

# Sugar Maple Dieback in the Upper Great Lakes Region

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**GMO**  
Renewable Resources

# Outline

- What is Dieback?
- Historical Dieback in Michigan
  - Maple Dieback etiologies in Eastern U.S.
- Current Dieback (Initial Findings)
  - Plot Characteristics
  - Nutrient Analysis
  - Growth Analysis
  - Sapstreak
- Further Research and Analysis
  - Management Recommendations



# Why is Maple Dieback on the Radar?

- Severe dieback recently noted in the western Upper Peninsula by area foresters
  - Noted first on industry lands
- High Value of Sugar Maple
- Concerned about possibly management induced dieback
- Other than salvage cutting, what can management do to minimize dieback?
  - How soon do they need to remove a tree?

# Terminology

- A disease is induced by a specific causal organism
- Dieback is recent mortality of fines and outer branches usually due to a single factor
  - Dieback may be a symptom of disease

# Crown Dieback

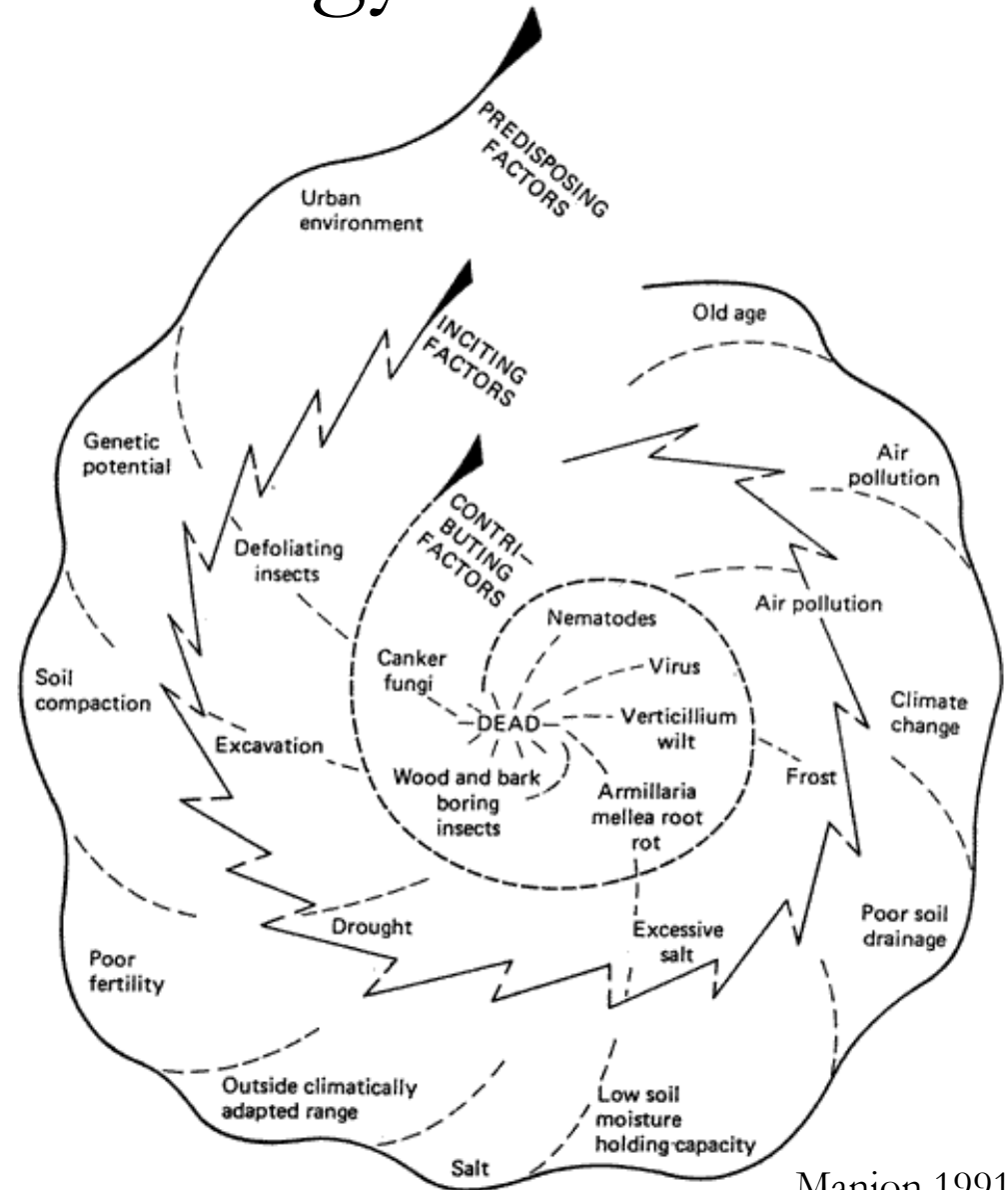
- Recent mortality of branches
- Begins at the terminal portion of a branch and proceeds downward and inward towards stem
- Shaded out branches held on under main crown are not included
- Very old, dead forks not included



# Terminology

A decline is reduced growth and increased mortality due to multiple factors or a combinations of factors

Do we have a true decline?



**Severe Dieback**



Lizzardro Rd, Keweenaw County, MI, 2009

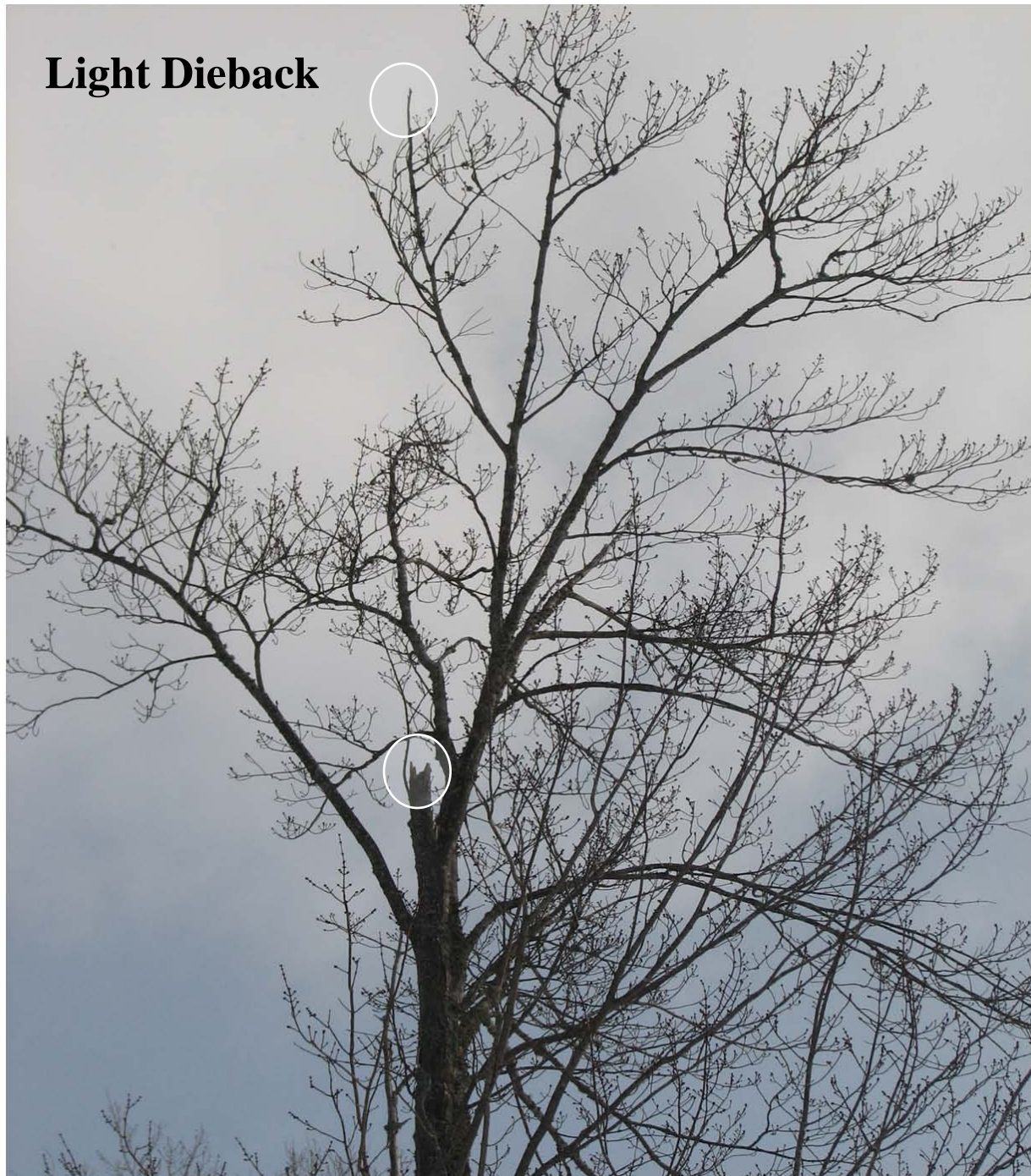
## Moderate Dieback



Bluff Rd, Keweenaw County, MI, 2009



**Light Dieback**



Gay-Lake Linden Rd,  
Houghton County,  
MI, 2009



# Historical Maple Dieback

Relationships have been drawn to

- environmental disturbances (climate)
- defoliation events
- nutrient perturbation
- management practices

Appears very locally driven...

- More recent research suggests that most cases are predisposed by soil nutrients and incited by heavy defoliation, severe drought, or a decade of bad winters

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Table 1. Order of most often reported nutrient deficiencies associated with sugar maple dieback or decline.

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1. Multiple deficiencies interacting

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2. Calcium

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3. Magnesium

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4. Potassium

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5. Phosphorus

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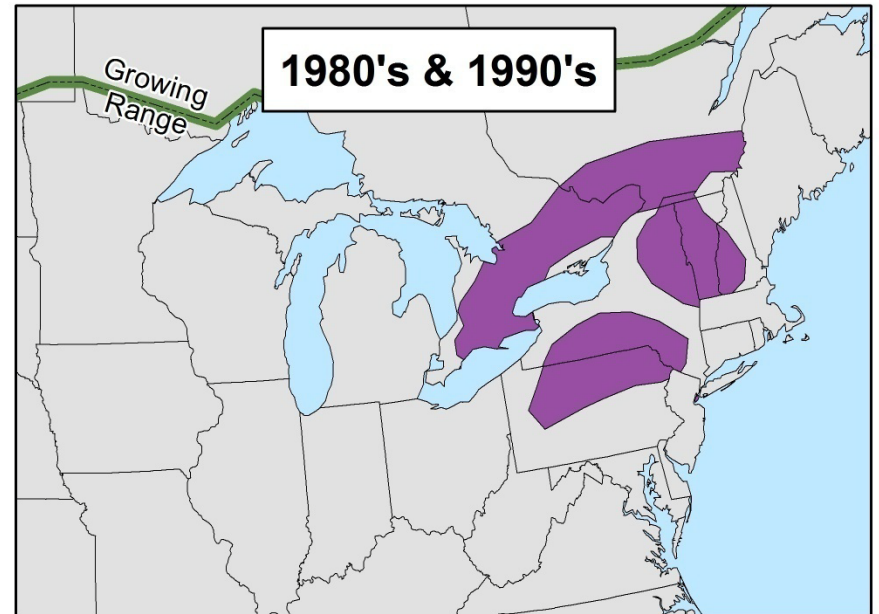
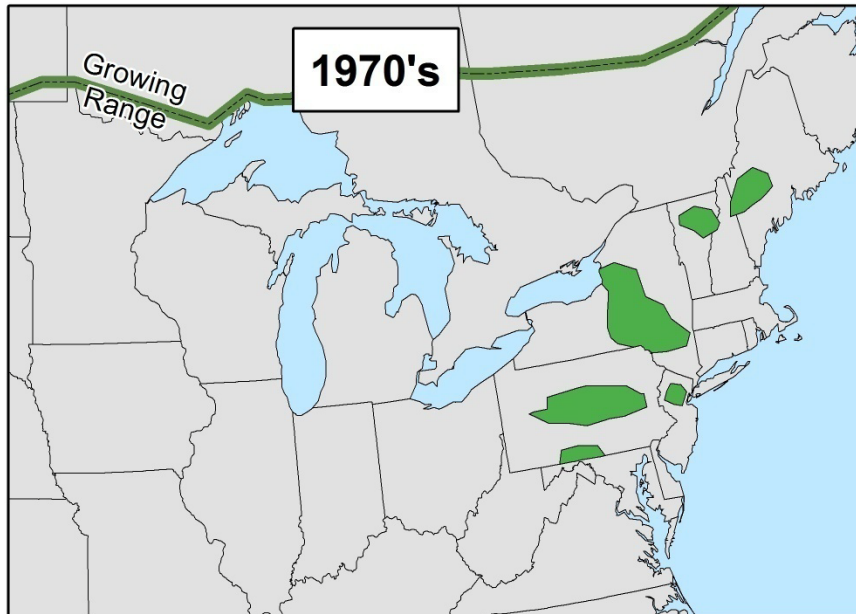
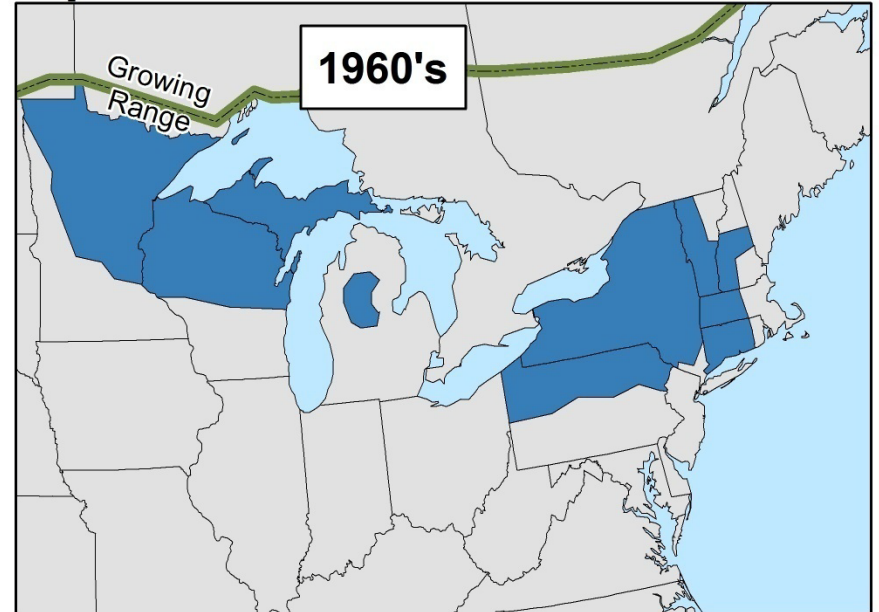
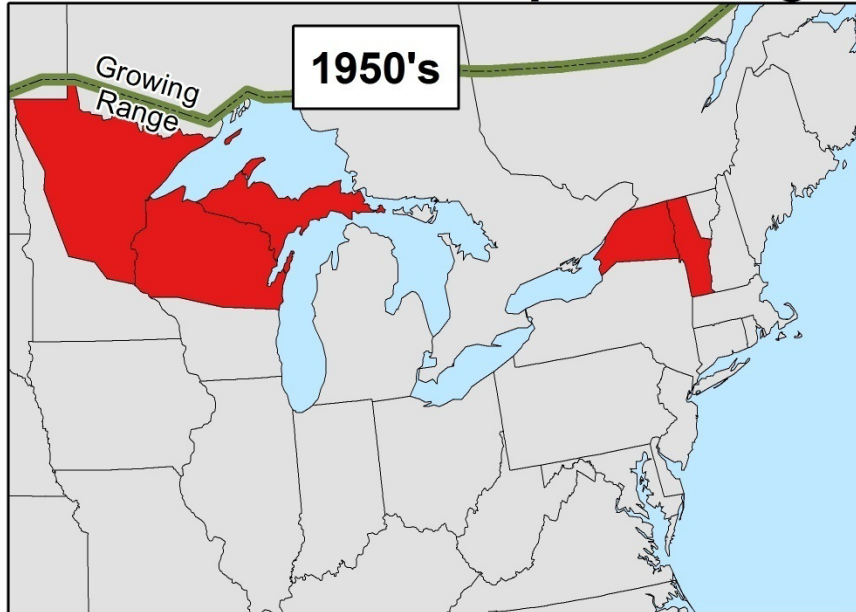
6. Manganese toxicity

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7. Nitrogen (not since 1960's)

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# Historical Reported Sugar Maple Dieback: 1950 - 2000





# Historical Dieback in Michigan

- Reports intermittent in great Lakes since the 1920s
- Late 1950's, early 1960's
  - Duke Experimental Forest, Marquette, 28% SM
  - Scattered dieback MN, WI, MI
  - High water tables, heavy cutting implicated \*
- Wisconsin maple blight
  - Late 50's, rapid death of all maples
  - By 1958 seemed recovered
  - Cause never specified, defoliation followed by hard spring frosts implicated

# Evaluation of Sugar Maple Dieback in the Upper Great Lakes Region

## Research Objectives

1. Evaluate the extent of sugar maple dieback in the Northern Great Lakes Region
2. Characterize the rate of change of dieback symptoms in sugar maple in the region
3. Determine the etiology of the current sugar maple dieback in the Northern Great Lakes Region
  - Particularly its correlation to nutrients and tree growth.
4. Develop management guidelines to help when making silvicultural decisions when dieback is present.

# Plot Establishment

**A network of 120 forest evaluation plots** ( public and private lands)

- varying amounts of dieback symptoms and a variety of soil types.
- 1/0th acre in size with at least 10 sugar maple trees  $\geq 4''$  dbh

## Tree Measurements

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

## Standard plot measurements

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



# On a Subset of Plots...

## Foliage, Soil, and Growth Cores

- 60 plots revisited in August
- 3 trees with a high and low dieback level selected

Each of the 3 selected trees:

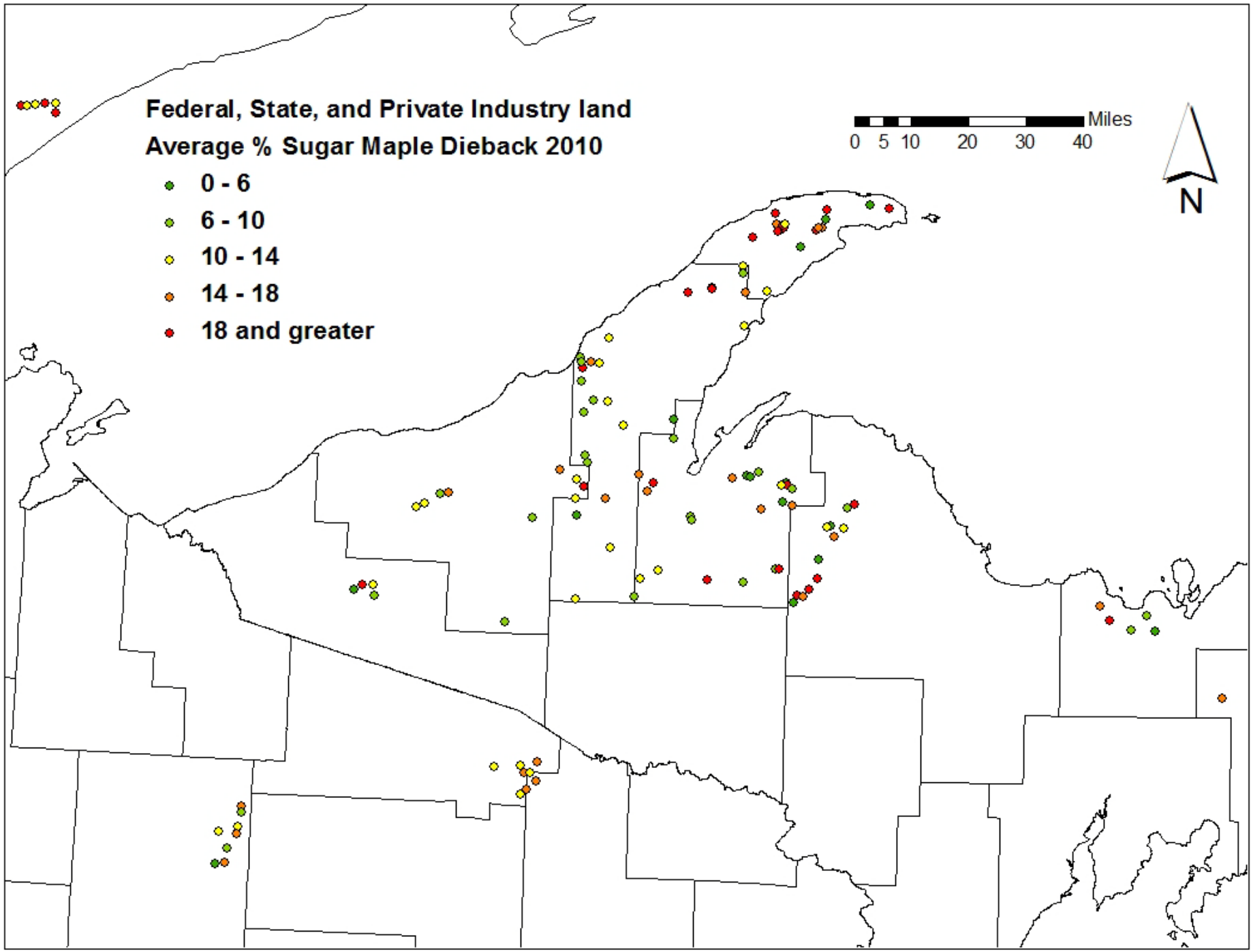
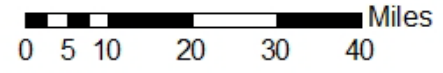
- Cored for growth rings
- Soil samples from within drip-lines
- Foliage collected for nutrient analysis





**Federal, State, and Private Industry land  
Average % Sugar Maple Dieback 2010**

- 0 - 6
- 6 - 10
- 10 - 14
- 14 - 18
- 18 and greater



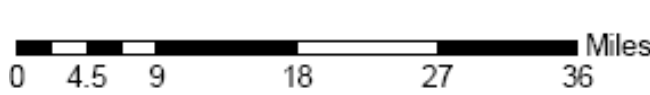
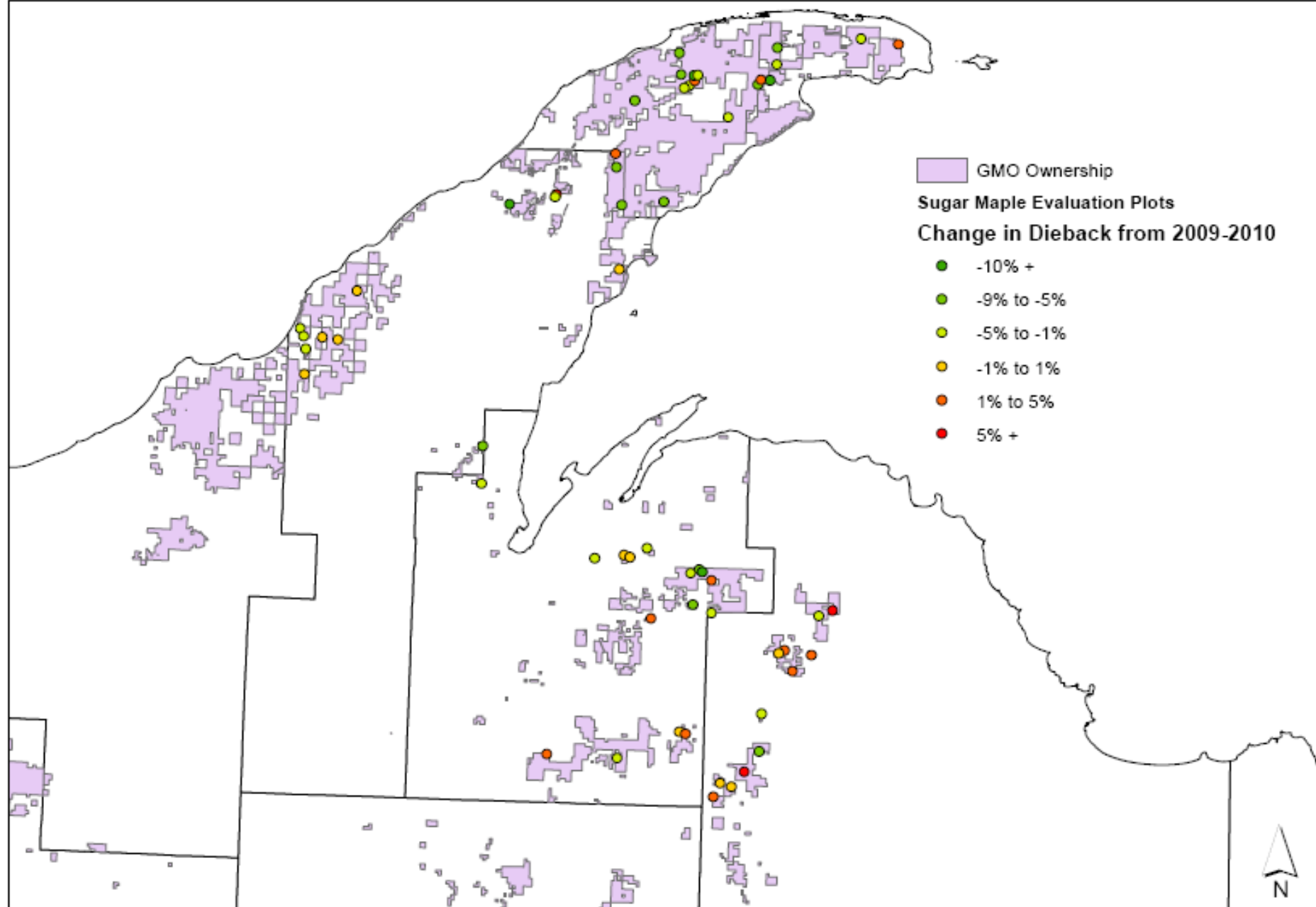


# Initial Plot Characteristics

- 120 Plot Av. sugar maple dieback 2010 = 14.4%
- 60 Plot Av. SM dieback public lands in 2010 = 12.6%
- 60 Plot Av. SM dieback on industry lands decreased from 17.6% in 2009 to 17.2% in 2010
  - Not a significant change, or enough for a pattern
  - Precipitation in 2010 greater than in last decade

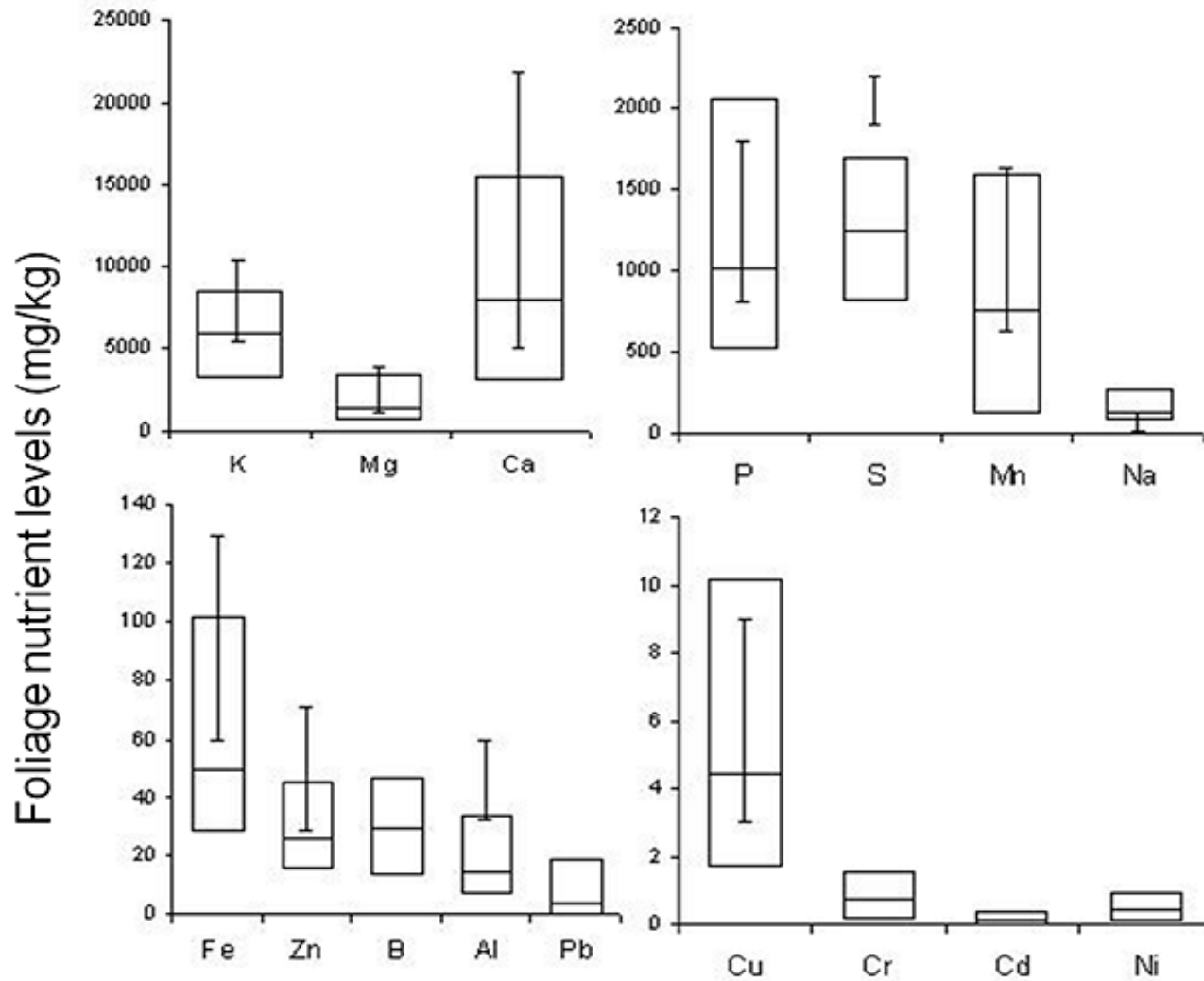


Figure 4. Dieback progression from 2009 to 2010 of a sugar maple in Keweenaw County, MI.



Change in Sugar Maple Dieback  
 From 2009 to 2010 on GMO lands  
 Negative Numbers represent a decrease in Dieback

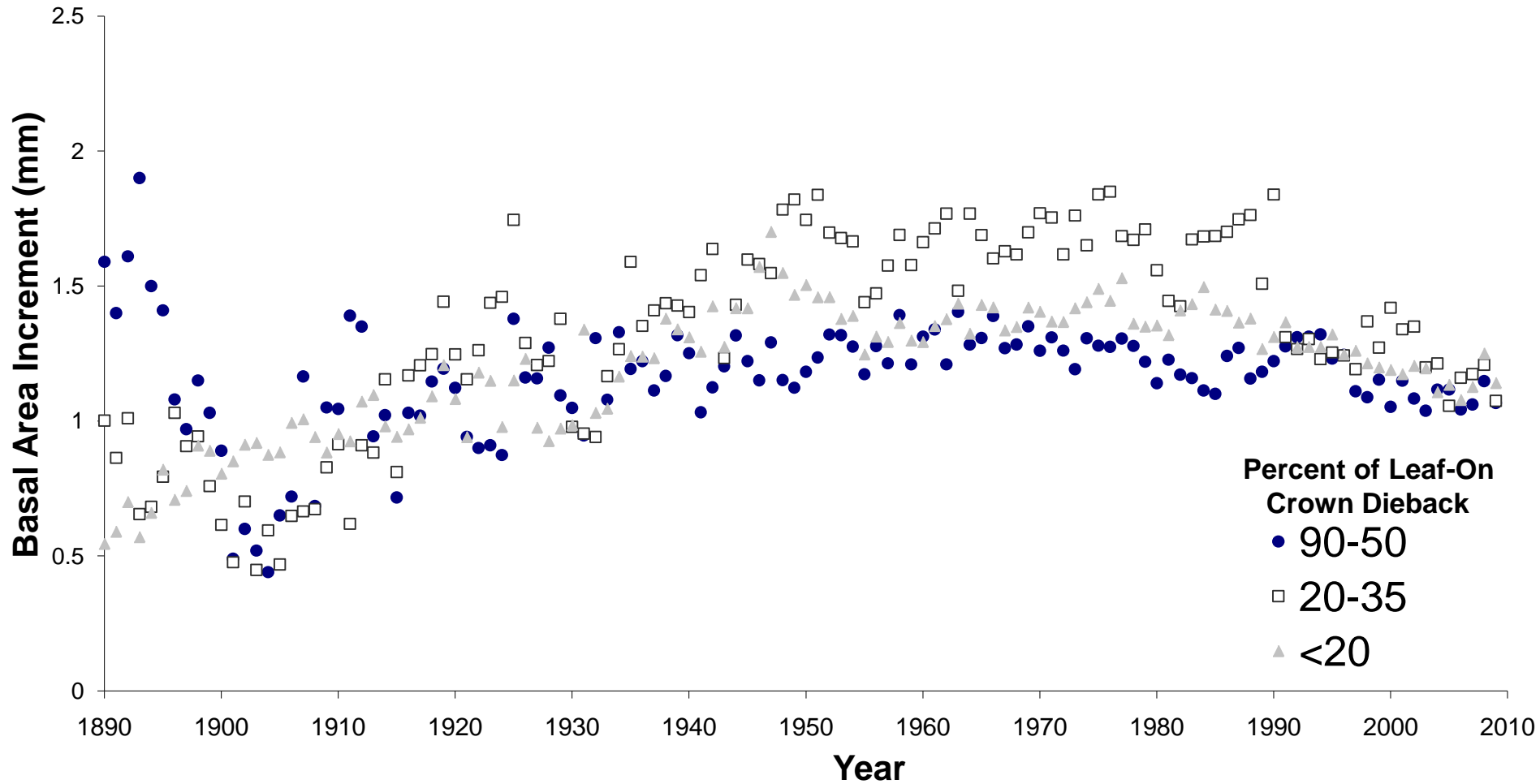
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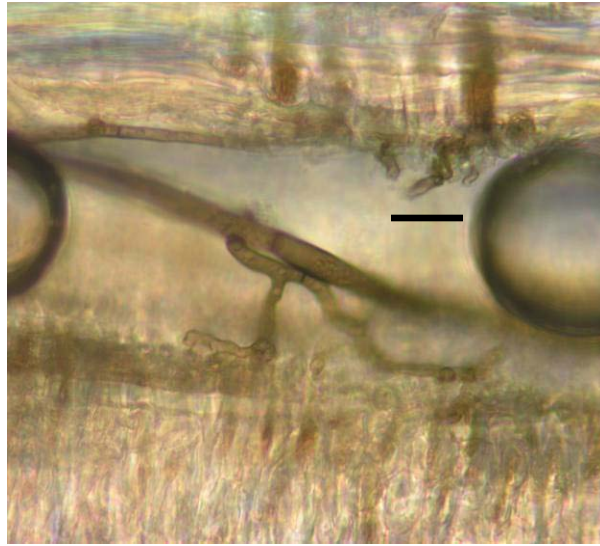


# Sugar Maple Foliage Nutrients

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.

# Tree Growth Analysis



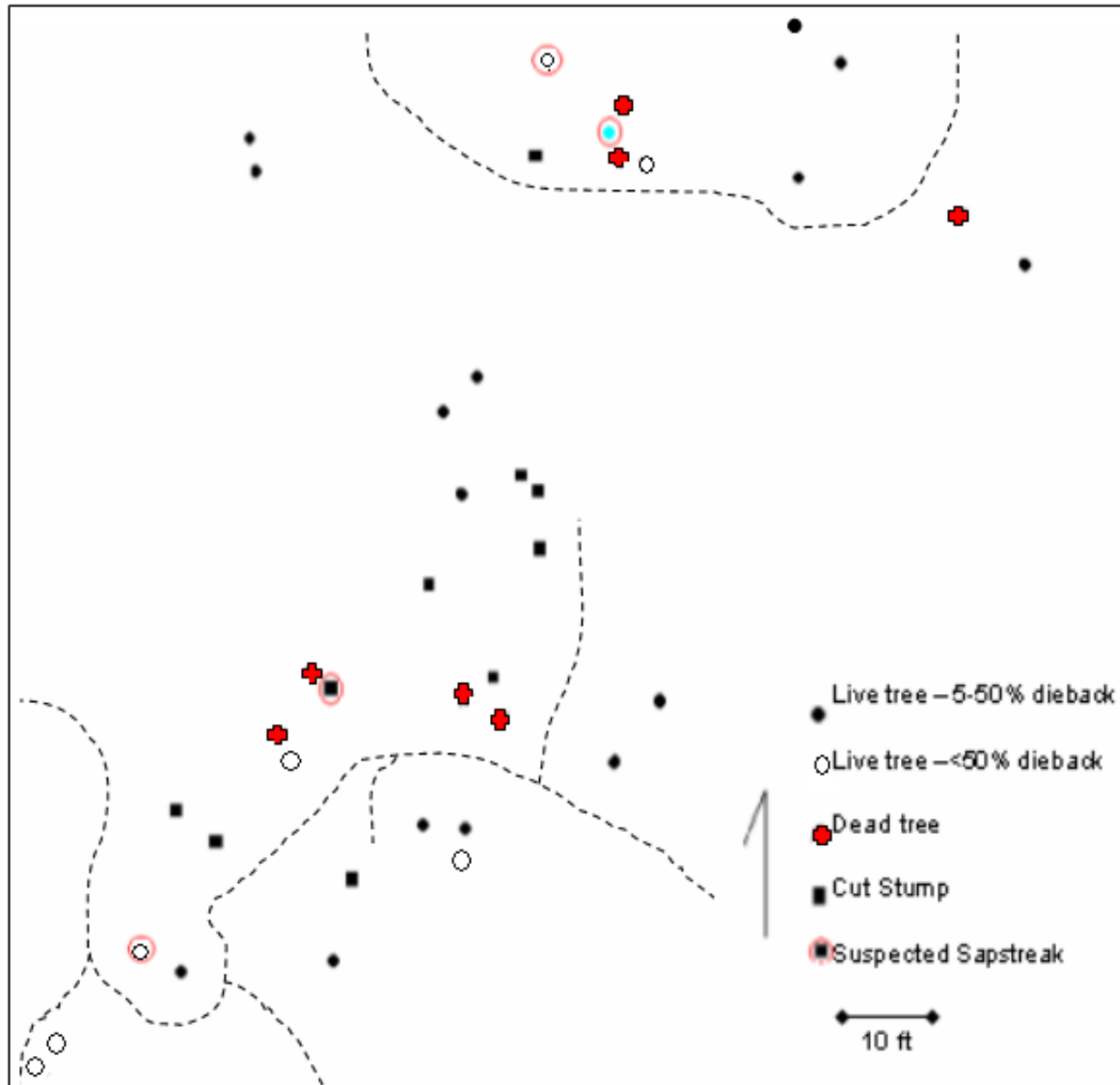


## Influence of sapstreak?

Dark, watersoaked staining in freshly exposed sapwood in the root collar of a sugar maple tree positive for *C. virescens* and *C. virescens* hyphae in a vessel in dark stained sugar maple wood (bar = 10  $\mu\text{m}$ , air bubbles are artifacts).

Objective was to characterize the prevalence of sapstreak disease in a subset of plots to evaluate maple health and intensively examine an industrial forest land site for sapstreak in Upper Michigan

# Sapstreak Intensive Sampling



Map of cut stumps and live sugar maples with dieback around the live tree in Keweenaw County, MI, where *C. virescens* TB 001 was isolated (solid circle within a circle). Dashed lines represent equipment tracks.

# So what is causing dieback?

- Can't really overlay a soils map and say here are the nutrient deficient areas!
- defoliations, sugar maple borer, fungi distribution, climate, deposition history, forest composition, comparable assessments in literature, interest by owners to ameliorate it, >>>all effect the answer
- Large scale databases of drought, defoliation, FIA, atmospheric deposition tend to miss a lot of the localized, stand level interactions



# Continuing Monitoring & Research

- Characterize geographic extent in Great Lakes Region
- Determine progression of maple dieback
  - Visit sites with historical tree vigor data to compare with current tree health in U. P.
- Clarify relationships between management activities, precipitation events, insect activity, and soil chemistry
- These relationships will help with recommendations for management to prevent, anticipate, reduce or salvage stands with dieback in the future.





# Questions?

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