Nature Center Summit

February 14, 2020

Oak Wilt

Oak Decline

Hemlock Woolly Adelgid

Asian Longhorned Beetle

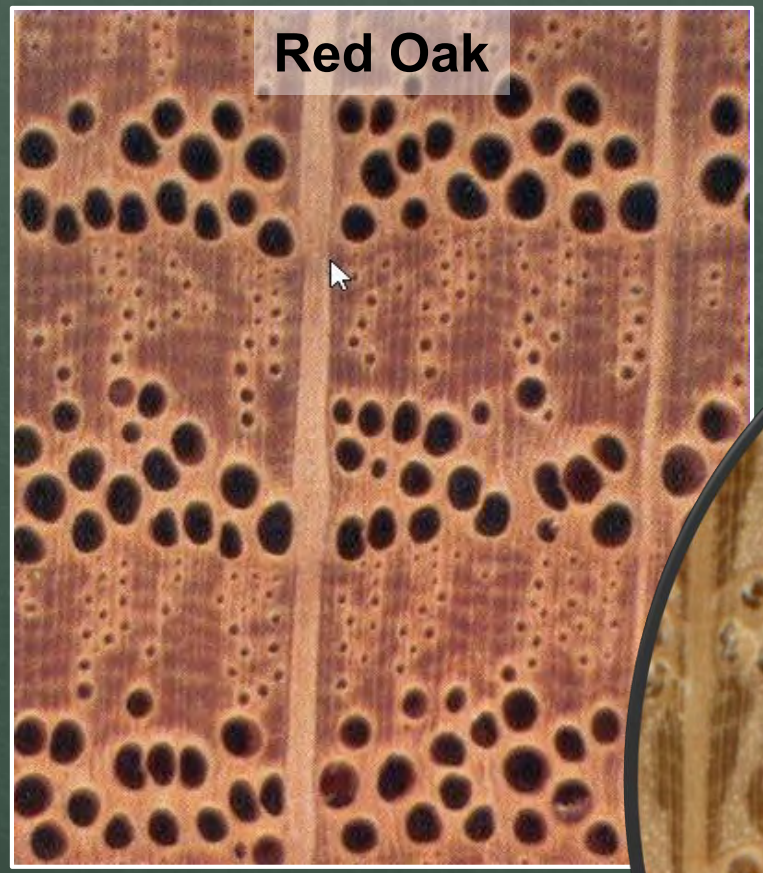
Importance of Oak Trees

- Acorns are an important food source for many wildlife species
- Oaks are abundant and important landscape trees in urban areas
- Annual value of oak stumpage exceeds $10 million (10% of the forest volume in the state)

Oak wilt is a vascular wilt disease caused by the fungus *Bretziella fagacearum*

- One of the most serious tree diseases in the eastern United States, killing thousands of oaks each year
- Oak wilt was first identified in Michigan in the 1940's. The extent of its impact wasn't realized until the1980s.
- Oak wilt has recently been reclassified as an exotic disease

- Affects vascular tissue of the tree (xylem) impeding its ability to transport water
- Red oaks more vulnerable than white oaks
- White oaks can become infected but are rarely killed (less vulnerable and more resistant)



Why are white oaks rarely killed?

- White oaks produce a bubble-like structure called “tyloses”
- Makes wood almost impervious to liquids; slows the spread of the oak wilt fungus


MWP CUBA, MO
MED. TOAST

Symptoms:

- Wilting and premature defoliation beginning at the upper branch tips and moving down the tree
- Rapid leaf drop during the summer going from healthy green leaves to bare canopy within 6 weeks

Impact of oak wilt in Ogemaw County.

Wilting of the leaf beginning at the outer margins and moving inward

Discoloration of the vascular tissue

Spore Mats / Pressure Pads

Generally produced only in the year following tree mortality

Spore Mats / Pressure Pads

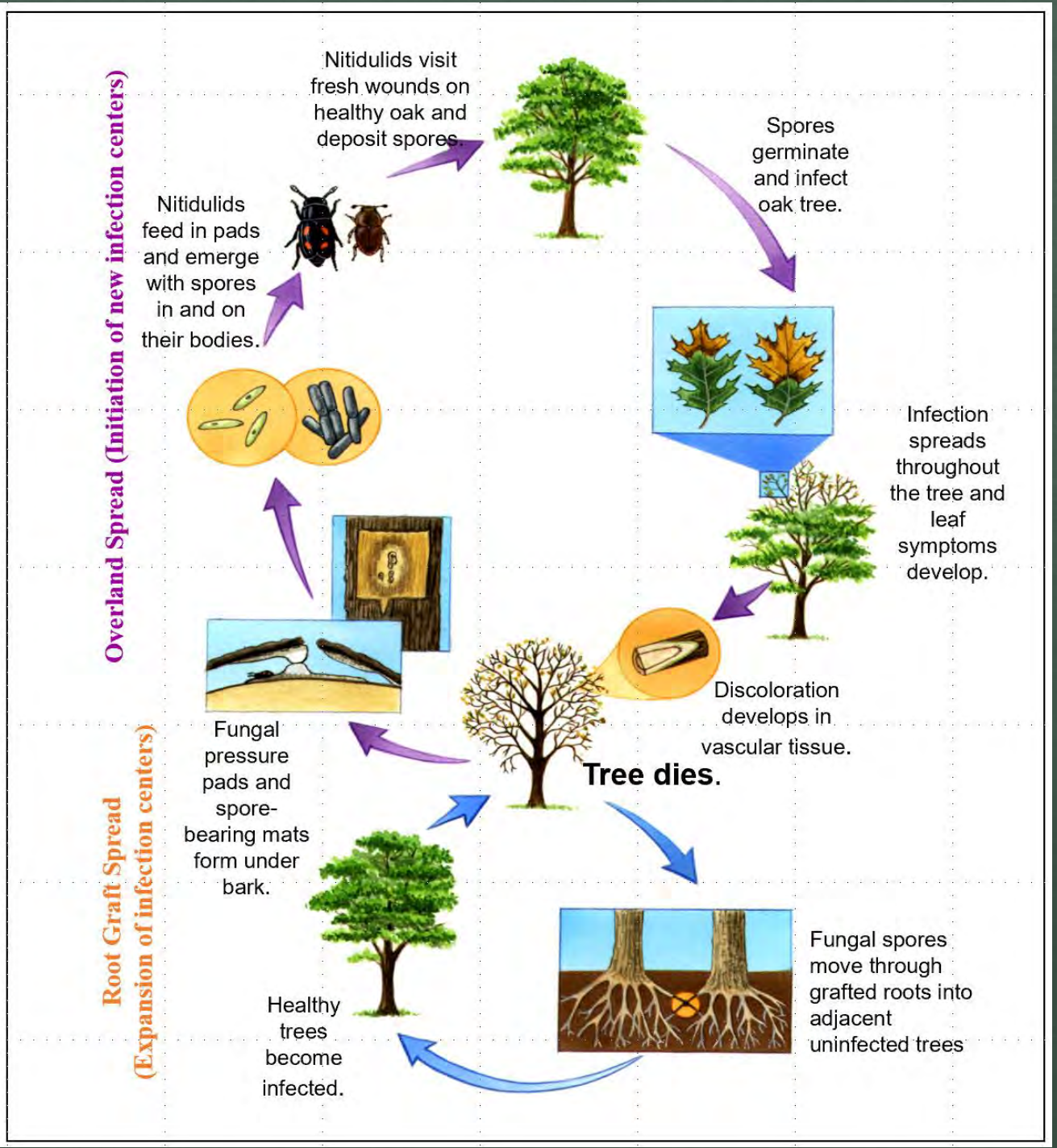
Generally produced in the year following tree mortality

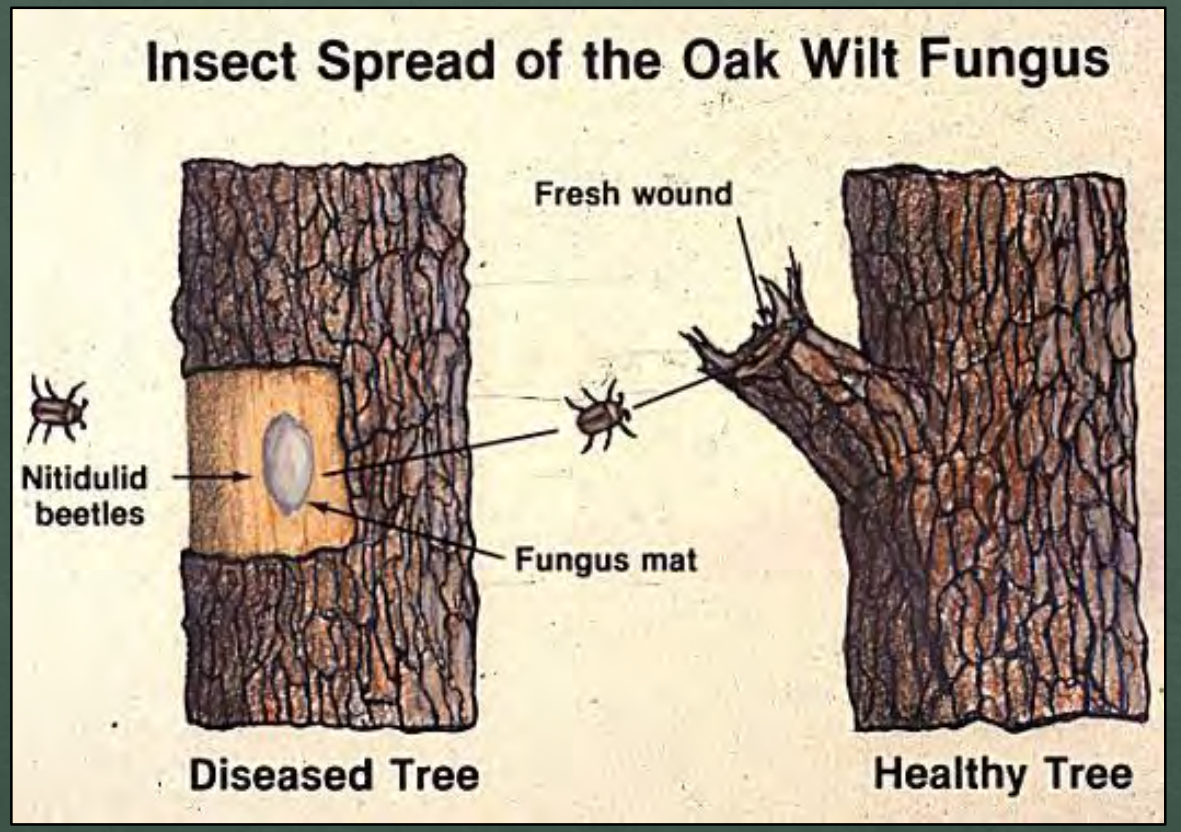
Transmission:

Below ground
through root graphs

Above ground through sap-feeding nitidulid (picnic) beetles

PEOPLE!


Overland Spread (Initiation of new infection centers)
Nitidulids visit fresh wounds on healthy oak and deposit spores.
Spores germinate and infect oak tree.
Infection spreads throughout the tree and leaf symptoms develop.
Discoloration develops in vascular tissue.
Tree dies.
Fungal pressure pads and spore-bearing mats form under bark.
Nitidulids feed in pads and emerge with spores in and on their bodies.
Root Graft Spread (Expansion of infection centers)
Fungal spores move through grafted roots into adjacent uninfected trees
Healthy trees become infected.


Insect Spread of the Oak Wilt Fungus
Fresh wound
Nitidulid beetles
Fungus mat
Diseased Tree
Healthy Tree

Pathway Concerns?

Stumps of cut trees
probably not susceptible

Spread on nursery stock is unlikely

Never been reported in bare-root or container nurseries

Control and Prevention

- Do not cut or prune oak trees during the growing season from April 15 to July 15. This is when the adult beetles are most active and can spread the oak wilt spores to a wounded tree.

- If damage occurs or pruning is necessary during this time cover the wood with spray paint immediately. (latex paint is ok)

- Don’t move infected wood off-site without debarking, chipping or properly drying it. If this isn’t possible, use plastic tarps to cover the wood (to prevent access to flying insects) for at least one year.

Before oak wilt management is discussed, ***confirm*** that you have oak wilt!

- Have sample confirmed through testing by MSU's diagnostic lab
- A forest health specialist finding pressure pad

Treatment Options

To stop the spread of oak wilt **both** overland and underground routes of spread need to be disrupted.

Underground- Vibratory plowing uses a 5-foot plow blade to sever root grafts, disrupting the spread of the pathogen. Plow line location is determined by calculating root growth distance based on tree diameters and soil types.

Overland- Identifying and removing the spore producing trees will eliminate the source for the beetles. (Note that infected trees *that are removed* can still develop pressure pads and need to be disposed of properly)

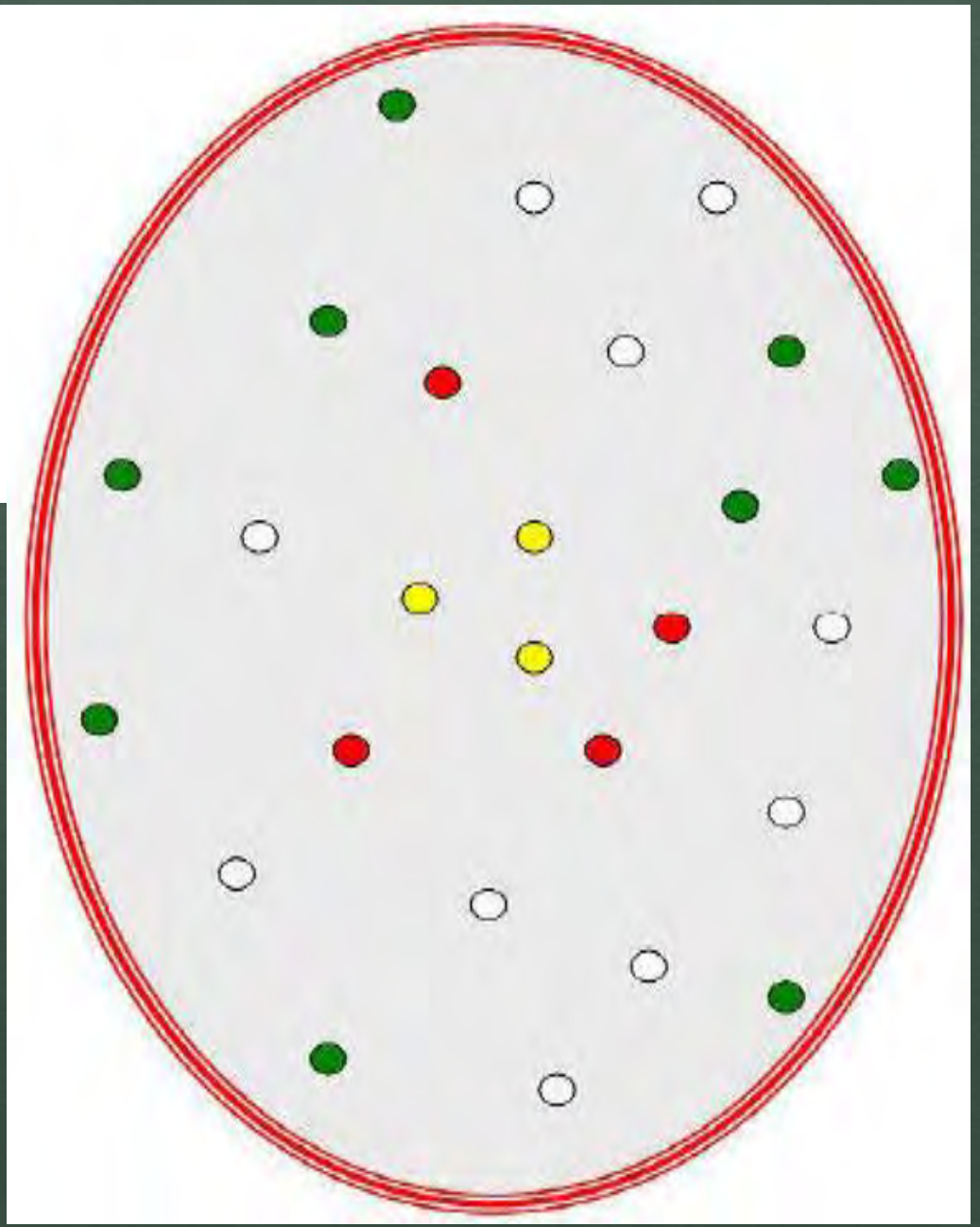
Determining plow line distance

Table 1. Determining the distance of the two barrier lines from an infected tree. Distance in feet is listed below the soil type.

Size of Two Trees Combined	95% Barrier Line		98% Barrier Line	
	Soil Type		Soil Type	
Combined DBH*	Loamy soil	Sandy soil	Loamy soil	Sandy soil
Inches	feet	feet	feet	feet
2	3	4	4	5
4	6	8	8	10
6	9	12	12	15
8	12	16	16	20
10	15	19	20	26
12	19	23	24	31
14	22	27	29	36
16	25	31	33	41
18	28	35	37	46
20	31	39	41	51
22	34	43	45	56
24	37	47	49	61
26	40	50	53	66
28	43	54	57	72
30	46	58	61	77
32	49	62	65	82
34	53	66	69	87
36	56	70	73	92
38	59	74	77	97
40	62	78	81	102
42	65	82	85	107
44	68	85	89	112
46	71	89	94	117
48	74	93	98	123

Diagram of an Oak Wilt Treatment Area

- Apparently healthy trees
- Dying & recently dead
- Dead 2+ years
- Non-oak trees
- Epicenter perimeter



Vibratory plow used to sever root graphs

Cut down spore producing trees

Fungicides: Can be used to prevent underground transmission of oak wilt symptoms on high value trees in residential and community areas.

Products containing ***propiconazole*** are injected into oaks in the spring and protection lasts up to two years. (Homeowners do not need to be licensed but if you hire someone they need to be licensed)

These fungicides cannot "cure" trees that are already infected.

Oak wilt persists in roots up to 5 years

Approximate cost to have someone treat your trees:

- $10-$12 per DBH inch
- At least 2-3 treatments spaced 2 years apart

Other Oak Wilt Look-Alikes

Anthracnose

A fungal leaf disease that affects oaks. It exhibits different patterns of brown tissue and can cause premature leaf drop

Occurs more often in spring when it is cool and wet, with symptoms disappearing with warmer and drier summer weather

Doesn't kill the tree just weakens it. White oaks are more susceptible than red oaks.

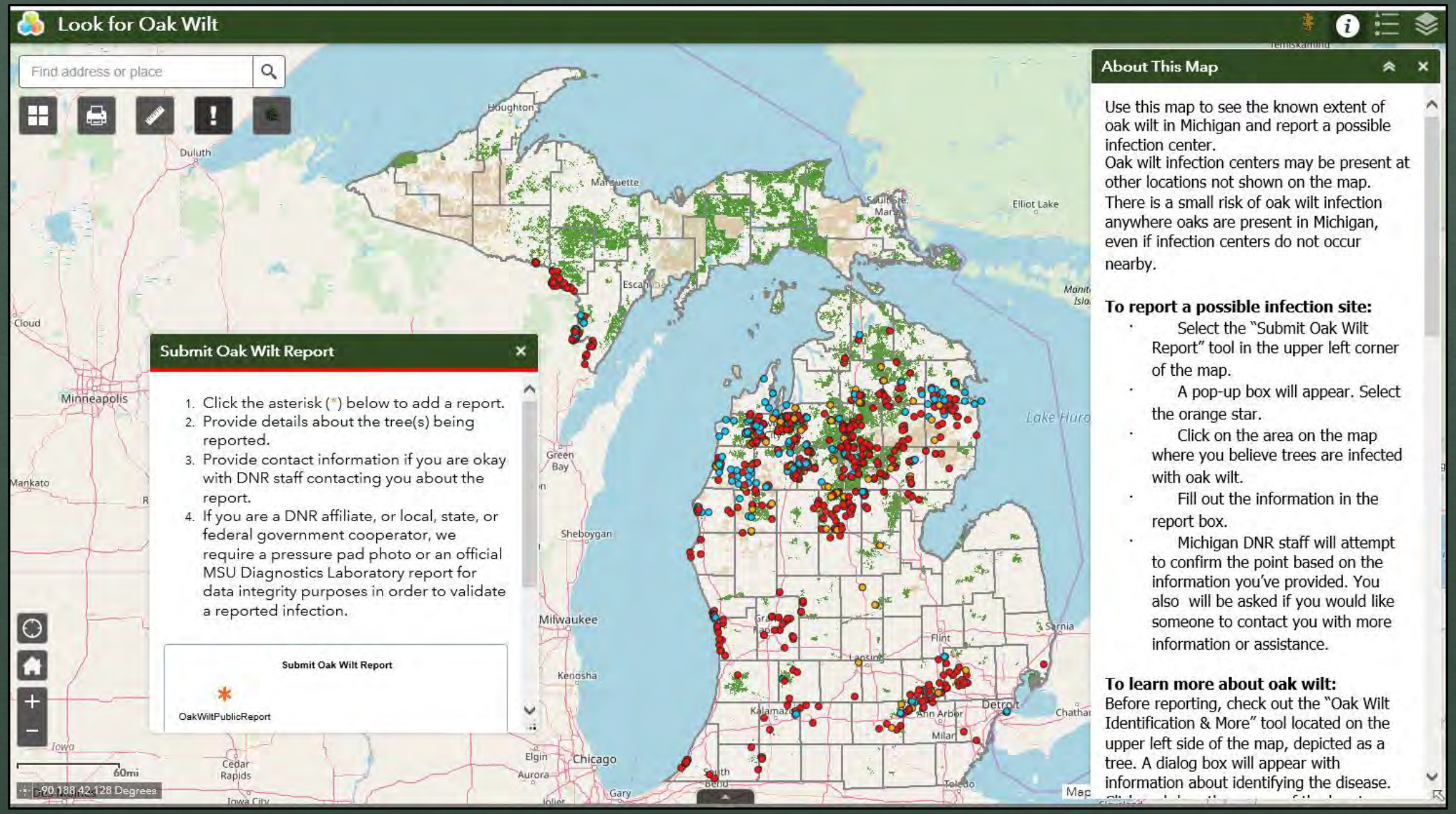
Bacterial Leaf Scorch

The bacteria invades the vascular tissue of the trees resulting in mortality over several years.

Browning leaves and leaf curl are caused by bacterial infections in the tree. Red oaks are more susceptible than white oaks.

MI DNR Oak Wilt Viewer: www.michigan.gov/foresthealth

Click on: ***VIEW AND REPORT OAK WILT LOCATIONS***



Look for Oak Wilt

Find address or place

Oak Wilt Identification & More

Oak Wilt

The oak wilt fungus was first identified in Michigan in the 1940s. Since then, it has affected many state parks, recreation areas, state forest campgrounds and other forested areas or sites as well as urban landscapes.

Oak wilt is a vascular disease that affects the tree's ability to transport water, causing the tree to wilt, and die quickly.

Oak Tree Species

Oak trees are deciduous, which means they lose their leaves on an annual basis. Oak trees are valued as an important source of food for many wildlife species as well as for their high quality wood.

Red and white oaks are found in Michigan. Red oaks have leaves with pointed tips, and white oaks have leaves with rounded tips. Within these two families there are eleven native species of oak that occur in Michigan.

Red oaks are more vulnerable to oak wilt than white oaks. Oak wilt rapidly kills infected red oaks. While white oaks infected by oak wilt show signs of decline, they are rarely killed by the disease.

Pathogen Characteristics

The disease spreads through fungal spores carried overland by insects from an infected tree to an injured tree and underground root grafts.

Nitidulid beetles are attracted to the sweet scent of the fungal spore mats. These elliptical black mats may be up to 6 inches long.

*The movement of firewood by humans (that is produced from oak trees infected by oak wilt) can spread the fungus to new areas where beetles feeding on the fungus pick up spores and can cause new infections

Delta
Menor
Marinette
Suamico
Howard
Green Bay
Oneida
Oneida Reservation
Allouez
De Pere
Two
Manitowoc
Chilton
New Holstein
10mi
Kiel
Mason
-87.665 44.995 Degrees

About Oak Wilt

Oak wilt is a deadly disease that mainly affects red oak trees. The fungus enters the tree through fresh wounds or from underground root connections with infected trees. The disease causes the leaves to wilt from the top down, followed by leaf drop and rapid death of the tree, often within 4-6 weeks. Look for these symptoms beginning in early July.

Compact masses of spore-producing fungal material called "fungal mats" form under the bark of trees infected with oak wilt, usually the year after a tree dies. Pressure pads then form on fungal mats that exert outward pressure causing the bark to split. The mats exude a sweet smell which attracts sap beetles. The spores stick to these beetles as they feed.

Oak wilt infections start in new locations when spore-carrying sap beetles feed on fresh oak wounds. New oak wilt infections are often traced to wounds from pruning, construction, logging equipment, climbing spikes, kids with hatchets, and occasionally, damaging storms. In Michigan, the greatest risk of infection occurs between April 15 and July 15.

Look for Oak Wilt

Find address or place

Submit Oak Wilt Report

Submit Oak Wilt Report

First Name

Last Name

E Mail

Phone Number

Does your oak have pointed or rounded leaf tips?

Is the tree dropping leaves or are the leaves turning brown from the top down?

Was the tree pruned or injured between April and July?

Is this the first tree to show these symptoms or did you see other nearby trees die last year?

Would you like to be contacted by someone to help you diagnose or confirm whether this is oak wilt and what your possible treatment options may be?

Preferred method of contact

Comments

Attachments:

Browse...

Edited seconds ago

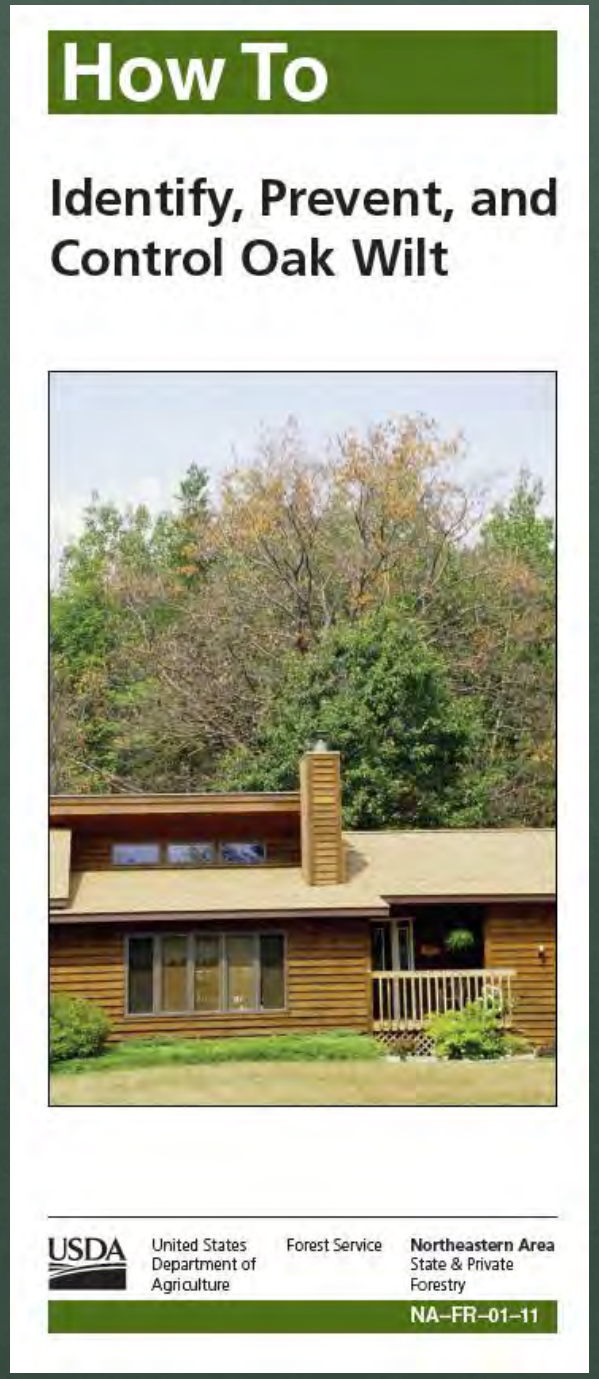
Edit Geometry

Clear

Save

For more information see:

USDA-FS Publication NA-FR-01-11



Oak Decline

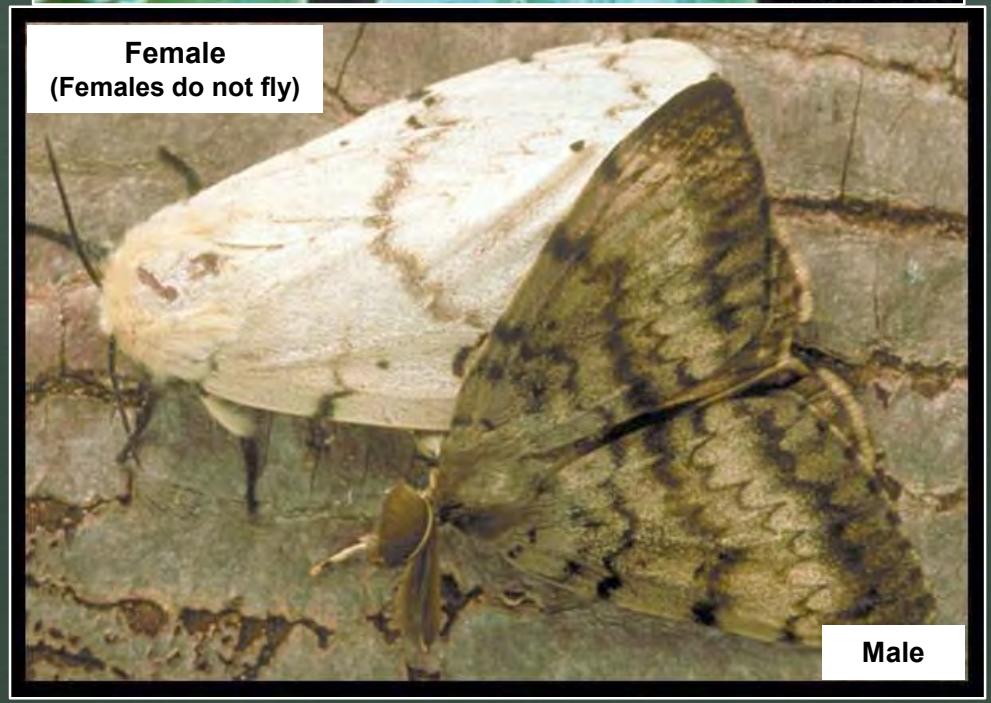
- Predisposing factors
- Inciting factors
- Contributing factors
    - Insects
    - Disease

Predisposing factors:

- Early land use (over-harvesting, grazing, burning)
- Growing on dry, nutrient-poor, sandy soils
- South- and West- facing slopes
- Tree age (100 years +)

Inciting factors:

- Short-term severe drought
- Repeated defoliation by insects
- Frost, ice, and/or wind damage



Contributing factors:

Disease

Armillaria root rot fungus

Contributing factors:

Insects

Two-lined chestnut borer

Cerambycid Beetles

Long-term Strategy

- Increase the diversity of forest stands to reduce the dominance of one or two tree species
- Encourage growth of younger and more vigorous trees in a stand by thinning out the weak ones
- Encourage long-lived and drought-tolerant species such as white oak, and red pine

Oak Decline

Symptoms:

- Twig and branch dieback in top and outer portions of the crown
- Sprouting (epicormic) branching common

Oak Wilt = Results in rapid defoliation (bare canopy)

Vs

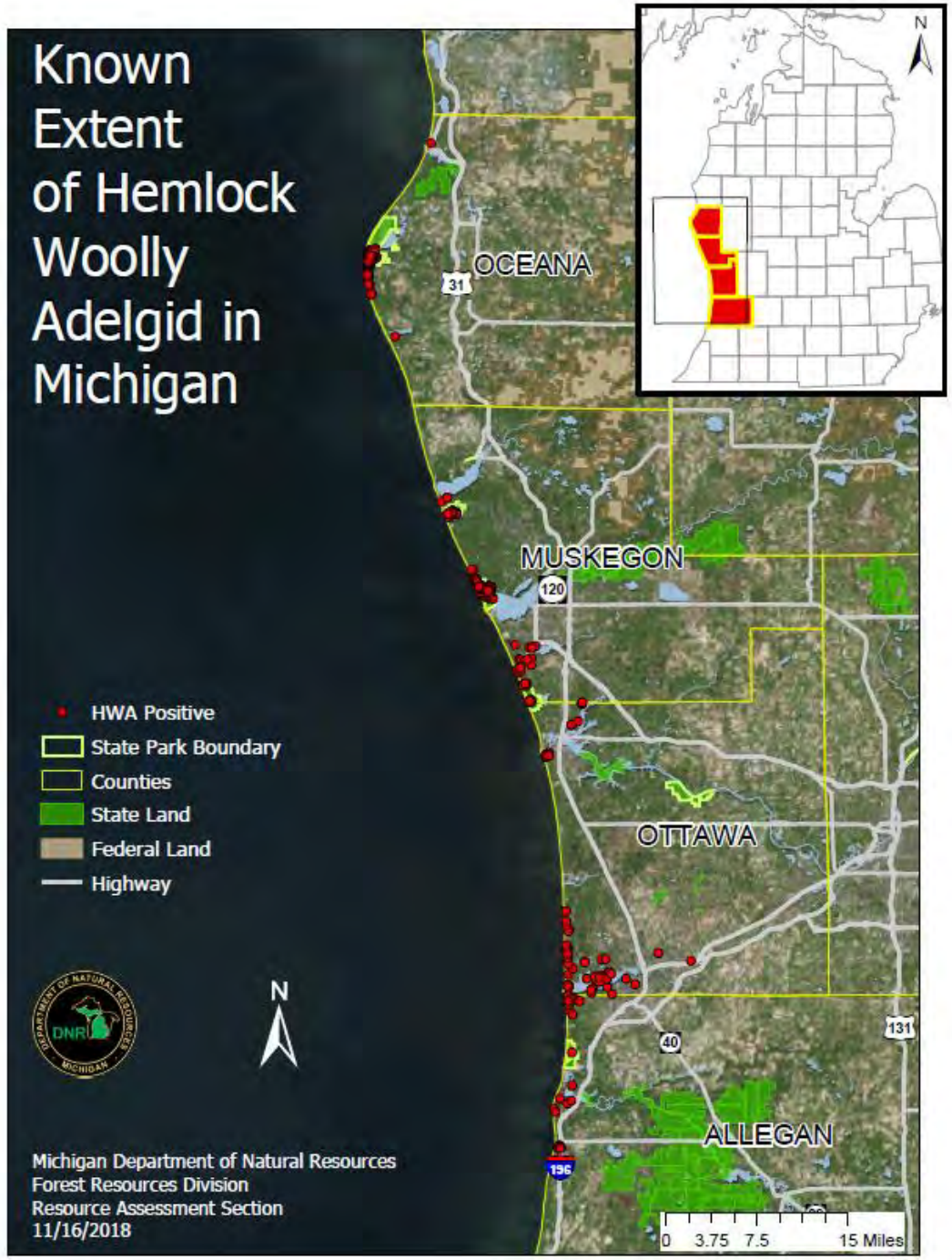
Oak Decline = Normally takes years and holds onto its leaves after they turn brown

75% of Oak Wilt concerns are Oak Decline

Hemlock Woolly Adelgid (HWA)

Native to Japan

- First observed in the Eastern US in 1951 near Richmond, Virginia
- First observed in Michigan in 2006
- Over 170 million Hemlocks grow in Michigan forests
- Infested trees usually die within 4-10 years



Why are hemlock important?

- Provide shade to rivers, stream, lakes
- Keeps water temperatures cool
- Provide diversity across the landscape
- Critical winter cover, food, and habitat for several bird and mammal species including deer yarding areas

Attacks eastern hemlock by using a piercing mouth part to suck the moisture and nutrients from the tree

White cottony masses found on the underside of the twig at the base of the needle

White cottony masses


White woolly masses
~ 1/16” – 1/4”


100X 20 kV
0008
100u
5449453

Crawlers plus wax

First Instar. (Note small halo of wool)

Crawler

Crawlers (1st instar nymphs) are the mobile life stage. They may be carried through wind, on birds and other animals, and improper disposal of infested branches.

HWA Life Cycle

- Has 2 generations per year, stages can overlap
- Parthenogenic reproduction – all females
- Insects & eggs are protected by the **ovisacs** – white wax

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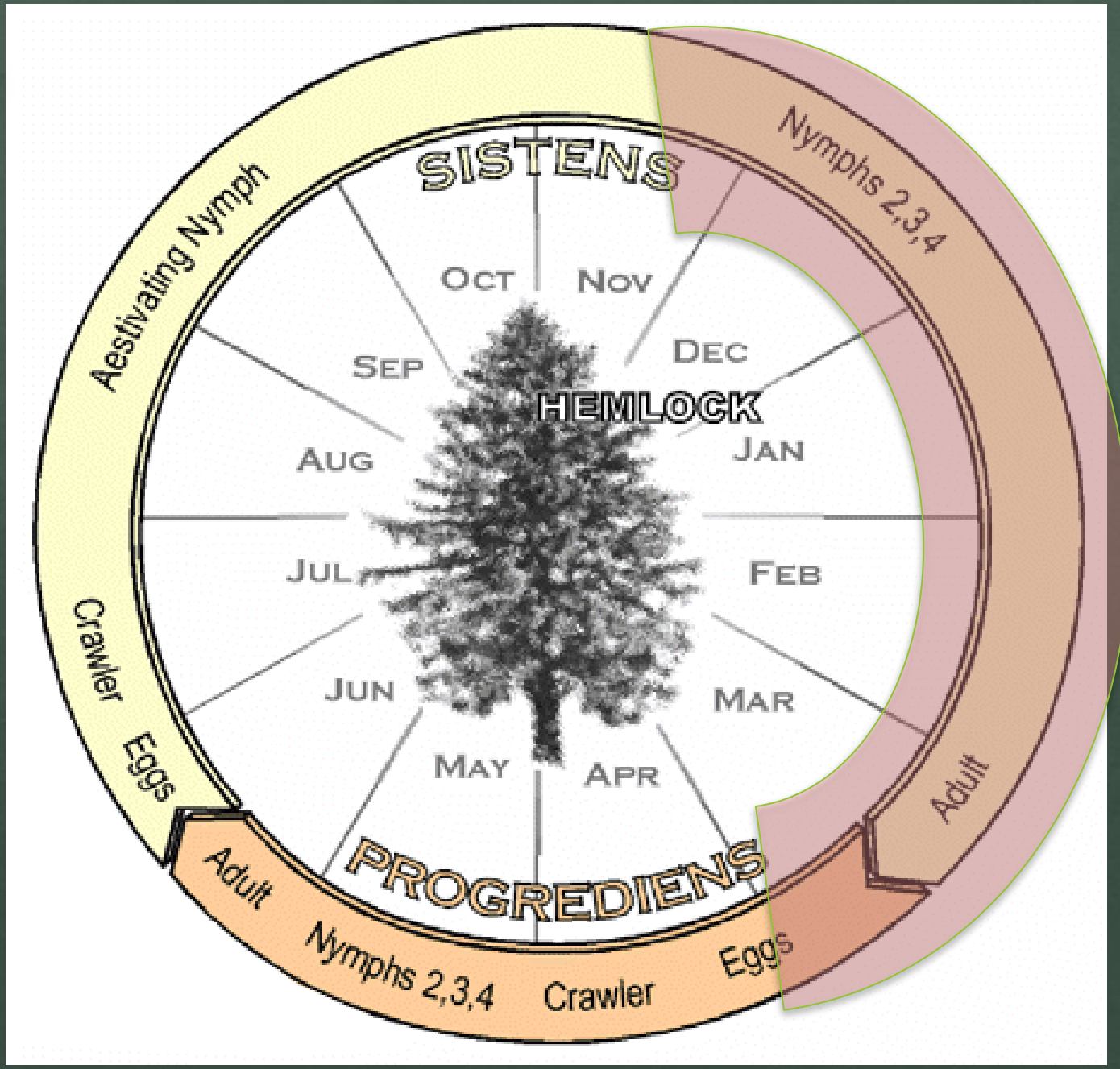
- **Progrediens:**
  Feed from late spring to early summer. Each female lays up to 50 eggs (avg. 20). Those eggs hatch into sistens.

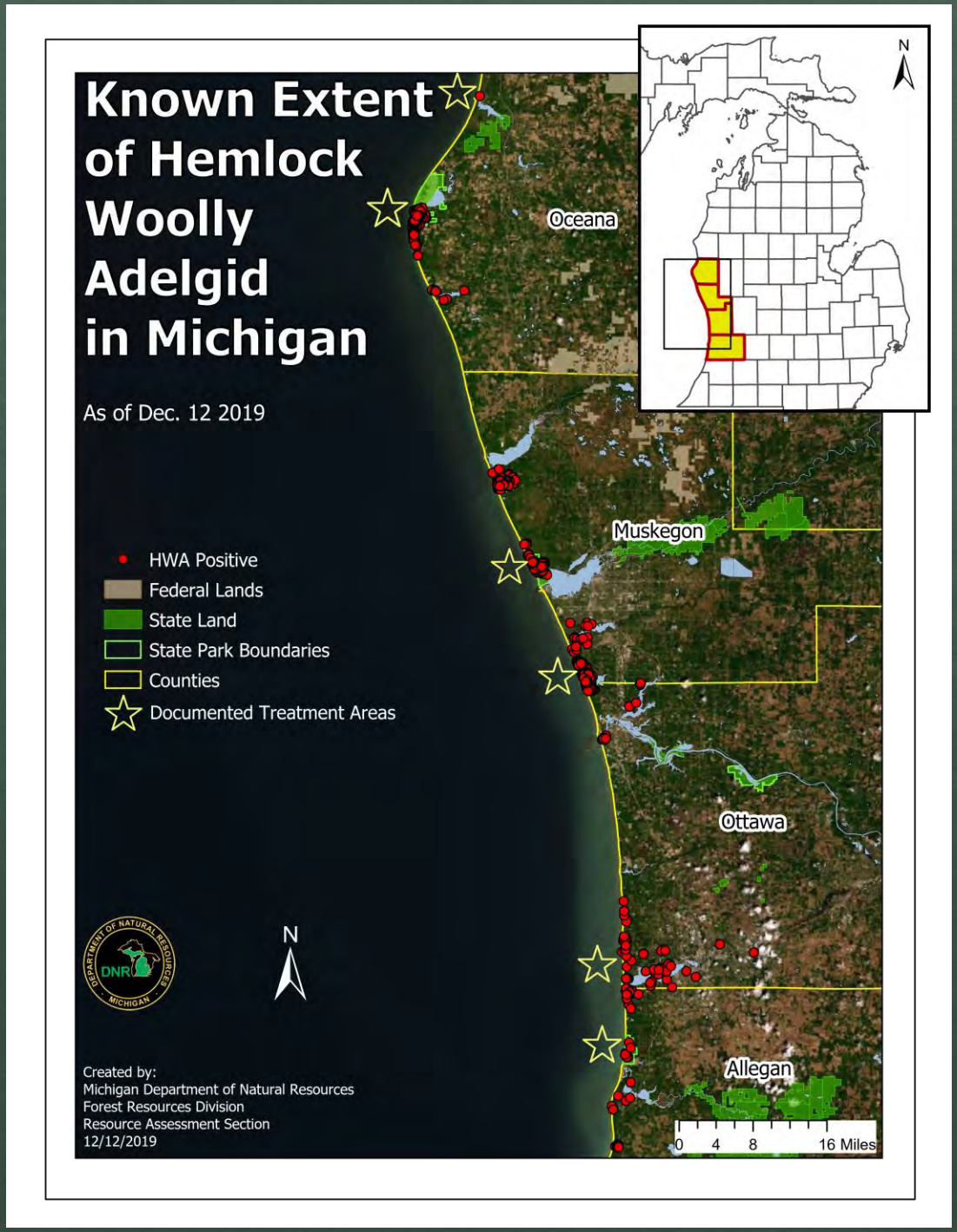
- **Sistens:**
  Feed from late fall to early spring! Each female lays up to 200 eggs (avg. 80-100) in spring. Those eggs hatch into progrediens. (Best time to survey; November through March)

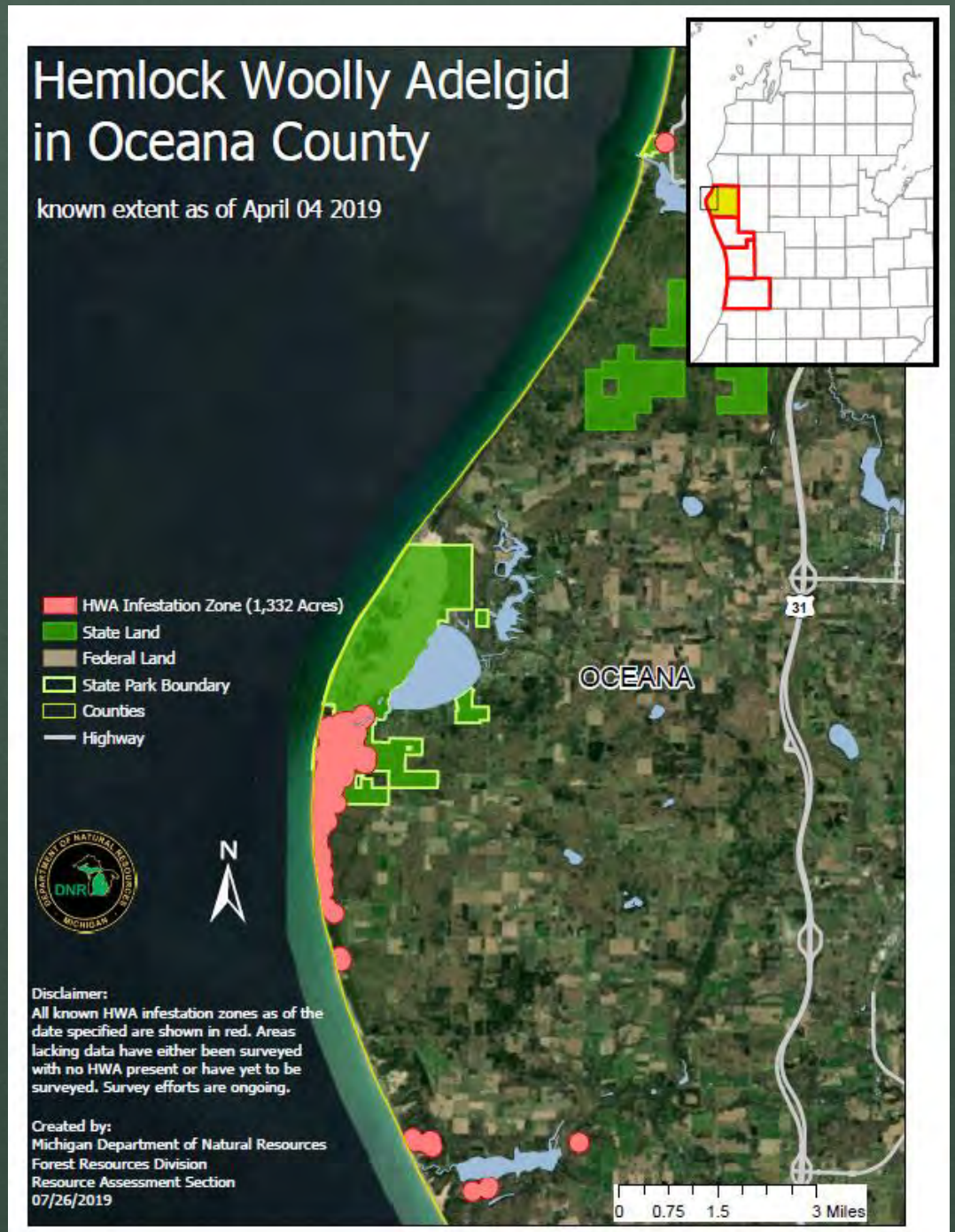


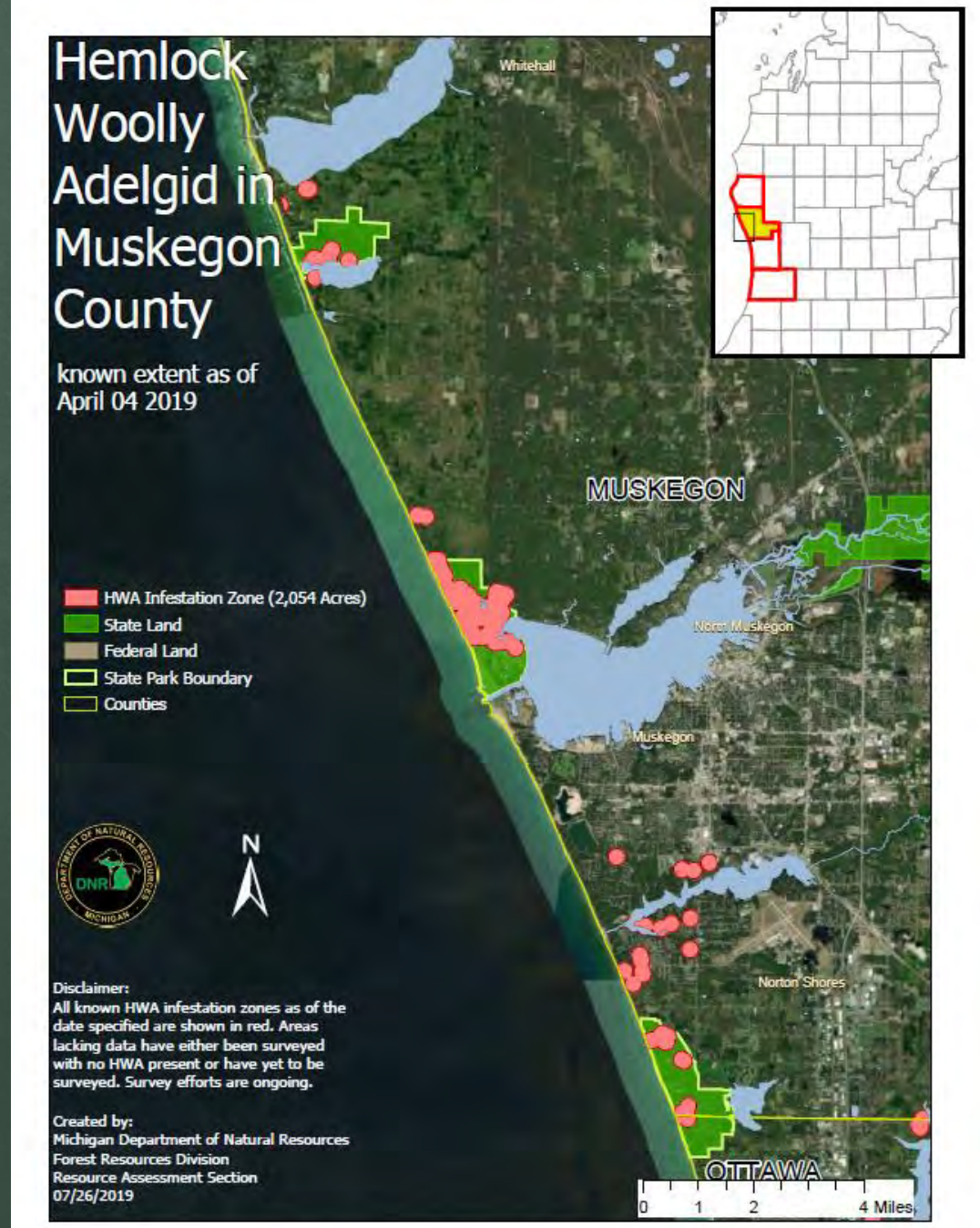
Current infestations were first detected in 2015 in Ottawa County

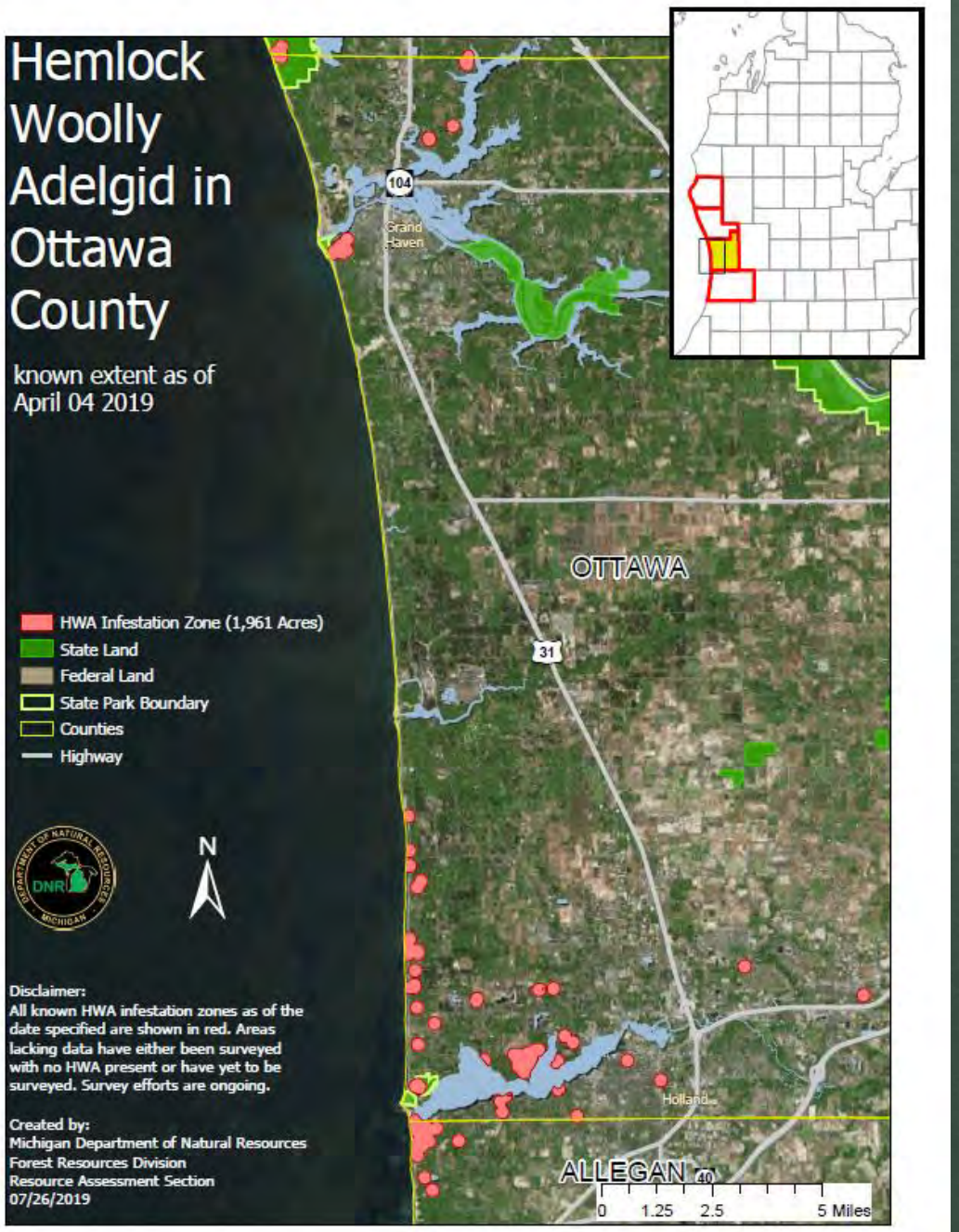
~85 miles along the shore area of eastern Lake Michigan

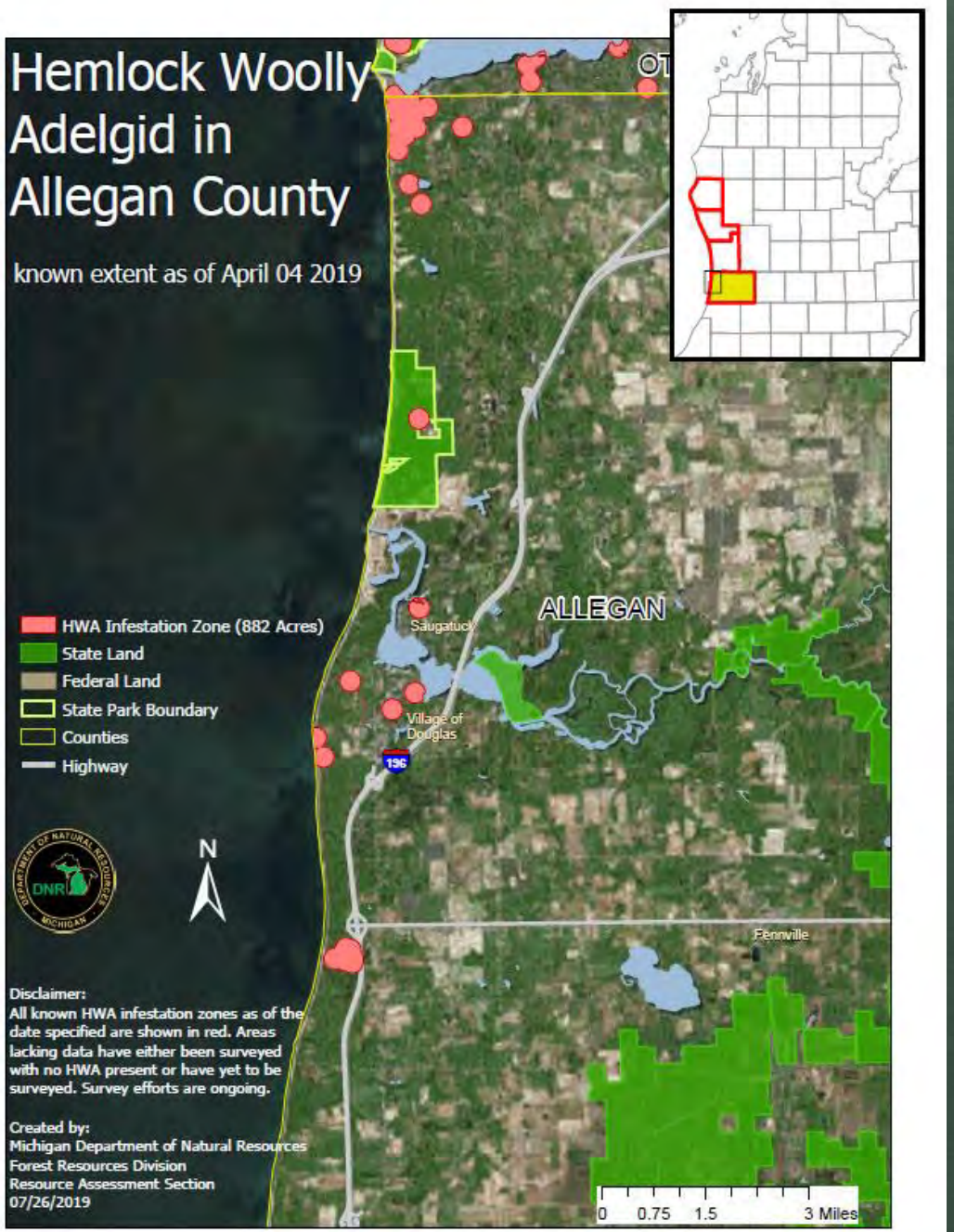
Northern most known location is at Mears State Park in Pentwater




Hemlock Woolly Adelgid in Oceana County
known extent as of April 04 2019
HWA Infestation Zone (1,332 Acres)
State Land
Federal Land
State Park Boundary
Counties
Highway
OCEANA
31
N
Disclaimer:
All known HWA infestation zones as of the date specified are shown in red. Areas lacking data have either been surveyed with no HWA present or have yet to be surveyed. Survey efforts are ongoing.
Created by:
Michigan Department of Natural Resources
Forest Resources Division
Resource Assessment Section
07/26/2019
0 0.75 1.5 3 Miles


Hemlock Woolly Adelgid in Muskegon County
known extent as of April 04 2019
Whitehall
MUSKEGON
Norton Muskegon
Muskegon
Norton Shores
OTTAWA
HWA Infestation Zone (2,054 Acres)
State Land
Federal Land
State Park Boundary
Counties
N
Disclaimer:
All known HWA infestation zones as of the date specified are shown in red. Areas lacking data have either been surveyed with no HWA present or have yet to be surveyed. Survey efforts are ongoing.
Created by:
Michigan Department of Natural Resources
Forest Resources Division
Resource Assessment Section
07/26/2019
0 1 2 4 Miles


Hemlock Woolly Adelgid in Ottawa County
known extent as of April 04 2019
HWA Infestation Zone (1,961 Acres)
State Land
Federal Land
State Park Boundary
Counties
Highway
N
Disclaimer:
All known HWA infestation zones as of the date specified are shown in red. Areas lacking data have either been surveyed with no HWA present or have yet to be surveyed. Survey efforts are ongoing.
Created by:
Michigan Department of Natural Resources
Forest Resources Division
Resource Assessment Section
07/26/2019
OTTAWA
ALLEGAN
Grand Haven
Holland
104
31
40
0 1.25 2.5 5 Miles


Hemlock Woolly Adelgid in Allegan County
known extent as of April 04 2019
HWA Infestation Zone (882 Acres)
State Land
Federal Land
State Park Boundary
Counties
Highway
N
Disclaimer:
All known HWA infestation zones as of the date specified are shown in red. Areas lacking data have either been surveyed with no HWA present or have yet to be surveyed. Survey efforts are ongoing.
Created by:
Michigan Department of Natural Resources
Forest Resources Division
Resource Assessment Section
07/26/2019
ALLEGAN
Saugatuck
Village of Douglas
Fennville
196
0 0.75 1.5 3 Miles

Survey and Treatment

- DNR Forest Health Response Team
- DNR Parks and Recreation
- Cooperative Invasive Species Management Areas
- West Michigan CISMA
- The Nature Conservancy
- Michigan Department of Agriculture and Rural Development


HWA Survey Zones
N
5 mile UP Lake Michigan zone
5 mile LP Lake Michigan zone
5 mile buffer of known sites
10 mile buffer of known sites
20 mile buffer of known sites
Counties
Michigan Department of Natural Resources
Forest Resources Division
Resource Assessment Section
07/10/2018
0
120 Miles

Survey

Treatment

Insecticide treatment kills the adelgid NOT the tree

- Top Down Approach
- WMCISMA coordinating Treatment on Private Land
- DNR PRD and FRD coordinating on State Land
- Treating all trees within 800 feet of an infested tree with a goal of local eradication

Treatment

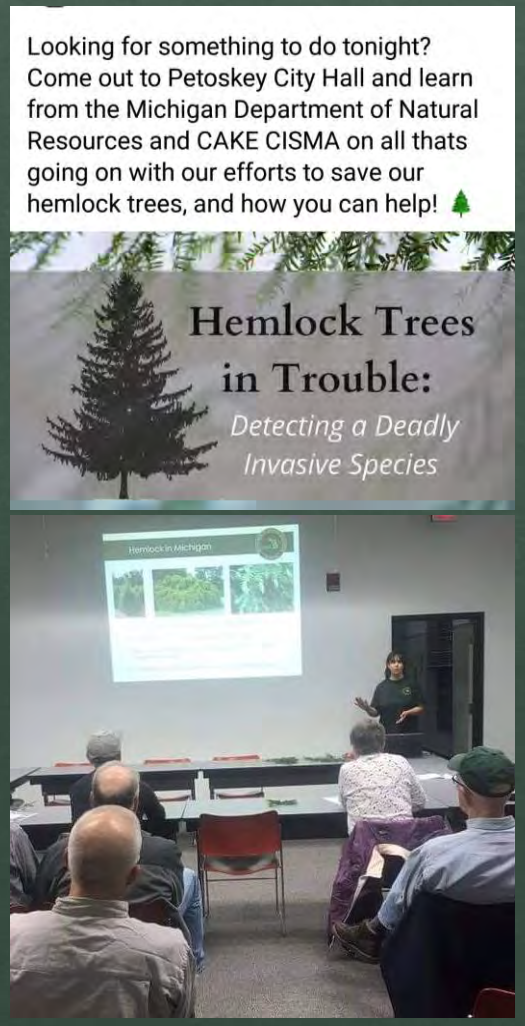
Dinotefuran - Applied as a basal trunk spray
- Annual application

Both can be applied as a soil drench but due to the proximity to Lake Michigan we are avoiding it over leaching concerns

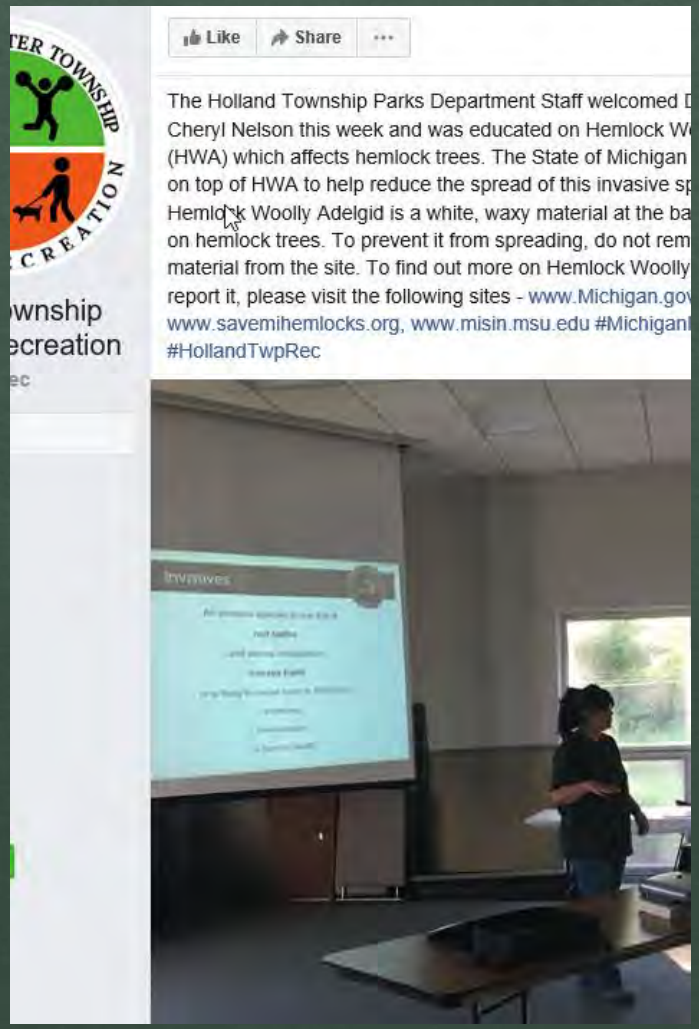
Imidacloprid - Applied as a tree injection or basal spray
- Persists for 3-5 years

Outreach and Education Efforts

CAKE CISMA



Holland Charter Twp. Parks Dept.



Lake County Get Outdoors Day

Hemlock Woolly Adelgid Kills Trees

Watch for this invasive pest

Host: Hemlock Tree

What: White masses 1/16 to 1/4-inch, cotton ball like texture

Where: On the twig at the base of the needles

When: Present year-round, most visible November through July

If you suspect HWA, please note the location and report it.
Phone:1-800-292-3939
Online: *misin.msu.edu*
E-mail: MDA-Info@michigan.gov

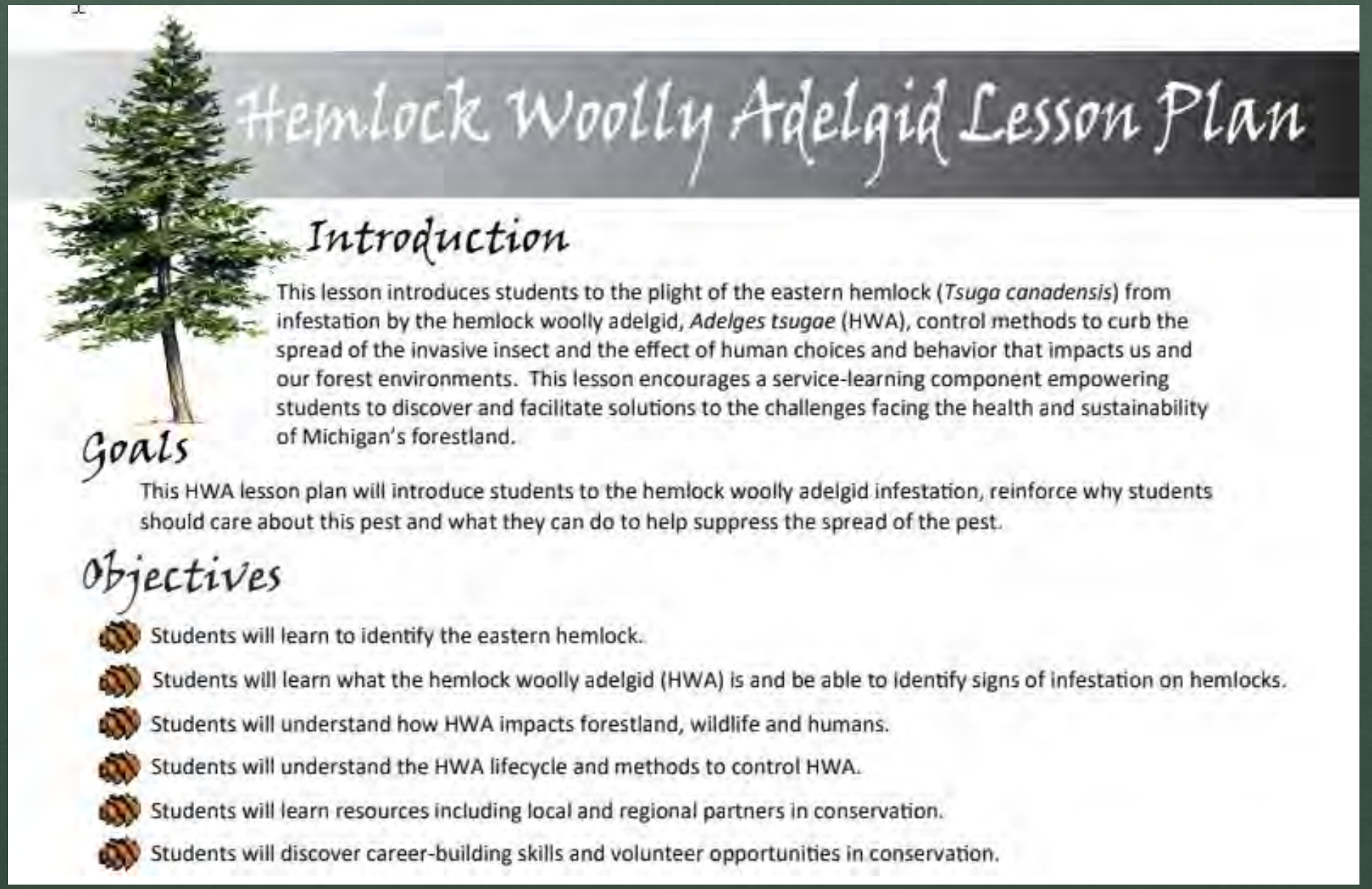
Hemlock Tree Identification

Leaf: Flat, single-needle, approximately 1/2-inch long, underside has two white lines; attached to twig with short stem

Where: Near water, along streams/rivers, lowland slopes or planted in landscapes

Michigan Department of Agriculture & Rural Development
DNR
EGLE
Michigan Department of Environment, Great Lakes, and Energy

michigan.gov/HWA



Hemlock Woolly Adelgid Lesson Plan

Introduction

This lesson introduces students to the plight of the eastern hemlock (*Tsuga canadensis*) from infestation by the hemlock woolly adelgid, *Adelges tsugae* (HWA), control methods to curb the spread of the invasive insect and the effect of human choices and behavior that impacts us and our forest environments. This lesson encourages a service-learning component empowering students to discover and facilitate solutions to the challenges facing the health and sustainability of Michigan's forestland.

Goals

This HWA lesson plan will introduce students to the hemlock woolly adelgid infestation, reinforce why students should care about this pest and what they can do to help suppress the spread of the pest.

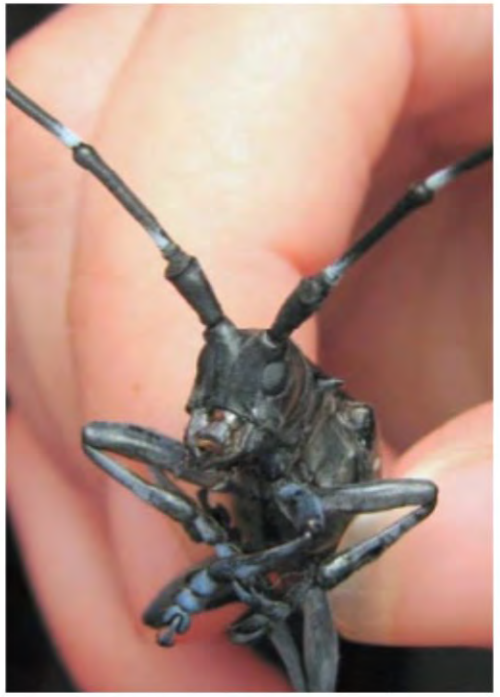
Objectives

- Students will learn to identify the eastern hemlock.
- Students will learn what the hemlock woolly adelgid (HWA) is and be able to identify signs of infestation on hemlocks.
- Students will understand how HWA impacts forestland, wildlife and humans.
- Students will understand the HWA lifecycle and methods to control HWA.
- Students will learn resources including local and regional partners in conservation.
- Students will discover career-building skills and volunteer opportunities in conservation.

- Contracting with Maureen Stine (natureology.me)
- For Teachers and Educators participating in prevention and detection activities
- Focus is to start high school students

Asian Longhorned Beetle

- Not known to be in Michigan
  - Boring insect
  - Moved in firewood
- Arrived from Asia in solid wood packing material



More than 1 billion maples grow in Michigan

Ontario, Canada
First detected in Vaughan in 2003
Declared eradicated in 2013
First detected in Mississauga in 2013

Massachusetts
First detected in Worcester in 2008

Illinois
First detected in Chicago in 1998
Declared eradicated in 2008

New York
First detected in Brooklyn in 1996

New Jersey
First detected in Jersey City in 2002
Declared eradicated in 2013

Ohio
First detected in Tate Township in 2011

Map Key
- Maple Forests*
- ALB Infestations
- Eradicated ALB Infestations

** Preferred ALB Host. (USFS FHTET, 2012; USGS, 2002; Yemshanov et al. 2012)*

N W E S

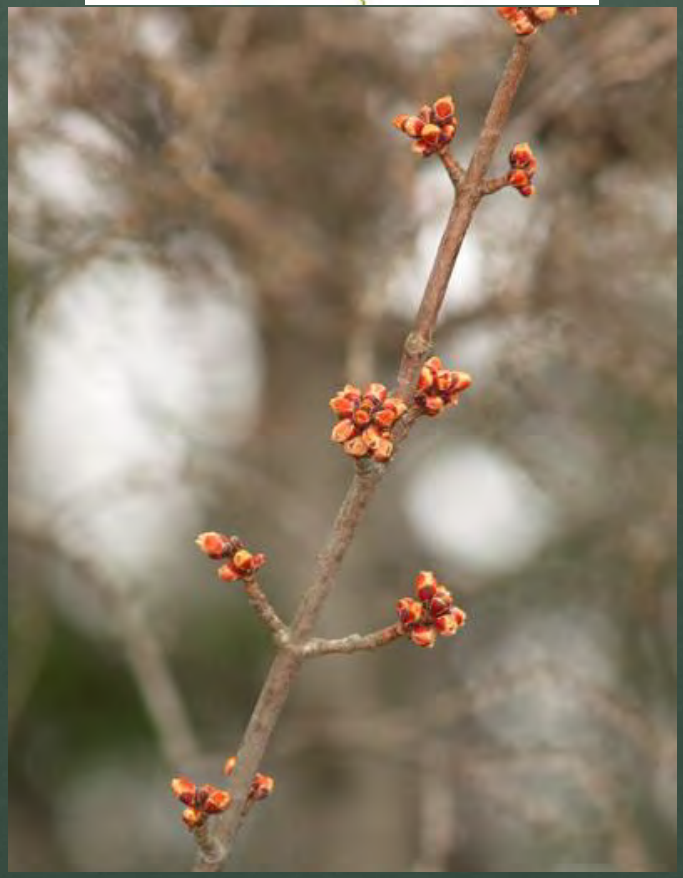
0 100 200
Miles

US Forest Service
Northeastern Area State and Private Forestry
Forest Health Protection, Durham, NH
www.na.fs.fed.us/fhp

The US Forest Service is an equal opportunity employer and provider.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

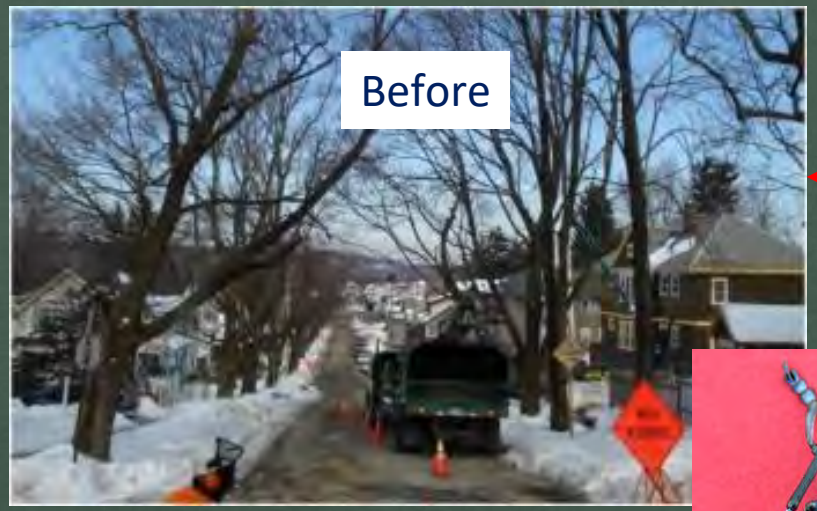
Preferred host: Maples

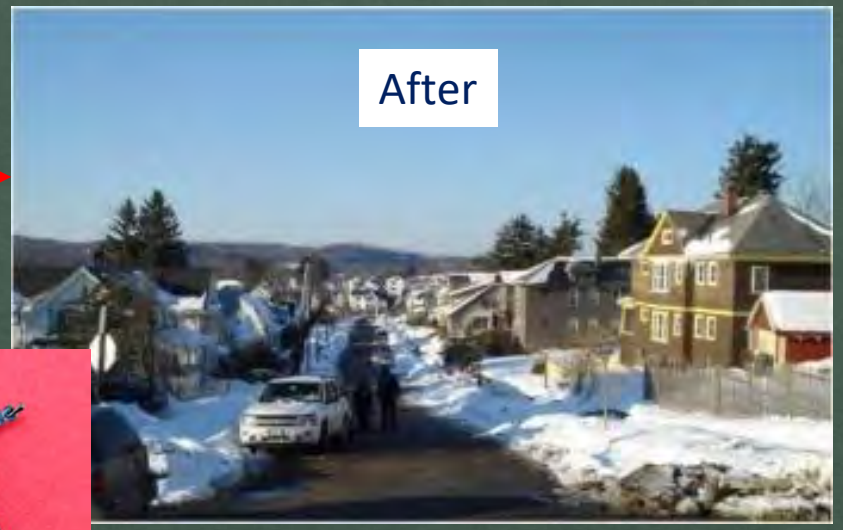


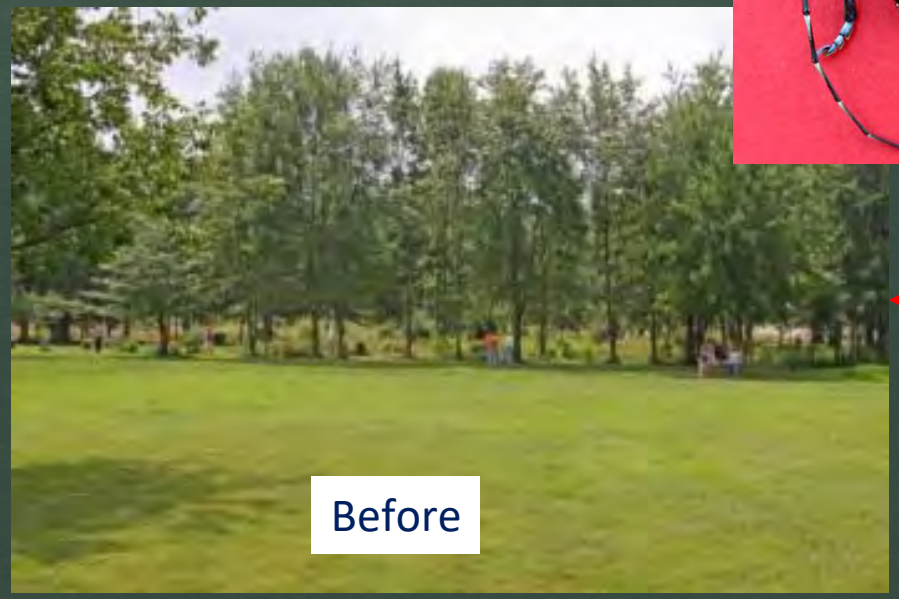
Impacts to Hosts

Hosts:

- Maples
- Buckeye
- Horsechestnut
- Birch
- Willow Elm
- Ash
- Sycamore
- Cottonwood
- Aspen
- Others







Life Cycle

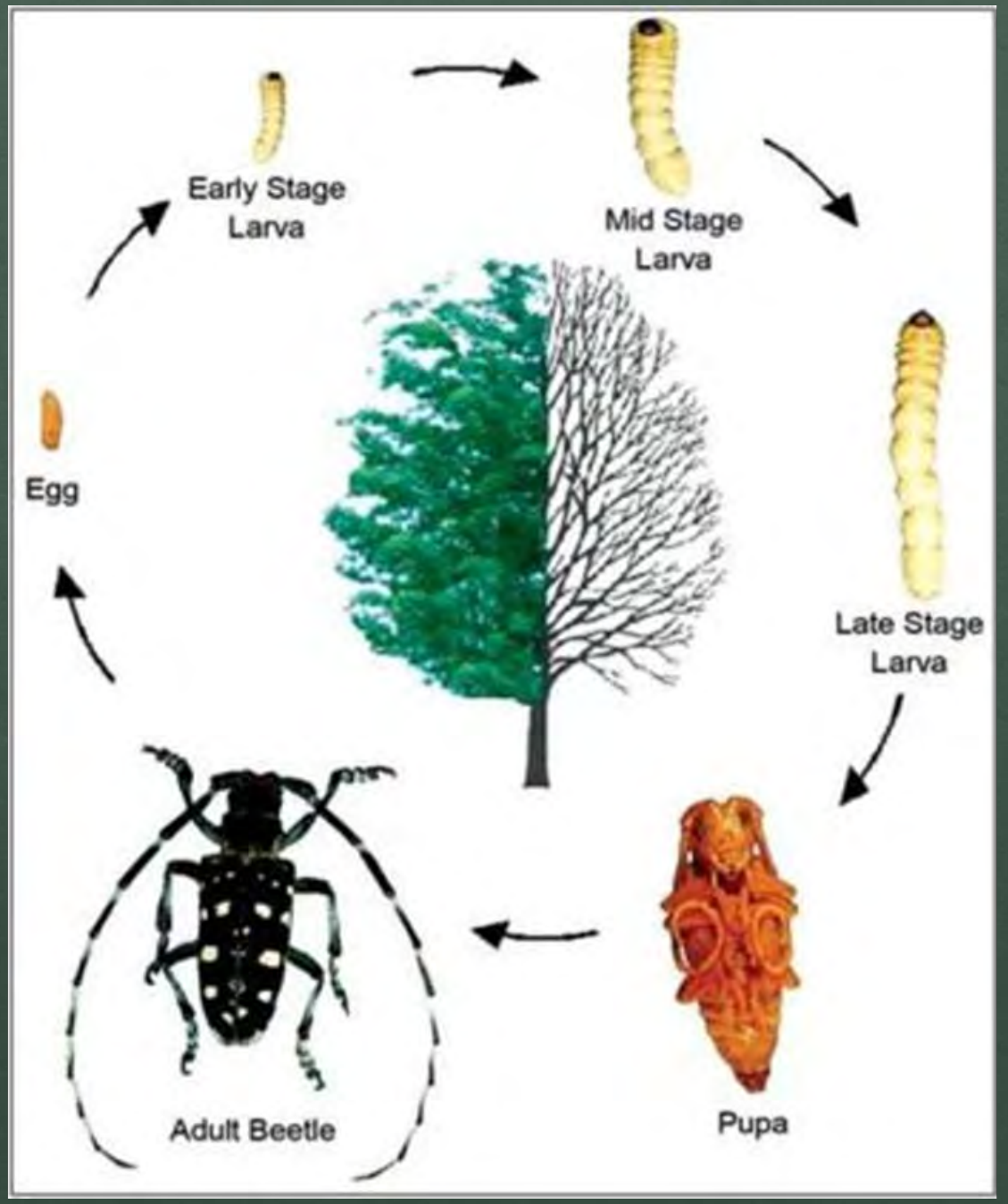
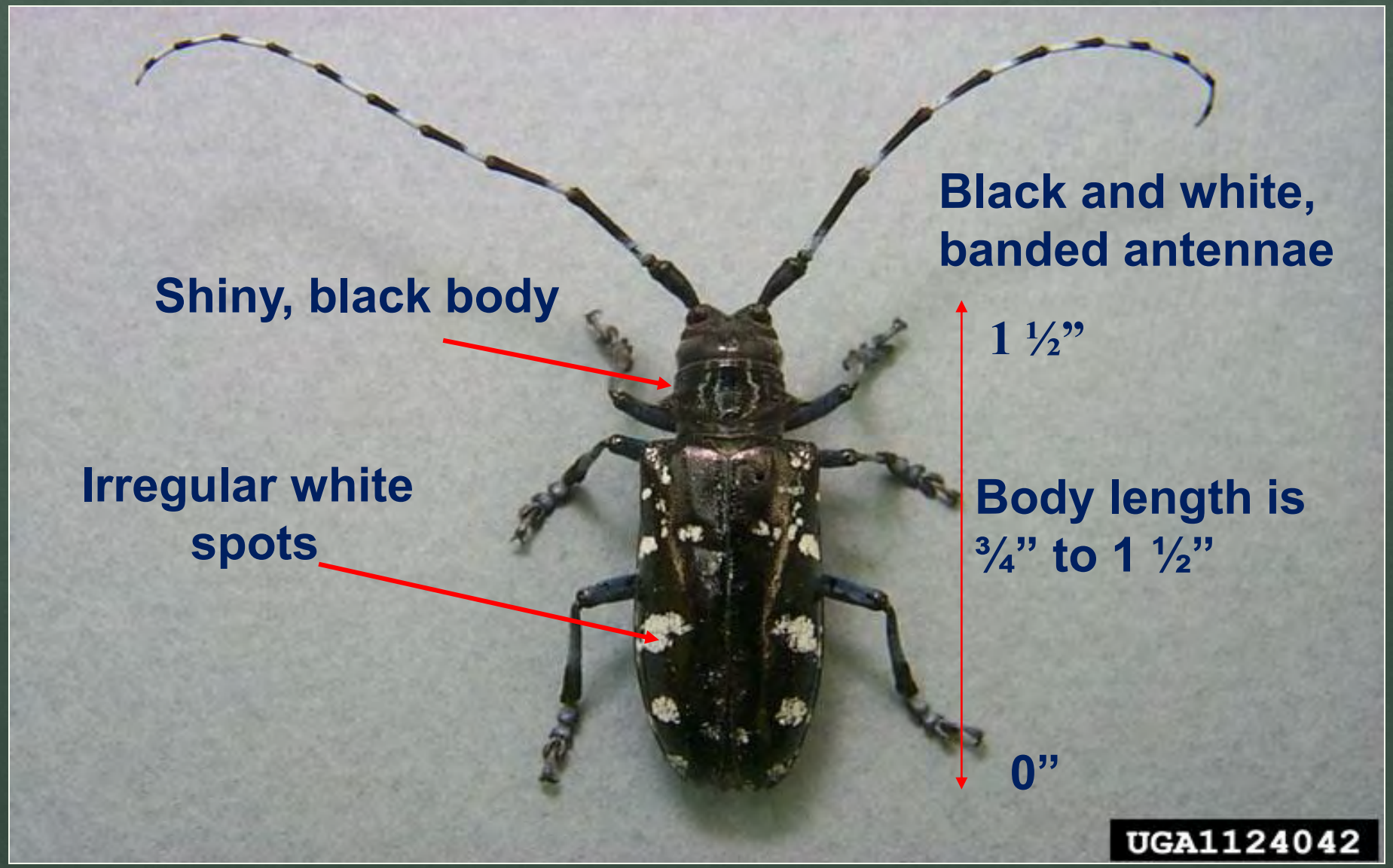

Early Stage Larva
Mid Stage Larva
Late Stage Larva
Egg
Adult Beetle
Pupa


Photo: Steven Katovich, U.S. Forest Service


Photo: Michael Bohne


Photo: PA Dept. of Conservation & Natural Resources

Identifying *ALB* Adults



Look-a-Likes


Native Longhorned beetle


White-spotted pine sawyer

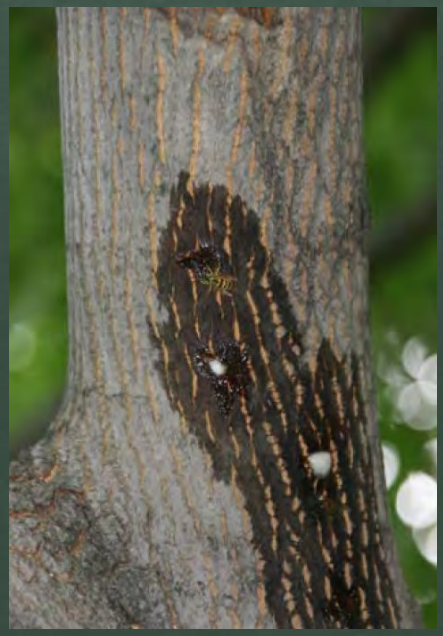

Native Longhorned beetle


Cottonwood borer



Symptoms: Adult Feeding

Insect Signs: Oviposition Pits / Egg Laying



Insect Signs: Frass

Insect Signs: Exit Holes

Insect Signs: Galleries

MISIN Midwest Invasive Species Information Network

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MISIN

Midwest Invasive Species Information Network

The MISIN smartphone app provides a mobile solution for the capture of invasive species field observation data. You can play an important role in the early detection and rapid response to new invasive threats in your area by contributing invasive species observations to the MISIN database.

- Identify and report 300+ invasive plant and animal species
- Capture and submit species observations from the field
- Include images taken in the field with your observation
- Browse images and species information on the top Midwest invaders

ANDROID APP ON Google play

Available on the App Store

- **Michigan DNR Forest Health:**

  Website: www.michigan.gov/foresthealth

- **Michigan Invasive Species:**

  Website: www.michigan.gov/invasives

- **Midwest Invasive Species Network – MISIN:**

  Website: **www.misin.msu.edu**

  Download MISIN app to report sightings

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Email: nelsonc6@michigan.gov