



# The Emerald Ash Borer:

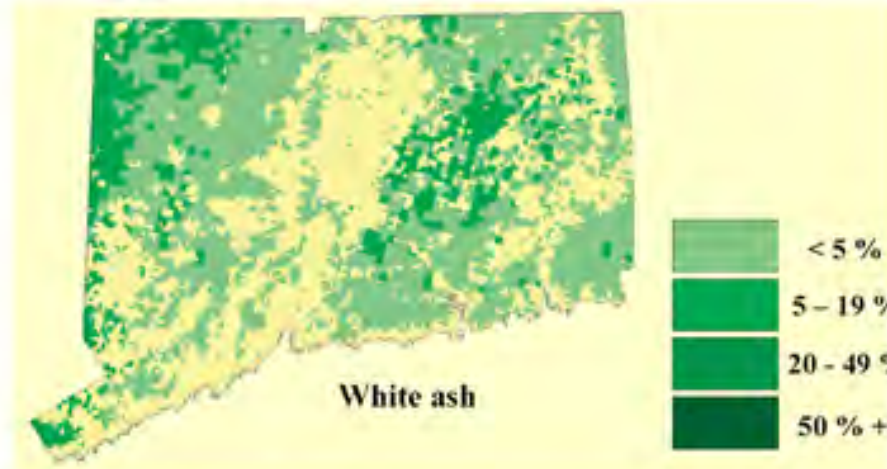
## An Introduction to Management Strategies for Towns and Woodland Owners in Connecticut

# 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

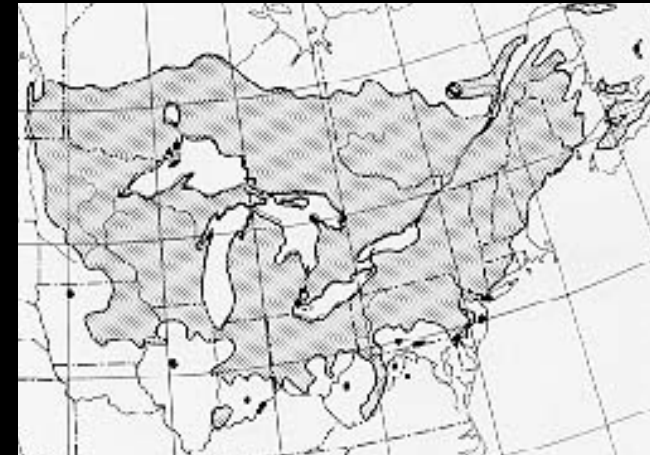
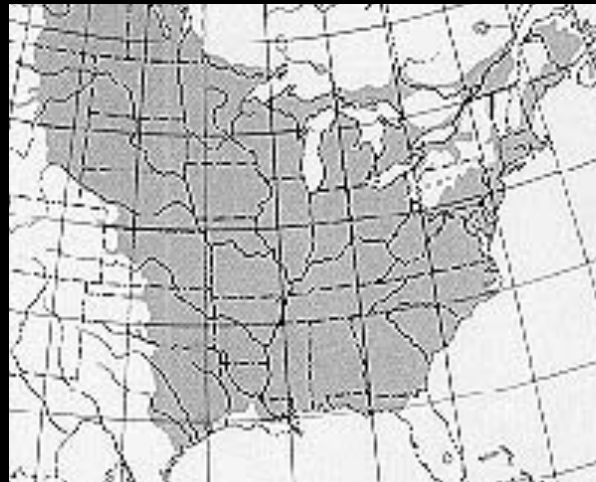
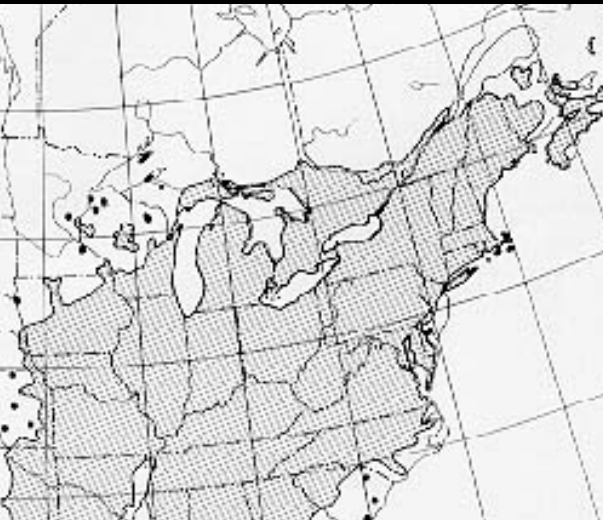
# White Ash tree distribution across the state

Dark green  
up to 19%  
ash  
component



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

# 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

# White ash Tree Facts

- 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



Ash seedlings fighting for the light



# 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



Compare to  
Alternate  
Branching  
Pattern of  
American  
Beech



Twigs in pairs across from  
each other

**Maple**  
**Ash**  
**Dogwood**  
**Viburnum**  
**Horsechestnut**  
**Hydrangea**

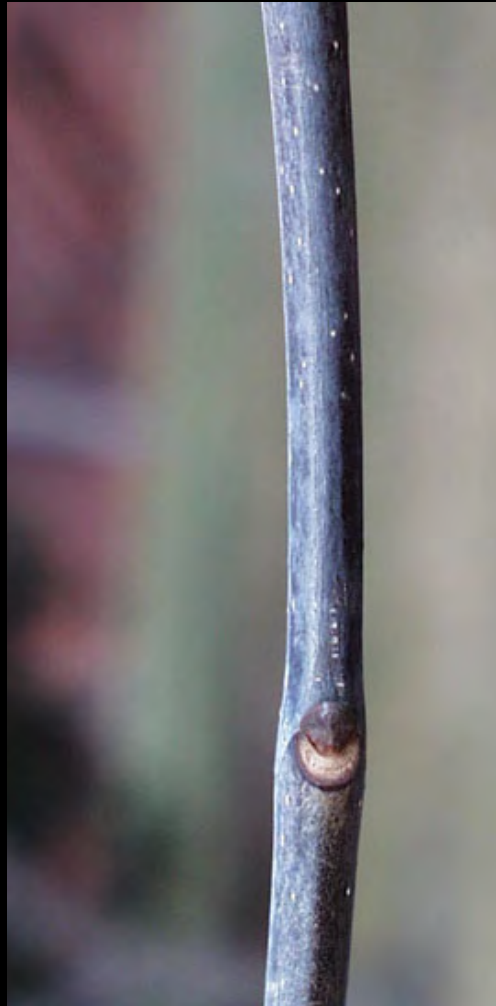


# Identifying the Native Ash: LEAF SCARS

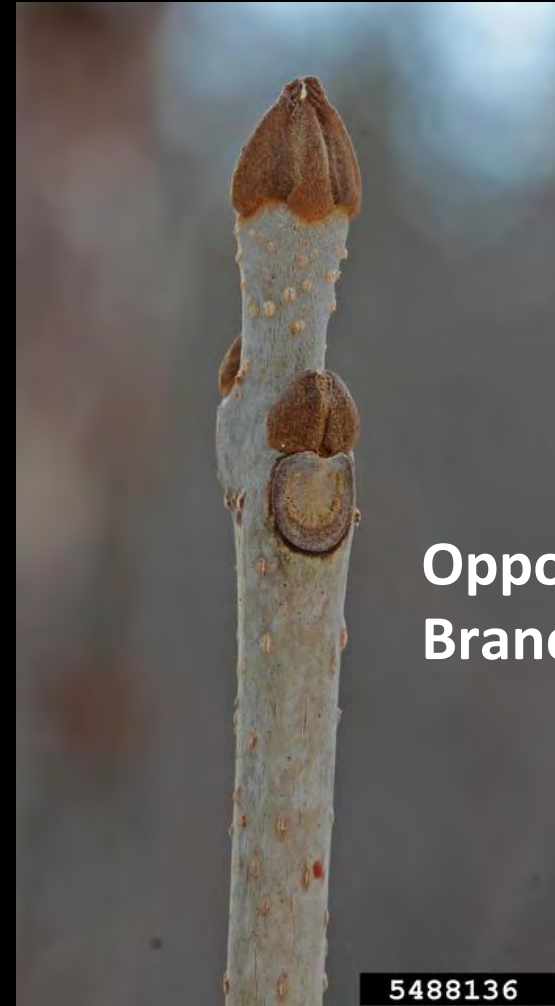
**Green Ash**



**White Ash**



**Black Ash**



# #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



## Mountain Ash

Not susceptible to EAB; not a true ash



## White

Found on upland sites ; Xeric – rarely experience flooding



## Black

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

#4

Identifying  
the Native  
Ash: SEEDS



Black Ash



White Ash



Green 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

# What to look for:

Before EAB                      After



Tree begins to decline from the top down.  
Root still alive.



# Branch die-back



0%



10%



20%



30%



40%



50%



60%



70%



80%



90%



100%

**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



UGA5016050

**Water sprouts –  
desperate attempt**



1241005

**Splits in  
bark  
reveal S-  
shaped  
galleries**



**D-shaped exit holes**



# 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

Adult emerges:  
About middle of June

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

Pupa: Late-April to  
June



D-shaped exit hole



Overwinters as pre-  
pupal larva

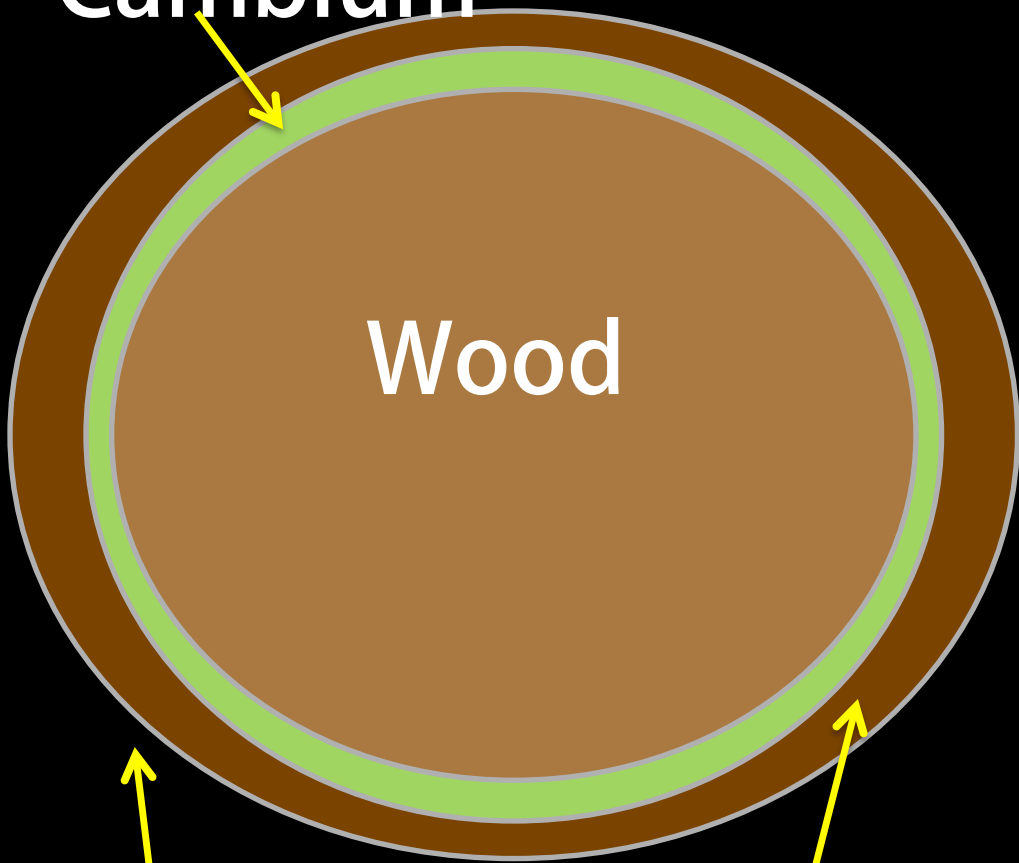
Larval Stage:  
(Inner bark)  
Mid-July-Sept



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

# Emerald Ash Borer look-alikes



Caterpillar Hunter



Emerald Ash Borer



Japanese Beetle



Six Spotted Tiger Beetle

Two-lined Chestnut Borer



Bronze Birch Borer



Both borers do not feed on ash trees





Prospect, CT – Summer 2014



# 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%



Prospect, CT – Summer 2014



Prospect, CT – Summer 2014

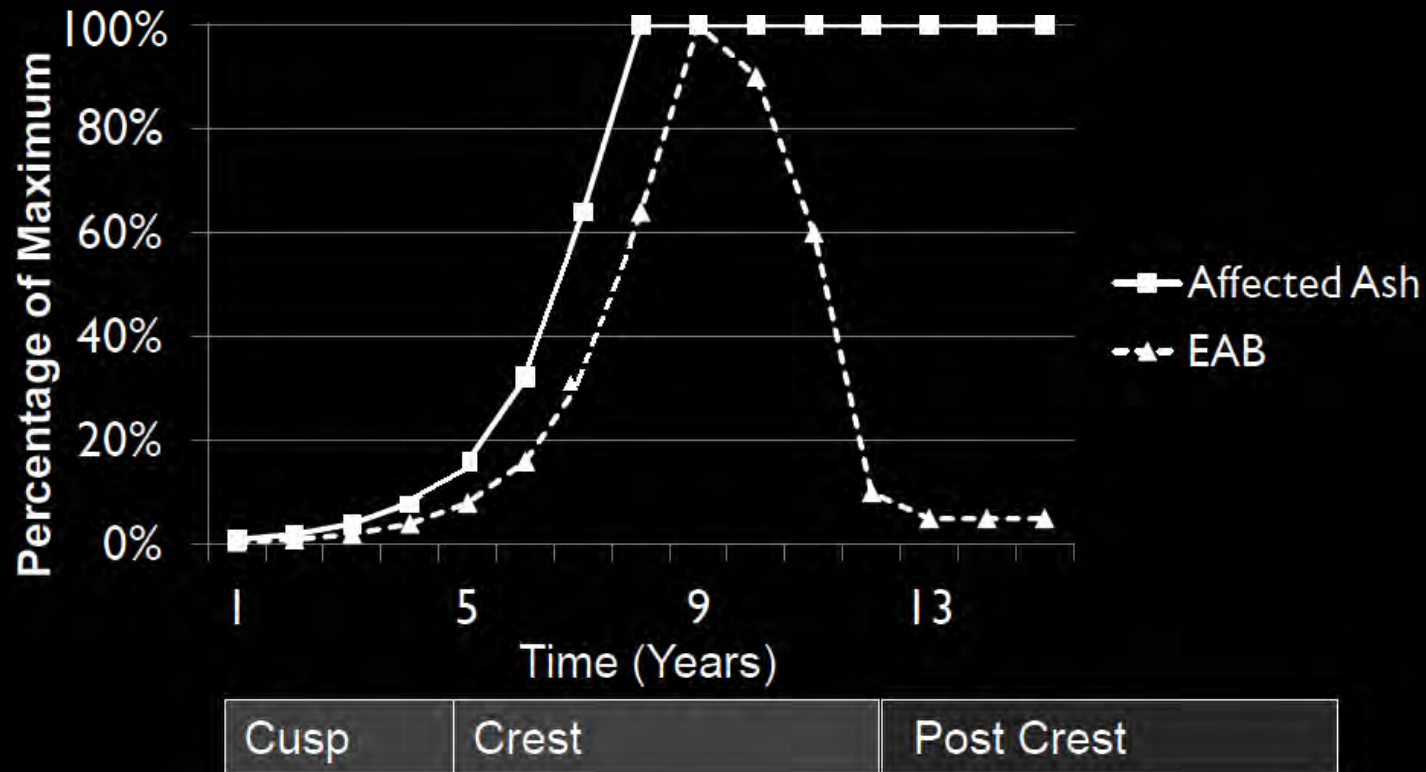


Prospect, CT – Summer 2014

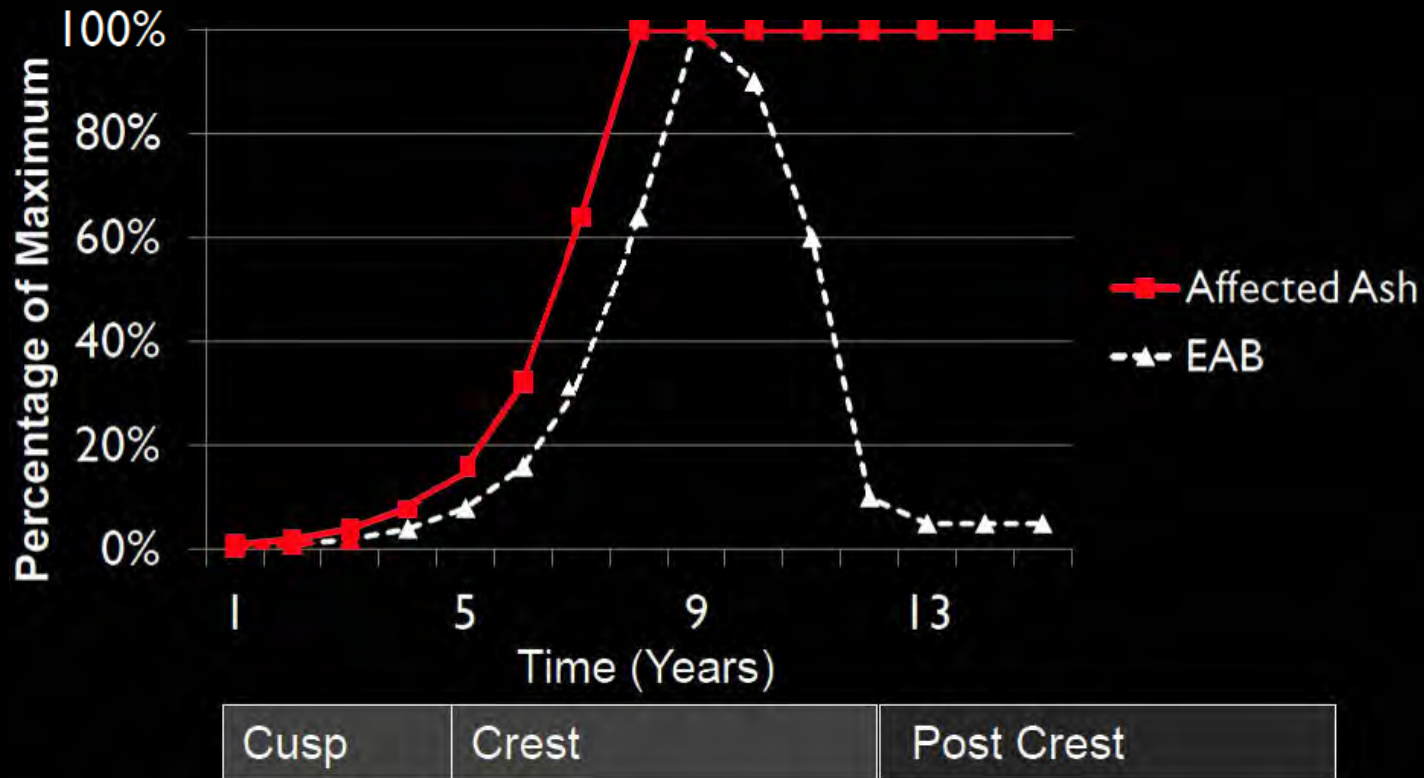


Prospect, CT – Summer 2014

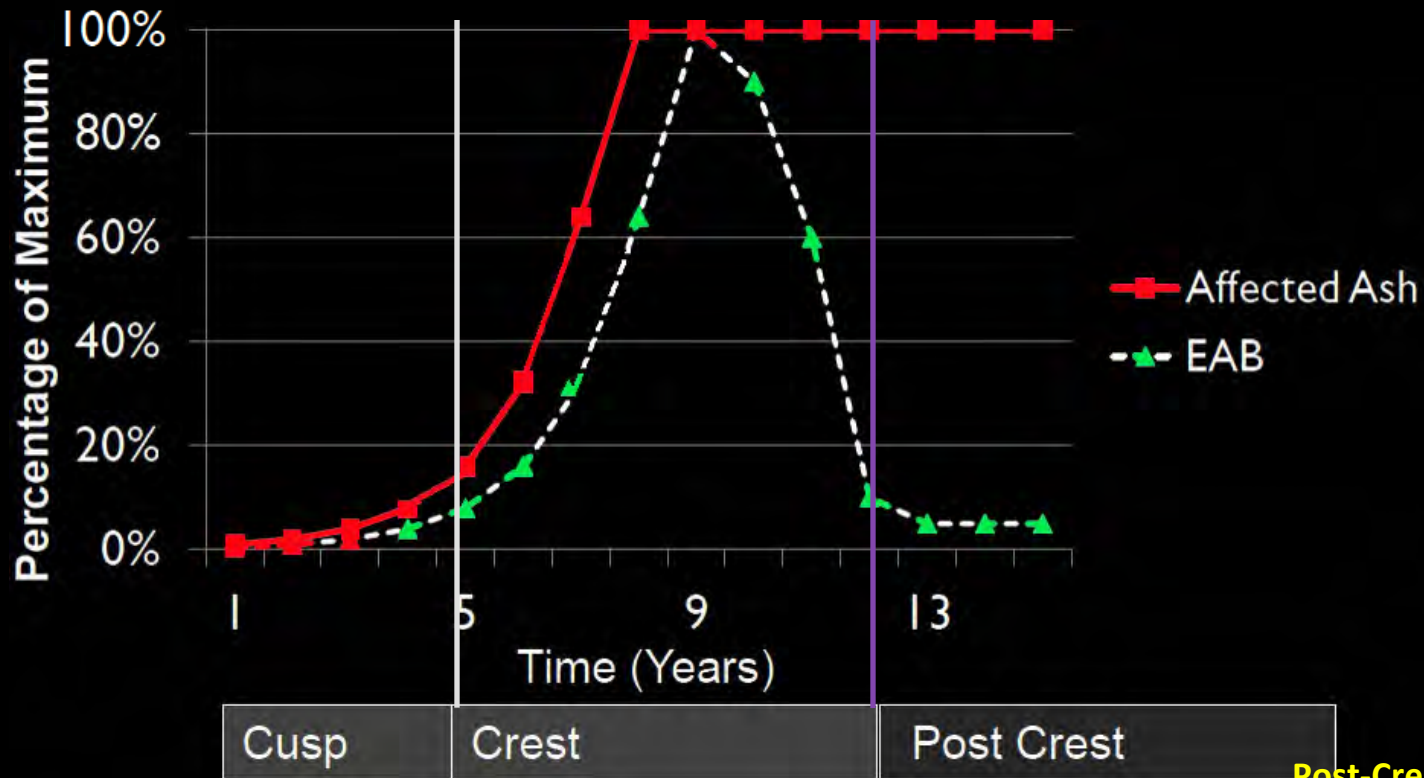
# EAB Invasion Wave Curve



# EAB Invasion Wave Curve



# 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.

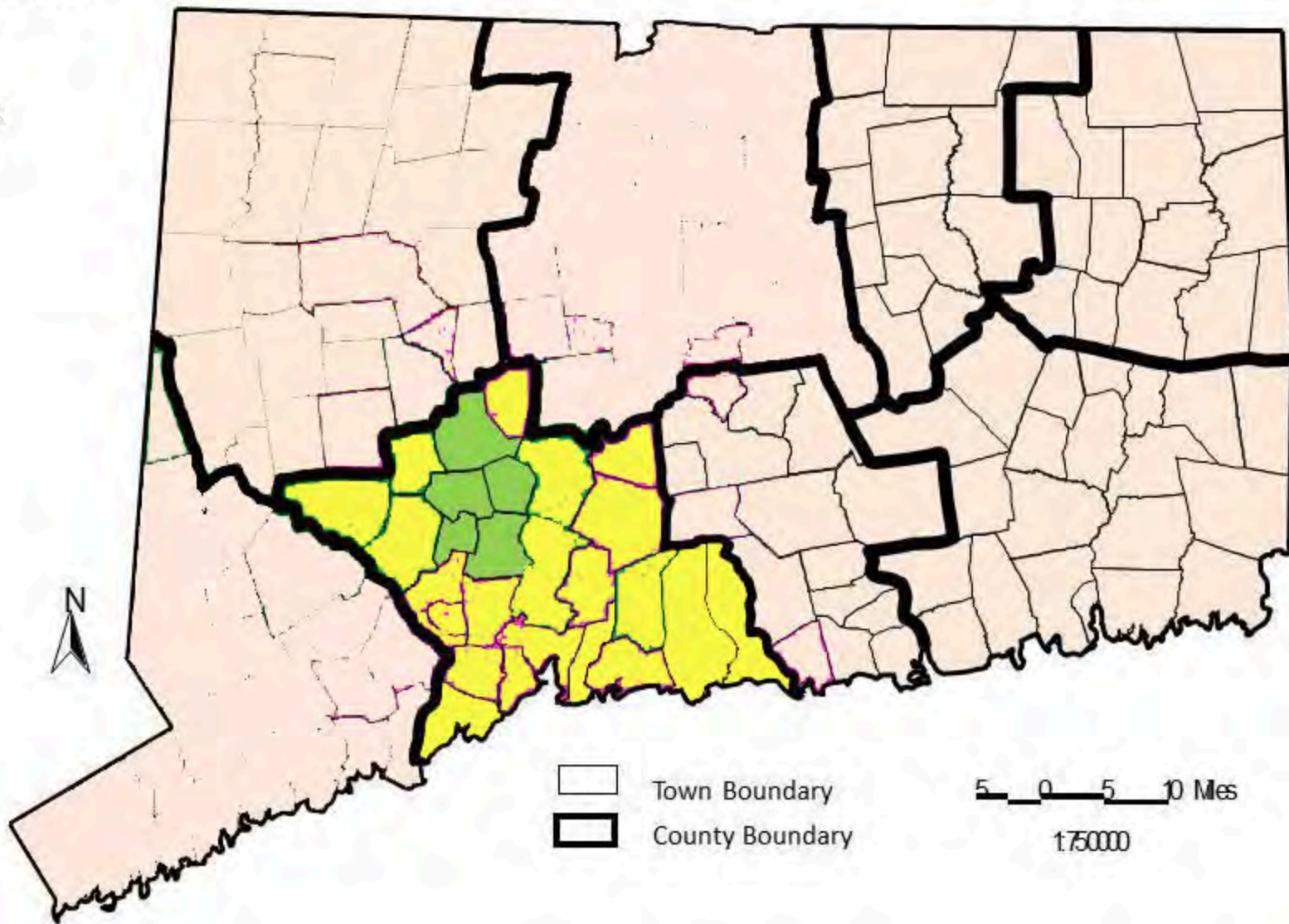
# What is Ash Used For?

Ash lumber is used to make products such as...



Quarantine

2012



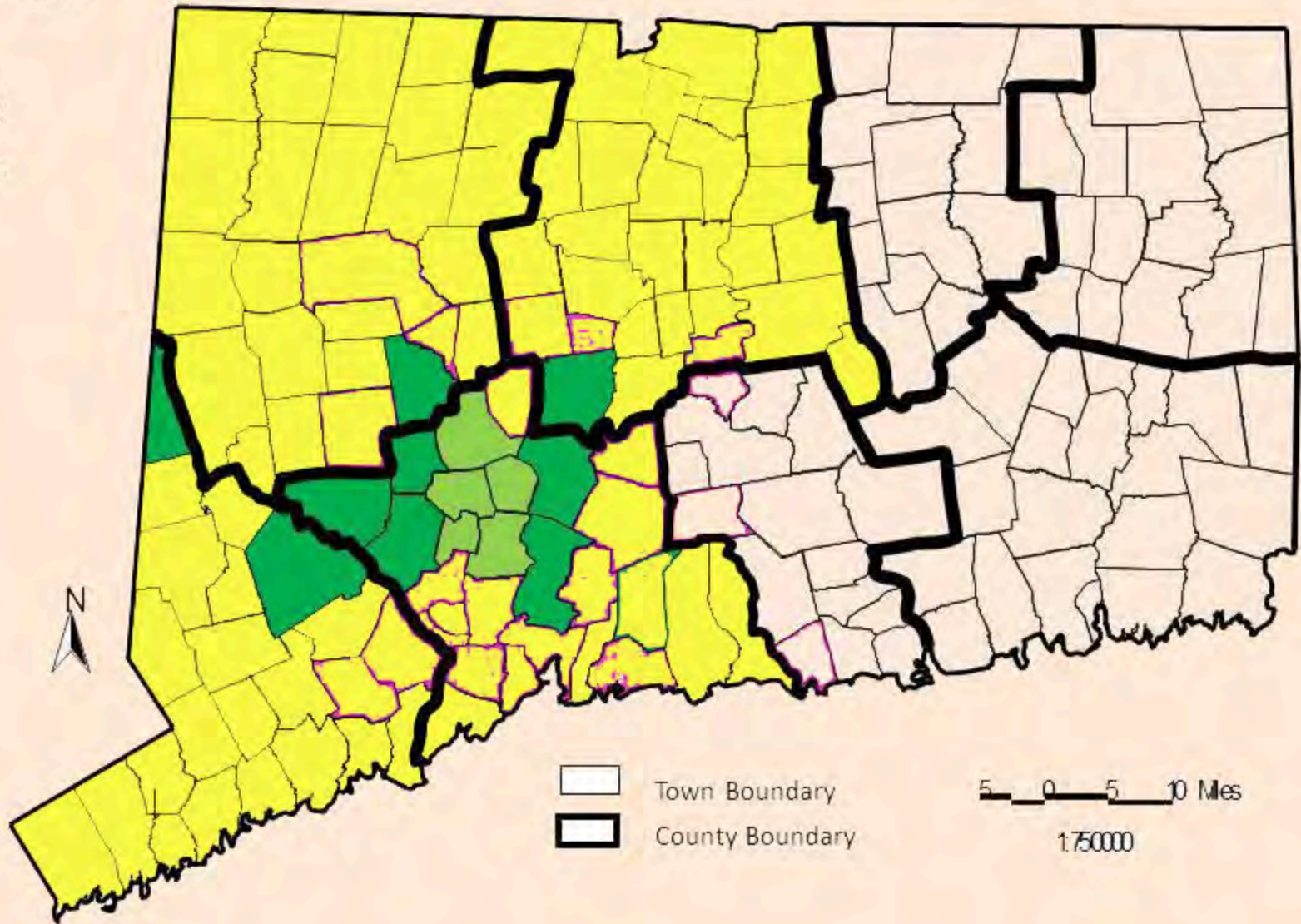
Town Boundary  
County Boundary

5 0 5 10 Miles  
1:75000

Quarantine

2012

2013



Town Boundary  
County Boundary

5 0 5 10 Miles  
1:75000

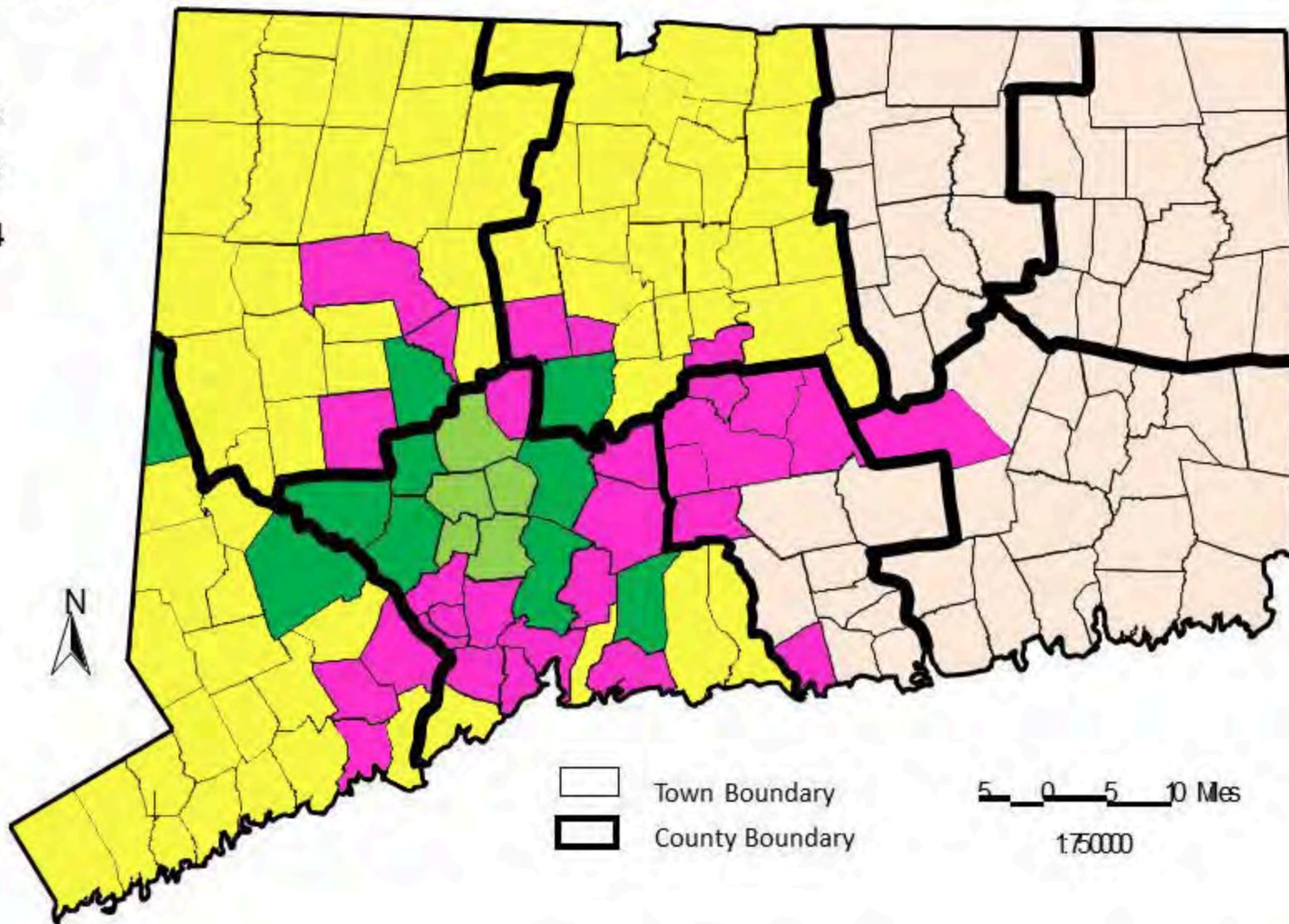
Quarantine extended August 29, 2013  
no regulated articles out of western 4 counties.

Quarantine

2012

2013

2014



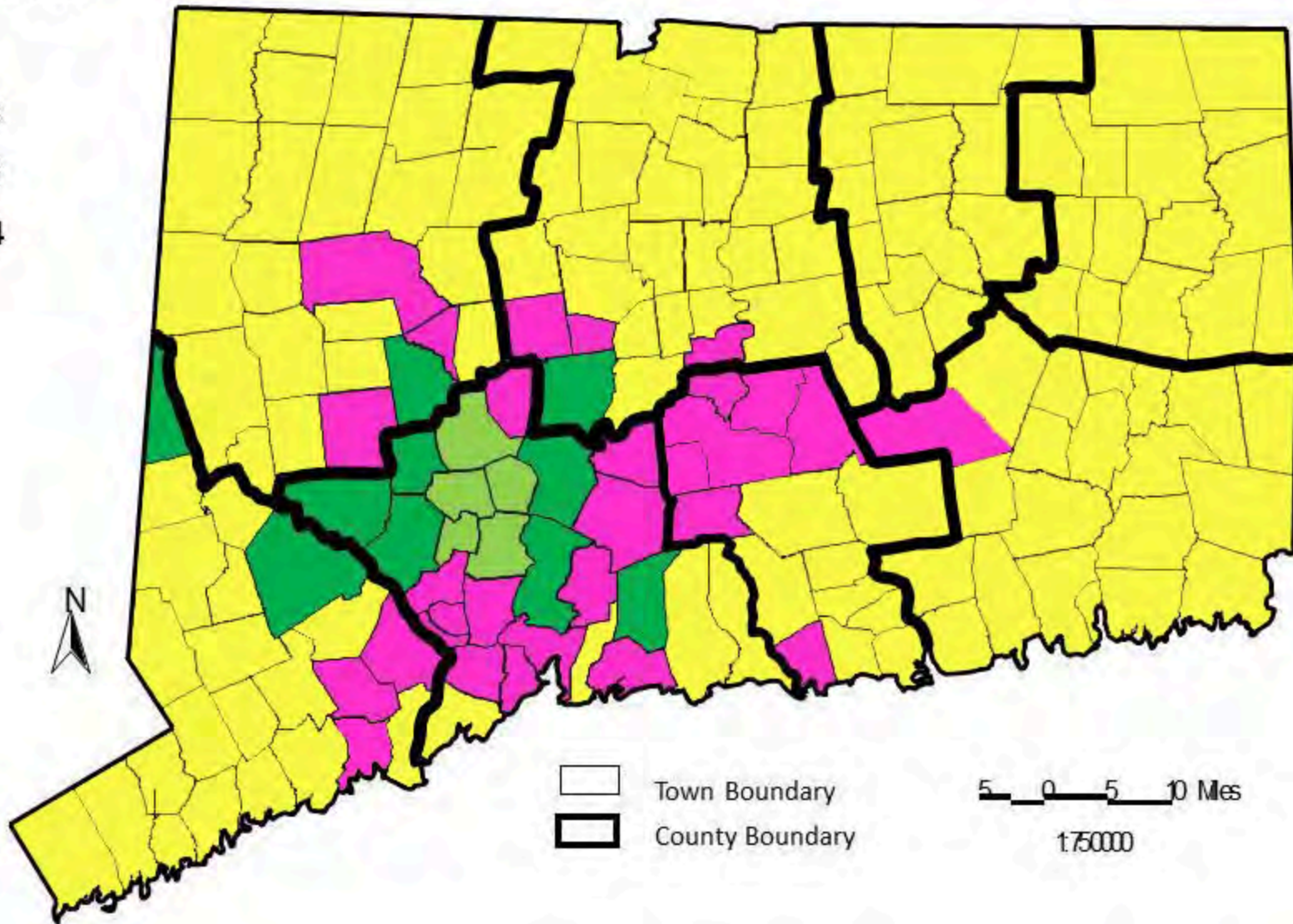


Quarantine

2012

2013

2014



Town Boundary



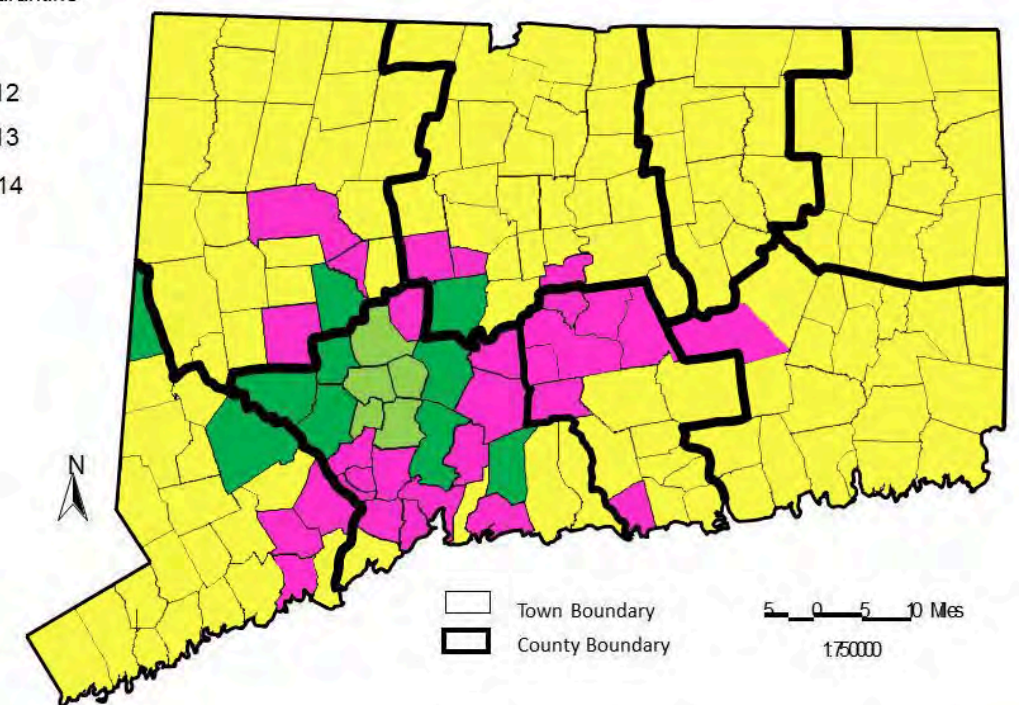
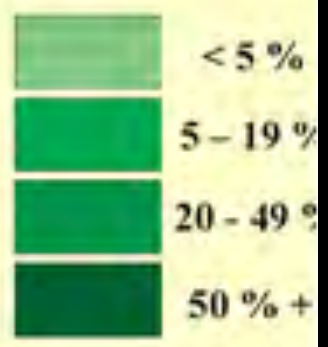
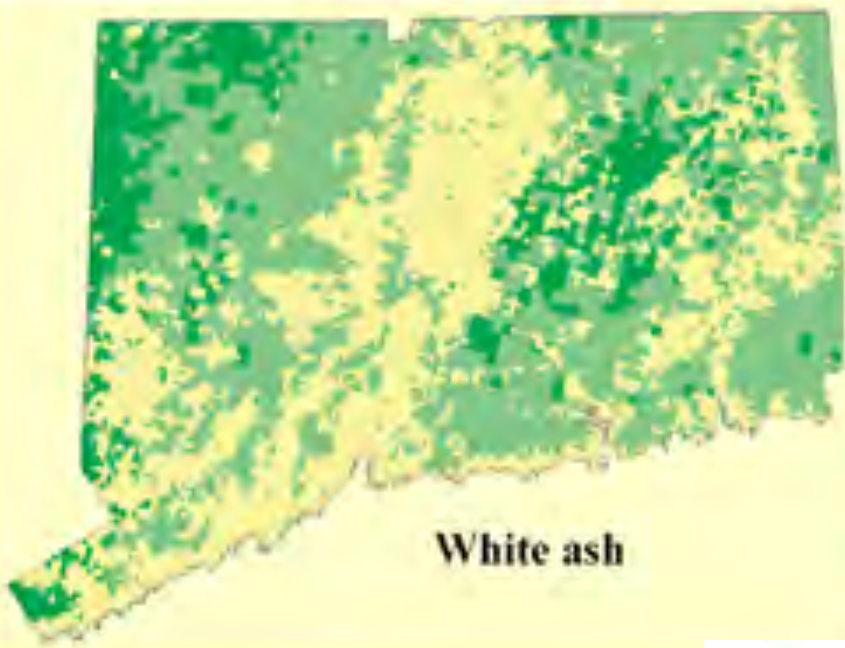
County Boundary

5 0 5 10 Miles

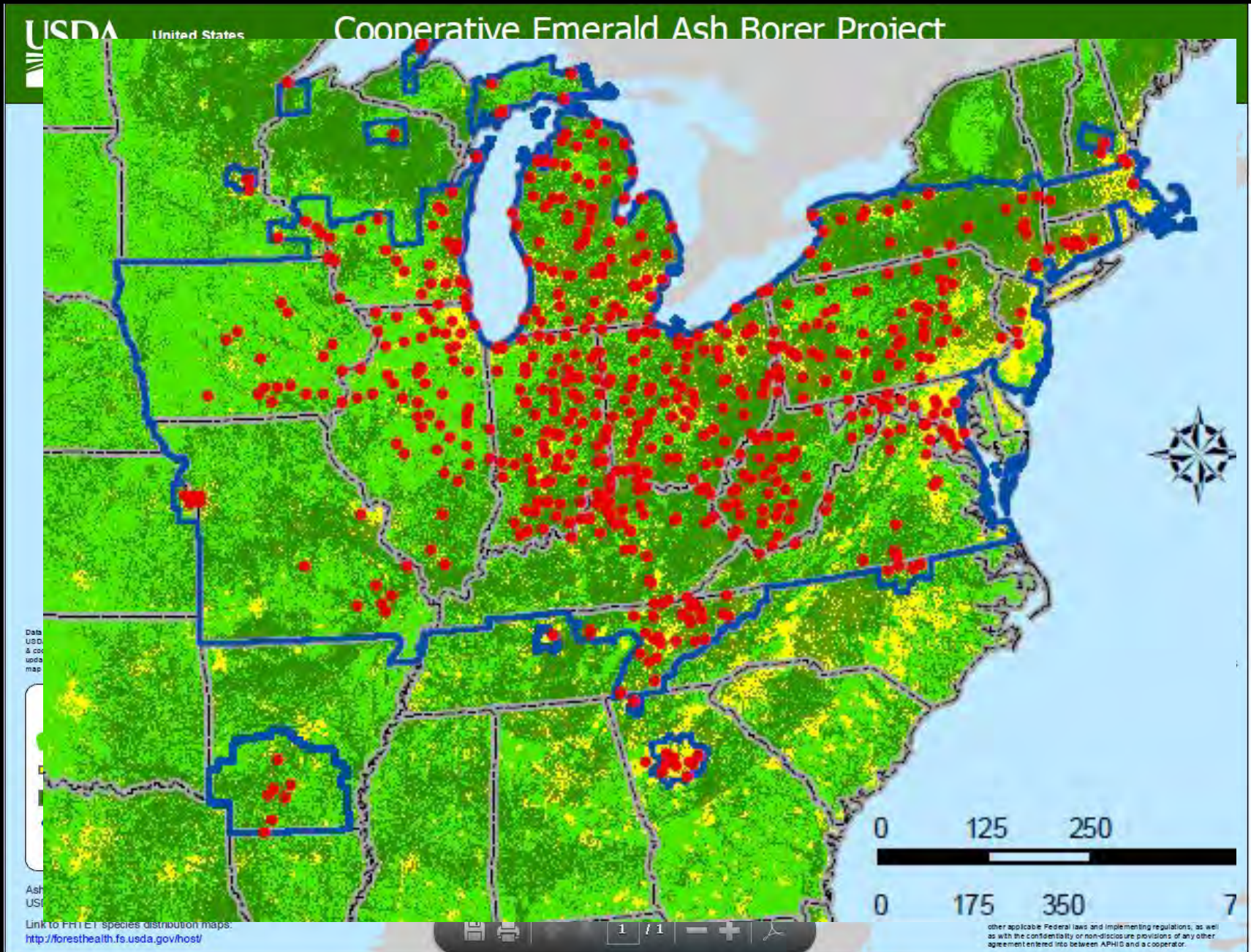
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CAES  
Center for Agricultural and Environmental Sciences



# Federal Quarantine





# 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](http://www.emeraldashborer.info)

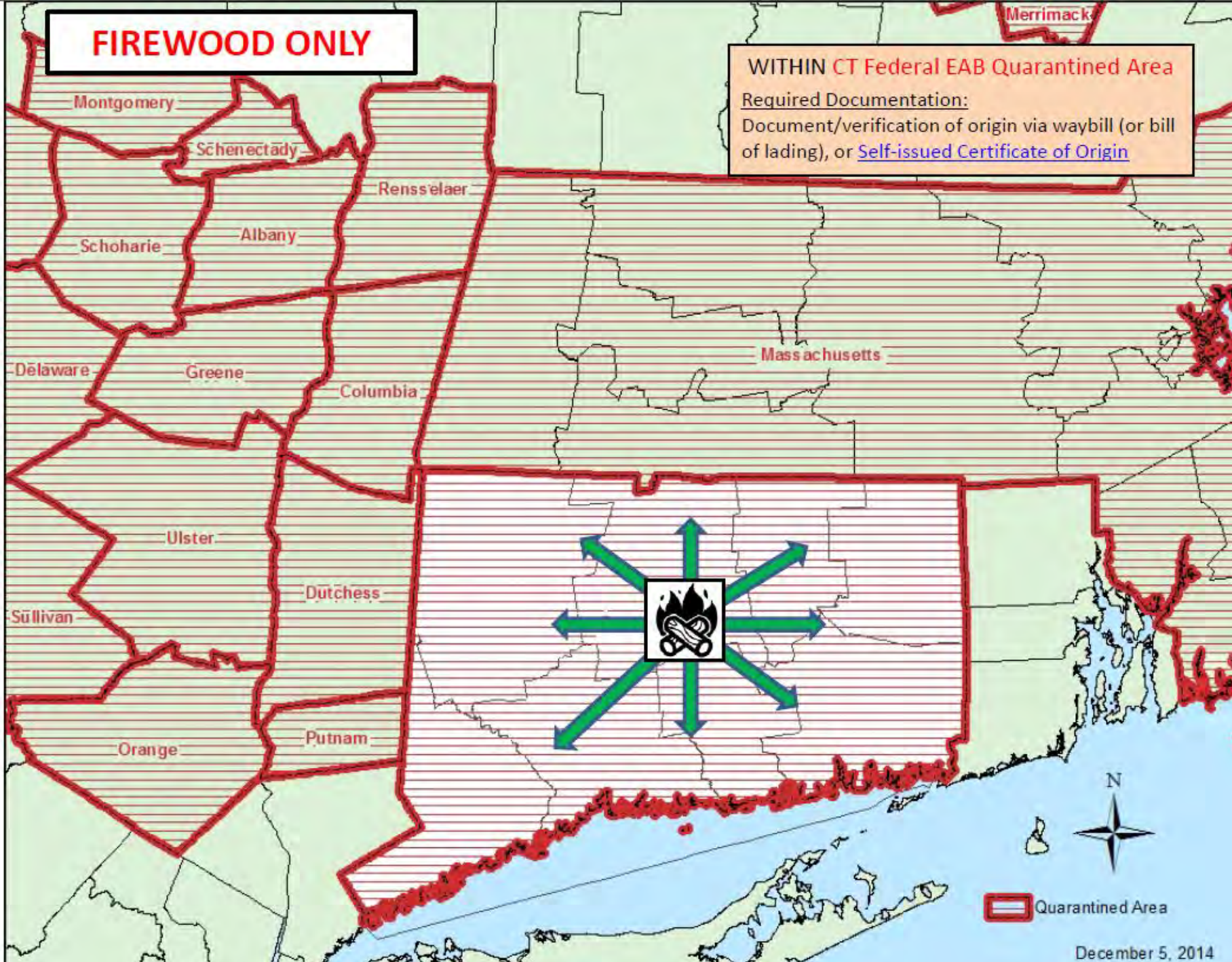


# FIREWOOD ONLY

## WITHIN CT Federal EAB Quarantined Area

### Required Documentation:

Document/verification of origin via waybill (or bill of lading), or [Self-issued Certificate of Origin](#)





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 203-974-8474 prior to moving firewood out of or through an affected county.  
 Zip Code: \_\_\_\_\_

#### Part III: Destination of Firewood Being Transported

Street Address: \_\_\_\_\_  
 City/Town: \_\_\_\_\_  
 County (refer to [county map](#)): \_\_\_\_\_  
 Zip Code: \_\_\_\_\_  
 Approximate Volume Being Transported (in Cords): \_\_\_\_\_

Available at [www.ct.gov/deep/eab](http://www.ct.gov/deep/eab)

# FIREWOOD ONLY

FROM **CT Federal EAB Quarantined Area**  
TO **Other States Non EAB Quarantine Areas**

## Required Documentation

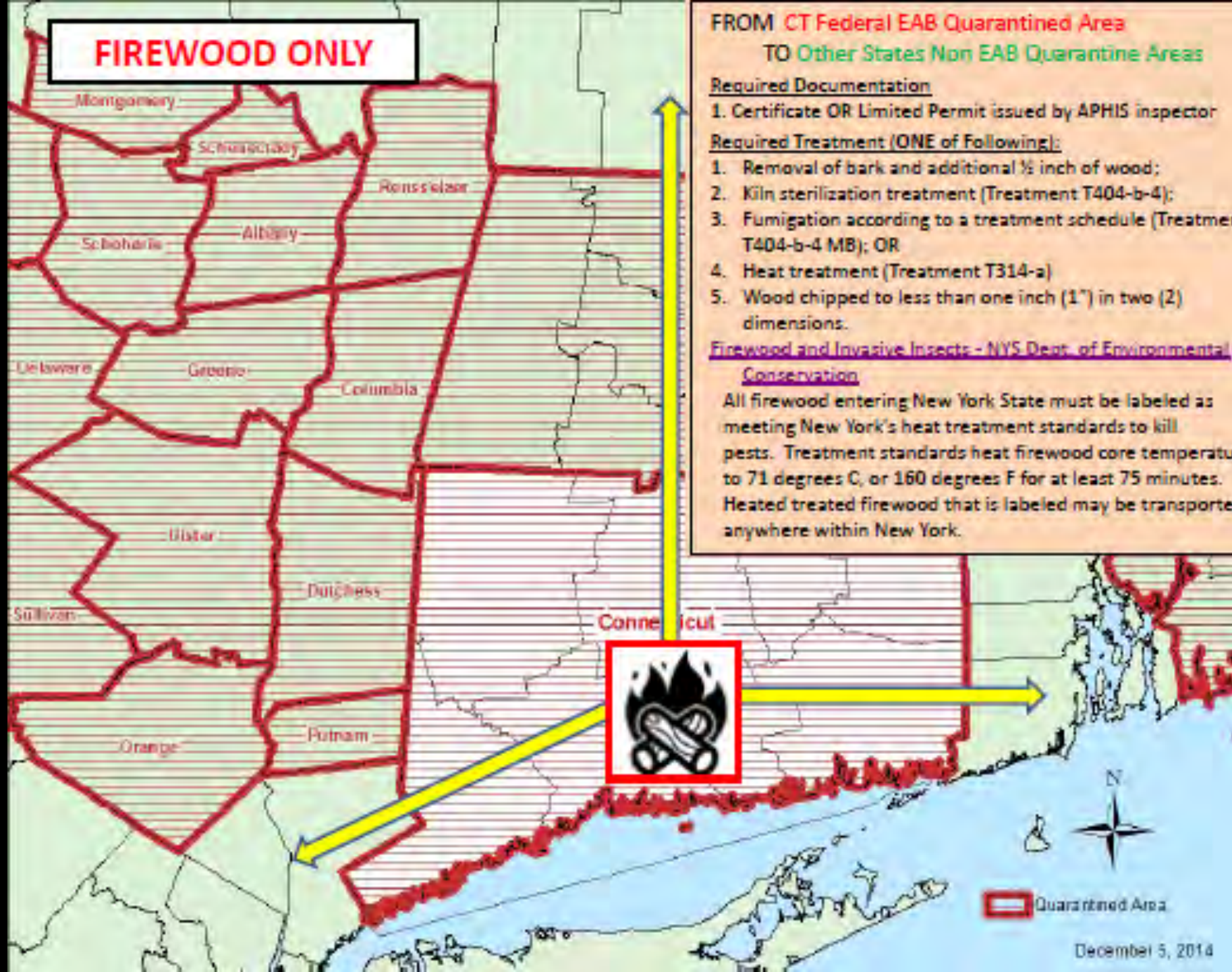
1. Certificate OR Limited Permit issued by APHIS inspector

## 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.



Quarantined Area

December 5, 2014



# FIREWOOD ONLY

FROM **EAB Non-Quarantined Area** AND  
**EAB Quarantined Area** INTO **Connecticut**

See Section 22-84-5g (a) (2)

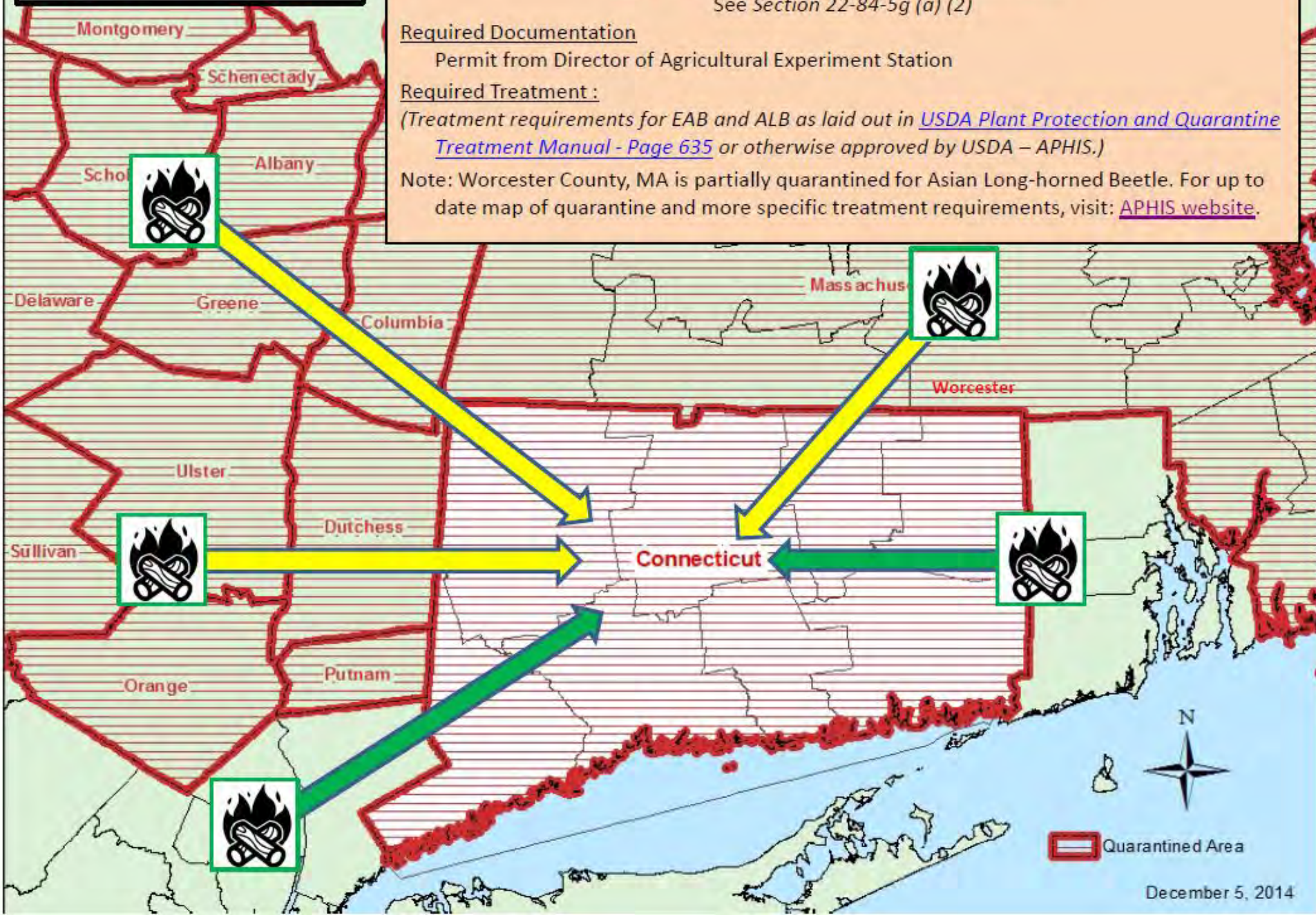
## Required Documentation

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](#).





OUT - OF - STATE  
FIREWOOD  
REGULATED  
PERMIT REQUIRED

WELCOME TO  
CONNECTICUT



# 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.



Japanese barberry



Winged Euonymus



Multiflora rose

# Wetlands



TIGA1118288







# 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**



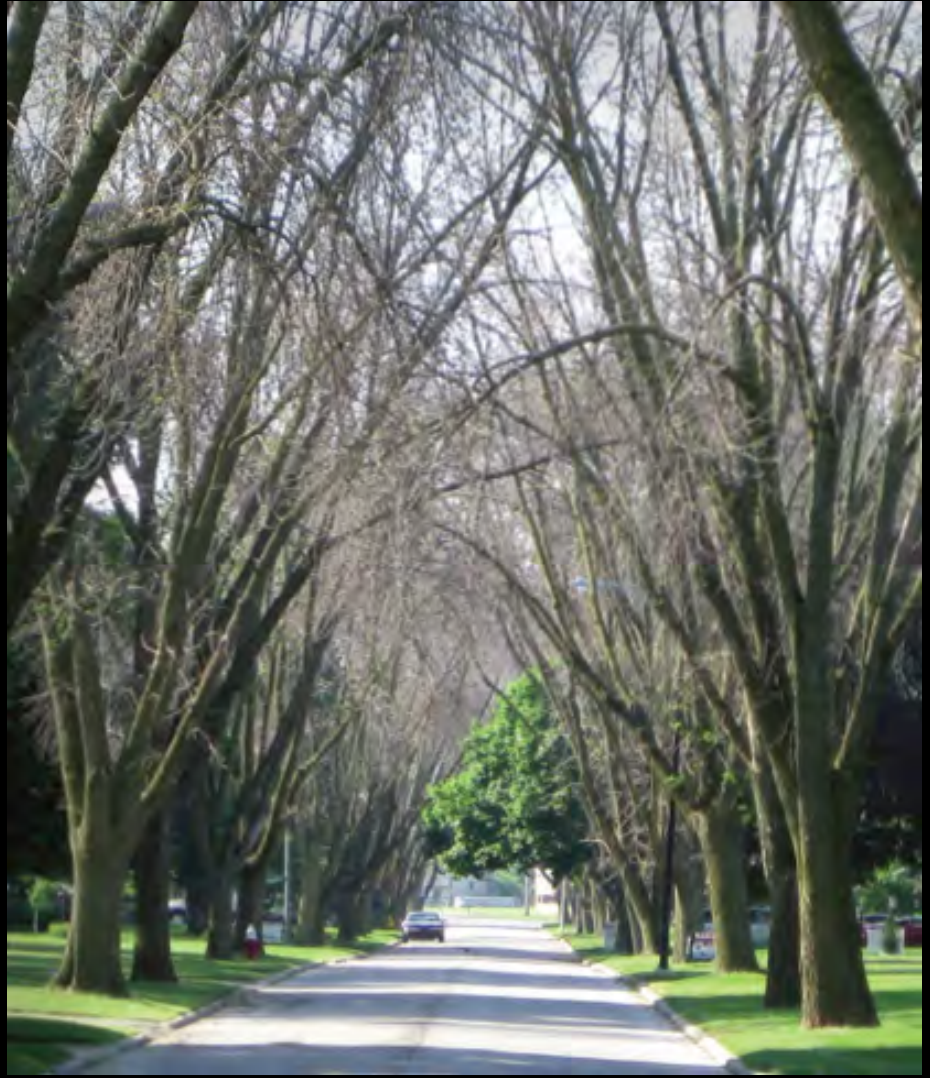




# Loss of Millions of Ash Trees in North America



Before



After

Dan Herms, The Ohio State University

# 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.

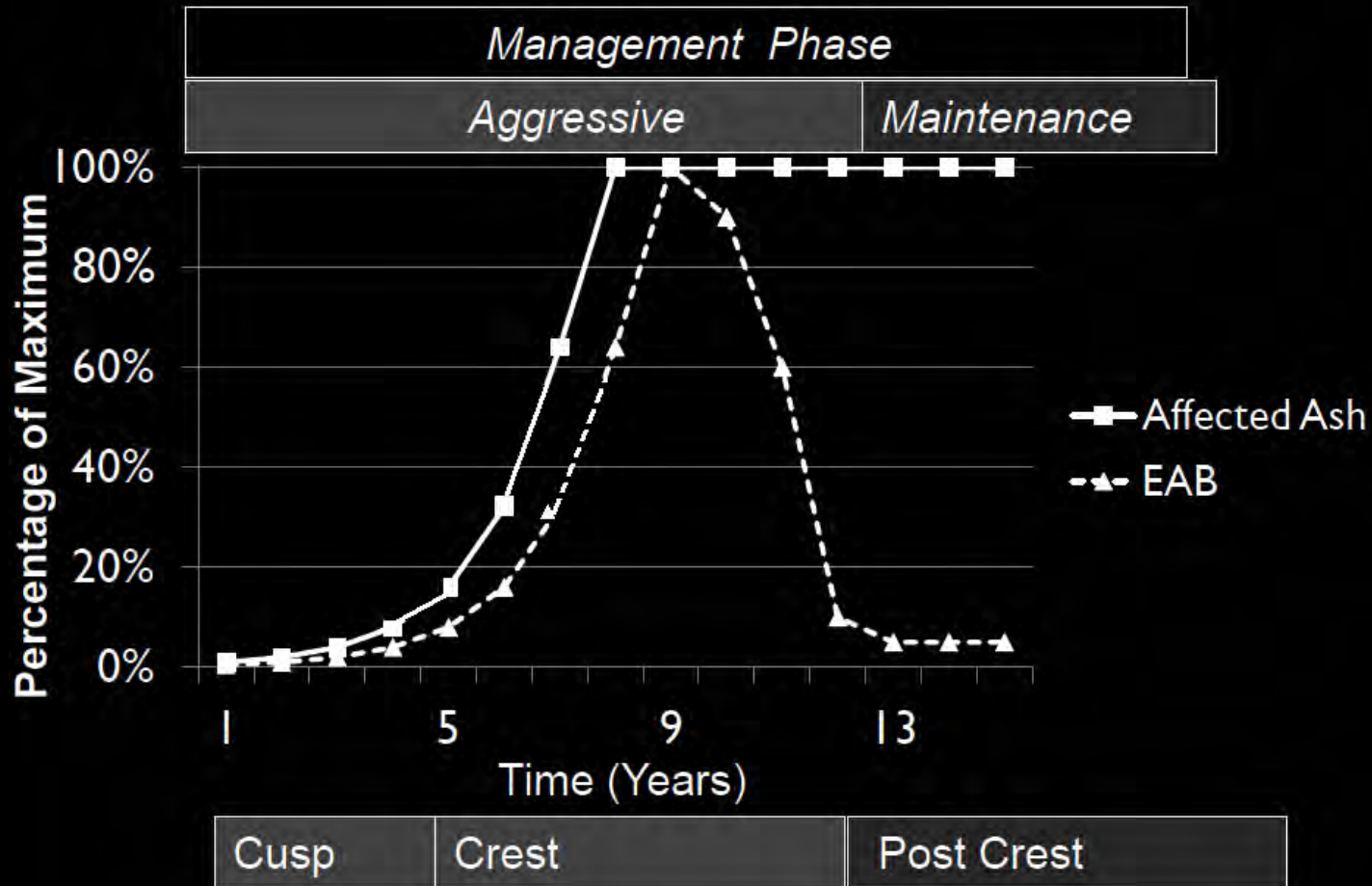
Sadof et al., 2011



# 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

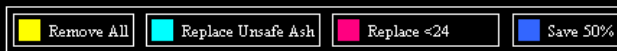
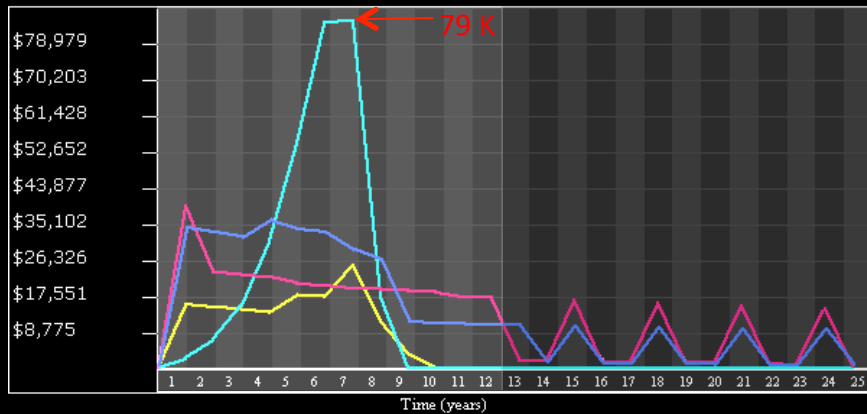


# Milford's Case

- 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

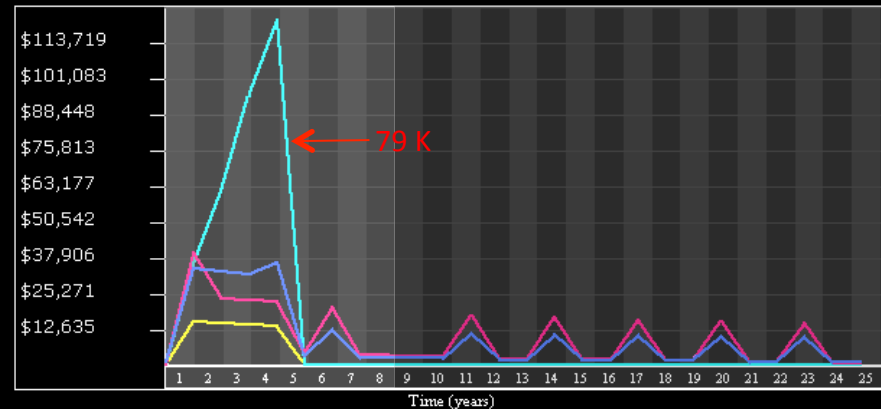
# Annual Cost Comparisons

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



Year 0

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



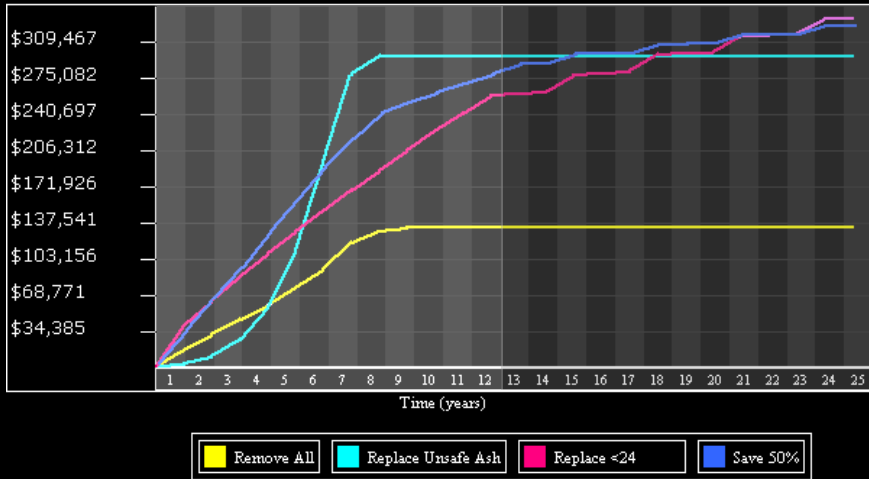
Year 4

Aggressive Phase (1 year)

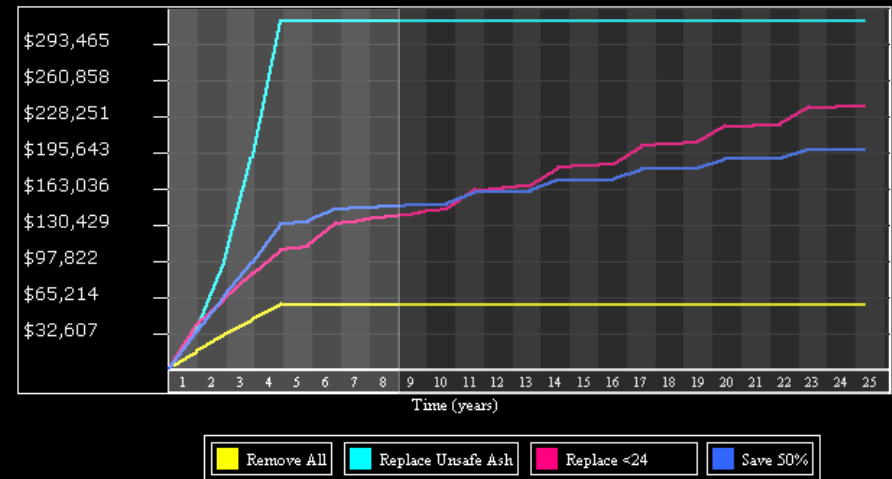
Maintenance Phase (3 years)

# Cumulative Cost Comparison

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



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

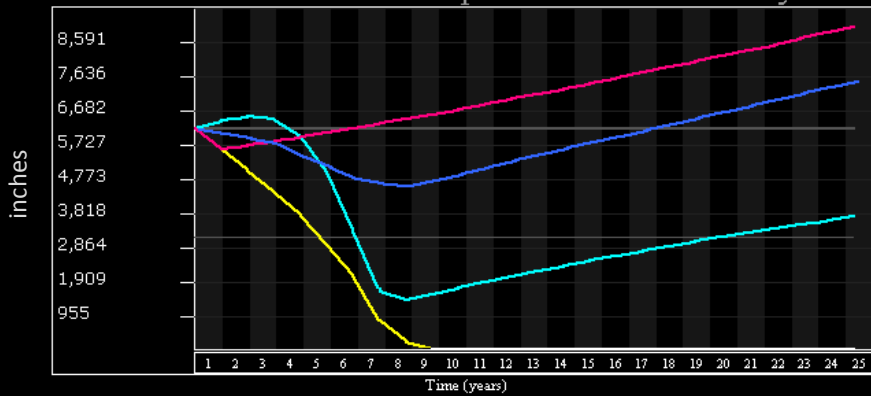


- Aggressive Phase (1 year)
- Maintenance Phase (3 years)



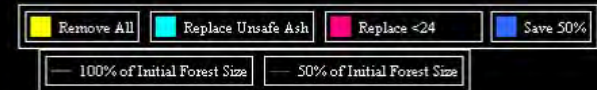
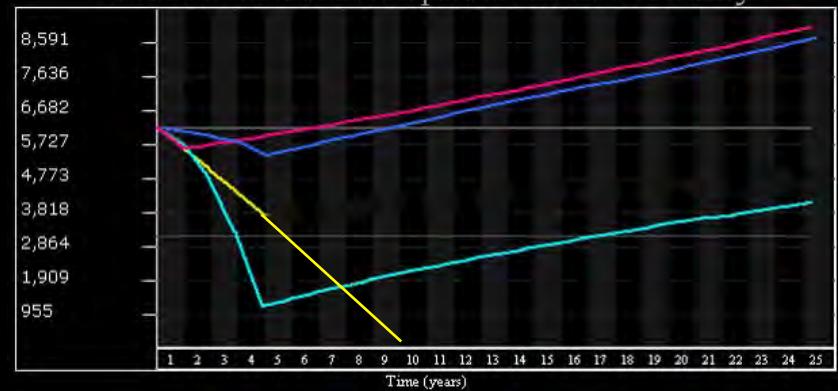
# Total DBH

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



Year 0

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



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.itreetols.org](http://www.itreetols.org)

## Benefits

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

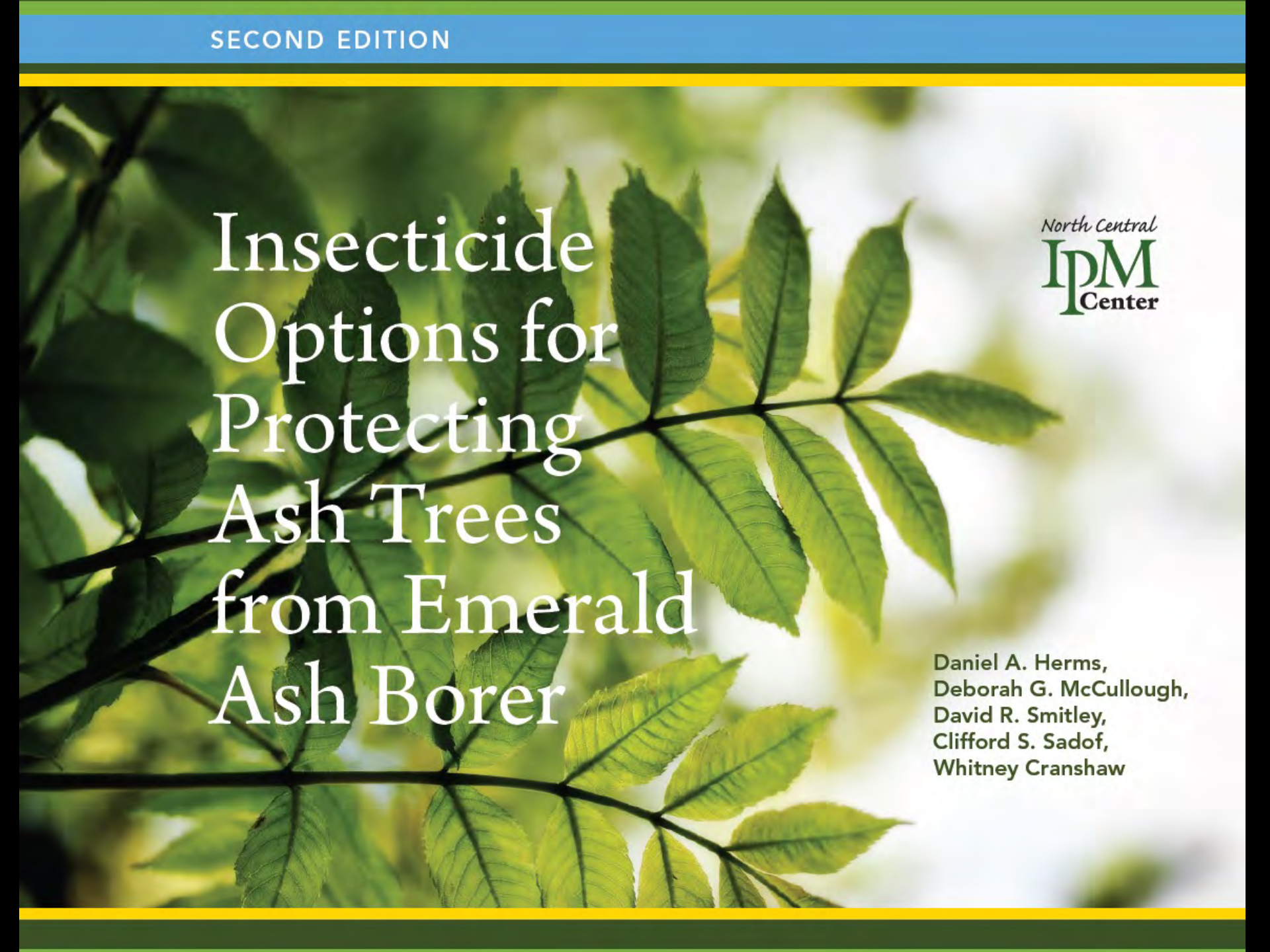
	All ash trees (518 trees)		Ash Trees Larger than 24" (44 trees)	
	Annual Benefits (US \$/tree)	Net Annual Benefits (US \$/year)	Annual Benefits (US \$/tree)	Net Annual Benefits (US\$/year)
<i>Fraxinus americana</i>	120.76	38,160	286.84	6,884
<i>Fraxinus pensylvanica</i>	128.74	26,258	276.17	5,523
Average/Total	124.74	64,418	281.51	12,407

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





SECOND EDITION



# Insecticide Options for Protecting Ash Trees from Emerald Ash Borer

*North Central*  
**IPM**  
Center

Daniel A. Herms,  
Deborah G. McCullough,  
David R. Smitley,  
Clifford S. Sadof,  
Whitney Cranshaw

Insecticide Formulation	Active Ingredient	Application Method	Recommended Timing
<i>Products Intended for Sale to Professional Applicators</i>			
Merit® (75WP, 75WSP, 2F)	Imidacloprid	Soil injection or drench	Early to mid-spring or mid-fall
Safari™ (20 SG)	Dinotefuran	Soil injection or drench	Mid- to late spring
Transect™ (70WSP)	Dinotefuran	Soil injection or drench	Mid- to late spring
Xytect™ (2F, 75WSP)	Imidacloprid	Soil injection or drench	Early to mid-spring or mid-fall
Zylam® Liquid Systemic Insecticide	Dinotefuran	Soil injection or drench	Mid- to late spring

Azasol™	Azadirachtin	Trunk injection	Mid- to late spring after trees have leafed out
Imicide®	Imidacloprid	Trunk injection	Mid- to late spring after trees have leafed out
TREE-äge™	Emamectin benzoate	Trunk injection	Mid- to late spring after trees have leafed out
TreeAzin®	Azadirachtin	Trunk injection	Mid- to late spring after trees have leafed out
Safari™ (20 SG)	Dinotefuran	Systemic bark spray	Mid- to late spring after trees have leafed out
Astro®	Permethrin		Two applications at 4-week

*Products Intended for Sale to Homeowners*

Bayer Advanced™ Tree & Shrub Insect Control	Imidacloprid	Soil drench	Early to mid-spring
Optrol™	Imidacloprid	Soil drench	Early to mid-spring
Ortho Tree and Shrub Insect Control Ready to Use Granules®	Dinotefuran	Granules	Mid- to late spring





# 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

Gabriela Doria & Chris Donnelly

Urban Forestry Program, Forestry Division
Department of Energy and Environmental Protection
State of Connecticut
79 Elm Street, Hartford, CT 06106-5127
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http://emeraldashborer.info

http://www.ct.gov/caes

Coalition for Urban Ash Tree Conservation - Emerald Ash Borer Management Statement -

www.emeraldashborer.info/files/conserv\_ash.pdf signed 06 Jan 2011

We the undersigned strongly endorse ash tree conservation as a fundamental component of integrated programs to manage emerald ash borer (EAB) in residential and municipal landscapes.

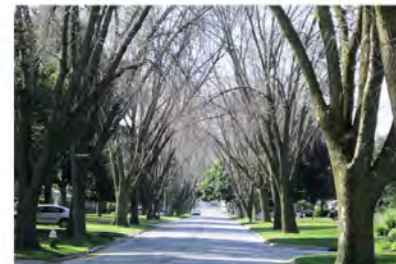
Emerald ash borer has killed millions of ash trees since its discovery in 2002 and the number of dead ash is increasing rapidly.

Ash trees provide substantial economic and ecosystem benefits to taxpayers, ranging from increased property value, to storm water mitigation, to decreased energy demands

Consequently, widespread ash mortality in urban forests and residential landscapes is having devastating economic and environmental impacts.

After its initial discovery, regulatory agencies attempted to eradicate EAB through removal and destruction of all ash trees in infested areas.

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



Untreated ash trees after EAB peak, Belvedere Dr., Toledo, OH, June 2009.

However, despite availability of cost-effective treatments, many municipalities, property managers, and homeowners continue to rationalize tree removal as the only viable management strategy for EAB.



Ash trees before EAB devastation -- Belvedere Dr., Toledo, OH, June 2006.

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 bark or soil application, emamectin benzoate for trunk injection only, and imidacloprid 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.

http://www.ct.gov/deep/forestry

http://www.ct.gov/deep/eab

# Need more information?

- CT Agricultural Experiment Station:  
[www.ct.gov/caes/](http://www.ct.gov/caes/)
- CT DEEP Forestry: [www.ct.gov/deep/](http://www.ct.gov/deep/)
- CT DEEP Certified Forest Practitioners Link:  
[http://www.ct.gov/deep/lib/deep/forestry/  
forest\\_practitioner\\_certification/directry.pdf](http://www.ct.gov/deep/lib/deep/forestry/forest_practitioner_certification/directry.pdf)
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# Thank you

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- 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

