Beech Leaf Disease and the Future of Our Forests

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ABSTRACT

Beech Leaf Disease (BLD) is a lethal disease that is targeting a major component of our forests in the Northeastern US-the beech tree (*Fagus grandifolia*). The cause of BLD has been linked to the presence of a nematode called Litylenchus crenatae mcannii (LCM). The purpose of our project is to set the foundations for future BLD research and draw initial connections, observations, and predictions about how BLD and widespread beech death will alter forest structure over the next few decades. The results of our study are ongoing as they are the initial recordings of a long-term study, but the data we have collected indicates that BLD has already had an impact on forest structure and it is likely that it will continue to do so.

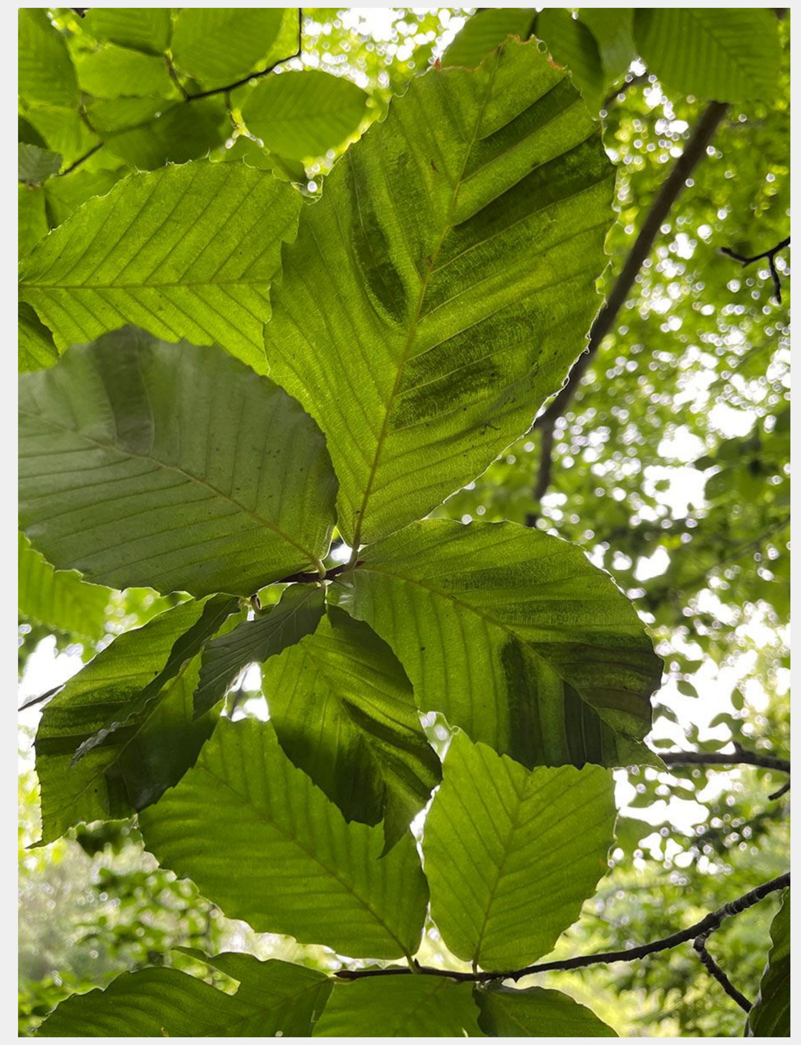

fig. 1: Interveinal Leaf Banding

INTRODUCTION

The American beech is a tree species which makes up a large portion of the northeastern US forests-particularly beech-maple forests. They serve as food sources and habitats for multiple species. They provide canopy cover which constitutes the competition balance among plant species. The survival of beeches is being threatened by BLD, which is associated with the invasive LCM nematode. First documented in Ohio, it has since then spread to many forests of the Northeast and Canada. Its presence harms the tree to the point where it cannot survive. The main symptoms of BLD occur on the leaves: banding patterns (*fig. 1*), darkened color, and crinkled, leathery texture. Leaf processes such as photosynthesis, carbohydrate production, and carbon sequestration significantly decline. The tree is unable to continue its necessary functions and is more prone to succumbing to secondary invaders. BLD causes death in adult trees within 5 to 7 years and 2 to 3 years for saplings. We are conducting ongoing efforts to monitor the long-term effects of BLD. We estimate that a vast portion of the beech population will perish within the next decade. In turn, this will create a gap in the ecological chain for many forests. Our objective is to monitor present symptoms in beech groves and to determine how forest composition will change. We are predicting a change in species composition as a result of beech dieback.

METHODOLOGY

Plots were defined as 37.2in radius circles. We then divided the plot into 4 quadrants representing the cardinal directions (N,E,S,W) as well as defining a smaller center plot. For each of the directional plots we documented the seedling (woody species only) distribution, aerial cover, and the presence of earthworms within a 1m radius of the plot center. We then looked at saplings which we defined as all species <5" diameter and measured the DBH and dieback cover class. For beech trees we then measured if BLD was present, cover class rank for each severity (normal leaves no symptoms, discolored leaves, and curled leaves), and presence of neonectria and beech scale (Cryptococcus fagisuga). Lastly, we measured mature trees within the main plot and documented species, DBH, Crown class, leaf density, dieback, leaf discoloration, canopy assessment, dead main branches severity, dead fine branches severity, and for presence of neonectria and beech scale for beech trees. From there we conducted data analysis and created visuals in RStudio, such as graphs.

Acknowledgements

We want to thank Rohan Watt, Justin Bowers, Andrew Reinmann, the CUNY Advanced Science Research Center, and the New York Botanical Garden for making this research possible!

RESULTS:

<u>Dieback (fig 2)</u>

Figure 2 shows the relation between the number of trees and percentile class of dieback throughout our plot. According to the graph, 22 trees have a measure of 0 dieback which makes nearly 25% of the total. Calculating the percentages of the rest of the trees recorded; 31 trees were recorded as 1-10 making nearly 35%, 17 trees were recorded as 10-25 making 19.1%, 7 trees were recorded as 25-50 making 8%, 4 trees were recorded as 50-75 making 4%, 5 trees were recorded as 75-99 making 6%, and 3 trees were recorded as 100 making up the remaining 3%.

<u>Neonectria and Scale (fig 4)</u>

Figure 4 was separated into 4 sections: beech trees with both neonectria and scale, neither, only scale, and only neonectria. There were 31 beech trees that had both scale and neonectria, 2 trees had neither, 1 tree had only scale, and 19 trees with only neonectria.

<u>Leaf Severity (Fig 3a,3b,3c)</u>

Our figures are split into 3 separate graphs; shrunken, striped, and normal leaves. We made the data more digestible by splitting them up to how many trees have a leaf canopy, with a certain leaf condition, with more or less than 50%. For leaves with shrunken condition, there are around 8 trees with over 50% in the canopy and around 33 beech trees with under 50% of shrunken leaves in the canopy. In the striped leaf severity graph, around 18 trees were over 50% in the canopy and around 22 trees were under 50% present in the canopy. Lastly, there were around 9 trees with over 50% of normal leaves in the tree canopy and 39 trees with under 50% in the canopy.

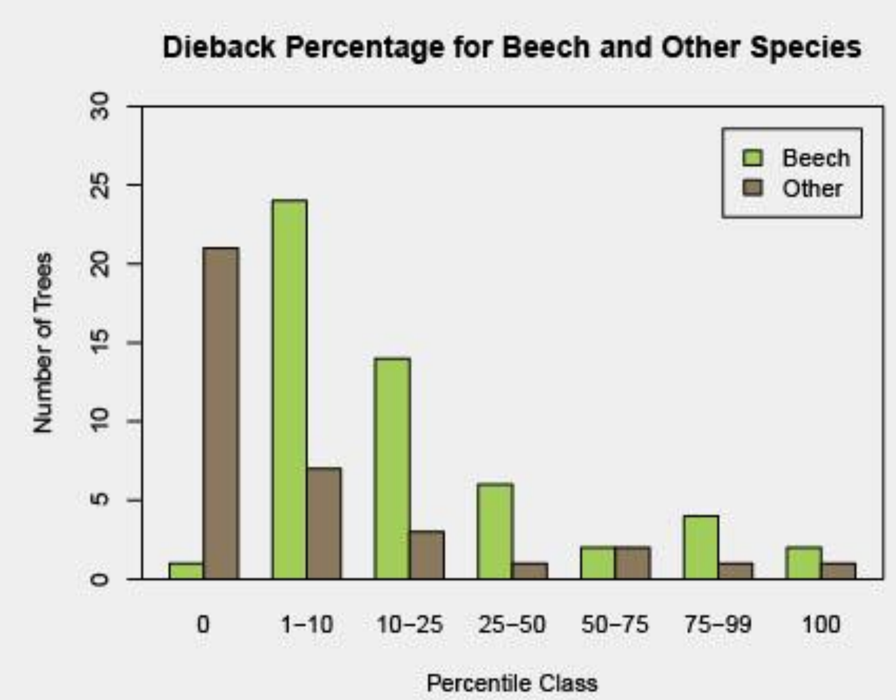

Fig. 2. Dieback percentiles for all species

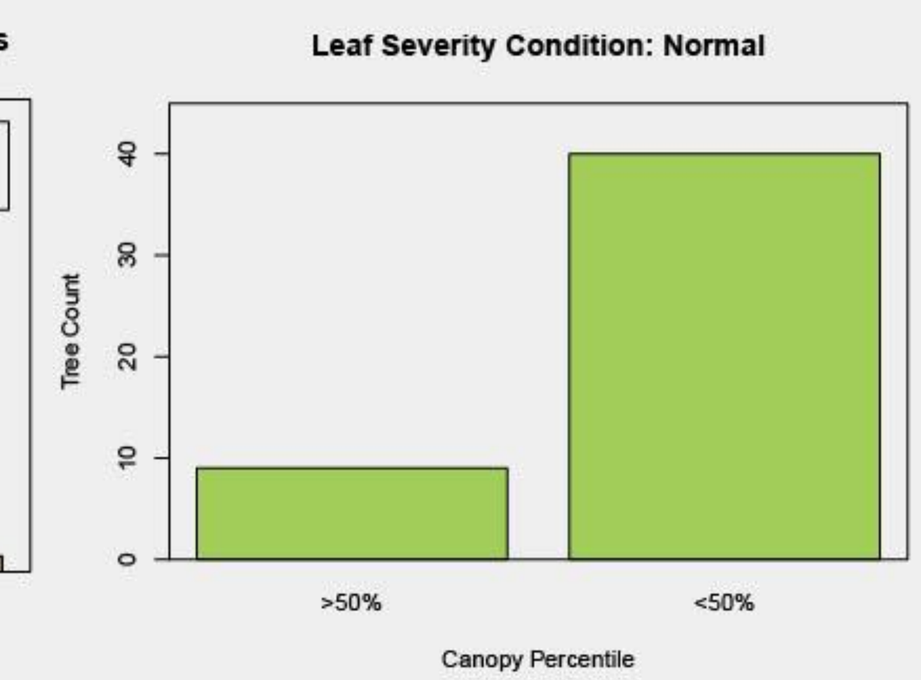

Fig. 3a. Leaf severity condition showing canopy cover of normal leaves.

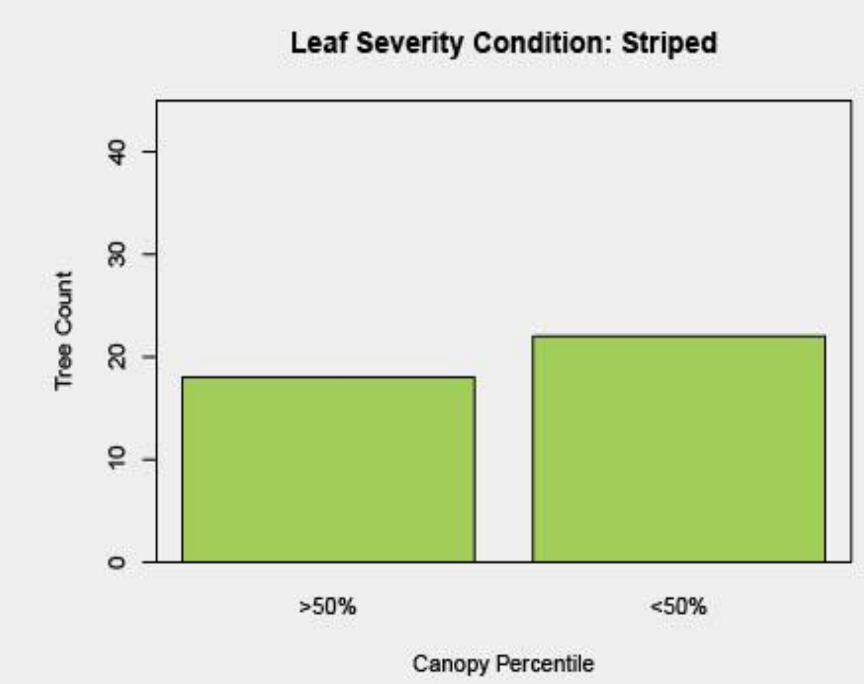

Fig. 3b. Leaf severity condition showing canopy cover of Striped leaves.

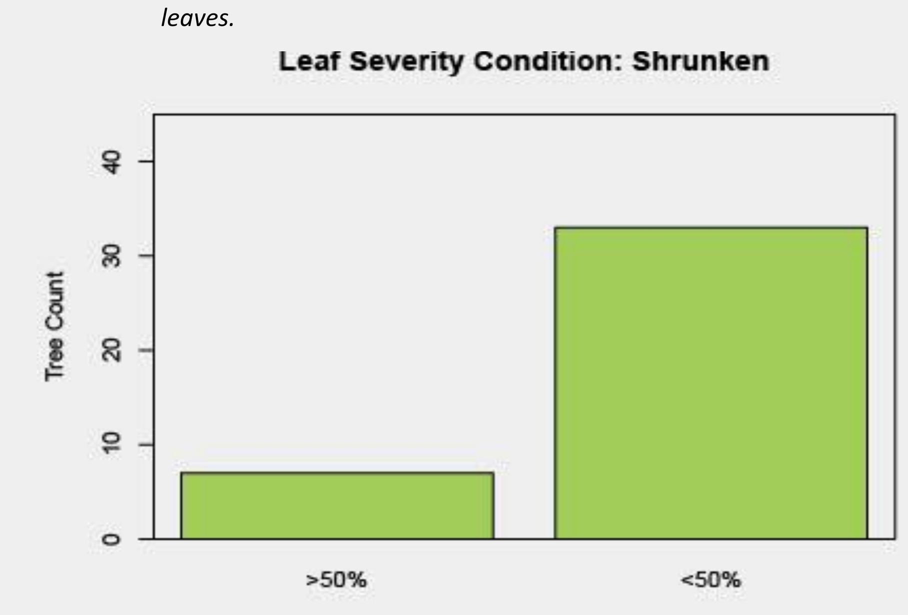

Fig. 3c.. Leaf severity condition showing canopy cover of shrunken leaves.

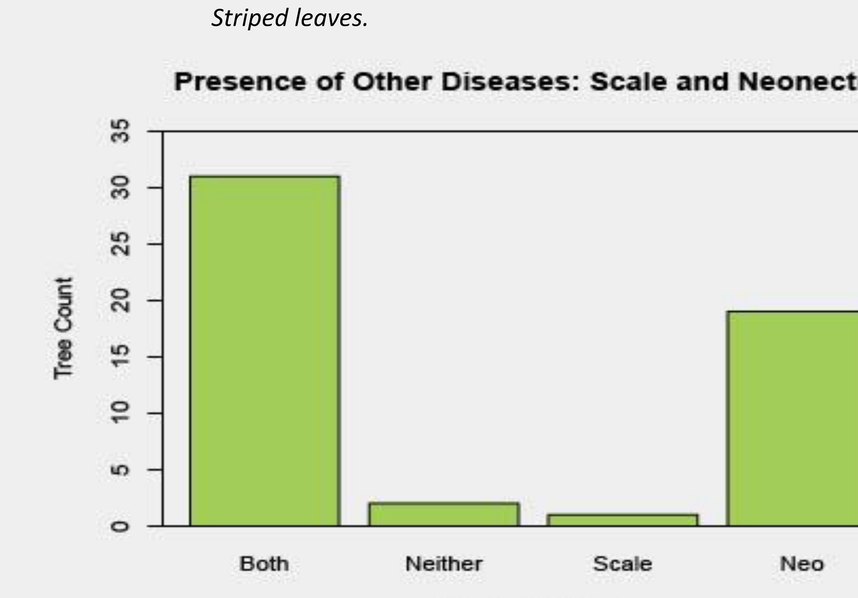

Fig. 4. Showing tree count infected by Beech Scale and Neonectria

DISCUSSION

A study done by the Department of Environmental Conservation documents the rapid spread of BLD since its first observation in 2012 (DEC.2021). Our findings support this as we also found that every mature and sapling stage beech tree in our plots are infected with BLD and the number of trees >50% normal or apparently uninfected leaves is significantly less than the same count of infected leaves (fig.3a,b,c). Figure 2 shows the majority of trees are suffering from dieback which are predicted to lead to forest compositional changes. Findings by Garnas, Marra, and Hausman suggest that canopy change from increased dieback will result in dominant species change and increase in invasives. Figure 4 shows presence of secondary invaders on 51 of the 53 beeches. A study done by Borden found presence of secondary invaders creates a feedback loop further weakening the trees' defenses to BLD.