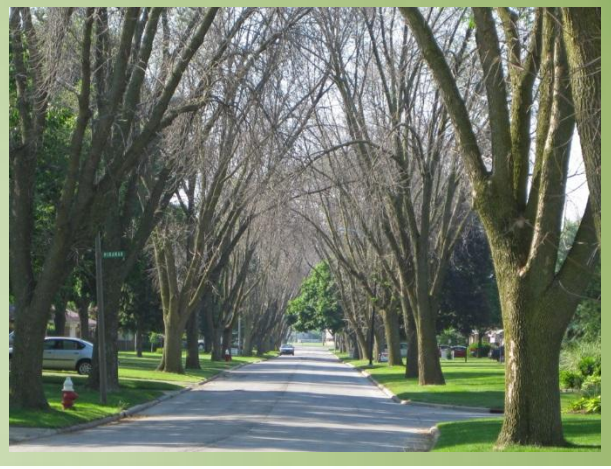
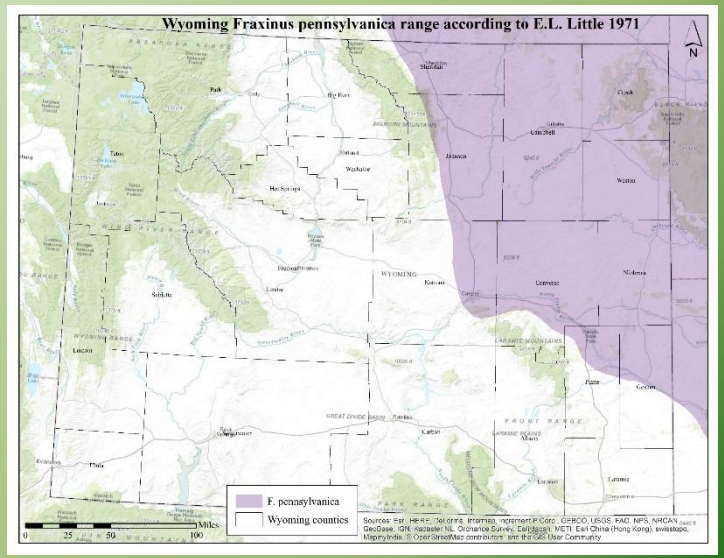
Emerald Ash Borer

Introduction, Detection & Treatment in WY





Introduction to EAB

- Adult green, ½” long
- Larva flattened, legless, bell-shaped segments
- Larval galleries winding in phloem (between inner bark & outer sapwood; girdles trees, disrupting water & nutrient transport, eventually killing trees)
- Tunnels packed w/boring dust
- Adult exit holes 1/8” diameter, D-shaped

Introduction to EAB

- NNIB native to eastern Asia (Family Buprestidae)
- Detected in North America in 2002 (southeastern MI, established since early-mid 1990s; first CO detection 2013)
- Larvae feed on ash xylem & phloem (girdles trees, disrupts water & nutrient transport, causes tree mortality)
- Estimated economic value of US ash timber loss due to EAB in next decade: $ hundreds of millions

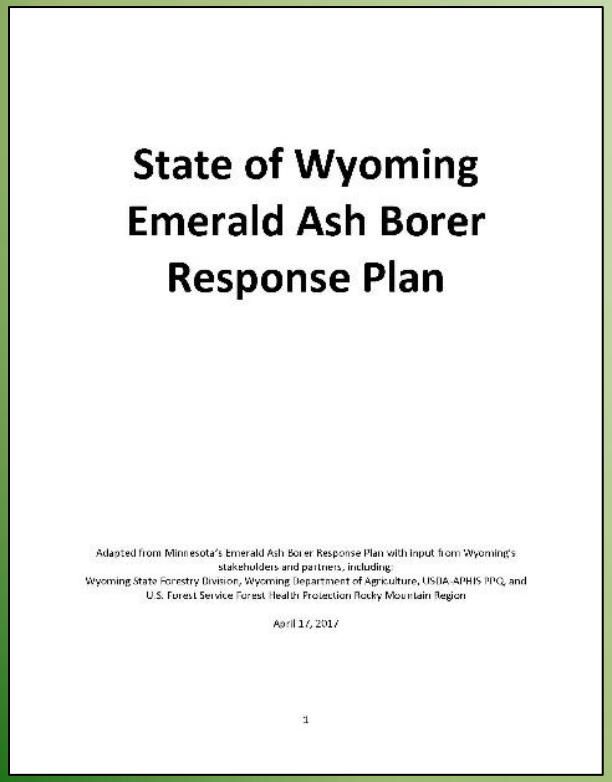
  (ash timber important in Midwest & northeast U.S.; value of urban ash also $ hundreds of millions)

Introduction to EAB

- Killing >99% of Midwest & northeast ash >1” dbh (all size classes; blue ash not as susceptible but green, white, and black ash highly susceptible and comprise >99% of all ash; Asian ash species not infested & killed)
- EAB on ash different than DED on elm (mature trees AND sprouts infested)
- Spreading at 12 mi/yr (as of 2012, average short range dispersal from core infested area in southeastern MI; excludes additional spread from inadvertent human-assisted transport)

Looking for EAB

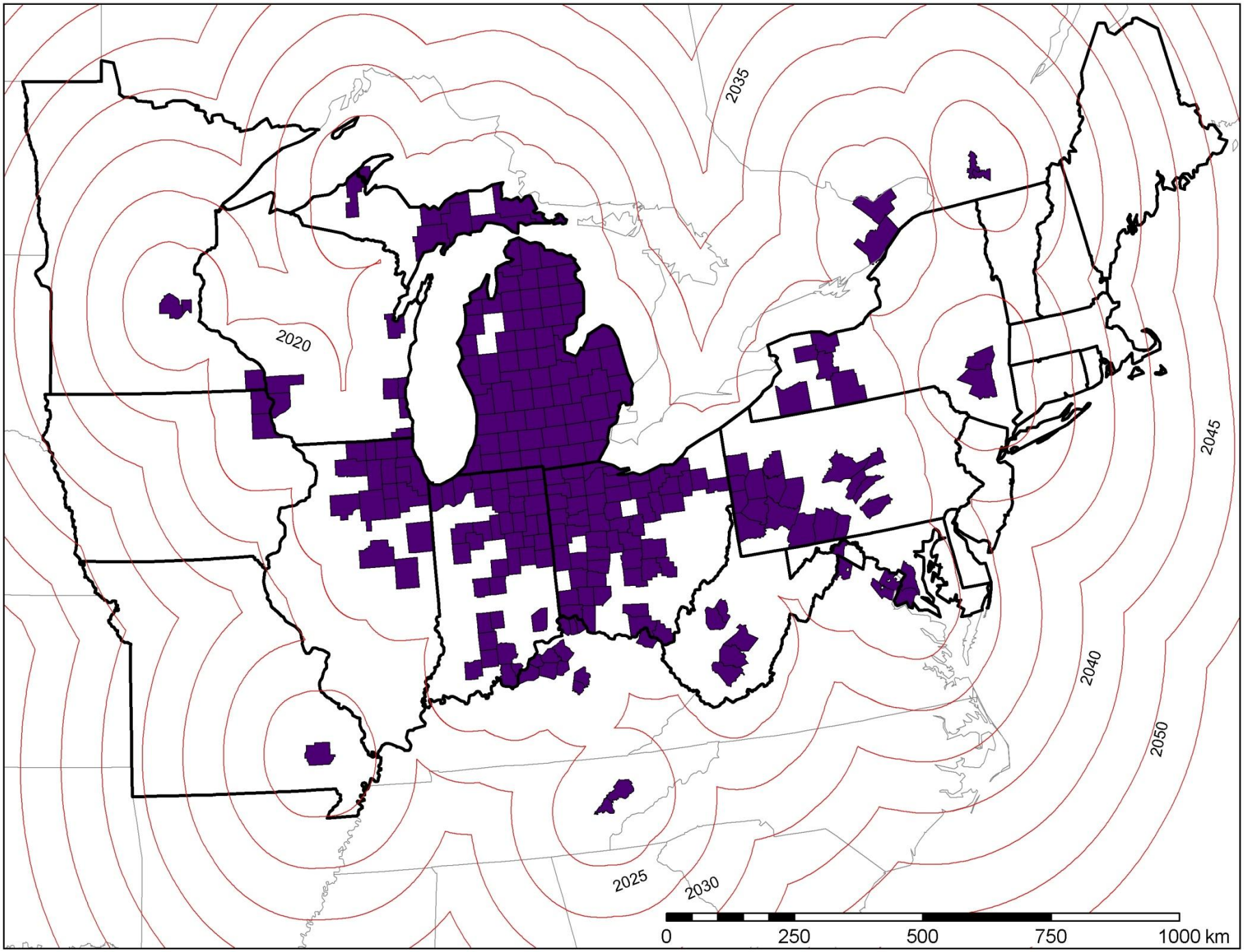
- **Trapping efforts** w/APHIS, others (60+ traps)
  - Traps
  - Trap trees?
- **Not yet found in WY**, found across Boulder County, CO
  - Boulder, Longmont

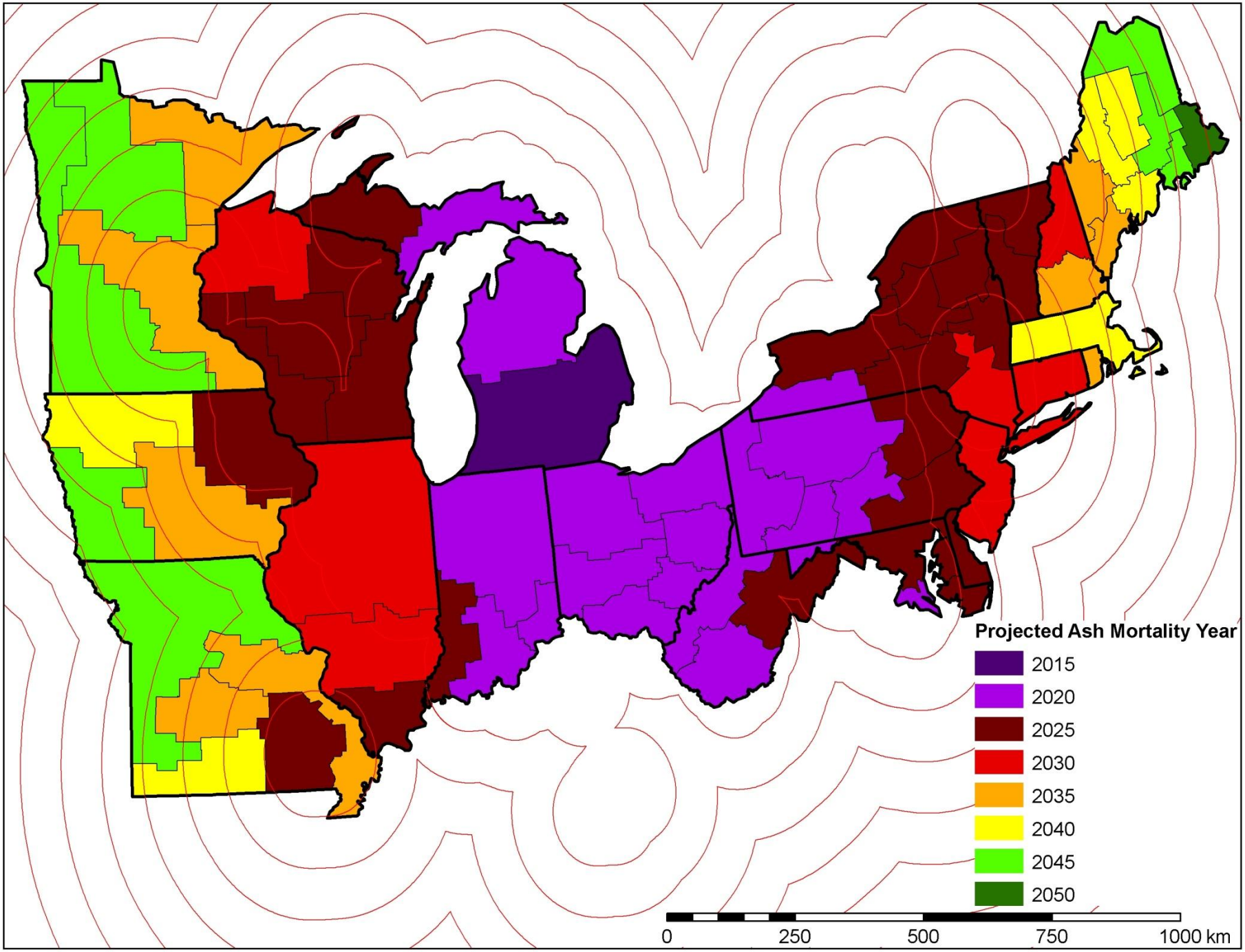

State of Wyoming
Emerald Ash Borer
Response Plan

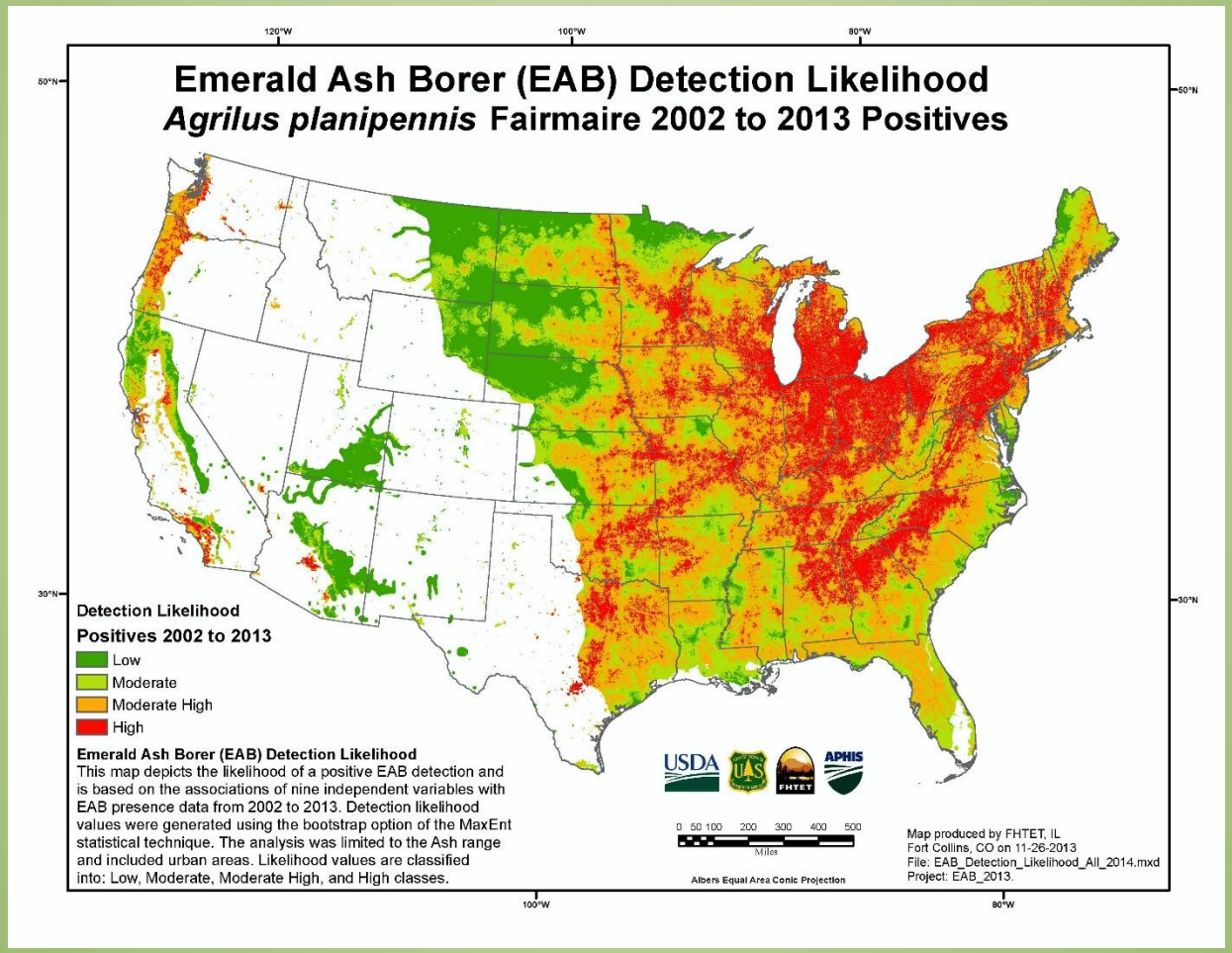
Adapted from Minnesota's Emerald Ash Borer Response Plan with input from Wyoming's stakeholders and partners, including:
Wyoming State Forestry Division, Wyoming Department of Agriculture, USDA-APHIS PPQ, and U.S. Forest Service Forest Health Protection Rocky Mountain Region

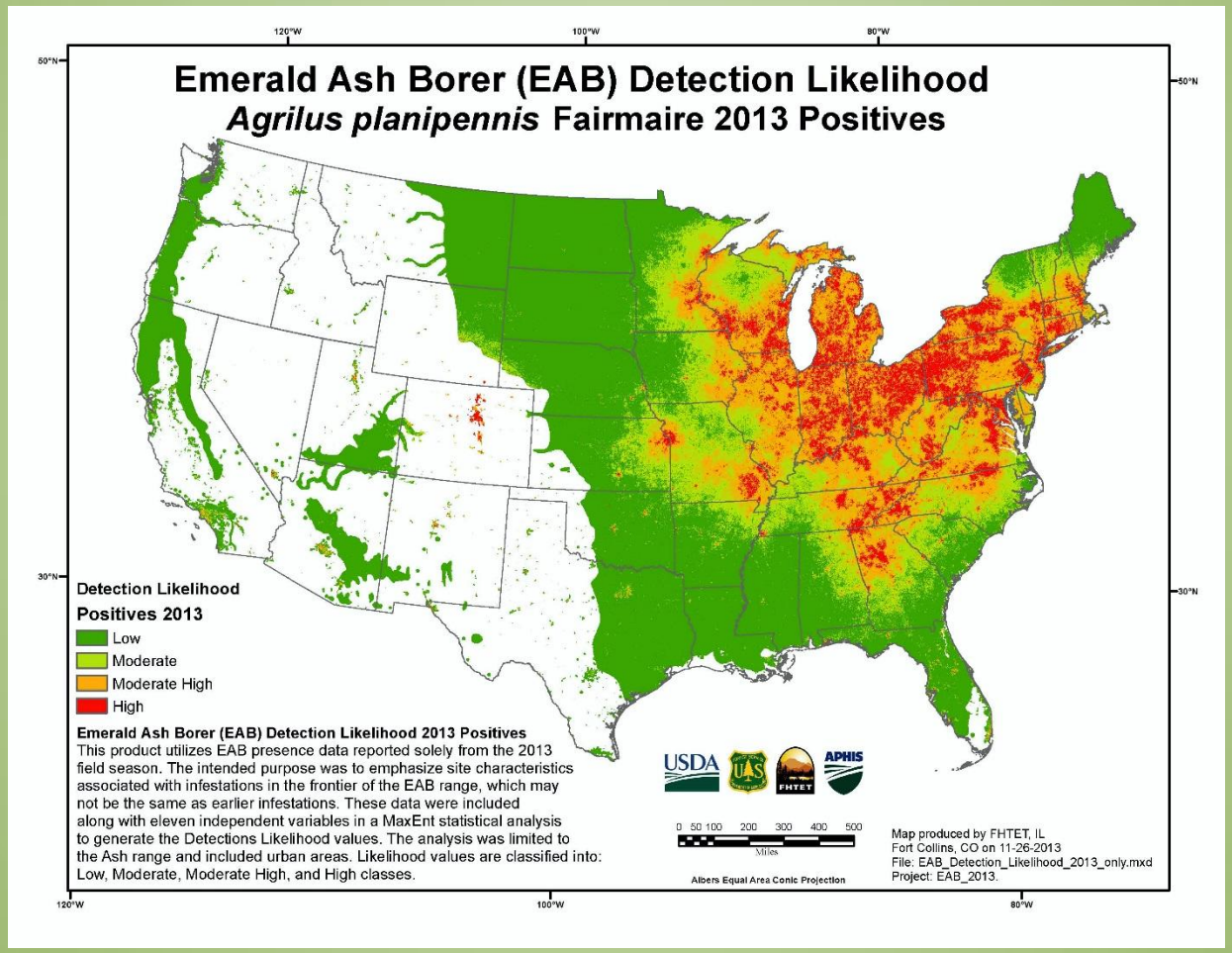
April 17, 2017

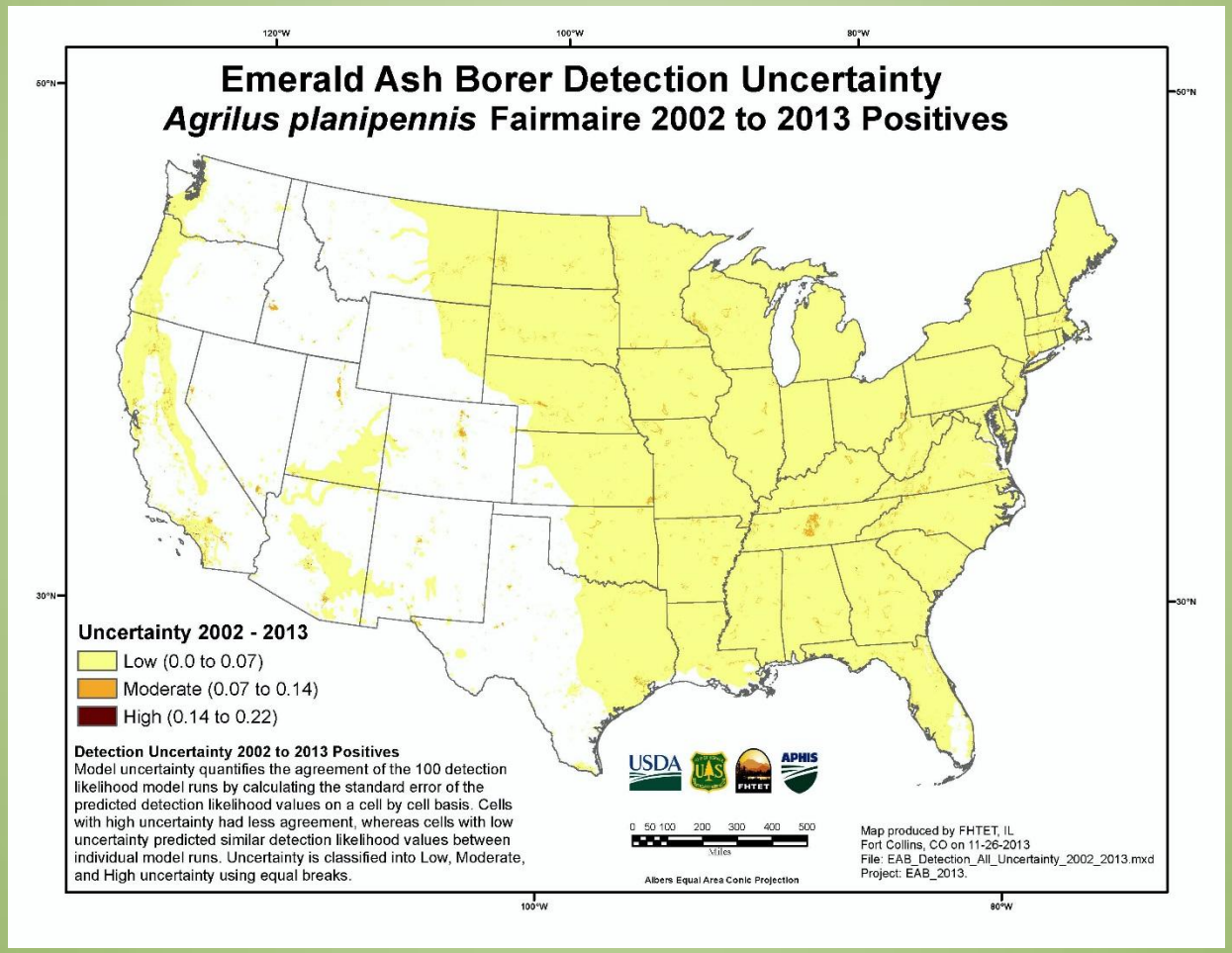
1

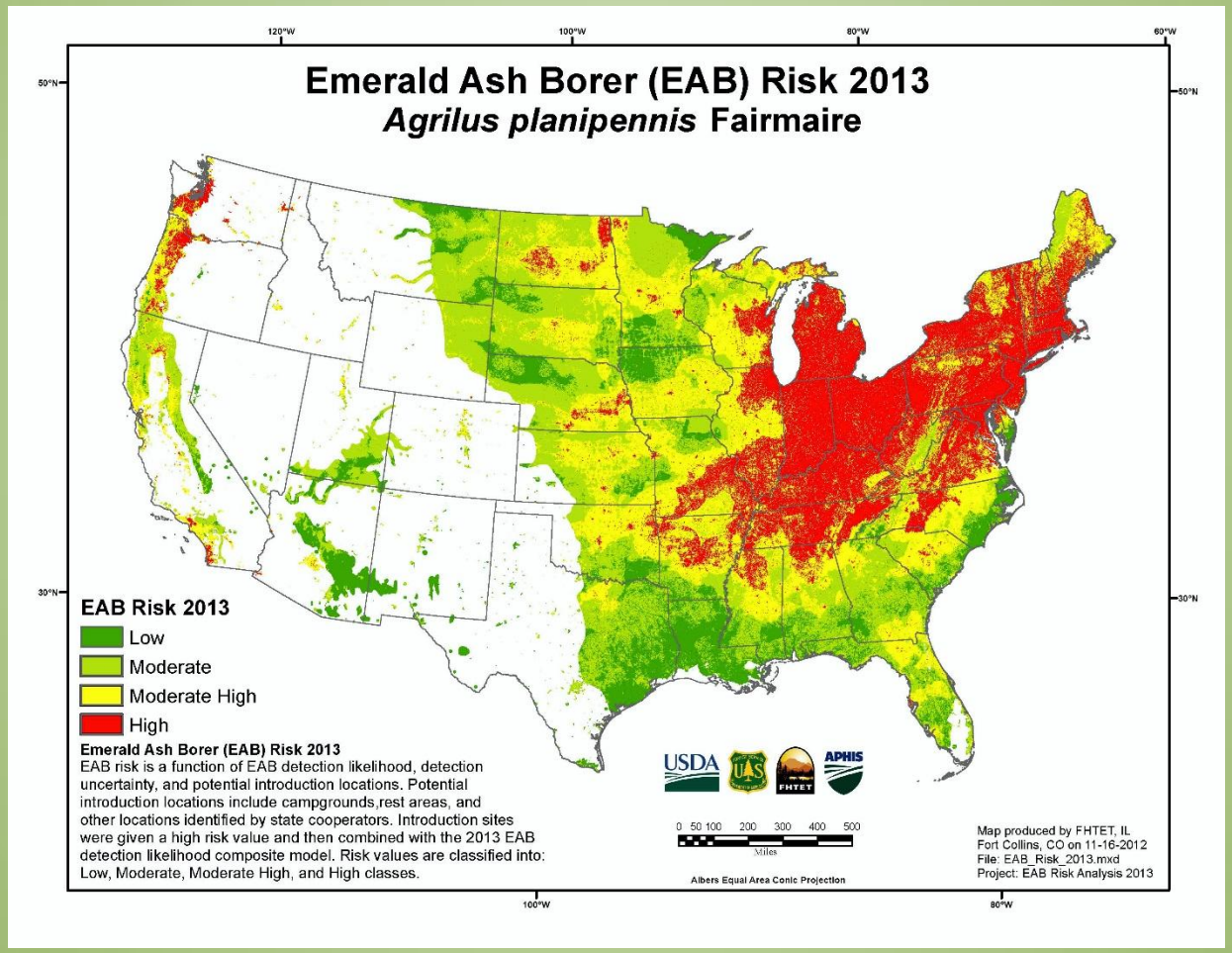

2020
2025
2030
2035
2040
2045
2050
0
250
500
750
1000 km

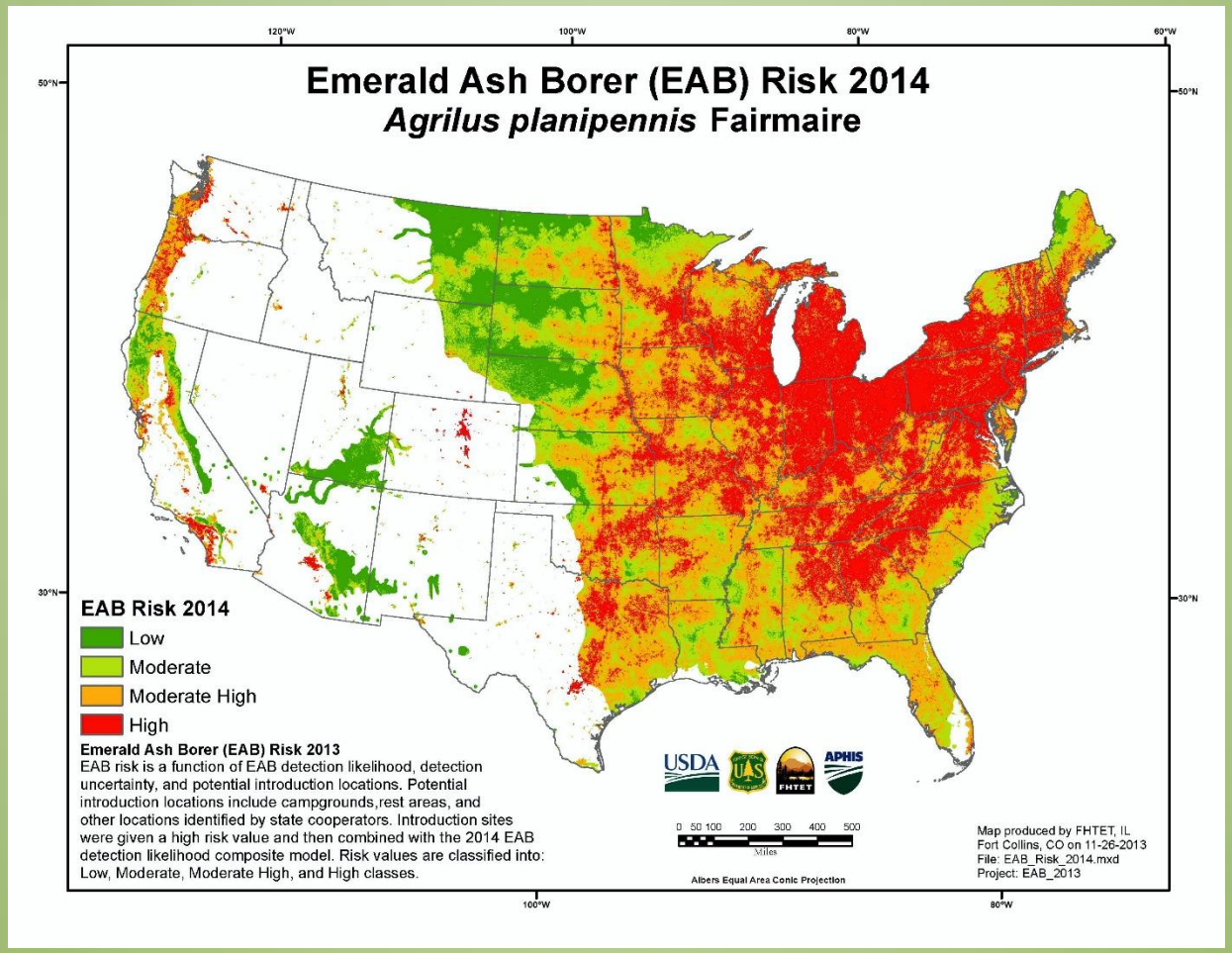

Projected Ash Mortality Year
2015
2020
2025
2030
2035
2040
2045
2050
0
250
500
750
1000 km

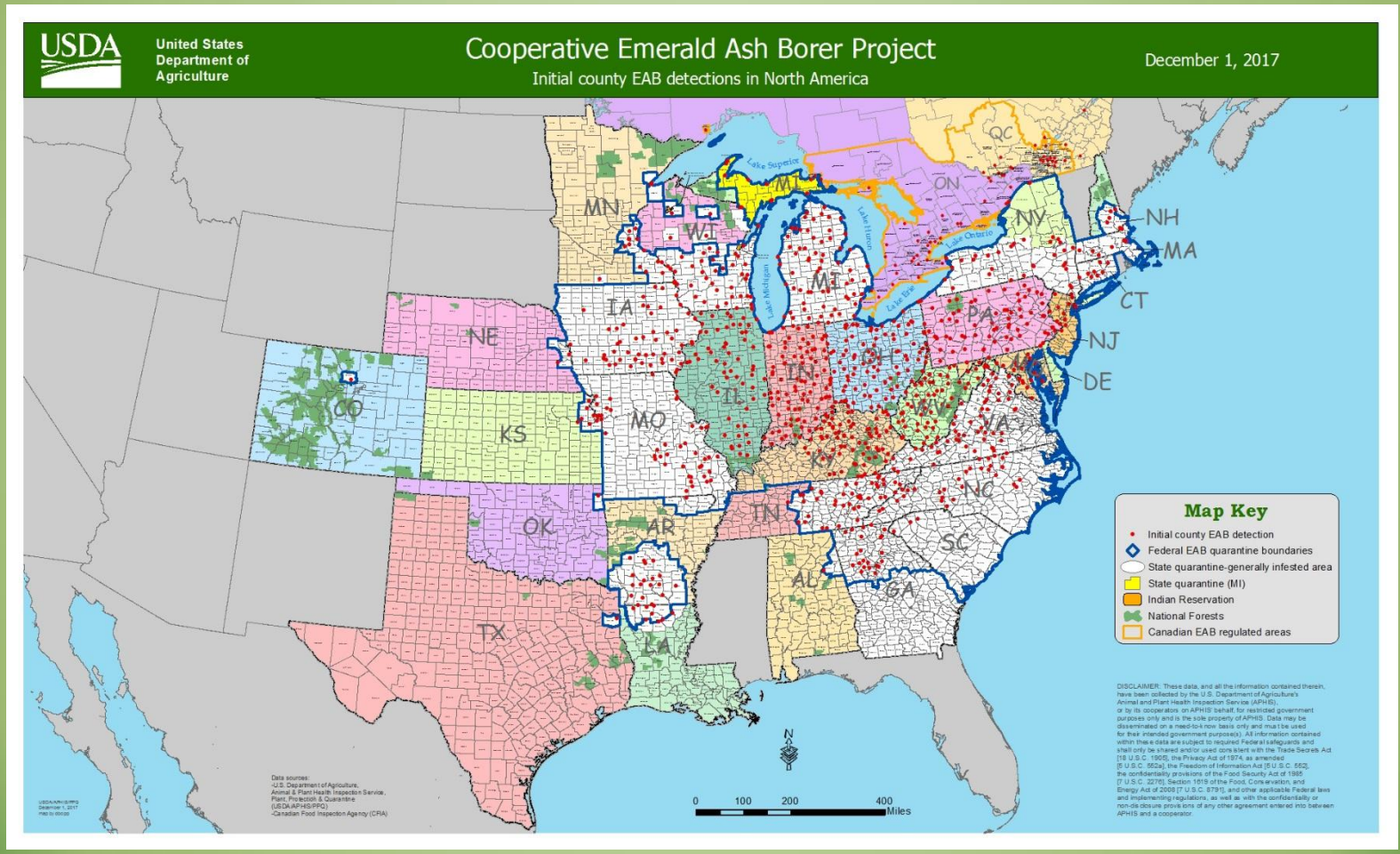

Emerald Ash Borer (EAB) Detection Likelihood
Agrilus planipennis Fairmaire 2002 to 2013 Positives
120°W
100°W
80°W
50°N
30°N
Detection Likelihood
Positives 2002 to 2013
Low
Moderate
Moderate High
High
Emerald Ash Borer (EAB) Detection Likelihood
This map depicts the likelihood of a positive EAB detection and is based on the associations of nine independent variables with EAB presence data from 2002 to 2013. Detection likelihood values were generated using the bootstrap option of the MaxEnt statistical technique. The analysis was limited to the Ash range and included urban areas. Likelihood values are classified into: Low, Moderate, Moderate High, and High classes.
USDA
APHIS
FHTET
0 50 100 200 300 400 500
Miles
Albers Equal Area Conic Projection
Map produced by FHTET, IL
Fort Collins, CO on 11-26-2013
File: EAB_Detection_Likelihood_All_2014.mxd
Project: EAB_2013.


Emerald Ash Borer (EAB) Detection Likelihood
Agrilus planipennis Fairmaire 2013 Positives
120°W
100°W
80°W
50°N
30°N
Detection Likelihood
Positives 2013
Low
Moderate
Moderate High
High
Emerald Ash Borer (EAB) Detection Likelihood 2013 Positives
This product utilizes EAB presence data reported solely from the 2013 field season. The intended purpose was to emphasize site characteristics associated with infestations in the frontier of the EAB range, which may not be the same as earlier infestations. These data were included along with eleven independent variables in a MaxEnt statistical analysis to generate the Detections Likelihood values. The analysis was limited to the Ash range and included urban areas. Likelihood values are classified into: Low, Moderate, Moderate High, and High classes.
USDA
FHTET
APHIS
0 50 100 200 300 400 500
Miles
Albers Equal Area Conic Projection
Map produced by FHTET, IL
Fort Collins, CO on 11-26-2013
File: EAB_Detection_Likelihood_2013_only.mxd
Project: EAB_2013.


Emerald Ash Borer Detection Uncertainty
Agrilus planipennis Fairmaire 2002 to 2013 Positives
120°W
100°W
80°W
60°N
30°N
Uncertainty 2002 - 2013
Low (0.0 to 0.07)
Moderate (0.07 to 0.14)
High (0.14 to 0.22)
Detection Uncertainty 2002 to 2013 Positives
Model uncertainty quantifies the agreement of the 100 detection likelihood model runs by calculating the standard error of the predicted detection likelihood values on a cell by cell basis. Cells with high uncertainty had less agreement, whereas cells with low uncertainty predicted similar detection likelihood values between individual model runs. Uncertainty is classified into Low, Moderate, and High uncertainty using equal breaks.
USDA
APHIS
FHTET
0 50 100 200 300 400 500
Miles
Albers Equal Area Conic Projection
Map produced by FHTET, IL
Fort Collins, CO on 11-26-2013
File: EAB_Detection_All_Uncertainty_2002_2013.mxd
Project: EAB_2013.


Emerald Ash Borer (EAB) Risk 2013
Agrilus planipennis Fairmaire
120°W
100°W
80°W
60°W
50°N
30°N
EAB Risk 2013
Low
Moderate
Moderate High
High
Emerald Ash Borer (EAB) Risk 2013
EAB risk is a function of EAB detection likelihood, detection uncertainty, and potential introduction locations. Potential introduction locations include campgrounds,rest areas, and other locations identified by state cooperators. Introduction sites were given a high risk value and then combined with the 2013 EAB detection likelihood composite model. Risk values are classified into: Low, Moderate, Moderate High, and High classes.
USDA
FHTET
APHIS
0 50 100 200 300 400 500
Miles
Albers Equal Area Conic Projection
Map produced by FHTET, IL
Fort Collins, CO on 11-16-2012
File: EAB_Risk_2013.mxd
Project: EAB Risk Analysis 2013


Emerald Ash Borer (EAB) Risk 2014
Agrilus planipennis Fairmaire
120°W
100°W
80°W
60°W
50°N
30°N
EAB Risk 2014
Low
Moderate
Moderate High
High
Emerald Ash Borer (EAB) Risk 2013
EAB risk is a function of EAB detection likelihood, detection uncertainty, and potential introduction locations. Potential introduction locations include campgrounds,rest areas, and other locations identified by state cooperators. Introduction sites were given a high risk value and then combined with the 2014 EAB detection likelihood composite model. Risk values are classified into: Low, Moderate, Moderate High, and High classes.
USDA
FHTET
APHIS
0 50 100 200 300 400 500
Miles
Albers Equal Area Conic Projection
Map produced by FHTET, IL
Fort Collins, CO on 11-26-2013
File: EAB_Risk_2014.mxd
Project: EAB_2013

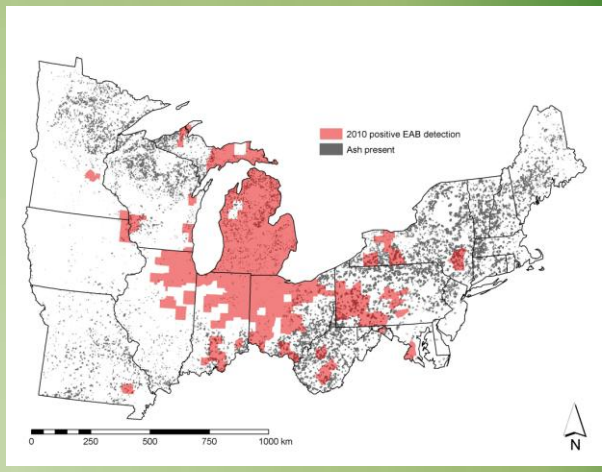

USDA
United States Department of Agriculture
Cooperative Emerald Ash Borer Project
Initial county EAB detections in North America
December 1, 2017
Lake Superior
Lake Michigan
Lake Huron
Lake Erie
Lake Ontario
MN
WI
MI
IA
IL
IN
OH
PA
NY
NE
CO
KS
MO
KY
WV
VA
NC
SC
GA
AL
MS
LA
TX
OK
AR
TN
ON
QC
NH
MA
CT
NJ
DE
MD
Map Key
Initial county EAB detection
Federal EAB quarantine boundaries
State quarantine-generally infested area
State quarantine (MI)
Indian Reservation
National Forests
Canadian EAB regulated areas
0 100 200 400
Miles
N
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.

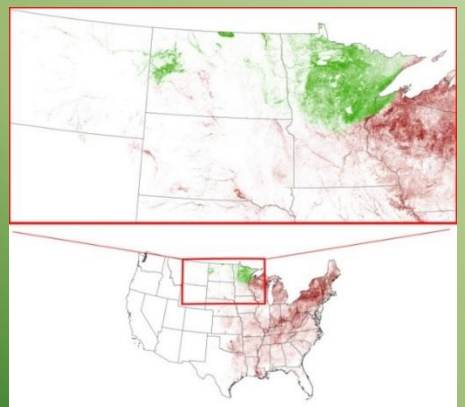
Where is the ash?

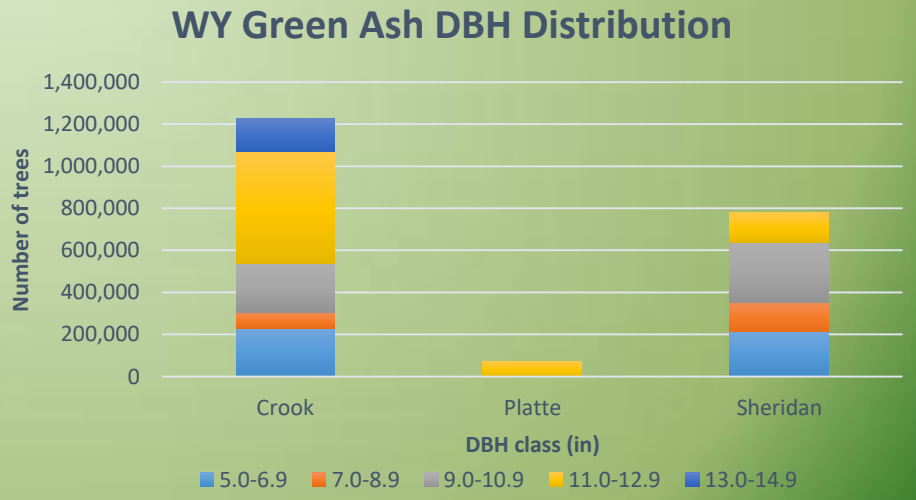
- **Current WY ash resource**
  - Rural?
    - Native = mostly riparian green ash in NE WY
    - FIA: 2,075,272 trees, all on private land
  - Urban?
    - Ash % tree canopy varies

    from low % (Laramie) to

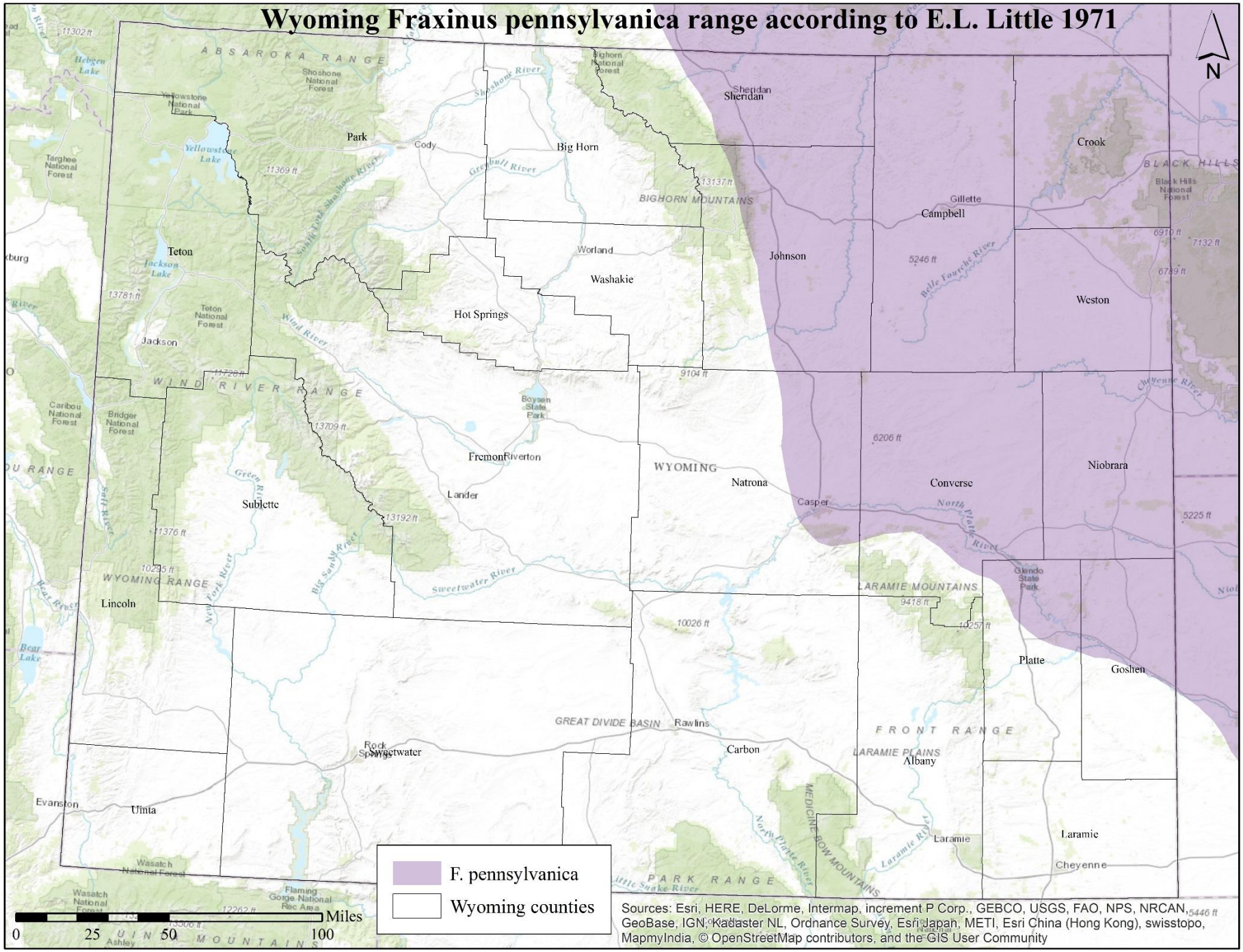
    High % (Powell)
  - Native: green ash







Wyoming Fraxinus pennsylvanica range according to E.L. Little 1971



EAB monitoring

Monitoring efforts (traps, trap trees) focused on

1. High% urban ash
2. Larger human population
3. Transportation corridors
4. Recreation/camping nearby
5. Within ash native range

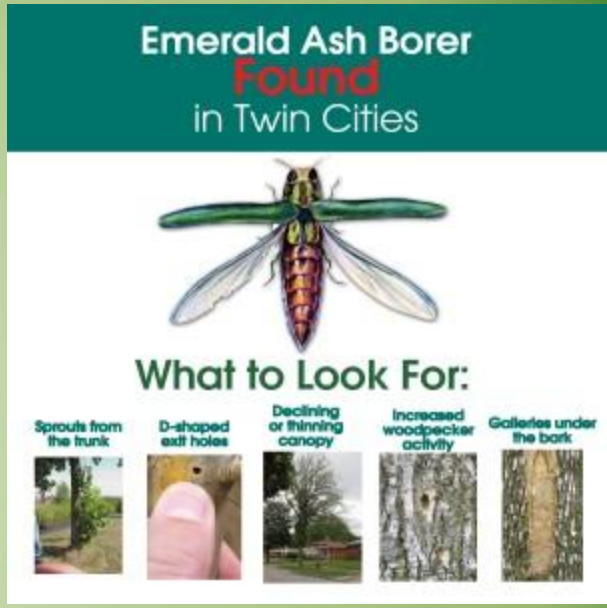
Location	green ash range	urban ash%
Powell		41
Riverton		28
Cody		22
Douglas	x	21
Worland		18
Cheyenne	x	15
Rock Springs		15
Casper	x	14
Lander		14
Rawlins		12
Sheridan	x	10
Gillette	x	7
Buffalo	x	6
Pine Bluffs	x	4
Evanston		4
Newcastle	x	3
Laramie		3
Jackson		3

Infestation symptoms of EAB on ash

- **Midwest/northeast U.S.**
  - Dieback (many other causes not EAB-related… ash yellows, drought, soil compaction & root injury, ash/lilac borer, other ash borers & bark beetles)
  - Suckering & epicormic branching (could be caused by some of the above, e.g. ash yellows)
  - Bark splits (could be caused by fungi e.g. Cytospora)
  - Woodpecker damage (could be searching for other insects)
  - D-shaped exit holes (could be mistaken for other insects)

Infestation symptoms of EAB on ash

- **Colorado**
  - Usually no suckering
  - Little epicormic branching, especially lower on bole
  - Ash health/growth rates (<CO vs >Midwest)
    - Lilac/ash borer, banded ash borer, redheaded ash borer
    - Ash bark beetles
    - Cytospora canker
    - Drought
    - Spring freezes
    - Dry summers
  - Increased ash mortality/decline not EAB-related
    - Cold-killed cambium & drought, trees dying & falling down
    - Ash limbs breaking clean, not tearing (drought-related?)



Infestation symptoms of EAB on ash

- **Potential local symptoms**
  - Crown thinning, early Fall color, mid-crown sprouting, dieback
  - Bark splits & galleries, D-shaped exit holes, larvae (Fall to Spring), adults (Summer)
  - Detection difficult because many ash are already in poor health
  - KS: Look on S side of tree, underside of branch @width of forearm, @eye level, if bark looks different consider peeling to look for EAB

Treatment options

- When to treat ash trees (≤15mi; >50% canopy intact)
- When to remove ash trees (well ahead of infestation front timed replacement; low-value trees within quarantine zone)
- Small-scale: private landowners can protect individual trees with a variety of chemicals (**imidacloprid** (Imicide, Xytect), dinotefuran (Safari), azadirachtin (TreeAzin), **emamectin benzoate** (ArborMectin, **Boxer**, TREE-age), permethrin, bifenthrin, cyfluthrin, carbaryl)
- Soil injection, trunk injection, trunk/branch spray
- Systemic insecticides: tree must be healthy enough to transport chemicals up the trunk and into branches/canopy!

Treatment options

1. Systemic insecticides applied as soil injections/drenches
2. Systemic insecticides applied as trunk injections
3. Systemic insecticides applied as lower trunk sprays
4. Protective cover sprays applied to trunk, main branches

Treatment options: Systemic insecticides applied as soil injections/drenches

- Imidacloprid, dinotefuran
- Taken up by roots, translocates throughout
- Injection can distribute product closer to root zone than drench (**less slope runoff**)
- Must be done when soil is moist, not saturated
- **Should not be done-**
  - **to soils that are sandy, low OM, prone to leaching**
  - **with shallow water table**
  - **when there is risk of contaminating nearby water**
  - **When root systems of nearby plants visited by pollinators will be affected (plants around base of tree)**
- Inconsistent results
  - May be more effective with small trees
  - Most effective when done at base of trunk

Treatment options: Systemic insecticides applied as trunk injections

- Emamectin benzoate (low rates can provide control for 2+ years), azadirachtin (effective up to 2 years but must be applied more often when EAB density is high), imidacloprid (inconsistent results)
- Can be used where soil injections are not possible
- Injected by drilling into bark & outer sapwood **(could cause tree damage)**
- **High-pressure needle injections can cause bark separation**
- Products transported & absorbed quicker than by soil injection
- Most effective when soil is moist, not saturated

Treatment options: Systemic insecticides applied as lower trunk sprays

- Dinotefuran
- **Neonicotinoid** (like imidacloprid, but more water-soluble & moves better throughout plants)
- Sprayed on lower 5-6’ of trunk
- Penetrates bark, transported throughout tree
- Quick, easy application requiring only low-pressure common garden sprayer
- **If done properly, should not wound tree or penetrate soil**
- Dinotefuran spray = similar effectiveness to soil-applied dinotefuran or imidacloprid
- Translocates to canopy at similar rates of trunk-injections and faster than soil-applied products
- Effectiveness variable, must be applied annually

Treatment options: Protective cover sprays applied to trunk, main branches

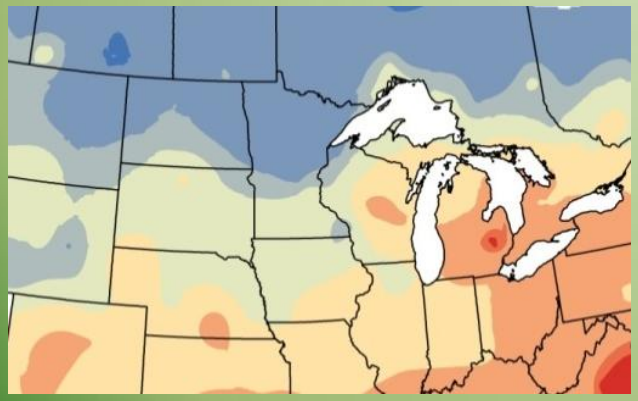
- Permethrin, bifenthrin, cyfluthrin, carbaryl
- Can be sprayed on trunk, branches and possibly foliage
- Kills adults feeding on foliage and newly hatched larvae chewing through bark
- No effect on larvae feeding under bark
- Complete coverage necessary for best results
- Variable results based on product used (Onyx, Tempo, Sevin SL may provide good EAB control)
- **<u>Spraying large trees can result in substantial insecticide drift</u>**

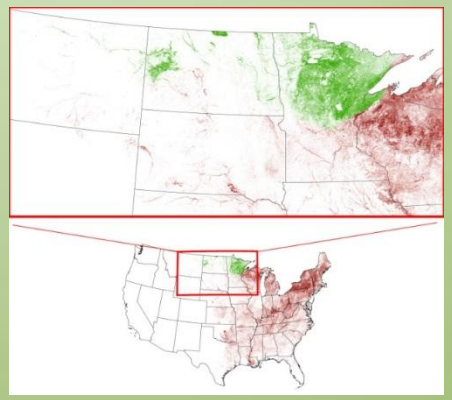
Treatment options summary

- Emamectin benzoate (ArborMectin, **Boxer**, TREE-age; trunk injection) consistently effective regardless of tree size, 2+ years EAB control
- Azadirachtin (TreeAzin; trunk injection) may provide protection for 1-2 years depending on EAB population
- Dinotefuran (Safari; lower trunk spray) effective for 1 year on smaller trees
- Imidacloprid (Imicide, Xytect), dinotefuran (soil injection) effective for 1 year on smaller trees regardless of EAB population, most effective when applied at base of trunk and soil is moist but not saturated; **as neonicotinoids, could be harmful to pollinators**

Can climate limit EAB spread?

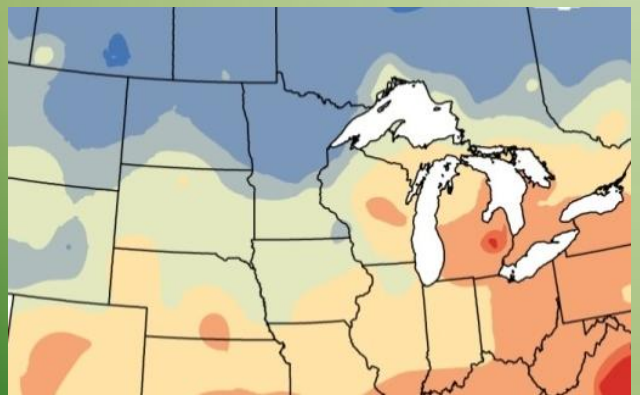
- EAB overwintering:
  - Larvae or prepupae
  - ½" beneath bark surface, *anywhere* on tree, including at base of tree bole near ground level
  - Lowest recorded EAB supercooling point = -31.54°F
  - At least half of the EAB population may not survive -22°F

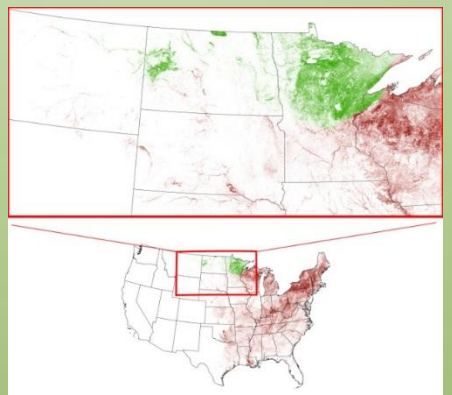




Can climate limit EAB spread?

- No evidence that North American climate can 100% limit EAB survival
- Possible climatic constraints to EAB infestation in north-central US, south-central Canada
- EAB at low populations that do not infest trees usually do not cause ash mortality (Ash may persist in MN, ND, MT but not farther S)





Can climate limit EAB spread?

- In northern ranges of ash, EAB may not kill much ash and EAB spread may take some time:
  - Resource limitations on EAB spread
  - Climatic constraints to EAB spread
- In WY, not much chance for climatic constraints to EAB spread; possibility for resource limitations on EAB spread?
  - Gypsy moth:
    - Found in Lovell 2015, no spread
    - Found in Casper 2016, no spread
- <u>Biggest threat is transporting firewood!</u>


Troy Kimoto, Canadian Food Inspection Agency, Bugwood.org

Questions?

http://emeraldashborer.info/

http://www.emeraldashborer.info/documents/Multistate_EAB_Insecticide_Fact_Sheet.pdf

https://nfs.unl.edu/documents/EAB/EABTmtOptionsFH13-2012.pdf