

Michigan Department of Agriculture and Rural Development

Hemlock Woolly Adelgid

In

Muskegon and Ottawa Counties



Michigan Department of Agriculture & Rural Development





Hemlock Woolly Adelgid In Muskegon and Ottawa Counties

- **Introductions**
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- **Current Local HWA Situation**
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“Costs” of Forest Invasives:
Environmental – Economic – Emotional - Cultural

- **Tree removal & replacement**
- **Ecological damage**
- **Reduced property values**
- **Lost timber value**
- **Lost aesthetic value**
- **Impacts on tourism**
- **Effects on utilities & other industries**





Hemlock



- **Over 170 million hemlocks grow in Michigan Forests**
- **Thousands more hemlock have been planted in landscapes**
- **Abundant in the Northern LP and UP and common in other areas**
- **Much of the hemlock resource in Michigan forests consists of relatively old trees due to browsing by deer on young regenerating hemlock**



Hemlock

- Hemlock is shade tolerant, long lived, a resource for wildlife and plays an important role in many ecological processes in forests
- Hemlock provides critical winter cover, food and habitat for several birds and mammal species
- Loss of hemlock could:
 - Alter soil temperatures, nitrogen cycling and decomposition rates impacting forest structure
 - Allow for increased erosion/reduced water quality/increased water temperatures altering communities of aquatic organisms





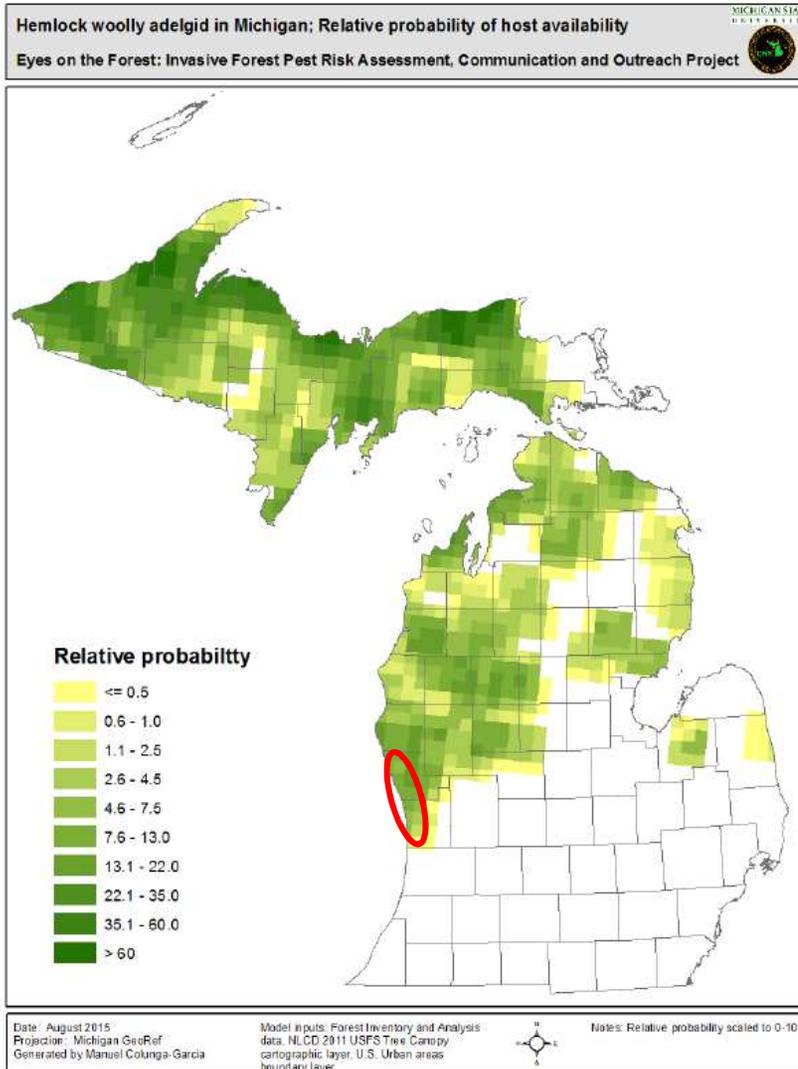
Hemlock Identification

- **NEEDLES** are flattened, about $\frac{1}{2}$ inch long, glossy green above, and pale green with two white stripes below
- Needles have a flattened, rather than spiral, appearance on the **BRANCH**
- Small papery **CONES** about $\frac{3}{4}$ of an inch long
- On large trees, **BARK** is thick, corky and heavily ridged
- For more information on Hemlock Identification please visit: www.michigan.gov/HWA





Relative Probability of Host Availability





Hemlock Woolly Adelgid (HWA)

Adelges tsugae

- An insect that as an adult pierces its host and sucks out nutrients
- Introduced from Asia
- First discovered in the 1920's in western states
- Found in eastern states in 1950's





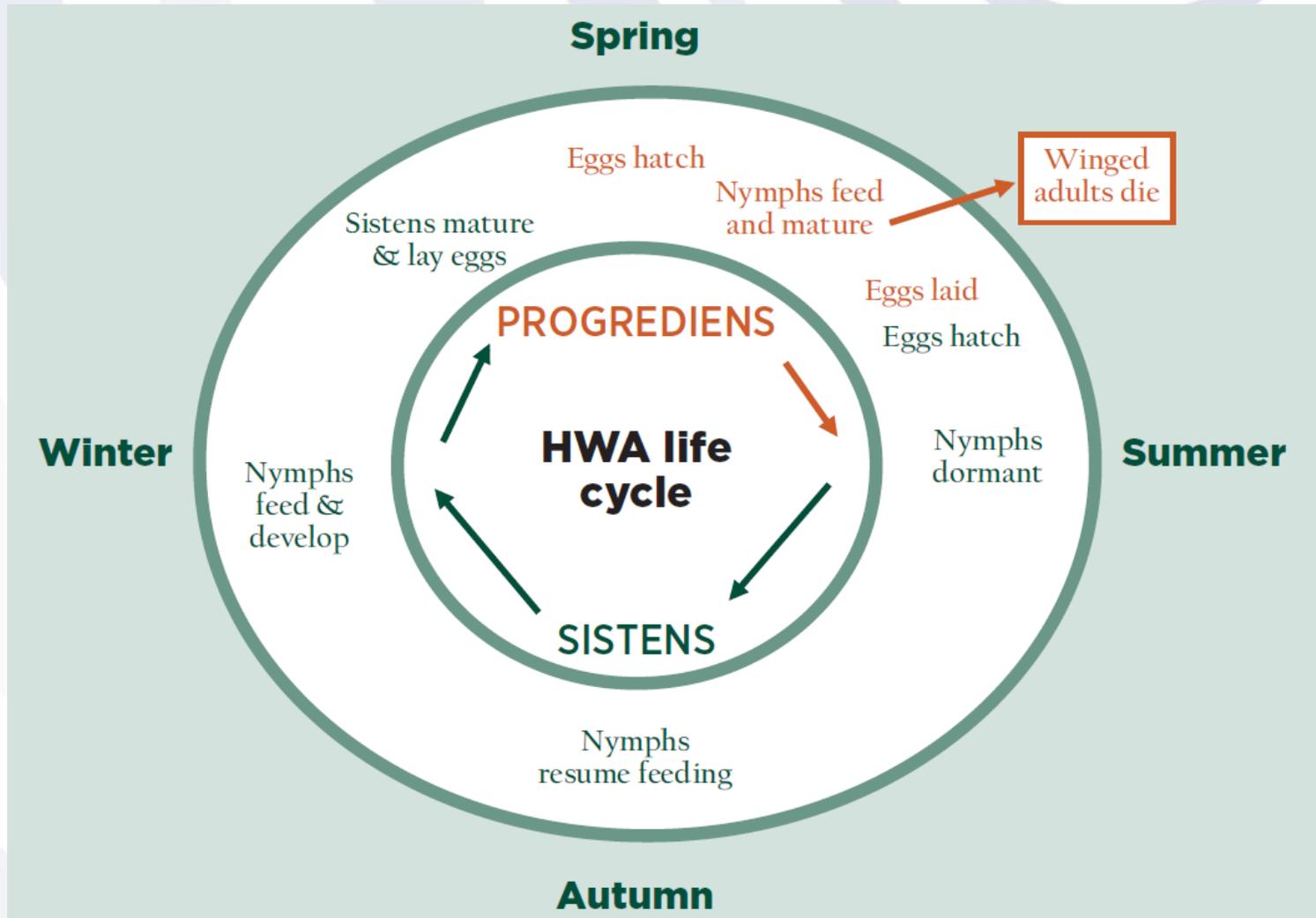
Hemlock Woolly Adelgid *Tree Injury and Symptoms*

- Lives off twigs
- Needles turn greyish green
- No buds
- Needle drop
- Low vigor
- Secondary infestations
- Four-year mortality



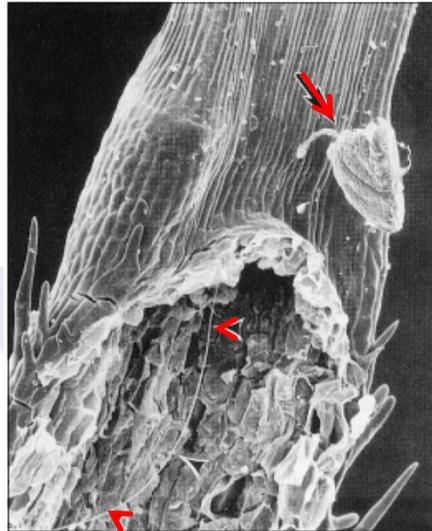


Hemlock Woolly Adelgid Life Cycle





HWA nymphs settled and feeding at the bases of needles.



Hemlock needle torn away from stem shows position of nymph (arrow) and its stylet bundle (arrowheads) within the plant.



An adult hemlock woolly adelgid, *Adelges tsugae*, removed from its host plant and cleaned for imaging.



Ovisacs



First Instar. (Note small halo of wool)



Available at:

www.michigan.gov/hwa

Extension Bulletin E-3300 • New • December 2015

Hemlock Woolly Adelgid

A little insect that means big trouble for hemlock trees in Michigan

Hemlock woolly adelgid (*Adelges tsugae* Annad) has been on Michigan's "most unwanted" list for years. This invasive forest insect has killed hundreds of thousands of hemlocks (*Tsuga canadensis*) in eastern states. It threatens more than 170 million hemlock trees in Michigan forests, and if not controlled, it will also kill hemlock trees in landscapes.

Small, localized infestations of hemlock woolly adelgid (HWA)



Hemlock shoot with hemlock woolly adelgid.

were recently discovered in western lower Michigan. Evidence suggests that some of these infestations are at least 10 years old and probably originated when infested hemlock trees from other states were planted in landscapes. Surveys are continuing, and additional HWA infestations may yet be found. This bulletin is designed to help you learn to recognize HWA and understand the potential impacts of this invader in Michigan.

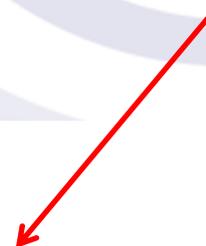
Michael Montgomery, USDA Forest Service, Bugwood.org

Look for:

MORE INFORMATION:

Educational Materials:

- [NEW! MSUE Hemlock Woolly Adelgid Bulletin \(printable PDF\)](#)



Invasion history and current HWA distribution

Hemlock woolly adelgid is native to Japan and possibly China, where it feeds on Asian hemlock and spruce species in forests and landscapes. Asian species of hemlock and spruce are quite resistant to HWA and rarely sustain serious injury. In addition, several predatory insects attack HWA in Japan and probably help to control HWA populations there. In North America, HWA attacks only hemlock trees; spruce trees are not suitable hosts. Areas in the Pacific Northwest and California were invaded by HWA in the 1920s. Western hemlock (*Tsuga heterophylla*), however, is resistant to HWA and sustains little damage.

In the eastern region of the United States, however, HWA has been a devastating pest. Eastern hemlock and the relatively rare Carolina hemlock

(*T. caroliniana*), which grows in North Carolina, are much less resistant to HWA than western or Asian hemlocks. Hundreds of thousands of eastern hemlock trees growing under a wide variety of conditions in forests and in landscapes have died. The first report of HWA in the eastern United States came in 1951, when infested hemlocks were observed in Virginia. Since then, HWA has spread up and down the east coast and to the west. Currently, HWA populations are present in at least 19 states, from Georgia to Maine and west into Pennsylvania. Infested landscape trees have been reported in two counties in southeastern Ohio. Areas of extensive tree mortality and decline are found throughout the infested region, but HWA impacts have been especially severe in areas of Virginia, New Jersey, Pennsylvania and Connecticut.



White cottony masses found on the twig at the base of needles





Not to be confused with:





Not to be confused with:





Not to be confused with:



Drops of Pine Sap



Spider Egg Sacks





Not to be confused with:

Elongate Hemlock Scale

Elongate Hemlock Scale (EHS) has been observed on trees in areas infested with HWA, at a relatively high incidence.



The main distinguishing feature between EHS and HWA is that EHS is primarily attached to the underside of the needles and HWA is attached to the twigs, at the base of needles.



Remember that HWA:

- **Has “wool” that is attached to the twig not the needle.**
- **Is immobile when covered in wax**
- **Is waxy, not silky or stretchy**
- **Is wispy like a cotton ball, not fabric-like**
- **Has separate balls of “wool”**
- **Doesn’t look painted on (like pine sap)**





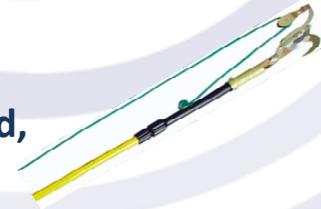
Survey

- **Visual survey**

- Binoculars may have some utility



- Using a pole pruner to sample from high in the canopy is recommended, especially on larger trees



- Looking on the ground under hemlock for broken/chewed off branch tips can be effective, especially after severe weather events (wind, hail, ice, heavy snow) When snow cover is present fresh tips can be easier to find.



- Newly formed woolly masses are most evident in late winter/early spring but remnants of the previous generation's woolly masses may be present any time of year. Surveying for earlier life stages requires the use of a hand lens.



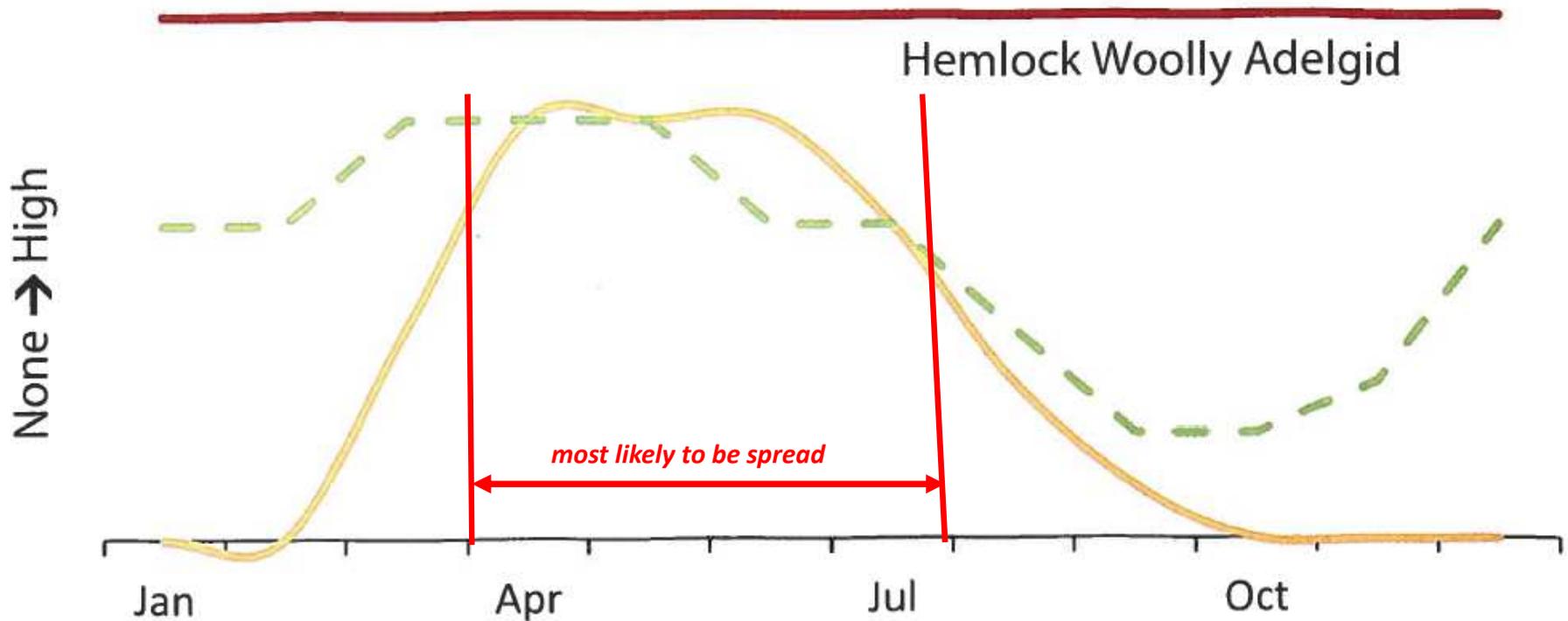
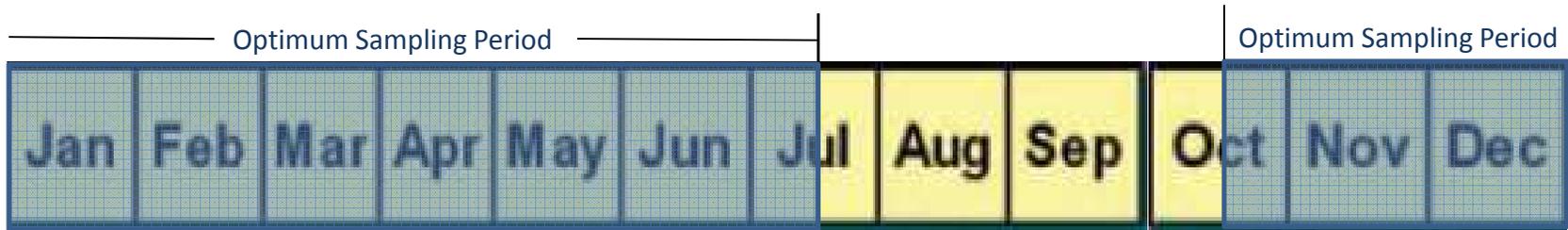
- Sites where hemlock has been planted should be a focus of initial survey efforts



- Surveying around bird feeder locations may be productive



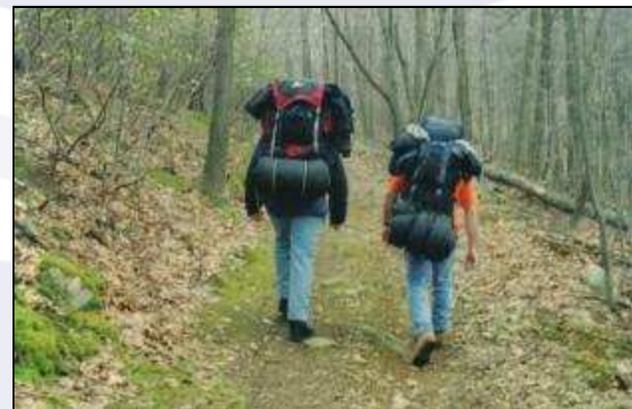
- Hemlock woolly adelgid can be difficult to detect at low levels, especially in the upper portions of large trees



- Risk of spread on live plants
- Risk of spread on clothing, machinery, etc.
- - - Visibility of insect life stages

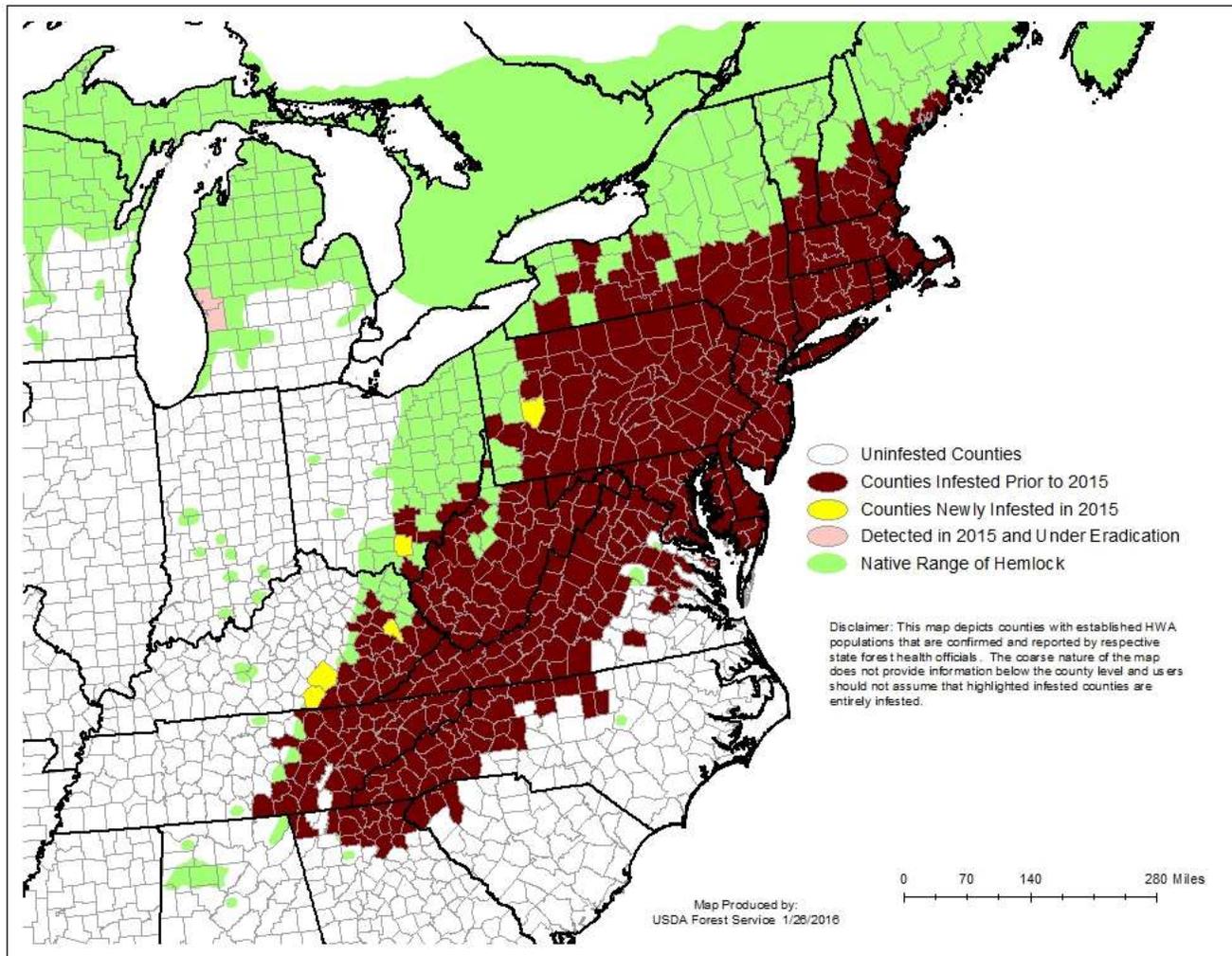


Dispersal

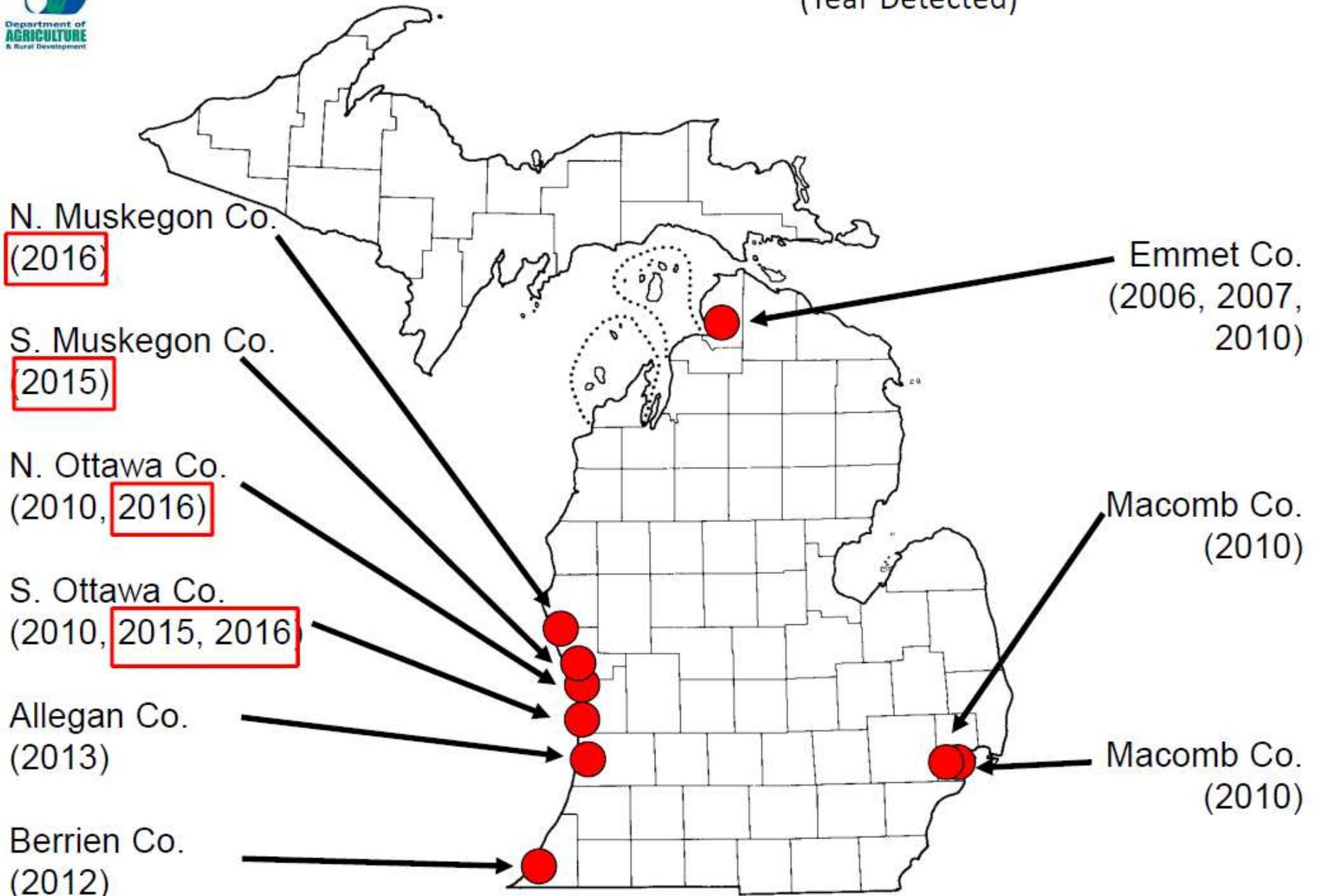




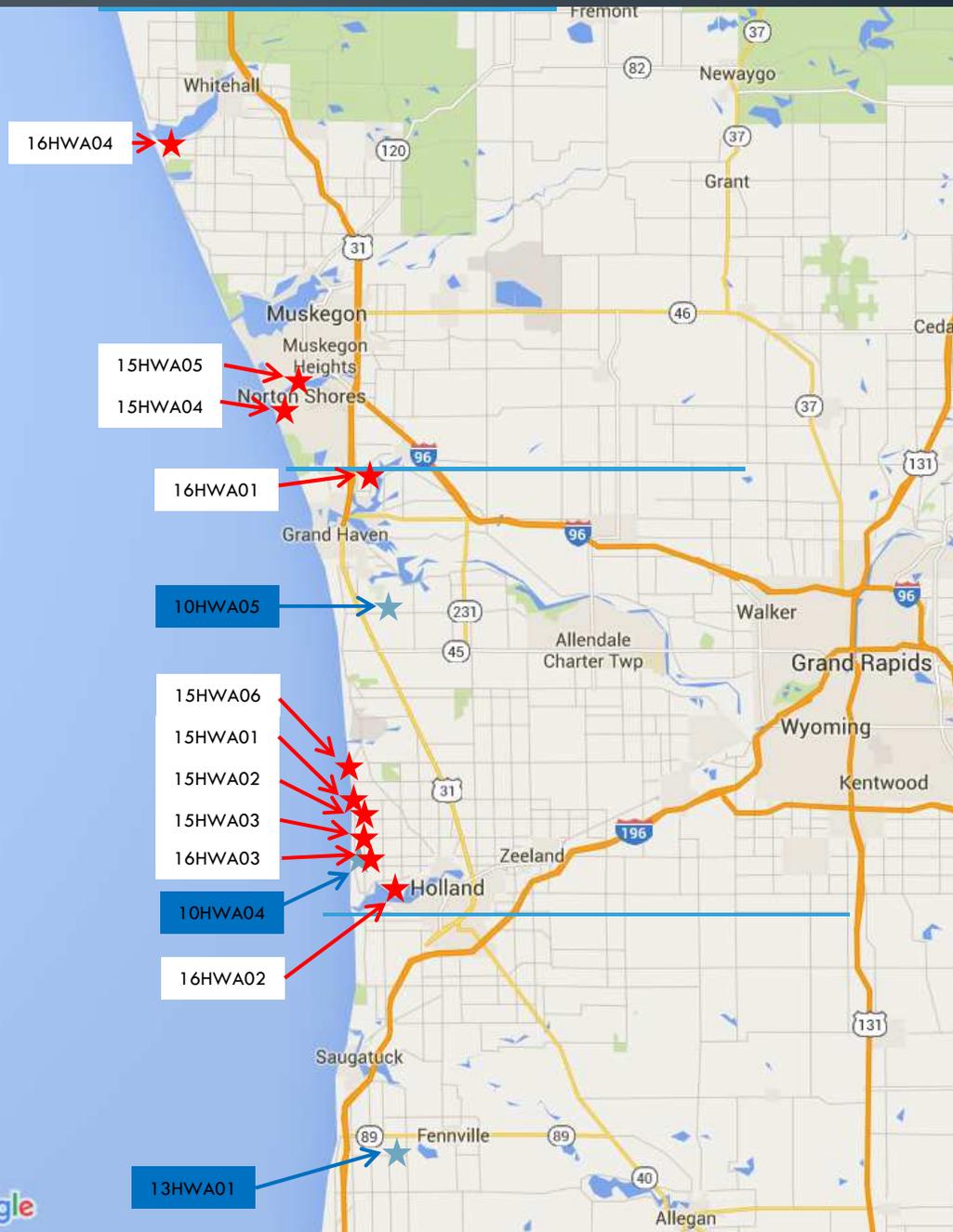
Hemlock Woolly Adelgid Distribution as of 2015



Hemlock Woolly Adelgid Infestation History in Michigan (Year Detected)

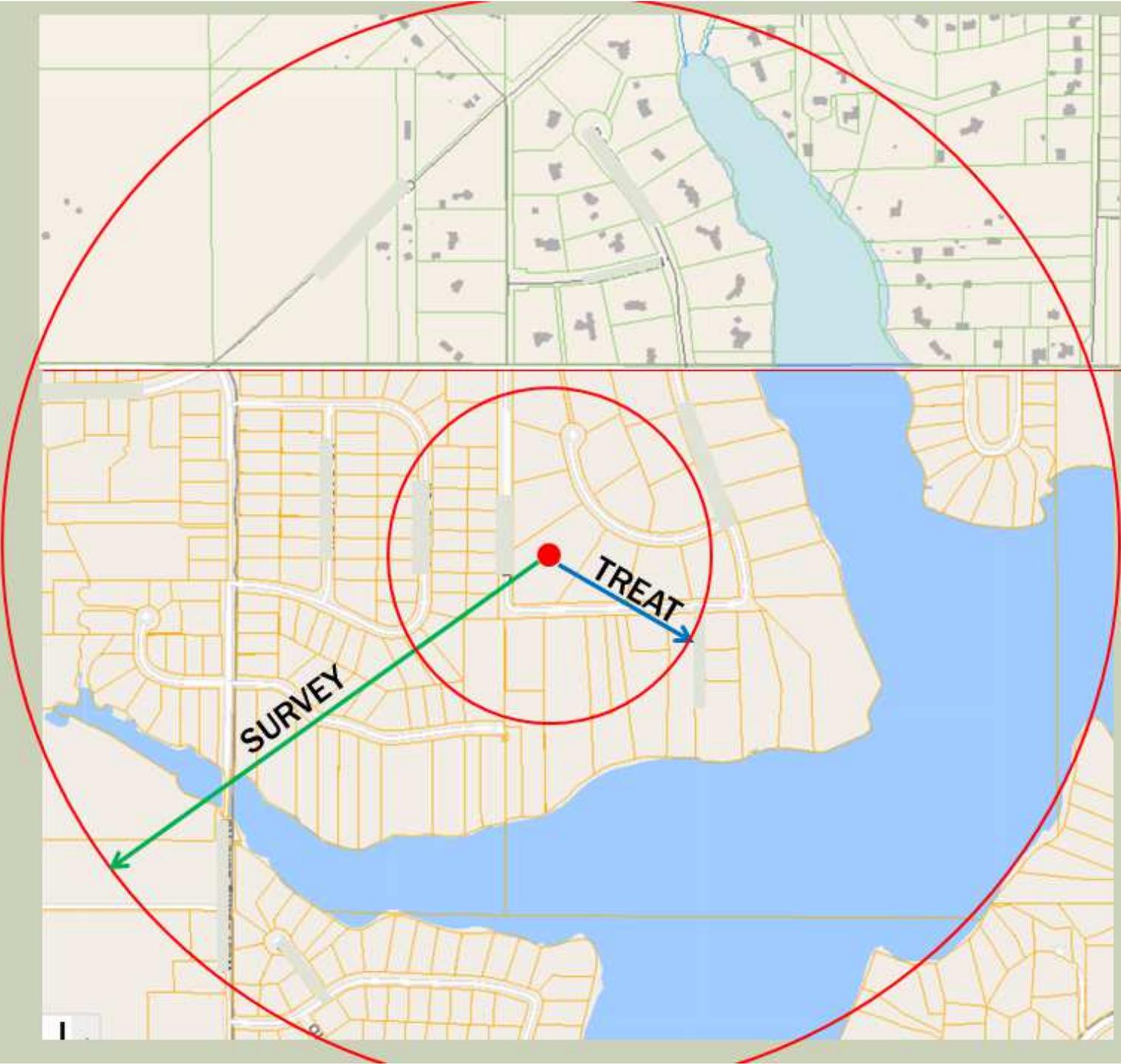


Allegan, Ottawa & Muskegon counties



16HWA01

**½ Mile
&
800 Foot
Buffer**





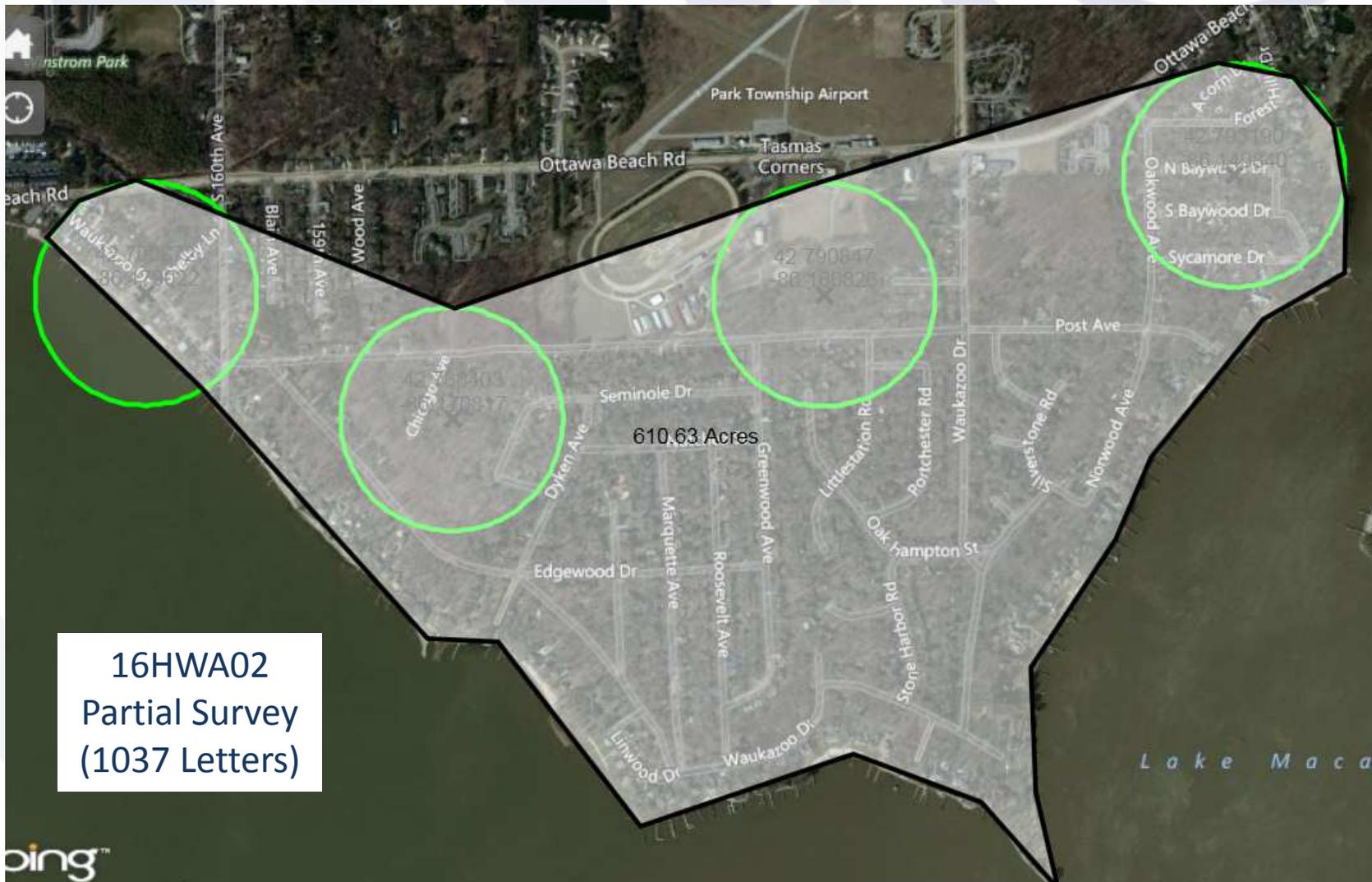
Holland/Park Township/Ottawa Co.



16HWA02
Partial survey
(1037 Letters)



Holland/Park Township/Ottawa Co.



16HWA02
Partial Survey
(1037 Letters)



Norton Shores/Muskegon County



15HWA04
Partial Survey
547 Letters





Communications

- **Week of 9/12/16** – Information about the HWA situation in West MI including treatment options mailed to ~240 licensed pesticide application businesses in Allegan, Kent, Muskegon, Oceana and Ottawa counties.
- **Week of 9/19/16** - Information about the HWA situation in West MI including treatment options mailed to ~2200 property owners in and around the known infested areas in Park and Port Sheldon townships and Spring Lake in Ottawa County; and Norton Shores and Whitehall in Muskegon County.
- **Public information meetings scheduled for:**
 - **10/3/16** – Park Township, Ottawa County
 - **10/5/16** – City of Roosevelt Park, Muskegon County



Treatments

GROUP	4A	INSECTICIDE
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Dinotefuran

2.0 SG INSECTICIDE

FOR FOLIAR AND SYSTEMIC INSECT CONTROL IN ORNAMENTAL PLANTS, VEGETABLE TRANSPLANTS IN ENCLOSED STRUCTURES.

For Greenhouse, Nursery, Interior Plantscape and Outdoor Landscape Use Only

Active Ingredient:
 Dinotefuran, [N-methyl-N'-nitro-N''-(tetrahydro-3-furanyl)methyl]guanidine) 20%
 Other Ingredients 80%
 Total 100%

EPA Reg. No. 86203-11-59639 EPA Est. 67545-AZ-01

**KEEP OUT OF REACH OF CHILDREN
CAUTION**
 SEE BELOW FOR ADDITIONAL PRECAUTIONARY STATEMENTS.

FIRST AID	
If on skin or clothing:	Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for further treatment advice.
If swallowed:	Call poison control center or doctor immediately for treatment advice. Do not induce vomiting unless told to do so by the poison control center or doctor. Have person sip a glass of water if able to swallow.

USER SAFETY RECOMMENDATIONS

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

FIRST AID (continued)

If inhaled: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment advice.

HOT LINE NUMBER

Have the product container or label with you when calling a poison control center or doctor or going for treatment. You may also contact 1-800-892-0099 for emergency medical treatment information.

Imidacloprid 2F

Turf & Ornamental Insecticide

FOLIAR AND SYSTEMIC INSECT CONTROL (including sod farms), landscape ornamentals, fruit and nut trees, and interior plantscapes. Personnel licensed or registered by the state to apply turf maintenance, nursery/greenhouse, etc. States may have more restrictive requirements regarding qualifications of persons using this product, structural pest control regulatory agency of your state prior to use of this product.

ACTIVE INGREDIENT: Imidacloprid, 1-[(6-Chloro-3-pyridinyl)methyl]-N-nitro-2-imidazolidinimine	% BY WEIGHT 21.4%
INERT INGREDIENTS:	78.6%
TOTAL:	100.0%

Contains 2 pounds of imidacloprid per gallon. Shake well before using.
 EPA Reg. No. 53683-229-73220

EPA Est. No. 53683-TX-002

**KEEP OUT OF REACH OF CHILDREN
CAUTION**

PRECAUCION AL USUARIO: Si usted no puede leer o entender ingles, no use este producto hasta que la etiqueta le haya sido explicada ampliamente. (TO THE USER: If you cannot read or understand English, do not use this product until the label has been fully explained to you.)

FIRST AID	
IF SWALLOWED:	<ul style="list-style-type: none"> • Call a poison control center or doctor immediately for treatment advice. • Have person sip a glass of water if able to swallow. • Do not induce vomiting unless told to do so by the poison control center or doctor. • Do not give anything by mouth to an unconscious person.
IF INHALED:	<ul style="list-style-type: none"> • Move person to fresh air. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. • Call a poison control center or doctor for further treatment advice.
IF ON SKIN OR CLOTHING:	<ul style="list-style-type: none"> • Take off contaminated clothing. • Rinse skin immediately with plenty of soap and water for 15-20 minutes. • Call a poison control center or doctor for treatment advice.
IF IN EYES:	<ul style="list-style-type: none"> • Hold eyelids open and rinse slowly and gently with water for 15 to 20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • Call a poison control center or doctor for treatment advice.

HOT LINE NUMBER

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact Prostar at 1-800-308-5391 for emergency medical treatment information.

NOTE TO PHYSICIAN

No specific antidote is available. Treat the patient symptomatically.

See inside booklet for complete Precautionary Statements, Directions for Use, and Conditions of Sale and Warranty

Net Contents: 1 Gallon

485-11-15
EPA 072007

Faster acting: 1-2 years control

Slower acting: 3-5 years control



Treatments

- Follow the label. It's the law.
- Both products have ACTIVE INGREDIENT per ACRE per YEAR use restrictions on their labels
- Yearly application records will be important to maintain
 - For all uses of imidacloprid and/or dinotefuran (Not just what is applied to hemlock)
- Application methods other than soil drench, soil injection or tablets should be considered when working in areas with coarse soils.



Treatments



Soil Injection

(Wear proper Personal Protective Equipment!)





Treatments

Basal Bark Spray





Treatments



Soil Drench





Treatments

Trunk Injection





Treatments

Tablets





Treatments



Foliar Sprays

- Horticultural Oil
- Insecticidal Soap
- Other



Insectaries/Biocontrol





Treatments

- **Mechanical/Physical Control**
 - Severely infested trees can be cut down and destroyed
 - In April - June, eggs and crawlers may be dislodged by hosing infested branches with a strong stream of water.
 - Heavily infested twigs/branches can be pruned out and destroyed.

Note: Neither of the last two practices, however, is effective enough to attain control without the use of other control options.



Best Management Practices

- **Don't move infested or potentially infested material**
 - Whenever possible, dispose of debris from infested hemlock on-site
 - When possible burn or bury cut infested branches (obtain burn permits as needed)
 - Drench cut stems and branches with soapy water (1/4 cup per gallon)
 - Cover debris for three weeks with a clear plastic tarp (if daytime temperatures are above 50°F)
- **Take down or empty birdfeeders and bird baths April – July, or move them at least 100 feet from hemlocks**
- **Limit activity in infested areas April - July. Brush off and wash clothing, vehicles and equipment after working in infested areas.**
- **Maintain proper soil moisture in hemlock root zones especially in times of low rainfall/drought**
- **Avoid the use of nitrogen fertilizers on infested hemlock**
- **Treat for other pests that may stress hemlock**
 - scales, mites, loopers, gypsy moth, etc.
- **Consider alternate species for future planting**



What not to do



Michigan HWA Quarantines

- **Exterior**
 - Regulates the movement of hemlock/hemlock materials *into* Michigan
 - In place since 2001
- **Interior**
 - Regulates the movement of hemlock/hemlock materials *within* Michigan
 - Proposed implementation by 2017

Visit www.michigan.gov/pestquarantines for more information



Education/Outreach Materials

NEW !– Just posted to MDARD HWA webpage 9/19/16

HEMLOCK WOOLLY ADELGID IN MICHIGAN

Recommendations for Landowners

September 2016 www.michigan.gov/HWA

❑ What is Hemlock Woolly Adelgid?

The Hemlock Woolly Adelgid (*Adelges tsugae*) or HWA, is an invasive, aphid-like insect that attacks North American hemlocks. HWA are very small (1.5 mm) and often hard to see, but they can be easily identified by the white woolly masses (ovisacs) they form on the underside of branches at the base of the needles. These masses or ovisacs can contain up to 200 eggs and remain present throughout the year.

White woolly ovisacs on a branch of eastern hemlock



Connecticut Agricultural Experiment Station, Bugwood.org

❑ How did it get here?

Native to Asia, HWA was introduced to the western United States in the 1920s. It was first observed in the eastern US in 1951 in Virginia after an accidental introduction from Japan. HWA has since spread along the East Coast from Georgia to Maine and now occupies nearly half the eastern range of native hemlock where it has become a devastating pest. HWA can be moved from tree to tree by birds, other wildlife, the wind, and on gear, equipment, clothing, infested nursery stock or other hemlock materials. HWA is most easily spread April through July. HWA is believed to have arrived in Michigan on infested hemlock nursery stock that was brought in either prior to, or in violation of, Michigan's exterior HWA quarantine which was first implemented in 2001. The quarantine prohibits the importation of hemlock nursery stock into Michigan from areas outside of Michigan that are known to be infested with HWA. For more information on the Michigan HWA quarantine visit: www.michigan.gov/pestquarantines.

❑ What trees are affected?

All species of hemlock are vulnerable to attack. Severe damage and death of eastern hemlock (*Tsuga canadensis*) has been documented. Eastern hemlock is the most common species of hemlock in Michigan. For information on "Hemlock Tree Identification" visit www.michigan.gov/HWA.

❑ What does HWA do to trees?

Once hatched, juvenile HWA, known as crawlers, search for suitable sites on the host tree on the twigs at the base of the needles. They insert their long mouthparts and begin feeding on the tree's stored starches. HWA remain in the same spot for the rest of their lives, continually feeding and developing into adults. Their feeding severely damages the canopy of the host tree by disrupting the flow of nutrients to its twigs and needles. Tree health declines and mortality usually occurs within 4 to 10 years.

HWA infested counties/Hemlock native range



Map produced by USDA Forest Service 1/26/06

Tree mortality caused by HWA



Jason van Dineche, Bugwood.org

Options for Protecting Hemlock Trees from Hemlock Woolly Adelgid

DRAFT – September 2016

I

Hemlock woolly adelgid (*Adelges tsugae* Annand), a tiny aphid-like insect native to Japan, is one of the most damaging invasive forest pests in eastern North America. Since it was discovered in 1951 in Virginia, this pest has been spreading across much of the range of eastern hemlock (*Tsuga canadensis*). It has killed hundreds of thousands of hemlock trees in states along the east coast, much of New England, Pennsylvania and parts of New York. Localized populations of hemlock woolly adelgid (HWA) were recently found in areas of Ottawa and Muskegon Counties in western Lower Michigan. Surveys are ongoing and there may be other infestations that have not yet been detected.

Biology and impacts of HWA

The adelgids feed at the base of needles by inserting their long stylets into the woody shoots and sucking up moisture and nutrients. For much of the year, HWA life stages are protected beneath the white "wool" on the hemlock shoots. This "wool" is actually filaments of wax secreted by the adelgids as they feed. There are two generations of HWA each year and all individuals are females. This means the density of HWA can build rapidly. Natural enemies such as native predators and parasitoids do not attack HWA. Extremely cold winter temperatures has caused some HWA mortality in the eastern US, but populations may build back up within a few years. Hemlock woolly adelgids will not fly, but life stages can be blown in the wind or transported on birds, animals or even on clothing. Long range spread of HWA occurs when people transport and plant infested hemlock nursery trees into new areas.

In Michigan, the hemlock trees growing in landscapes, forests and riparian areas along streams or rivers are all vulnerable to HWA. High densities of HWA will cause needles and buds to die, canopies to thin and foliage will often take on an unhealthy grayish-green color. Trees typically succumb after 4-10 years of infestation, depending on the vigor of the tree, winter weather and the density of the HWA population. Additional stress from drought, poor growing conditions or other pests can result in more rapid mortality.

Options for HWA control

Valuable hemlock trees in landscapes can be effectively protected from HWA. For now, Michigan arborists and property owners will need to rely on recommendations developed in eastern states. Eventually, we hope to evaluate and refine HWA control tactics for Michigan conditions. It will be important to keep up to date with the HWA situation in Michigan, particularly in or near areas where HWA is already established.

Systemic insecticides

In the eastern U.S., many hemlock trees are regularly treated with systemic insecticides containing imidacloprid or dinotefuran. These products are most often applied as a soil drench, a soil injection or as a basal bark spray to the lower 4-5 feet of the trunk. Systemic insecticides, including imidacloprid and dinotefuran, are carried in the cells that transport water from the roots to the foliage. These products should ideally be applied to hemlocks in spring or fall, when soils are not too dry nor too wet. As with any insecticide, be sure to read and follow the directions on the label. There are restrictions on the amount of imidacloprid or dinotefuran that can be applied per acre per year. This may be an important consideration when multiple hemlocks on a given property are infested.

Imidacloprid products move relatively slowly into trees, up the trunk and into the branches and shoots where the HWA feed. It may take up to a year for the insecticide to be fully distributed throughout the canopy and control HWA, especially on large trees. A single imidacloprid application, however, should control HWA for at least five years and one study reported seven years of HWA control.

Many products containing imidacloprid are available but some can only be applied by Certified Pesticide Applicators. Other products can be purchased on-line or at garden stores by homeowners who wish to treat hemlocks on their own property. Products available to homeowners are applied as a soil drench around the base of the tree. The amount of insecticide needed will be based on the diameter of the tree, measured 4.5 feet above ground. Mix the proper amount of insecticide with water in a bucket, following label directions. Rake needles and leaves away from



www.michigan.gov/HWA

Invasive Species Home 

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Michigan Invasive Species

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Insects

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Take Action

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Permits

Control & Management

INVASIVE SPECIES / SPECIES PROFILES & REPORTING INFORMATION / INSECTS

Hemlock Woolly Adelgid

(*Adelges tsugae*)
Detected in Michigan

WATCH LIST

Report this species:

If you notice white, waxy material at the base of the needles on hemlock trees, to prevent spread, do not remove potentially infested material from the site. Take photos, note the location of the affected trees and report it to:

Michigan Department of Agriculture and Rural Development, MDA-Info@michigan.gov or phone the MDARD Customer Service Center, Call: 800-292-3939.

If possible, please take one or more photos of the invasive species you are reporting. Also make note of the location, date and time of the observation. This will aid in verification of your report. You may be asked to provide your name and contact information if follow-up is needed.

- Or - use the Midwest Invasive Species Information Network (MISIN) online reporting tool - <http://www.misin.msu.edu/report/>

- Or - download the MISIN smartphone app and report from your phone - <http://www.misin.msu.edu/tools/apps/#home>



MORE INFORMATION:

Muskegon and Ottawa Counties Hemlock Woolly Adelgid Information:

- [Hemlock Woolly Adelgid Informational Meeting Opportunities - 10-3-16 and 10-5-16](#)
- [Hemlock Woolly Adelgid in Michigan - Recommendations for Landowners - September 2016](#)
- [Options for Protecting Hemlock Trees from Hemlock Woolly Adelgid, DRAFT - September 2016 - MSUE](#)
- [Letter to Licensed Pesticide Application Businesses in Allegan, Kent, Muskegon, Oceana and Ottawa Counties](#)
- [Letter to Property Owners in Muskegon and Ottawa Counties](#)
- [Insecticide Label Guidance for Use Limits](#)



Midwest Invasive Species Information Network

www.misin.msu.edu

MISIN Midwest Invasive Species
Information Network

Welcome to MISIN, John ([My Account](#)) | [Logout](#)

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Hemlock woolly adelgid (*Adelges tsugae*)

Description: First described in western North American in 1924 and first reported in 1951 near Richmond, VA. It is a true bug native to East Asia.

Identification: Small, less than 1/16 in (1.5 mm) long and varies from dark reddish-brown to a purplish-black color. As it matures, it produces a covering of wool-like wax filaments to protect itself. They are parthenogenic, meaning all individuals are female.

Hosts: Native to Japan and China; Eastern hemlocks and Carolina hemlocks are most vulnerable. They can develop on all species of hemlock trees.

Life Cycle: Life cycle includes six stages of development: egg, four nymphal instars, and adult. They completes two generations a year on



[Report a Sighting of this Species!](#)

Species Summary

Common Name:	Hemlock woolly adelgid
Scientific Name:	<i>Adelges tsugae</i>
Family:	Adelgidae (Adelgid family)
Habit:	Insects

Search

MISIN Factsheets

List All, Plants, Animals, Common Name, Scientific Name or select:



Report suspect infestations



Phone

(800) 292-3939

MDARD Customer Service Center

OR

On-Line

www.misin.msu.edu

OR

Email

MDA-info@michigan.gov

Questions?



Michigan Department of Agriculture & Rural Development

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of Agriculture



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Mlagriculture