Black Ash Dieback in Northern Minnesota:
Will Emerald Ash Borer Really Make a Difference?

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Extensive crown dieback is a common sight in black ash stands in northcentral Minnesota.
Lakes States
Aerial sketch mapping of ash dieback and survey areas
2004 and 2005
Regional decline/dieback

Widespread dieback was noted throughout the state of Maine by 1993 (Trial and Devine, 1994)

BIA Tribal Lands CFI – Minnesota and Wisconsin: regional onset of decline appears 1988 and 1992

In Minnesota, dieback has occurred periodically over the last several decades: 27,000 ac (2004), 22,000 ac (2009)

Minnesota: mortality increased 18% between 1990 and 2003
Dieback of *Fraxinus nigra* has an unknown disease etiology

*Cohort senescence*: populations are senescing due to old age in synchrony across the landscape

*Drought stress*: trees on wet sites have reduced access to water during spring drought; unable to fill new vessels prior to leaf expansion (Livingston and White 1997)

*Moisture stress*: sites are too wet, even for a wetland species (dieback more frequent on wetland site (FIA data); Ward et al. 2009).

*Road impacts*: dieback (FIA data) clustered near roads; changes in hydrology; deicing salt (Ward et al. 2009).
Our goal:
Better understand stand-scale dieback and its variability and relationship to potential causes

Before EAB impacts begin!

How variable is dieback across the region?
Is dieback related to wetland status and site moisture?
Is dieback related to tree age/size distributions in a stand?
Is dieback related to road proximity?
What is the potential successional trajectory of stands with ash loss?
Study Area and Sites

- Sites selected without bias towards health condition

5 counties
- 54 stands
- 205 1/20 ac plots
- 5,400 trees
Study Area and Sites

Northern Superior Uplands
Northern Minnesota Drift and Lake Plains
Western Superior Uplands

WFn55 Northern Wet Ash Swamp
WFn64 Northern Very Wet Ash Swamp
MHn46 Northern Wet-Mesic Hardwood Forest
MHc47 Central Wet-Mesic Hardwood Forest
Tree/Crown Condition:

- Alive or Dead
- If Alive, Crown Dieback or Not
  - loss of apical dominance
  - epicormic branching
  - dead branches
Field Sampling

Site Variables:
- NWI system (upland, wetland)
- Wetness index
- Depth to a perching layer

Vegetation:
- Woody vegetation
- Shrub vegetation
- Tree ages
Overstory Composition

- Black ash
- Balsam fir
- Balsam poplar
- Paper birch
- American elm
- Green ash
- Quaking aspen
- Red maple
- White cedar
- Yellow birch

Species

No. per ha
How variable is dieback across the region?
How variable is dieback across the region?

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Mean</th>
<th>Range</th>
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<tbody>
<tr>
<td>Healthy (%)</td>
<td>53 (28)</td>
<td>0-95</td>
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Is dieback related to wetland status and site moisture?

Trees

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<th>Percent of Black Ash Trees</th>
<th>NWI Classification</th>
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<tr>
<td>Healthy p=0.03</td>
<td>Upland</td>
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<tr>
<td>Dieback p=0.05</td>
<td>Wetland</td>
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<tr>
<td>Dead p=0.06</td>
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Is dieback related to wetland status and site moisture?

**Depth to a Restrictive Layer**
- Shallow
- Deep
- Thin sponge
- Thick sponge

**Wetness Index**
- 0
- 3
- No standing water
- Ponded water throughout

**Graphs**
- Depth to a Restrictive Layer (m)
  - Shallow
  - Deep
  - Thin sponge
  - Thick sponge
  - p=0.005

- Wetness Index
  - No standing water
  - Ponded water throughout
  - p=0.061
Dieback and moisture

Wetter sites = more dieback
Is dieback related to tree age/size distributions?

Cohort Senescence?

Mean Stand Age

Percent Healthy

Mean Stand Age

Percent Dieback

Mean Stand Age

Diameter (cm)

Age (years)

r=0.53
p<0.0001
Is dieback related to tree age/size distributions?

Larger diameter stands have more dieback
Is dieback related to road proximity?
- altered hydrology; -deicing salt toxicity

*Fraxinus nigra* is rated as moderately tolerant of soil salt and salt spray by some (Ritchie, 1996) to intolerant by others (USDA NRCS Plants Database).
Is dieback related to road proximity?

![Graph showing the relationship between road proximity and dieback of Black Ash trees.](image)

- **Healthy p=0.006**
- **Dieback p=0.007**
- **Dead p=0.2**

**Average:**
- Plot 1: (24 m)
- Plot 2: (70 m)
- Plot 3: (116 m)
Dieback and road proximity

Other factors unchanging with distance

- Tree Diameter
  - p = 0.79

- Depth to Restrictive Layer (m)
  - p = 0.94

- Wetness Index
  - p = 0.64
Summary

1) High incidences of crown dieback, but dieback was variable across the region

2) More dieback occurred on jurisdictional wetlands and locally wetter conditions

   *Stress related to excessive flooding or drought in shallow rooted trees on wet sites?*

3) Dieback positively correlated with stand diameter and diameters increased with age

   *Cohort senescence?*

4) Dieback occurred with higher frequency nearer to roads

   - *Hydrological alterations or toxicity from road deicing salt*
   - *Perception that dieback is more severe regionally than our study suggests?*

Results indicate that healthiest stands are likely to be younger, on drier sites, and farther from roads, compared to stands with significant amounts of crown dieback.
A Caution!

### Dieback vs Decline

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- Is black ash declining or experiencing episodic periods of environmental stress and responding through dieback?
- Is the relatively low tree mortality and presence of epicormic branches and crown re-growth indications of tree recovery?
Potential successional trends in declining? stands

- Sapling layer
- Advanced regeneration
- Seedling/shrub layer
Sapling layer composition

Diverse and variable, however…

[Graph showing species distribution with labels for various tree species such as Green Ash, Balsam Poplar, Quaking Aspen, Yellow Birch, Sugar Maple, etc., along with axis labels: Axis 1 (21%), Axis 2 (14%).]
Mostly black ash and alder

Sapling layer does not contain abundant stems of canopy replacement species
Health of black ash saplings?

Sites with dieback are not replacing themselves with healthy saplings.
Black ash advanced regeneration

Less in less healthy stands

No self-replacement?

Overstory Condition
Sub-sapling woody vegetation (other than black ash)

Dominated by sub-canopy & shrub spp.
- speckled alder
- raspberry
- hazel
- Ribes
- mountain maple
- dogwood

Only 3 of 54 stands contained canopy tree species at high enough abundance to be noted

Take home: there are no tree species other than black ash that appear to be regenerating in abundance in black ash stands & ash regeneration is not abundant in stands with dieback
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- Yes, because currently healthy stands exist
- Yes, if dieback does not result in decline (i.e., currently unhealthy stands may recover)
- Yes, will hasten canopy loss in systems with regeneration & successional replacement bottlenecks
We thank the following forestry and land departments for logistic support and access to study sites:

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- The Chippewa National Forest
- The Cloquet Forestry Center

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