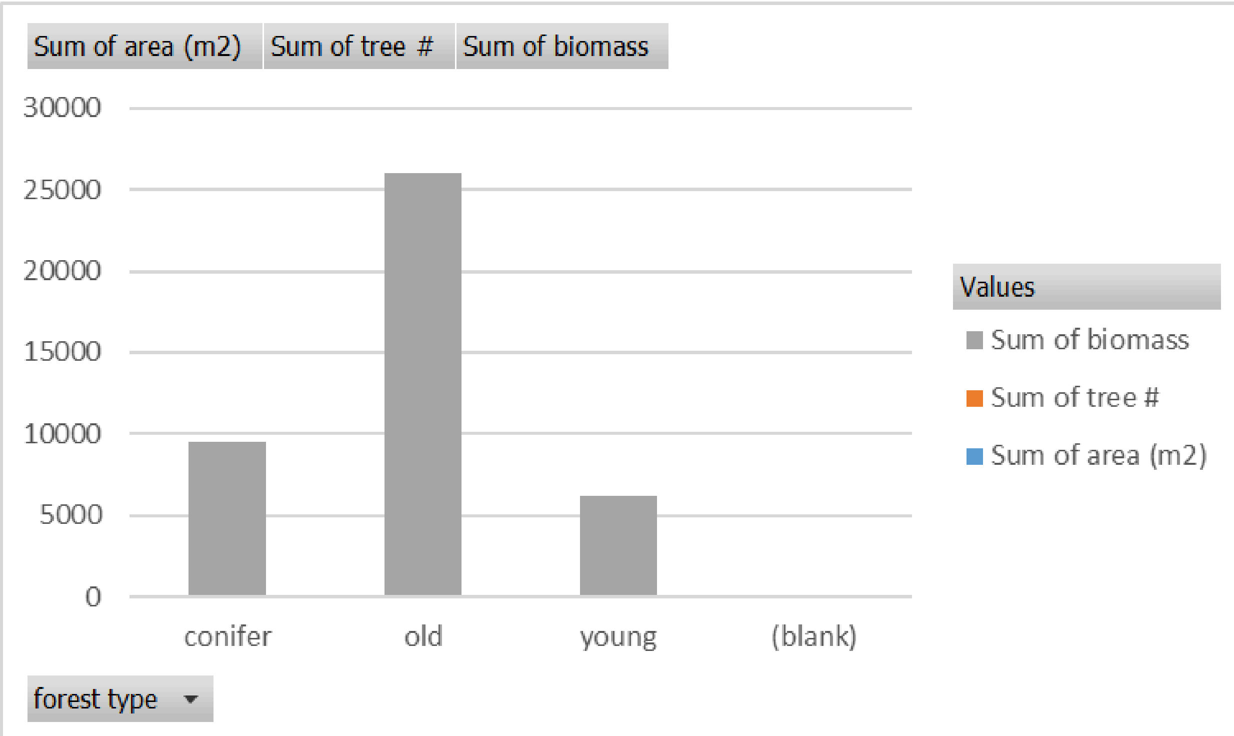

Figure 4

Among the three forest successions, the oldest succession exhibits the greatest carbon storing abilities as it contains more than double the amount of biomass compared to its young and conifer counterparts. In Figure 2, the oldest succession contains 260,000 g/m² of biomass per hectare, whereas the youngest succession contains only 100,000 and conifer contains about 60,000. As stated previously, the oldest forest succession in Coopers Woods has been given the largest period of regrowth and faced the least amount of disturbance in its land use history. Similarly, in Figure 1, the oldest succession contains 6,000 g/m² of biomass per forest type, with conifer at 1,900 and young at 1,100. The same pattern continues in the average basal area measurements of the three successions, with the oldest at a basal area of about 33 ft²/acre, and conifer at 20 and young at about 13.

Based on these calculations, total carbon stored in Coopers Woods is 907353.6418; average biomass per hectare for each forest succession was converted to acres, multiplied by each successions number of hectares, and the sum of these amounts was divided to produce the estimated total carbon amount for the entire forest.

DISCUSSION

Originally, it was hypothesized that the oldest succession of Coopers Woods would contain the most amount of biomass, and in turn, the greatest carbon storing abilities. As the oldest forest succession, it has the longest history of recovery after a period of agricultural use and anthropogenic influences. This dynamic between future growth and forest successions, and forests serving as carbon sinks links forests to climate change solutions and reversing our increasing carbon emissions (Thompson, et al, 2011). Possible sources of error in the fieldwork may include an insufficient number of recorded plots, insufficient number of trees within each plot, and a lack of archival land use history specific to Coopers Woods. However, collected data and additional information on tree species' Bo and Bi allowed for required calculations and estimated carbon within the lab location.

SOURCES

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