The Emerald Ash Borer:

An Introduction to Management Strategies for Towns and Woodland Owners in Connecticut

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Webinar Outline

• I. Introduction about the tree, insect, and symptoms
• II. Emerald Ash Borer (EAB) in CT, updates on tracking the insect, the quarantine
• III. Advice for woodland owners
• IV. Advice for municipalities and homeowners
• V. Wrap-up and Q&A
White Ash tree distribution across the state

Dark green up to 19% ash component

- About 3% total forest trees
- Locally abundant
- Pioneer stands
- Riparian environments

Source: USFS, Forests of CT, 2004
Native range of 3 Ash species in Connecticut

**WHITE ASH**  
*Fraxinus americana*

**GREEN ASH**  
*Fraxinus pennsylvanica*

**BLACK ASH**  
*Fraxinus nigra*

Only 3% CT forest is ash
Pioneer species
Shade tolerant in youth but increasing shade intolerant with age.
Wildlife value: Large seed crop feeds many different kinds of wildlife; dead trees provide nest cavities
How to Identify an Ash Tree in 4 Easy Steps

Step #1: The Bark
Identifying the Native Ash: BARK

Black

White

Green
#2: Opposite Branching Pattern

Twigs in pairs across from each other

Maple
Ash
Dogwood
Viburnum
Horsechestnut
Hydrangea

Compare to Alternate Branching Pattern of American Beech
Identifying the Native Ash: LEAF SCARS

Green Ash

Buds in pairs across from each other

White Ash

Black Ash

Opposite Branching
#3: Compound Leaves

Leaves may be finely toothed
Or with smooth edges.
Leaves are compound with 5-9 leaflets
Leaves 8-12” long
Identifying the Native Ash: LEAF

**Green**
- Found on river banks, riparian areas; Mesic sites – sometimes flooded and sometimes dry

**White**
- Found on upland sites; Xeric – rarely experience flooding

**Black**
- Found in wetlands and bogs; Hydric sites – often have standing water

**Mountain Ash**
- Not susceptible to EAB; not a true ash
Identifying the Native Ash: SEEDS

Black Ash

Green Ash

White Ash
Be on the look out for 5 signs of EAB infestation:
Symptoms may take several years to develop. A newly infested tree may not show symptoms for several years.

• 1. Upper canopy thinning and dieback decline (infests top of tree first)
• 2. Woodpecker activity
• 3. Bark two-toned, bark on ground
• 4. Water sprouts
• 5. D-shaped exit holes (or half moon)
• Individual trees may take 2-3 yrs to die. Stands of trees within 8 yrs once insect enters the stand.

See anything – call one of the state agencies (links at end) or a certified forester
Tree begins to decline from the top down. Root still alive.
Branch die-back

Tree begins to decline from the top down. Root still alive. Takes 4-6 yrs to die
Woodpecker activity

Hairy woodpecker
Two-tone bark (varying degrees)
Signs of serious infestation

Water sprouts – desperate attempt

D-shaped exit holes

Splits in bark reveal S-shaped galleries
The Emerald Ash Borer:

Only attacks ash trees and the white fringetree
Emerald Ash Borer: Adult

• Metallic wood-boring beetle
• Size of a tic-tac (about ½” long)
• Purple abdominal sections beneath wing covers

Emerald Ash Borer: Immature form (larvae)

• Flat-headed borer
• Creamy-white
• Feeds on inner bark
Life Cycle of Emerald Ash Borer

1 generation in 1-2 yrs

Pupa: Late-April to June

D-shaped exit hole

Overwinters as prepupal larva

Larval Stage: (Inner bark) Mid-July-Sept

Mid-May to August: Adult feeds for 1-2 wks

Adult emerges: About middle of June

Eggs laid on bark

Eggs laid on bark
EAB attacks underneath the bark

Vascular Cambium

Wood

Bark

Conductive tissue of Inner bark (phloem)

S-shaped tunnels disrupt water and nutrient transport
Both borers do not feed on ash trees.
Top Ten Forest Hardwoods by number of individual stems (1.0 dbh and up)

1. Red Maple - 27%
2. Black Birch - 10%
3. Sugar Maple - 6%
4. Northern Red Oak - 6%
5. Beech - 5%
6. Black Cherry - 3%
7. Yellow Birch - 3%
8. Pignut Hickory - 3%
9. White Ash – 3%
10. Black Oak – 3%
EAB Invasion Wave Curve

- Affected Ash
- EAB

<table>
<thead>
<tr>
<th></th>
<th>Cusp</th>
<th>Crest</th>
<th>Post Crest</th>
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<tr>
<td>Percentage of Maximum</td>
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<tr>
<td>Time (Years)</td>
<td>1</td>
<td>5</td>
<td>9</td>
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</table>
EAB Invasion Wave Curve

- Affected Ash
- EAB

Time (Years)

Percentage of Maximum

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

Cusp  Crest  Post Crest
**EAB Invasion Wave Curve**

- **Cusp**
  - EAB population builds up
  - No or little visible symptoms
  - EAB hard to detect
- **Crest**
  - Peak of population density
  - Widespread symptoms & Hazardous trees
- **Post-Crest**
  - Untreated trees have died
  - Resources have depleted
  - EAB colonizes new areas
Regulatory Response to Emerald Ash Borer

-Research has shown that EAB is too well established in North America to be eradicated.

-However, there is evidence that the spread of new infestations can be significantly slowed when appropriate action is taken early.

Photo Courtesy of Macroscopic Solutions by way of Dr. Claire Rutledge
Quarantines

- Both the Federal Government and Connecticut have placed quarantines in effect to limit the spread of EAB through limiting the movement of regulated articles.

- In addition, regulations have been established that define how the quarantines will work – especially firewood.
Regulated Articles

- Regulated articles are defined as:
  - Ash nursery stock, ash sawlogs, ash wood packing materials, ash limbs and branches, and untreated ash lumber with the bark attached.
  - Firewood of all hardwood species
  - Ash wood debris greater than 1 inch in diameter
  - Chips greater than 1 inch in 2 dimensions
  - Living or dead ash roots, logs, stumps or branches.
  - As well as the Emerald Ash Borer in any life stage.
What is Ash Used For?

Ash lumber is used to make products such as...
QuaranGne put in place August 9, 2012

no regulated articles out of New Haven County
Quarantine extended August 29, 2013
no regulated articles out of western 4 counties.
QuaranGne extended again December 5, 2014. Now whole state is covered by quaranGne.
Firewood Regulations

-A major means by which EAB is spread is through the movement of infested ash firewood.

-State regulations now limit the movement of all hardwood firewood within Connecticut.

-The reason all hardwood firewood, and not just ash firewood, is regulated has to do with the difficulty many average users of firewood have in identifying ash wood within a firewood pile.

Don't move firewood, it BUGS me! www.emeraldashborer.info
WITHIN CT Federal EAB Quarantined Area

Required Documentation:
Document/verification of origin via waybill (or bill of lading), or Self-issued Certificate of Origin

December 5, 2014
State of Connecticut
Connecticut Agricultural Experiment Station
and the
Department of Energy and Environmental Protection

In-State Firewood Transportation
Self-Issued Certificate of Origin

When transporting untreated firewood within Connecticut, you must keep a signed copy of this completed document with you.

This Self-Issued Certificate is for cut and split firewood or wood intended to be cut and split and used as fuel for heating purposes.

Part I: Transporter Information

Transporter Name: ________________________________
Mailing Address: __________________________________
City/Town: __________________________ State: ______ Zip Code: ______
Home, Business or Cell Phone: __________________________
E-mail: __________________________

Part II: Source of Firewood

Street Address: ________________________________
City/Town: __________________________
County (refer to county map): __________________________
NOTE: If the source of the firewood is in an affected county, then additional regulations apply. Contact CAES at 203-974-9474 prior to moving firewood out of or through an affected county.

Part III: Destination of Firewood Being Transported

Street Address: ________________________________
City/Town: __________________________
County (refer to county map): __________________________
Approximate Volume Being Transported (in cords): ____________

Available at www.ct.gov/deep/eab
FROM CT Federal EAB Quarantined Area TO Other States Non EAB Quarantine Areas

Required Documentation:
1. Certificate OR Limited Permit issued by APHIS inspector

Required Treatment (ONE of Following):
1. Removal of bark and additional 3/8 inch of wood;
2. Kiln sterilization treatment (Treatment T404-b-4);
3. Fumigation according to a treatment schedule (Treatment T404-b-4 MB); OR
4. Heat treatment (Treatment T314-a)
5. Wood chipped to less than one inch (1") in two (2) dimensions.

Firewood and Invasive Insects - NYS Dept. of Environmental Conservation

All firewood entering New York State must be labeled as meeting New York’s heat treatment standards to kill pests. Treatment standards heat firewood core temperature to 71 degrees C, or 160 degrees F for at least 75 minutes. Heated treated firewood that is labeled may be transported anywhere within New York.

December 5, 2014
FROM EAB Non-Quarantined Area AND
EAB Quarantined Area INTO Connecticut
See Section 22-84-5g (a) (2)

Required Documentation:
Permit from Director of Agricultural Experiment Station

Required Treatment:
(Treatment requirements for EAB and ALB as laid out in USDA Plant Protection and Quarantine Treatment Manual - Page 635 or otherwise approved by USDA – APHIS.)

Note: Worcester County, MA is partially quarantined for Asian Long-horned Beetle. For up to date map of quarantine and more specific treatment requirements, visit: APHIS website.
Woodland Management
Take a hike!
Total loss of ash stand due to EAB
Objectives

• How many ash trees on site
• The variety of species present
• Quality of the trees
• Their size, density
• Presence of invasive species
BIG STEP: Know the non-native invasive plants — the opportunists. Eliminate prior to harvest.
Wetlands
Wildlife Cavities
Don’t move firewood. The movement of infested firewood has been identified as one of the main reasons EAB has spread so quickly.
Woodland management

Take action now. EAB is in CT. Determine if you have ash trees on your property. Do not panic!

If you have lots of ash trees, and they show no outward signs of infestation, harvesting those trees may be an option to capture the value of the wood

• Cut largest trees first; Maintain a small ash component
• Promote diversity and maintain the health of the woodland
• Goal is to slow the spread of the insect and take steps to minimize its impact.
Woodland management

• You may want to work with neighboring woodland owners to implement a joint harvest.
Remember…

• There is no right strategy for every woodland. Every property is unique.
Young Woods

• If the trees are small, reduce the overall abundance of ash in your woodland, but don’t eliminate it. Kill the ash that compete with the more desirable species.

• Ash is great firewood (but don’t move it!)
Mature Woods

• In mature forests or those with a lot of ash, a harvest could take place to capture the economic value. Those woodlands with an abundance of ash may be dramatically affected. A mixed species composition should be the goal.

• Ideally, the woods will regenerate naturally. If this strategy is unsuccessful, however, native trees could be planted in their place AS LONG AS those trees are protected from deer browse and the owner is willing to care for the trees.
• Infested trees will need to be removed to ensure developing EAB larvae will not emerge. Ways to do this are chipping, grinding, debarking, burning.
Conclusions

• Ash trees may not show outward signs for years after initial attack
• Ash trees grow across a wide variety of habitats
• Consider developing a written forest management plan for your woodland to keep track of species inventory, tree health, and work done on the property.
• Take the time to consider all your options
THERE IS NO RIGHT STRATEGY for ALL WOODLANDS
Loss of Millions of Ash Trees in North America

Dan Herms, The Ohio State University

Before

After
Concerns

• Safety
  – Trees break apart
  – Trees sprout and block sightlines
  – Stump hazards

• Loss of property value and community spirit

• Loss of ecosystem benefits

• Accelerating costs

• Predictability, Confidence and Communication
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
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
EAB Invasion Wave Curve

Management Phase

Aggressive  Maintenance

Percentage of Maximum

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

Time (Years)

1  5  9  13

Cusp  Crest  Post Crest

Affected Ash
EAB
Milford’s Case

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

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

• **Treatment**
  – Systemic insecticide imidaclloprid-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

Year 0

Year 4
EAB Cost Calculator:

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

• Helpful to have an inventory
• Helpful to know costs
• Have various strategies in mind for your town that you wish to compare
Integrating Tree Benefits

• i-Tree Streets

www.itreetools.org

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

<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><em>Fraxinus americana</em></td>
<td>120.76</td>
<td>38,160</td>
</tr>
<tr>
<td><em>Fraxinus pensylvanica</em></td>
<td>128.74</td>
<td>26,258</td>
</tr>
<tr>
<td>Average/Total</td>
<td><strong>124.74</strong></td>
<td><strong>64,418</strong></td>
</tr>
</tbody>
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Larger (healthy) trees provide more benefits
9% of ash trees provide 20% of the benefits
Insecticide Options for Protecting Ash Trees from Emerald Ash Borer

Daniel A. Herms, Deborah G. McCullough, David R. Smitley, Clifford S. Sadof, Whitney Cranshaw
<table>
<thead>
<tr>
<th>Insecticide Formulation</th>
<th>Active Ingredient</th>
<th>Application Method</th>
<th>Recommended Timing</th>
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<tbody>
<tr>
<td>Products Intended for Sale to Professional Applicators</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Merit® (75WP, 75WSP, 2F)</td>
<td>Imidacloprid</td>
<td>Soil injection or drench</td>
<td>Early to mid-spring or mid-fall</td>
</tr>
<tr>
<td>Safari™ (20 SG)</td>
<td>Dinotefuran</td>
<td>Soil injection or drench</td>
<td>Mid- to late spring</td>
</tr>
<tr>
<td>Transect™ (70WSP)</td>
<td>Dinotefuran</td>
<td>Soil injection or drench</td>
<td>Mid- to late spring</td>
</tr>
<tr>
<td>Xytect™ (2F, 75WSP)</td>
<td>Imidacloprid</td>
<td>Soil injection or drench</td>
<td>Early to mid-spring or mid-fall</td>
</tr>
<tr>
<td>Zylam® Liquid Systemic Insecticide</td>
<td>Dinotefuran</td>
<td>Soil injection or drench</td>
<td>Mid- to late spring</td>
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<tr>
<td>Azasol™</td>
<td>Azadirachtin</td>
<td>Trunk injection</td>
<td>Mid- to late spring after trees have leafed out</td>
</tr>
<tr>
<td>Imicide®</td>
<td>Imidacloprid</td>
<td>Trunk injection</td>
<td>Mid- to late spring after trees have leafed out</td>
</tr>
<tr>
<td>TREE-äge™</td>
<td>Emamectin benzoate</td>
<td>Trunk injection</td>
<td>Mid- to late spring after trees have leafed out</td>
</tr>
<tr>
<td>TreeAzin®</td>
<td>Azadirachtin</td>
<td>Trunk injection</td>
<td>Mid- to late spring after trees have leafed out</td>
</tr>
<tr>
<td>Safari™ (20 SG)</td>
<td>Dinotefuran</td>
<td>Systemic bark spray</td>
<td>Mid- to late spring after trees have leafed out</td>
</tr>
<tr>
<td>Sevin® SE</td>
<td>Permethrin</td>
<td>Two applications at 4-week</td>
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<tr>
<td>Bayer Advanced™ Tree &amp; Shrub Insect Control</td>
<td>Imidacloprid</td>
<td>Soil drench</td>
<td>Early to mid-spring</td>
</tr>
<tr>
<td>Optrol™</td>
<td>Imidacloprid</td>
<td>Soil drench</td>
<td>Early to mid-spring</td>
</tr>
<tr>
<td>Ortho Tree and Shrub Insect Control Ready to Use Granules™</td>
<td>Dinotefuran</td>
<td>Granules</td>
<td>Mid- to late spring</td>
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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
Public Involvement

- EAB detection
- Tree surveys (inventories)
  Complete inventory
  Sample based survey
  “Windshield survey”
The Potential for Biological Control

- *Tetrastichus planipennisi*
- *Spathius agrili*
- *Oobius agrili*

Releases of the first and third are being done by researchers at CAES.
Using the Emerald Ash Borer (EAB) Cost Calculator: A Case Study for Milford, Connecticut

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http://emeraldashborer.info
http://www.ct.gov/caes

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Coalition for Urban Ash Tree Conservation
- Emerald Ash Borer Management Statement -
www.emeraldashborer.info/file/conservash.pdf
signed 05 Jun 2011

Emerald ash borer has killed millions of ash trees since its discovery in 2002, and the number of dead ashes is increasing rapidly. Ash species are abundant in planted and natural areas of urban forests, representing 10% – 40% of the canopy cover in many communities.

Ash trees provide substantial economic and ecosystem benefits to taxpayers, ranging from increased property value, to storm water mitigation, to decreased energy demands (http://www.columbusforeers.org/benefits.htm).

Consequently, widespread ash mortality in urban forests and residential landscapes is having devastating economic and environmental impacts. Indeed, EAB is predicted to cause an unprecedented $10.2 billion in losses to urban forests over the next 30 years (http://www.fs.fed.us/wr/2010/wr2010_30year_forest2040.pdf).

After its initial discovery, regulatory agencies attempted to eradicate EAB through removal and destruction of all ash trees in infested areas. Unfortunately, this proved unsuccessful and was soon abandoned.

Since then, university scientists have developed and refined treatment protocols that can protect healthy ash trees from EAB and help conserve the urban forest.

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Based on research conducted by university scientists, and careful review of the potential impacts on human health and the environment, the Environmental Protection Agency (EPA) has registered three systemic insecticides for control of EAB – dinotefuran is registered for basal trunk bait or soil application, imidacloprid is registered for trunk injection only, and tebufenozide is registered for soil application or trunk injection.

When applied using formulations, products, and protocols documented as effective by university research, these treatments can provide environmentally sound control of EAB, sufficient to maintain a functional and aesthetically pleasing ash canopy.
Need more information?

- CT Agricultural Experiment Station: www.ct.gov/caes/
- CT DEEP Forestry: www.ct.gov/deep/
- Chris Donnelly: chris.donnelly@ct.gov
- Nancy Marek: nancy.marek@uconn.edu
Thank you

- Dr. Claire Rutledge, Gabriela Doria, Hannah Reichle, Bud Neal and Sandy Ingellis – each of whom contributed greatly to the previous set of slides.

- Images: forestry images.org, shutterstock.com
- Resources: Emeraldashborer University, Ohio State Extension, Michigan State, USFS Silvics, vol. 2, CT DEEP, CAES
Slainte
Happy St. Patrick’s Day