NPDN National Plant Diagnostic Network
Northeastern IPM Center
APHIS
Cornell University

INTRODUCTION TO EAB

First Detector Training

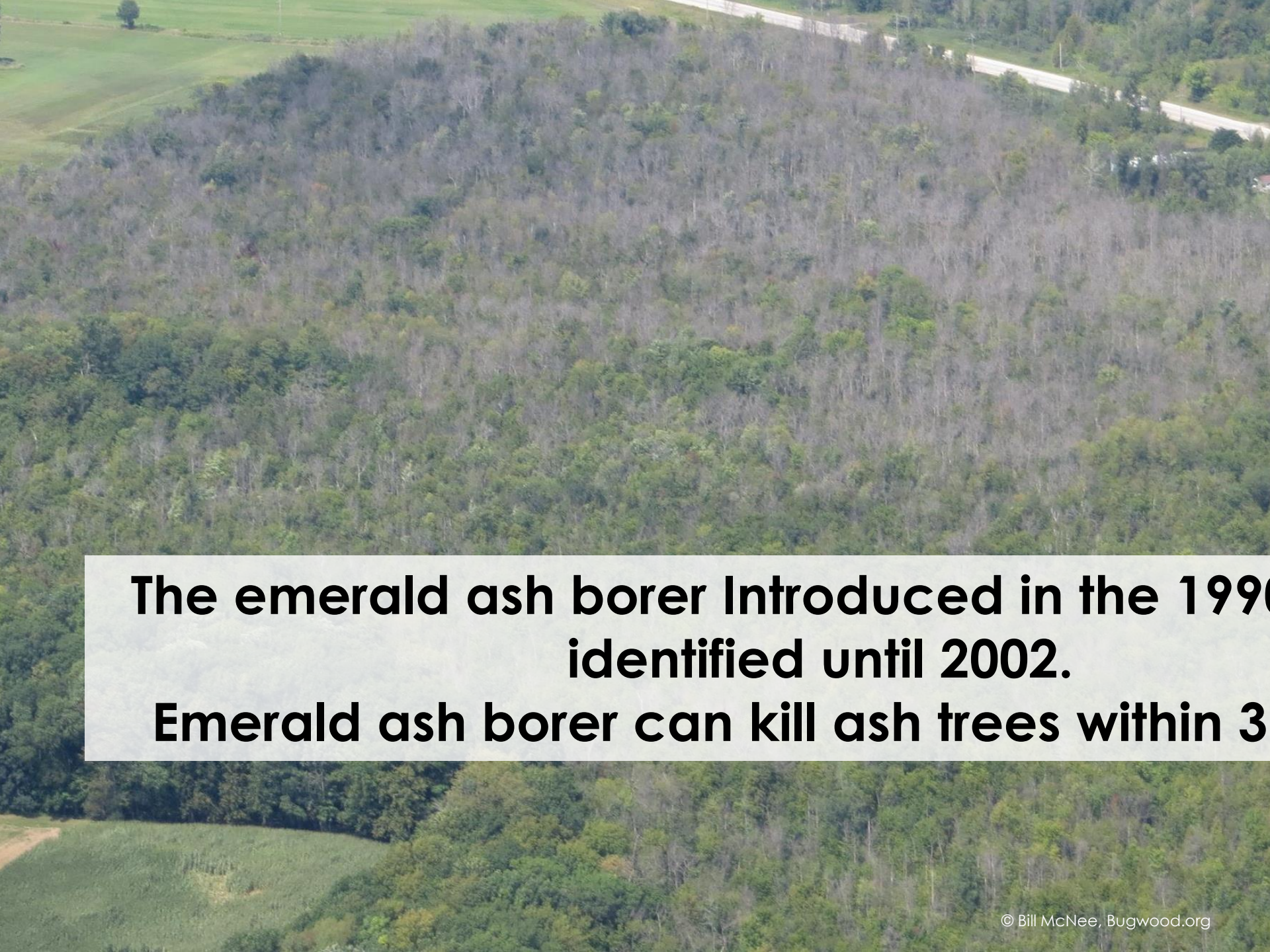
EMERALD ASH BORER

Dr. Joanna J Fisher,
Cornell University
Department of Entomology

What comes to mind when you hear the word “invasive”?

What is the Emerald Ash Borer (EAB)?

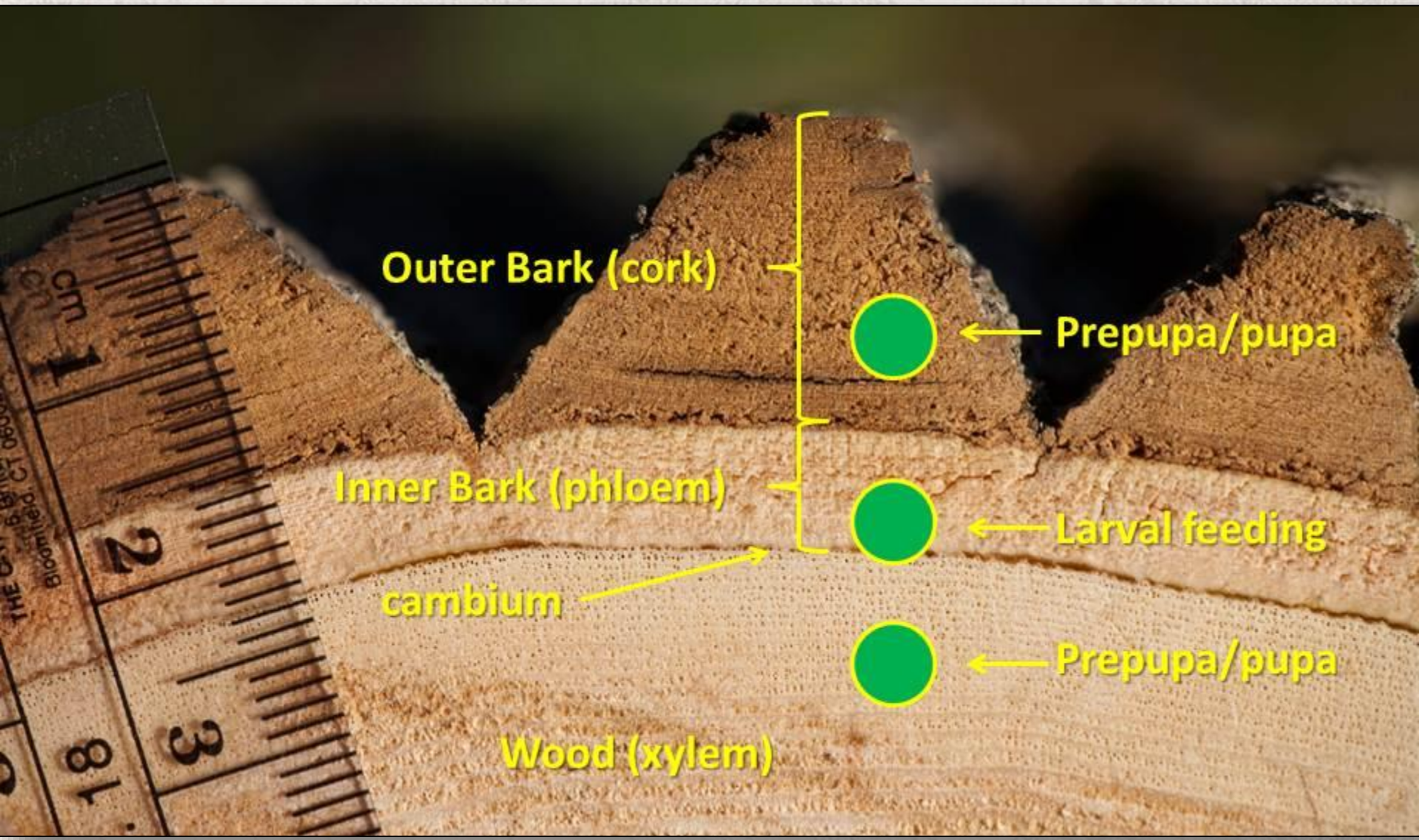
A destructive invasive wood borer from Eastern Asia



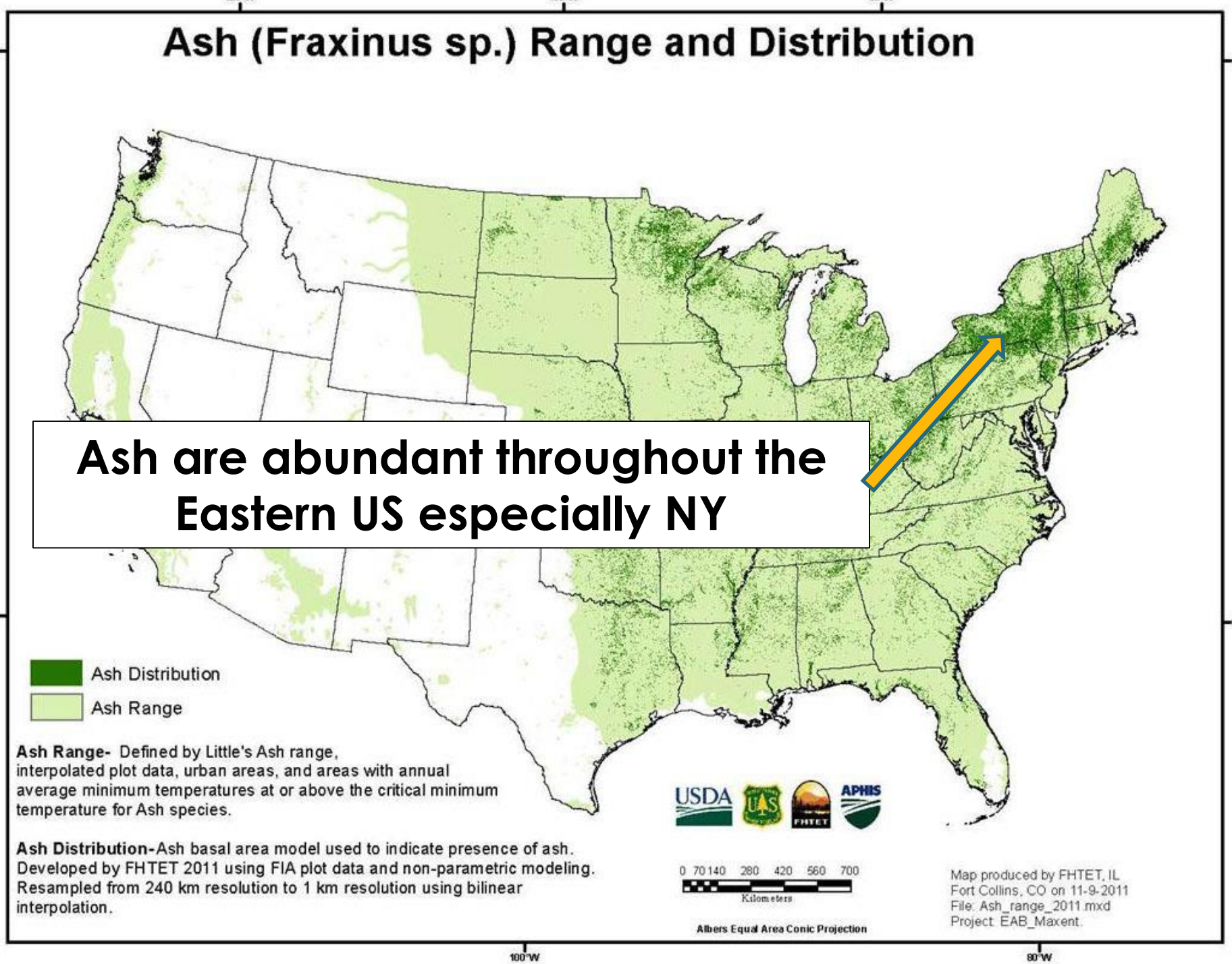
The emerald ash borer Introduced in the 199
identified until 2002.
Emerald ash borer can kill ash trees within 3

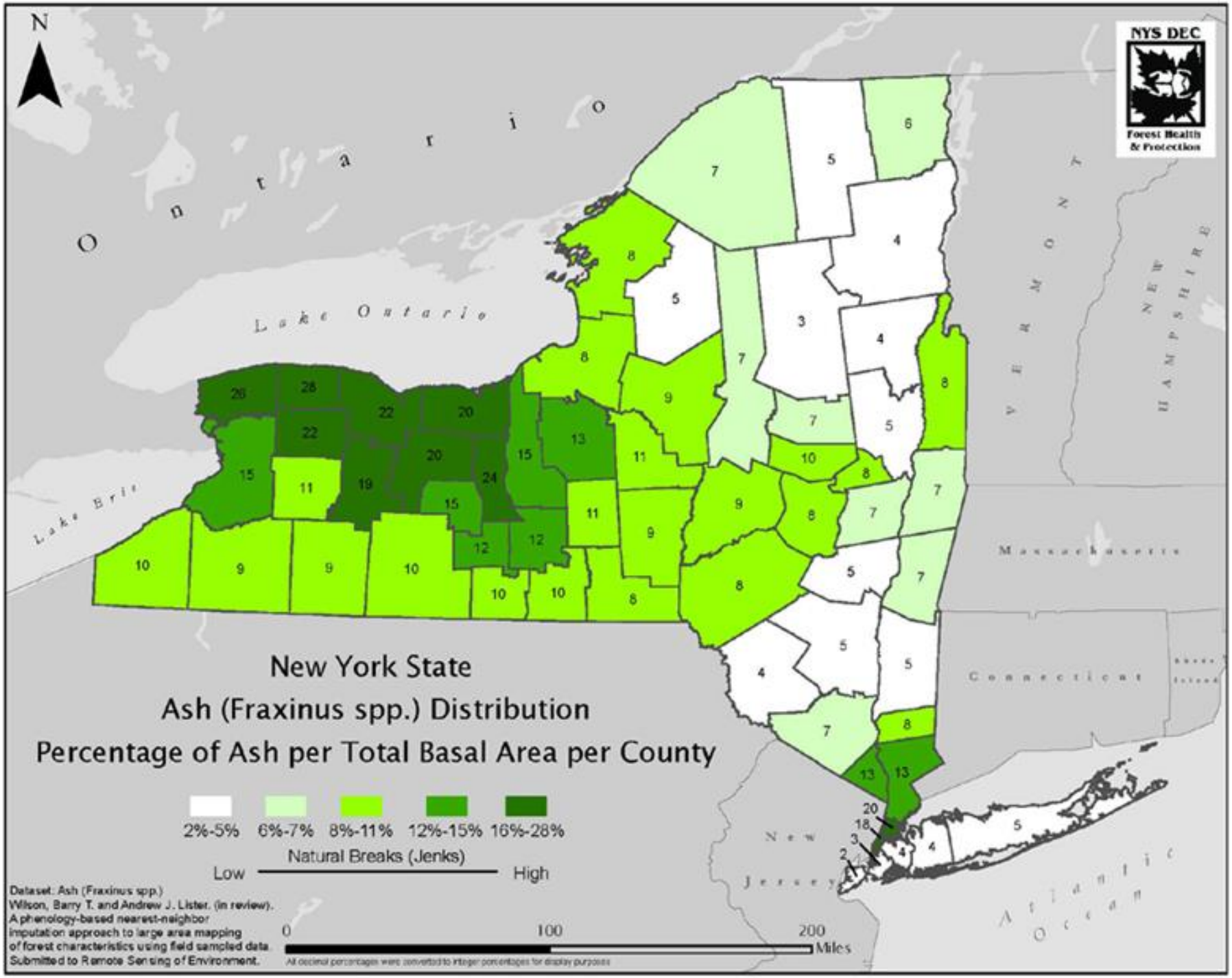
Infested trees are a health hazard
Cost of removal and replacement of trees will be <u>>$10.7 billion</u>

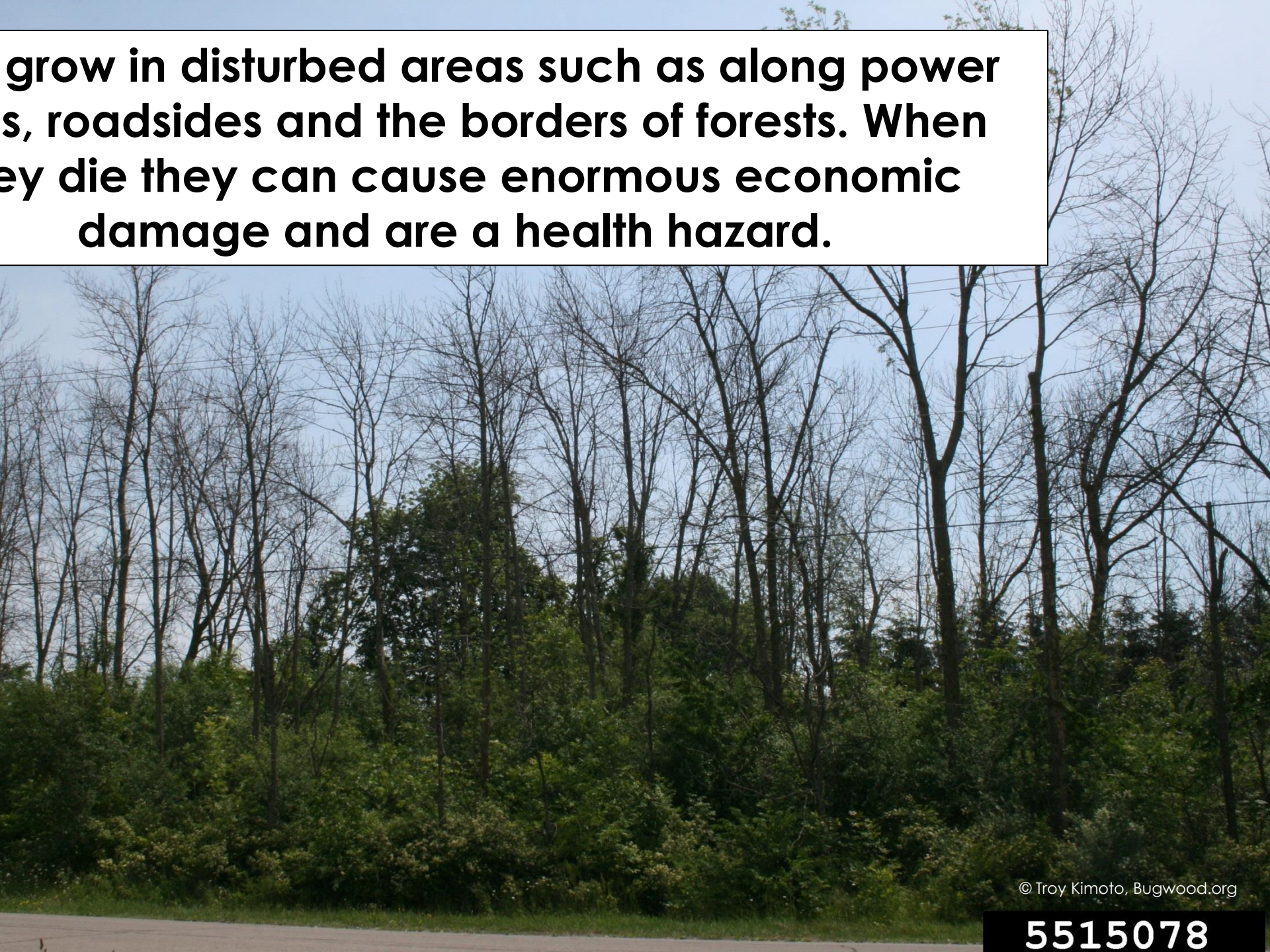
Larvae kill the tree by feeding in the tree's phloem and cambium region, blocking the transport of nutrients



Ash (Fraxinus sp.) Range and Distribution




N
NYS DEC
Forest Health & Protection
Ontario
Lake Ontario
Lake Erie
Vermont
New Hampshire
Massachusetts
Connecticut
New Jersey
Atlantic Ocean
New York State
Ash (Fraxinus spp.) Distribution
Percentage of Ash per Total Basal Area per County
2%-5%
6%-7%
8%-11%
12%-15%
16%-28%
Natural Breaks (Jenks)
Low
High
Dataset: Ash (Fraxinus spp.)
Wilson, Barry T. and Andrew J. Lister. (in review).
A phenology-based nearest-neighbor
imputation approach to large area mapping
of forest characteristics using field sampled data.
Submitted to Remote Sensing of Environment.
0
100
200
Miles
All decimal percentages were converted to integer percentages for display purposes


grow in disturbed areas such as along power
s, roadsides and the borders of forests. When
ey die they can cause enormous economic
damage and are a health hazard.
© Troy Kimoto, Bugwood.org
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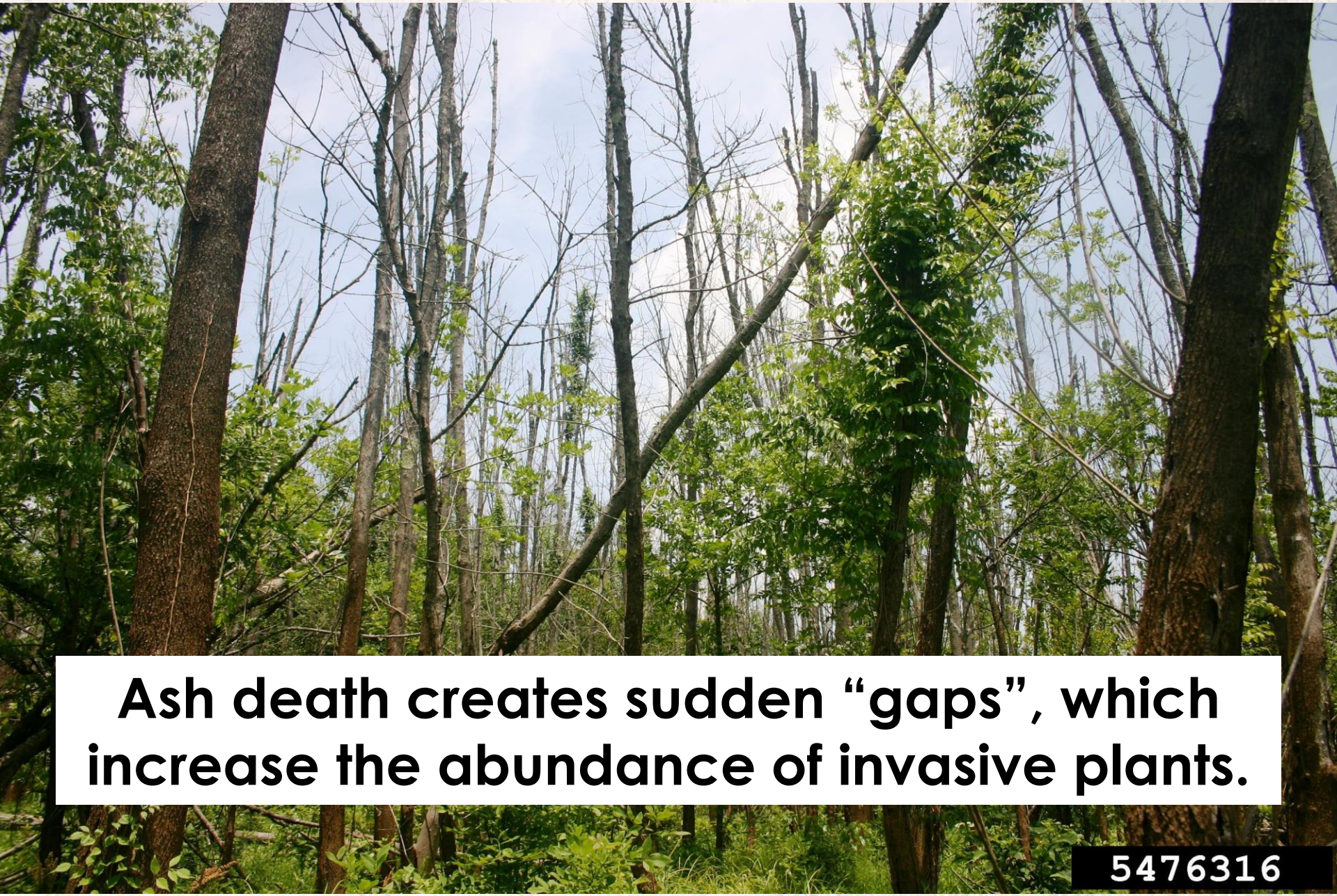
Native Ash trees are key species in the forest.



Ash death creates sudden "gaps", which increase the abundance of invasive plants.

Life Cycle: Pupae

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EAB pupate in the wood of the tree in spring

Life Cycle: Pupae

Adults emerge in spring, with black locust bloom at 450 Growing Degree Days (GDD) base 50 F

© David Cappaert, Michigan State University, Bugwood.org

When adults emerge they make <u>D-shaped Exit holes</u>

© Daniel Herms, the Ohio State University, Bugwood.org

Life Cycle: Adults & Eggs

EAB adults are active from late May to mid-August, lay eggs on the bark of ash trees

Eggs hatch in 7-10 days

Larvae bore into the bark and begin feeding

Life Cycle: Timing

June/July
Oviposition

Summer/Fall
Larval growth

May/June
Adult Emergence
Ovary maturation

Winter
Pre-
pupae

Early
spring
Pupation

Economic impacts

Ash one of **the most widely planted** urban trees

Removal and replacement of trees: **>$10.7 billion** (2009 estimate)

Table 1. Annualized damage in U.S. $1,000,000 associated with each guild and cost category.

Guild	Federal Government Expenditures	Local Government Expenditures	Household Expenditures	Residential Property Value Loss	Forest Landowner Timber Loss
BORERS ($N = 71$, $N_i = 14$)					
Poster: emerald ash borer damages ($10^6)	38	850	350	380	60
Total damage ($10^6)	92 [62–97]	1700 [1100–1900]	760 [460–820]	830 [510–900]	130 [81–150]

% of overall cost

EAB	2.3%	50.7%	20.9%	22.6%	3.6%
All Borers	2.6%	48.4%	21.6%	23.6%	3.7%

Aukema et al., 2011: Economic Impacts of Non-Native Forest Insects in the Continental United States

Economic impacts

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Table 1. Annualized dam[illegible]

Guild					Forest Landowner Timber Loss
BORERS (N = 71, N_i = 14)					
Poster: emerald ash borer damag[illegible]					60
Total damage ($10^6)	92 [62–97]	1700 [1100–1900]	760 [460–820]	830 [510–900]	130 [81–150]

Local governments and households will bear 94% of the economic cost of EAB

% of overall cost

EAB	2.3%	50.7%	20.9%	22.6%	3.6%
All Borers	2.6%	48.4%	21.6%	23.6%	3.7%

Aukema et al., 2011: Economic Impacts of Non-Native Forest Insects in the Continental United States

Cultural Impact

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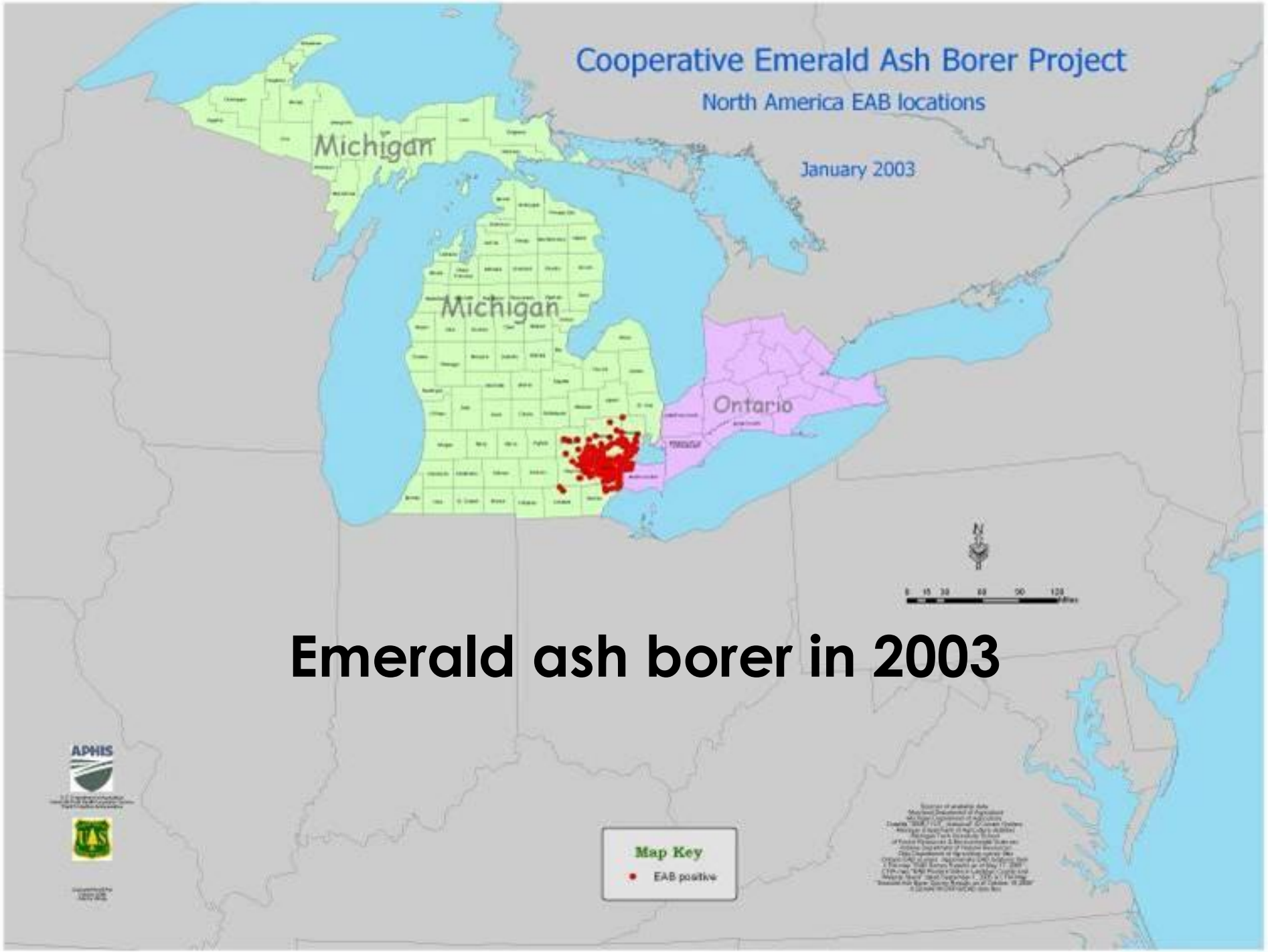
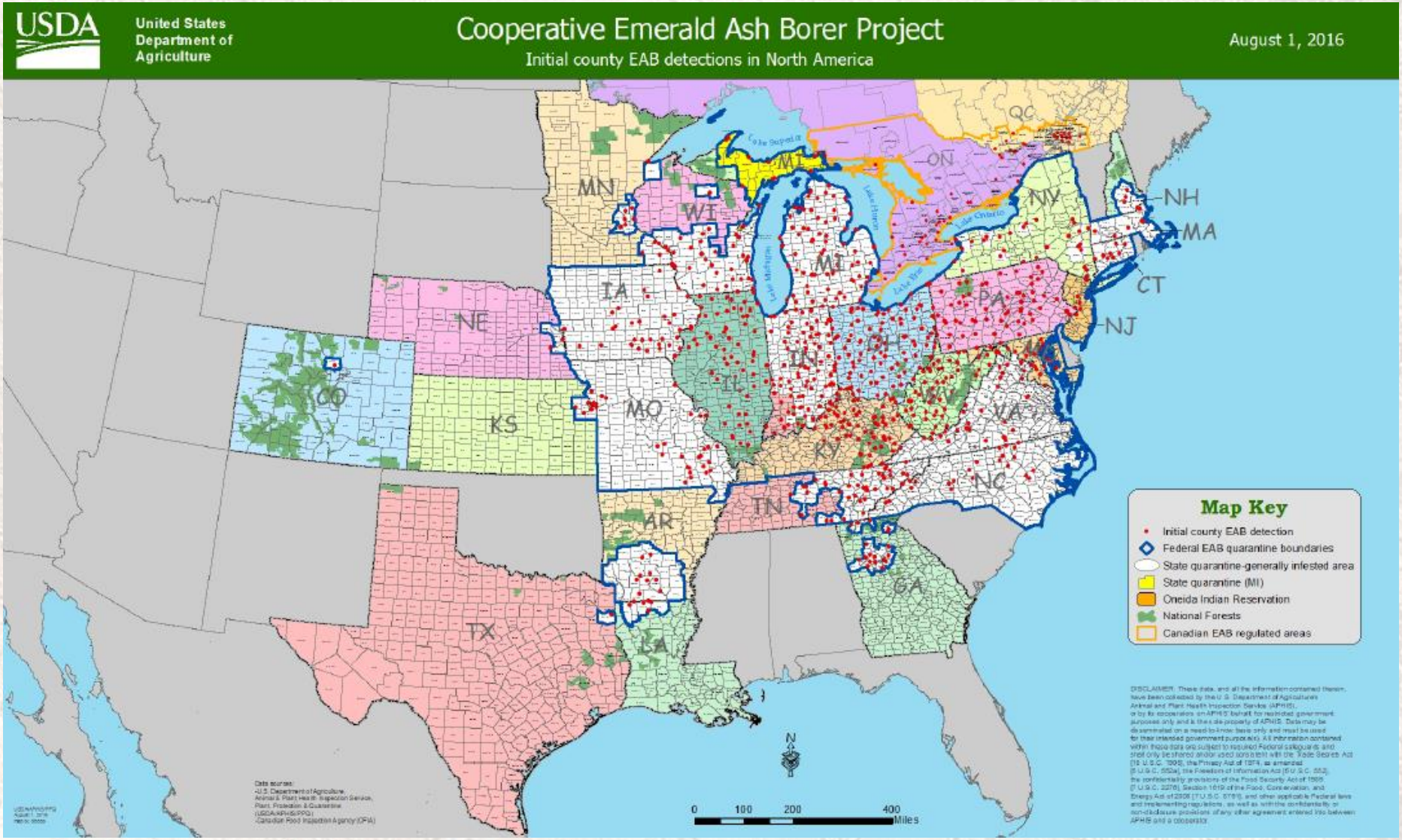
Black ash is culturally important to the Indigenous peoples of the Great Lakes region who use it to craft many items

Black ash baskets by artists Kelly Church (center red basket) and Katie Sickles (2 outer baskets). © Nick Reo, Michigan State University

Questions/Comments?



Emerald ash borer in 2003



Red dots: Initial county EAB detection

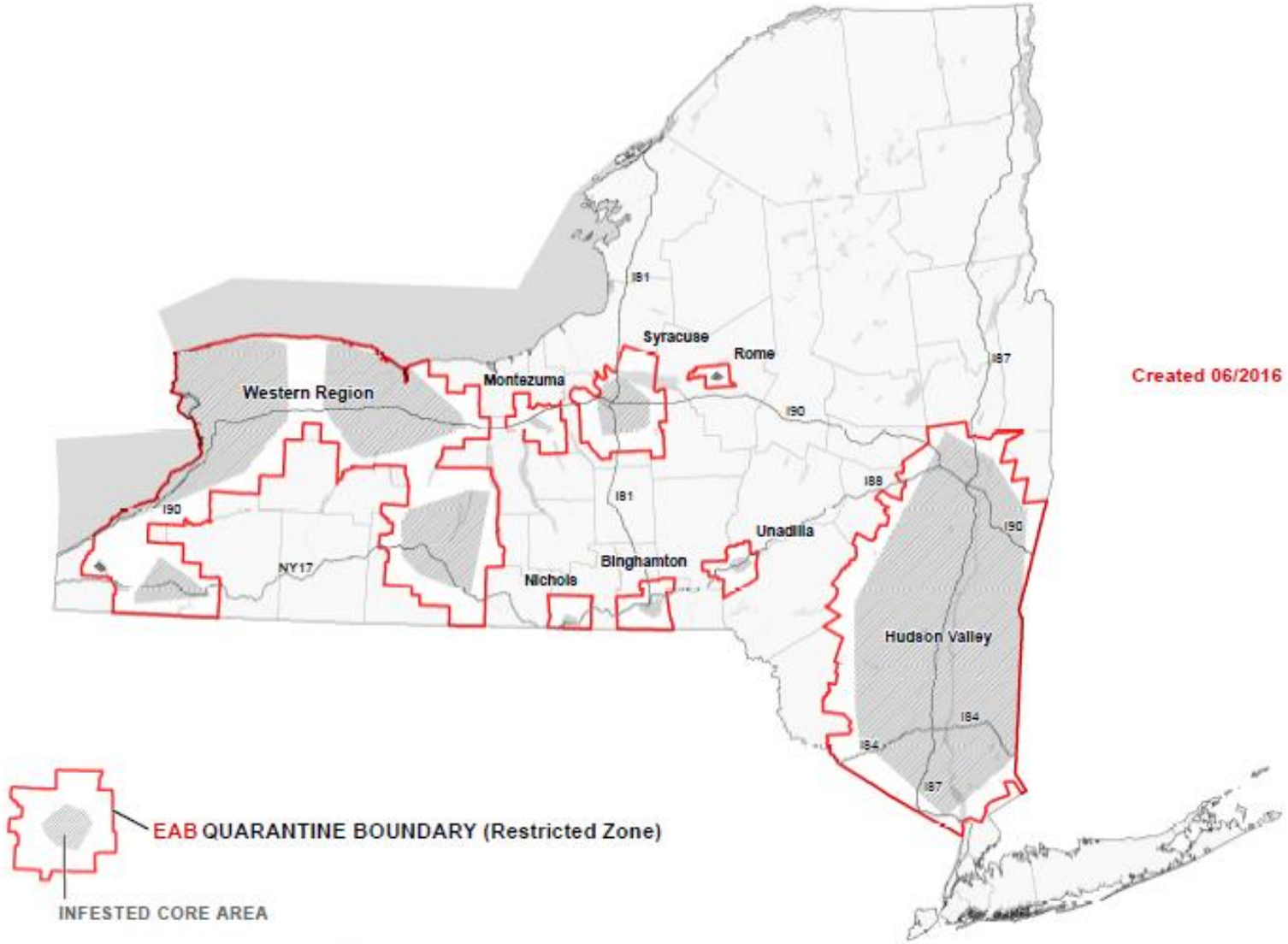
Blue lines: Federal quarantine boundaries

Updated map can be found at: http://www.emeraldashborer.info/about-eab.php

Emerald Ash Borer (EAB)
Quarantine Boundaries (Restricted Zones)

Binghamton, Hudson Valley, Montezuma, Nichols,
Rome, Syracuse, Unadilla, Western Region

NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation | Agriculture and Markets



Created 06/2016

S. McDonnell - Geographer
Division of Lands and Forests
Forest Health Unit

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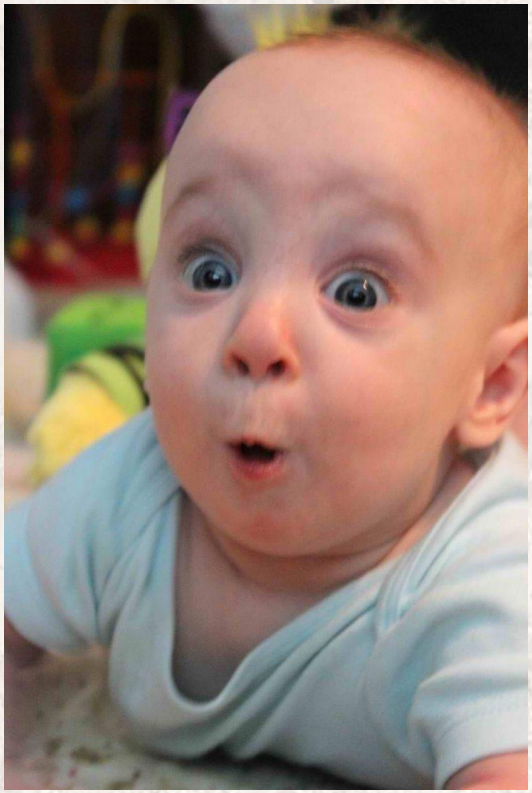
Entered US in the late 1980s to early 1990s in solid-wood packing material from China.

Only identified as killing trees in 2002 in Detroit, Michigan.

You find the emerald ash borer in your backyard.
How could it have gotten there?



Emerald Ash borer is still spreading…

Humans are part of the problem…

Slow the spread!

Don't import or move raw ash wood products

Protect your ash

Don't move firewood, buy locally

Slow the spread!

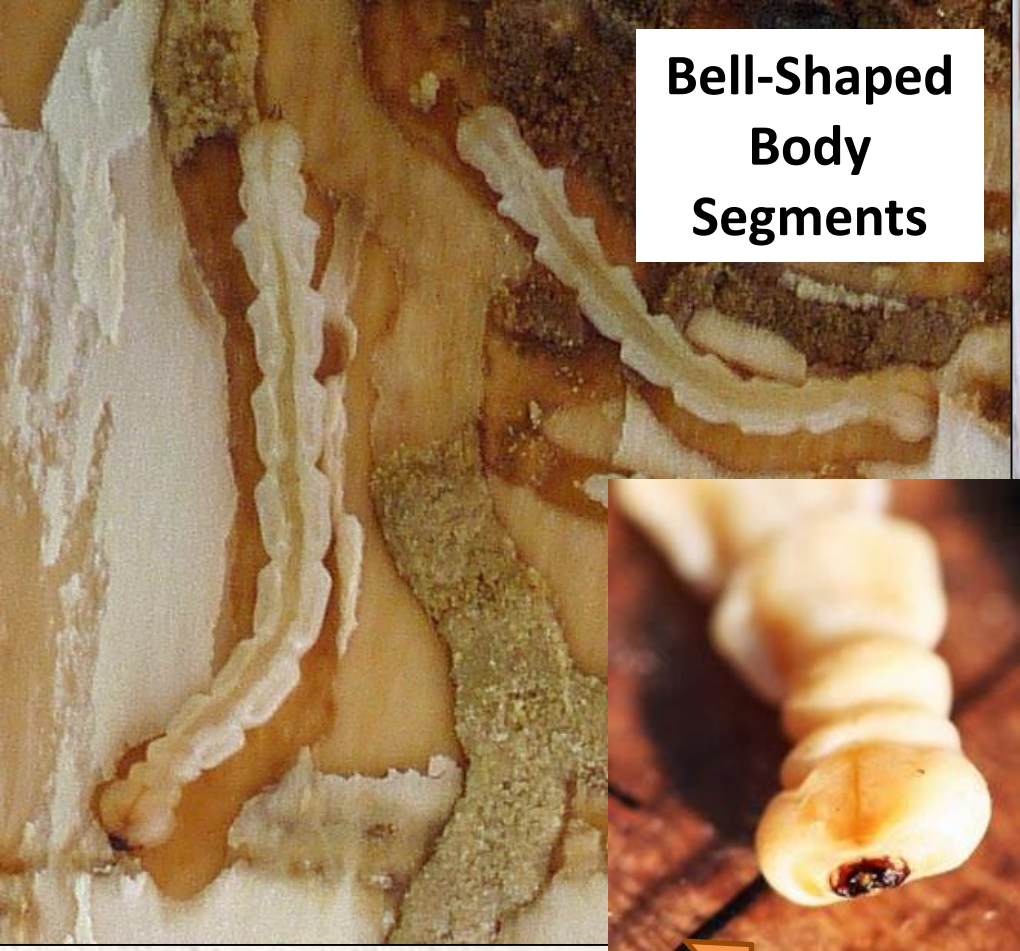
In NY state firewood cannot be transported more than 50 miles. Additionally, firewood cannot be transported out of certain zones.

Go to dontmovefirewood.org for more info

Identifying the Emerald Ash Borer

1. Larval and Gallery ID

Bell-Shaped Body Segments



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Mark Whitmore @ Cornell University

Flat Head

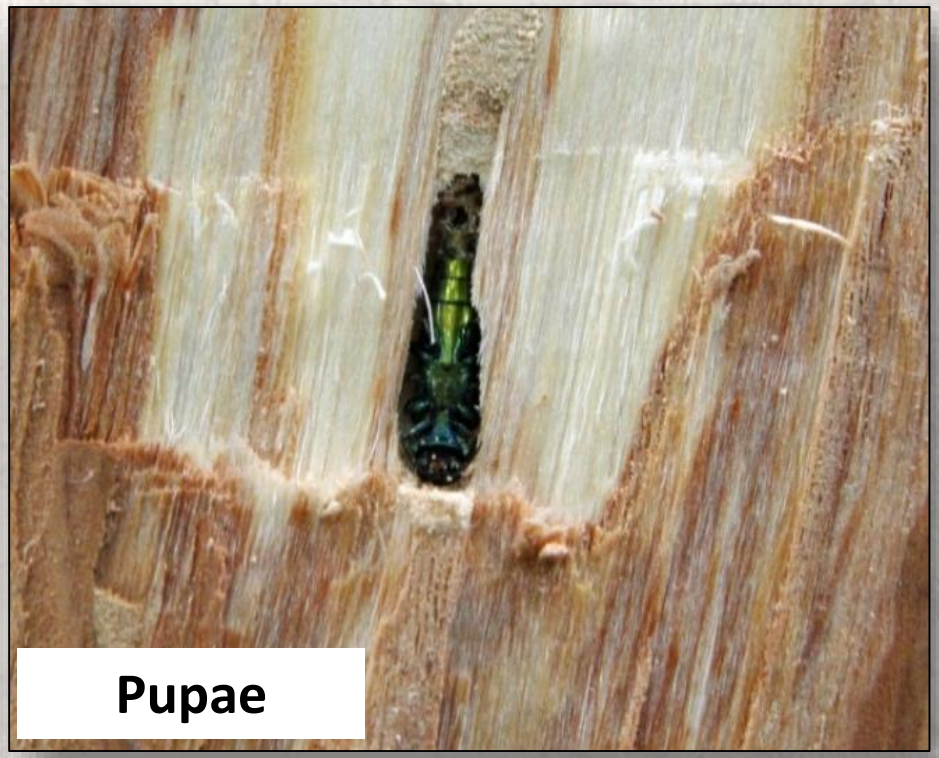
“S” Shaped Galleries

Bugwood.org

Identifying the Emerald Ash Borer

2. Adult and Exit Holes

Prepupae

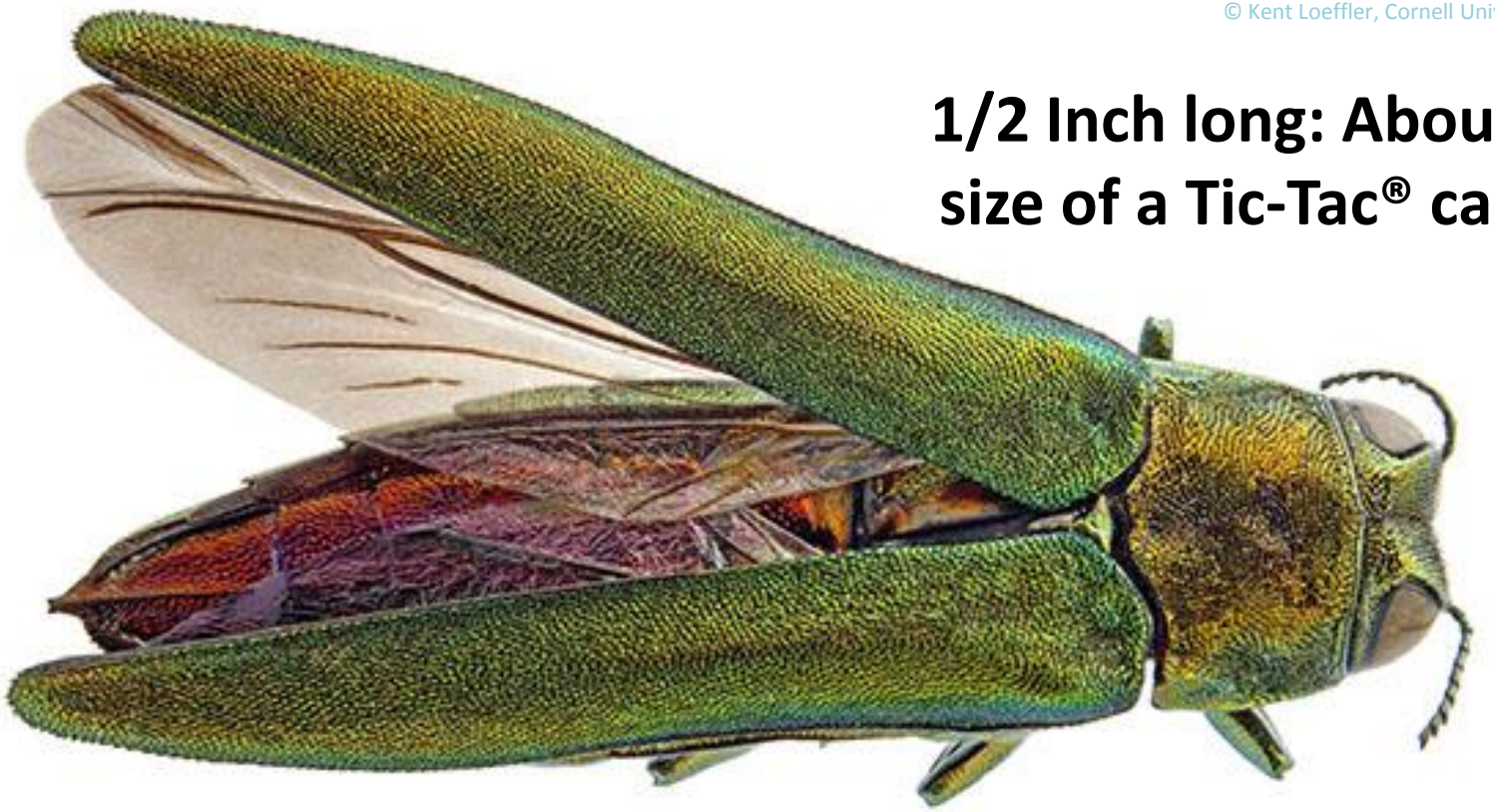


Pupae

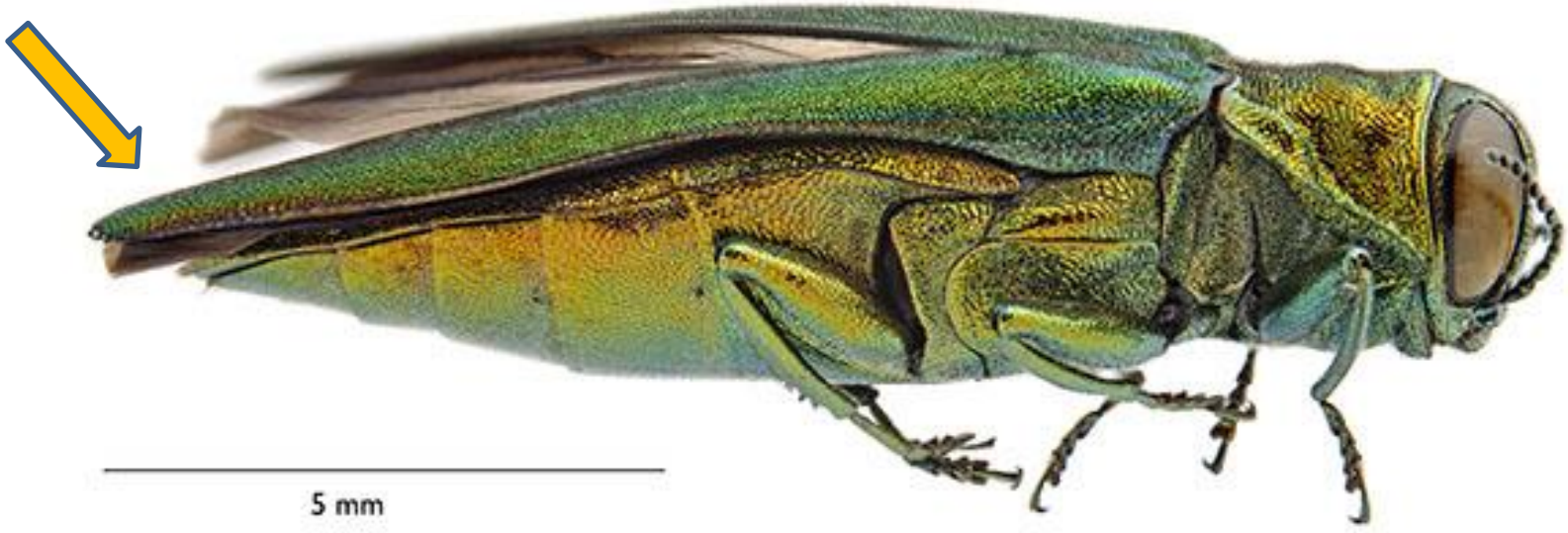
D-Shaped Exit Hole

Made when adults exit tree

1/2 Inch long: About the size of a Tic-Tac® candy!



Metallic green in color



Adult Look-Alikes: Which one is EAB?

1

2

3

Adult Look-Alikes: Which one is EAB?

1

Bronze birch borer
(*Agrilus anxius*)

2

Two-lined chestnut borer
(*Agrilus bilineatus*)

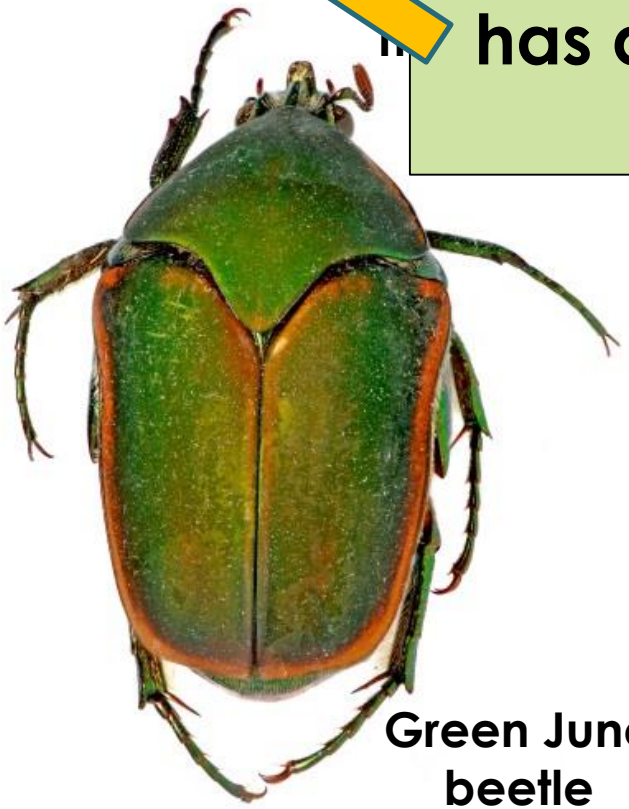
Adult Look-Alikes: Which one is EAB?

Sharpshooter

Sweat bee

EAB is quite small and has a bullet-shaped body

bottle



Green June beetle

Green stink bug

Tiger beetle

Japanese beetle

EAB Hosts: Native Range

Hosts of EAB in its Native Range

- **Manchurian ash** (*F. mandshurica*)
- **Chinese ash** (*F. chinensis*)
- **Korean ash** (*F. rhynchophylla*)

These trees co-evolved with the beetle and are resistant

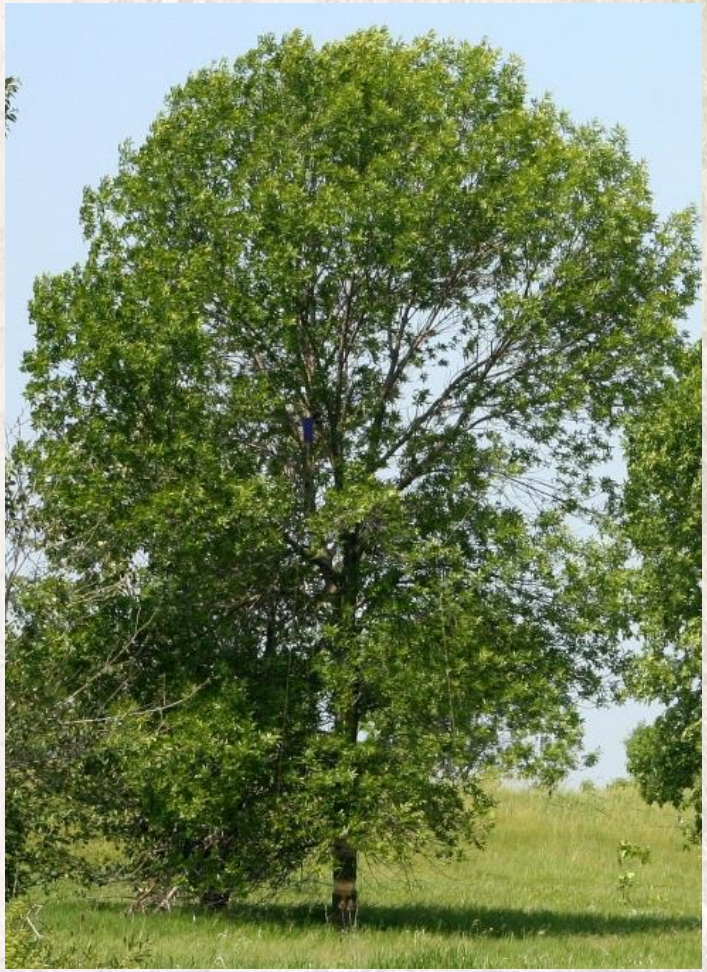
EAB Hosts: Introduced Range

All native ash trees genus *Fraxinus!*

Species commonly found in NY

- **White ash** (*F. amaericana*),
- **Green ash** (*F. pennsylvanica*)
- **Black ash** (*F. nigra)*

These trees are all susceptible to the beetle!



Steps to Identify Ash

1. Opposite branching (with stout twigs)
2. Pinnate compound leaves
3. 5-11 (7) leaflets
4. Single samara
5. Pronounced diamond pattern bark

© Keith Kanoti, Maine Forest Service, Bugwood.org

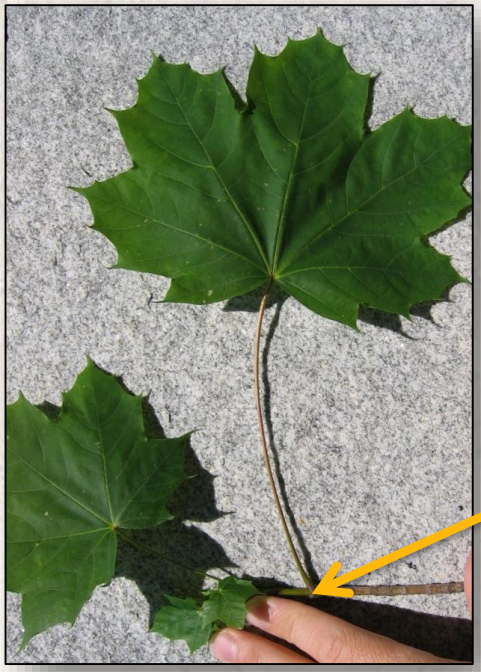

Ash Trees
• Upright silhouette
• Elongate, oval shape
© David Cappaert, Michigan State University, Bugwood.org

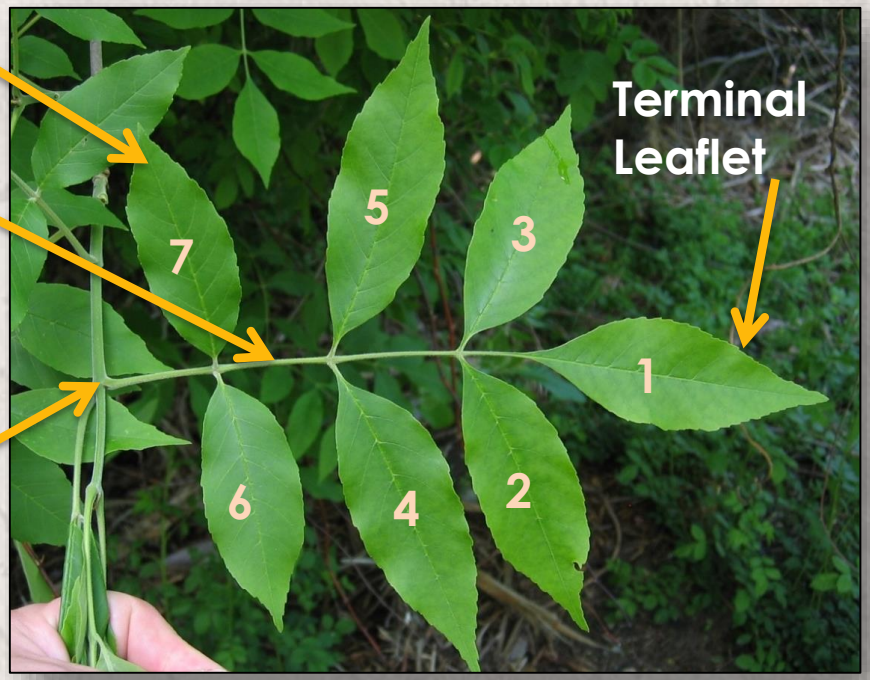
Opposite branching, large, stout buds + prominent leaf scars

Pinnately Compound Leaves

5-11 leaflets

- **Compound leaves**: leaves made up of multiple leaflets
- **Pinnate**: leaflets arranged linearly along a rachis (stem)





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Distinct diamond patterns in ash bark

Green & White Ash

- Young white ash have smooth bark

Black Ash

- Cork-like, soft bark
- Note diamond pattern still visible

Detecting an EAB Infestation

<u>Symptoms</u> – Host responses to pest infestation.

<u>Signs</u> – Physical clues of a pest unrelated to host responses

2 or more years for signs and symptoms to show

Canopy thinning (smaller leaf size, not loss of leaves):

Can take years to become apparent

Trees with canopy thinning will be unable to recover with pesticide treatments

Sign: Woodpecker Damage, Best Sign to Look For!

Look for:

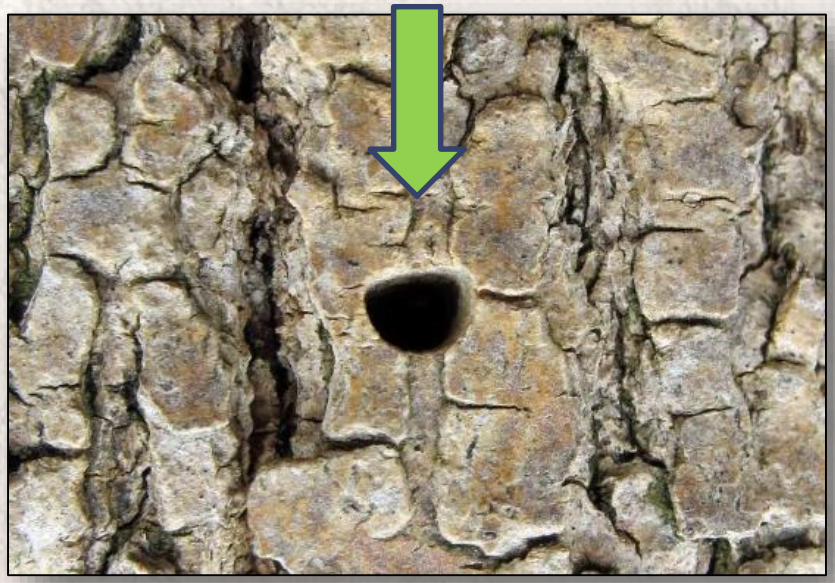
- Light brown color, freshly flaked bark
- Low infestation: checkerboard pattern
- High infestation: all over trunk

Sign: Woodpecker Damage, Best Sign to Look For!

Look for:

- Foraging in the bark vs. deep in the wood
- In sound wood vs. rotten wood
- Damage in a line and old = not EAB

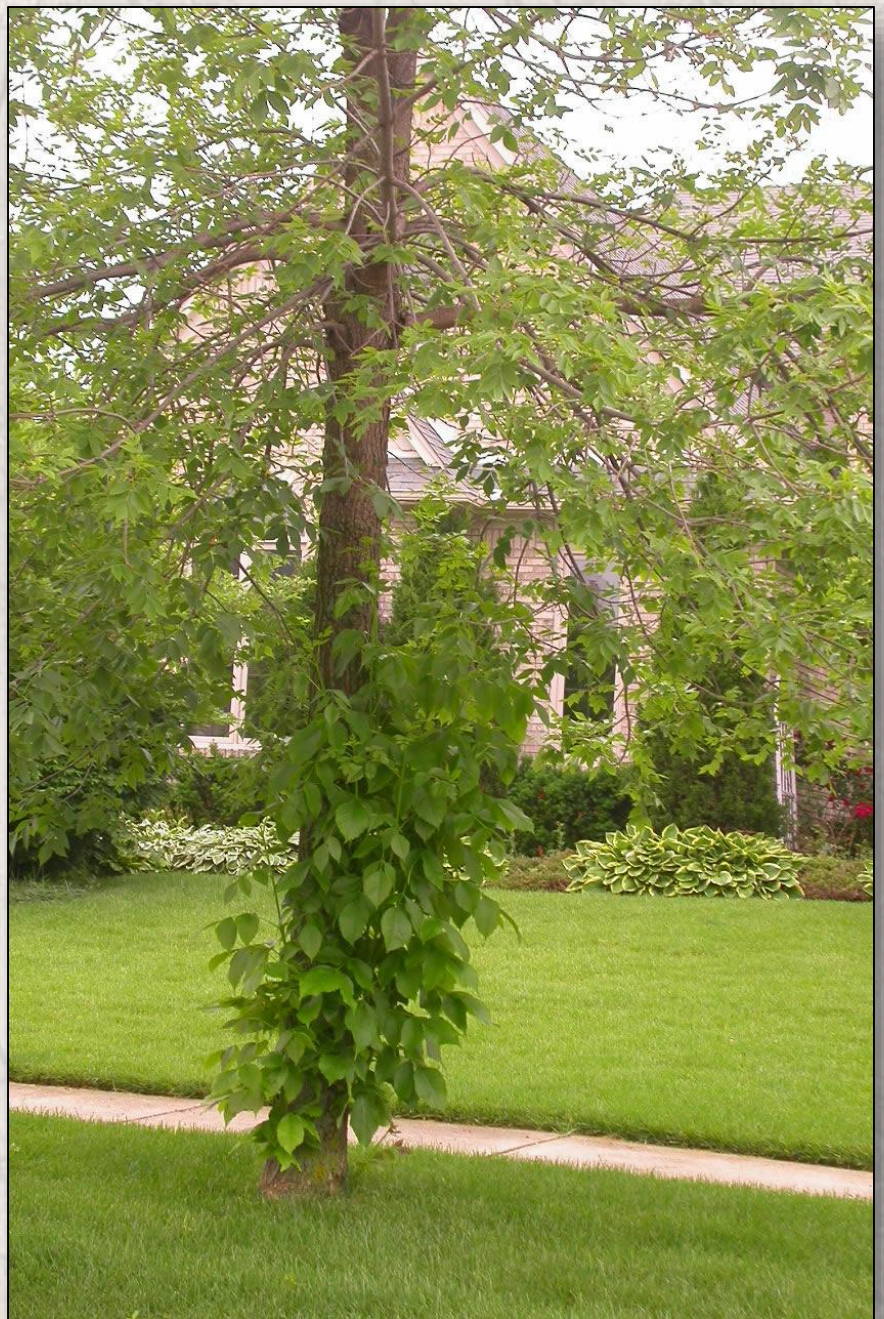
D-Shaped Exit Hole (small; 3-4mm wide!)



"S" Shaped Galleries

Symptom: Epicormic sprouting (water sprouting)

- Response by tree to fill out lost canopy
- Trees won't recover using pesticide treatments



Symptom: Vertical Bark Cracks

- Above old attacks,
- Easy to mistake as disease or injury
- Seen only at low population levels

Early detection is key!

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Why is monitoring important?

- Slow the spread
- Help communities prepare and plan: Saves $$
- Conserve genes for future forests

How can we monitor for emerald ash borer?

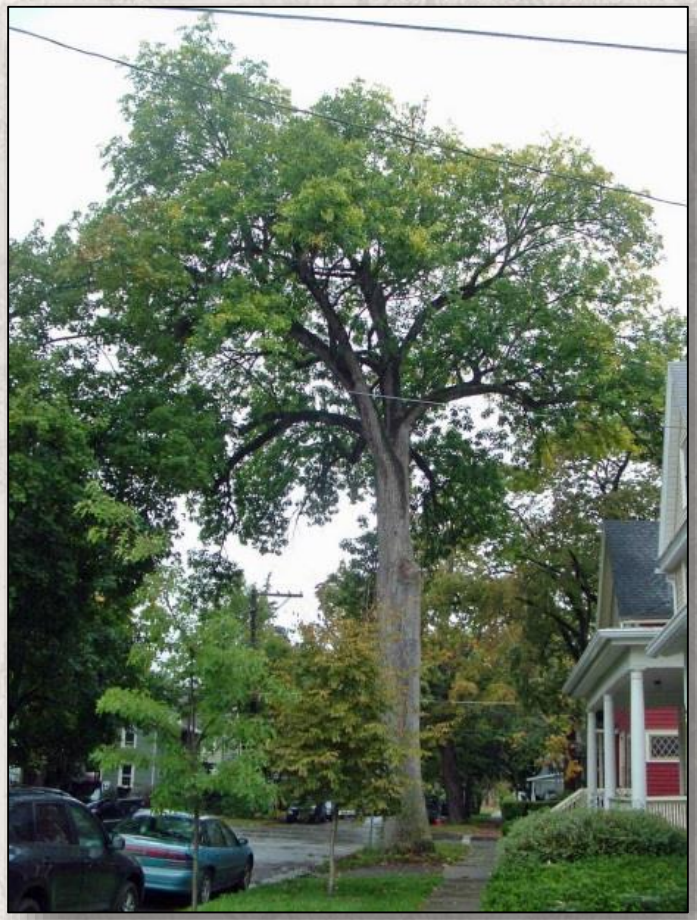
- How will you find where the ash trees are in your community?
- Where should you look for the beetle?
- What time of year should you monitor?

Monitoring for EAB

1. Know where ash trees are located in your community

2. Identify high risk trees if all trees can't be monitored

3. Develop a monitoring program to inspect trees periodically



Finding ash:

- Tree Inventories
- Survey trees and record locations

Priority areas to survey

- Near saw mills, import businesses, wood waste disposal sites, along roads, railroad yards, rest stops along highways

Time of year?

- Anytime! Winter is good, no leaves on trees easier to see woodpecker damage

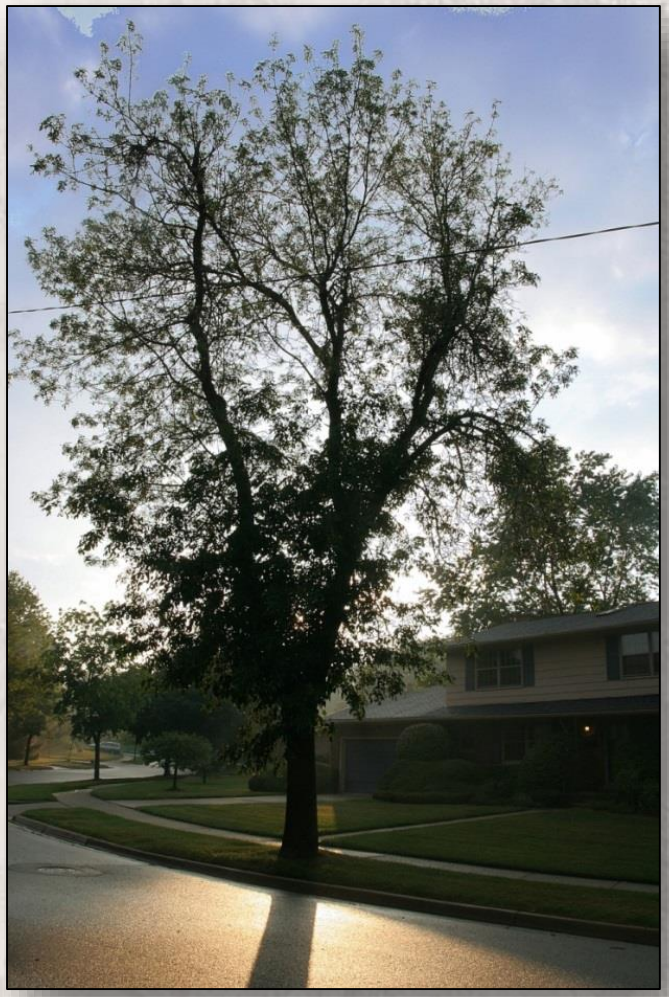
Which trees are infested first? Stressed Trees!

EAB can be detected in infested trees year-round!

Year round –Woodpecker foraging, S-shaped larval galleries, vertical bark cracks

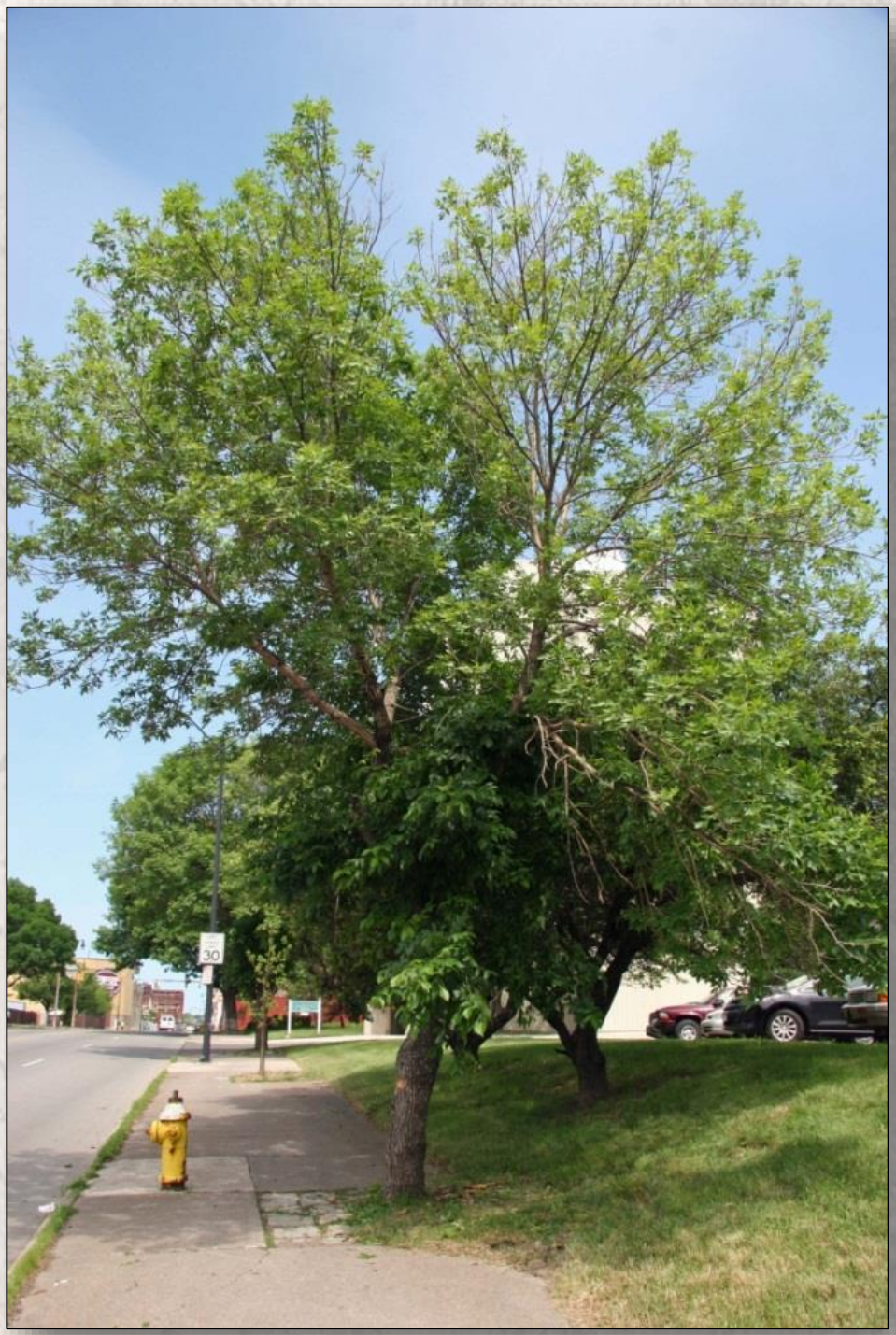
When tree is foliated – Canopy thinning, branch dieback, epicormic sprouting

May-August –Adult beetles



Infestations can be hard to spot, if your concerned about a tree

<u>Get an arborist to inspect!</u>



Emerald Ash Borer: Monitoring

Advanced Monitoring Techniques: Traps Used to detect new infestations

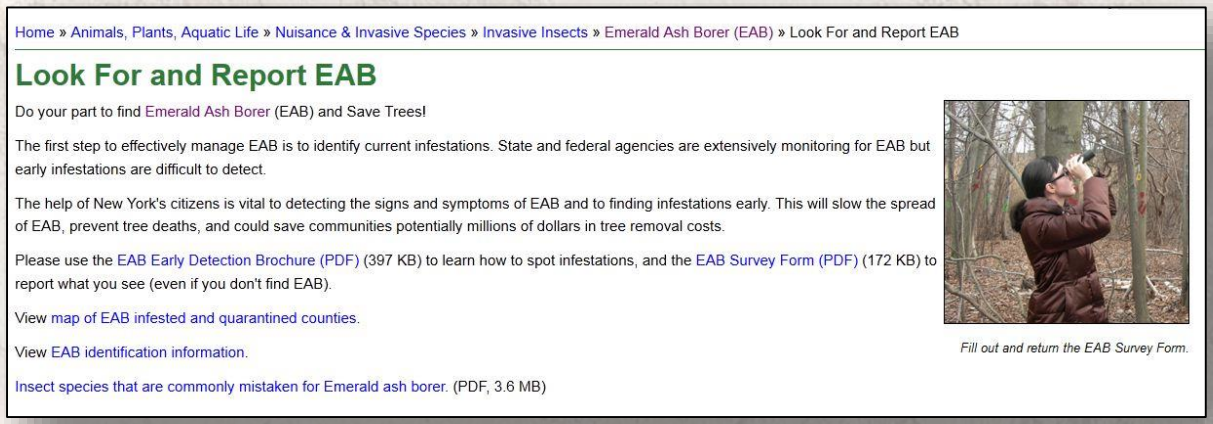
Documenting & Reporting a Suspected EAB infestation

1. **Document your location: Use GPS if possible**
2. **Collect a sample or photograph** of the insect or symptomatic tree part

Interested in learning more? Review the **NPDN module "Quality Sample Submission" at** www.firstdectector.org

3. **Report your discovery** to local, state, or federal authorities.

- Cornell Cooperative Extension and NYSDEC offices
- EAB Task Force
- Go to **www.nyis.info/eab** for resources and the appropriate telephone numbers to call.



Home » Animals, Plants, Aquatic Life » Nuisance & Invasive Species » Invasive Insects » Emerald Ash Borer (EAB) » Look For and Report EAB

Look For and Report EAB

Do your part to find Emerald Ash Borer (EAB) and Save Trees!

The first step to effectively manage EAB is to identify current infestations. State and federal agencies are extensively monitoring for EAB but early infestations are difficult to detect.

The help of New York's citizens is vital to detecting the signs and symptoms of EAB and to finding infestations early. This will slow the spread of EAB, prevent tree deaths, and could save communities potentially millions of dollars in tree removal costs.

Please use the EAB Early Detection Brochure (PDF) (397 KB) to learn how to spot infestations, and the EAB Survey Form (PDF) (172 KB) to report what you see (even if you don't find EAB).

View map of EAB infested and quarantined counties.

View EAB identification information.

Insect species that are commonly mistaken for Emerald ash borer. (PDF, 3.6 MB)

Fill out and return the EAB Survey Form.

What happens when emerald ash borer is found in a community?

4 Phases of State's Response Plan

1. **Delimitation**

   Determine extent EAB infestation using surveys

2. **Quarantine**

   Prevent spread of EAB by people

3. **Mitigation**

   Limiting damage within infested areas

4. **Restoration**

   Plant diverse tree species!

Emerald Ash Borer (EAB)
Quarantine Boundaries (Restricted Zones)
Binghamton, Hudson Valley, Montezuma, Nichols,
Rome, Syracuse, Unadilla, Western Region

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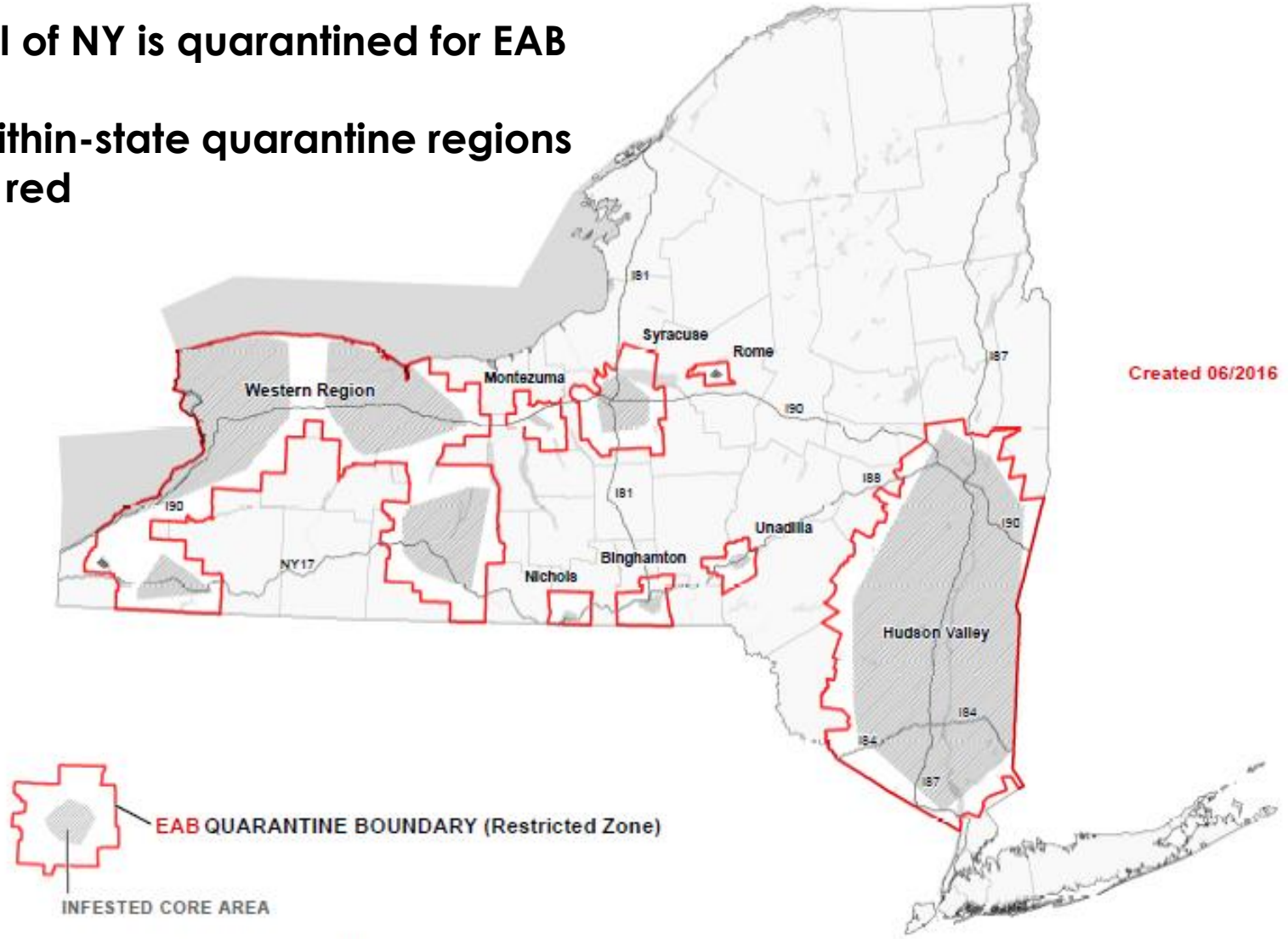
All of NY is quarantined for EAB

Within-state quarantine regions in red



Created 06/2016

S. McDonnell - Geographer
Division of Lands and Forests
Forest Health Unit

Management: Suppression

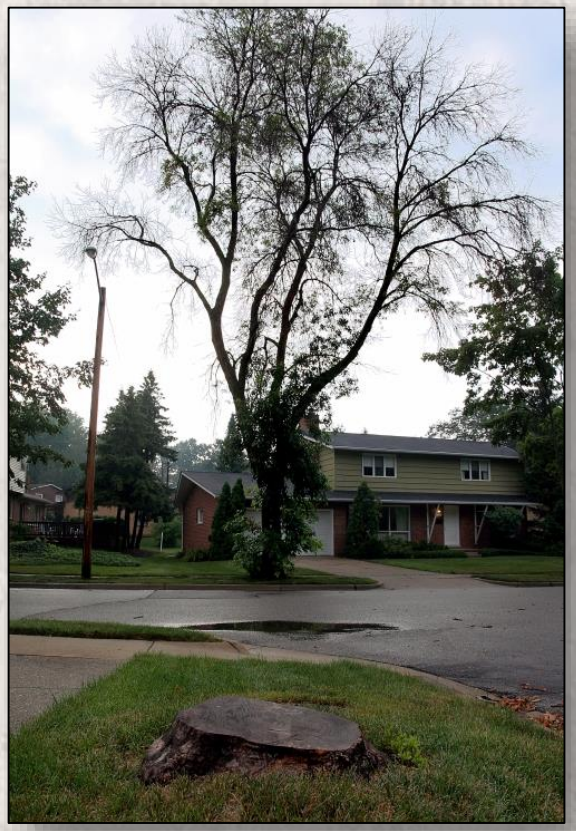
Objective: Slow the spread of EAB

Uses an Integrated Pest Management Strategy (IPM)

Includes:

- Monitoring
- Trapping
- Sanitation
- Tree removal
- Biological control
- Insecticide treatment

.



Sanitation + Tree Removal

- Reduce EAB populations: Remove hosts
- Remove over-mature, poor-condition ash trees that may become health hazards
- Reducing ash in the community

Tree Removal

- Decide early to either treat or remove tree
- Davey Tree experts won't climb trees with crown symptoms because it is too dangerous
- This increases the cost of removal

Davey Tree

Davey Tree

Biological Control

Atanycolis cappaerti

Thanasimus dubius

Oobius agrili

Spathius agrili

Tetrastichus planipennisi

Insecticides can protect high value ash trees

Insecticides save trees for their seed, maintaining genetic resources

A single insecticide treatment is effective for:

- **3 years with Emamectin benzoate**
- **1 year with imidacloprid**

Recommendation: Hire a professional if you want to save your tree

Mark Whitmore

Insecticides can protect high value ash trees

Not every tree can be effectively treated,

Trees with >30% dieback may not respond to treatment

Recommendations: Mark Whitmore

Which Pesticide?

Systemic pesticides; effective for trees over 25 inches in diameter

Emamectin benzoate,

Two formulations are available from:

Rainbow Tree Care

Arbor Jet (Tree-age)

Recommendations: Mark Whitmore

When to treat?

- When tree is still healthy-looking; inquire early because arborists will be booked
- When EAB pest pressure is low
- In spring if possible
- Before crown symptoms appear or <30% dieback

Recommendation: Hire a professional!

Recommendations: Mark Whitmore

Recovering from an outbreak

Recovery Plan Focus Areas:

- **Remove:** low-value ash trees
- **Protect** high-value ash trees from EAB
- **Replace** lost ash trees with diverse species not susceptible to EAB

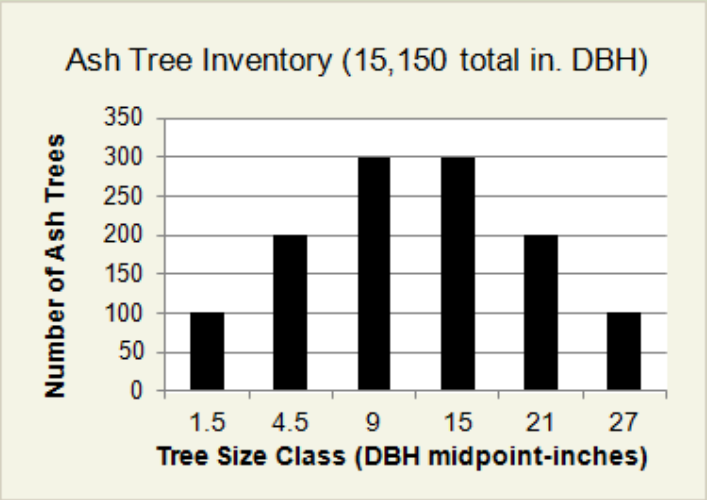
The EAB response plan should include a recovery plan!

Designing the best strategy for your community

EAB Cost Calculator (Purdue University): Great tool to help develop a plan for managing EAB in your community

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

Representative Forest with 1200 Ash Trees



Strategies

Replace Unsafe Ash
Replace ash as they die

Remove All Ash
Replace over 7 years

Save 50%
Treat half the ash and replace the rest over 7 years

Treatment Assumptions

Costs
$3/ in DBH per year

Frequency
Aggressive = yearly
Maintenance = every 3 years

Treatments save 95% of trees
Annual mortality of saved tree is 2%

Cost of removal and Stump grinding

DBH[1]	Avg. Cost / DBH
1 - 3	$11.15
3 - 6	$11.15
6 - 12	$13.35
12 - 18	$17.75
18 - 24	$17.75
24 -	$25.00

Replacement Tree Assumptions
Tree Size is 1.25" DBH
Trees Cost $400 to purchase, plant and stake

Created by Dr. Cliff Sadof, Purdue Univ.

Created by:

Joanna Fisher, Extension and Outreach Assistant Cornell University Department of Entomology
jjf236@cornell.edu

Assistance, control recommendations and materials provided by:

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