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# Five Year Carbon Storage Analysis in the Gordon Natural Area

Joy Fritschle

*West Chester University*, jfritschle@wcupa.edu

Chad Hudson

*West Chester University*

Catherine Spahr

*West Chester University*

Andy Tamez

*West Chester University*

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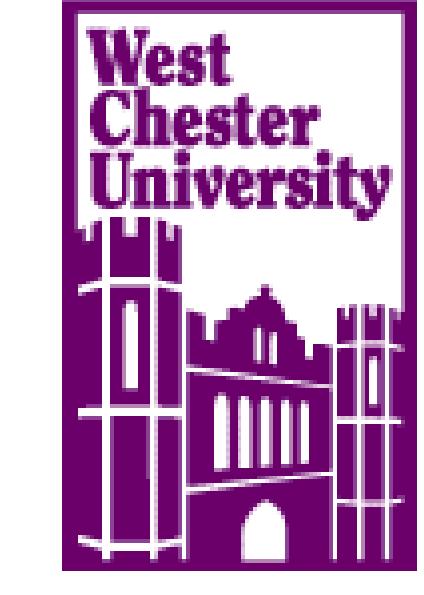
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# Five Year Carbon Storage Analysis in the Gordon Natural Area

Joy Fritschle, Chad Hudson, Catherine Spahr, and Andy Tamez  
Department of Geography & Planning, West Chester University



## ABSTRACT

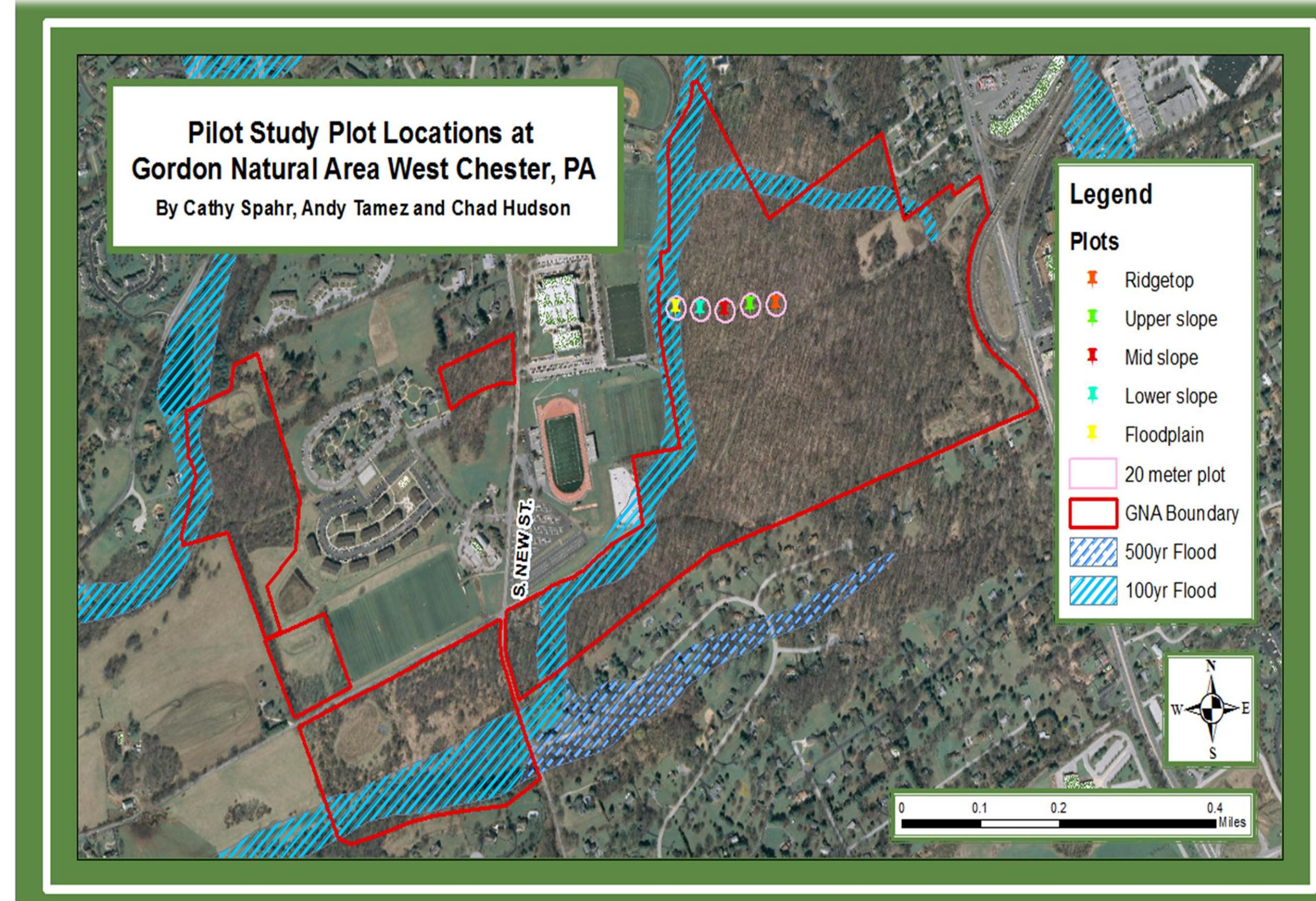
The Gordon Natural Area (GNA) serves as a natural laboratory for a range of class research projects. In a Geography Field Methods course led by Dr. Fritschle, students established five permanent carbon-study plots in 2008. Since then, students have returned to these plots to measure the carbon stock of standing trees in five plots located along a topographic gradient: floodplain, ridge-top, lower mid-slope, mid-slope and upper mid-slope. Using U.S. Forest Service established guidelines, all trees greater than 5 cm and up to 73 cm in diameter at breast height (DBH) were measured and identified within each 40 m circular plot. To ensure the same trees were measured each year, distance and azimuth from plot center were also collected. The woody species composition, forest structure, and carbon stock were compared between plots and across years using non-metric multidimensional scaling.

While Tulip poplar (*Liriodendron tulipifera*) and American beech (*Fagus grandifolia*) remained the most single dominant overstory and understory species (respectively) through time, the analysis did suggest the forest is likely changing. Specifically, carbon stock appears to be declining; however no significant difference was established for data from one year to the next. This is further suggested by the paucity of understory trees compared to the overstory. Previous studies by students have found that these five plots are not statistically different from the rest of the "Big Woods" area in the GNA.

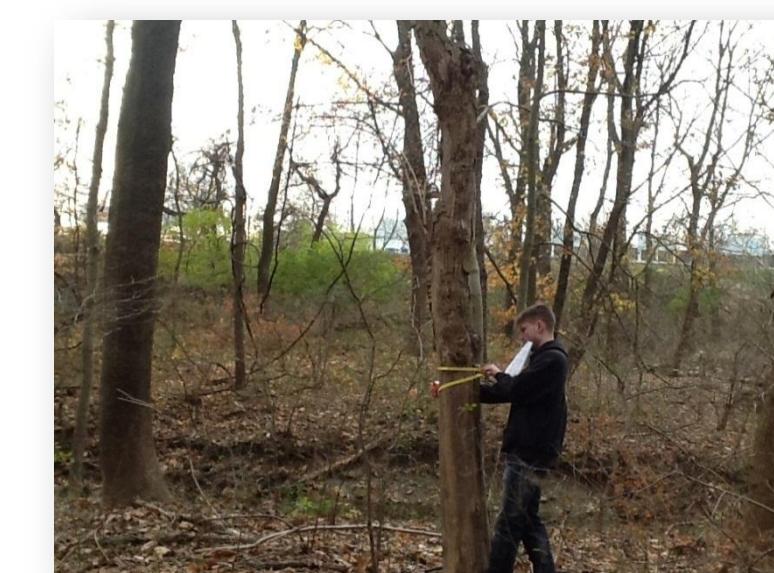
More study is needed as these permanent plots do point to a potential decline in standing tree carbon stock in the GNA over the last five years. Given the importance of forests in mitigating the negative effects of climate change, this finding is especially of concern.

## Research Objectives

- Determine the carbon stock of trees  $\geq 5\text{cm}$  diameter at breast height (DBH) in 5 plots surveyed annually from 2008-2012.
- Identify any significant changes in tree community composition, structure, and carbon storage.



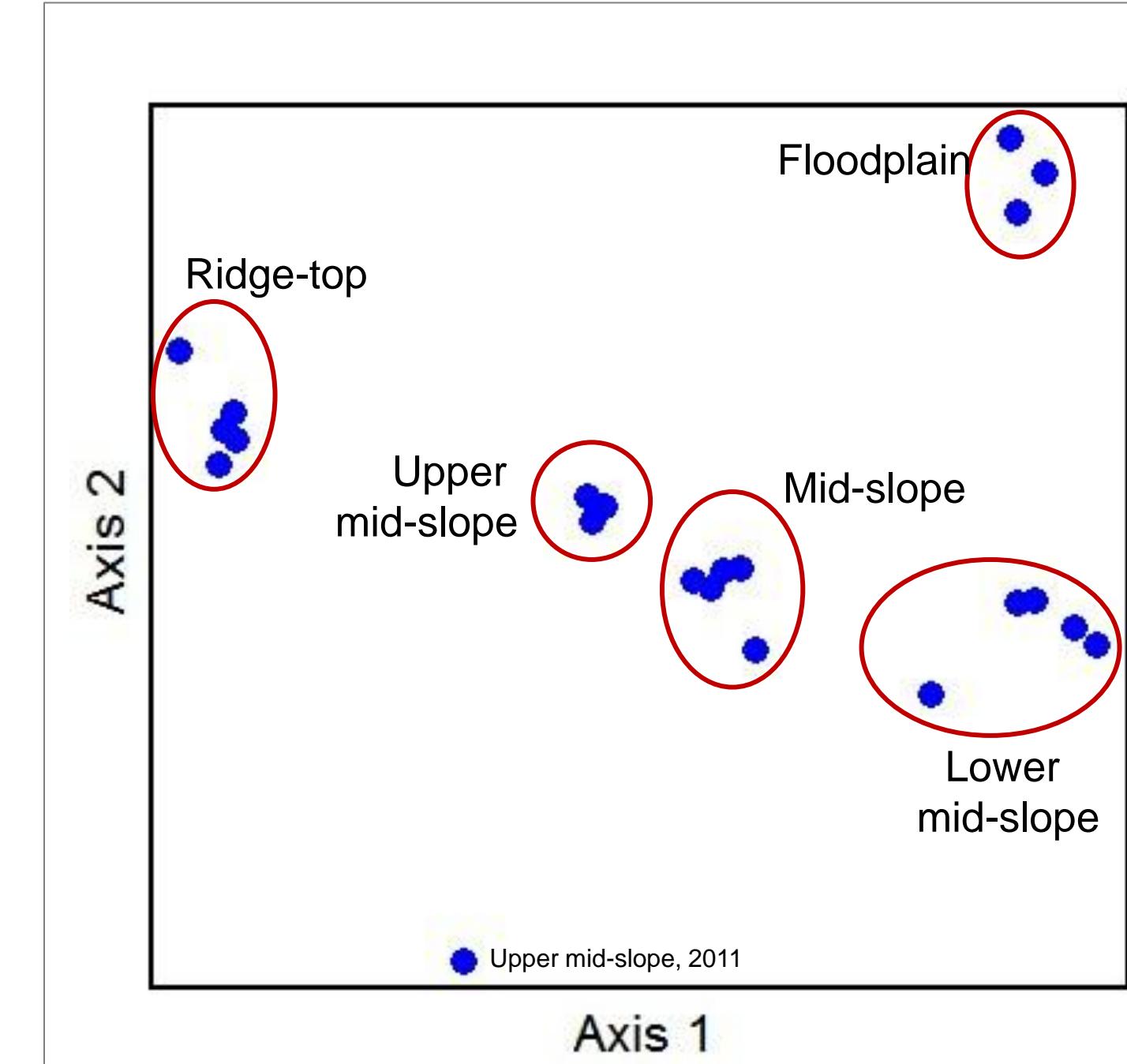
Geography & Planning  
students measuring the  
diameter-at-breast-height  
(DBH) of trees 5-73 cm in size.



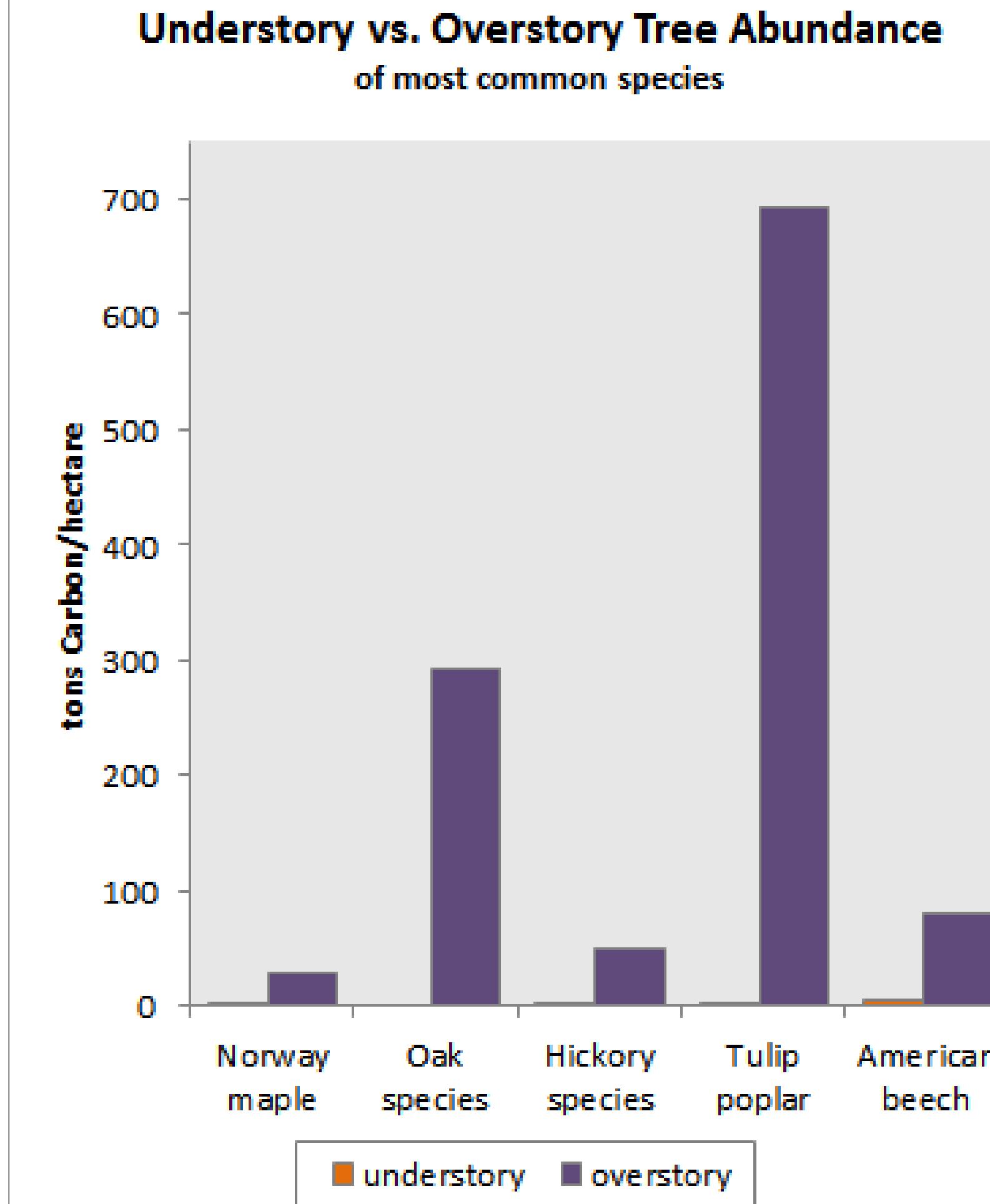
## Methods

- Five carbon plots established along a topographic gradient from a ridge top down to a floodplain.
- Calculated:
  - ✓ Carbon stock
    - aboveground and belowground biomass (after Pearson et al. 2007).
  - ✓ Abundance of understory ( $<10\text{cm}$ ) and overstory ( $\geq 10\text{cm}$ ) of species within each plot
    - relative density, relative frequency, relative coverage, important values (Kent and Coker 1992).
  - ✓ Non-metric multidimensional scaling (NMS) to ascertain differences between plot locations and years (PC-ORD 6.0)

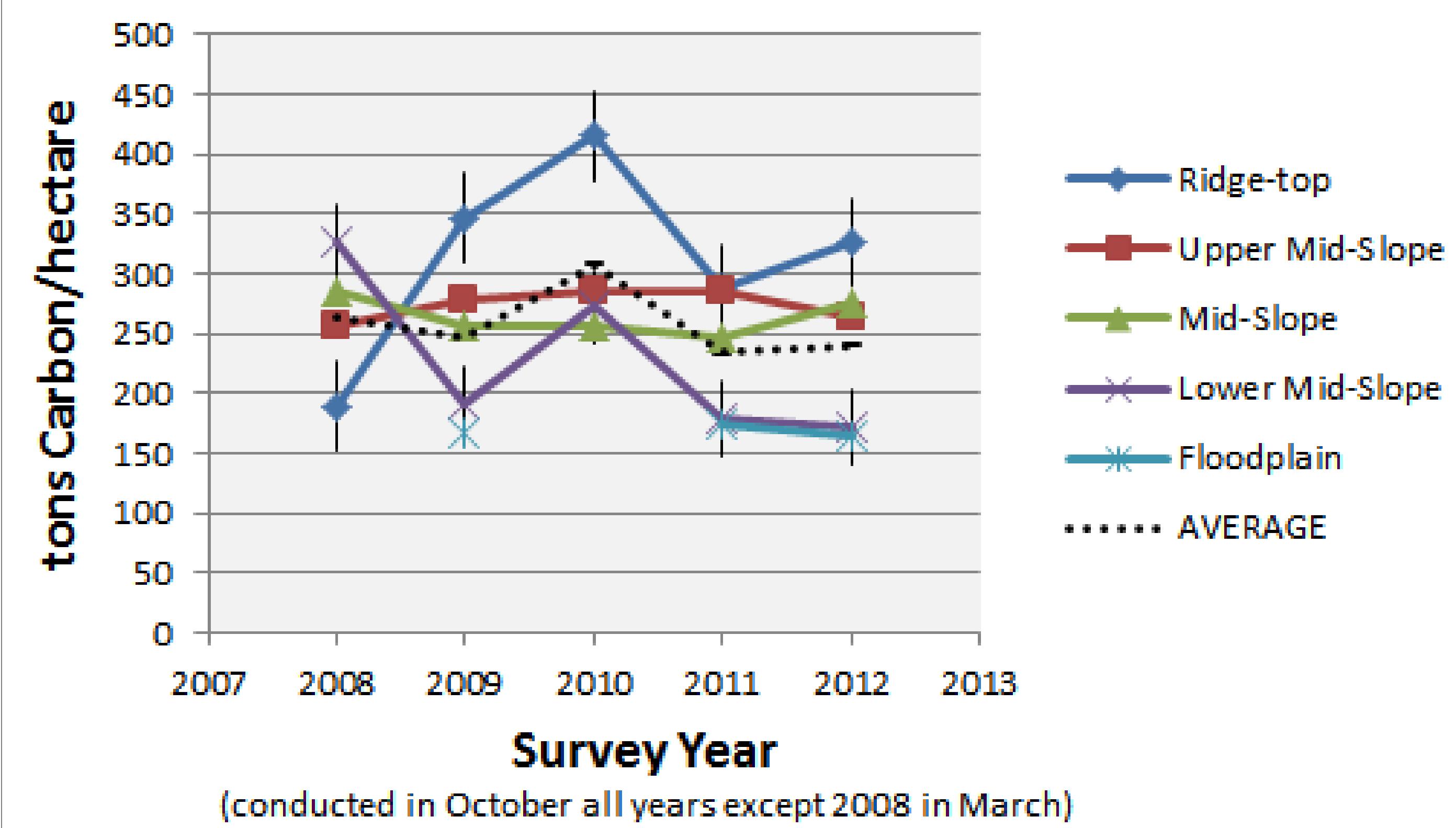
## Results



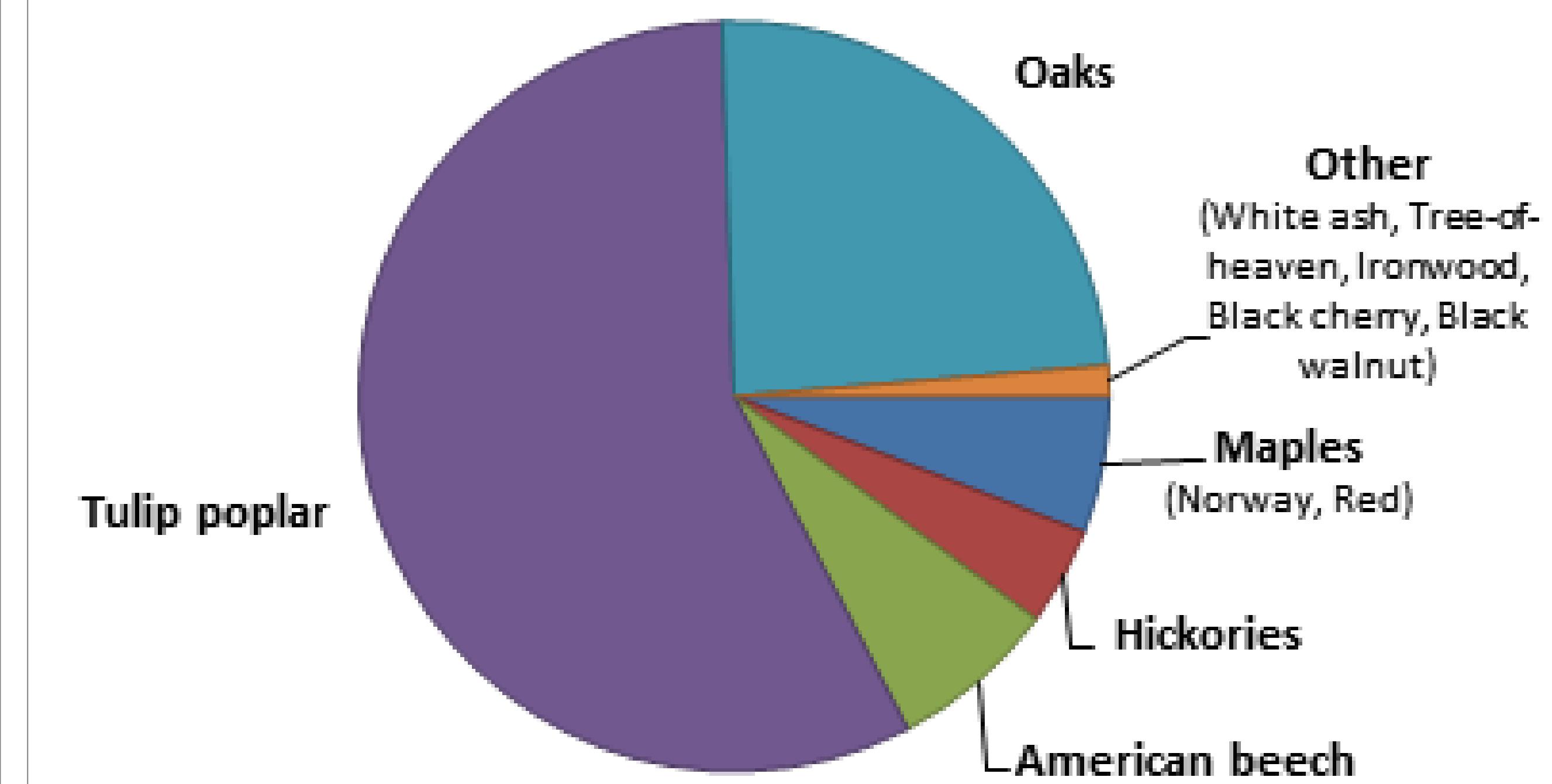
Statistical analysis (NMS) reveals that each year's total carbon stock groups according to plot location, and that plots are not demonstrating much variation through time.



## GNA 5-yr Carbon Stock (with Standard Error bars)



## Carbon Stock by Species (2012)



## Conclusions and Future Directions

- Carbon stock varies more according to topographic position than year-to-year, though trend-lines suggest changes through time are likely occurring.
- The total carbon stock of the invasive Norway maple decreased from years 1 to 5, suggesting a decreased presence in the forest through time. However the invasive Tree-of-heaven was absent from the plots until the most recent survey year, suggesting it may become more of a presence in the Big Woods area through time.
- More research is needed to determine if observed changes in carbon stock through time will become statistically significant. This research should continue with yearly surveys of carbon storage, species composition, and forest structure of trees to better assess the Gordon Natural Area's Big Woods.