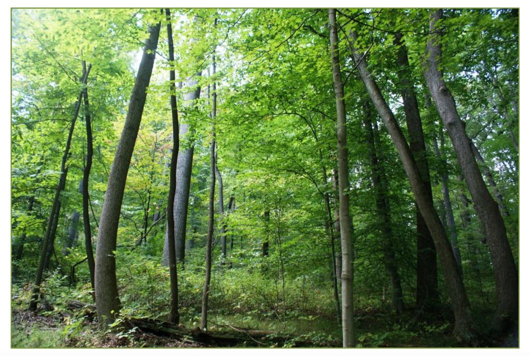

Dynamics of a 2-hectare temperate forest plot over a five-year period

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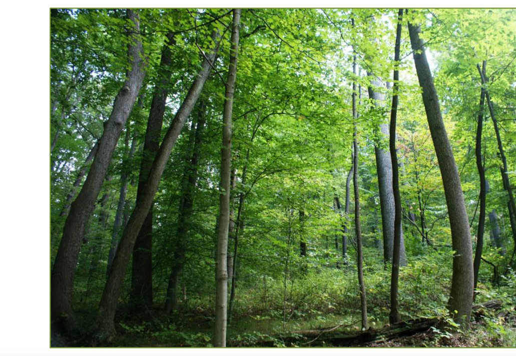

Abstract

Temperate forest dynamics occur at very long time scales and thus require long-term studies to detect changes in spatial patterns and species composition. Five years after its initial survey, 1,984 trees in a 2ha plot in Bishop's Backbone, Gambier, OH were remeasured, along with 40 new individuals. Of the 28 species present in the plot, the most abundant and dynamic remains *Acer saccharum* (sugar maple), with both the most deaths and the most new recruits. A large portion of its population consists of small, young individuals. The most dominant species was *Quercus alba* (white oak), but its population consisted almost exclusively of relatively few, large individuals. Small individuals had the highest mortality rate, likely due to shading or self-thinning that naturally occurs among groups of small individuals. Regular surveys, such as this one, are crucial in studies monitoring long-term processes, giving more insight into the factors affecting changes in species composition along the way. Our observation of dominance by older oaks combined with abundant maples is characteristic of the widely observed "oak-maple transition" that is occurring in many upland eastern deciduous forests. The transition possibly results in part from fire repression, but shifting species ranges due to climate change could further complicate that transition, since conditions in the region are predicted to become climatically unfavorable to *Acer saccharum* over the coming century.

Introduction

- Temperate forest dynamics occur at very long time scales and thus require long term studies to detect changes in spatial patterns and species composition.
- There is growing concern of an oak-maple transition in Eastern forests, since fire repression has favored maple seedling establishment over that of oaks. Additionally, large deer populations graze on oak seedlings, reducing their chance of survival (1).
- The purpose of this project was to resurvey the 2-hectare Bishop's Backbone forest plot, which was initially surveyed in 2006-7, using a streamlined geographic information system (GIS)-based approach developed in the spring.

Methods

Study site: 200m x 100m (2-hectare) plot in the Brown Family Environmental Center's Bishops Backbone area, initially surveyed in 2006-7

GIS-based protocol: Streamlined data entry process using GIS map in ArcPad (handheld GIS software)

Figure 1. Map of Bishop's Backbone forest plot.

Survey: Remeasured 1699 trees to determine growth and recorded species, location and diameter at breast height (DBH) of 40 new individuals with DBH>1cm

Updated Plot Map: Mapped location of old, dead, and new trees

Analysis: Calculated basal area, abundance, importance value (IV), mortality and establishment rates of the most dominant and abundant species, and mortality rate by size class.

Acknowledgments

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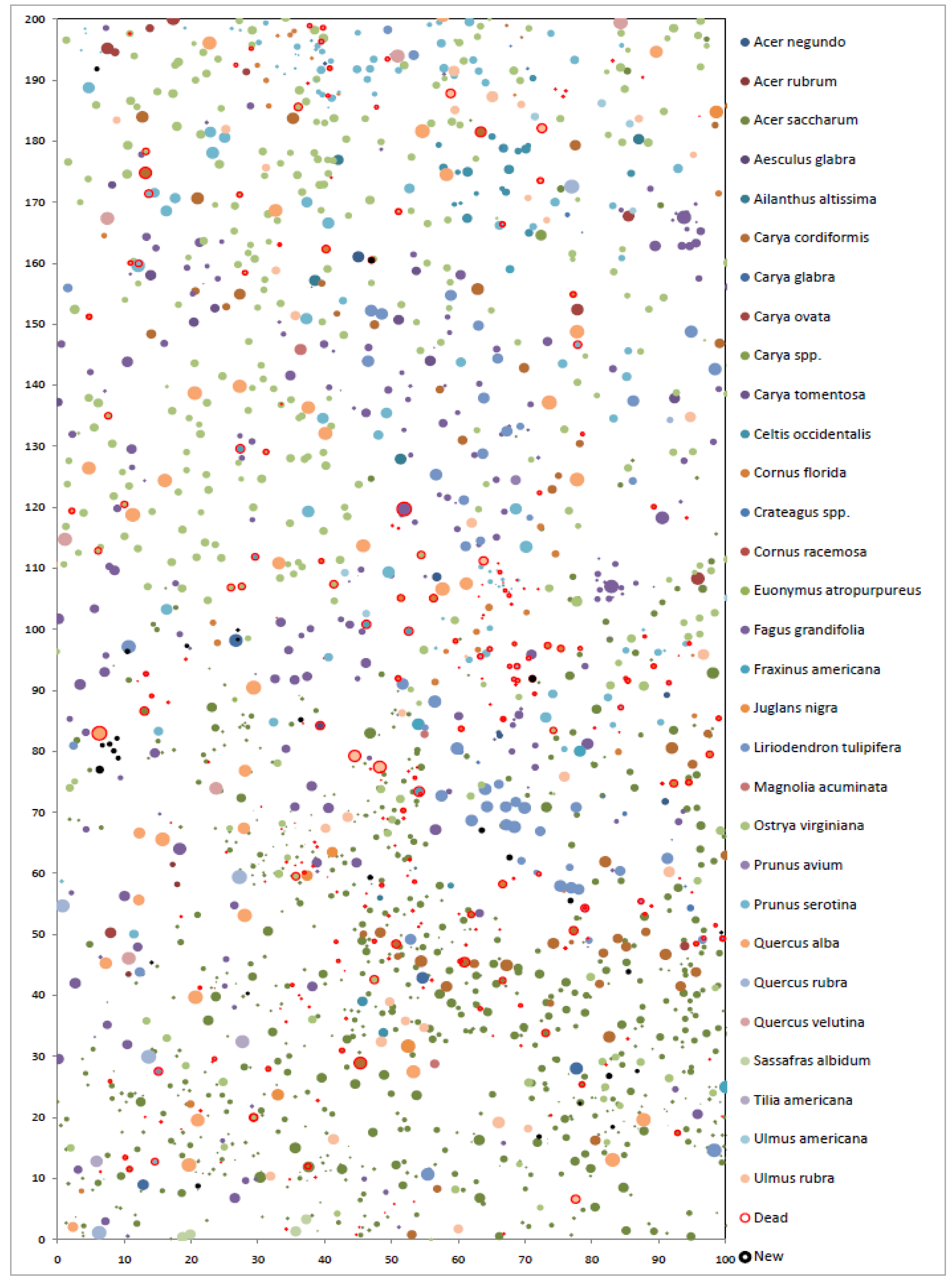

Figure 2. (above) Map of the Bishop's Backbone forest plot (200m x 100m). Bubble size is proportional to logDBH.

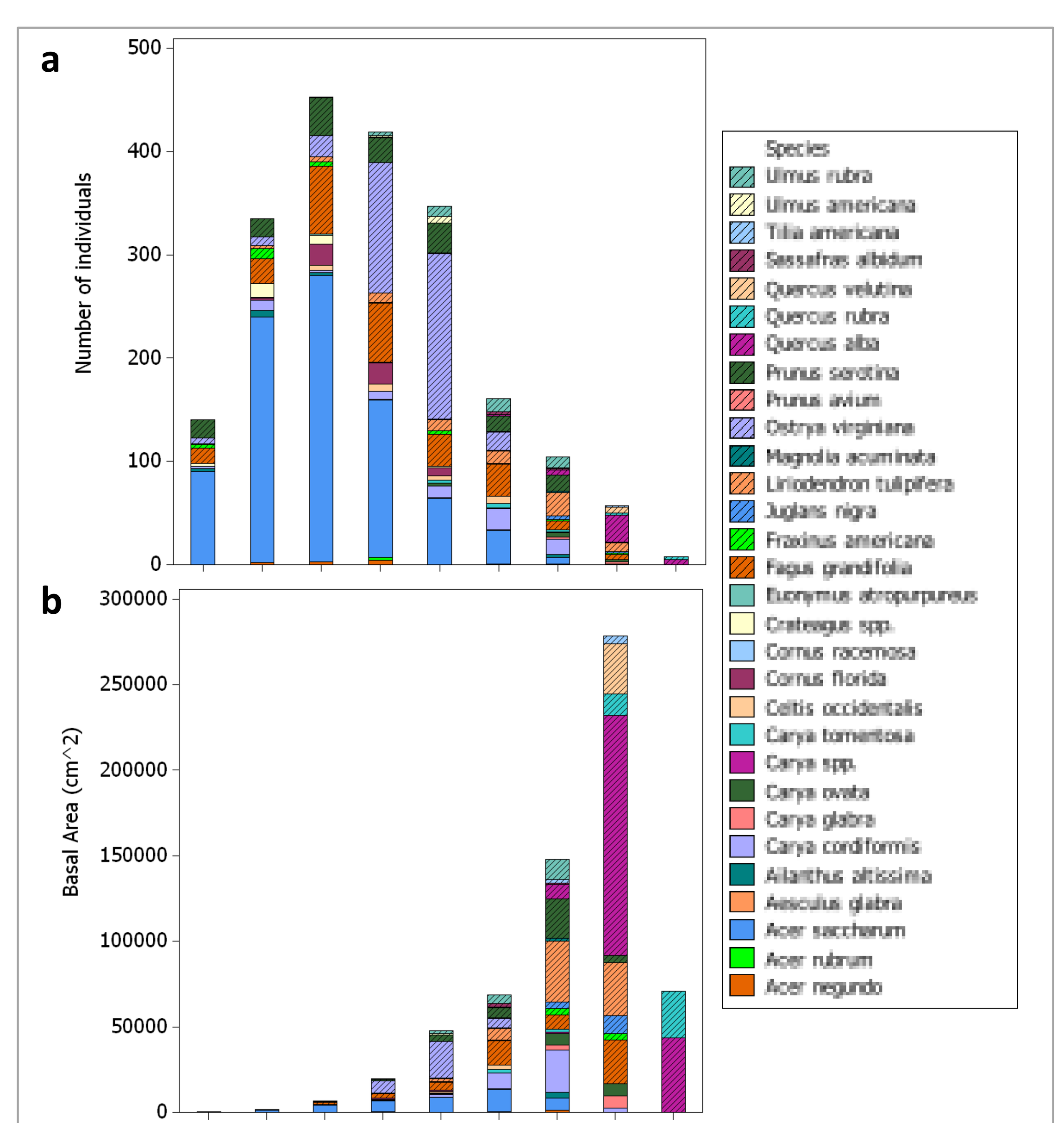

Figure 3. (left) Number of individuals **(a)** and total basal area **(b)** of size classes by species. Note high abundance of *A. saccharum* in **(a)** and high dominance of *Quercus* spp. in **(b)**.

Results

<u>Most abundant</u>: *Acer saccharum, Ostrya virginiana, Fagus grandifolia*
<u>Most dominant</u>: *Quercus alba, Liriodendron tulipifera, F. grandifolia*

<u>Basal Area</u>

- Whole plot increased 5.2% in basal area (27% *A. saccharum*, 21% *Quercus* spp.)
- *A. saccharum* increased in basal area by 25%, *Quercus* spp. by 2%
- Of 28 species present, 5 decreased in basal area
- Although invasive *Ailanthus altissima* decreased in abundance by 65%, it still had a relative increase in basal area of 6.2%
- No species increased in abundance
- *Cornus florida* had great losses in both basal area (43%) and abundance (46%)

<u>Size class</u>

- Majority of small individuals were *A. saccharum*
- Small individuals had the highest mortality rate
- Most of the basal area of larger individuals came from *Quercus* spp.

Discussion

- Because forest dynamics occur on time-scales much longer than five years, significant changes will only be seen after several more surveys.
- A resurveying method using GIS mapping software was developed, hopefully speeding up the process for future surveys.
- Most of the *A. saccharum* recruitment occurred in the shaded, downhill half of the plot - *A. saccharum* has much higher shade tolerance than *Quercus* spp. (2), giving maples a competitive advantage
- Oak seedlings do not establish successfully under a tall understory layers that develop in the absence of disturbance (3), in this case shaded out by tall maple seedlings
- Overall higher relative growth and seedling establishment in *A. saccharum* supports the oak-maple transition, though longer-term data is needed for more conclusive results
- Climate change, on the other hand, is expected to shift species ranges, making this region unfavorable to *A. saccharum* and complicating the predicted dominance of maples.

Future Research

- Continue surveys every five years to develop long-term data on forest dynamics, particularly on changes in oak and maple populations
- Seedling plots to survey and monitor long-term seedling establishment patterns

Figure 4. (right) Mortality rate of trees by size. Note highest mortality rate in small individuals.