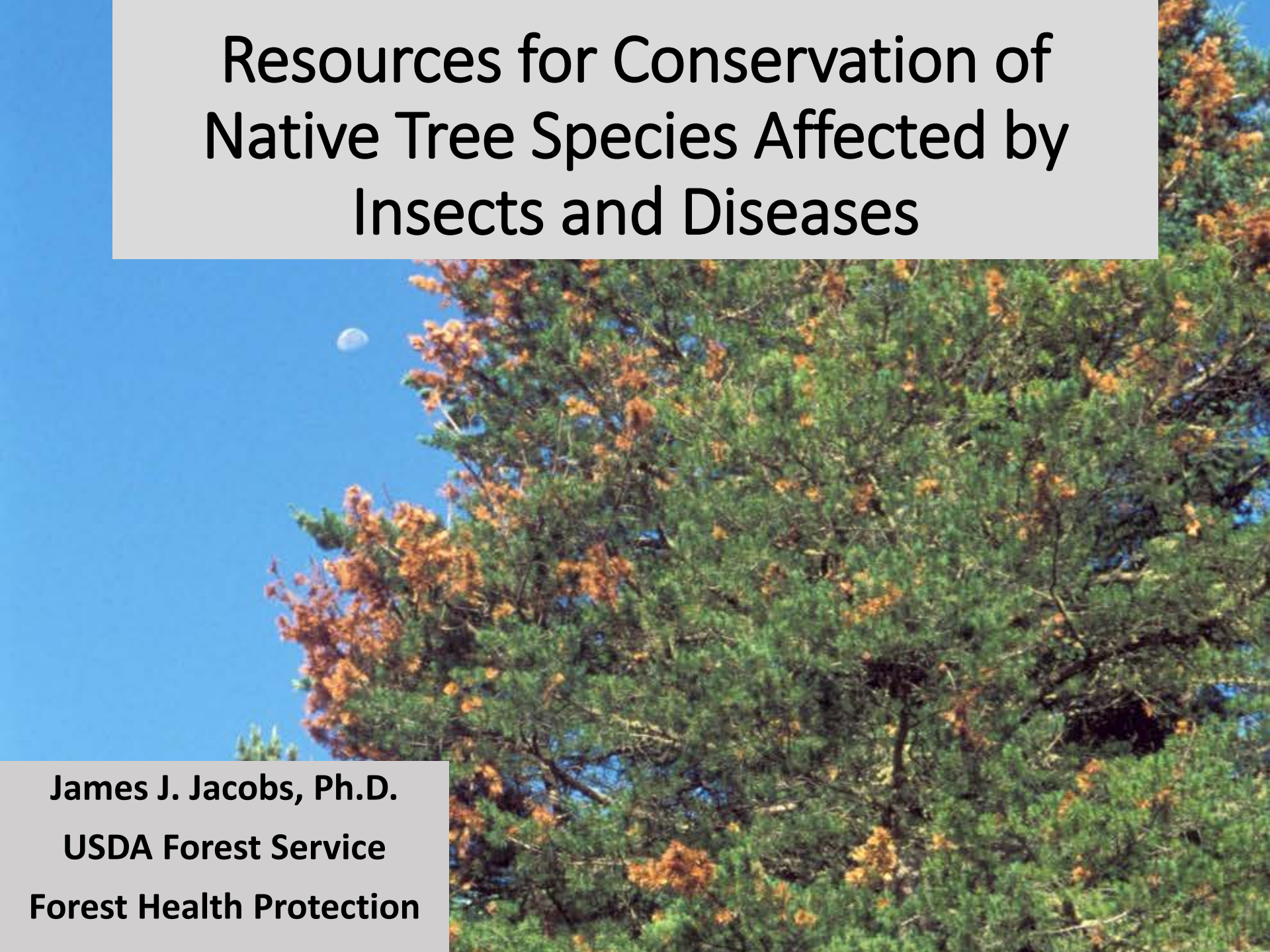
Resources for Conservation of Native Tree Species Affected by Insects and Diseases



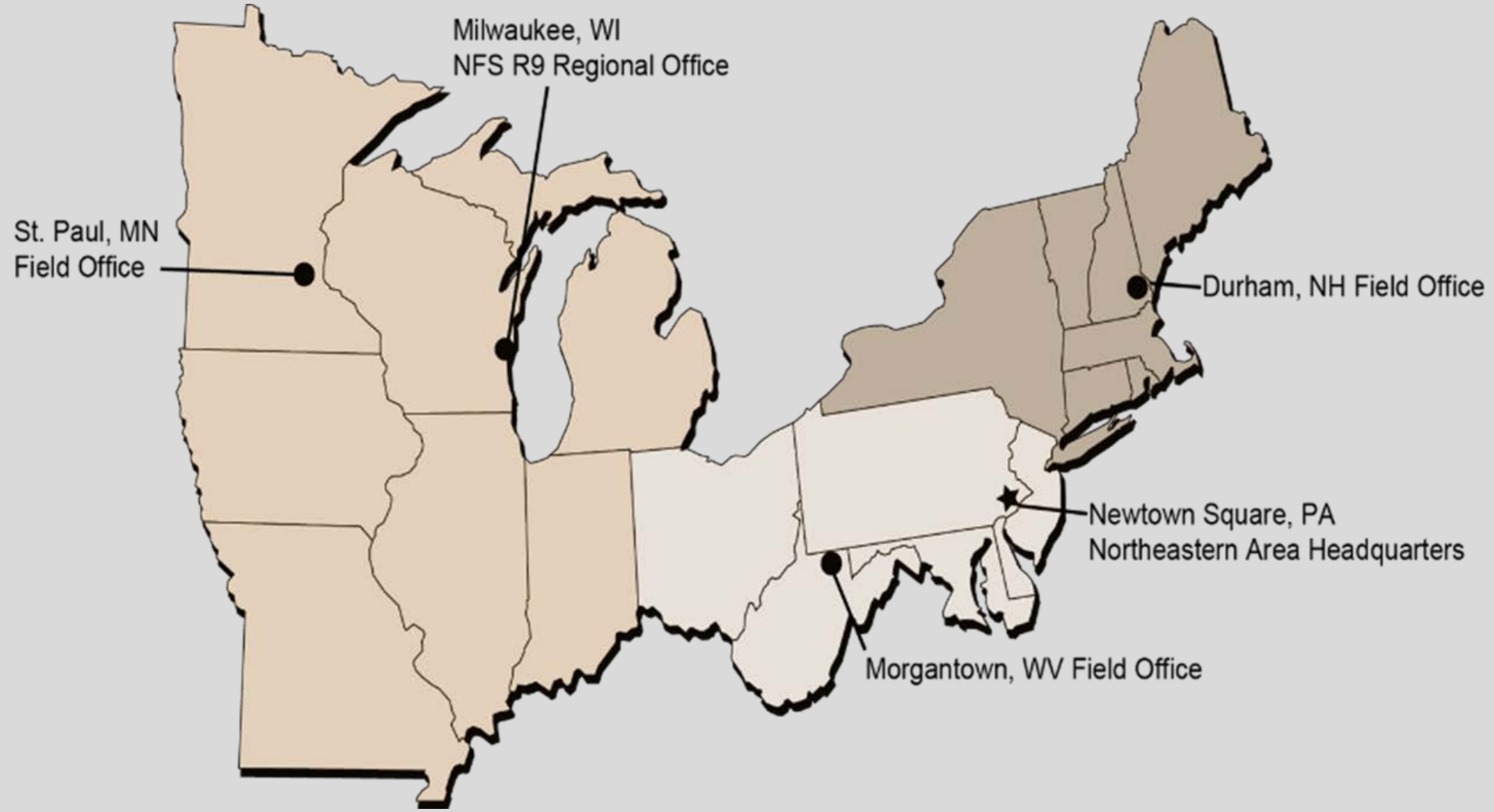
James J. Jacobs, Ph.D.

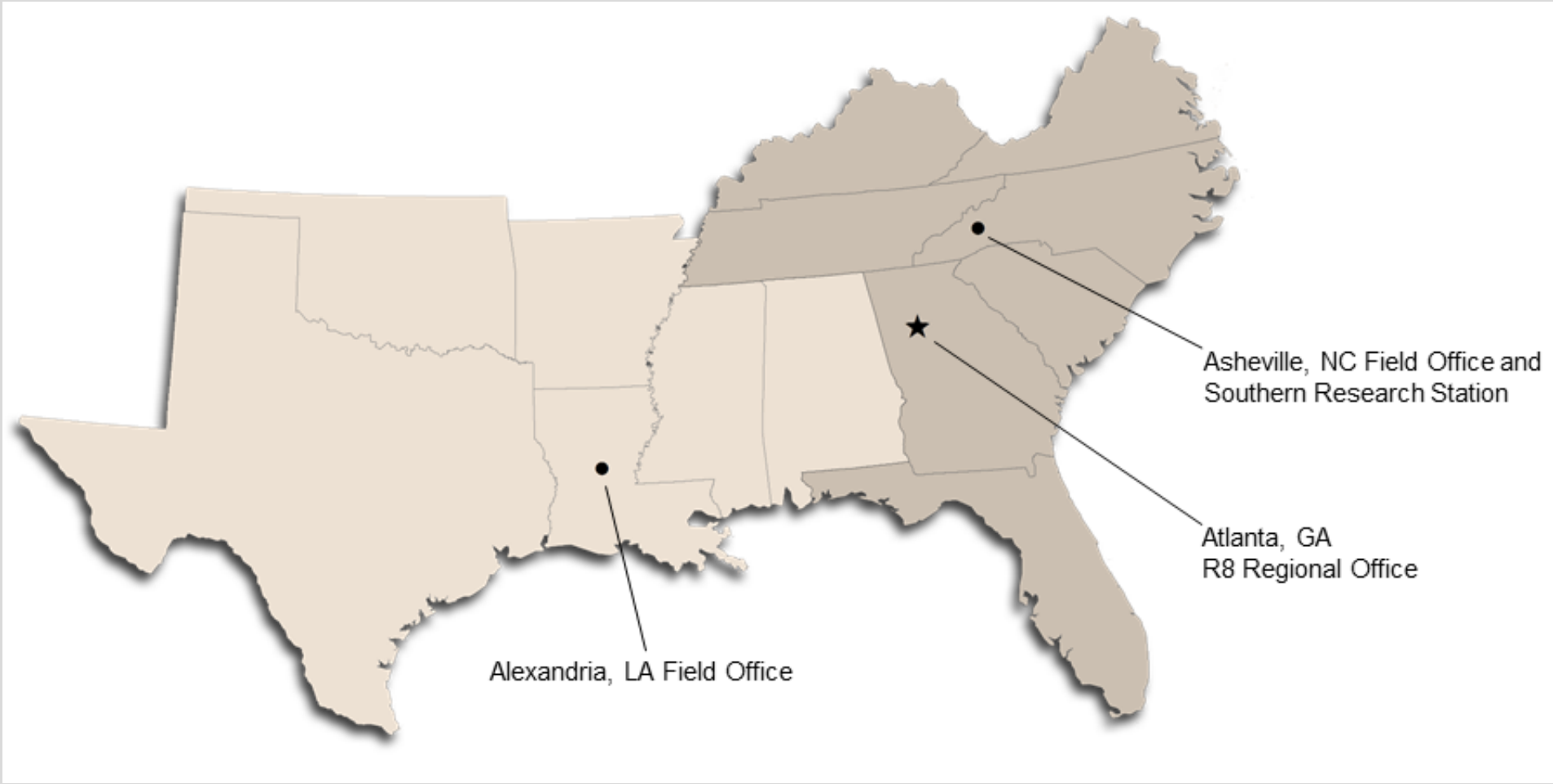
USDA Forest Service

Forest Health Protection

Northeastern Area Forest Health Protection

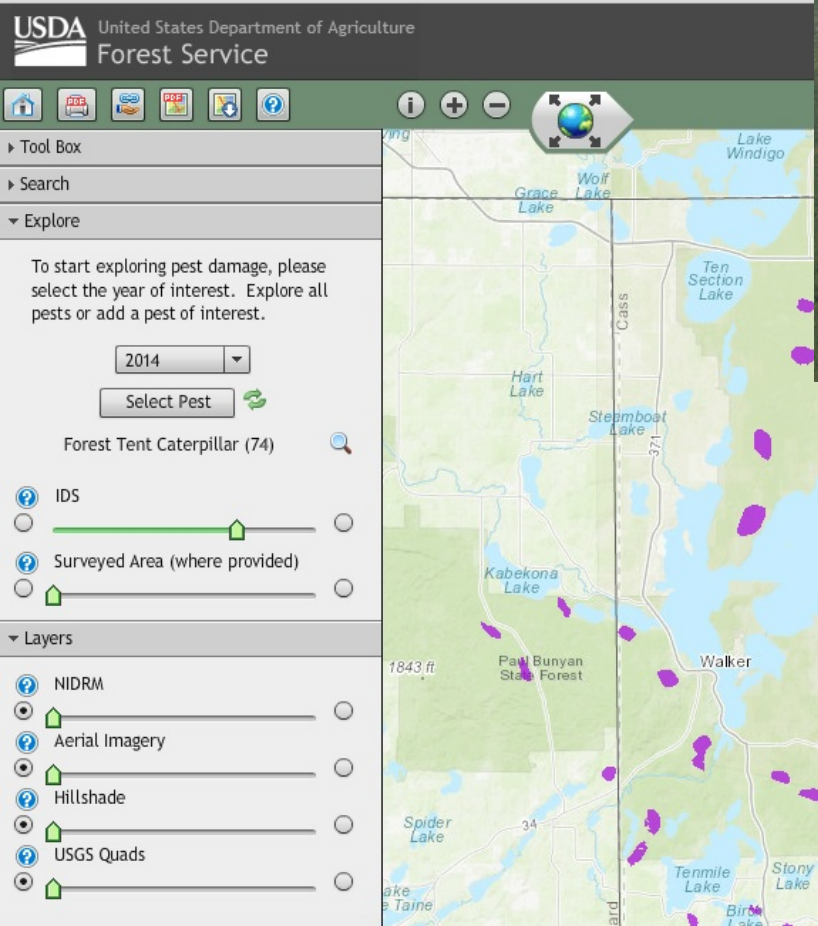
- Three field offices
- Tribal Governments, USFS, NPS, BIA, Army Corp, etc.
- Detection Survey
- Tech dev for I&D management
- Site Assistance
- Training
- WE'RE FREE!


Milwaukee, WI
NFS R9 Regional Office
St. Paul, MN
Field Office
Durham, NH Field Office
Newtown Square, PA
Northeastern Area Headquarters
Morgantown, WV Field Office


Asheville, NC Field Office and
Southern Research Station
Atlanta, GA
R8 Regional Office
Alexandria, LA Field Office

Aerial Detection and Ground Survey Program

- How does it work?



Technical Assistance

- Insect and Disease assessments

Technical Assistance

- Management Alternatives

Technical Assistance

- Survey
- Technology and treatment development

Training

- Insect and Disease Identification and Management

Training

- Tree Risk Assessment and Hazard Tree Mitigation

Prevention/Suppression Program

- National FHP program
- Gypsy moth, oak wilt, Southern pine beetle, other bark beetles in the west, mistletoe, etc.
- Other things can be funded
- We need to know there is a need

Prevention/Suppression Program

- How does it work?

Fall Request For Special Project Proposals

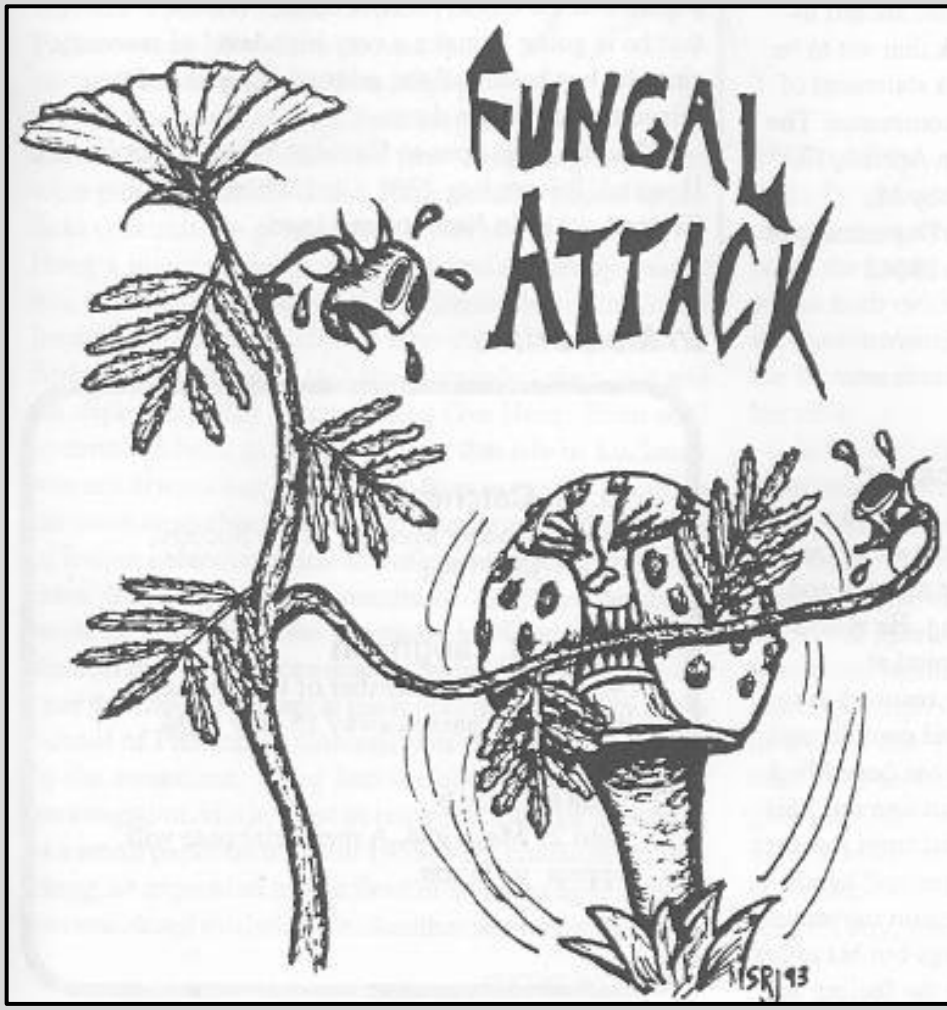
- Fall RFP
  - Evaluation Monitoring (EM)
  - Special Technology Development Program (STDP)
  - Biological Control of Invasive Native and Non-native Plants (BCIP)
  - Forest Service Pesticide Impact Assessment Program (FS-PIAP)
- Need an FHP sponsor
- We can help develop proposals

Diseases and Insects in Forests

- Under natural conditions, pathogens/insects and hosts have evolved together
- Epidemics generally from:
    - Exotic pathogens (e.g. chestnut blight, white pine blister rust)
    - Exotic insects (e.g. EAB, ALB, gypsy moth)
    - Forest practices (off-site plantings, monocultures)
    - Unusual climatic events (drought, climate change)
    - Are these things going to keep happening?

Disease Management?

- Traditional Principles of Plant Disease Control
- **Avoidance**
- **Exclusion**
- **Eradication**
- **Protection**
- **Resistance**
- **Therapy**



Just as valid today as 1929! But not practical

Insect and Disease Management

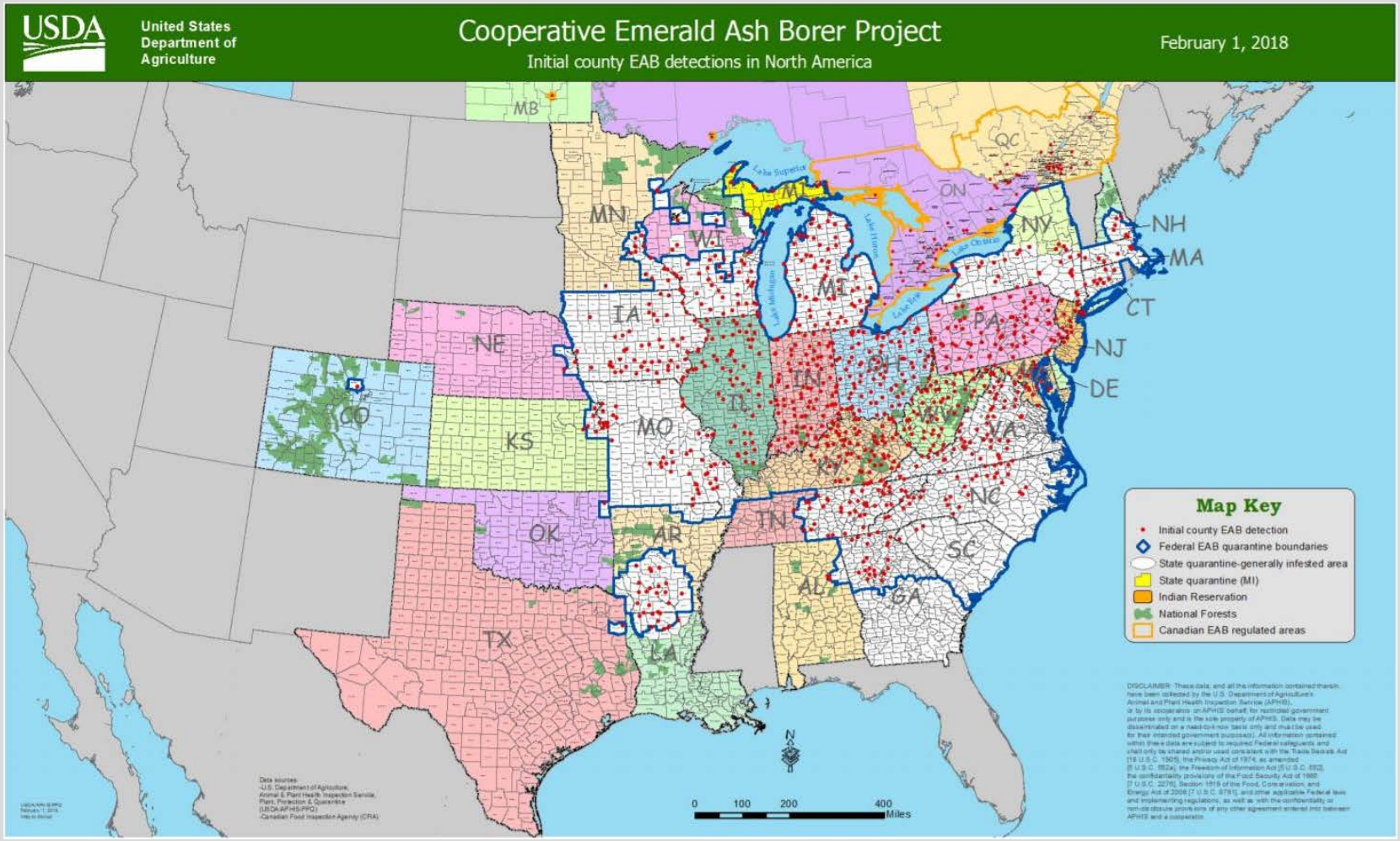
- Tools in the toolbox
  - Biotic – antagonists and/or inhibitory organisms
  - Resistance (plant selection)
  - Fungicides and Insecticides
  - Water/environment management
  - Sanitation

A few systems for discussion

- Ash/EAB
- Beech/BBD
- White Pine/WPBR
- Elm/DED
- Hemlock/HWA
- Walnut/TCD
- Butternut/butternut canker

Ash and Emerald Ash Borer

- Native trees
  - All 16 species
- Exotic Insect



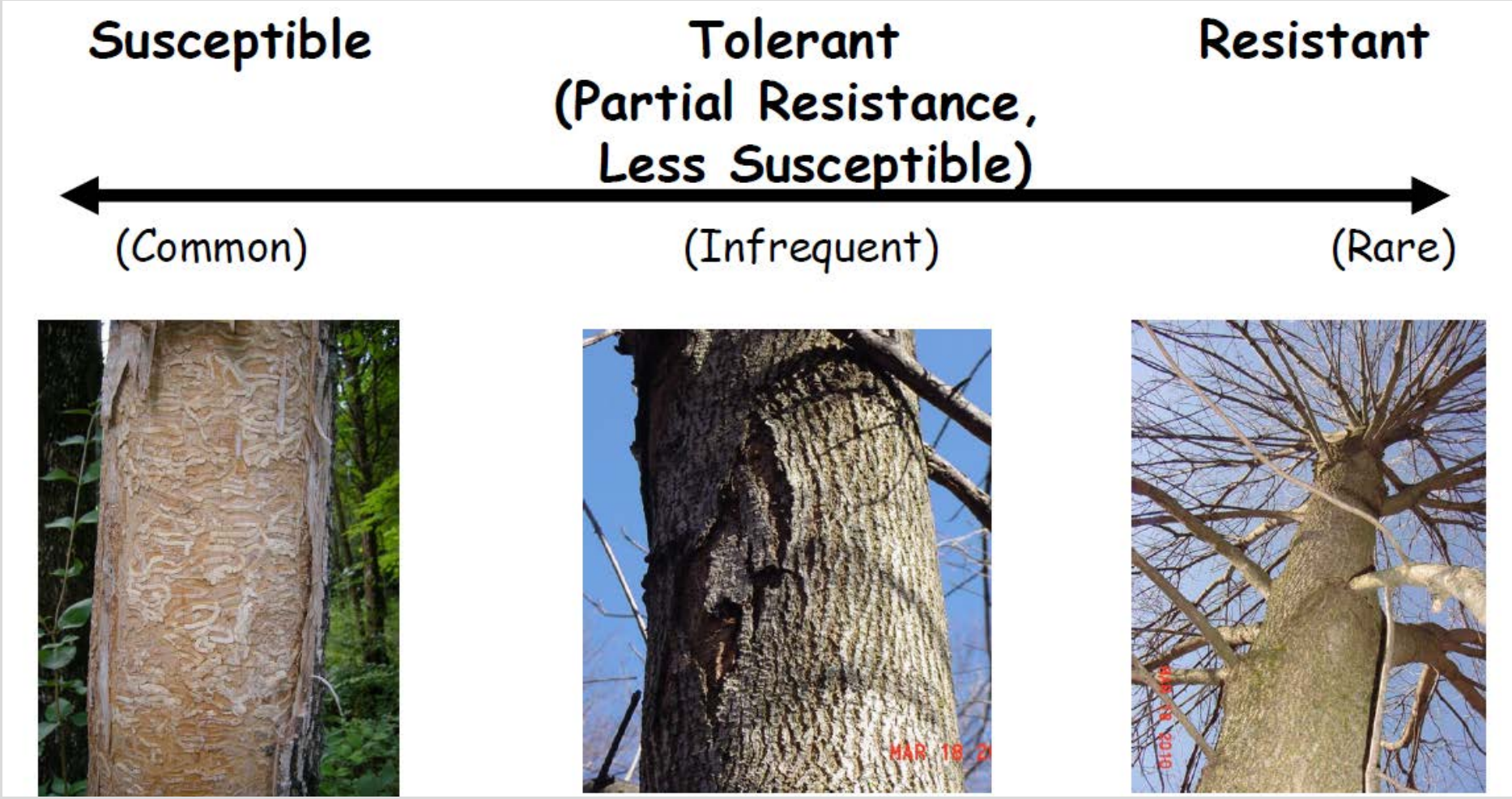
Ash and Emerald Ash Borer

- “Lingering Ash”
  - Various Academic and NRS Researchers
  - Rare, but not that rare - ~1-2%
  - Are they escapes?

Kathleen Knight

Ash and Emerald Ash Borer

- So we have survivors



Koch et al., 2018

Ash and Emerald Ash Borer

EAB Egg Bioassay

(assess resistance phenotype)

Coffee filter with eggs affixed to bark

Three grafted replicates of each genotype

Koch et al. method

Ash and Emerald Ash Borer

1 Year Bioassay of Lingering Ash

- Test ramets 2-3 years after grafting
- Non-destructive assessment
- Not as labor intensive

Lingering Ash

Larval outcome:

29% parasitized

37% woodpecker predation

7% exit hole (adult)

Host tree survival rate: 47%

Susceptible Controls

Larval outcome:

29% parasitized

35% woodpecker predated

17% exit hole (adults)

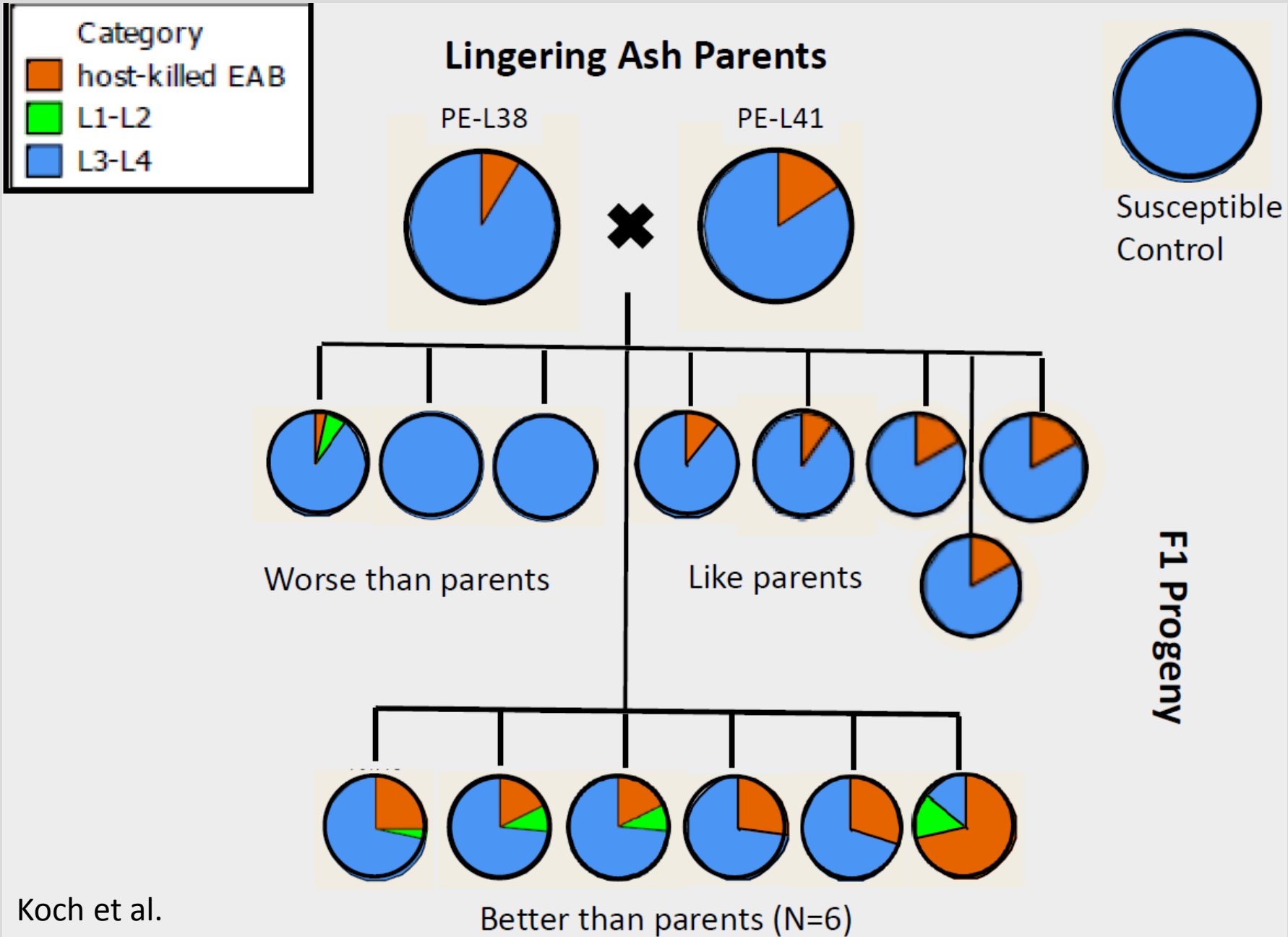
Host tree survival rate: 26%

2.3 fold higher rate of survival!

*More evidence that biocontrol alone won't work!

Koch et al., 2018

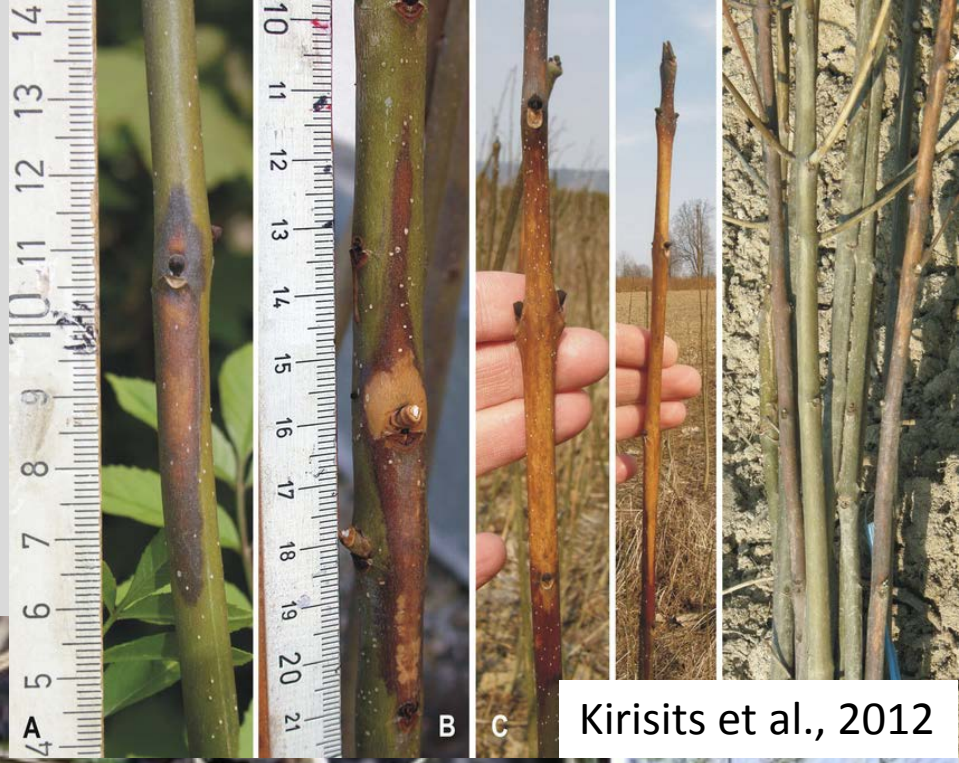
Ash and Emerald Ash Borer



Koch et al.

Future Ash Threats

- Ash Dieback?
  - Chalara dieback
  - *Hymenocyphus fraxineus*

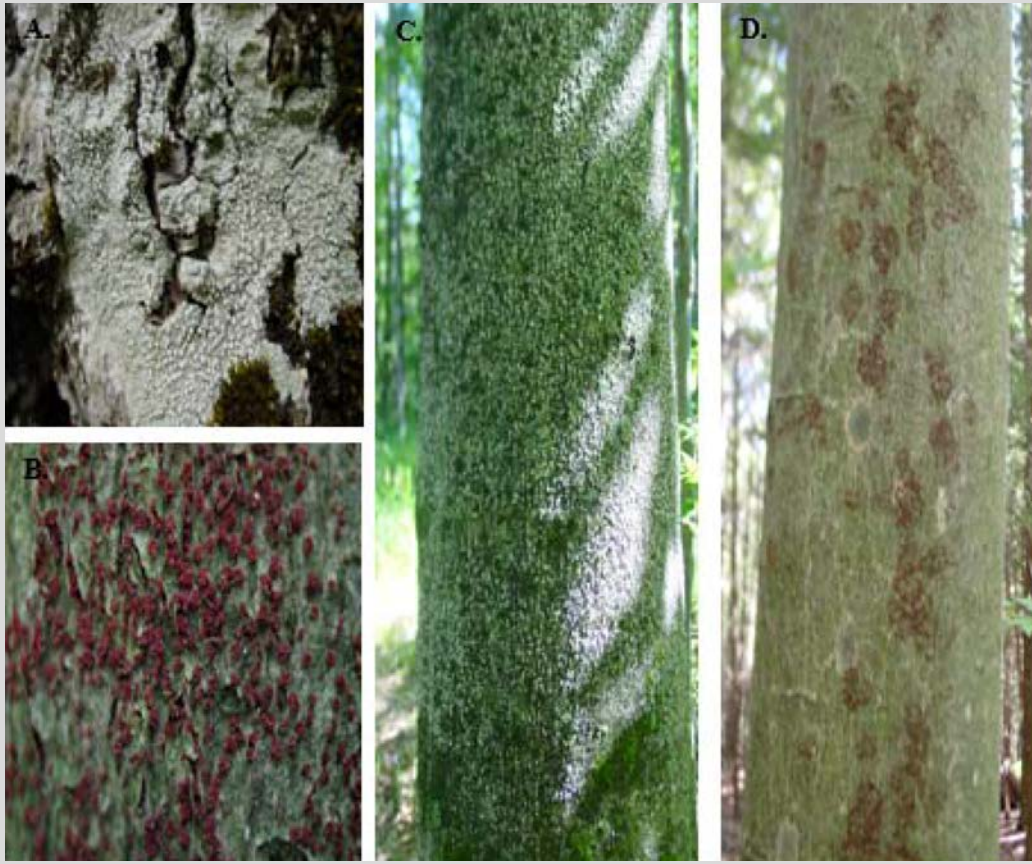


Kirisits et al., 2012

McMullan et al., 2018

Beech and Beech Bark Disease

- Native Tree
- Exotic Insect
- Exotic and Native Fungi
- Introduced in 1890
  - Kind of a slow mover



Stephenson and Coe, 2017

Beech and Beech Bark Disease

- Much like Ash/EAB
  - Lingering trees
- Resistance is key…but resistance to what?

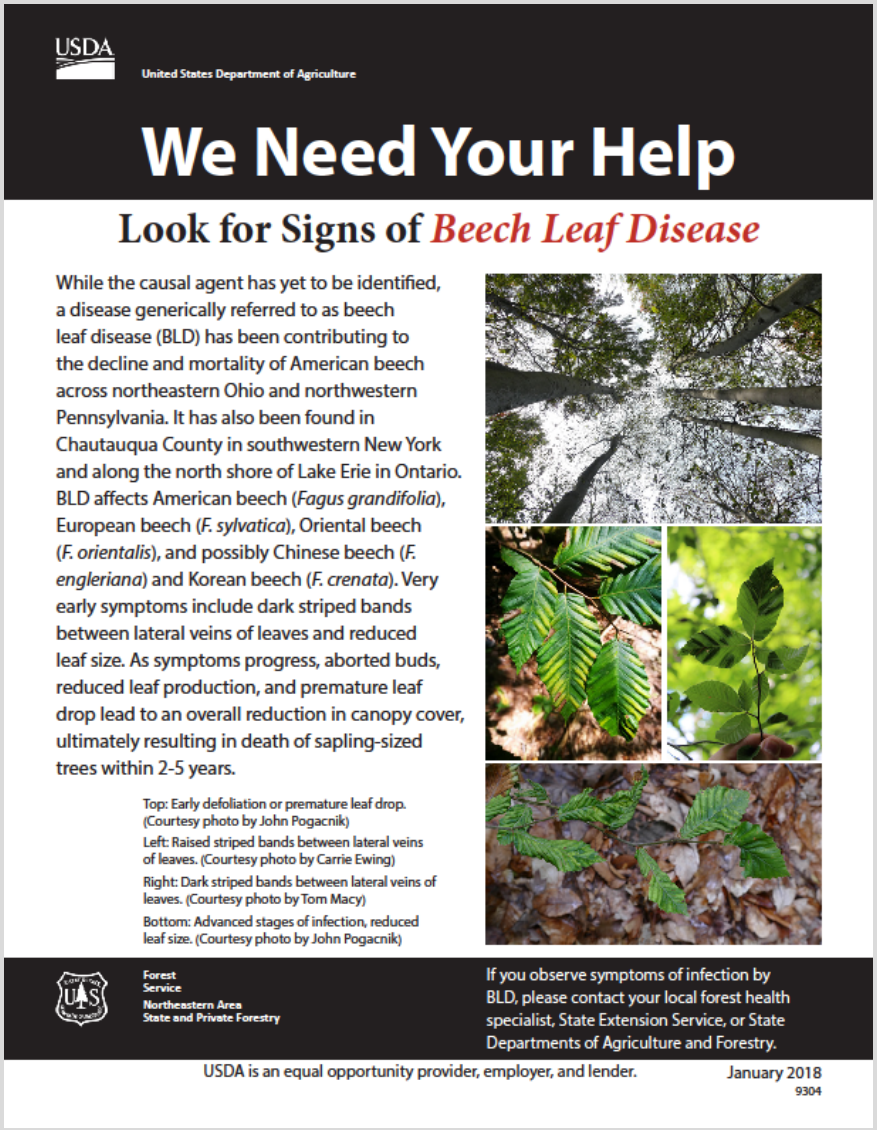
Koch and Carey, 2014

Beech and Beech Bark Disease

- Jennifer Koch et al. have found what appears to be durable
- Current planting in MI and other states

Future Beech Threats

- Beech Leaf Disease
- First observed in Ohio in 2012
- Little known
- Currently in Ohio, Pennsylvania, New York, and Ontario



USDA
United States Department of Agriculture

We Need Your Help

Look for Signs of *Beech Leaf Disease*

While the causal agent has yet to be identified, a disease generically referred to as beech leaf disease (BLD) has been contributing to the decline and mortality of American beech across northeastern Ohio and northwestern Pennsylvania. It has also been found in Chautauqua County in southwestern New York and along the north shore of Lake Erie in Ontario. BLD affects American beech (*Fagus grandifolia*), European beech (*F. sylvatica*), Oriental beech (*F. orientalis*), and possibly Chinese beech (*F. engleriana*) and Korean beech (*F. crenata*). Very early symptoms include dark striped bands between lateral veins of leaves and reduced leaf size. As symptoms progress, aborted buds, reduced leaf production, and premature leaf drop lead to an overall reduction in canopy cover, ultimately resulting in death of sapling-sized trees within 2-5 years.

Top: Early defoliation or premature leaf drop. (Courtesy photo by John Pogacnik)
Left: Raised striped bands between lateral veins of leaves. (Courtesy photo by Carrie Ewing)
Right: Dark striped bands between lateral veins of leaves. (Courtesy photo by Tom Macy)
Bottom: Advanced stages of infection, reduced leaf size. (Courtesy photo by John Pogacnik)

Forest Service
Northeastern Area
State and Private Forestry

If you observe symptoms of infection by BLD, please contact your local forest health specialist, State Extension Service, or State Departments of Agriculture and Forestry.

USDA is an equal opportunity provider, employer, and lender.

January 2018
9304

Future Beech Threats

Elm and Dutch Elm Disease

- Exotic pathogen
- Native trees
- Incredible damage

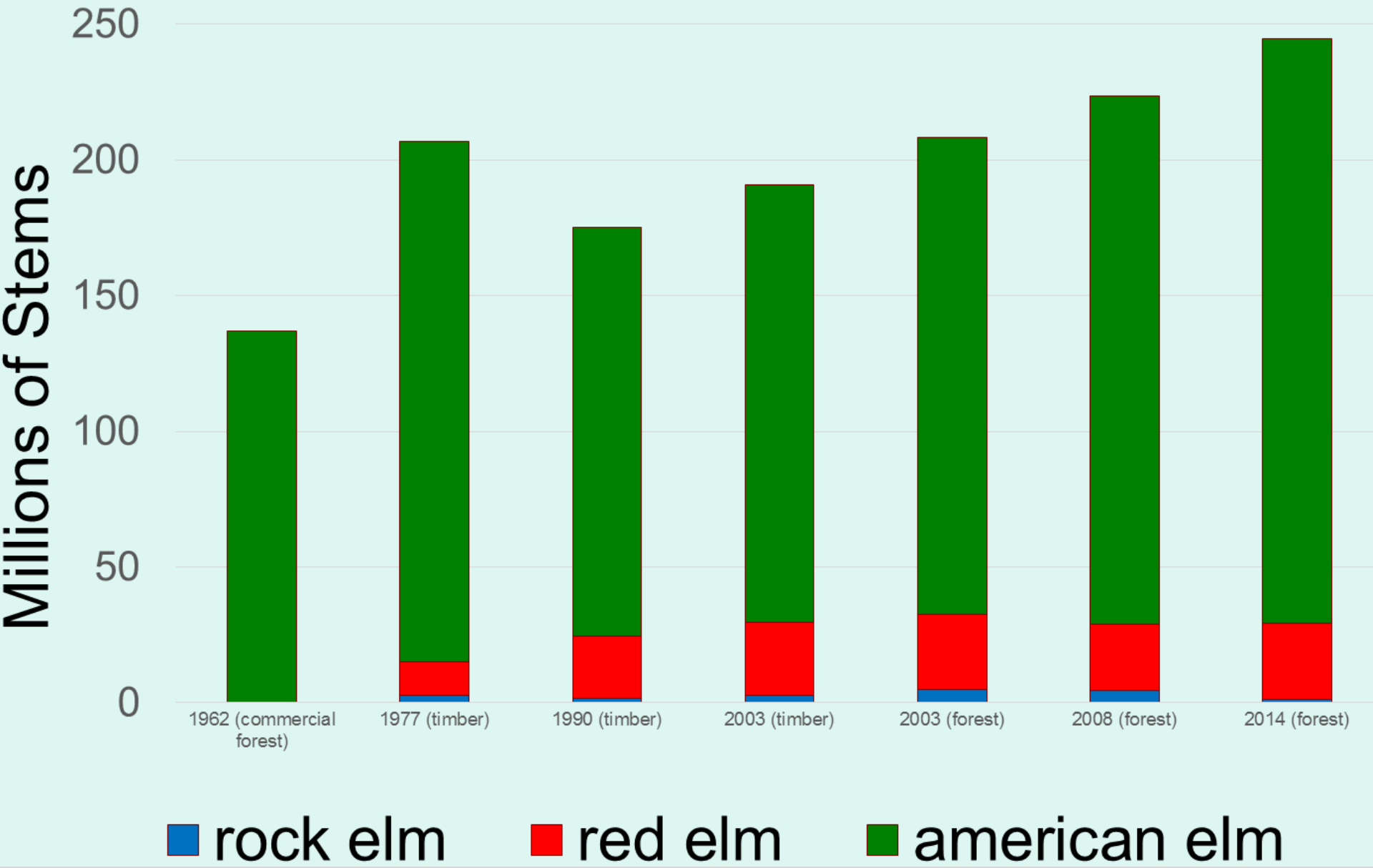
Elm and Dutch Elm Disease

In 1977: 1,300,000 American elm trees greater than 21” in diameter.

In 2014: 57,000 American elm trees greater than 21” in diameter in Minnesota.

Over 95% of the BIG trees gone.

Estimated Stems of Elm in Minnesota (FIA data)



Elm and Dutch Elm Disease

- Elm present after disease moved through may have tolerance or resistance.

Princeton	Highly available
Valley Forge (Amer. 3)	Moderately to highly available.
New Harmony (Amer. 680)	Low to moderately available.
Lewis & Clark 'Prairie Expedition' TM	Limited availability
Jefferson (N3487) (triploid)	Beginning availability
American Liberty (W502, W503, W505, W507, W510, and M-8)	Only through the Elm Research Institute (ERI).
Independence (W510)	Yes, as part of American Liberty
Delaware 2 (Delaware)	Not commercial
R18-2	Not commercial
St. Croix	MN selection

Opportunity: DED tolerance enriched Seed

DED tolerant elm trees at a Forest Service research site in Delaware, Ohio.

Survived inoculation with DED, and are now producing seed.

Seed was collected in Spring 2012.

Open pollinated. One parent is known DED tolerant, second parent is unknown. However, trees are growing in a cluster of DED tolerant trees

Operational Trials Site details

Agency	Site name	year planted	Description	details of site, planting
ACoE	Gores (Goodhue County)	June 2013, flooded after planting	Mississippi bottoms	56 acres. Cut in 2012. Planted 1600 elm seedlings, with swamp white oak and black walnut.
WiDNR	Pine Creek (Pierce County)	late May 2013 and Spring 2014	Floodplain along a restored trout stream	4 acres; 550 elm plus 700 swamp wh… r oak, and 700 black walnut. 300… 2014, with walnu…
MnDNR	Eggleston (Red Wing)	Late July 2013	Mississippi bottoms	Se… e flo… pla…
WiDNR	Coon Creek	June 2013	Floodplain along trout stream	200 e… …te oak.
IaDNR	Little Paint Creek	May 2013, flash flooded in June	Floodplain along trout stream	Old crop … 975 elm seedlings, interplanted with swamp white oak and river birch.
WiDNR	Avon Bottoms	2014	Floodplain along Sugar River.	800 2-0 elm planted, along with River Birch, Swamp White Oak, and Sycamore.
ACoE	Trimbelle (Pierce County)	2014	Floodplain along Trimbelle River	Field with reforestation lanes, 825 elm seedlings. Interplant with hackberry and swamp white oak

5400 elm trees planted, plus other species

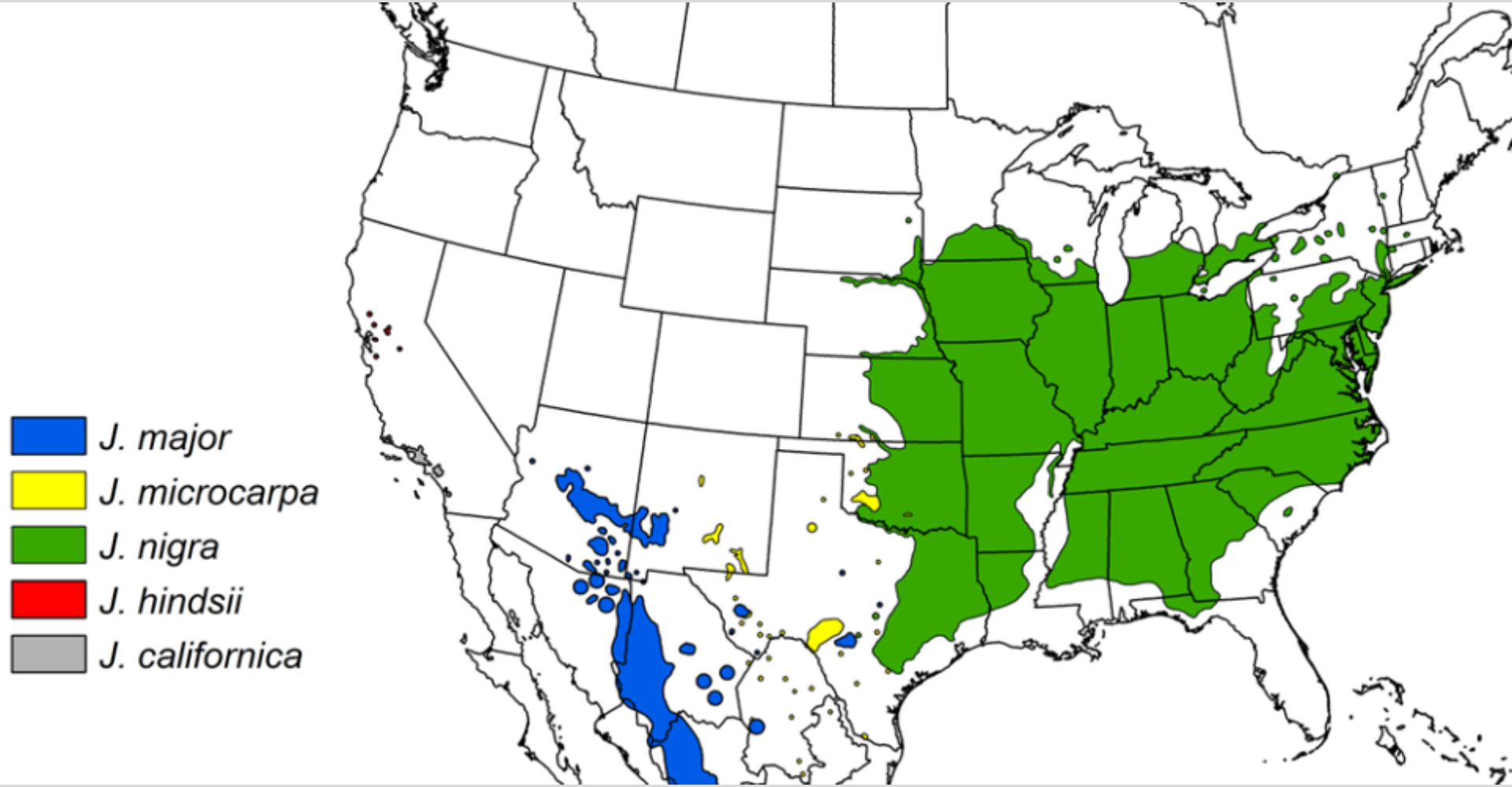
Elm and Dutch Elm Disease

- IPM
  - Monitoring
  - Maintain plant health (including injections)
  - Diseased tree removal and disposal
  - Utilize tolerant/resistant stock

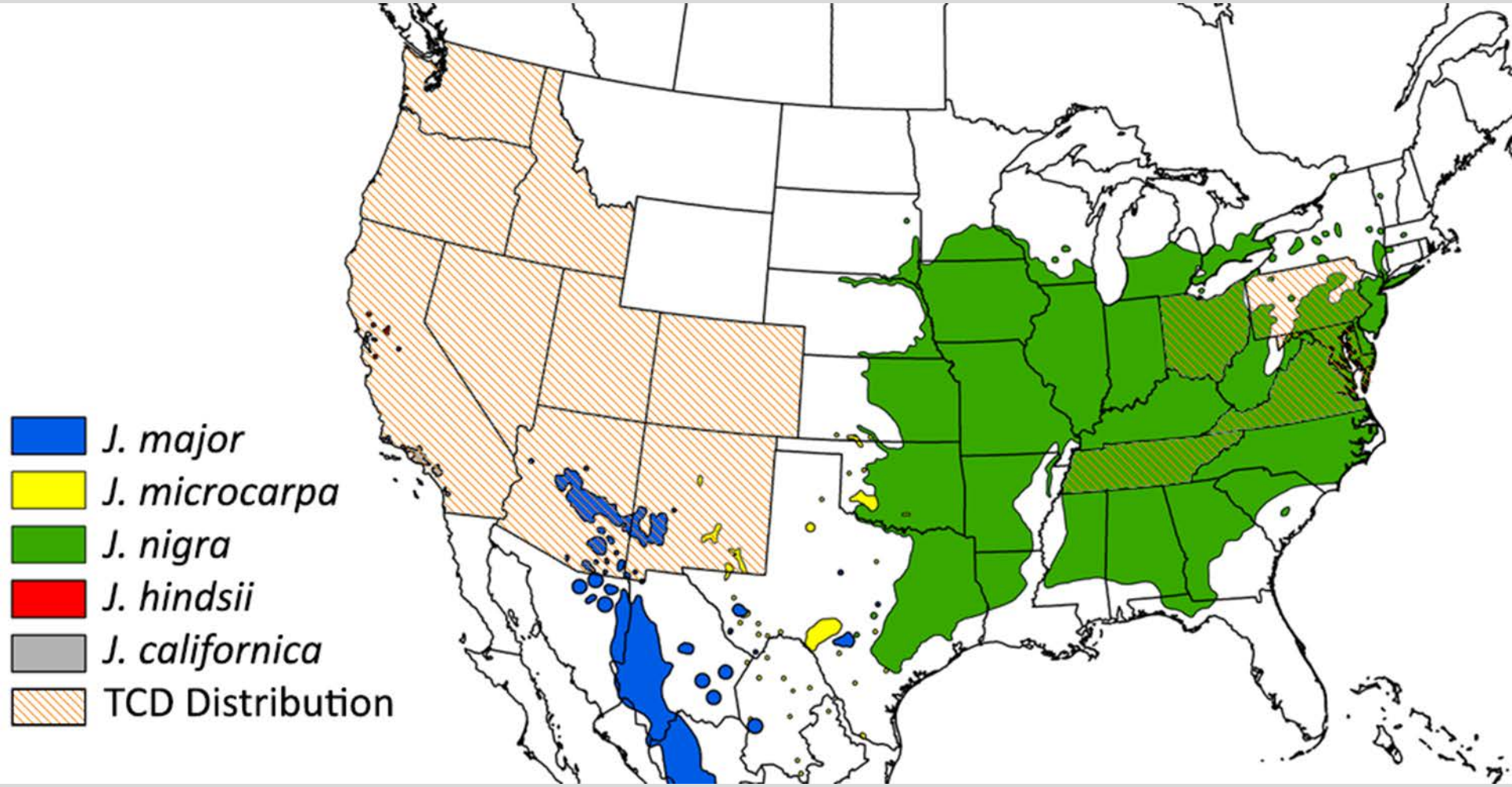
Walnut and Thousand Cankers Disease

- Native Insect. Native Disease?
- Native Trees

Walnut and Thousand Cankers Disease



Walnut and Thousand Cankers Disease



Comparative TCD Symptoms: *Juglans major* vs. *J. californica/regia*

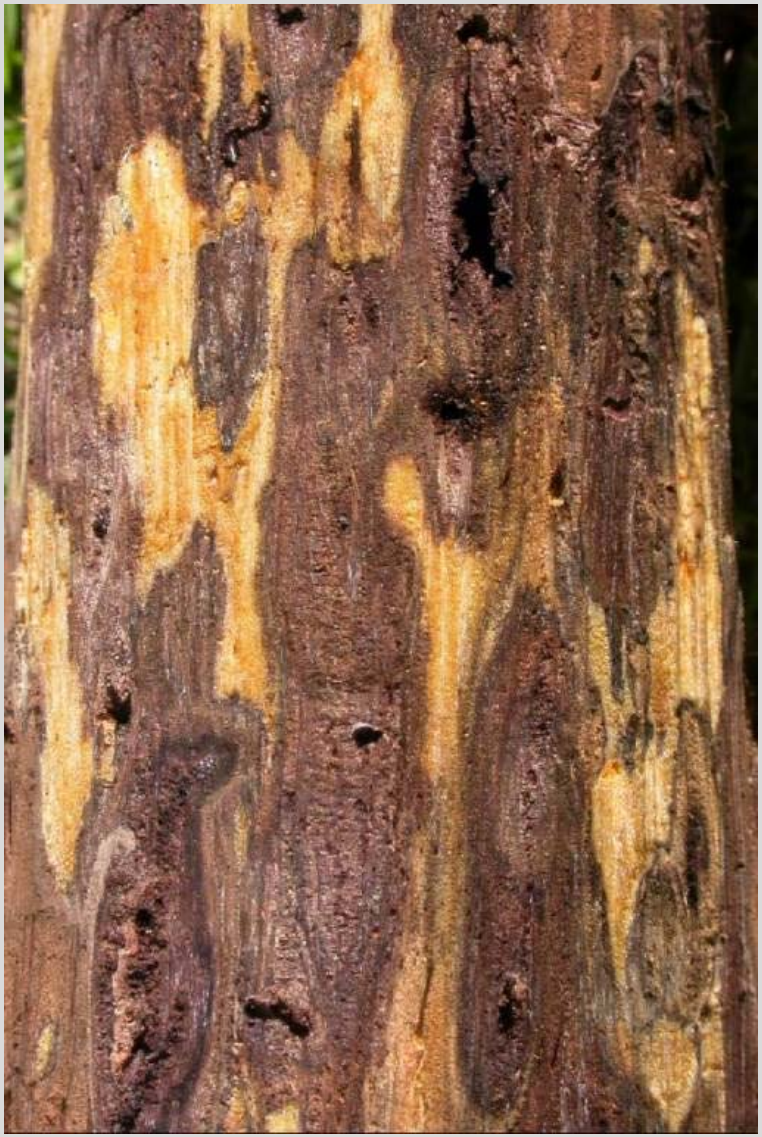
Juglans major
(southern NM)

Sporadic cankers, minimal staining on bark surface

Juglans californica/regia
(northern CA)

Numerous cankers, prolific staining on bark surface

Comparative TCD Symptoms: *Juglans nigra*



Colorado State Univ

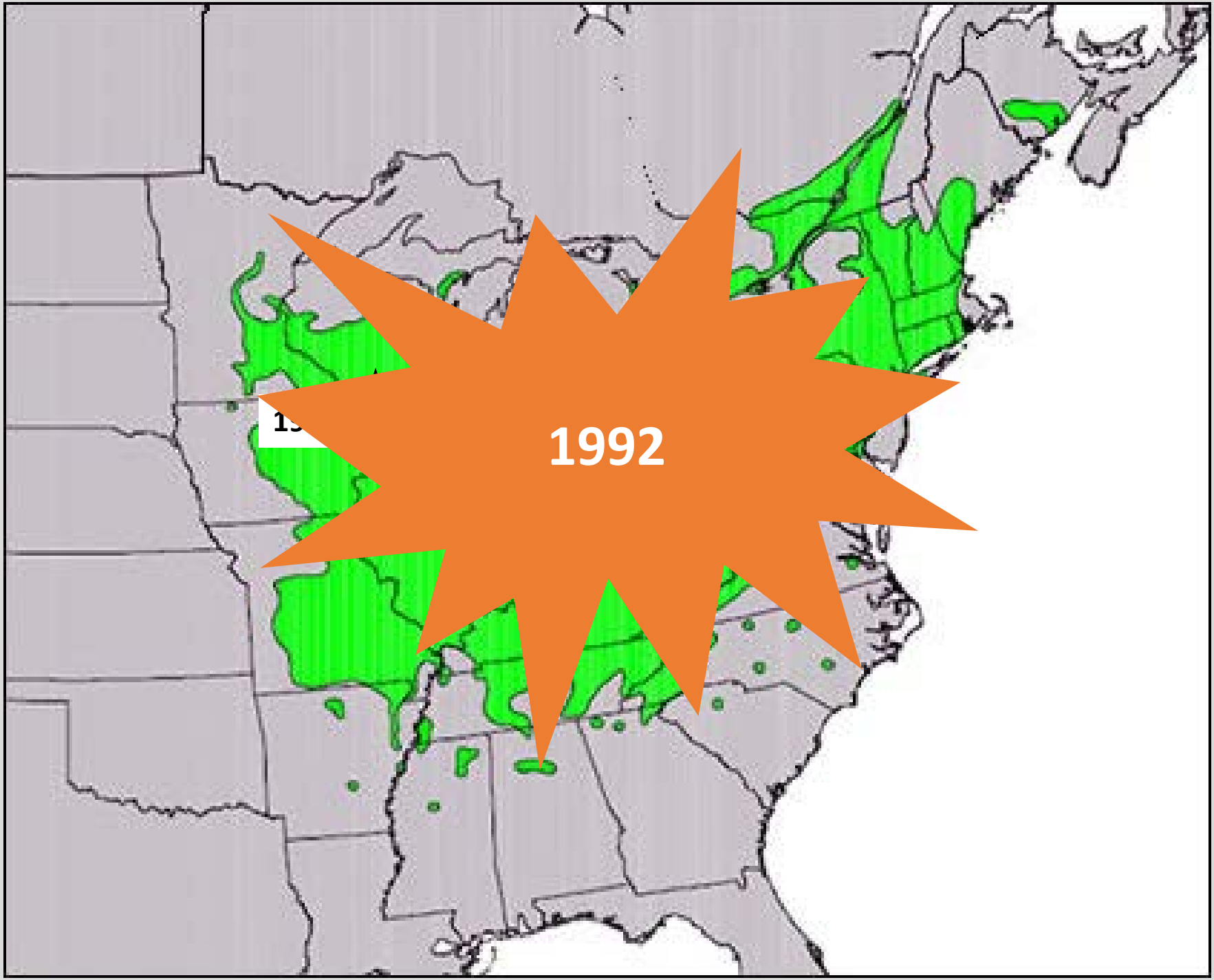
Walnut and Thousand Cankers Disease

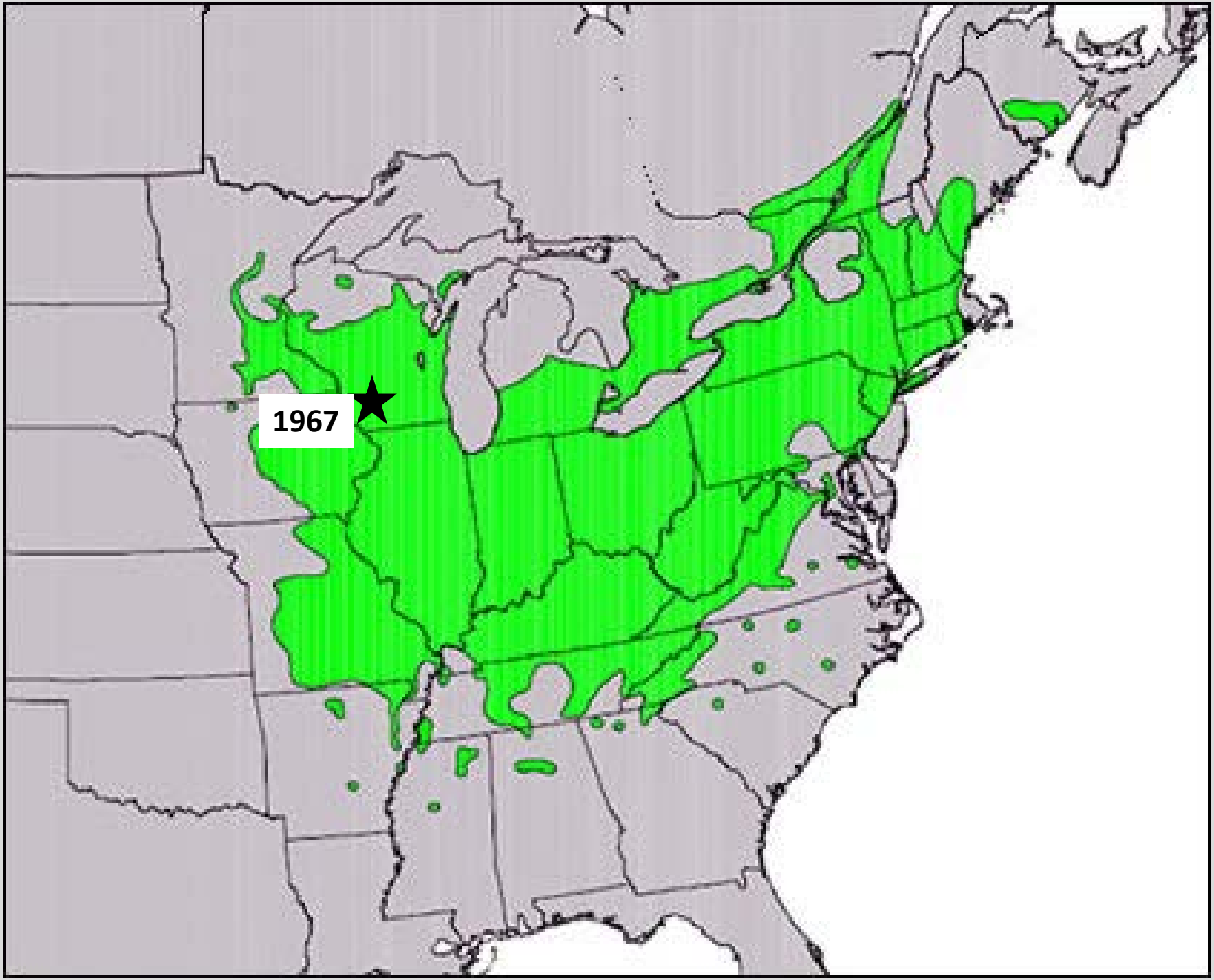
- Detection surveys being conducted
- Quarantines in place
- No significant mortality observed
- Will TCD be a threat in Eastern Walnut?

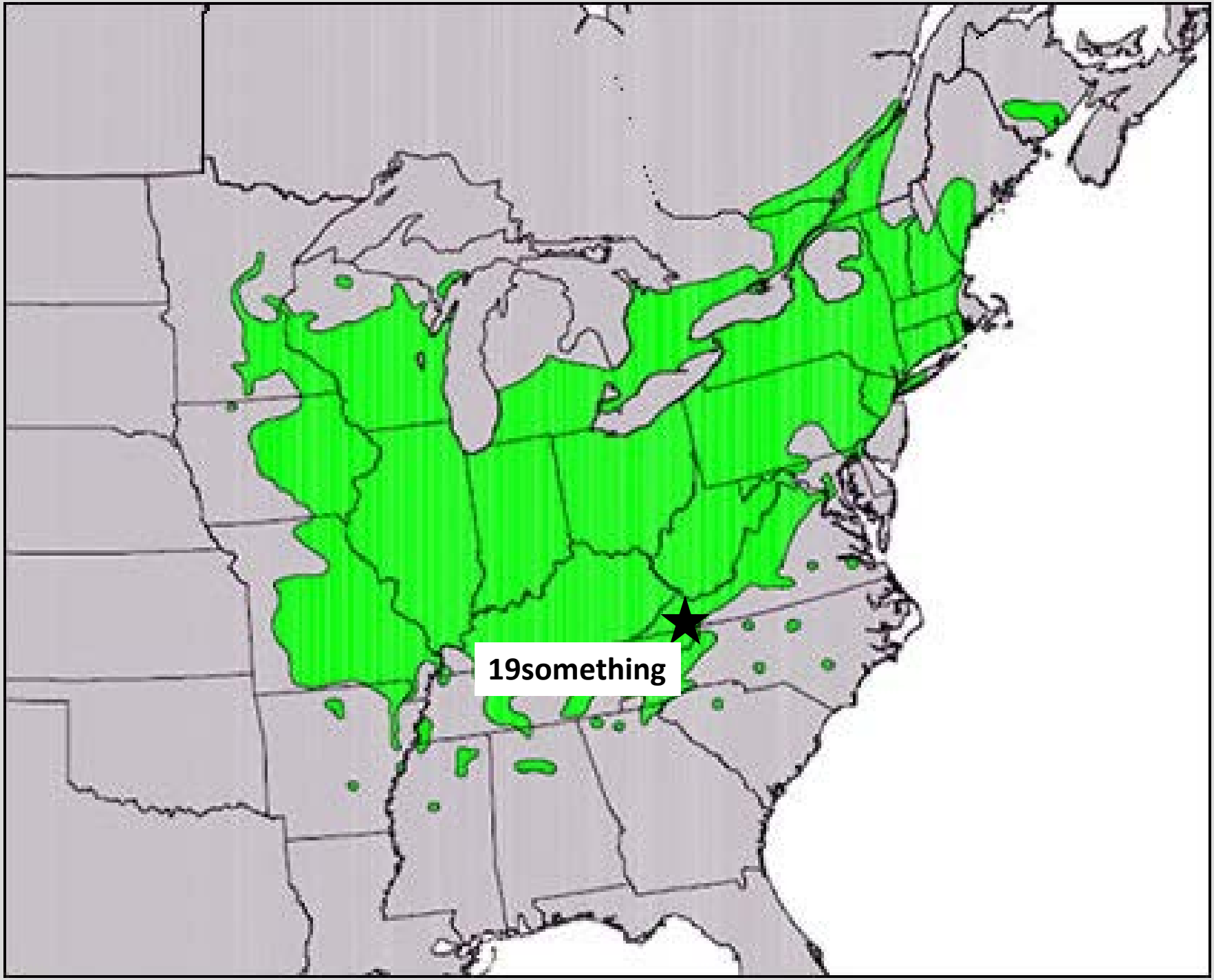
Colorado State Univ

Butternut and Butternut Canker

- Exotic Pathogen?
- Native Tree
- Mast producer, high quality/high value wood when available
- Variety of historic uses


1992


1967


19something

Butternut and Butternut Canker

Butternut and Butternut Canker

- Is it Genetic?
  - Ostry and Moore, 2008; McKenna et al., 2011
  - LaBonte et al., 2015
- Is it Environment?
  - Upland v lowland? McKenna and LaBonte documented decreased incidence and severity
- Close proximity between healthy and sick

Future/Current Threats to Butternut

- Hybridization….valuable?
- TCD susceptible
- Forestry practices inadequate to regenerate

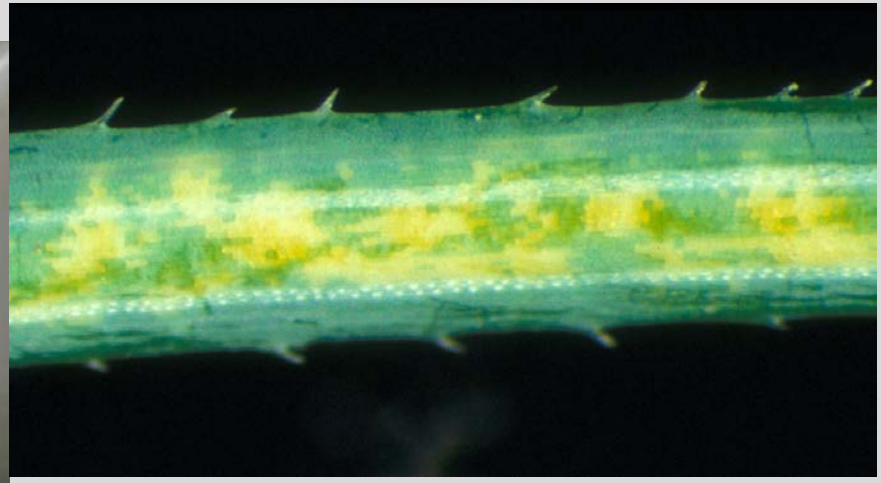
Philip Stouffer/LSU

EWP and WPBR

- Exotic pathogen
- Native trees
- Introduced to both coasts in early 20th century

EWP and WPBR

EWP and WPBR



EWP and WPBR

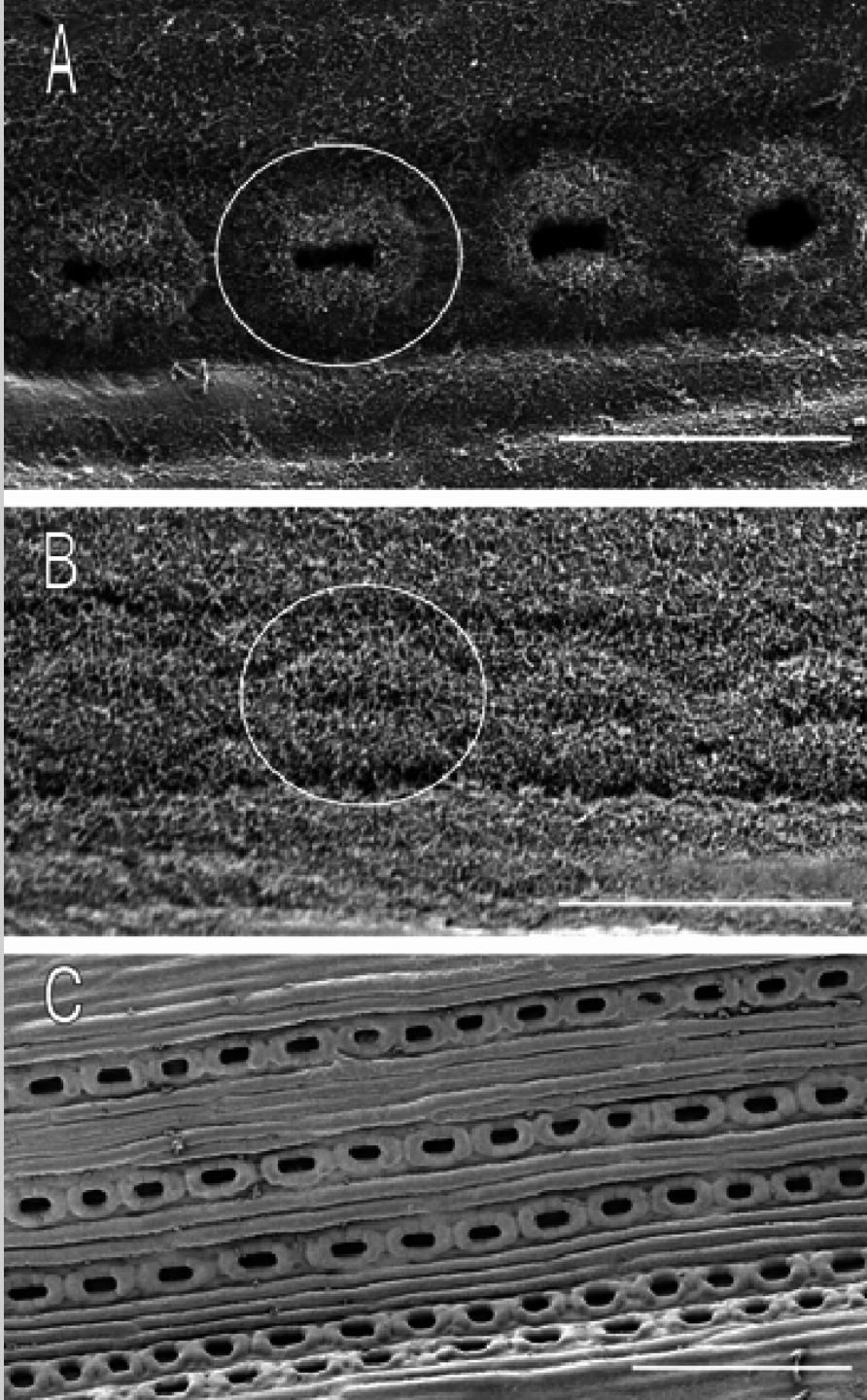
EWP and WPBR

Symptoms	2010	2011	2012	2013
% with foliar spot	94%	99%	99.5%	78%
1st year survival	95%	72%	88%	99%
2nd year survival	39%	34%	29%	42%
2^{nd} year H^2_{fam} (SE)[1]	0.86 (0.043)	0.80 (0.069)	0.81 (0.037)	0.83 (0.04)
2^{nd} year h^2_{ind} (SE)[2]	0.84 (0.237)	0.33 (0.12)	0.75 (0.148)	0.90 (0.184)
P-327: % survival	81%	72%	58%	75%
H-111: % survival	6%	24%	12%	21%

Pike et al., 2018

EWP and WPBR

- “Resistant standard”
  - Commercially available
- Some small percent of all 5-needle pines are resistant
- Field testing of selections ongoing



EWP and WPBR

- Other treatment options
  - Pathological Pruning
  - Avoid high hazard sites

****The use of trade names is for the convenience of the reader and does not imply official endorsement or approval by the USDA or the Forest Service of any product to the exclusion of others that may be suitable.****

- In
- Ca

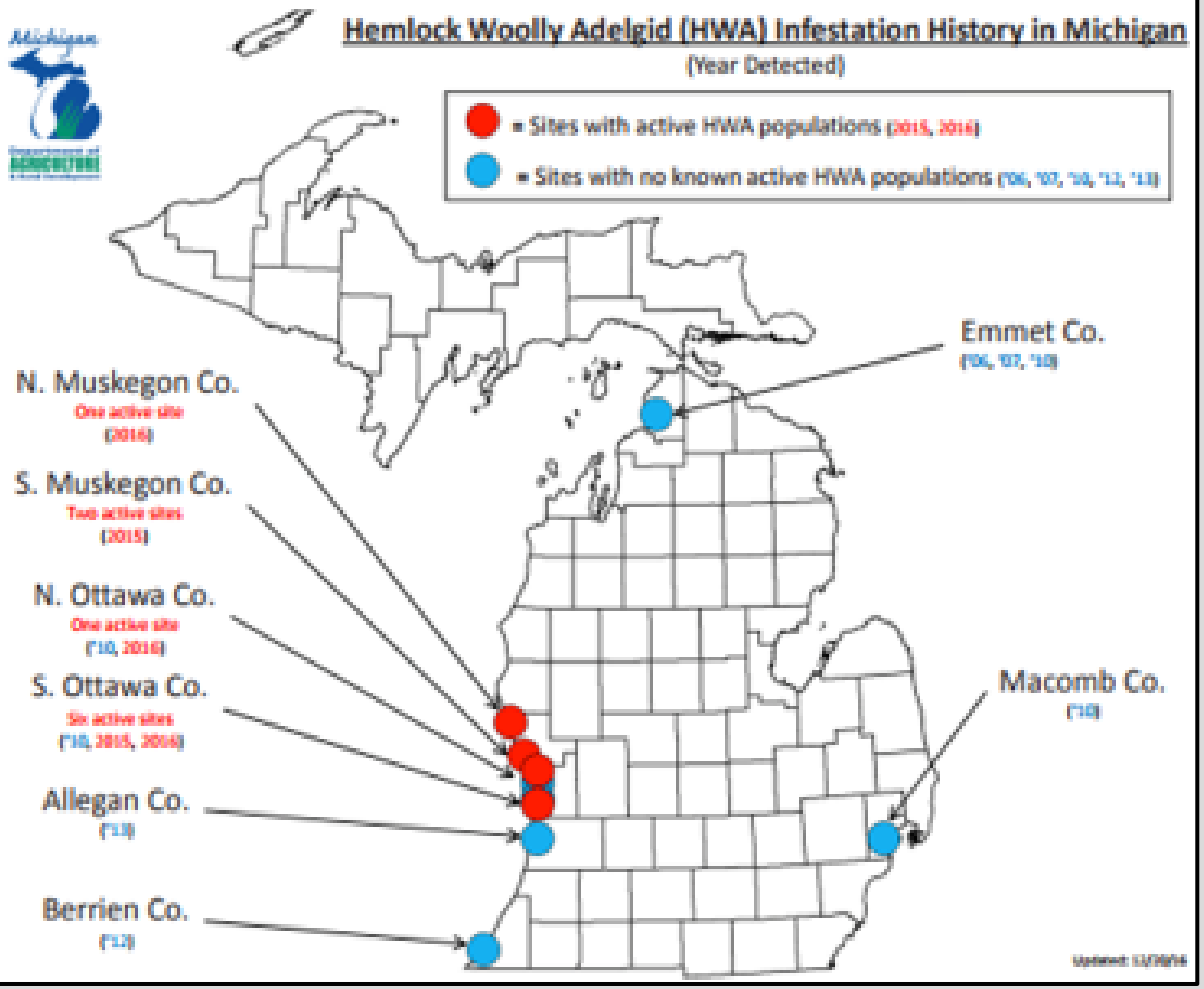
Hemlock and HWA

- Exotic Insect
- Native Host
- First detection in Virginia 1950s
- Eastern and Carolina Hemlock affected

Hemlock and HWA

HWA: the extent

MDARD map showing HWA infestation history in Michigan. Year listed is the year infestation was detected. **Shows sites with active infestations in red while eradicated sites are shown in blue.**



Hemlock and HWA

- **Prevent** HWA by maintaining, enforcing, and updating as needed existing internal and external state quarantines that will limit the likelihood of moving infested nursery stock and cut hemlock materials;
- **Detect** HWA populations by developing and implementing a HWA survey plan
- **Manage and use field data** via a GIS-based HWA data management system that provides a common platform for data and information sharing
- **Implement insecticide treatments** for HWA to the greatest extent possible with highest priority to slowing the spread, regardless of land ownership
- **Conduct research** via partnerships including hemlock models, climate-based HWA dispersal models, and consequences of treatment and restoration alternatives, including not coordinating treatments
- **Establish long-term funding** mechanisms adequate to achieve the goal and objectives of this plan.

Hemlock and HWA

- Silvicultural management should include IPM
  - Insecticide, bio-control, gene con, host resistance?
- Increased sunlight may decrease HWA on seedlings
- Detection is key

USFS

“The use of resistant varieties is the cheapest, easiest, safest and most effective means of controlling plant diseases in crops for which such varieties are available”

George Agrios, Plant Pathology, 2005