

Status of Selected Forest Insect and Pathogens Affecting the Eastern United States



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Presentation Outline

Introduction to Forest Health Protection program

Non-native forest pests and pathogens

- Asian Longhorned beetle

- Emerald ash borer

- Gypsy moth

- Hemlock Woolly Adelgid

- Oak wilt disease

- Heterobasidion root disease

- Thousand cankers disease

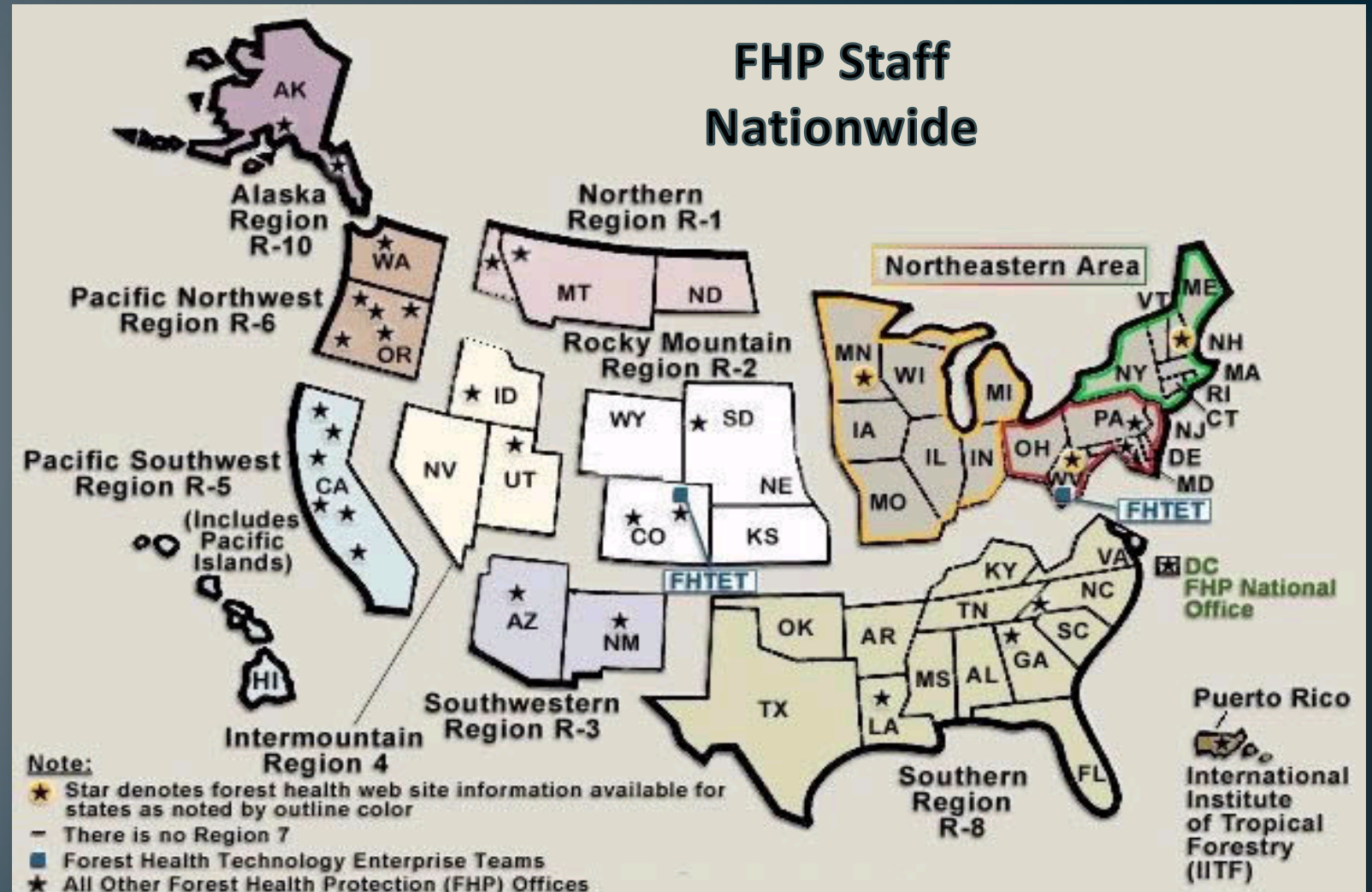
Resources available to you

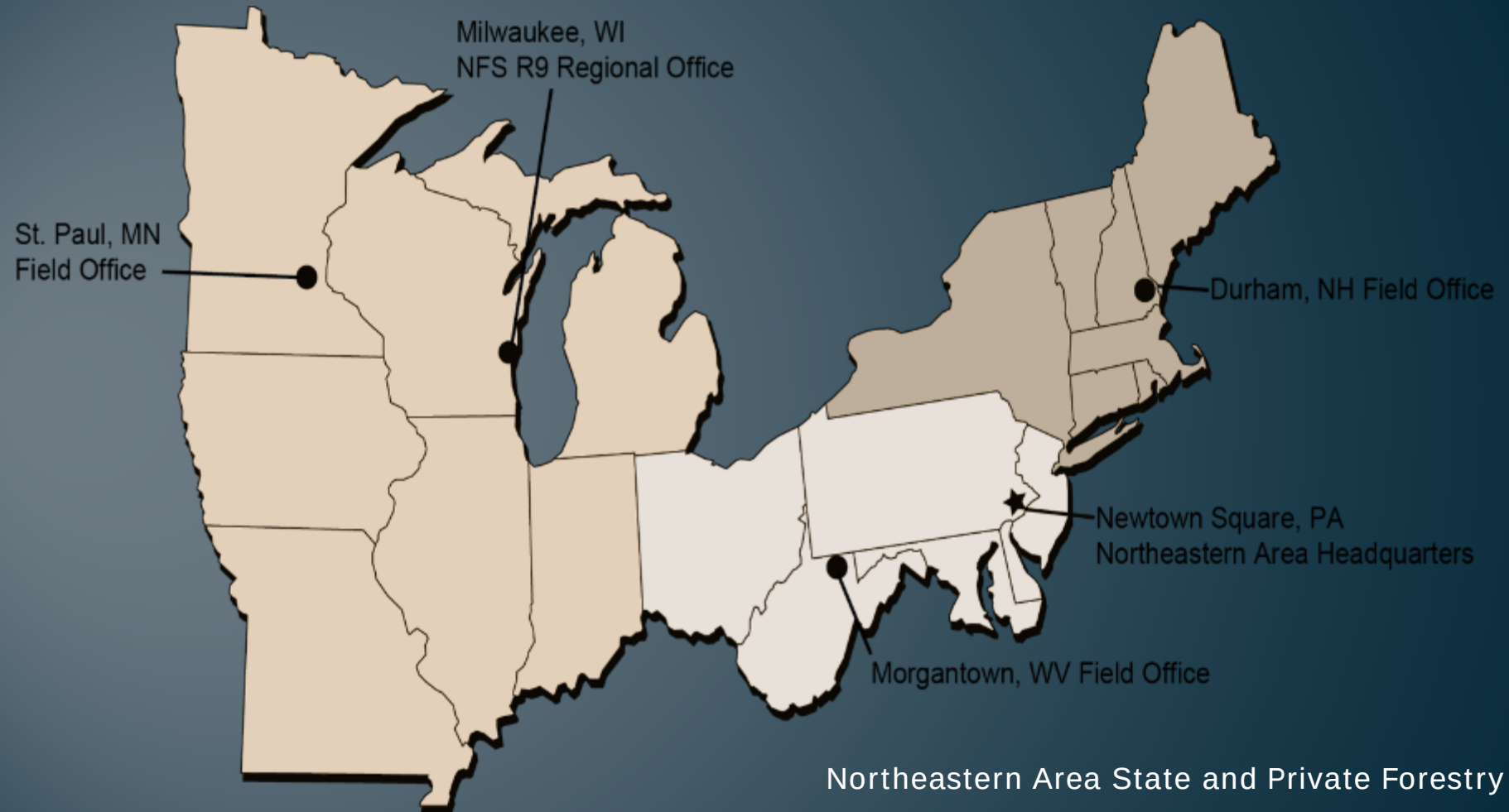
Forest Health Protection Program

Who Are We and Where
are We Located?

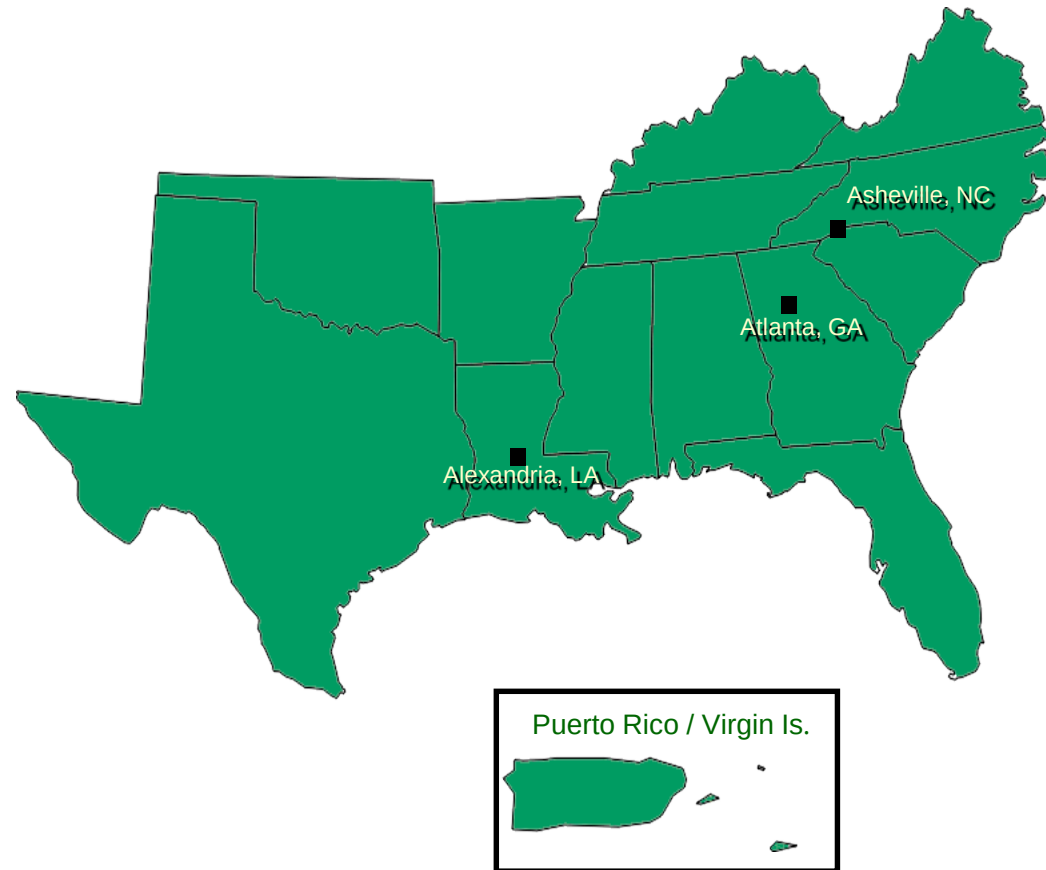
250 forest entomologists,
forest pathologists,
foresters and technical
staff

9 regions





Southern Region



What do we Do?

- conducting **surveys** to detect and assess insect, disease, invasive plant and other stressors;
- **monitoring and reporting** on the health of forests and trees;
- recommending measures to prevent, retard, slow the spread, control, **suppress or eradicate** incipient, potential, threatening or emergency forest and tree pests;
- **providing technical and scientific information**, advice, and related assistance;
- developing **applied methods and technology** to improve management of forest health;
- providing information on **pesticides** and their use;
- promoting implementation of appropriate silvicultural or **management techniques** to improve forest health;

How We Implement Our Program

Directly and in cooperation with:

- National Forests and other FS units
- USDI and DoD agencies and units
- Other Federal landowners

In cooperation with:

- State foresters and State plant pest regulatory officials (agriculture)
- Tribal governments

93% forest land in NA is NOT federally owned or managed

State forest health specialist are key partners (see resource section for contacts)

Asian Longhorned Beetle

Origin: China, Korea

Causal Agent: *Anoplophora glabripennis*

Federally Regulated: YES

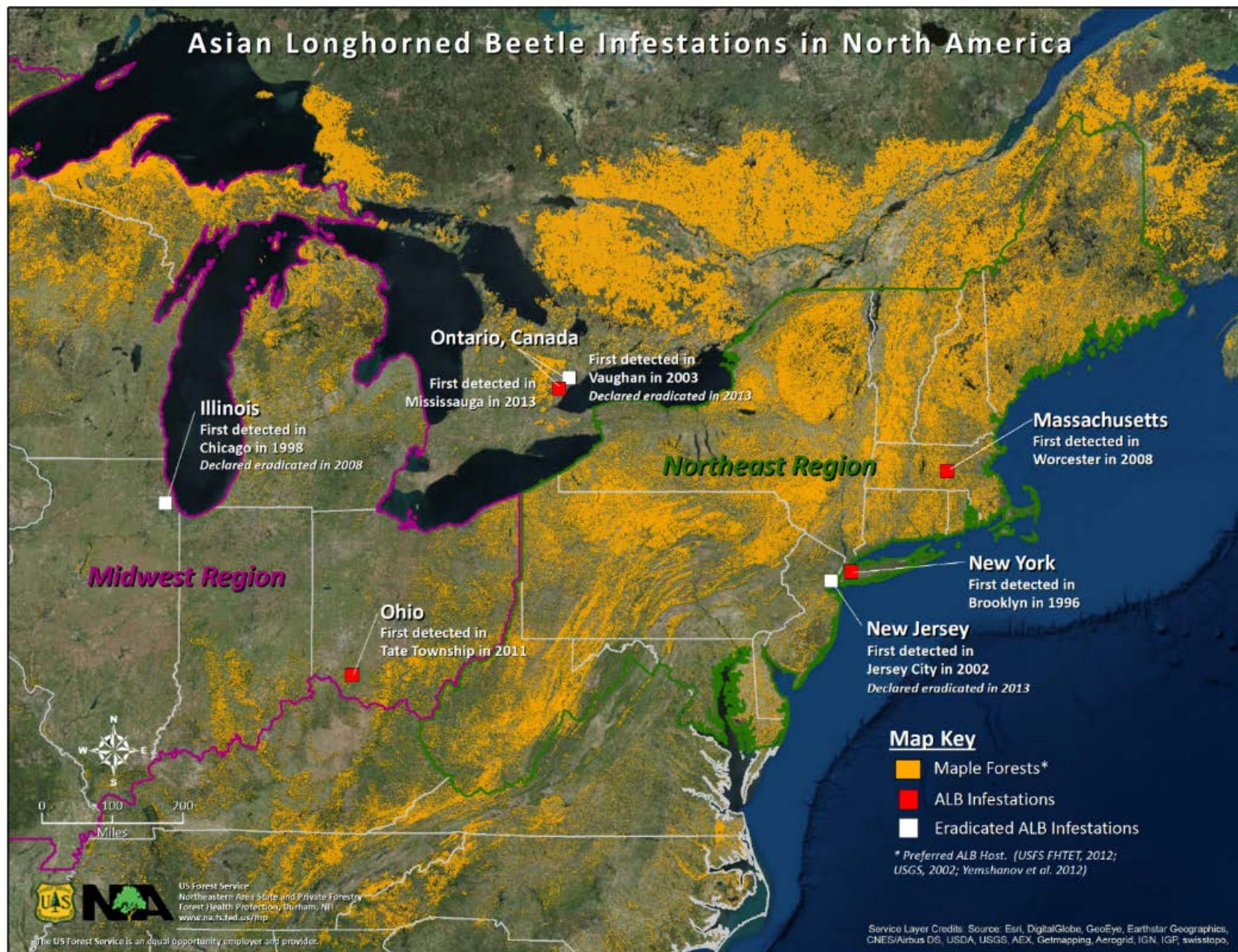
US Detections: NYC (Brooklyn) 1996; Chicago 1998; New Jersey 2001; Worcester (MA) 2008, Boston (2010); Bethel (OH) 2011. Also Toronto (CN) 2003

Hosts: 13 genera but maples, elm, willow, chestnut preferred

Damage: Dieback; tree mortality



Asian Longhorned Beetle Infestations in North America



Larval Feeding Injures Trees



Larvae tunnel into sapwood



Dieback in ALB infested tree



Infested maple with exit holes and egg niches

Within tree crown surveys are critical



Cut and Chip or Burn

As of end 2016:

> 49,000 infested removed

> 97,000 high risk host tree removed





Chemical Treatments

Tree injection

Soil injection

> 400,000 trees treated
to date (2016).

Current Status

Successful eradications in IL, NJ and part of NYC

Eradication remains the objective in NY, OH and MA

Research continues to improve survey and control tools

Emerald Ash Borer

Origin: China, Korea

Causal Agent: *Agrilus plannipenis*

Federally Regulated: YES

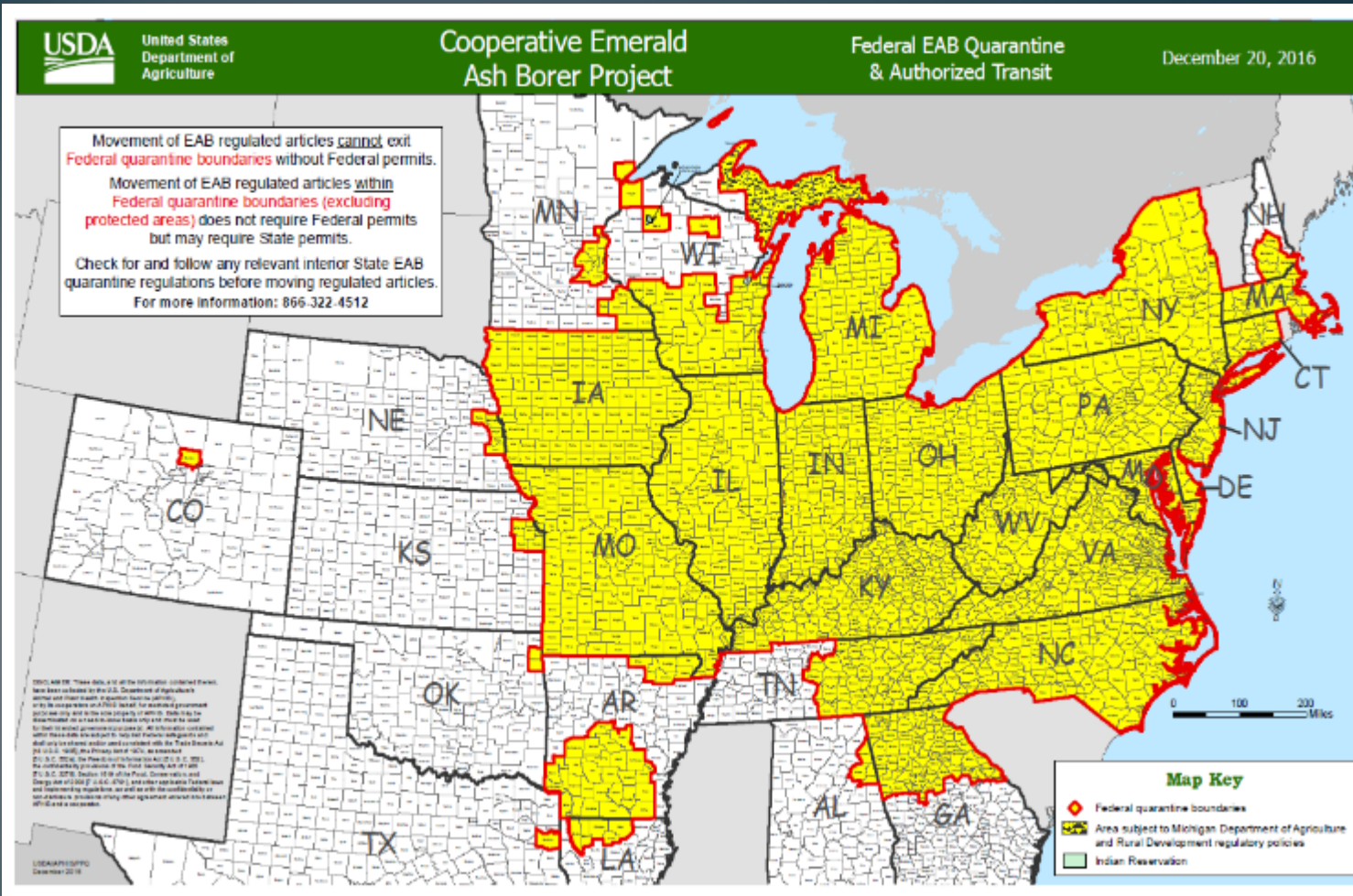
Initial Detection: Detroit 2002

Hosts: all species of ash

Damage: decline and rapid tree mortality

Impact: estimated >\$10 billion in costs to communities and homeowners over the next 20 years; threat of ash extirpation similar to American chestnut.





30 States

Including new in 2016:

1. Alabama
2. Delaware
3. Nebraska
4. Oklahoma
5. Texas

https://www.aphis.usda.gov/plant_health/plant_pest_info/emerald_ash_b/downloads/eab_quarantine_map.pdf

Extensive larval galleries in phloem (inner bark) disrupt translocation of water & nutrients in the tree.



Signs and Symptoms

Epicormic
branches and
sprouts



Characteristic “D” shaped emergence holes









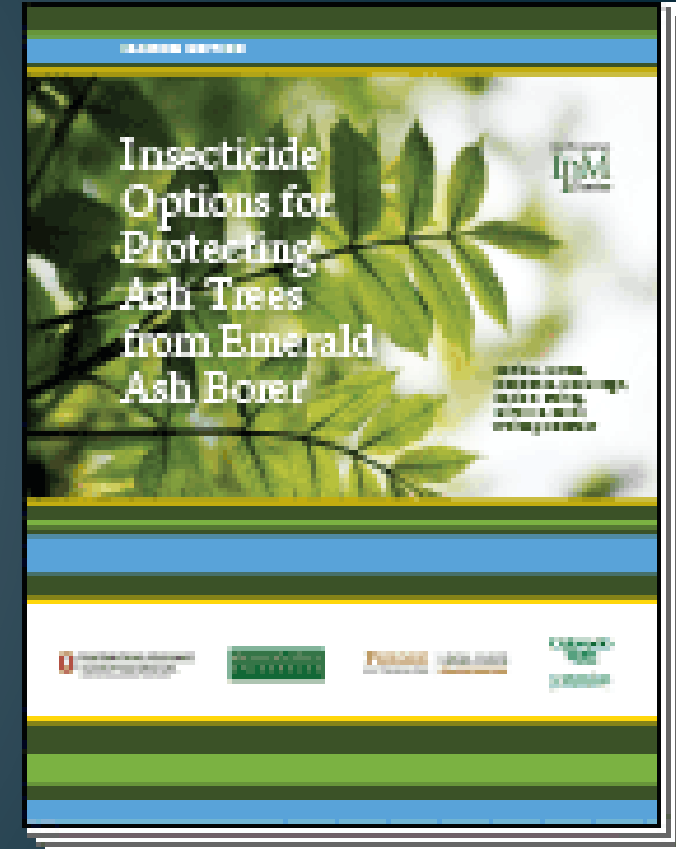
Michigan neighborhood following ash removal.

Control Methods

...cut, chip
or burn



Insecticide Treatments



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

Biocontrol Agents



PPQ



PPQ



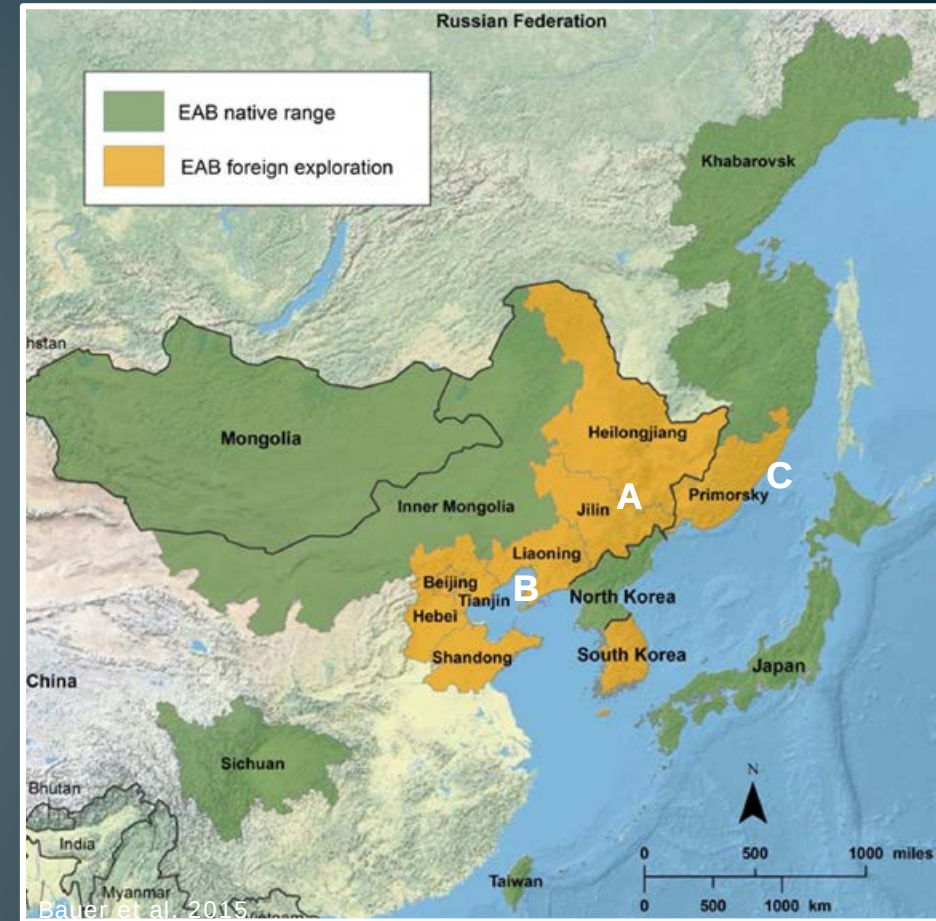
PPQ



USDA-
APHIS-PPQ

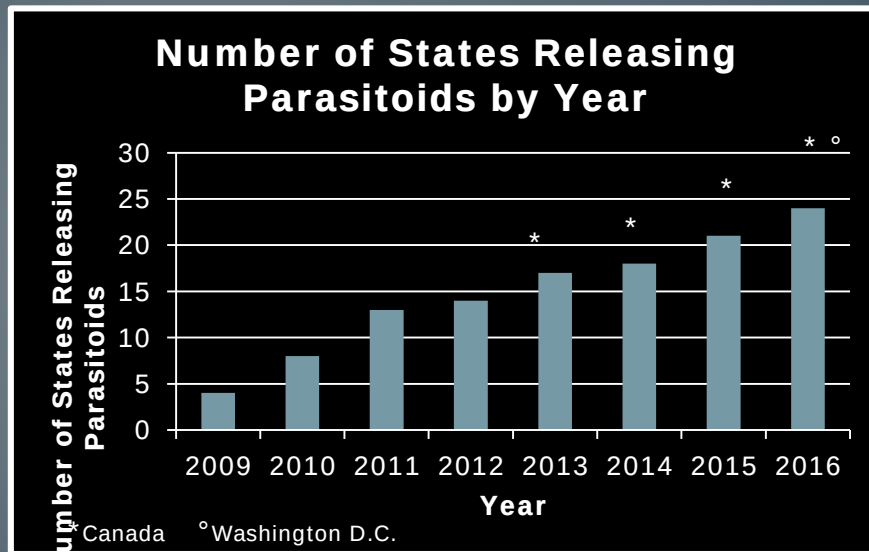


J. Duan

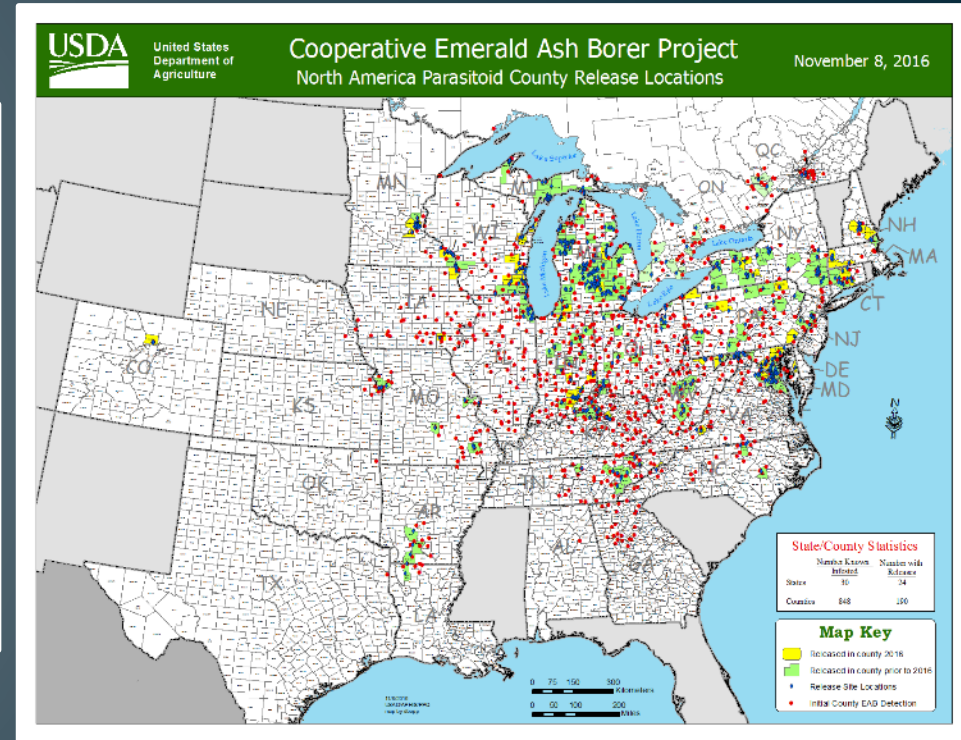


Source: Ben Slager, USDA APHIS-PPQ

Where have parasitoid releases occurred?



Source: Ben Slager, USDA APHIS-PPQ



Key Messages

- Eradication is no longer the goal
- National surveys and public outreach continue
- New counties and states will still be quarantined
- Insecticide treatments are effective but only short term
- Research continues on developing resistance in ash
- Biocontrol program provides EAB parasitoids to cooperators
 - **Mass rearing EAB parasitoids has been successful**
 - ***Oobius* and *Tetrastichus* appear to be establishing and impacting EAB**

Ongoing Forest Service Activities include:

- Targeted EAB treatments on National Forests and other federal lands (USDI, DoD)
- EAB treatments on public lands in concert with state coordinated EAB management plans
- Replanting trees in affected communities (LSR, GLRI, Joint Chief's projects)
- National EAB website portal: emeraldashborer.info
- EAB University Webinar series
- EAB kits and information products
- Technology development and methods improvement investments in biocontrol, host resistance and silvicultural tools to manage EAB.

Gypsy Moth

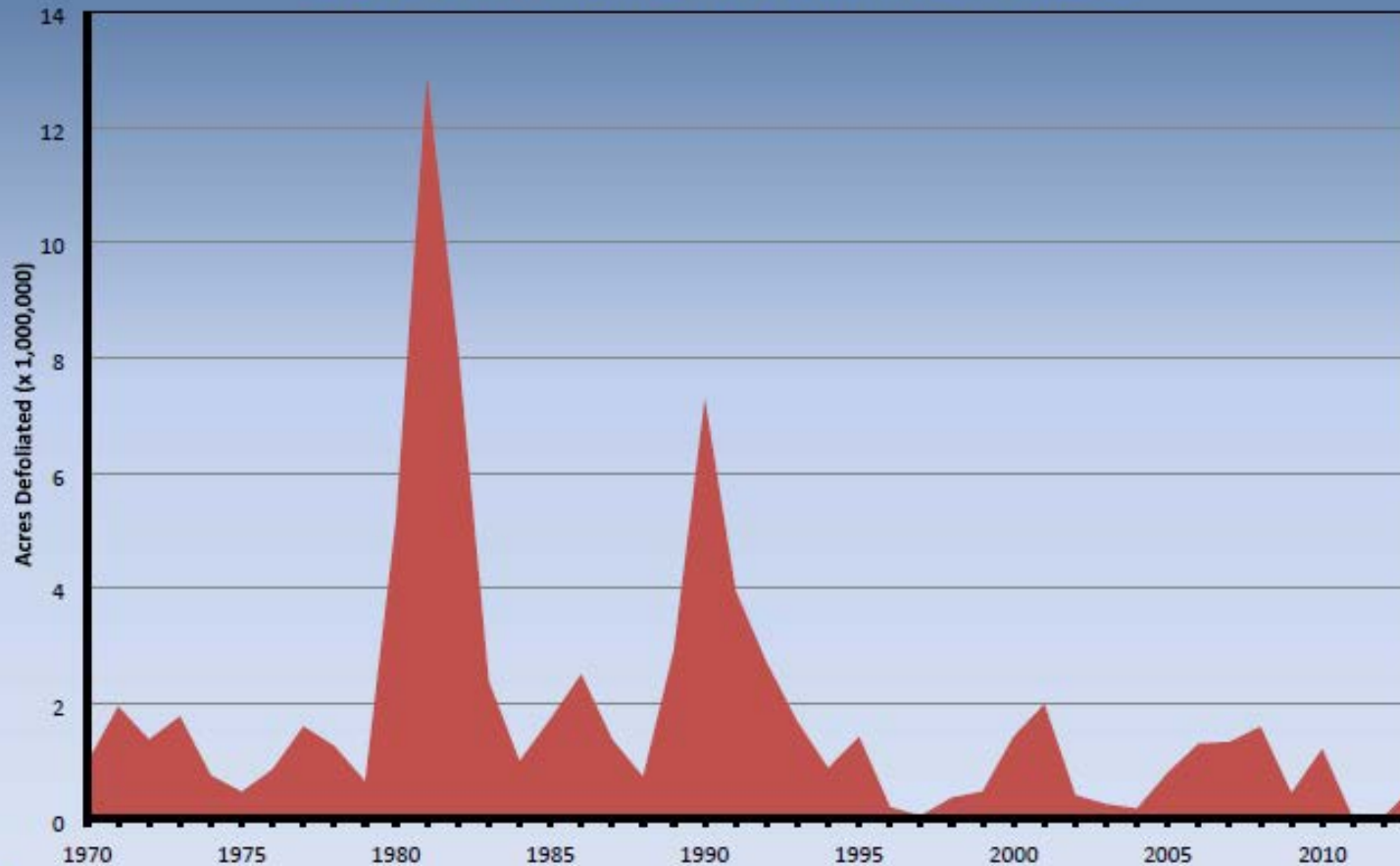
- Origin: Europe and Asia
- Accidentally introduced in Medford, MA in 1868 or 1869
- Federally Regulated: YES
- Hosts: Oaks highly preferred; +300 other trees and shrubs
- Damage: severe tree defoliation; tree mortality
- Current Status: 19 states and Washington DC
- Management Response: Shared between USFS and APHIS



When outbreaks occur tree defoliation can be complete and widespread....



81.0 Million Cumulative Acres

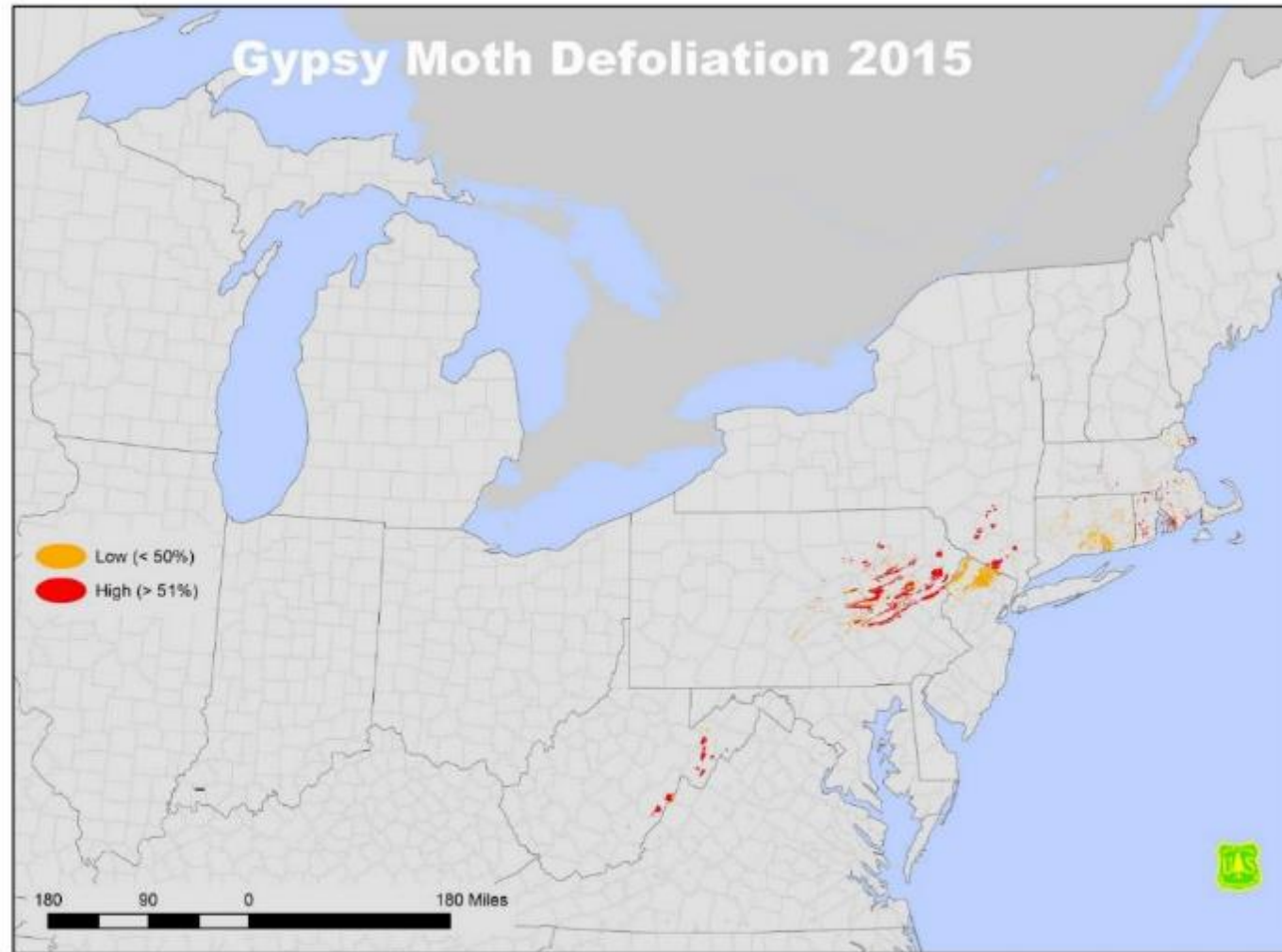


Source: US Forest Service, Northeastern Area State and Private Forestry, Gypsy Moth Digest <http://na.fs.fed.us/fhp/gm/>

2014 393,695 acres

2015 1,513,307 acres

2016 ~ 1,000,000 acres



1,513,307 acres in 7 states

+1,000,000 in 2016,
especially in New England

Shared Responsibilities



- 1990 Departmental Regulation
- 2009 MOU FS & APHIS
- 1996 EIS
- 2012 Supplemental EIS

USDA National Gypsy Moth Management Program

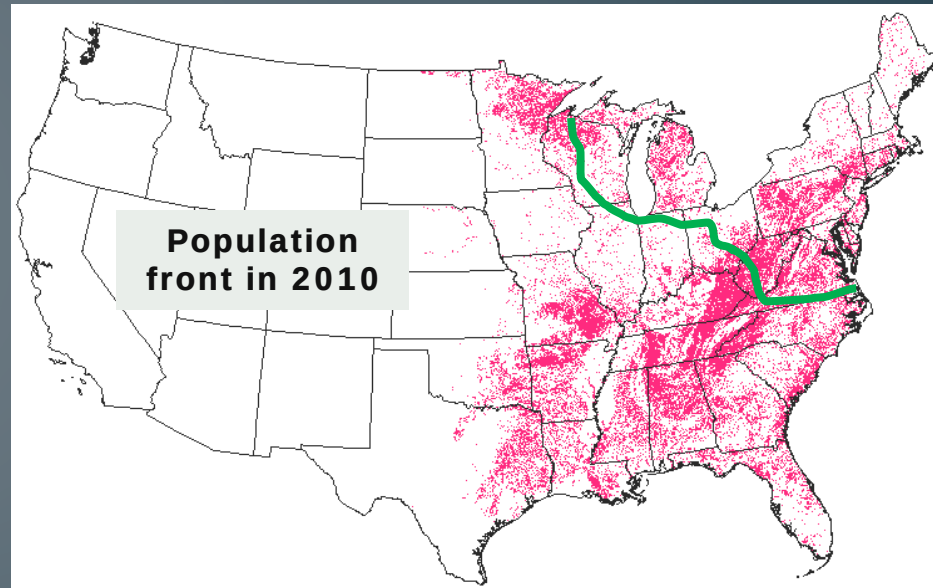
(1996 EIS, 2012 Supplemental EIS)

3 Strategies:

- Reduce damage caused by outbreaks of gypsy moth (suppression)
- Eliminate isolated infestations detected outside of the generally infested area (eradication)
- Reduce the rate of natural and short range human-aided spread along the leading edge (Slow the Spread)

Slow the Spread

Forest Service and states working together to slow the spread of the gypsy moth

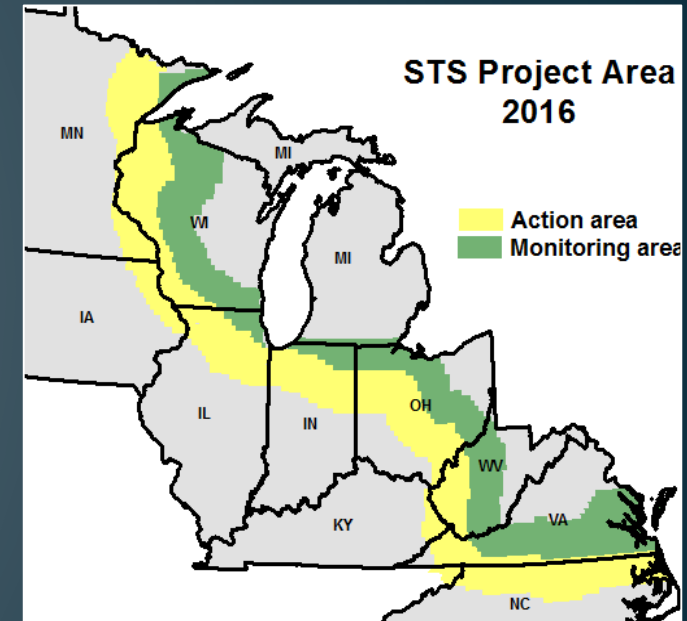


~ 70% of the susceptible host is still at risk

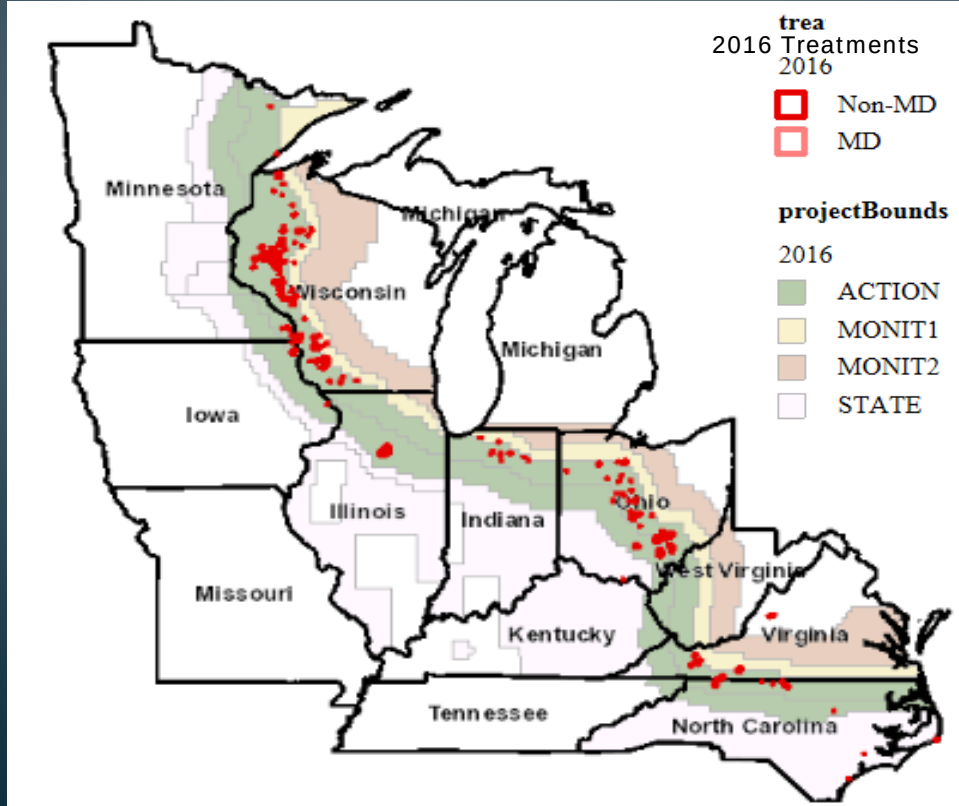
Slow the Spread



- Currently implemented by the 10 states located along the leading edge of GM populations
- Has reduced spread by at least 60%
- Prevented infestation of 80 million acres since the program began in 2000



2016 Program Stats



- \$7.5 million
- 65,000 traps
- Treated just over 452,000 acres
 - 95% Mating Disrupt
 - Disrupt II
 - Disrupt BioFlakes
 - SPLAT
 - 5% *Btk* or *Gypchek*



2016 Gypsy Moth Accomplishments

Suppression Projects (MD, NJ, OH, PA, WI, WV)
168,000 acres public and private

Eradication Projects (NC)
6900 acres



2017 Plans and Requests

Eradication

~7,000 acres (IN, MN, NC)

Suppression

- ~60,000 acres (NJ, OH, PA, MN, NJ, WV)

Slow the Spread

- ~400,000 acres (KY, IL, IN, MN, NC, OH, WI, WV)

Hemlock Woolly Adelgid

- Origin: Japan
- Causal Agent: *Adelges tsugae*
- First eastern US detection 1950's in Virginia
- Hosts: Eastern and Carolina hemlocks
- Damage: growth loss; decline and dieback; tree mortality
- Impact: Threatens climax forests and streamside habitats in the eastern U.S.
- Federally Regulated: NO



HWA Biology Basics

- Feeds at the base of needles on stored nutrients in the xylem ray parenchyma cells
- 2 generations/year
- Parthenogenetic (all females)
- Up to 300 eggs/female
- Active throughout the winter
- Spread is by wind, birds, deer, squirrels, and humans

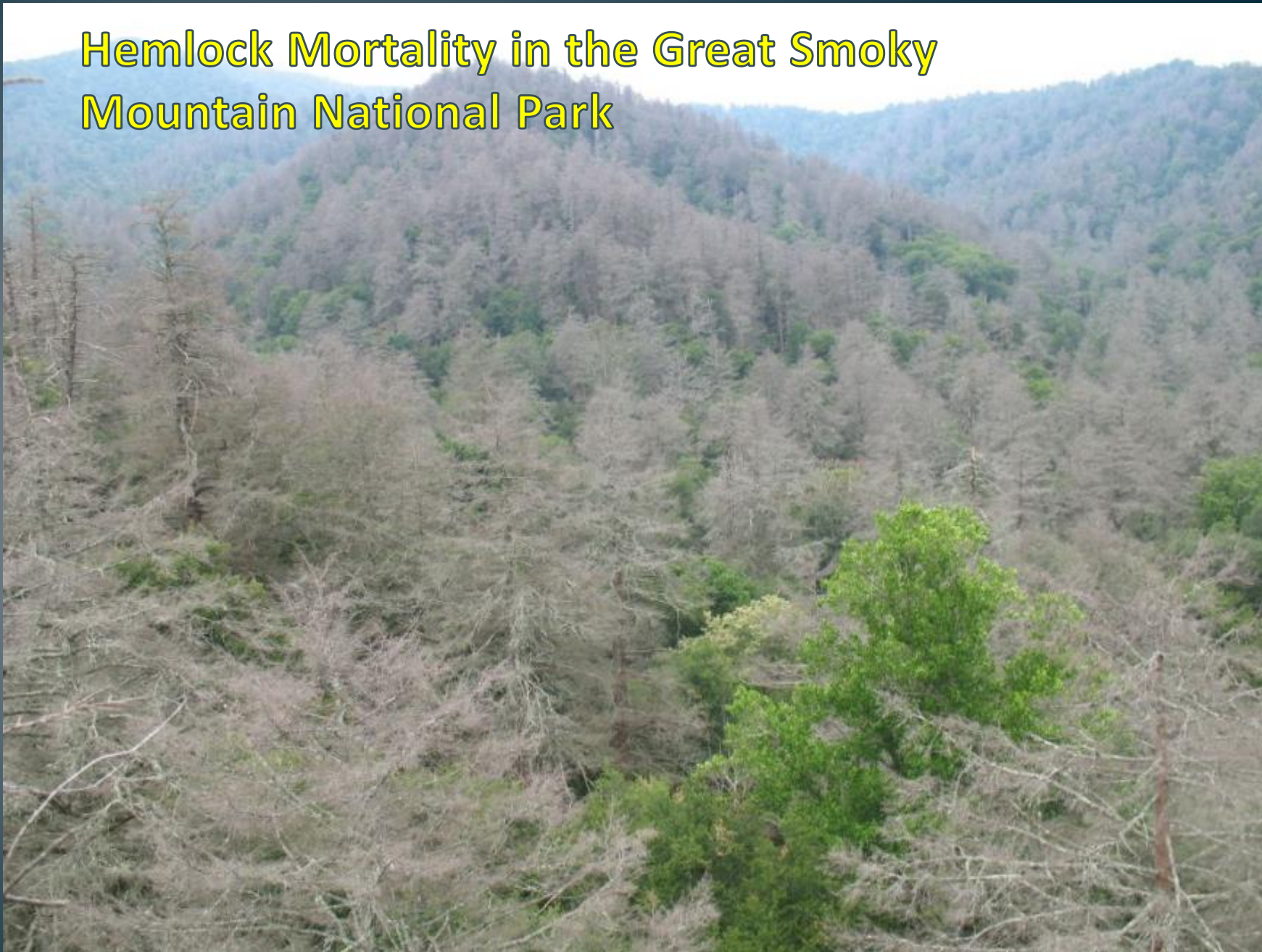


Physiological Impacts

- Depletion of nutrient reserves
- Desiccates needles causing pre-mature drop
- Stunted or no new growth
- Bud mortality
- Dieback of twigs and limbs
- Weakens overall tree health making it susceptible to other factors

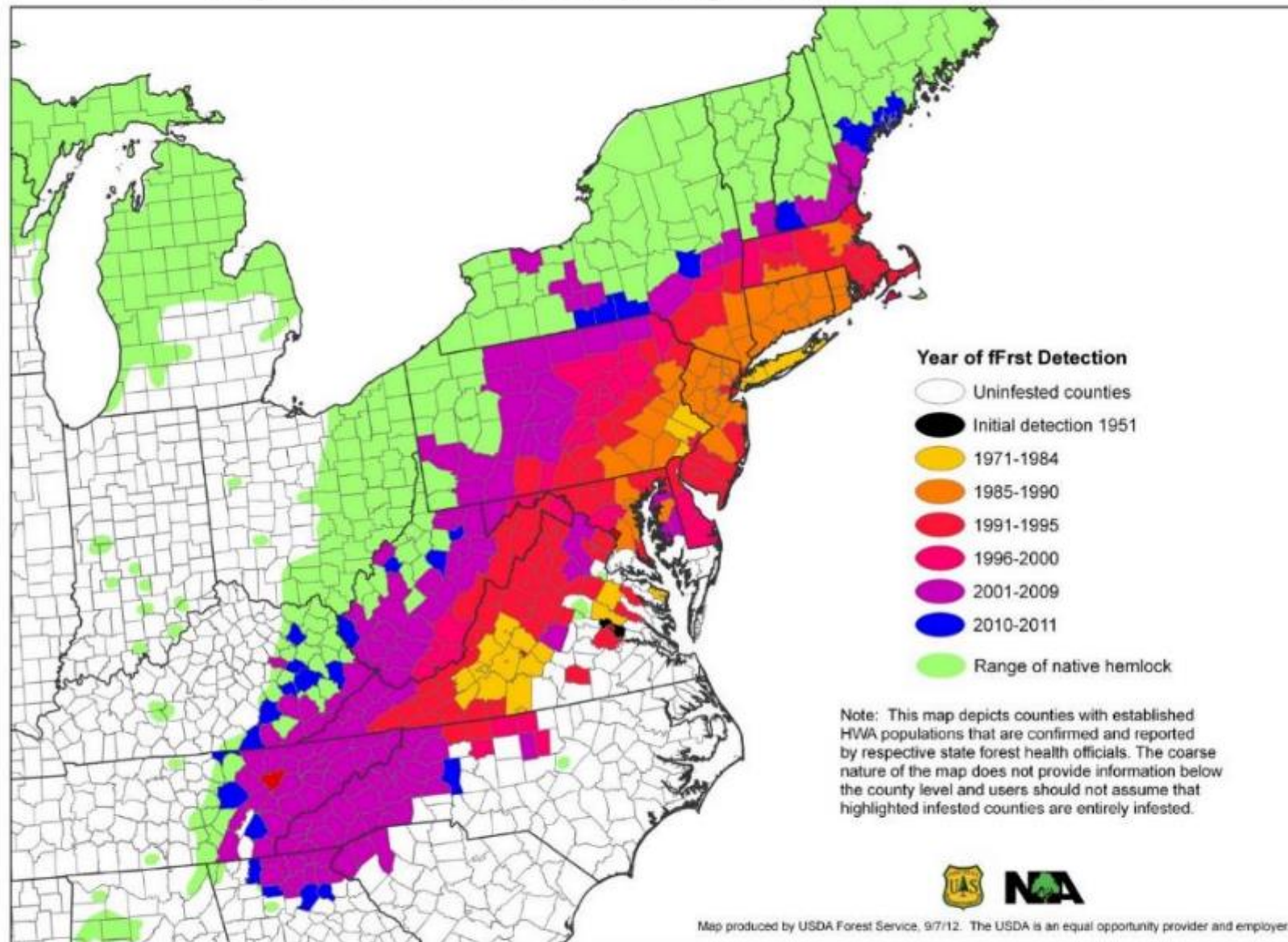


Hemlock Mortality in the Great Smoky Mountain National Park



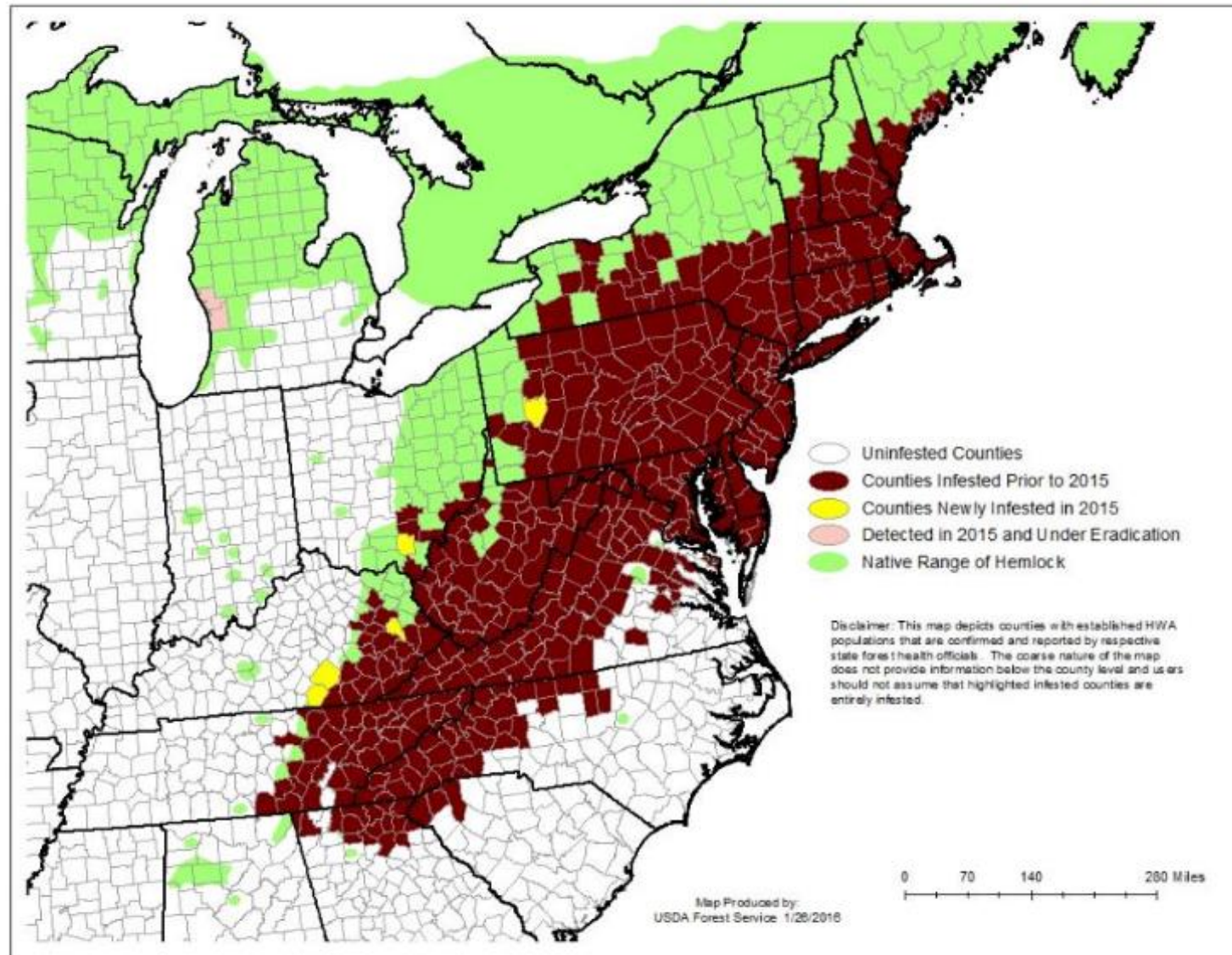


Progression of Hemlock Woolly Adelgid in Eastern North America



HWA Generally Infested Area as of 2015

19 States



A Call for Action: 2002

Eastern Plant Board

National Plant Board

National Association of State Foresters

Northeastern Area Association of State Foresters

“...proceed with preparation of a comprehensive strategic plan, including budget, research, and biological control for the management of HWA...”



HWA Initiative (2003)

Forest Service Priorities:

Survey and monitoring along the leading edge

Targeted suppression and eradication of HWA

Rearing, release and monitoring of HWA predators

Gene Conservation and Host Resistance

Technology Development and Methods Improvement

- Improvement in predator rearing technology

- Evaluations of promising new predators

- Developing tools for area wide management of HWA

2016 Insecticide Treatments

- >5,300 acres (~100,000 trees)
- 12 States
- Public Lands
 - 7 National Forests
 - BIA, ACE, NPS
 - Grey Towers (FS)
 - Non-Federal Public Lands

5-7 years of residual effectiveness



Biocontrol Program: Laricobius nigrinus

- Native on western hemlock
- Most intensively studied predator thus far
- Most widely established in greatest numbers
- Wild collections in the east have been going on since about 2011 however recent winter mortality of HWA has negatively affected predator populations too.

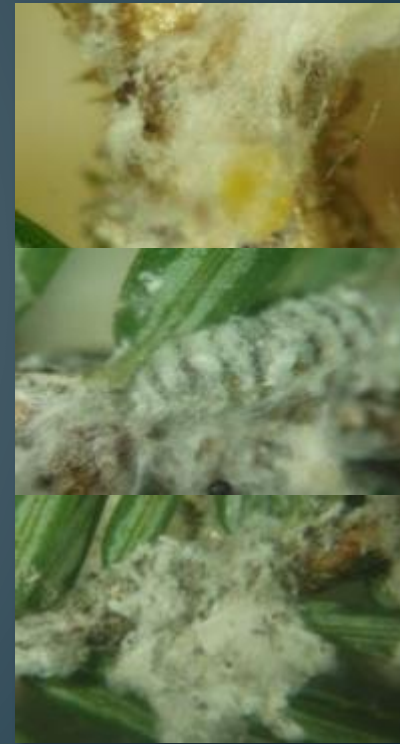


Biocontrol Program: *Laricobius osakensis*

Attributes

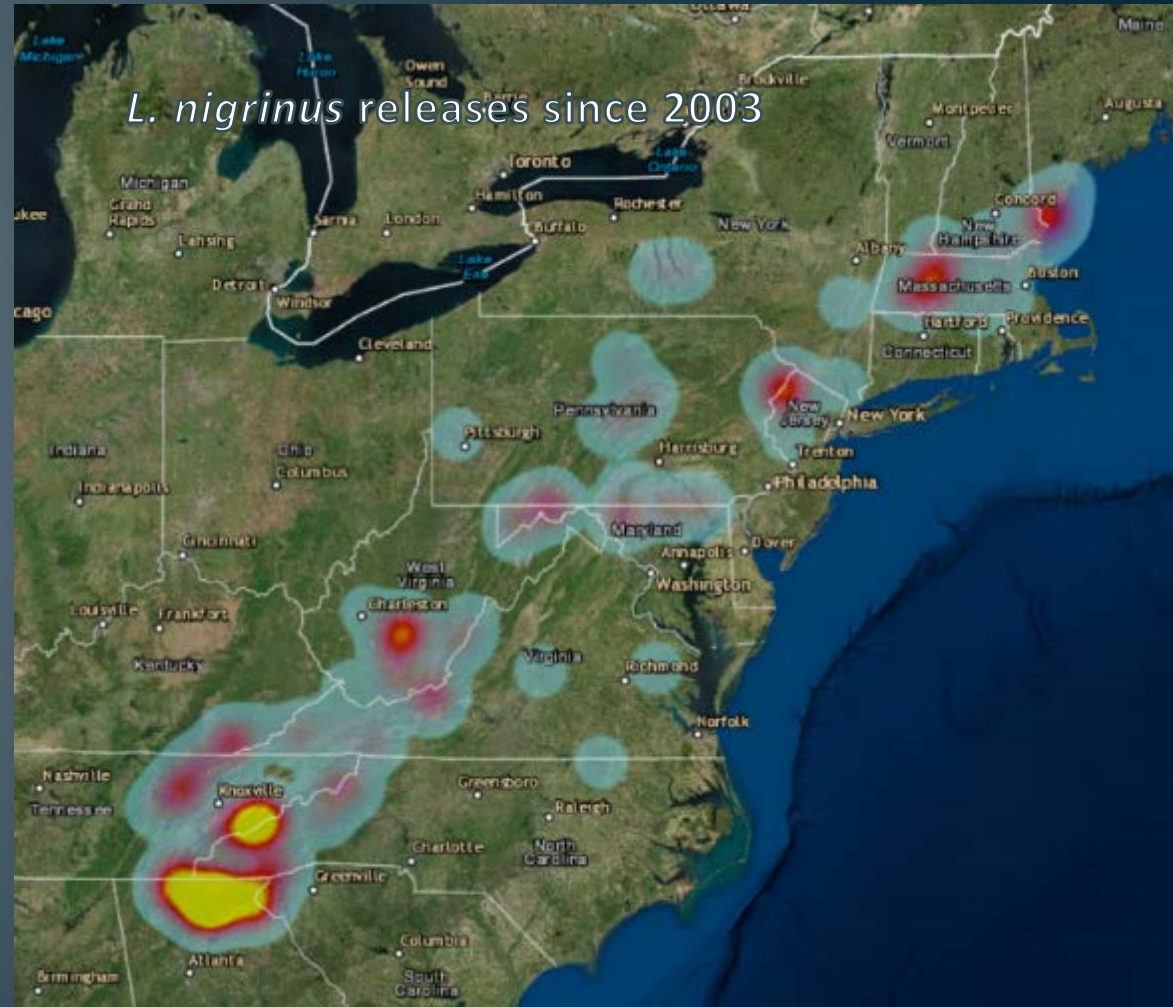
Native to Japan (Montgomery et al. 2011)

Discovered in near Osaka in 2005 and first imported to US in 2006



2016 Biological Control Program

- *Laricobius nigrinus* (Ln)
~10,100 beetles
KY, MD, NC, NH, NY, TN
- *Laricobius osakensis* (Lo)
~8,080 beetles
KY, ME, NC, NH, OH, PA, TN
- Minimal western collections of inland Ln
- Eastern wild Ln populations building



Leucopis argenticollis



World-wide distribution

Host records: HWA,
BWA, pine adelgids

Leucopis piniperda



North American distribution

Host records: HWA, BWA,
Adelges cooleyi, pine adelgids

- Field releases (2015, 2016) in NY and TN along the leading edge to evaluate establishment, reproduction and impact.
- Additional releases and evaluations planned in 2017



The Hedge Fund

Finding and establishing
suitable field insectaries

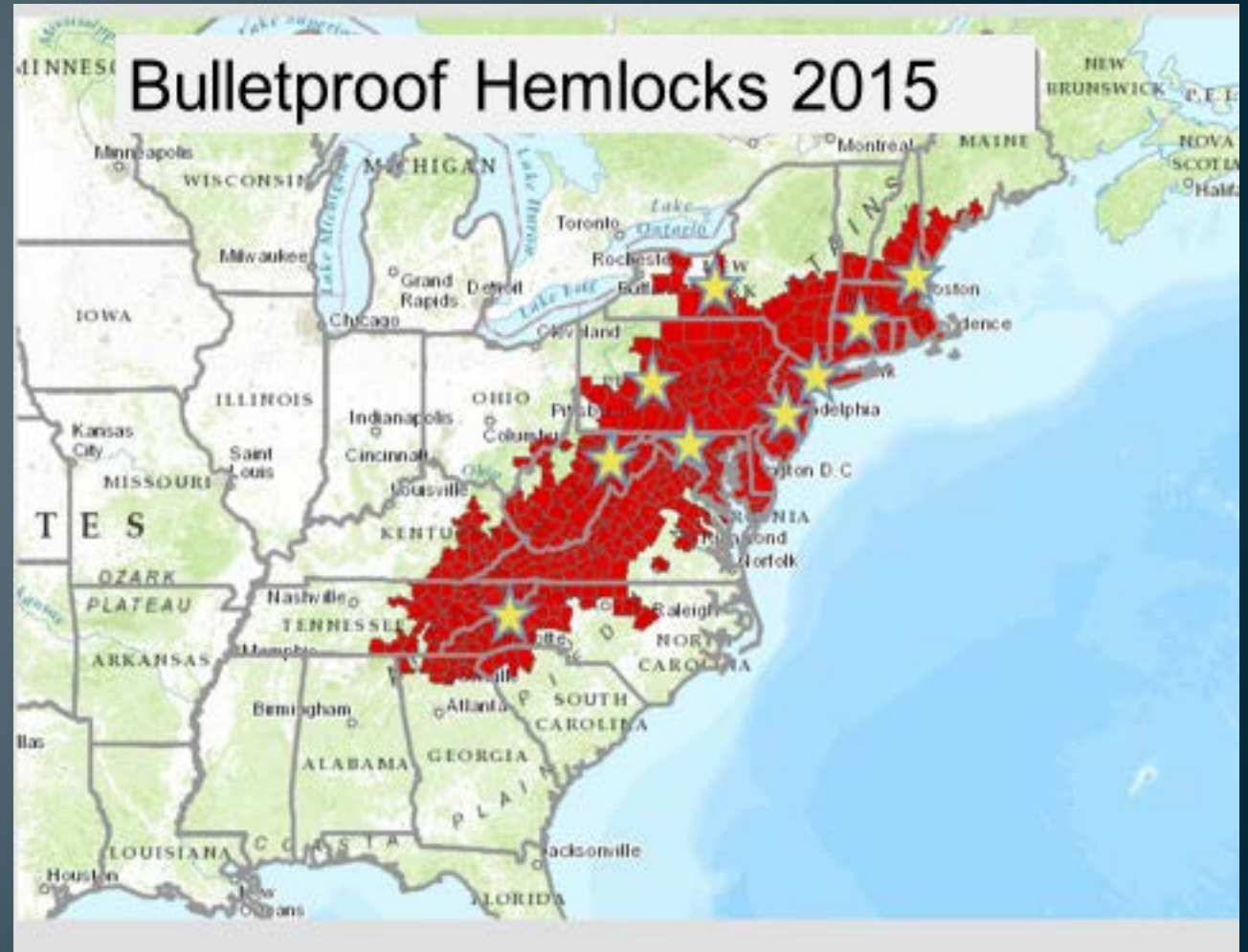
Cunningham Falls State Park (Thurmont, MD), October 2015

Planting hemlock clones from the “bullet proof stand”
inside a deer enclosure.



Long-term evaluation of putatively HWA resistant hemlocks

- 8 States
- Cooperators include:
 - US Forest Service (CT)
 - MD Dept. Ag and DNR
 - NC State Univ
 - Cornell Univ (NY)
 - NY Botanical Garden
 - Arnold Arboretum (MA)
 - NJ Dept Ag
 - PA Bureau of Forestry
 - WV Dept. Ag.





Oak Wilt Disease



Origin: Unknown, thought to be non-native

Causal Agent: *Ceratocystis fagacearum*

Federally Regulated: No

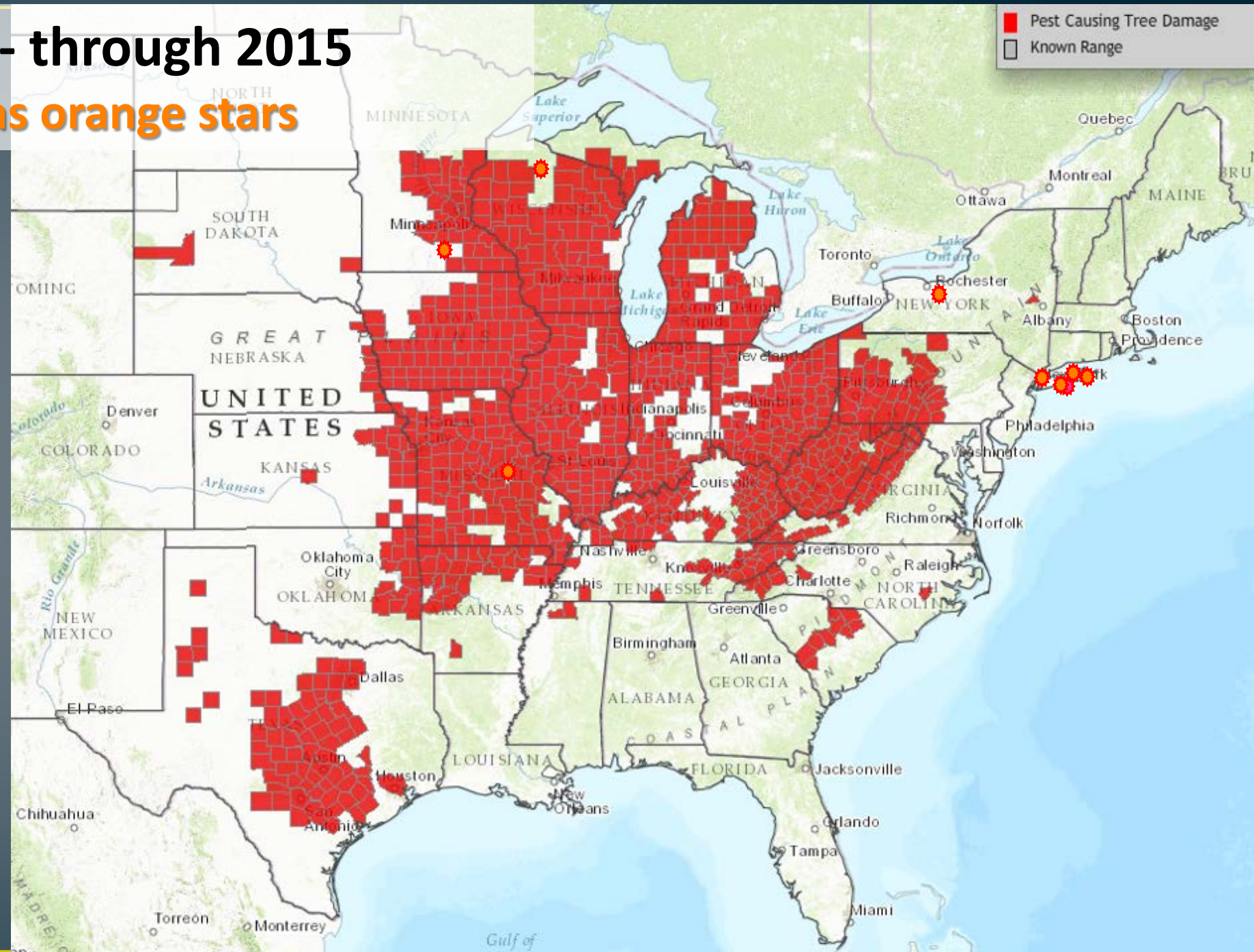
Hosts: All oaks. Red oak subgroup more than white oak.

Damage: vascular wilt causing whole tree mortality

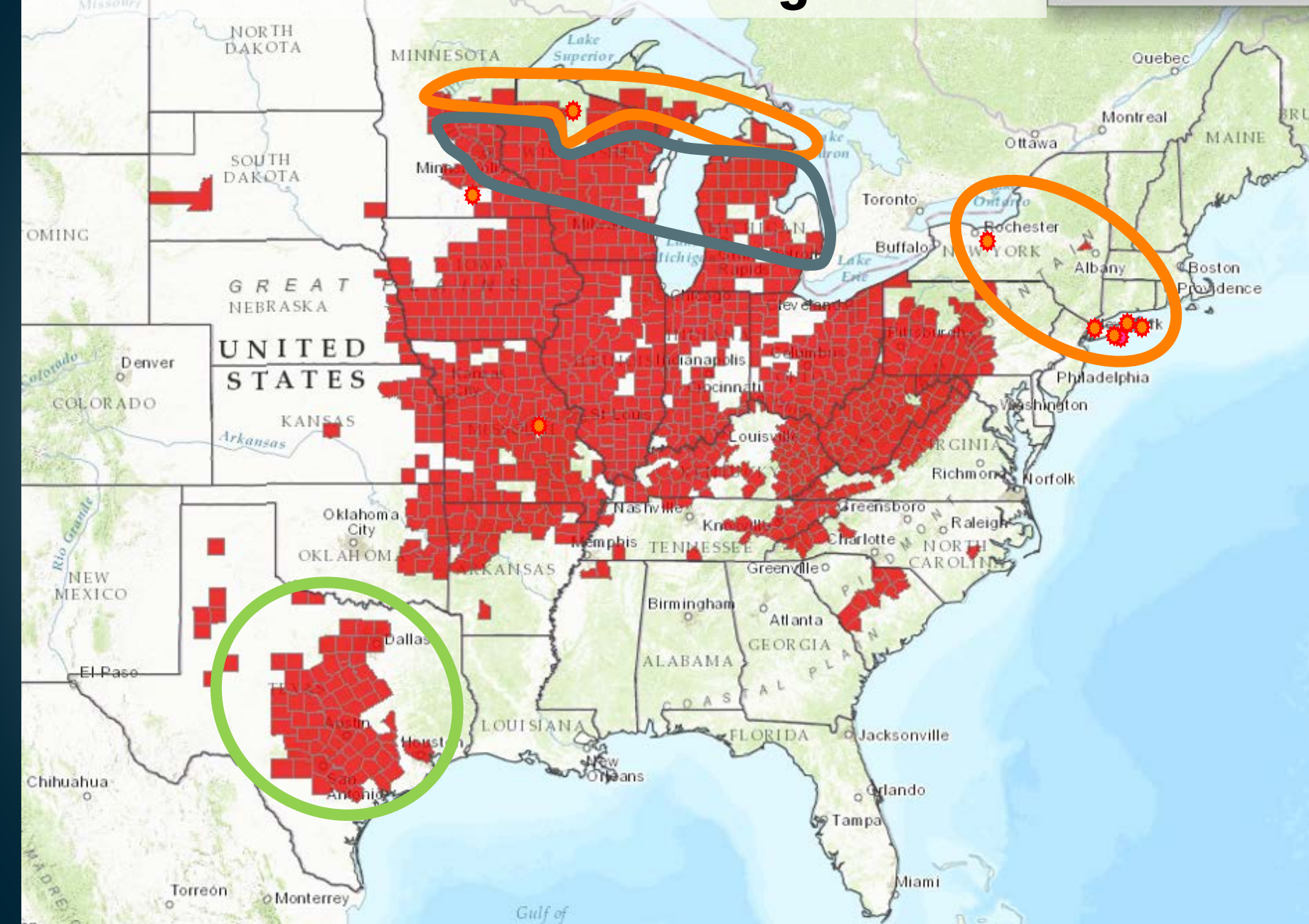
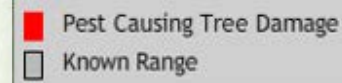


Oak Wilt Counties- through 2015

New in 2016 added as orange stars



Oak Wilt Counties- through 2015



The Biology, Diagnosis, Epidemiology, and Management of Oak Wilt in the Southeastern U.S.

Oct 26, 2016 View now on-demand.

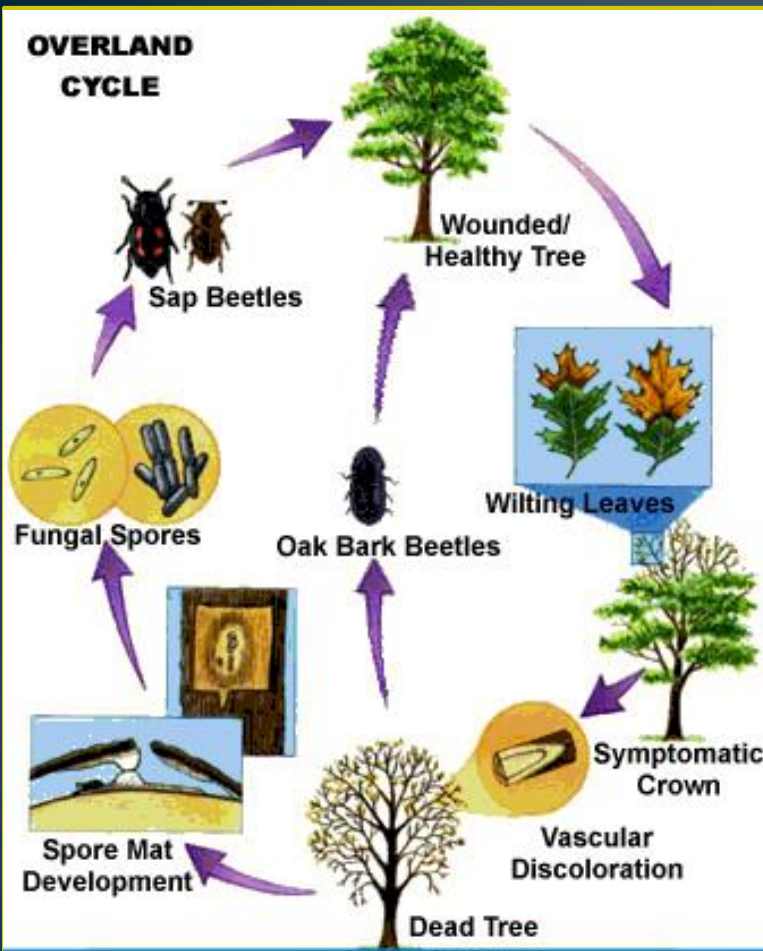
Dr. David Appel, Dept. of Plant Pathology and Microbiology, Texas A&M University

This webinar will cover the identification, biology, and management of oak wilt, with emphasis on the southeastern U.S.

<http://www.forestrywebinars.net/webinars/oak-wilt-identification-biology-and-management>

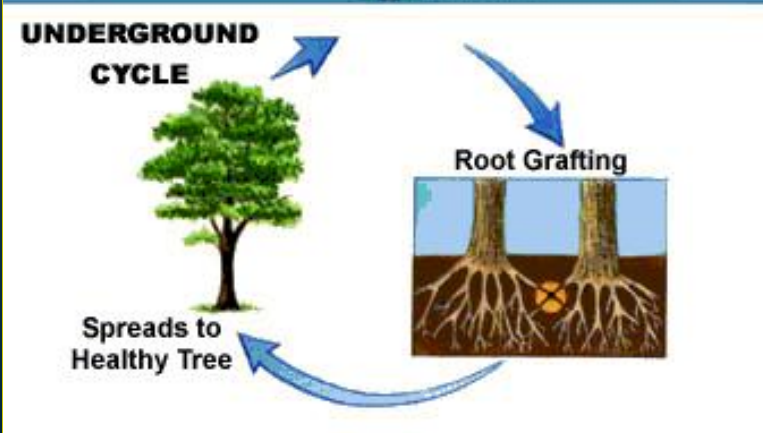


Oak wilt is a lethal disease of oaks (*Quercus* spp.) caused by the fungus *Ceratocystis fagacearum*. This disease is prevalent throughout the eastern U.S., and is the most serious on trees in the red oak family (e.g. red oak, black oak, pin oak, etc.). *Ceratocystis fagacearum* is an introduced (non-native or exotic) fungus, is transmitted by insects, and can travel through root grafts to infect neighboring trees. Attendees to this webinar will learn how to identify oak wilt (and distinguish it from similar oak maladies) and what to do once it's infected a tree. Management options, including chemical, will be covered.



Overland Cycle → establishment of new foci

- Importance of insect vectors
- Conditions for production of mats and pads



Underground Cycle → expansion of foci

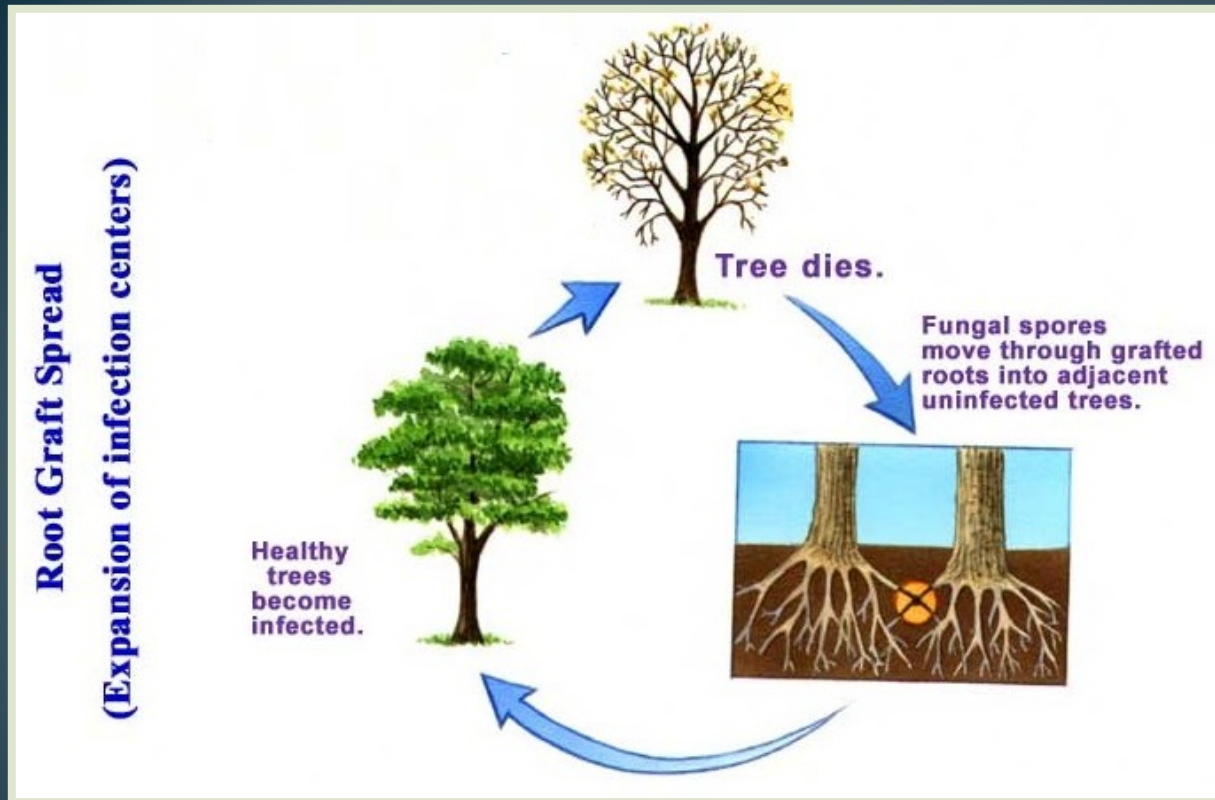
- affected by soil type, species mix, stand history...

Management choices depend on:

- Biology of the pathogen, vectors and host
- Abundance of the disease
 - eradication vs suppression
- Available tools
- Management objectives

There is No “One size fits all”

Tools to stop Underground Spread



- Root graft disruption
- (Fungicide Injection to Protect Individual Trees)

Root graft cutting tools



Vibratory plow



Other heavy equipment
(e.g. backhoe, dozer, rock saw)

Herbicide Treatment to kill roots

- Form of Root Graft Barrier
- Operational testing in Wisconsin
- Best used when other tools are not available.



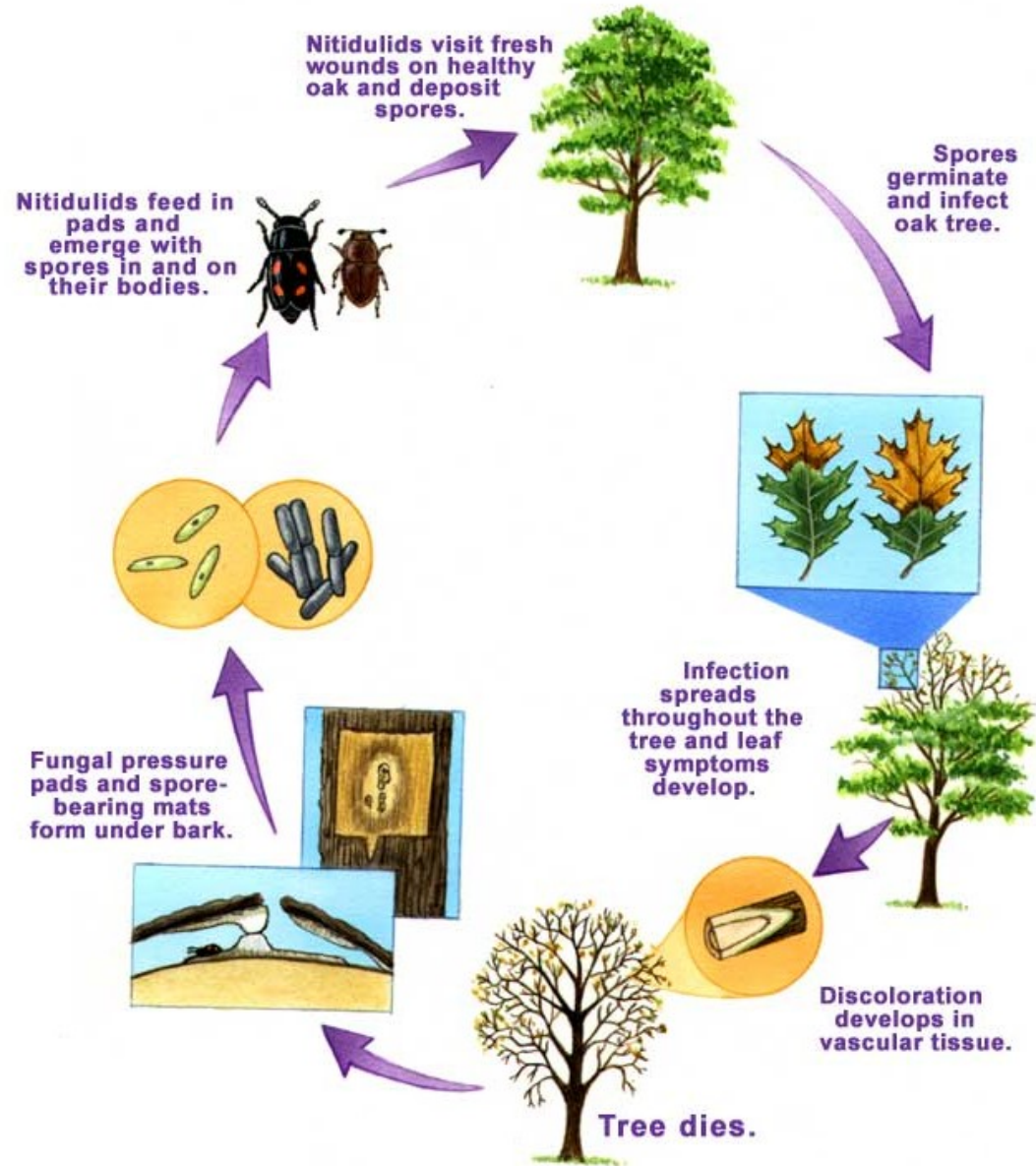
Fungicide Injection to Protect Trees



- Injectable formulation of Propiconazole (trade name Alamo)
- Does not kill the pathogen in the roots
- Not for eradication

Tools to stop Overland Spread

Overland Spread (Initiation of new infection centers)



- Wound Prevention
- Sanitation

Wound prevention and treatment

- Don't prune oaks in spring
 - nitidulids active
 - mats and pads present
 - susceptible springwood vessels in trees
- Protect trees during construction activities, especially in spring
- Wound dressing if wounds unavoidable



Sanitation



- Determine trees on which oak wilt mats will likely form in the spring
- Removal
- Proper disposal

Heterobasidion Root Disease

Origin: Native to North America, but not present everywhere.

Causal Agent: *Heterobasidion irregulare*

Federally Regulated: No

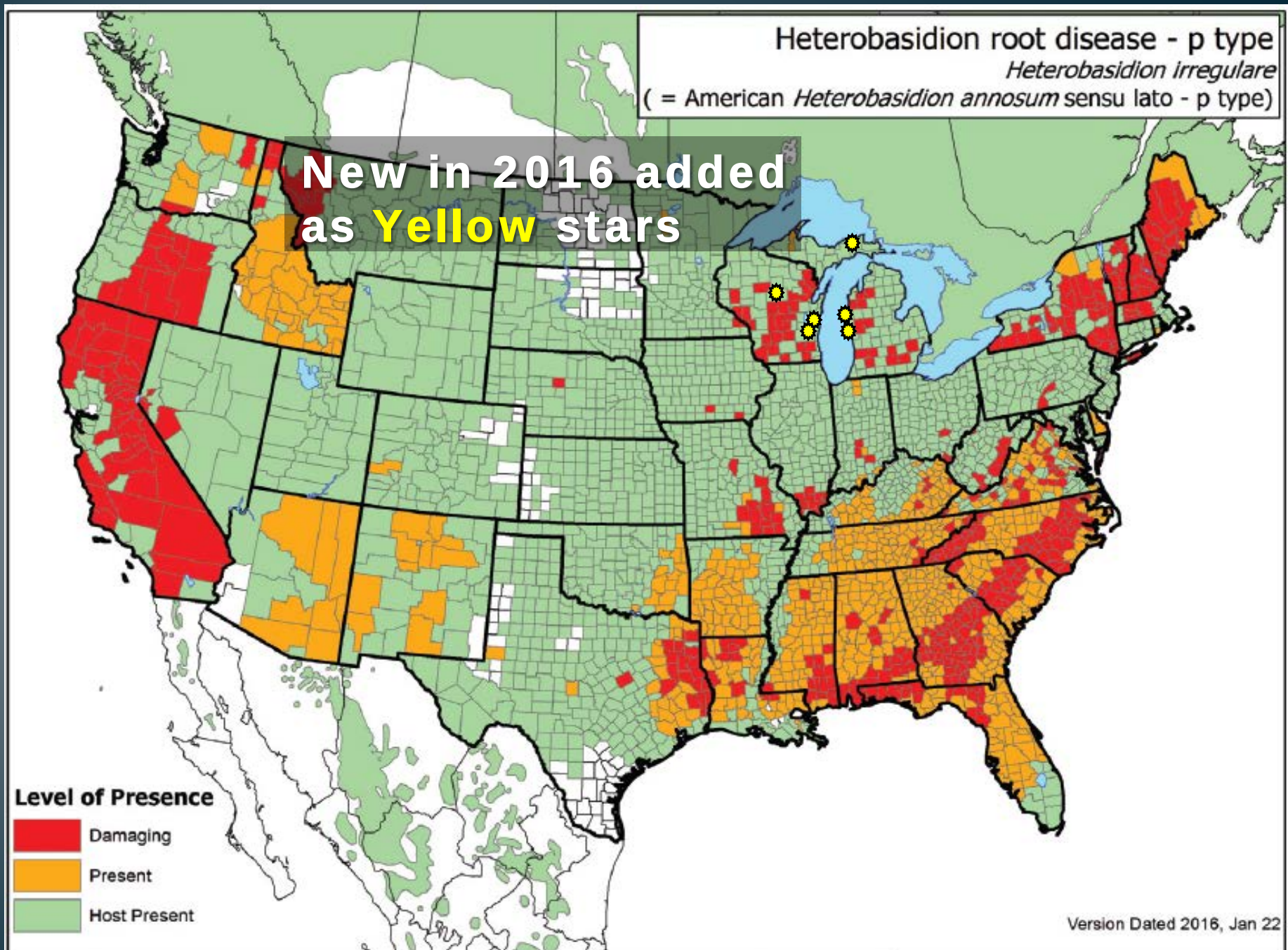
US Detections: Widespread in West and Southeast, discontinuous distribution in Northeast.

Hosts: Pines plus other conifers

Damage: root disease, tree mortality



Photo from Kyoko Scanlon, WI DNR



Heterobasidion root disease - p type
Heterobasidion irregulare
(= American *Heterobasidion annosum* sensu lato - p type)

New in 2016 added
as **Yellow** stars

Level of Presence



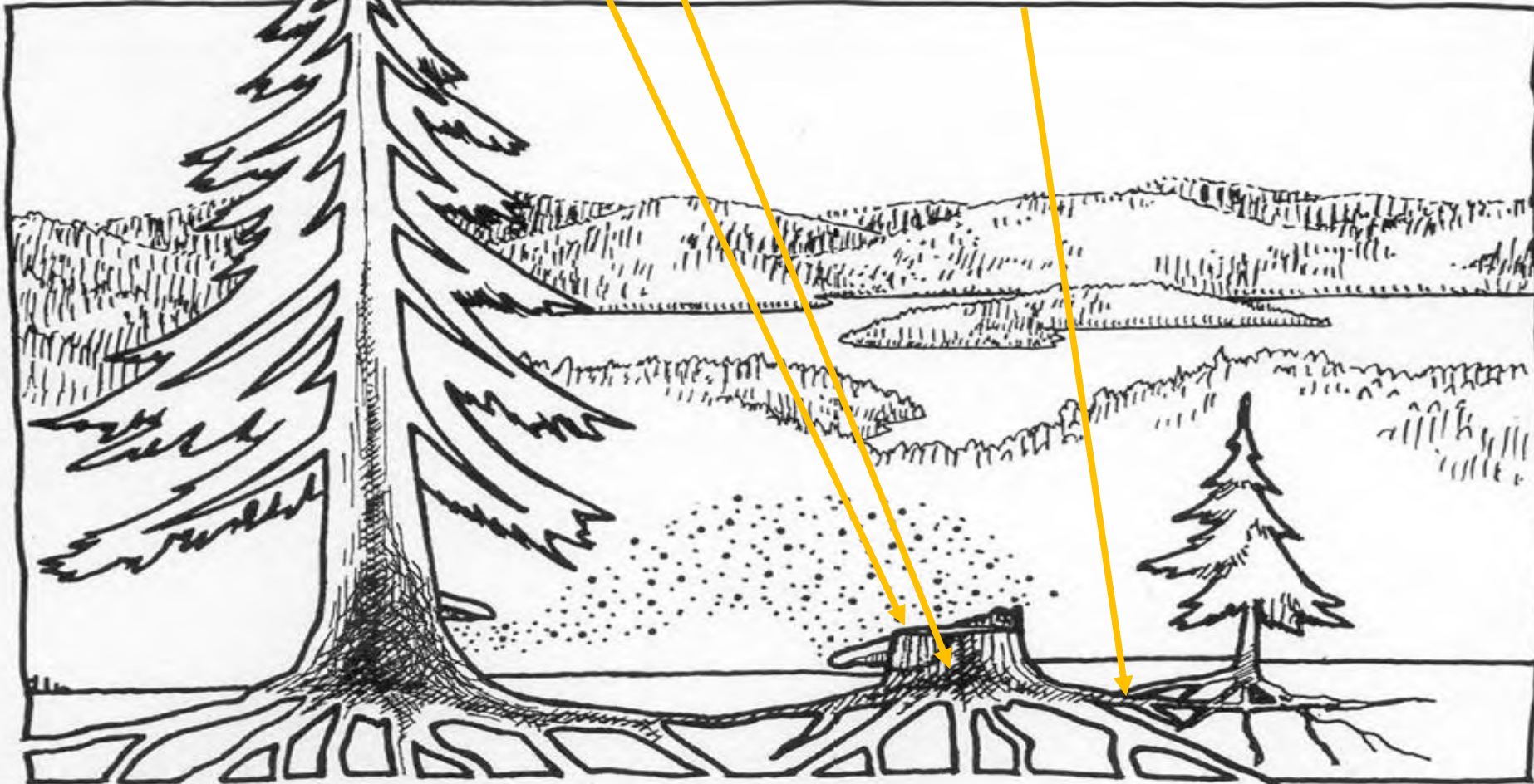
Version Dated 2016, Jan 22

Basidiospores on stumps— from near or far

Decay develops, moves into roots

And develops conks (more spores!)

Spreads to adjacent trees (including regeneration)
through touching roots.



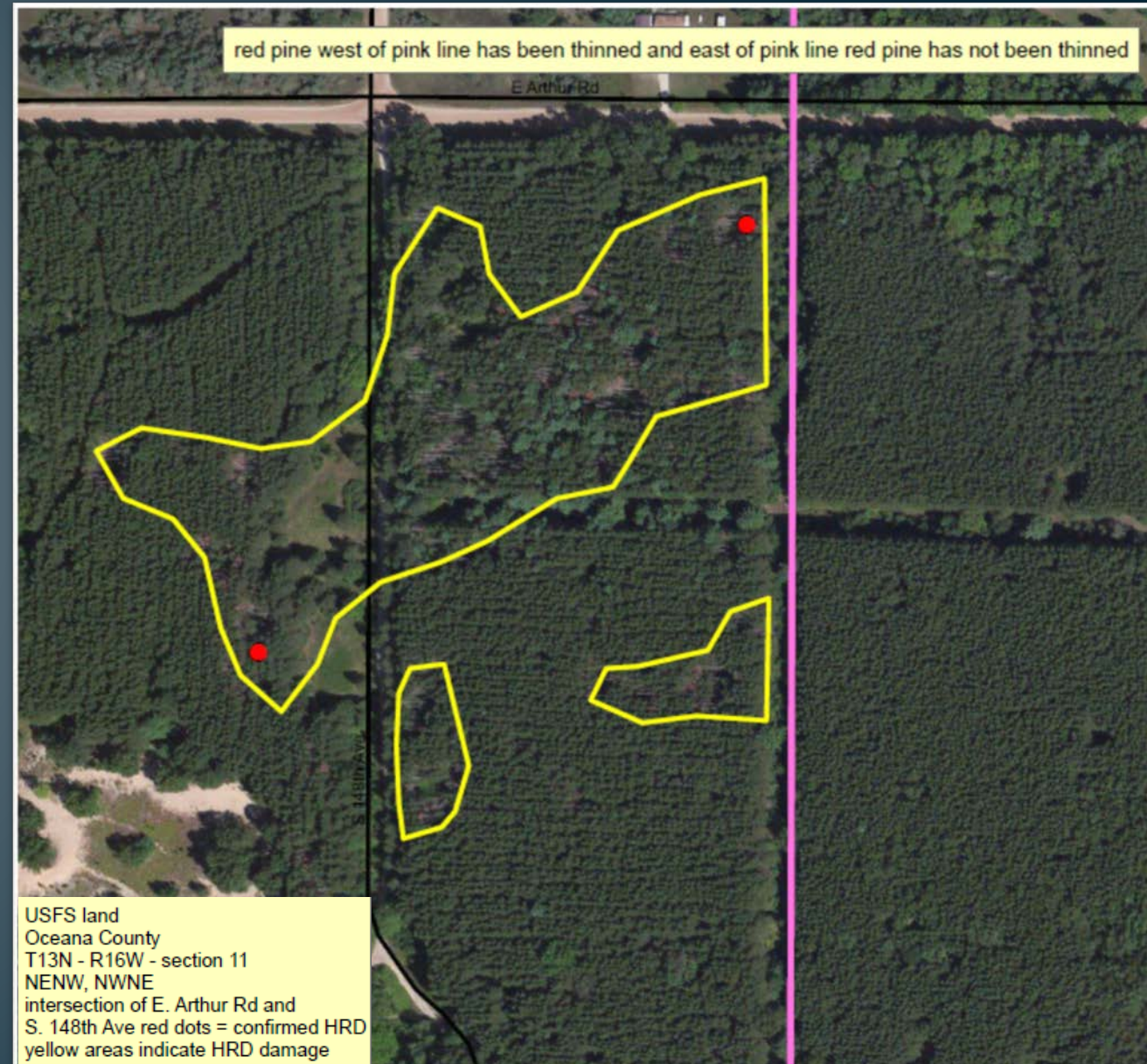
The main routes of spread for *Heterobasidion* (illustration by Tove Vollbrecht, Sweden).

STUMPS are the driving factor in developing an outbreak.

Behavior is different between North and South

South has a longer history of managing this disease, more tested tools.

- Relationship of soils to disease intensity is better understood in the South.
- Hot summer temperatures in the south make stump surfaces unsuitable for colonization– so summer is a SAFE PERIOD for logging/thinning. This rule DOES NOT APPLY in the NORTH.
- Stumps deteriorate fast in SOUTH. Not so in NORTH. So disease is more likely to persist on a site.



Heterobasidion (aka Annosum or Fomes) Root Disease of Pines in the South

Nov 17, 2016 View now on-demand.

Michelle Cram - Plant Pathologist, USDA Forest Service

This webinar will cover the identification, biology, and management of Heterobasidion root rot in the southeast U.S. Heterobasidion root disease is also known as annosum root disease or fomes root disease.

<http://www.forestrywebinars.net/webinars/heterobasidion-root-disease-of-pines-in-the-south>



Heterobasidion root disease (HRD), caused by the fungus *Heterobasidion irregulare*, occurs in pines (*Pinus* spp.) throughout the eastern U.S. HRD weakens tree roots, and causes canopy thinning, dieback, and sometimes tree mortality. Trees infected with HRD are at a greater risk of windthrow due to weakened roots. Damage from HRD can be confused with insect damage, as initial HRD symptom can be difficult to diagnose. This webinar will cover HRD identification, biology, and management on pines in the southeastern U.S.



- Decaying stumps or butt logs with white stringy rot.



- stumps with conks near the soil line.

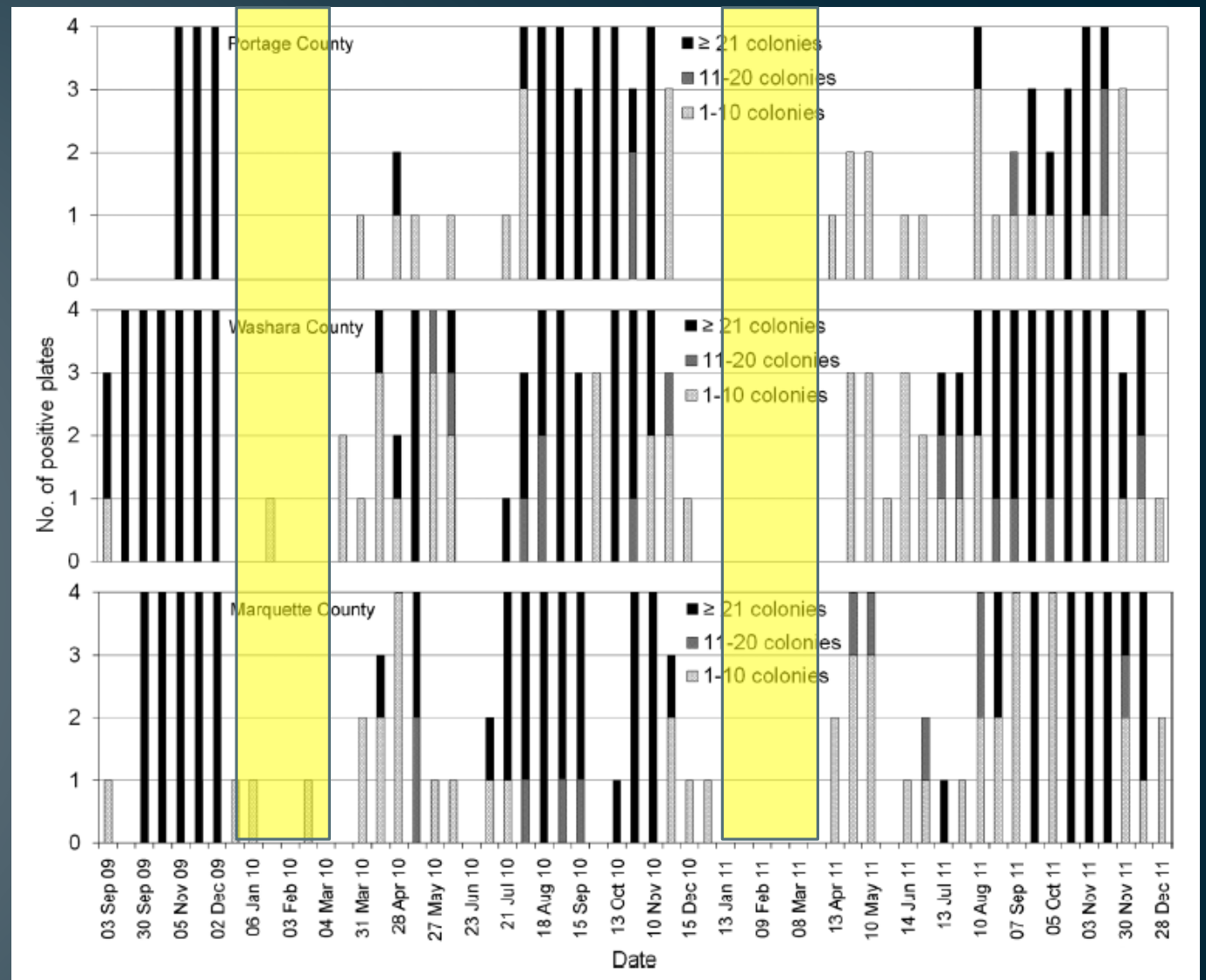
- Small conks on the base of recently killed trees or even on roots, usually below the duff. You may also note resin soaking in affected roots and stems. You can have both HRD and Armillaria on the same site, or even on the same tree.





Conks can
be highly
variable!

- There is never “ZERO” risk, but there are some lower risk times and distances.
- Same or adjacent stand is very high risk, far away stand is lower risk.
- Timing makes a difference on how much inoculum is available



Seasonal availability of inoculum of the *Heterobasidion* root disease pathogen in central Wisconsin

Glen R. Stanosz, Denise R. Smith, and Jennifer Juzwik

Can. J. For. Res. 46: 1076–1080 (2016) [dx.doi.org/10.1139/cjfr-2016-0136](https://doi.org/10.1139/cjfr-2016-0136)

2014 Guidelines for Prevention of Heterobasidion Root Disease (HRD) of Pines on NFS Region 9 National Forests

Prepared by SPFO and DFO FHP pathologists, with input from others: April 2014

Note: The Background portion of these guidelines was updated 2/2/2014.
The Recommendations portion was not modified, and is due for review.

Introduction

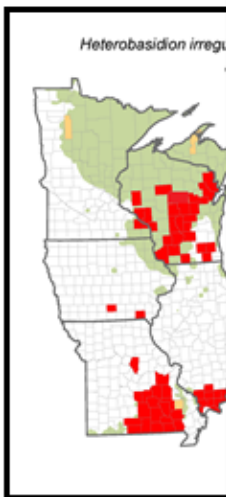
In 2010, the St. Paul Field Office (SPFO) Forest Health Protection Unit (FHPU) was established to manage the LAKE STATES National Forests. We now have new information of Heterobasidion Root Disease (HRD). These guidelines are intended to expand the scope to address National Forests of the entire Eastern

Background on Heterobasidion Root Disease

In this section, we provide background information that is foundational to the management of HRD. In many cases, we cite synopsis or overview documents (rather than the more detailed information generally available to the land manager. However, for some species, we cite more obscure sources.

Location/Distribution

Mycology collections and field observations from the mid-1900s identified multiple locations in the northeastern US. Molecular tools have identified American species, and we now recognize that in North America *H. occidentale* (formerly referred to as *H. annosum* s-type), which is found in the western states, and *H. irregulare* (formerly referred to as *H. annosum* p-type) are found in the eastern and western states (Otrasina and Garbellotto 2010). The name *H. irregulare* is now used to refer to a Eurasian species that is not present in North America, and therefore historical references to *H. irregulare* in the eastern United States and Canada likely refer to *H. irregulare*. *H. irregulare* is considered sister species, and have a high degree of mating compatibility. A doctoral thesis that the ancestor of the present day *H. irregulare* migrated to North America across a trans-Atlantic land bridge some 30 to 60 million years ago. Linzer et al. (2008) had suggested that an ancestral fungus entered North America from Asia across the Beringian land bridge, retreated to Mexico during glaciation, and gave rise to *H. irregulare* that subsequently migrated back north with conifer species. Regardless of origin, in their current geographic ranges, *Heterobasidion* species have developed differences in ecological behavior. Therefore, one cannot assume that management recommendations that have been developed for the Eurasian *H. annosum* will fully apply to *H. irregulare* in North America.



Summary of HRD Treatment Recommendations for R9 National Forests

Proximity

Site within 25 miles of known infection center.

High Risk

Site > 25 miles from known infection center.

Low Risk



Management Situation

Management for pine and an entry for thinning required.

Potential Impact High

Management for pine and an entry for harvest required, with desired pine future condition.

Potential Impact High

Entry for harvest of pine, but desired future condition is hardwoods (e.g. hardwood conversion).

Potential impact Low

Entry for harvest in a stand without a pine component, even though desired future condition is pine.

Potential impact Low



Mitigation/Prevention

Timing of entry

Limit cutting to the window of time between January 1 and March 31. Monitor weather conditions to potentially adjust window.

Stump Treatment

If cutting is done during higher risk period, treat all pine stumps with an approved boron containing compound or biocontrol agent (e.g. Sporax®, Cellu-Treat®, or Rotstop®.)

Thousand Cankers Disease

Origin: Native to Southwestern USA,
introduced to East

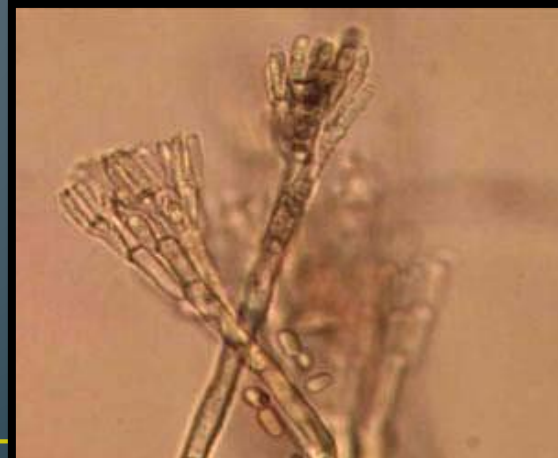
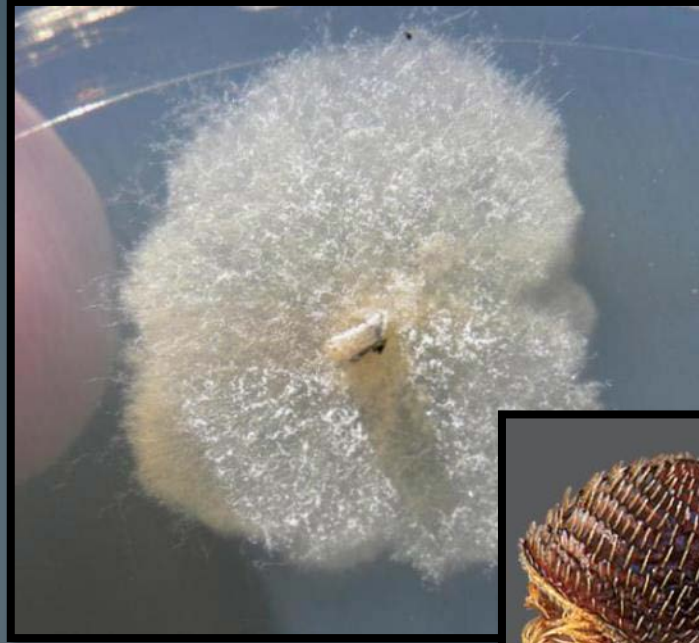
Causal Agent: Walnut Twig Beetle
(*Pityophthorus juglandis*) **PLUS** the
fungus *Geosmithia morbida*

Federally Regulated: No, but many State
quarantines.

US Detections: See distribution map

Hosts: Black Walnut, some other
Juglandaceae can be affected.

Damage: Dieback; tree mortality



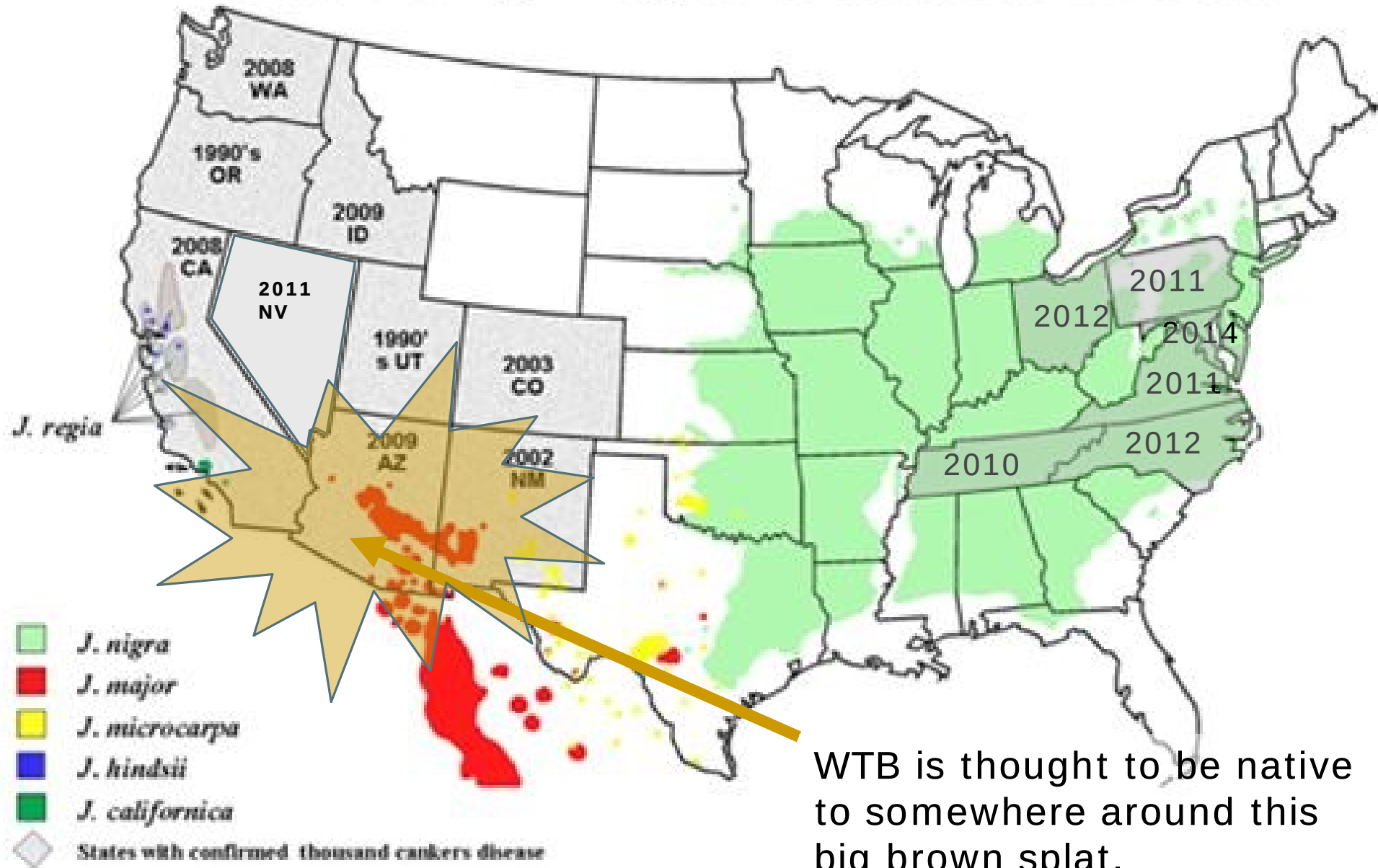


Symptoms



Karen Snover-Clift,
Cornell University, Bugwood.org

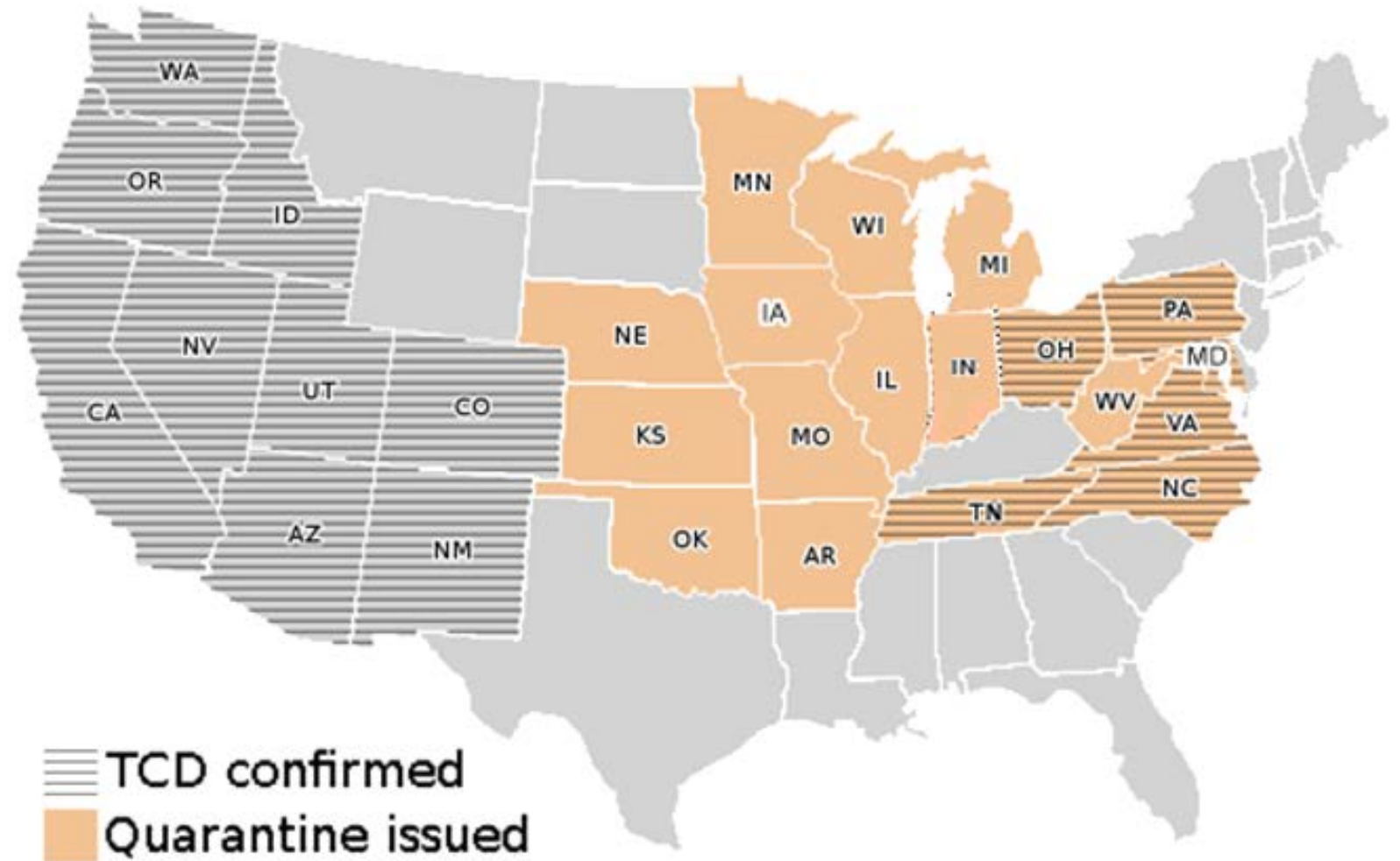
Distribution of *Juglans* spp. and thousand cankers disease



Many States
have external
quarantines
to prevent
introduction
of TCD

Thousand Cankers Disease Quarantine Information

Click on a state for more information on quarantines and local resources for thousand cankers disease.

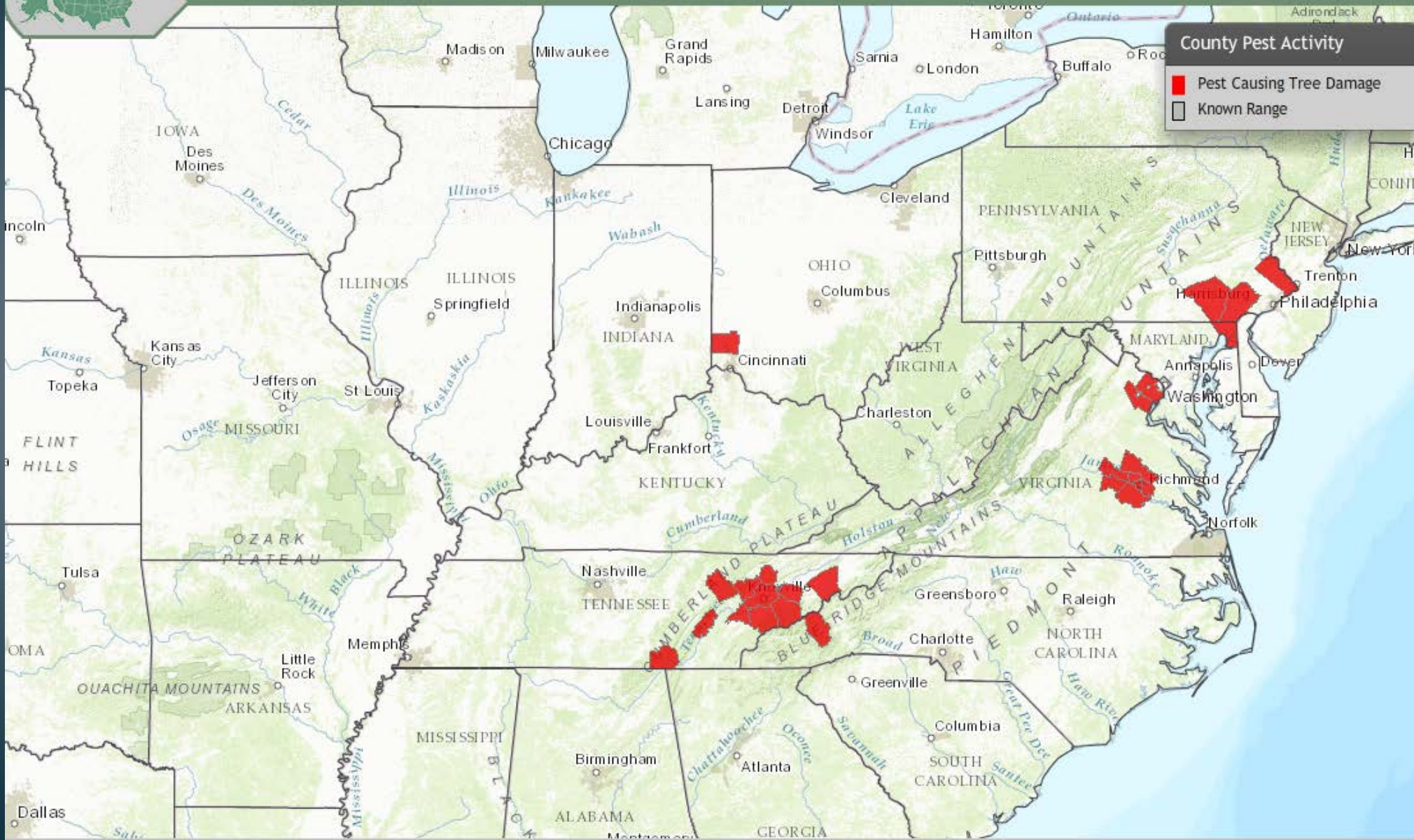




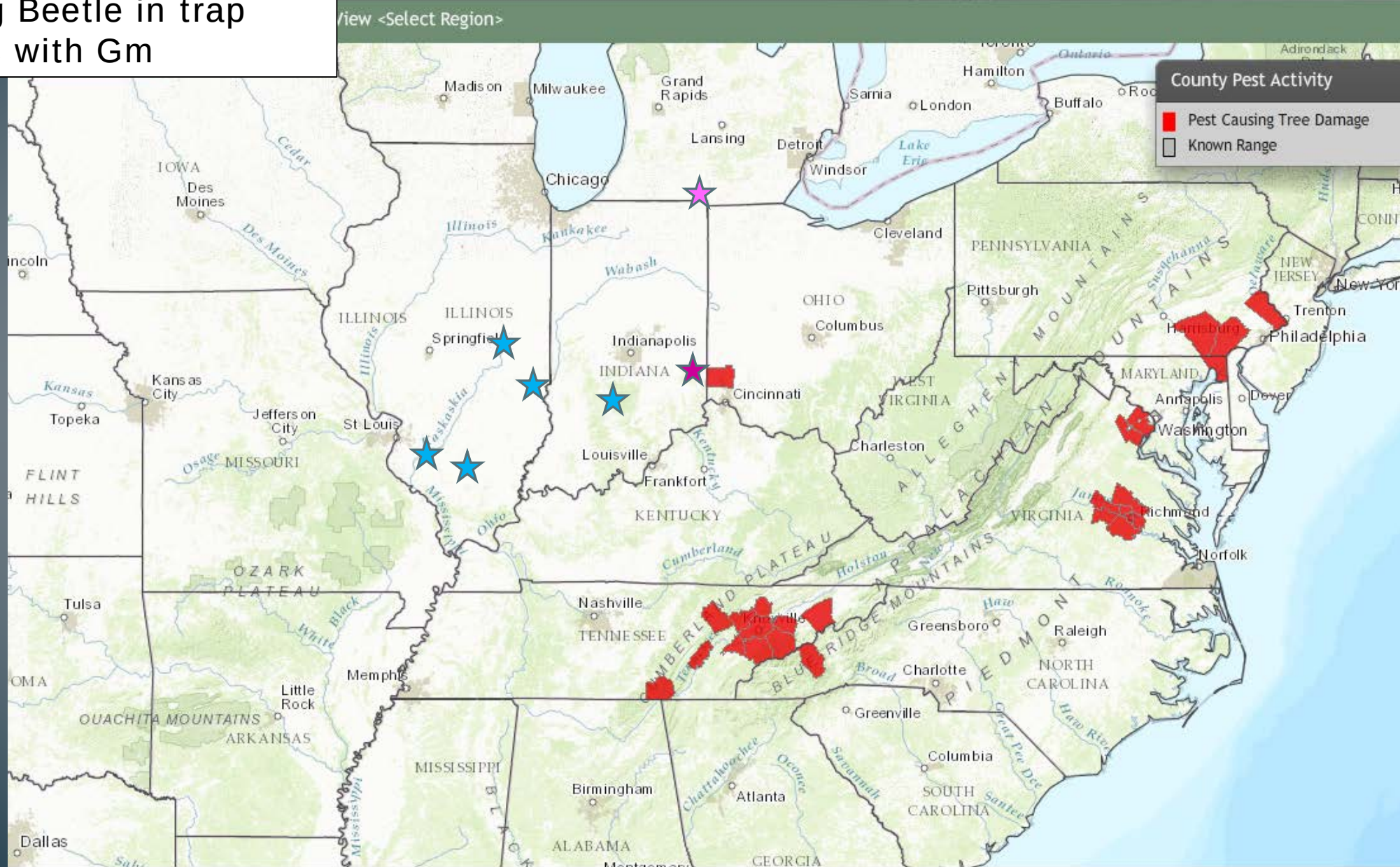
Showing National View <Select Region>

County Pest Activity

- Pest Causing Tree Damage
- Known Range



- ★ *G. morbida* on other beetles
- ★ Walnut Twig Beetle in trap
- ★ WTB in logs with Gm



Growing List of Insects Carrying Gm *

Bark Beetles



Weevils



Ambrosia Beetles

*Note: Does not necessarily mean they can transmit Gm

Detection Method:

-  Cultured
-  PCR
-  Both

What does this MEAN???

Is this pathogen more common than we thought?

What is the relationship this fungus has with insects other than Walnut Twig Beetle... symbiotic? Random hitchhiker?

Could it occur naturally in the environment separate from the WTB?

There is still basic ecological work to be done on *G. morbida*, WTB and other potential associates.

Impact

Damage on Eastern Black Walnut planted in Colorado and other western States has been severe.

Some of the infestations found in Eastern States may have been present 10 to 20 years before they were found.

Dr. Gary Griffin (Virginia Tech)(2014) documented disease development on individual trees in Knoxville, TN, and Richmond, VA, for 3 years and found moderate to stable disease progression on most trees.

Number of TCD-symptomatic trees does not seem to be increasing in Ohio or Pennsylvania.

We still don't know how high of impact this disease might have on Eastern black walnut over time.



Other Emerging Diseases to Watch for...

Diplodia corticola on oak– as both a twig blight and a bleeding canker

In Florida: <http://edis.ifas.ufl.edu/fr386>, <http://apsjournals.apsnet.org/doi/abs/10.1094/PDIS-02-11-0123>

In Maine: <http://apsjournals.apsnet.org/doi/full/10.1094/PDIS-09-15-0994-PDN>

In Massachusetts: <http://apsjournals.apsnet.org/doi/full/10.1094/PDIS-08-16-1118-PDN>

In West Virginia: <http://apsjournals.apsnet.org/doi/abs/10.1094/PDIS-08-16-1181-PDN>

Laurel Wilt (*Raffaelea lauricola*)

<http://southernforesthealth.net/fungi/laurel-wilt>

Bur Oak Blight (BOB) (*Tubakia iowensis*)

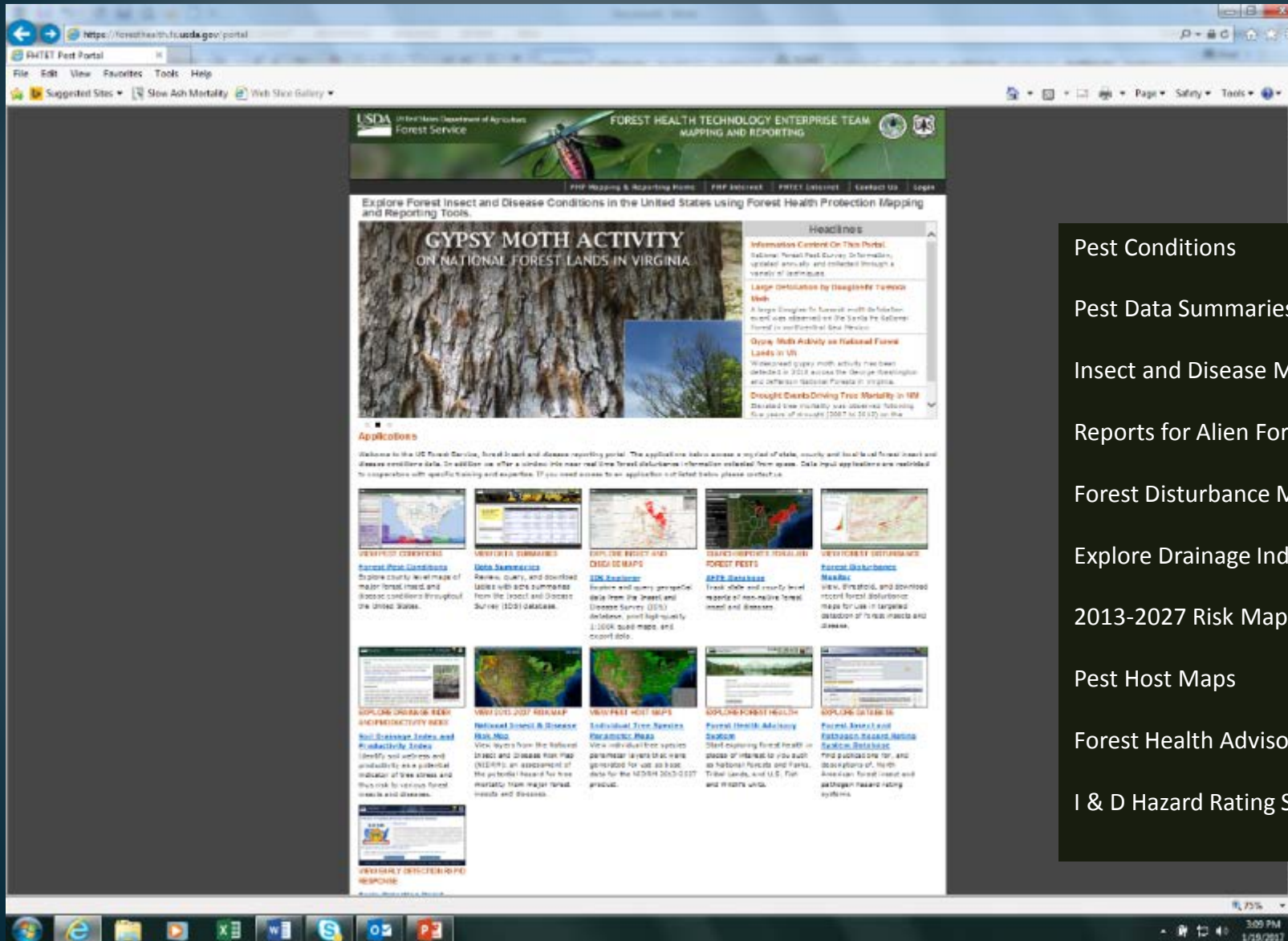
http://na.fs.fed.us/pubs/palerts/bur_oak_blight/bob_print.pdf

<http://www.ipm.iastate.edu/ipm/info/plant-diseases/bur-oak-blight>

Resources Available to You

Forest Health Pest Portal

<https://foresthealth.fs.usda.gov/portal>



Pest Conditions

Pest Data Summaries

Insect and Disease Maps

Reports for Alien Forest Pests

Forest Disturbance Mapping

Explore Drainage Index and Productivity Index

2013-2027 Risk Maps

Pest Host Maps

Forest Health Advisory System

I & D Hazard Rating System Database

State Contacts for Native and Non-Native Forest Pests

Directory of State Forestry Agencies

<http://www.stateforesters.org/about/who-we-are>

Directory of State Plant Pest Regulatory Agencies

<http://nationalplantboard.org/membership/>

ALB Resources

ALB and Its Hosts

<http://na.fs.fed.us/pubs/detail.cfm?id=5268>

Forest Service ALB Web Page

<http://www.na.fs.fed.us/fhp/alb/>

USDA APHIS Web Page

www.AsianLonghornedBeetle.com

www.aphis.usda.gov

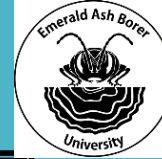
ALB pest alerts and ALB ID cards

Emerald Ash Borer Information Network

www.emeraldashborer.info

1. EAB University Webinar series Past and present webinars available
2. EAB University Webinars on YouTube
<https://www.youtube.com/channel/UCmSCQA0HmDeMULEI-FrIBpg>
3. Information for Homeowners
4. Links to State EAB webpages
5. Publications
6. Biological control
7. Wood use options
8. Other links

Keep Up-to-Date on Invasive Forest Pests
with Free Webinars from **EAB**
University!



Spring 2017 TOPICS

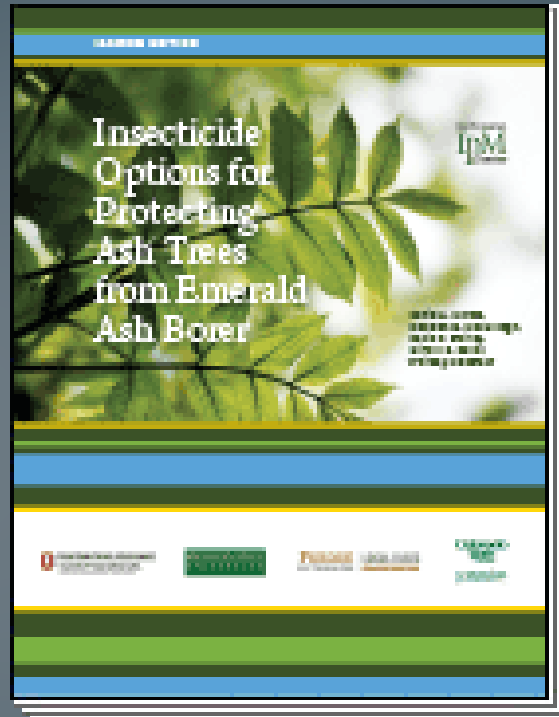
- Feb 21 Street Tree Surveys for Early Detection
and Rapid Response to Exotics
- Mar 2 Hemlock Woolly Adelgid in Michigan
- Mar 7 Ambrosia Beetle Vectors and Diseases
- Mar 14 Best Chemical Controls for EAB
- Mar 21 EAB Biocontrol Program Update

Presentations are At 11:00 AM.

View live or see past webinars, find out about
CEU's and more at:

www.emeraldashborer.info





Insecticide Recommendations

Also available from the FS:

EAB pest alerts

EAB ID cards

EAB brochures

EAB ID kits

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

Gypsy Moth Resources

USFS Gypsy Moth Digest

<http://na.fs.fed.us/fhp/gm/>

Gypsy Moth Slow the Spread project

<http://www.gmsts.org/about.html>

USFS Northern Research Station:

https://www.nrs.fs.fed.us/disturbance/invasive_species/gm/risk_detection_spread/

USDA APHIS

www.aphis.usda.gov

HWA Resources

HWA Initiative webpage

<http://hiro.ento.vt.edu/hwa/>

Hemlock Conservation Plan (Pennsylvania)

http://www.dcnr.state.pa.us/cs/groups/public/documents/document/dcnr_20030071.pdf

USFA Northern Research Station HWA webpage

https://www.nrs.fs.fed.us/disturbance/invasive_species/hwa/

USFA Southern Research Station HWA webpage

<https://srs.fs.usda.gov/coweeta/research/hwa/>

Sources of Additional information on Oak Wilt Disease

How to Identify Prevent and Control Oak Wilt Disease:

https://www.na.fs.fed.us/pubs/howtos/ht_oakwilt/identify_prevent_and_control_oak_wilt_print.pdf

USFS Northern Research Station:

https://www.nrs.fs.fed.us/disturbance/invasive_species/oak_wilt/

Texas Oak Wilt management “clearinghouse”:

<http://texasoakwilt.org/oakwilt/>

Free Webinar on identification, biology, and management of oak wilt, with emphasis on the southeastern U.S.

<http://www.forestrywebinars.net/webinars/oak-wilt-identification-biology-and-management>

Sources of Additional information on Heterobasidion Root Disease

New (2016) Southern Regional Extension Forestry Publication: Biology, diagnosis, and management of Heterobasidion root disease of southern pines

<http://southernforesthealth.net/fungi/annosum-root-rot/biology-diagnosis-and-management-of-heterobasidion-root-disease-of-southern-pines>

Wisconsin DNR HRD webpage, including interactive treatment guidelines:

<http://dnr.wi.gov/topic/ForestHealth/AnnosumRootRot.html>

Free webinar on Heterobasidion Root Disease of Pines in the South:

<http://www.forestrywebinars.net/webinars/heterobasidion-root-disease-of-pines-in-the-south>

Information on RotStop C:

<http://www.bioforest.ca/index.cfm?fuseaction=content&menuid=11&pageid=1030>

Information on Cellu-Treat

<http://shop.nisusc corp.com/products/Cellu%252dTreat-Wood-Preservative-%252d25-lb.-Bucket.html>

Sources of Additional information on Thousand Cankers Disease

Collaborative TCD Webpage, includes links to State information“:

<http://www.thousandcankers.com/>

USFS Northern Research Station:

https://www.nrs.fs.fed.us/disturbance/invasive_species/tcd/

Purdue Extension Publication, November 2016: Thousand Cankers Disease: Indiana Walnut Trees Threatened

<https://www.extension.purdue.edu/extmedia/BP/ID-478-W.pdf>

Southern Regional Extension Forestry webpage on TCD:

<http://southernforesthealth.net/fungi/thousand-cankers-disease>