Emerald Ash Borer and Potential Municipal Responses
Tools available to Public Tree Managers

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CCNR/ Storrs, CT
Introduction

*Agrilus planipennis*
(Coleoptera: Buprestidae, adult aprox. 1 cm long)

*Fraxinus americana* (Oleaceae), Simsbury, CT
22 North American species of *Fraxinus*
North America Invasion

Detected in 2002, Detroit-Michigan Area

Natural distribution of EAB in Asia

emeraldashborer.info
Spread of EAB in North America

20 US states, two Canadian provinces
Spread of EAB in North America

Natural spread: 0.5-1 miles per year
But...
Loss of Millions of Ash Trees in North America

Before

After

8 billion ash trees in North America
Tens of millions ash trees killed by EAB in North America
EAB Life Cycle

1. Adults mate
2. Adults lay eggs in ash bark
3. Eggs hatch into larvae and tunnel into tree
4. Larvae feed under bark, creating S-shaped galleries
5. Larvae pupates
6. Adults emerge, leaving D-shaped exit holes
Symptoms and Signs

S-shaped (serpentine) galleries
Larvae about 3 cm long
Disrupt flow of nutrients
Most of the damage
Symptoms and Signs

D-shaped adult exit holes (0.3-0.6 cm)
Symptoms and Signs

Epicormic shoots

Dieback
Symptoms and Signs

Woodpecker damage (yellowing)
Symptoms and Signs

Woodpecker damage (holes and bark flecking)
Ash Canopy Condition
(rating scale by Smith, 2006)

1  2  3  4  5

Healthy Tree

Dead Tree

Six years to kill a healthy, mature tree
EAB in Connecticut

- Pink: EAB Present
- Blue: Quarantine

Litchfield Co.
Hartford Co.
Middlesex Co.
Fairfield Co.

New Haven County – Federal and State Quarantine for the Emerald Ash Borer
<table>
<thead>
<tr>
<th>Cusp</th>
<th>Crest</th>
<th>Post-Crest</th>
</tr>
</thead>
<tbody>
<tr>
<td>- EAB population builds up</td>
<td>- Peak of population density - Widespread symptoms - Hazardous trees</td>
<td>- Untreated trees have died - Resources have depleted - EAB colonizes new areas</td>
</tr>
<tr>
<td>- No or little visible symptoms</td>
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<tr>
<td>- EAB hard to detect</td>
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</tbody>
</table>
EAB Cost Calculator

http://extension.entm.purdue.edu/treecomputer

Web-based tool to help urban foresters make decisions about ash tree management related to emerald ash borer.

Sadof et al., 2011
Milford, CT
Inventory

Size class distribution for Milford’s ash

<table>
<thead>
<tr>
<th>Size Span (inches)</th>
<th>Number of Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>95</td>
</tr>
<tr>
<td>4 - 6</td>
<td>32</td>
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<tr>
<td>6 - 8</td>
<td>74</td>
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<td>8 - 10</td>
<td>61</td>
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<tr>
<td>10 - 12</td>
<td>55</td>
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<tr>
<td>12 - 15</td>
<td>83</td>
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<td>15 - 20</td>
<td>43</td>
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<td>31</td>
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<td>25 - 30</td>
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<td>30 - 40</td>
<td>18</td>
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<td>40 - 50</td>
<td>7</td>
</tr>
<tr>
<td>50 -</td>
<td>3</td>
</tr>
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Milford
- 100% street tree inventory, 2004
- Milford Tree Inc. - Volunteers
- 15,871 street trees
- 518 (3%) ash trees
Inventory

Size class distribution for Milford’s ash

<table>
<thead>
<tr>
<th>Size Span (inches)</th>
<th>Number of Trees</th>
<th>DBH</th>
<th>Cost / DBH For Treatment</th>
<th>DBH</th>
<th>Avg. Cost / DBH</th>
<th>Adjusted Cost</th>
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</thead>
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<tr>
<td>0 - 4</td>
<td>95</td>
<td>0 - 4</td>
<td>$3</td>
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<td>$11.15</td>
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Costs of treatment and removal correspond to dbh
Management Strategies

• **Simple Strategies**
  – Treat ash trees with insecticides
  – Remove ash trees
  – Replace ash trees with resistant trees

• **Pre-designed Strategies**
  – Replace <24”
  – Save 50%, etc.

• **Custom Strategies**
EAB Invasion Wave Curve

Management Phase

Aggressive     Maintenance

Time (Years)

Percentage of Maximum

0% 20% 40% 60% 80% 100%

Staging the infestation
How many hazardous/dead trees
Associated cost

Milford, CT

Cusp    Crest    Post Crest

Aggressive
-Cusp+Crest
-Aggressive prevention
-More frequent treatment application

Maintenance
-Post-Crest
-Tree inspection
-Less frequent treatment application
Milford’s Case

• **Strategies**
  – Remove all
  – Replace unsafe ash
  – Replace <24”
  – Save 50%

• **Simulations**
  – Year 0
  – Year 4

• **Treatment**
  – Systemic insecticide imidacloprid-Merit ($3/dbh)
    • Aggressive- 1 year application
    • Maintenance- 3 year application
Annual Cost Comparisons

Annual Cost Comparison in Today's Dollars
Over Time With a 5% Discount Rate

Year 0

Year 4

Aggressive Phase (1 year)
Maintenance Phase (3 years)
Cumulative Cost Comparison

Cumulative Cost Comparison in Today's Dollars
Over Time With a 5% Discount Rate

Year 0

Cumulative Cost Comparison in Today's Dollars
Over Time With a 5% Discount Rate

Year 4

Aggressive Phase (1 year)

Maintenance Phase (3 years)
Total DBH

Total DBH Over Time
with 2% Ash and 2% Replacement Tree Mortality

Year 0

Year 4
Cumulative DBH

Year 0

Cumulative DBH-Years Over Time with 2% Ash and 2% Replacement Tree Mortality

Year 4

Cumulative DBH-Years Over Time with 2% Ash and 2% Replacement Tree Mortality
## Integrating Tree Benefits

- **i-Tree Streets**

  [www.itreetools.org](http://www.itreetools.org)

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<table>
<thead>
<tr>
<th></th>
<th>All ash trees (518 trees)</th>
<th>Ash Trees Larger than 24” (44 trees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fraxinus americana</td>
<td>Annual Benefits (US$/tree)</td>
<td>120.76</td>
</tr>
<tr>
<td></td>
<td>Net Annual Benefits (US$/year)</td>
<td>38,160</td>
</tr>
<tr>
<td>Fraxinus pensylvanica</td>
<td>Annual Benefits (US$/tree)</td>
<td>128.74</td>
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<tr>
<td></td>
<td>Net Annual Benefits (US$/year)</td>
<td>26,258</td>
</tr>
<tr>
<td><strong>Average/Total</strong></td>
<td>Annual Benefits (US$/tree)</td>
<td>124.74</td>
</tr>
<tr>
<td></td>
<td>Net Annual Benefits (US$/year)</td>
<td>64,418</td>
</tr>
</tbody>
</table>

Larger (healthy) trees provide more benefits
9% of ash trees provide 20% of the benefits

**Benefits**
- Energy conservation
- Air quality improvement
- Carbon dioxide sequestration
- Stormwater interception
- Increase in property value
Public Involvement

- EAB detection
- Tree surveys (inventories)
  Complete inventory
  Sample based survey
  “Windshield survey”
Conclusions

• EAB infestation is hard to detect before year 4-5
• Tree inventory is crucial
• Pro-active response reduces short-term costs
• Treatment and replacement strategies promote canopy recovery
• It is important to consider tree benefits
Acknowledgements

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Questions?

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Urban Forestry Program  
www.ct.gov/deep/forestry