Dendrochronological Assessment of Ash Growth Rates Relative to Emerald Ash Borer Infestation

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ABSTRACT

- Emerald ash borer (*Agrilus planipennis* [EAB]) is an invasive species introduced from Asia to North America in the 1990s. EAB has caused significant mortality in ash (*Fraxinus* spp.) in 20 US states and 2 Canadian provinces. However, some ash trees appear able to survive EAB attack, even within a few miles of the *de facto* epicenter.
- In a 10-year growth window ordination analysis, there was substantial overlap of the growth rates of trees from all sampled parks and throughout the three identified tolerance groups. A hierarchical cluster analysis including all years of growth also identified substantial overlap between the three tolerance groups, supporting the inference that growth patterns were similar throughout the life of the trees.
- Therefore, it does not appear that growth rates strongly influence mortality of trees in the event of an EAB attack. Results from this study will be incorporated into decision models to improve management of ash resources.

INTRODUCTION

Overview

- Emerald ash borer (*Agrilus planipennis* [EAB]) is an invasive species introduced from Asia in the 1990s that cause mortality in certain species of ash tree [1].
- Tens of millions of ash trees could be impacted causing an estimated $10.7 billion in damage by 2019 [2].
- However, even within a few miles of Westland-Garden City area of metro-Detroit, the *de facto* epicenter, there are large, mature trees that are healthy, with minimal signs of EAB attack [1].
- The significant loss of ash trees has been linked to increased mortality in people due to cardiovascular and lower-respiratory distress [3].

Objectives

- To investigate growth patterns among infested ash trees.
- To identify any existing relationship between EAB attack/ash growth.

METHODS

- Ash trees (N = 80) were selected from a gradient of apparent host tolerance to EAB attack [4] in Kensington, Oakwoods, Lower Huron, and Willow Metroparks, MI (Figure 1).
- Visual health indicators including vigor (overall health), percent dieback (canopy health), and signs of attack (i.e. bark splits, exit holes, wood pecker activity) were used to determine susceptibility.
- Two tree cores were collected from each tree at breast height using an increment borer during July 2013.
- Measured tree core rings to determine growth rate of each tree relative to EAB introduction.

Figure 1. Metropark locations in southeastern Michigan.

- Non-metric multidimensional scaling ordination (NMDS) was used to visualize relationships between parks and tolerance groups relative to growth rates, and cluster analysis was used to group individual trees and years.

RESULTS

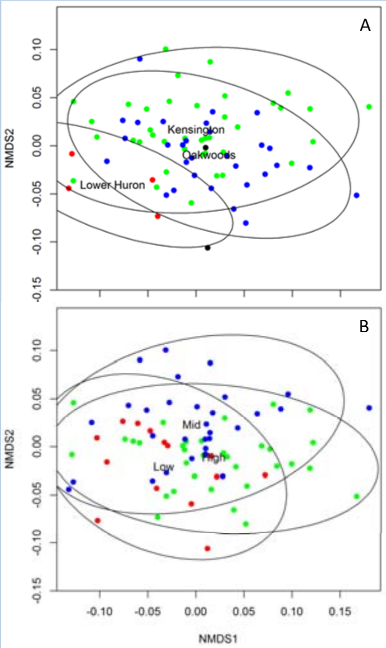

Figure 2. Non-metric multidimensional scaling (NMDS) ordination for growth rates between Metroparks (A) and host tolerance groups (B) with 95% confidence ellipses.

- Significant overlap between parks (Figure 2A) and tolerance groups (Figure 2B) indicated tree growth rates were relatively similar.
- NMDS ordination included trees with rings from 2002-2012.
- Final NMDS stress (0.124) suggests it provided a reasonable assessment of relationships (Figure 3).

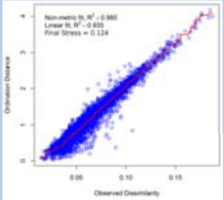

Figure 3. Non-metric multidimensional scaling (NMDS) ordination stress plot.

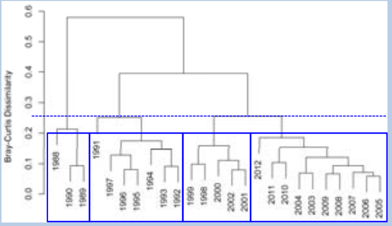

Figure 4. Cluster analysis of growth rates by year with Bray-Curtis dissimilarity. Dash line indicates 25% dissimilarity for branching, blue boxes indicate clustered years.

- Clustered years (blue boxes Figure 4) may align with EAB infestation (pre-introduction, post-introduction, accelerated population growth, exponential population growth).

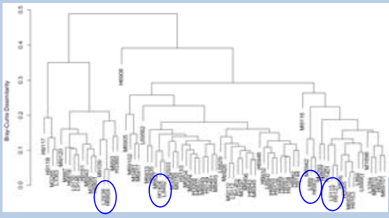

Figure 5. Cluster analysis of growth rates by tolerance group with Bray-Curtis dissimilarity. Blue ellipsis indicate trees of low and high apparent tolerance with similar growth rates.

RESULTS cont.

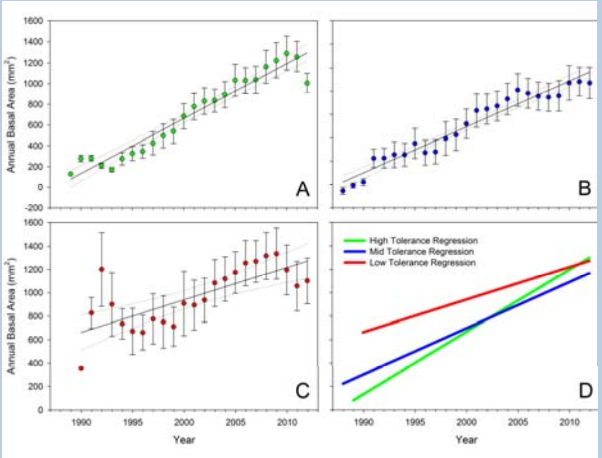

Figure 6. Simple linear regression for mean annual basal area growth per year for tolerance groups with 95% confidence intervals (dotted lines).

- Slope for high tolerance group was significantly different from the low and mid tolerance groups (Figure 6D).

CONCLUSIONS

- Individual trees from different Metroparks or different tolerance groups had substantial overlap in growth rates.
- There appear to be four distinctly different time periods of growth: 1) 1988-1990, 2) 1991-1997, 3) 1998-2002, and 4) 2003-2012. This suggests different phases of EAB infestation may have impacted tree growth rates.
- Individual tress from different tolerance groups had little dissimilarity; high and low tolerance trees grew in similar patterns.
- While linear growth rates appear to be relatively similar between tolerance groups; high tolerance group had the fastest and most consistent area growth rate while the low tolerance group had the slowest and most erratic area growth rate.
- Consistency in growth may be an indicator of tolerance to EAB attack.

Literature Cited

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