

Sugar Maple Dieback

Evaluation in the Upper Great Lakes Region

Tara L. Bal, Andrew J. Storer, Dana L. Richter, Martin F. Jurgensen, and Michael C. Amacher¹

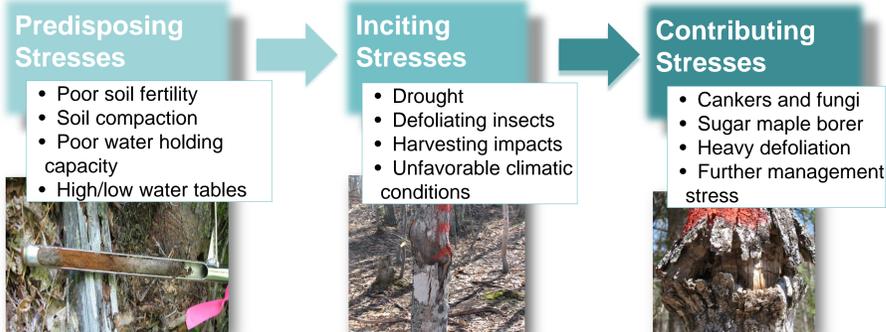
School of Forest Resources and Environmental Science, Michigan Technological University, Houghton, MI 49931

¹ Rocky Mountain Research Station, USDA Forest Service, Forestry Sciences Laboratory, 860 N 1200 E, Logan, UT 84321

Introduction

Unusual levels of sugar maple (*Acer saccharum* Marsh.) dieback have recently been reported in northern hardwoods throughout the Upper Great Lakes Region¹. The etiology of the dieback is unclear but it is most likely being caused by a combination of edaphic conditions, lack of precipitation in previous years, and management in some areas. Both biotic and abiotic factors have historically been associated with sugar maple dieback and decline.

Historical Factors Associated with Sugar Maple Dieback



Little is known about the etiology and extent of sugar maple dieback in the Great Lakes region compared to Northern Appalachia and the eastern U.S. where the extent, progression and cause of dieback events have been more intensively studied^{2, 3}. The historical factors listed above have been attributed to maple dieback in the past and are being investigated here as potential contributors to the current dieback situation^{3, 4}.

Objectives

- Determine the extent and rate of spread of the current sugar maple dieback in the upper Great Lakes region.
- Determine and evaluate contributing factors associated with the dieback.
- Develop recommendations for private and public forest land managers.

Initial Results - Foliage Nutrients in Sugar Maples

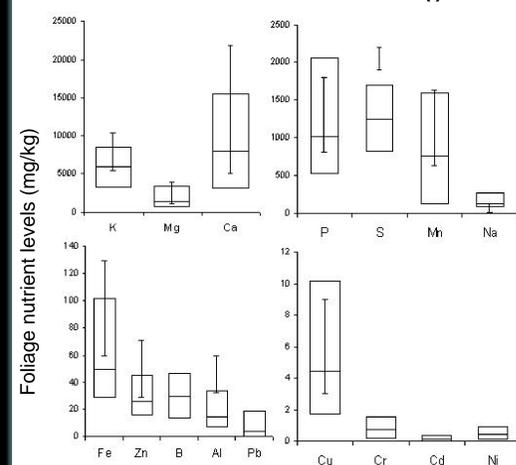


Figure 1. The range in foliage nutrients in the Upper Peninsula, MI from sugar maple on private lands. Boxes represent the range found in plots with the line through the box being the average value from foliage sampled. Bars represent the range in the literature of foliage nutrients in apparently healthy trees.

The range in foliage nutrients from Upper Michigan in sugar maples with and without dieback in 2009 shows that most of the foliage nutrients are on the lower end of the ranges for healthy sugar maple found in the literature, except specifically for sodium (Fig 1). Nutrients missing bars have not been reported for sugar maple.

Soil nutrients are currently being analyzed to determine soil fertility and relationships to foliage nutrients along with differences between summer and fall foliage to examine nutrient translocation. Samples have also been collected from public lands.



High dieback in a sugar maple stand in the Upper Peninsula, MI, 2009.

Methodology

Plot Establishment

A network of 120 forest evaluation plots on public and private lands in the Upper Great Lakes Region was established throughout 2009 and 2010 (Figure 2). Plots were selected based on the amount of sugar maple present and were established with the help of area foresters in areas known to have varying amounts of dieback symptoms and a variety of soil types. Plots are 2 chains away from roadways and are 1/0th acre in size with at least 10 sugar maple trees ≥ 4" diameter breast height (dbh).

Tree Measurements

All trees within the plot had full bole and crown assessments completed following standard Forest Health Monitoring Protocols (USFS) including:

- wounds, cankers, or other damage
- crown class
- crown ratio
- crown light exposure
- foliage transparency and density
- crown dieback % and category

Standard plot measurements included:

- understory regeneration, habitat
- earthworm density
- soil compaction
- canopy density
- topography, aspect
- stand history

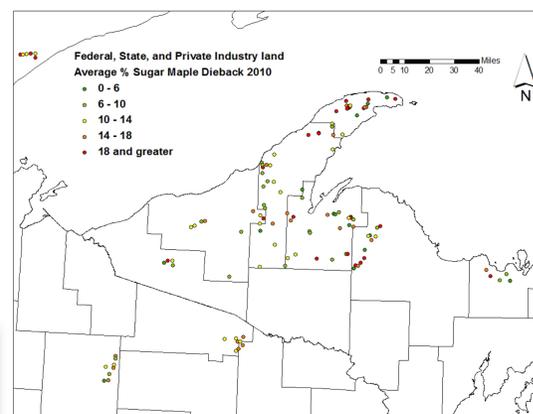
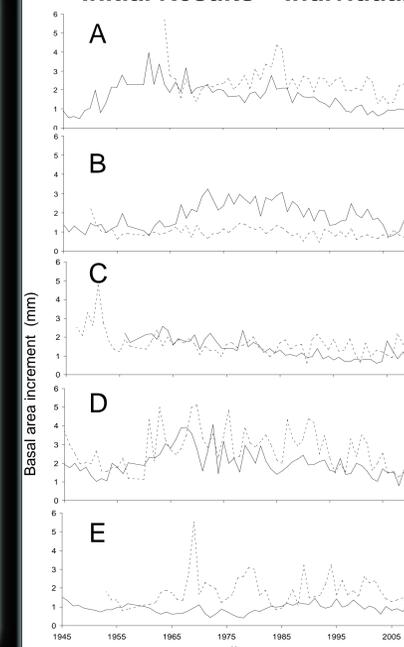


Figure 2. Plot locations and average sugar maple dieback of individual plots in 2010.

Foliage, Soil, and Growth Cores

Half of the established plots were revisited in August to collect live foliage, growth cores, and soil samples from 3 trees within each plot. Plots selected for revisits had at least one comparable plot on the same soil type and represented a variety of average plot dieback levels. The 3 trees within each plot were selected based on their similar size and represented both high and low dieback levels.

Initial Results – Individual Chronologies of Maples with Dieback



Examining tree ring growth chronologies can give insight into the health of a stand even before the trees show visual signs of dieback and has been used in Eastern States to determine dieback etiologies⁵. Comparing chronologies of trees with dieback and apparently healthy trees in the same stands can determine the timing of a decline in the stands history.

In the cores shown here, trees with a higher level of dieback between two trees in the same plot generally have lower basal area increments (BAI) for the past few decades than the trees with less dieback (Fig. 3). Chronology B is the only one shown with the pattern reversed as the tree with more dieback appears to have higher BAI, but more of a drop off in recent years than the tree with less dieback.

Figure 3. The dotted lines indicate more apparently healthy trees (smaller amounts of dieback) and solid lines indicate trees with higher dieback levels from within the same plots.

Initial Results – Average Chronologies of Maples with Dieback

Another method of investigating the relationship between dieback and basal area growth is to examine all trees within the region by the level of dieback. Here, all sugar maples on private lands were compared. Trees with the highest dieback have had the smallest amount of basal area growth in the last 70 years. Trees with the 20-35% dieback have had the highest amount of growth but also the steepest decline in BAI since the 1980's. The trees within this category of dieback are at the highest risk of not recovering based on literature³.

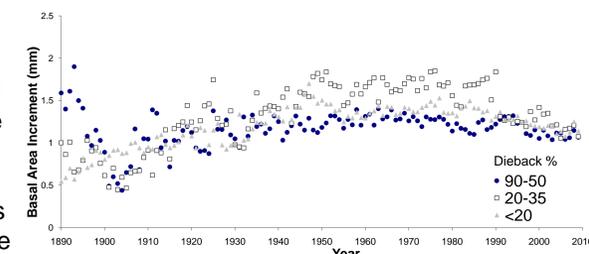


Figure 5. Average basal area increment separated by dieback category on private industry land in northern Michigan.

Initial Dieback Results and Continuing Research

In 2010, the average sugar maple dieback from all plots was 14.4 % with dieback ranging from 75% to 3% (Fig. 2) In evaluations of maple dieback in the eastern U.S., dieback values over 10% are generally indicative of unhealthy crown symptoms³.

The geographic extent and progression of the sugar maple dieback needs to be characterized. Relationships between management activities, temperatures, drought levels, precipitation events, insect or pathogen activity, soil chemistry or any other factors with the current dieback should be clarified. Historical climate data, anthropogenic disturbances, and defoliations are anticipated to be compared to the plot chronologies to find any correlations with the amount of dieback. These relationships will help with recommendations for management to prevent, anticipate, reduce or salvage stands with dieback in the future.