The Invasive Species Leadership Team Presents:

Emerald Ash Borer Impact to USACE

By Nathan Beane, Tara Whitsel, and Courtney Chambers
ERDC Environmental Laboratory

The meeting will start at 1:00 PM Central Time
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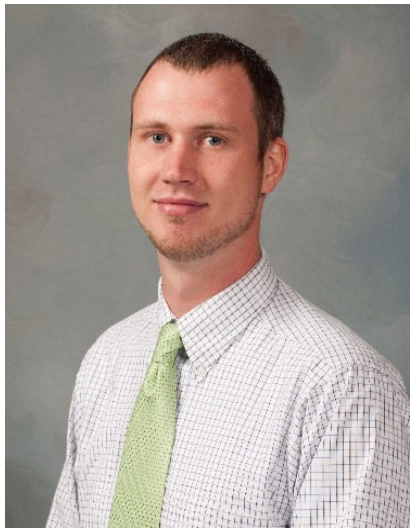
Speakers



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Emerald Ash Borer Impact to USACE

April 2020

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US Army Corps of Engineers

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Emerald Ash Borer - Overview

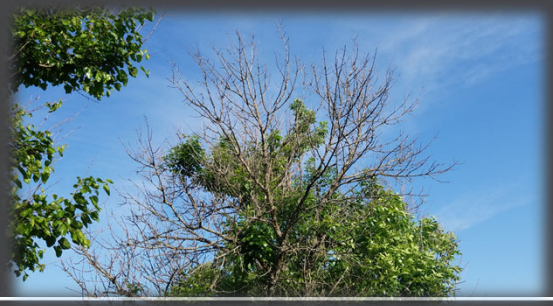
1. About EAB and Problem for USACE
2. Assessing the Threat
3. First Hand Experience
4. Estimated Cost to USACE
5. Summary

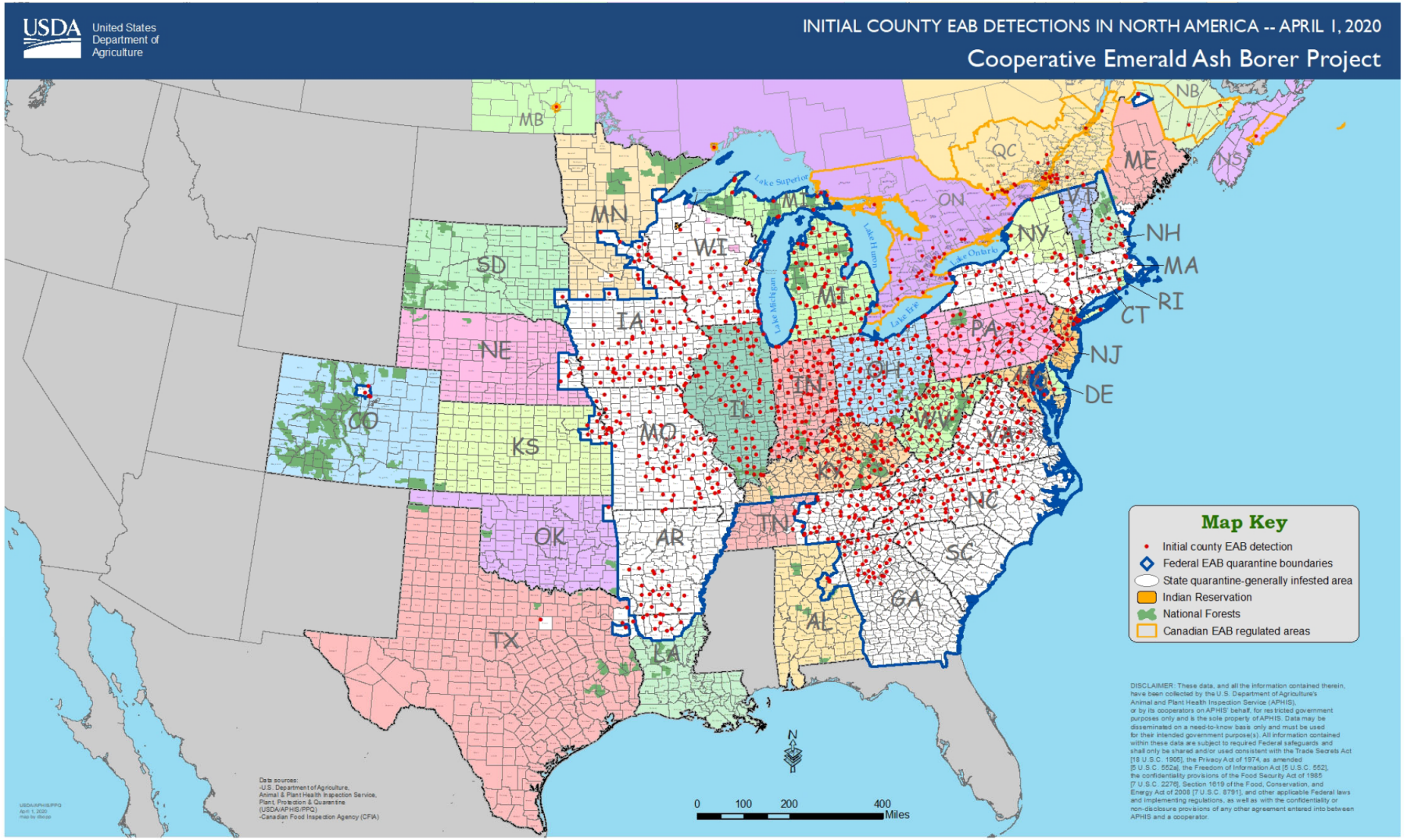
Introduction

Emerald Ash Borer (*Agrilius planipennis*)—a wood boring beetle whose larvae feed on ash (*Fraxinus* sp.) trees

- First discovered in 2002 (Detroit MI)
- Currently found in 35 states
- Emerald Ash Borer Information Network: http://www.emeraldashborer.info/index.php

- First discovery in USACE Project county 2006




USDA
United States Department of Agriculture
INITIAL COUNTY EAB DETECTIONS IN NORTH AMERICA -- APRIL 1, 2020
Cooperative Emerald Ash Borer Project
MB
NB
QC
ME
NS
ON
MN
WI
MI
NY
VT
NH
MA
RI
CT
SD
IA
NE
PA
NJ
DE
CO
IL
IN
OH
WV
VA
KS
MO
KY
NC
OK
AR
TN
SC
GA
AL
TX
LA
Lake Superior
Lake Michigan
Lake Huron
Lake Ontario
Lake Erie
Map Key
Initial county EAB detection
Federal EAB quarantine boundaries
State quarantine-generally infested area
Indian Reservation
National Forests
Canadian EAB regulated areas
N
0 100 200 400
Miles
Data sources:
-U.S. Department of Agriculture, Animal & Plant Health Inspection Service, Plant, Protection & Quarantine (USDA/APHIS/PPQ)
-Canadian Food Inspection Agency (CFIA)
DISCLAIMER: These data, and all the information contained therein, have been collected by the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS), or by its cooperators on APHIS' behalf, for restricted government purposes only and is the sole property of APHIS. Data may be disseminated on a need-to-know basis only and must be used for their intended government purpose(s). All information contained within these data are subject to required Federal safeguards and shall only be shared and/or used consistent with the Trade Secrets Act [18 U.S.C. 1905], the Privacy Act of 1974, as amended [5 U.S.C. 552a], the Freedom of Information Act [5 U.S.C. 552], the confidentiality provisions of the Food Security Act of 1985 [7 U.S.C. 2276], Section 1619 of the Food, Conservation, and Energy Act of 2008 [7 U.S.C. 8791], and other applicable Federal laws and implementing regulations, as well as with the confidentiality or non-disclosure provisions of any other agreement entered into between APHIS and a cooperator.

Emerald Ash Borer Assessment and Monitoring at six USACE Public-Use Areas in Kansas

April 2020

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Purpose

Perform site investigations at 6 Public-Use Areas

- Deploy insect traps to determine presence of EAB adults
- Determine ash density and abundance within forested areas
- Evaluate individual ash trees health and susceptibility in maintained areas
- Prioritize campsite hazard of individual ash trees

Big Hill Lake—Cherryvale Park
Fall River Lake—White Hall Bay
John Redmond Reservoir—Riverside East
Council Grove Lake—Richie Cove
Marion Reservoir—Hillsboro Cove
Elk City Reservoir—Outlet Channel

EAB Site Monitoring

- Purple Prism Traps
  - 5 traps deployed at each site
  - Attractant lure—Leaf alcohol Kairomone
  - Traps suspended 12-15’ near tree bole
  - Deployed 22-25 May 2019

Individual Ash Tree Assessment

- Determined overall health and EAB susceptibility
  - Canopy % Cover
  - Canopy Stress
  - Epicormic Branching
  - Bark Fissures
  - Woodpecker Damage
  - Fungal Activity
  - EAB sign (D-shaped exit holes; egg deposits)
  - Soil Compaction
- Determined risk to campsite and visitors
  - Structures, buildings, fire rings
- All trees GPS'd, 10-12 July 2019

Individual Ash Tree Assessment

- Equation for Health Rating:

$$\sum(LCS + CS + EB) + \frac{1}{2}(BF + WPD + WWB + FA)$$

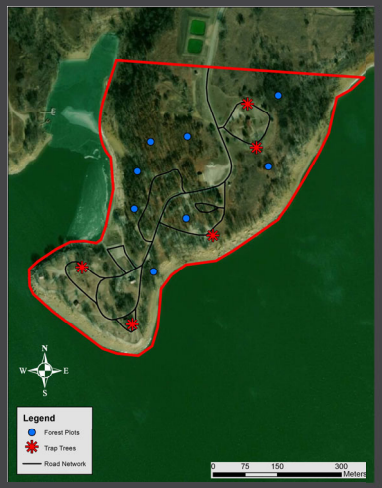
where:

LCS = Live Canopy Score [0,1,1½,2,3]
CS= Canopy Stress
EB= Epicormic Branching
BF= Bark Fissures
WPD= Woodpecker Damage
WWB= Wound Wood/Burls
FA=Fungal Activity

- Range of 0-7, with seven represented as a dead or dying tree.

Forest Assessment of Ash Density

- 10-BAF prism sampling in forested areas
- All trees ≥3” DBH, diameter and species
- Understory trees (<3” DBH and >3.3’ (1m) height) noted
- Ash regeneration recorded if present



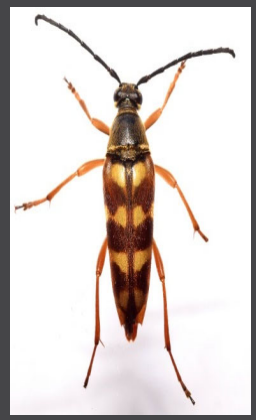
Results—EAB Trapping

- No EAB were identified
- Several beetles were similar in appearance

Chrysobothris sp. (Coleoptera: Buprestidae)

Elateridae (Coleoptera)- Click beetles

Longhorn beetle (Cerambycidae)

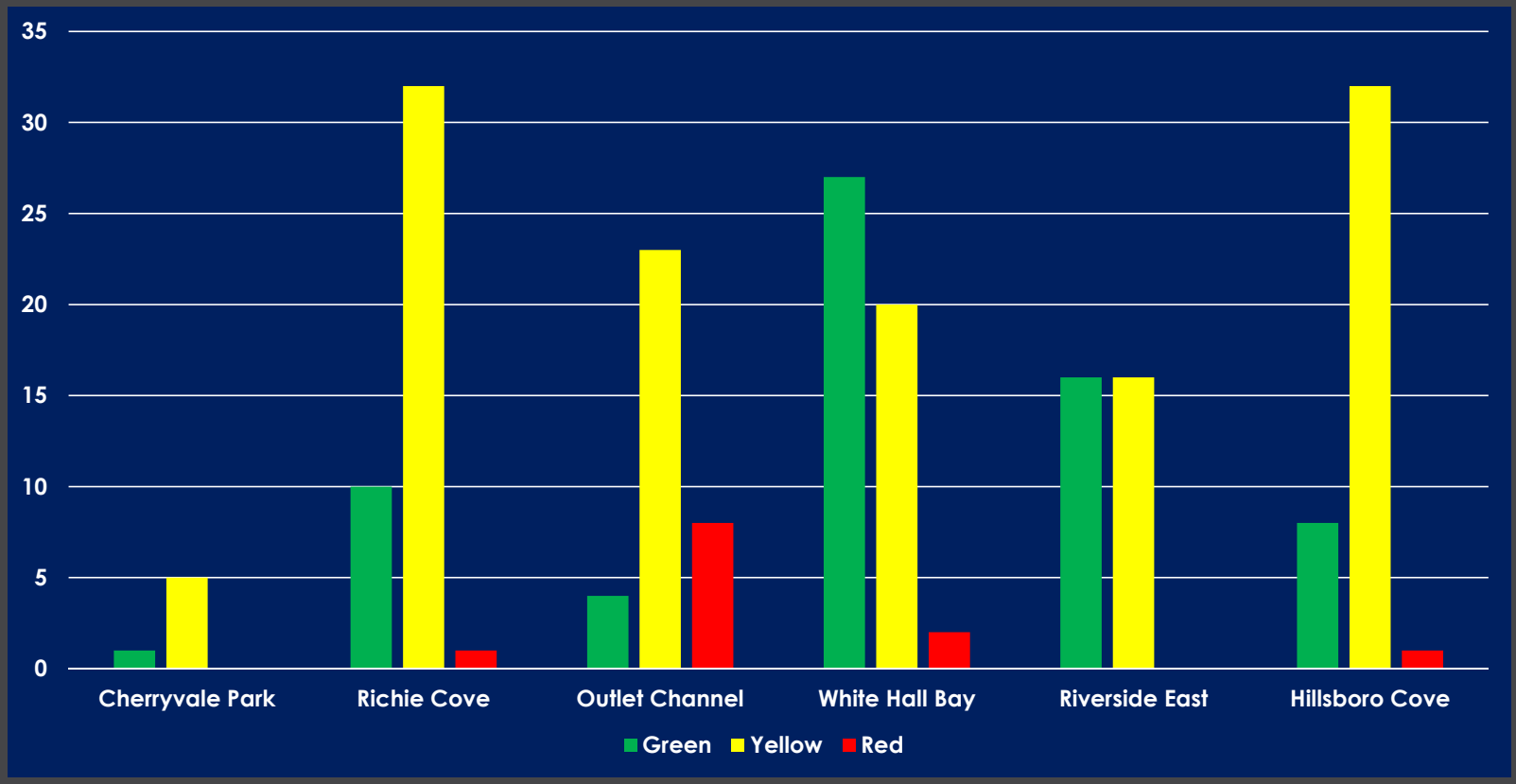


Results—Ash Tree Assessment

Site	Ash Tree Count	Overall Health Rating			Soil Compaction (%)	Campsite Hazard (%)	EAB Sign	Insects Collected
		H	M	L				
Cherryvale Park	6	0	83	17	67	50	Absent	34
White Hall Bay	49	4	41	55	78	39	Absent	25
Riverside East	32	0	50	50	66	19	Absent	18
Richie Cove	43	2	74	24	65	37	Absent	19
Hillsboro Cove	41	2	78	20	100	20	Absent	19
Outlet Channel	35	23	66	11	86	37	Absent	66

Health Rating Scores are defined as: Healthy (Green; 0-2), Moderately Stressed (Yellow; >2-4), and Heavily Stressed (Red; >4-7)

Results—Ash Tree Assessment



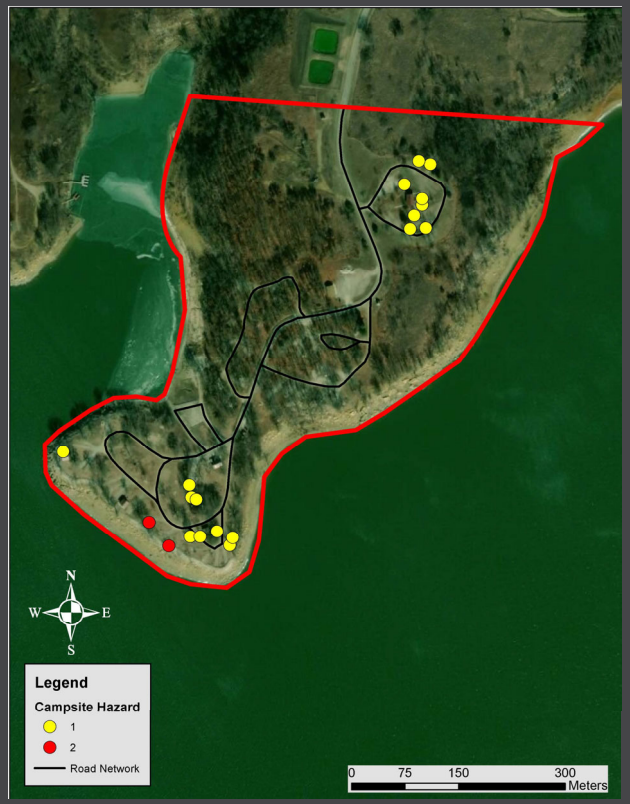
Health Rating Scores are defined as: Healthy (Green; 0-2), Moderately Stressed (Yellow; >2-4), and Heavily Stressed (Red; >4-7)

Cherryvale

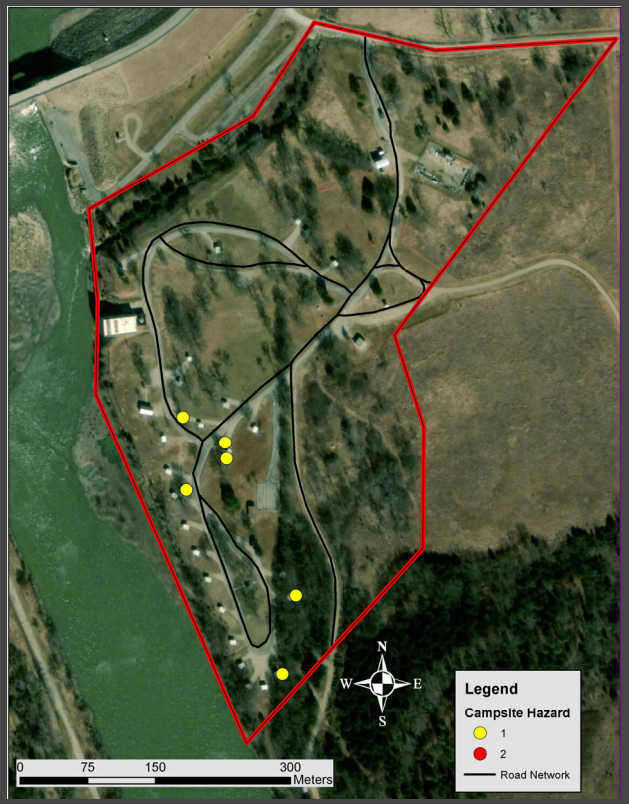

N
W
E
S
Legend
0 - 2
>2 - 4
>4 - 7
Road Network
0
75
150
300
Meters


N
W
E
S
Legend
Campsite Hazard
1
2
Road Network
0
75
150
300
Meters

White Hall Bay



Riverside East



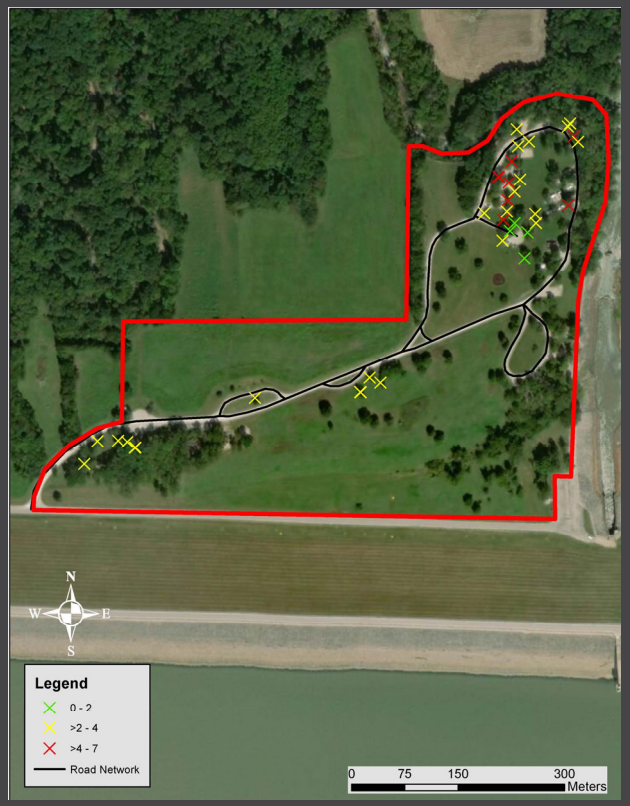
Richie Cove

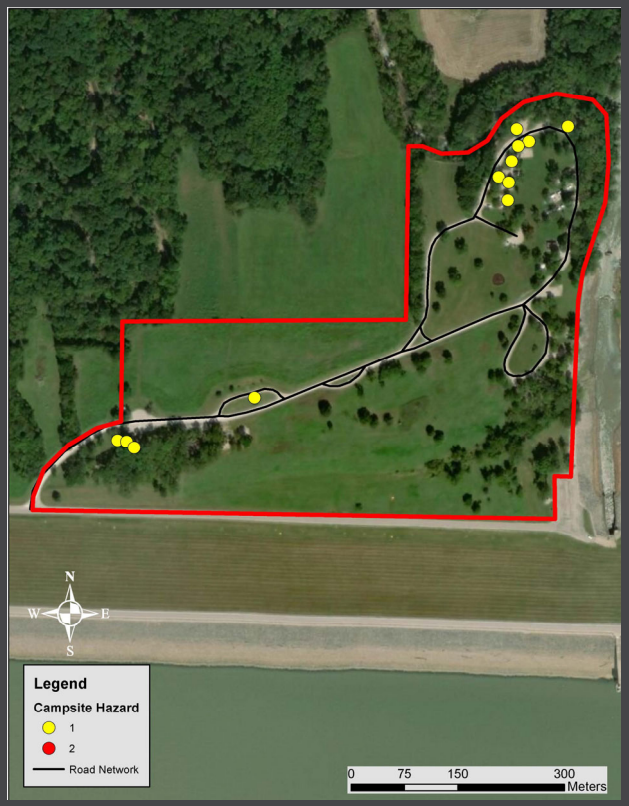

N
W
E
S
Legend
0 - 2
>2 - 4
>4 - 7
Road Network
0 75 150 300
Meters


N
W
E
S
Legend
Campsite Hazard
1
2
Road Network
0 75 150 300
Meters

Hillsboro Cove

Outlet Channel





Results—Forest Assessment and Ash Density

Site	Plot Count	Overstory Species Count (Ash Percentage)	Basal Area (ft2/acre)	Trees per Acre	Average DBH (in.)	Understory Species Count (Ash Percentage)	Ash Regeneration Percentage	Snags per Acre (Ash Percentage)
Cherryvale Park	10	14 (0%)	97.0	75	11.2	13 (10%)	20%	15 (0%)
White Hall Bay	8	10 (10%)	103.8	91	11.9	18 (25%)	25%	3 (50%)
Riverside East	8	12 (42%)	88.8	59	8.8	14 (38%)	63%	13 (60%)
Richie Cove	8	15 (3%)	122.5	125	12.2	20 (38%)	50%	6 (20%)
Hillsboro Cove	6	9 (24%)	118.3	123	12.2	13 (33%)	67%	5 (0%)
Outlet Channel	8	17 (12%)	116.3	167	14.6	13 (0%)	25%	9 (12%)

Findings

- Many of the ash trees we examined exhibited moderate stress
- Soil compaction, while frequently observed, did not correlate well to overall health rating
- Only White Hall Bay had more trees in lower stress condition “Green”
- Increased risk within PUA’s because of tree condition and likelihood of spread via human activity

Next Steps

- While no EAB was detected, need to continually monitor
- Onset of EAB is likely in PUA's
- Future trap locations should be placed in high-risk areas
- Ash tree health evaluations are recommended every other year
- Resulting maps provide a means to prioritize removal and identify highest-risk areas for future management

Emerald Ash Borer: Raystown Lake Experience

April 2020

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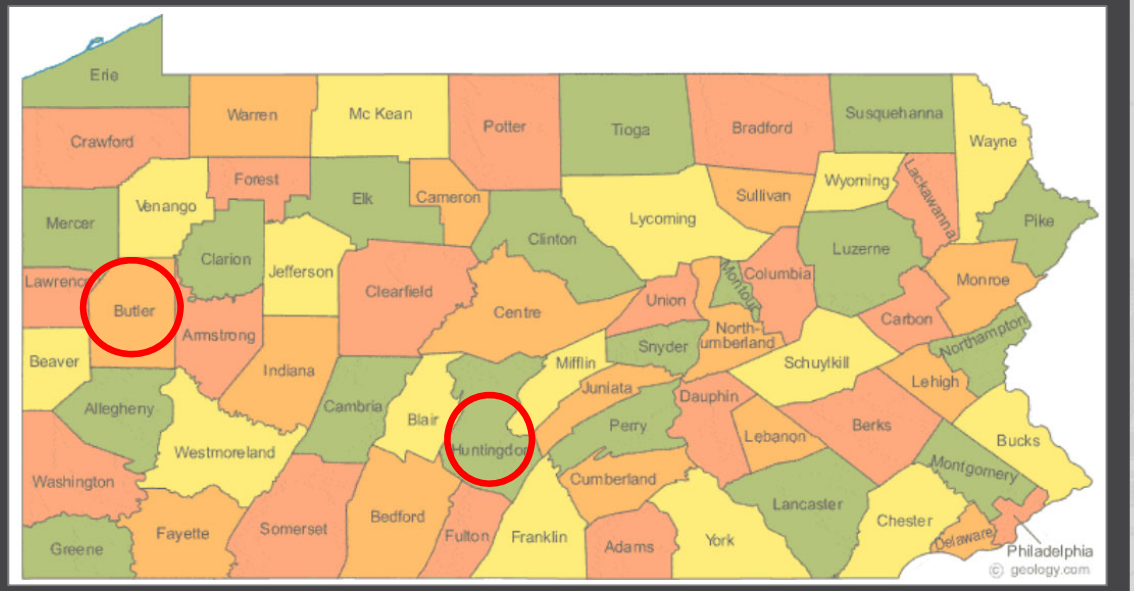
EAB in PA

- In 2007, EAB was detected in Butler and Allegheny Counties in Pennsylvania – 140 miles from Huntingdon County (Raystown Lake).
- After EAB was detected an internal quarantine was enacted to limit the spread of EAB in Pennsylvania and at the same time, the USDA enacted a federal quarantine to limit the movement of ash out of Pennsylvania.

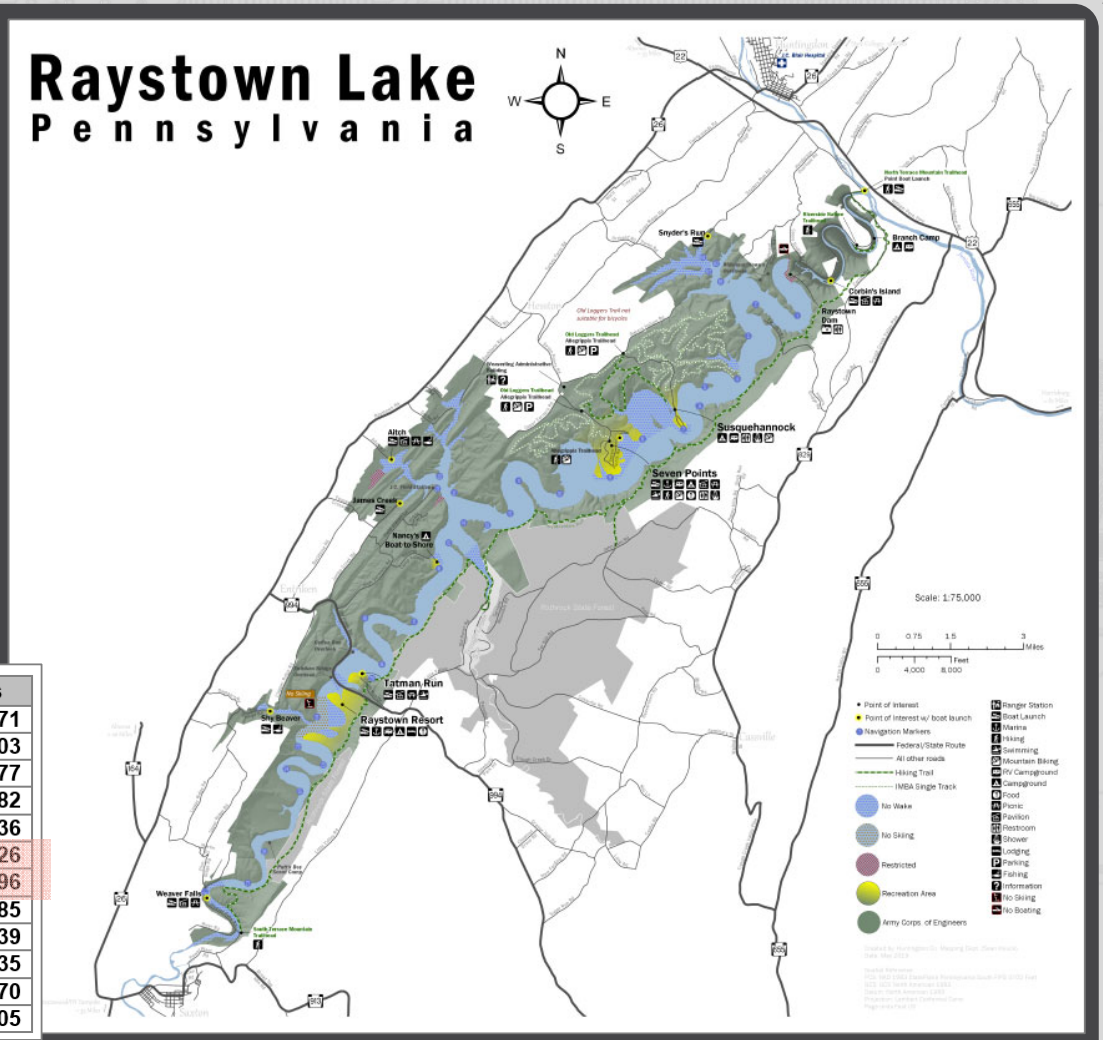


- Due to a number of EAB detections in Pennsylvania and adjacent counties in neighboring states, in April of 2011 the internal state quarantine restricting the movement of ash within Pennsylvania was rescinded.

Raystown Lake

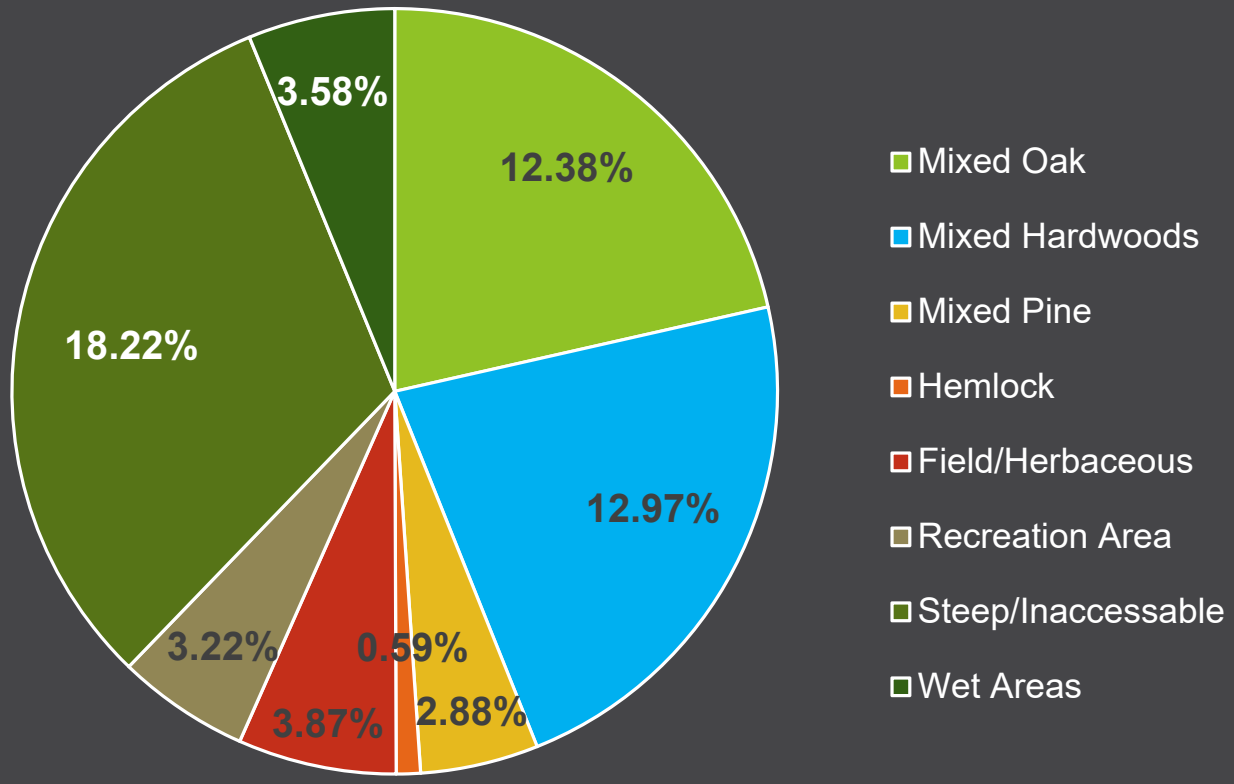
- 22,000 acres land (plus 8,000 acres water).
- Adjacent lands include Rothrock State Forest (97,000 acres).
- Large contiguous blocks of forest.

Classification	Acres
Project Operations	241.71
High Density Recreation	1,067.03
Mitigation	2,653.77
Environmentally Sensitive Areas	507.82
Multiple Resource Management Lands: Low Density Recreation	2,694.36
Multiple Resource Management Lands: Wildlife Management	7,012.26
Multiple Resource Management Lands: Vegetative Management	5,466.96
Multiple Resource Management Lands: Future/Inactive Recreation	1,698.85
Water Surface: Restricted	236.39
Water Surface: Designated No-Wake	1,908.35
Water Surface: Fish and Wildlife Sanctuary	43.70
Water Surface: Open Recreation	6,144.05



Raystown Lake – Typical Land Composition

- Original forest in the region was predominantly comprised of the mixed oak-chestnut and white pine-hemlock forest type.
- Due to past land use practices the forest species composition has changed to predominantly mixed oak.
- Historically, the forests surrounding the Project were heavily harvested and allowed to naturally regenerate.
- The result has been a forest comprised of mostly oak species and a loss of much of the white pine, hemlock and spruce forests.



Raystown Lake-EAB

- Decision: Recreation Areas vs. Non-Recreation Areas.
  - EAB infested trees marked as Hazardous in Recreation Areas when they posed an immediate safety concern for recreational users located in high use areas.
    - 10 High Density Recreation Areas of which:
      - 3 are campgrounds
      - 7 are boat launches

- EAB infested trees in Non-Recreation areas left standing for wildlife purposes (i.e. den trees for species such as Northern Long-eared Bat) – impact NOT calculated.

Raystown Lake - EAB

2013

2 out of 44 (4.5%) trees marked as hazardous during annual survey were ash.

Forester noted the presence of EAB infestation and level of projected impact.

2014

11 out of 34 (32.4%) trees marked as hazardous during annual survey were ash.

Forester noted that several campgrounds that contain white ash trees were showing signs of EAB infestation and significant dieback.

2015

110 out of 149 (73.8%) trees marked as hazardous during annual survey were ash.

2016

132 out of 179 (73.7%) trees marked as hazardous during annual survey were ash.

Forester noted that additional hazard trees that were not immediately adjacent to the main roadway and trail, but were within falling distance of the road/path were not marked due to the abundance of them (primarily ash).

2017

3 out of 26 (11.5%) trees marked as hazardous during annual survey were ash.

2019

91 out of 363 (25.1%) trees marked as hazardous during annual survey were ash.

Raystown Lake - EAB

Hazardous Trees Marked	2015	2016	2017	Total
Total Ash (Hazard) Trees Marked	110	132	3	245
Total Hazard Trees Marked	149	179	26	354
% Ash	73.83%	73.74%	11.54%	**69.21%**
Ash/Acre (Approximately 120 acres)				**2.04**

*Hazard trees were ones that pose an immediate safety concern for recreational users and/or are located in high use areas were counted above. Forester notes that additional hazard trees that were not immediately adjacent to the main roadway and trail, but were within falling distance of the road/path were not marked due to the abundance of them (primarily ash). Same location each year equalling approximately 120 acres (annually).

Costs	Hours	Rate	Sub-Total	Hours	Rate	Sub-Total	Hours	Rate	Sub-Total	Total
Forester (Mark)	40	$79.21	$2,338.98	40	$79.21	$2,336.37	40	$79.21	$365.57	$5,040.92
Forester (Remove*)	90	$79.21	$5,262.71	110	$79.21	$6,425.01	10	$79.50	$91.73	$11,779.45
Required 2nd Person (Equip Operator)	90	$51.67	$3,433.11	110	$51.67	$4,191.33	10	$51.67	$59.62	$7,684.06
Required 3rd Person (Truck Driver-Debris)	90	$51.67	$3,433.11	110	$51.67	$4,191.33	10	$51.67	$59.62	$7,684.06
General Cleanup	90	$51.67	$3,433.11	110	$51.67	$4,191.33	10	$51.67	$59.62	$7,684.06
Equipment 1 (Backhoe)	90	$100.00	$6,644.30	110	$100.00	$8,111.73	10	$100.00	$115.38	$14,871.41
Equipment 2 (Truck)	90	$100.00	$6,644.30	110	$100.00	$8,111.73	10	$100.00	$115.38	$14,871.41
Contract Preperation	10	$86.91	$641.62	10	$86.91	$640.90	10	$86.91	$100.28	$1,382.80
Contract (CT Cost)			$2,657.72			$2,654.75			$415.38	$5,727.85
Replacement (Cost)			$19,800.00			$58,080.00			$1,320.00	$79,200.00
*Costs based on Percent Ash noted above			$54,288.94			$98,934.49			$2,702.59	$155,926.01

*Remove is to cut down and de-limb only. Allow firewood cutting by public under permit to remove felled trees. Debris removal is limbs etc. **Contract cost is actual. For this spreadsheet a 1:1 replacement of lost ash was utilized. This was not done in the field.

Total Cost	$155,926.01
Total Trees	245
Cost/Tree	$636.43
Total Cost	$155,926.01
Total Acres	120
Cost/Acre	$1,299.38

Emerald Ash Borer Estimated Cost to USACE

April 2020

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Estimating EAB Cost to USACE - *Why?*

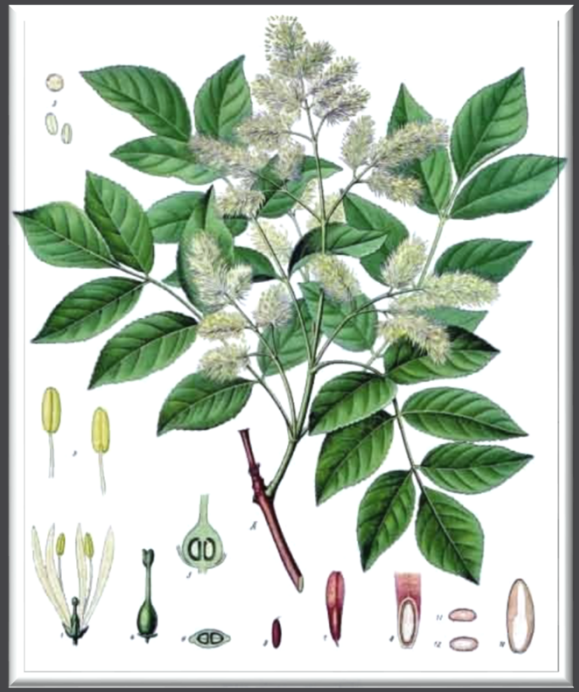
1. Determine the magnitude of EAB cost to USACE
2. Inform cost budget for USACE projects yet to be impacted by EAB
3. Raise awareness of cost to USACE from a single invasive species

Method - Literature Informed

Kovacs et al. (2010)

Estimated the cost of ash treatment, removal, and replacement on developed land within communities in a 25-state study area from 2009-2019

- 17 million trees
- $10.7 billion



Method – Kovacks, et al. 2010

20% **X** (Total Trees Managed) **X** (Management $/Tree) **X** (Present Value Factor)

20% Decay

- Every year for 5 years an equal number of trees removed until all gone
- 1 year delay in detection
- 4 year lag from detection to first removal

Example: EAB detected in 2006, 100 vulnerable trees

- Costs begin in 2010
- 20 trees removed every year for 5 years

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Project 1	Intial Detect					$ 15,573	$ 15,267	$ 14,968	$ 14,675	$ 14,387

Model Time Delay

Method – USACE Application

20% **X** (Total Trees Managed) **X** (Management $/Tree) **X** (Present Value Factor)

Total Trees Managed = (Trees/Acre) **X** (Loss Rate) **X** (Project Acres)

Trees/Acre
- USDA Forest Service, Forest Inventory and Analysis, 2006-2017
- Trees > 7in diameter

Loss Rate = % Ash trees expected to succumb to EAB
- 2006-2017 Average = 26%

Project Acres = Acres of publically accessible Corps land

Method – USACE Application

20% **X** (Total Trees Managed) **X** (Management $/Tree) **X** (Present Value Factor)

Management Cost per Tree

- Kovacs cost per tree by state indexed to 2019
  - Remove, remove & replace, treat
  - Average of all states - $651/tree
- Raystown Lake Case Study
  - $648/tree

Present Value Factor – opportunity cost of money spent treating Ash trees

Case Study - Raystown Lake

	Modeled	Actual	Difference	%*
Years Managed	2014 - 2018	2015 - 2017	2 years	40%
Acres Managed	537	120	417	348%
Trees Managed	369	245	124	51%
TPAM	0.69	2.04	-1.35	-66%
CPT	$ 687.50	648.44	39.06	6%
Cost	$ 269,672	$ 158,868	$ 110,804	70%

TPAM: Trees Per Acre Managed

* Percent Difference over actual

Results

Emerald Ash Borer estimated cost to USACE

$72 - $121.9 MILLION

From 2006-2026
122,800 acres & 181,000 ash trees

Results

District	Number of Projects	Acres	ETL	PV Cost
LRB	2	563	915	$ 554,496
LRE	8	68	131	$ 88,654
LRH	43	7,127	17,277	$ 14,189,779
LRL	26	10,051	40,267	$ 31,616,726
LRN	10	9,936	15,179	$ 7,989,660
LRP	16	4,897	4,071	$ 2,984,464
MVK	10	4,131	1,211	$ 706,395
MVP	2	150	153	$ 103,479
MVR	6	3,901	3,477	$ 2,114,283
MVS	8	23,559	20,367	$ 13,825,299
NAB	14	3,414	3,100	$ 2,100,324
NAE	26	1,111	1,502	$ 700,007
NAP	4	1,030	2,506	$ 1,689,877
NWK	9	16,082	8,890	$ 5,479,271
NWO	2	16,410	52,435	$ 31,766,778
SAM	3	4,711	3,816	$ 2,435,257
SAS	1	1,569	2,353	$ 1,281,332
SAW	4	9,434	1,555	$ 961,052
SWF	2	971	81	$ 48,524
SWL	5	3,692	1,734	$ 939,501
Total	**201**	**122,807**	**181,020**	**$ 121,575,158**

Year	PV Cost
2006	$ -
2007	$ -
2008	$ -
2009	$ 1,624,809
2010	$ 2,386,958
2011	$ 3,405,983
2012	$ 4,501,598
2013	$ 6,686,467
2014	$ 5,387,457
2015	$ 4,816,532
2016	$ 4,962,623
2017	$ 6,980,164
2018	$ 8,585,387
2019	$ 9,411,285
2020	$ 13,982,488
2021	$ 13,283,097
2022	$ 12,866,752
2023	$ 9,171,837
2024	$ 7,842,314
2025	$ 3,172,864
2026	$ 2,506,543

Limitations

- The margin or uncertainty could be improved upon (e.g., FIA data provided confidence levels by county).
- Loss rates and impacts costs could have confidence levels developed with inclusion of actual data points similar to Raystown Lake.
- Only includes project in counties where EAB has been detected.

Summary

- Ash removal is not a budgeted cost, yet Emerald Ash Borer will likely cost USACE over $100 million in ash treatment, removal, and/or replacement.

- If you haven't encountered EAB yet, Nathan can help.
  1. Consider a forest health assessment
  2. Establish a monitoring plan

- More EAB Info: http://www.emeraldashborer.info/index.php

http://www.emeraldashborer.info/index.php

Emerald Ash Borer

Emerald ash borer (EAB), *Agrilus planipennis* Fairmaire, is an exotic beetle that was discovered in southeastern Michigan near Detroit in the summer of 2002. The adult beetles nibble on ash foliage but cause little damage. The larvae (the immature stage) feed on the inner bark of ash trees, disrupting the tree's ability to transport water and nutrients. Emerald ash borer probably arrived in the United States on solid wood packing material carried in cargo ships or airplanes originating in its native Asia. **As of October 2018**, it is now found in 35 states, and the Canadian provinces of Ontario, Quebec, New Brunswick, Nova Scotia and Manitoba.

Since its discovery, EAB has:

- Killed hundreds of millions of ash trees in North America.
- Caused regulatory agencies and the USDA to enforce quarantines and fines to prevent potentially infested ash trees, logs or hardwood firewood from moving out of areas where EAB occurs.
- Cost municipalities, property owners, nursery operators and forest products industries hundreds of millions of dollars.

Recommended Resources

Initial county EAB detections in North America & Canada

As of April 1st, 2020

Click to enlarge

Changes/additions included since March 2nd 2020:

Initial county detections in:
Franklin County, MA
Rice County, MN

Added to the list of counties quarantined by their state:
Cumberland County, ME
Five towns in south Oxford County, ME
Rice County, MN

What To Know About EAB

Adult Beetles are metallic green and about 1/2-inch long.

It attacks only ash trees (*Fraxinus* spp.)

Adults leave a D-shaped exit hole in the bark when they emerge in spring.

Woodpeckers like EAB larvae; heavy woodpecker damage on ash trees may be a sign of infestation.

Firewood cannot be moved in many areas because of the EAB quarantine.

It probably came from Asia in wood packing material.

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