Michigan Department of Natural Resources

Forest Resources Division

2024

Forest Health Highlights

Introduction

During 2024, the Michigan Department of Natural Resources' forest health team got new recruits and hit the ground running.

The restructured Forest Health program includes a new entomologist, pathologist and invasive species response coordinator who report to the Forest Health Section Manager. It also includes a new operations manager to oversee an expanded Forest Health and Invasive Species Response Team covering all regions of the state.

New investments through the Bipartisan Infrastructure Legislation and an increase in funding for Michigan's Invasive Species Program provided us more boots on the ground to improve detection and management of forest health threats. Already it is paying off – new detections occurred for the first time in Marquette and Montmorency counties of oak wilt and Heterobasidion root disease, respectively. The team has detected expanded ranges for several forest health concerns: hemlock woolly adelgid, balsam woolly adelgid, oak wilt and Heterobasidion root disease. The team was also able to develop and implement a number of management plans to mitigate impacts from these issues around the state. Continued monitoring occurred to assess the success of previous treatments.

The team continued aerial survey support with the help of new hires, mapping issues like cyclical outbreaks of pests and disease epicenters. For example, jack pine budworm defoliation continues for the third year and spongy moth populations continue to collapse across the state. Looking forward, there are some good reasons for optimism. Improved early detection is made possible with more forest health staff and new tools. One new tool is the use of environmental DNA, or eDNA, to help detect invasive species. Efforts to breed trees that are resistant to invasive insects and disease increased dramatically. The DNR also has continued to increase collaboration, gathering partners to coordinate and amplify work across multiple agencies and organizations across multiple states. All of this is in addition to the increased capacity within our program and within our sister agency, the Michigan Department of Agriculture and Rural Development.

Our program is made possible by the USDA Forest Service, State, Tribal and Private Forestry Program, through the Cooperative Forestry Act of 1978. Our federal partners provide support, technical expertise and funding to each state to ensure the nation's forests are protected and that forest health issues are addressed through cooperation and coordination. This federal support is critical to ensuring we have adequate resources to meet the increasing need for coordinated forest health activities in Michigan's 20 million acres of forestland.

We look forward to 2025 with renewed enthusiasm and increased capacity. We stand ready to respond to the endless introductions of new invasive species while addressing those invasive and native pests already within our boundaries.

Yours in cooperation,

Sue Tangora,
Forest Health and Cooperative Programs Manager, MI DNR, Forest Resources Division

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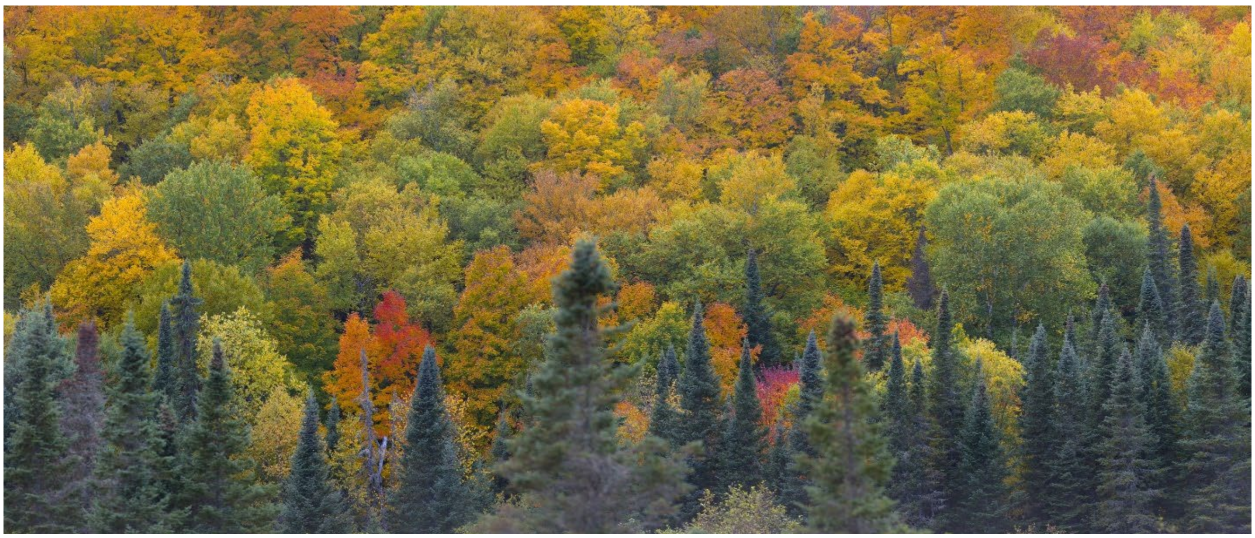
Key forest health highlights

Michigan DNR Forest Health Program: Protecting Michigan's Forests

Michigan is home to nearly 20 million acres of forests. Forests help provide diverse habitats across the state for many organisms like fish, birds, and mammals as well as humans. Many species rely on unique habitats found in Michigan to thrive including threatened and endangered species that need our help to survive. Maintaining the health of these forests is critical to preserve the diverse benefits of the ecosystems they provide.



Michigan is home to nearly 20 million acres of forests.

Today, Michigan forests face increasing pressure from native and non-native pests, diseases and invasive plants that threaten the health of the forest. Modern travel and transportation have made it easier for many pests, plants and diseases to find their way into the state in record time. These introductions can lead to invasive species establishments causing significant impacts to the environment, economy or human health. In addition, climate change has started a cascade of new issues within the state, amplifying the impacts of native pests. This contributes to tree stress that leads to more significant impacts. This, in turn, can cause historically minor native pests to have more significant impacts to Michigan trees.

But what happens when the health of our forests is negatively affected by native or invasive pests? Economies can suffer greatly when forest health issues arise and the beauty of the woods we love can be jeopardized. It is estimated that invasive insects alone cost the U.S. more than $2 billion per year and an additional $1.5 billion in lost property value (MI DNR, Forest Health Highlights 2023). Addressing forest health issues plays a vital role in protecting forest benefits making a forest health program a wise investment.

The DNR Forest Resources Division's Forest Health Program focuses on Michigan's state forests covering nearly 4 million acres. State forests provide clean air and water, multiple recreational opportunities including hunting, fishing, foraging, off-road vehicle trails, birding, and hiking, and support a strong forest products industry. These forests consist of diverse trees, shrubs, and other plant species, providing habitat for animals from deer, turkey, and bears down to small organisms such as insects, salamanders, turtles, and mushrooms. Furthermore, the program assists land management professionals with identification, prevention, and, if needed, recommendations for controlling forest health issues.

In recent years, the program has evolved to include a focus on mitigating the growing threat of forest health concerns. Today a team of forest health specialists work with other experts to chart program direction. Regional forest health foresters develop and implement management plans while working closely with partners. These foresters are a new addition to the program and have already increased the program's ability to detect and respond to forest health issues in a timely fashion.

Logging equipment adapted to spray chemicals on cut stump to prevent Heterobasidion Root Disease infection.

The program also has been able to increase capacity to work with forestry professionals through outreach and education. Providing expertise to and communicating with partners has strengthened our ability to better understand the issues plaguing Michigan forests, allowing the program to mitigate their impacts to a higher level.

The program gives guidance on forest health concerns to inform management plans and decisions such as the State Forest Management Plan, Forest Action Plan and specifications for state timber sales which may place restrictions on harvesting depending on tree species and distance to known pests like oak wilt and Heterobasidion root disease.

Staff conduct aerial and ground surveys covering over 19 million acres each year to assess the health of Michigan forests. Staff consult local DNR land managers or conduct site visits to state forest land to determine the cause of a problem.

The Forest Health Program and partners have been addressing forest health issues for decades dating back to 1950. Some issues, like oak wilt, have been managed since the early 1950s. Thanks to many of these efforts, we still have a large oak resource on the landscape. Others like balsam woolly adelgid, beech leaf disease and spotted lanternfly are new to the state, detected in the last few years. For more information on the current status of Michigan forest health concerns, visit Michigan.gov/ForestHealth and click on "Annual Forest Health Highlights."

Forester tagging HWA infected tree for treatment

But the Forest Health Program can't do it alone. We work with many internal and external partners to increase and share knowledge, research, and experience. Partners include the National Forest Service, Michigan State University, Michigan Technological University, and Conservation Districts, to name a few. Having access to the latest research is critical to effectively manage invasive species in cooperation with partners.

Annually, program staff-led trainings for DNR forestry staff around the state on the importance of identification, reporting, risk tolerance, and mitigation. Staff also train local Conservation District, Forestry Assistance Program staff and other forestry professionals, on issues to better assist private landowners with their needs.

Highlights from the Highlights: Statewide, there was a decrease in areas impacted by the current spongy moth outbreak. Defoliation peaked in 2021 when over 1.3 million acres were mapped in annual aerial surveys. This dropped to 168,000 acres mapped in 2024 after spongy moth predators and diseases caused a population collapse. Localized areas of defoliation continued in several areas of the state with the primary defoliation occurring in southwest Michigan.

Hemlock woolly adelgid (HWA) continues to be a top priority in the state. Through the combined efforts of the DNR and partners, we continue the fight to protect our hemlock resource in both the northern Lower and Upper Peninsulas from HWA through targeted surveys and treatments. Currently, HWA is only known to be in the lower peninsula along the western lakeshore as far north as Antrim County, but a small population can be found in Washtenaw County. The native jack pine budworm outbreak continued to cause concern for the third year across areas of the northern Lower and Upper Peninsulas in 2024. Outbreaks usually only last four years. Typically, jack pines younger than 45 years old can withstand severe defoliation over multiple years. Severe impacts in older, over-mature jack pine stands include top dieback and death.

The future of forest health includes the development of pest resistant trees to replace species devastated by invasive insects and diseases. The program assists with identifying and breeding potentially resistant or tolerant ash, beech, and elm to help with restoration efforts through the Great Lakes Basin Forest Health Collaborative

Foresters work to harvest branches from a disease resistant tree to propagate new seed-producing trees.

Additional resources on Michigan forest health issues:

1. The Michigan DNR forest health webpage shares insect and disease threats to Michigan's forests through online interactive maps, the annual Forest Health Highlights report, and a wealth of other information. Visit www.michigan.gov/foresthealth. For previous Forest Health Highlights, visit Forest Health Highlights (usda.gov)
2. For information on state forest management and planning, visit: Michigan.gov/Forestry
3. For more information on the Michigan Invasive Species Program, including invasive plants, visit Michigan Invasive Species Program
4. The Michigan Association of Conservation Districts provides local natural resource management. Many have a Forestry Assistance Program forester available for outreach and technical assistance. To find a FAP forester for your area, please visit MDARD - Forestry Assistance Program (michigan.gov).
5. Cooperative Invasive Species Management Areas are partnerships that work to address invasive species impacts within a defined region. To find a CISMA near you, visit Invasive Species: Local Resources (michigan.gov).
6. To learn how you can help in the efforts to find resistant trees, go to Treesnap.org

Eastern white pine.

Michigan State University – McCullough Forest Entomology Lab

The invasive forest insects just keep coming and if they weren't enough, invasive plants and tree pathogens also affect Michigan forests.

We are continuing our research with hemlock trees in western Lower Peninsula sites where hemlock woolly adelgid (HWA) is established. Recent projects have included a dendrochronological study (study of tree rings) to evaluate effects of HWA infestation on radial growth and to see whether radial growth recovers following insecticide applications. Spoiler alert – HWA feeding leads to a dramatic reduction in annual growth rates as needles drop and canopies become thin and transparent.

Ava Stallman labels a red oak for her oak wilt study.

Applying imidacloprid or dinotefuran controlled HWA and we can see radial growth of treated trees increased somewhat compared to untreated trees. Other HWA-related projects under way include a so-called "Lazarus" study to determine whether trees in poor condition can recover if they are treated with dinotefuran. This insecticide, which is 80 times more water soluble than imidacloprid, is more readily transported in trees and can control HWA within weeks rather than months.

Ava Stallman, a master of science graduate student in Forestry, is currently working on projects related to red oaks, oak wilt and the Bretziella fagacearum fungus that causes this disease. She conducted a greenhouse study to assess effects of paclobutrazol (a plant growth hormone) and propiconazole on young red oaks inoculated with the fungus or left as untreated controls. Ava also launched a large-scale field study in 2024 in an oak wilt infection center on state forest land to test both compounds on mature trees.

Tim Harrison, a master of science graduate student in Entomology, is working with spotted lanternfly, Michigan's newest invasive forest insect. Tim worked in areas where lanternfly populations were either very low or very high to assess development and captures by life stage. Newly designed "lampshade" traps on tree of heaven appear to attract adult female lanternflies, who lay their eggs on or beneath the traps. Tim is also

Lampshade traps attract adult female lanternflies.

determining if systemic insecticides applied in summer to protect maple trees from SLF will affect sap and syrup.

Adult spotted lanternflies.

Recently completed studies include documenting the distribution and impacts of beech bark disease in northern Lower and Upper Peninsulas, identifying optimal treatments to control chestnut weevil larvae in freshly harvested chestnuts, and tracking spread of the invasive Asian chestnut gall wasp along with its specialized and highly effective parasitoid. We quantified annual radial growth and survival of four North American and two Asian ash species planted as whips in 2007 in a common garden and exposed to emerald ash borer for more than 12 years.

Chinese ash killed by EAB

We also continued to monitor growth and survival of blue ash (*F*raxinus quadrangulata) in a provenance test. Blue ash is as resistant to the ash borer as Manchurian ash, a species native to Asia that co-evolved with the insect. These trees, now 8 to 9 years old, were grown from seeds collected from 12 populations of blue ash in six states. Detailed summaries of projects focusing on EAB impacts on black ash forests and native longhorned beetle diversity are described below.

Can Black Ash Bounce Back? A Look at Regeneration in the Wake of Emerald Ash Borer

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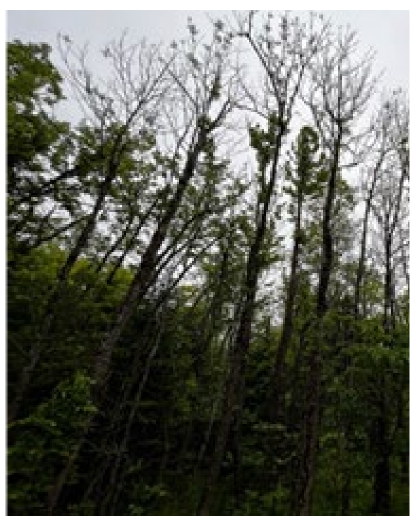
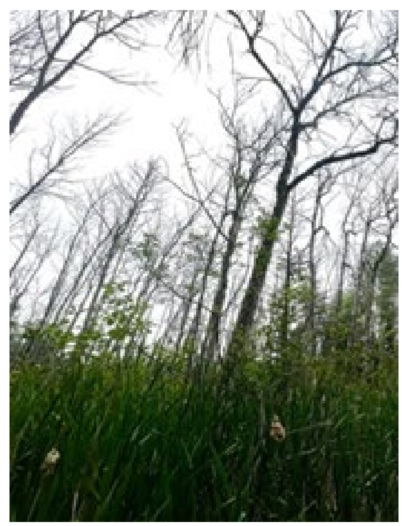
Black ash is a foundational wetland species that is prevalent in northern Lower Michigan and the Upper Peninsula, where it plays key roles in regulating water tables and nutrient cycling. Unfortunately, black ash is the most preferred host and the most vulnerable species of all the North American ash species encountered to date by emerald ash borer (EAB; *Agrilus planipennis* Fairmaire). Recent projections have shown that EAB is likely to extirpate black ash across its native range in the eastern US and Canada by 2040-2050.

To better understand impacts of EAB on black ash forest communities, we surveyed 24 black ash stands in Michigan, the state with the longest history of EAB invasion. These stands were selected to represent conditions ranging from Post- to Mid- to Pre-Invasion. Variables measured included abundance, radial growth and condition of black ash regeneration. Results show that black ash recruits (DBH 2.5-10 cm) in Post-Invasion stands, where all overstory ash were killed by EAB, had higher annual ring widths (1.42 ± 0.25 mm) than recruits in Pre-Invasion stands (0.75 ± 0.09 mm).

Pre-Invasion



Mid-Invasion



Post-Invasion

This indicates that black ash recruits are released as overstory trees die and more light penetrates the canopy. Despite increased growth, an average of 56% (± 8%) of black ash recruits in Post-Invasion stands are dead, compared to 24% (± 10%) in Mid- and 12% (± 13%) in Pre-Invasion stands. Additionally, a higher proportion of live black ash recruits in Post-Invasion stands (52 ± 10%) and Mid-Invasion stands (58 ± 15%)

have been infested by EAB compared to Pre-Invasion stands (8.5% ± 2%). Given these results and the ongoing spread of EAB, the likelihood that young black ash recruits will survive, reach the overstory and produce seed appears to be limited.

(Left) A technician visually evaluates a black ash recruit in a Pre-Invasion stand. (Center) Technicians collecting data in a Post-Invasion stand. (Right) A graduate student extracts an increment core from an overstory black ash tree to quantify annual growth.

Diversity and abundance of native longhorn beetles in urban and forested sites

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Native longhorn beetles (*Cerambycidae*), which feed in phloem and sapwood of dying or newly dead trees, play important roles in nutrient cycling and decomposition, but often, little is known about the distribution, abundance or host range of many native species. From 2017-2023, we deployed two cross-vane panel traps baited with a broadly attractive sex-aggregation pheromone at 15 sites for 3-7 years. Within each site, a "canopy" trap was suspended from a low to mid canopy branch (3-5 m) and a "ground" trap was supported on rebar, 1.5 m aboveground. Sites varied from small urban parks with relatively few trees to large forests surrounding campgrounds or recreation areas. We assessed overstory tree species and coarse woody debris (>10 cm diam) in fixed radius plots and linear transects, respectively, centered on the traps. Land use classes within a 1 km radius were identified to quantify forested land that may support the development of longhorns.

A cross-vane canopy trap and ground trap deployed in a forested site.

Example of Orthosoma brunneium, a native longhorned beetle that develops in decaying wood. Adult beetles stridulate (squeak) by rubbing their wings over their abdomen to communicate and attract mates.

Between 2017 and 2023, we captured and identified 10,215 longhorn beetles representing 86 unique species. On average, 7 (± 0.9) to 21 (± 2.2) beetle species were captured per site each year. The most frequently captured species was *Neoclytus m. mucronatus*, with 2837 individuals. This reddish beetle with yellow, and black markings develops in decaying hardwood trees. It is known as a wasp mimic, both because of its color and its habit of waving its hind legs around, which sort of look like wasp wings. Ground traps captured more beetles than traps in tree canopies but numbers of species were similar. Traps in urban sites with small pockets of trees captured more beetles than traps in forested sites. Number of beetles and species captured was related to the basal area of snags (standing dead trees) but not to the abundance of logs on the ground (coarse woody debris).

Surveys and observations

Noteworthy 2024 pest activity

The following tables share data for a series of frequently reported pests and diseases causing major and minor forest health impacts in 2024. These are not comprehensive lists of all reported pests.

Name	Hosts	Status	Impact	Signs	Symptoms	Goal
Diplodia shoot blight	Red, jack and ornamental pines	Common statewide	Seedling/sapling mortality, defects	Microscopic fungal structures, shoots, cones	Stunted straw-colored needles on shoots, sticky resin, dead branches and seedlings	Avoid susceptible pine overstory, reduce tree stress
Dwarf mistletoe	Primarily black spruce	Range of black spruce	Mortality	Yellow/orange aerial mistletoe shoots	Witches brooms, decline	Eliminate infected trees
Eastern larch beetle	Tamarack	Limited activity	Mortality	Small holes, reddish boring dust, tunnels under bark	Resinous sap ooze, tree death	Sanitation, stand health
Emerald ash borer	Ash species	Detected statewide	Mortality	1/8 inch "d" shaped holes, "s" shaped tunnels under bark, cream colored larvae with bell-shaped segments	Canopy thinning and dieback, trunk sprouts	Avoid planting, promoting ash; identify lingering trees
Larch casebearer	Tamarack	Limited activity	Tamarack decline	Camouflaged cases protecting larvae	Bleached/straw-colored needles	Promote tree health
Satin moth	Aspen, oak, willow	Extensive defoliation on Isle Royale	Tree stress, top kill, mortality	Larvae, silk webbing and pupae in rolled leaves	Defoliation in spring, skeletonized leaves in summer	Promote tree health
Redheaded pine sawfly	Primarily jack and red pine	Low activity	Threat to pine seedlings	Groups of larvae on branch tips	Defoliation, mortality	Minimize plantation edges and competition
White pine weevil	Pine, spruce	Common statewide	Poor tree form	Feeding punctures, oviposition punctures in leaders	Crooked, wilted leaders oozing resin, leader mortality	Pruning, dense plantings
Anthracnose	Many hosts	Common statewide	Aesthetic	Microscopic fungal structures	Dark blotchy lesions, leaf drop	Promote tree health
Melampsora leaf rust	Aspen species	Extensive in Upper Peninsula	Aesthetic	Lemon to orange pustules on lower leaf surface	Yellow leaf spots progressing to brown leaves	Promote tree health, limited impact
Fall webworm	Many species	Common statewide	Limited tree stress	Silk nests at ends of branches	Defoliation	No treatment necessary, can prune out webs
Oak skeletonizer	Oaks	Low activity	Aesthetic	Silk cocoons on nearby objects, larvae hanging from silk threads	Brown leaves with holes and surface damage	No treatment necessary

Eyes in the sky help detect pockets of pests, disease in forests

Michigan is the 11th largest state in the United States with approximately 37.5 million acres of land. Roughly half of Michigan's land mass is forested in addition to scattered trees and forested parcels in or near urban areas. Estimates suggest there are roughly 11.4 billion trees in Michigan that are larger than one inch diameter at breast height. Knowing that forest health issues can get started anywhere in the state, that is a large number of trees to keep an eye on over a vast area.

Looking for problematic trees or even conducting formal surveys on the ground aren't enough to catch issues before they severely impact forested stands or spread throughout the state. That's where an eye in the sky comes in handy. Michigan's Forest Health Program in the Forest Resources Division at the DNR conducts annual aerial surveys of forested areas to look for major issues. On average, the program surveys 20 to 24 million acres each year to detect issues including tree damage from insects, diseases, severe weather events, climatic extremes and other causes. In 2024, damage was detected on 324,000 acres. Data gathered from the air is critical for wildland fire fuels assessments, timber salvage, forest management planning, forest health research and to develop training for land managers. Aerial surveying allows the forest health program to view forest health issues on a broad scale across land ownerships. Then, the team can set priorities for on-the-ground efforts.

2024 Aerial survey results

Causal agent	Acres
Spongy moth	168,879
Jack pine budworm	81,664
Forest tent caterpillar	45,120
Oak decline	20,301
Unknown	3,432
Spruce budworm	2,470
Larch casebearer	2,257
Wind-tornado/hurricane	343
Beech bark disease complex	110
Fire	83
Oak wilt	59

Aerial view of defoliation.

Both native and non-native insects are detected during aerial survey. Native defoliators such as forest tent caterpillar, cherry scallop moth, large aspen tortrix, spruce budworm, and jack pine budworm strip trees of leaves and can be quite visible in surveys. These species have cyclical outbreaks lasting a few years before populations crash due to predation, parasitoids and/or diseases. While they may not often kill otherwise healthy, vigorous trees, they can contribute to decline and mortality when trees are already stressed for other reasons. These outbreaks can be good for the overall health of the forest by removing older, stressed, and struggling trees to allow younger, more vigorous trees to take their place. Knowledge of impacted stands provided by aerial surveys can also allow land managers to plan treatments in response. While it's always hard to lose a large, older-aged tree, nothing lives forever, and discovering and managing the issue provides an opportunity to allow the forest to thrive once more.

Some non-native defoliators can become invasive and have particular impacts to forests. However, spongy moth, introduced from Europe more than a century ago, is now "naturalized" in Michigan's forests and behaves more like a native pest. Spongy moth outbreaks typically last two to three years and recur every seven to 10 years. Defoliation peaked in 2021 with 1.4 million acres mapped through aerial survey. We watched the defoliation move across the state and it is now collapsing in the southwestern Lower Peninsula. During aerial survey in 2024, just under 169,000 acres of defoliation were mapped.

Besides defoliators, aerial surveys pick up aggressive tree-killing diseases. Surveyors look for pockets of dead or dying red pine and oak trees that may suggest Heterobasidion root disease or oak wilt. These diseases can have big impacts and once established, they can continue to spread to adjacent trees. New detections of these diseases are often the result of on-the-ground follow-up from aerial surveys.

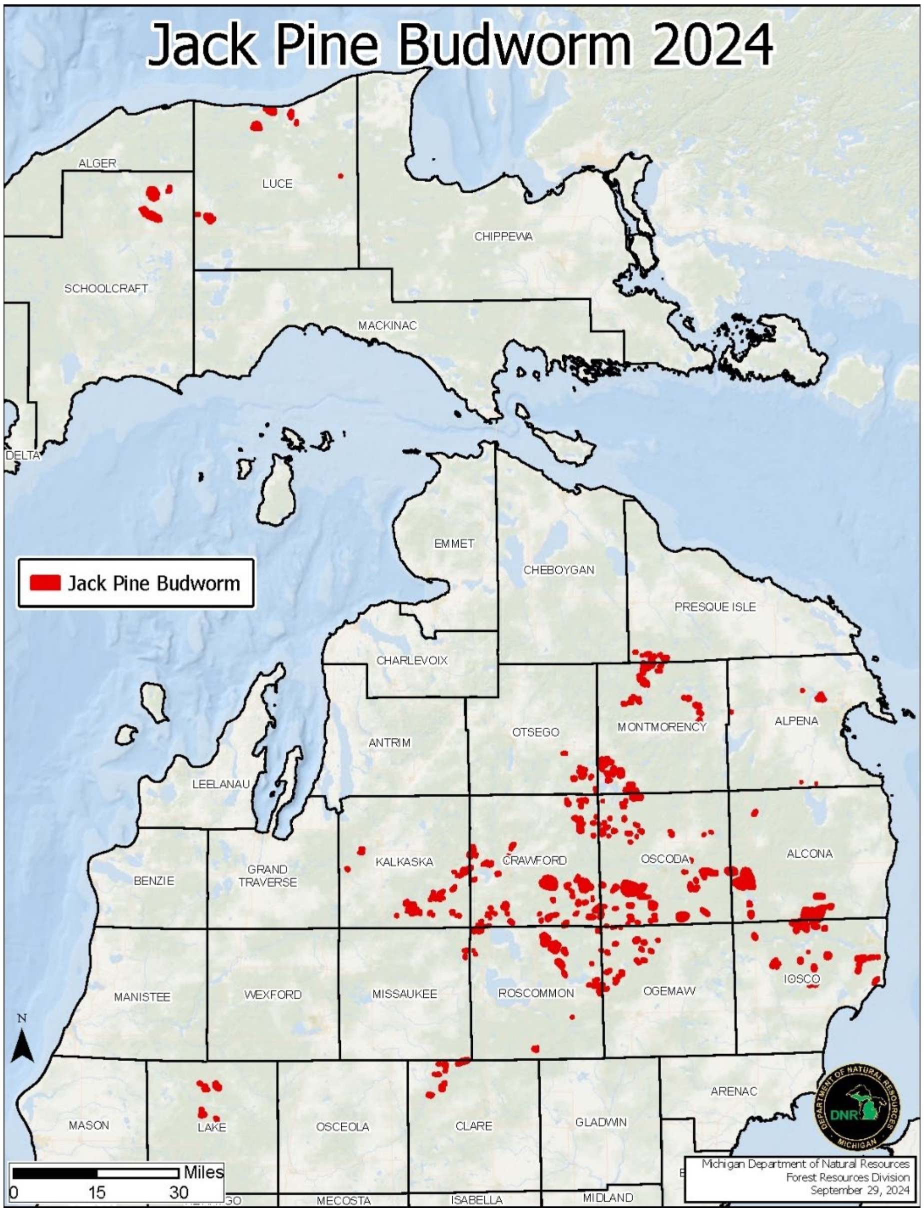
Aerial photo of jack pine budworm defoliation.

Pests and diseases aren't the only issues aerial surveys can help with. In cases with extreme weather, storm damage may be mapped to help salvage timber. Mapping may also occur after a wildfire or a late spring frost to define the extent of the impact. Mapped information is important for land examiners so they can better manage the forest to mitigate a variety of factors that can stress or kill trees.

Insects

Still here: Jack Pine Budworm Outbreak Continues Its Cycle

The native jack pine budworm caused ongoing concern across Michigan's northern Lower and Upper Peninsulas in 2024. This insect, a periodic troublemaker, has a well-known cycle, erupting in outbreaks every six to 12 years. These outbreaks tend to be brief, typically intensifying over two to four years before collapsing to low or even undetectable levels due to predators, parasites, diseases and even some bird species.



Map of jack pine budworm defoliation in 2024.

In 2024, the outbreak continued to intensify in the northern and eastern Lower Peninsula, while the eastern Upper Peninsula saw only scattered defoliation. Over 81,000 acres of forest were impacted. This is a notable increase from the 63,000 acres affected in 2023.

However, current-year estimates include defoliation mapped in the Huron National Forest which was not fully mapped in 2023. Given that this outbreak has been ongoing for three years, it is expected to naturally subside in the next year or two. The last major outbreak occurred from 2012 to 2015, peaking at 118,000 acres of defoliation in 2015, primarily in the northern Lower Peninsula, with a few smaller affected areas in the Upper Peninsula's Luce and Schoolcraft counties.

Younger jack pines (under 40-45 years old) tend to bounce back even after suffering multiple years of heavy defoliation. However, jack pine is a short-lived species where older, over-mature stands are more vulnerable, often suffering from top-dieback and eventual death. This dieback can increase the fuel load for wildfires, creating an additional threat. Stands that are already stressed by factors such as poor, sandy soils or drought are particularly susceptible to severe damage. To mitigate these risks, current forest management practices focus on harvesting jack pine trees before they reach the point of vulnerability. This helps reduce the impact of the budworm outbreaks on the forest ecosystem.

Jack pine budworm pupal case and damage.

Watch Out for the Asian Longhorned Beetle in Michigan

The Asian longhorned beetle – often referred to as ALB -- is a threat to Michigan's trees, especially maples, and could cause serious damage to both the environment and economy. Although this beetle has not been detected in Michigan yet, it's important to stay alert and report any suspicious sightings.

Adult ALB and signs of infestation (exit hole and egg). Source: Kenneth R. Law, USDA APHIS PPQ, Bugwood.org

The adult beetle is about 1.5 inches long, shiny black with irregular white spots, and has long, black-and-white striped antennae that can be 1.5 to 2.5 times its body length. Its legs and feet can have a bluish cast to them. The beetle feeds on several types of trees, including maples, elms, birches, and poplars.

While it's often hard to spot the beetle itself, people are more likely to notice damage to trees. The best time to look for signs of infestation is in the fall after the leaves have fallen but before snow covers the ground, or when branches from affected trees start breaking. Signs of an ALB infestation include round exit holes on trees about the size of a pencil, and dime-sized depressions in tree bark where the beetles lay their eggs. These are signs that the larvae have been tunneling into the tree, causing structural damage. If you see these signs and notice the tree's health declining, it's important to contact experts to investigate further.

Example of ALB damage in wood.

The closest known infestation to Michigan is in southwest Ohio, discovered in 2011, but thought to have been established in the area in the early 2000s. Eradication efforts are still ongoing but it is evident that the population is being reduced. Some satellite infestations have been eradicated, and eradication of the main infestation is anticipated in the near future. Other infestations in places such as Massachusetts

Adult ALB and larval tunnels.
Source: E. Richard Hoebeke, Cornell University, Bugwood.org

and South Carolina have also caused millions of dollars in damage. Early detection is critical to allow for effective and efficient eradication. Later detections may result in a successful eradication, but it would be more costly and less likely to succeed.

To help prevent the beetle from spreading, it's crucial not to move untreated firewood or packing materials, as these are common ways the beetle and other invasive insects and diseases are able to travel long distances. Local residents play an important role in detecting and reporting any signs of the beetle.

If you think you've found an Asian longhorned beetle, collect it if possible, take a picture and report it immediately to 1-800-292-3939 or MDA-Info@Michigan.gov. Store the beetle in a container or zip-lock bag in the freezer until experts can examine it. Early detection is the best way to protect Michigan's trees from this destructive pest.

Keep your eyes peeled for signs of Spotted Lanternfly

Since the first detection in Pennsylvania in 2014, spotted lanternfly has spread to 17 states throughout the eastern and central United States. Although adults are not strong flyers, the lanternfly is a notorious hitchhiker, with new detections occurring along railways, on shipped nursery stock, and on private and commercially transported materials.

In areas where it has been introduced, large numbers of feeding adults can be seen excreting sugary honeydew onto surfaces below, leading to the growth of sooty mold. Sooty mold is mainly a nuisance for homeowners, attracting flies and wasps and coating surfaces below the affected plant. But Michigan's grape growers are on high alert as other states have reported damage to their vines.

Spotted lanternfly was first detected in August 2022 in Michigan, in the Oakland County community of Pontiac, introduced through nursery stock from the eastern United States. Efforts to manage the infestation have included tree removal and herbicide treatments, insecticide application creating trap trees, and annual egg mass scraping. This has resulted in a decline in egg masses and no detected spread beyond the initial site.

Adult spotted lanternfly.
Photo credit: MDARD (taken by Lindsay Patrick)

New Detections

In June 2024, Michigan State University forest health monitoring traps detected lanternfly nymphs in Lambertville in Monroe County. The Michigan Department of Agriculture and Rural Development conducted a survey the first week of July within a 1-mile radius of the finding, focusing on SLF's preferred host, tree of heaven. SLF nymphs were found in scattered pockets throughout the search area, suggesting a diffuse infestation.

Public reports of spotted lanternfly are submitted to the state via the Eyes in the Field application, which collects observations and provides a method to investigate and respond. At the end of July 2024, a verified report was received which led to the discovery of a population in Highland Park, in Wayne County.

As more verified reports of the lanternfly were received, the need for additional survey grew. In August 2024, MDARD conducted a survey which covered the lower 20 counties in the state. Inspectors visited high-risk sites and inspected tree of heaven for the presence of the lanternfly. Locations reported via Eyes in the Field were also surveyed. No additional infested counties were added to the list, but new detections within previously reported counties were discovered (Temperence in Monroe County and Royal Oak in Oakland County).

What's Next?

Outreach efforts including press releases, news segments, social media campaigns, webinars, and articles have been ongoing to educate the public and assist in early detection. MSU Extension has released Spotted Lanternfly – A Guide for Homeowners and Residents in Michigan which provides a background on the pest and treatment options.

New detections are likely to continue as the USDA completes its annual rail line surveys and egg masses are discovered and reported through Eyes in the Field. MDARD is currently developing a response plan for 2025 to address the new detections, provide additional outreach, and contribute strategies to assist the public and municipalities in response efforts.

Big effort to protect hemlocks from tiny sap-sucking insect

Have you ever wondered how something so tiny could cause big problems? The hemlock woolly adelgid, often referred to as HWA, is a small, invasive insect that has been making waves in Michigan's forests. This pest feeds on the sap of hemlock trees and, if not stopped, it can kill an otherwise healthy tree. The adelgid is easy to spot because it creates little, cottony white ovisacs at the base of the tree's needles.

Why is it so important to control the adelgid?

Michigan is currently home to around 176 million hemlock trees and as these hemlock populations decline, the impact is more complex than the loss of a beautiful tree. These trees play a huge role in our landscape. Hemlocks, especially in dense stands, help stabilize sand dunes, provide food and shelter for wildlife, and keep cold-water streams cold, which is essential for trout and other fish species. That's why protecting these trees from the adelgid is so important.


Hemlock forest.

Hemlock woolly adelgid was first detected in Virginia in 1951. Since then, it has spread to many areas, killing millions of eastern and Carolina hemlock trees. In Michigan, the pest was discovered in 2006, and since then continued work between partners has limited HWA's spread. To date, established populations can be found in nine counties: Allegan, Antrim, Benzie, Leelanau, Mason, Muskegon, Oceana, Ottawa, and Washtenaw. The impacts of HWA can also be felt at a number of Michigan's state parks including (from south to north): Saugatuck Dunes, Holland, P.J. Hoffmaster, Muskegon, Duck Lake, Silver Lake, Charles Mears, Ludington, and Leelanau state parks. These parks include high-quality Element Occurrence forest types (home to threatened, endangered or sensitive plant species), stop-over habitat for migratory birds, state-designated critical dune habitat, and important public access to natural resources. The pest spreads through wind, birds and other animals, and even people who unknowingly carry it from one place to another.

Dense hemlock forest being surveyed for HWA.

Densities of hemlock woolly adelgid vary along the Lake Michigan shoreline, from single trees to infestations covering thousands of trees. The Michigan Hemlock Woolly Adelgid Strategic Plan focuses on slowing the northward spread of HWA, since infestations are surrounded by three natural barriers: Lake Michigan to the west and areas with few hemlocks to the south and east.

Efforts to slow the spread of the adelgid in Michigan have been under way for many years. In 2001, an exterior quarantine was established to prevent infested plants from entering the state. Current populations in Michigan were likely initially introduced through infested nursery stock planted before the quarantine or in violation of the quarantine. An internal quarantine was implemented in 2017. Since then, new measures have been put in place, including further restrictions on the movement of hemlock trees in 2020 and 2023.

To address HWA in Michigan, the Michigan Hemlock Woolly Adelgid Coordinating Committee's statewide strategy focuses on areas such as prevention, early detection, research, and outreach. This strategy was written in 2017, updated in 2021, and will be undergoing another update in 2025.

The coordinating committee is composed of representatives from state and federal agencies as well as institutions involved with regulation, land management, or research collaborates to address Michigan's unique situation. In 2024, several Michigan representatives attended the tenth annual Hemlock Woolly Adelgid

Program Managers' Meeting in Liverpool, Nova Scotia. This meeting brings together researchers and land managers from Canada and the eastern United States to facilitate networking and information exchange to address HWA within their jurisdictions.

Hemlock woolly adelgid collaborators

Federal: U.S. Department of Agriculture Forest Service Forest Health Protection & Animal and Plant Health Inspection Service, Huron-Manistee National Forest and Northern Research Station, and the Pictured Rocks and Sleeping Bear Dunes National Lakeshores.

State: Michigan Departments of Agriculture and Rural Development; Environment, Great Lakes, and Energy; and Natural Resources. DNR Michigan Civilian Conservation Corps

Local Cooperative Invasive Species Management Areas and affiliated organizations: Many partners work together in a coordinated effort to address HWA. Those most involved in 2024 include CAKE, Lake to Lake, North Country, Three Shores and West Michigan CISMAs, Northwest Michigan Invasive Species Network and Wild Rivers Invasive Species Coalition.

University partners: Grand Valley State University, Michigan State University, Michigan Technological University, and University of Michigan.

Hemlock woolly adelgid survey efforts
Extensive, systematic detection surveys to find the adelgid in Michigan began in 2016 after established infestations were found in two counties along Lake Michigan. Since then, state and local agencies have worked together to fully understand the distribution of the insect to properly prioritize response.

HWA - white ovisacs at the base of needles.

In 2024, new infestations were discovered in Antrim and Leelanau counties, shifting the infestation's leading edge farther north. Local partners and the DNR continue to survey those areas to determine the extent of infestation and prepare the sites for treatment.

High-risk areas along the Lake Michigan shoreline in both the Upper and Lower peninsulas continue to be surveyed by state and partner agencies.

Efforts to control hemlock woolly adelgid

Controlling HWA is a top priority for Michigan, with insecticide treatments being the primary tool. This year alone, more than 3,032 acres of land and over 87,720 trees were treated. Trees were treated with systemic insecticides (imidacloprid and dinotefuran) applied using trunk injection and bark basal spray methods. Treatments took place on state, federal, and private lands. DNR staff and partners work together to review survey data and develop collaborative, strategic treatment plans to address hemlock woolly adelgid across all ownerships.

The table below has a breakdown of treatments by year in Michigan and a total summary of all work completed since 2017 when treatments began.

Year	Trees Treated	Tree Diameter Inches Treated	Acres Treated
2017	1,591	12,980	248
2018	10,770	65,926	402
2019	36,141	235,454	1,795
2020	32,492	206,901	2,355
2021	37,497	268,529	2,401
2022	50,741	331,614	2,118
2023	63,384	506,728	3,508
2024	87,720	654,420	3,032
Total	**320,336**	**2,282,552**	**15,858**

What's Next?

Even though more than $8.3 million has been devoted to control the adelgid, the battle is far from over. Michigan's hemlocks are still at risk, but there is good news. Most of the state's hemlock trees are many miles away from established HWA populations. Adelgids are known to infest less than one percent of Michigan's hemlock trees. Recent studies also suggest that cold temperatures could play a role in the adelgid's spread and establishment. However, a changing climate and warmer winters may enhance HWA survival in colder areas of the state.

As the HWA Statewide Strategy is updated in 2025, greater emphasis will be placed on integrated pest management involving silvicultural treatments, biological control, potential tree resistance as well as chemical control mainly in core infestations where eradication is not an option and managers are forced to look at long-term control approaches. Funding from the Michigan Invasive Species Grant Program, Great Lakes Restoration Initiative, U.S Environmental Protection Agency, Recreation Passport (state park user fees), fundraising efforts supported by Bob Ross International and other internal state funds continue to support these response efforts.

Treated Hemlock trees (right) across from nontreated Hemlock trees (left).

Thanks to the hard work of state agencies, local organizations, researchers, and volunteers, Michigan is doing its best to protect these important trees for years to come.

Landowners: Report suspected cases

Report suspected hemlock woolly adelgid infestations through the Midwest Invasive Species Information Network, available online at MISIN.MSU.edu. If an infestation is confirmed, landowners can take action to treat trees. It is important to know which insecticides and application methods work best.

Michigan Mounts Strong Response to Balsam Woolly Adelgid

In 2024, Michigan continued its efforts to combat the invasive Balsam woolly adelgid (BWA), a small but destructive pest that threatens the state's fir trees. Michigan's balsam fir population, estimated at 1.9 billion trees across the northern Lower and Upper peninsulas, face significant risks due to the pest's impact. Firs are an important agricultural commodity, with Christmas tree farms producing nearly 13.5 million trees each year. This makes the state the country's third largest Christmas tree grower.

The first detection of Balsam woolly adelgid in Michigan occurred in August 2021, when the Michigan Department of Agriculture and Rural Development (MDARD) confirmed the presence of infested Fraser firs on private property. This finding prompted a swift and comprehensive response, which included public outreach, surveys, and the removal and destruction of infested trees. By the end of 2022, surveys in Kent County had not revealed any further infestations, and the origin of the initial outbreak remained unknown. Investigators determined that the trees were planted a decade ago but were not able to determine their origin. Since this tiny pest can move long distances on nursery stock, it is possible that the planted trees originated from an infested region.

BWA Survey efforts in Oceana, and Missaukee and Clare counties

In early October 2023, BWA was detected on a Christmas tree farm in Oceana County. Infested trees displayed symptoms of gouting, or swollen, deformed branches; stunted shoots, misshapen crowns, and flagging, where needles on individual branches turn brown and die. The origins of the infestation are currently unknown. A comprehensive survey was completed in December 2023 resulting in the destruction of infested trees; this happened again in October 2024, with infested Christmas trees flagged for removal and destruction.

Trunk of a balsam fir tree with BWA. Photo credit: MDARD Plant Health

In September 2023, BWA was detected on multiple trees on private property in Missaukee County. The symptoms included woolly masses on the trunks of the trees. No other symptoms of BWA infestations were observed (i.e. gouting, stunted shoots, flagging, or general decline). During the initial investigation, the landowner reported that a mix of conifers had been planted on the property decades earlier, providing a probable source of infestation.


Heavy BWA infestation.

In January 2024, a comprehensive survey for BWA in Missaukee and Clare counties was initiated to determine the extent of the infestation. Survey efforts began by surveying 4-acre parcels within a 1-mile radius of the known infestation. Due to the amount of BWA detected, the survey area was expanded, resulting in BWA being detected on roughly 560 acres. Additional surveying to determine the extent of infestation in the Missaukee area is planned for early 2025.

Separately, in January 2024, a small BWA infestation was detected on state forest land in Clare County, within 15 miles of a known infestation. The Clare County infestation is limited to a 0.75-acre stand of fir isolated within a wetland. Survey of the area did not provide any evidence of the origin of the infestation, and it is currently believed the infestation was spread by insects hitchhiking on wildlife. The Michigan Department of Natural Resources planned to cut infested trees over the winter of 2024-2025.

Response Efforts

Michigan maintains internal and external quarantines with the aim of preventing the introduction of BWA to new portions of the state. Low risk or mitigated materials such as holiday greenery, Christmas trees, debarked lumber and heat-treated material are exempted in both quarantines.

Early detection and response are key to preventing the spread of invasive pests. The Michigan Invasive Species Program has increased public outreach and boosted direct messaging to nursery growers, Christmas tree producers and landscapers across the state to help detect additional infestations. MDARD continues to respond to public reports of BWA and will continue delimitation survey efforts throughout the state.

Diseases

Mushroom hunters often become familiar with Armillaria root rot

Are you a mycophile? According to the Merriam-Webster Dictionary, a mycophile is: "a devotee of mushrooms, especially: one whose hobby is hunting wild edible mushrooms."

If this sounds like you, chances are one of your favorite wild mushrooms to eat is the honey mushroom, a common name covering many species in the Armillaria genus. Together, they are referred to as Armillaria root rot due to their impacts.

Armillaria fungi can be found throughout Michigan and in many areas of the United States. They infect many tree species, as well as shrubs, vines, and horticultural crops. Each species of Armillaria infects its hosts to different degrees. The role Armillaria plays in the death of a tree depends on an assortment of factors, including whether or not the tree is suffering from drought stress, advanced age, defoliation, and/or other disease and insect issues that can weaken a tree and hasten its decline.

A layer of white fungus under the bark indicates Armillaria infection.

When hunting for honey mushrooms, you may have noticed they are often found in areas with dead or dying trees such as declining oaks or pockets or dead red pine. Keying in on these areas is useful for mushroom hunting but Armillaria root rot may not be the only issue affecting these trees. It can also be found on trees that are dying for other reasons such as infection with oak wilt, Heterobasidion root disease or other issues.

Armillaria is frequently found in diseased or decaying plant material and roots, causing no apparent damage to healthy trees. It spreads by producing stringy, root-like structures called rhizomorphs that start out light-colored but turn dark brown or black over time and look a bit like shoestrings, giving Armillaria its other name -- "shoestring root rot." Although the roots of healthy trees may become infected when they grow near diseased roots and other materials, healthy trees have the defenses to stop the fungus from taking over and causing decline. During forest health surveys, staff will inspect underneath the bark at the base of severely stressed or dying trees for a mycelial fan, a white fan-like mat of fungal tissue, another tell-tale sign of Armillaria. Armillaria also spreads through spores produced by the honey-colored mushrooms.

Clumps of Armillaria mushrooms in the fall indicate infection.

Armillaria rhizomorphs on tree.

Maintaining tree health and vigor through good forest management practices is the best defense against Armillaria (and other pests and diseases) and helps suppress Armillaria infections in woodlots. Watering high-value ornamental landscape plantings during dry spells, avoiding soil compaction and wounding of trees will reduce the potential for infection in managed landscapes.

Bark, leaf diseases besiege Michigan's beeches

An estimated 37 million American beech trees over 5 inches in diameter occur in Michigan's diverse forest ecosystems, particularly in the eastern Upper and Lower peninsulas. But beech bark disease has rapidly changed beech-dominated forests over the past couple decades. Beech leaf disease now represents an additional threat. It was first detected in southeast Michigan in 2022.

Beech Bark Disease (BBD)

White wax produced by beech scale on an American beech tree is the first phase of beech bark disease.

Beech bark disease results from fungal infection of wounds created by the tiny insect known as beech scale. The disease first appeared in Michigan in the early 2000s and has since spread throughout much of the state. The disease begins when the beech scale insect (Cryptococcus fagisuga) attaches to the bark by inserting its stylet, or mouth parts, to feed on the sap. The scale are visible as individual tiny white bits of fluffy wax. With heavy infestations, white patches resembling a "painted" appearance may appear. Feeding by the insects damages the tree's bark and facilitates the entry of Neonectria fungi, which causes cankers to form under the bark. These cankers inhibit the flow of sap. This causes the tree to decline and can eventually kill the tree. However, heavily infested trees can also appear healthy despite a weakened main stem. Tree breakage, known as "beech snap," is common in large branches or along the main trunk of diseased trees.

Beech bark disease progresses in two phases. In the "advancing front," the scale insect damages the tree. In the "killing front," the fungus takes hold. While BBD is typically observed in mature trees, it can also affect younger ones, especially under conditions that make them more susceptible. The disease is most common in northern Michigan, where beech trees are abundant. It is moving south more slowly, where beech is sparse on the landscape.

Beech snap due to Beech bark disease.

Beech Leaf Disease (BLD)

In recent years, another serious threat, beech leaf disease has emerged in southeastern Michigan. First identified in the state in 2022, BLD is caused by a nematode — a microscopic, parasitic worm (Litylenchus crenatae). This nematode feeds on the tissue within beech buds, causing damage to become apparent when leaves unfurl in the spring. The disease is easily identifiable by the characteristic pattern of dark, irregular bands and stripes that appear across the leaves, leading to a leathery appearance and early leaf drop. Holding a leaf up to the sky for backlighting will make these dark bands easier to see. Severely affected leaves will be distorted and stunted. Heavily affected trees will abort buds.

Understory symptoms of BLD.

Impacts on Michigan's Forests

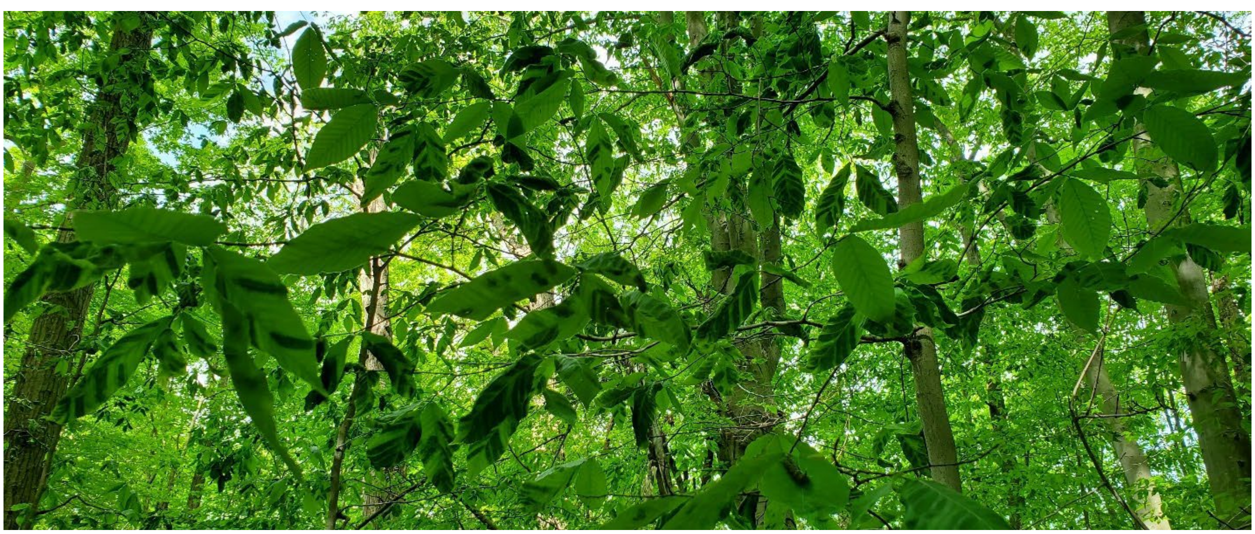
The combined effects of beech bark disease and beech leaf disease are a growing concern for Michigan's forests. Beech trees provide important ecological functions, including food for wildlife (such as squirrels, birds, black bears and deer), shade, shelter for small mammals and birds through cavities, perching locations for predatory birds, and the stabilization of forest soils and critical dune habitat. Beech timber is also widely used commercially for kitchen utensils, furniture and more. With the continuing spread of these diseases, the future of beech trees in Michigan's woodlands is uncertain.

The DNR Forest Health Program is monitoring both diseases and working with researchers to better understand their spread and to develop management strategies. Some specific research projects and surveys are described below and elsewhere in the forest health highlights.

Following internal trainings, DNR Parks and Recreation Division field staff made two detections of beech leaf disease totaling 10 acres, at Highland Recreation Area and Proud Lake Recreation Area, both in Oakland County. PRD is investigating the potential to increase survey coverage with drones to fill in the gaps in survey coverage.

Report observations of Beech leaf disease: Take closeup and full photos of affected trees, record the location and choose one of the following reporting options:

- Email DNR-FRD-Forest-Health@Michigan.gov.
- Use the Midwest Invasive Species Information Network (MISIN) online reporting tool.
- Download and use the MISIN app at MISIN.MSU.edu/.



Canopy symptoms of beech leaf disease.

Efforts to address BLD at University of Michigan

By Stella Cousins

Beech leaf disease (BLD) is gaining ground in southeast Michigan and throughout the northeast United States and Ontario as we learn more about the patterns of damage it causes. Statewide, BLD is currently known to occur in St. Clair, Macomb, Oakland, Wayne, Washtenaw, Hillsdale, and Lenawee counties. If you see beech leaves with the distinctive interveinal bands outside this area, please share your observation with the Forest Health Program or via MISIN!


Early stages of BLD symptoms.

During this year's growing season, many locations where the percentage of leaf area affected was low in previous years have seen increases in extent and severity of the disease as well as its spread to additional trees nearby. New BLD observations were not reported from any additional counties during 2024. However, new occurrences have emerged in southeast Michigan, including in parks and recreational areas. Most of the newly reported forests show mild to moderate symptoms that suggest BLD has been present for a few years before it was sighted. In 2023-2024, the DNR and students from the University of Michigan School for Environment and Sustainability also collaborated on a survey for the BLD nematode in unaffected beech forests, focusing on southern Michigan. The survey found no indication that the nematode was present in the 29 sampled sites. Occurrences have also increased throughout New York state. The expanding distribution of BLD symptoms into colder climates indicates that beech in northern Michigan and the Upper Peninsula likely are at risk also. Areas where BLD has persisted for eight to 10 years are now showing mortality of small diameter trees and also larger canopy trees. The pace of mortality appears to vary with tree vigor, and long-term studies hope to detect resistant trees and understand survival trends in greater detail.


Symptoms of BLD evident after growing season.


University of Michigan staff conducting research.

Meanwhile, researchers have continued clarifying the life cycle and dispersal routes of Litylenchus crenatae mccannii. This introduced species is now understood to be the nematode that drives BLD's characteristic banding, shriveling, and bud failure symptoms. It is most abundant in bud tissue, and in affected trees accumulates to high densities as buds form in autumn. Damage from Litylenchus causes disruption of the cellular organization of the bud and leaf and contributes to less-efficient photosynthesis.

With BLD on the rise in the region, many arborists and landscape managers in Michigan are gearing up to mitigate impacts to high-value trees. DNR Forest Health Specialists are studying application of phosphite fertilizers, which in other studies has shown potential to slow the advance of BLD symptoms. Nematicides have also shown some promise in reducing nematode populations; only those with fluopyram as the active ingredient are currently labeled for use against BLD in Michigan. While chemical treatment may only be viable for high-value landscape specimens, examination of silvicultural treatment trials continue in other states where BLD is well established in beech stands.

Oak decline woes continue in the northern Lower Peninsula

Oak decline is frequently confused with oak wilt and represents the majority of public oak wilt reports received by the forest health program. Although more common, oak decline occurs more slowly, often taking place over multiple years with progressive dieback. Extensive retention of dead leaves on dead branches is common, vs. the rapid leaf drop that occurs with oak wilt. Oak decline may be more widespread and random in appearance within a stand, while oak wilt spreads outward from year to year, creating distinct individual pockets of mortality.

Oak decline occurs when tree stressors compound leading to weakened oak trees that may eventually die. Usually multiple diseases, pests, environmental conditions and/or other variables are involved. Much of our oak resource continues to age. These forests formed in the aftermath of extensive logging in the early 1900s and frequently contain many more oak trees than historic forests on these often nutrient-poor, drought prone sites. These trees are all of a similar age and becoming less vigorous. Whenever there is extreme weather like drought, excessive rain/flooding, hail, late frost, or wind events, oak trees become further stressed.

Extensive defoliation in recent years by defoliators such as spongy moth further contribute to tree stress. While less spongy moth defoliation is anticipated in the next few years, it can take a few years for recovery to occur. In the meantime, additional tree stress may occur. When the trees are stressed, they become more attractive to insects and less successful at fighting infection. During surveys, the most common issues observed on declining oaks are two-line chestnut borer infestations in the branches or trunk and Armillaria root rot.

Long-term, we anticipate additional tree stress events. These may intensify with a changing climate. On sites with more moisture and nutrient availability, mature oaks may remain healthy for several years. On other sites, increasing vulnerability to decline is anticipated. Harvests or other treatments that favor younger stands with greater tree species diversity are expected to be less vulnerable to decline. At the same time, the disturbance created by thinning severely stressed stands prior to recovery from stressors can also trigger an additional wave of mortality in mature canopy trees.

Management is a priority for new oak wilt detections; outreach and training continue

Oak wilt is an invasive disease that continues to spread within Michigan. The fungus produces toxins and plugs the xylem/sapwood that moves water inside an oak tree. The oak rapidly wilts, drops leaves and dies. After death, most often in May or June, a spore mat forms under the bark of the tree which helps contribute to overland spread of the disease.


An oak wilt spore mat under the bark.

Oak wilt, which may have originated in Central America, is particularly aggressive in the red oak dominated forests of Michigan. All oak trees are susceptible to oak wilt; however, trees in the red oak group (those with pointed leaves) are more susceptible and will die within weeks, whereas native trees in the white oak group (those with rounded lobes on leaves) may die more slowly over several years. Chestnut trees, which are in the same family as oaks (Fagaceae), can also be affected by oak wilt.

Oak Wilt spreads in two ways: underground through connected or grafted roots between trees and overland via tiny sap feeding nitidulid beetles carrying the fungus to wounds on uninfected trees. Underground spread accounts for most of the mortality in natural oak-dominated stands, resulting in pockets of mortality. Consequently, the DNR Forest Health Program prioritizes management efforts to slow or stop the spread of oak wilt in these stands.

Overland spread occurs when oak wilt spore mats are produced. These spore mats have a noticeable sweet smell which attracts the nitidulid beetle. The beetles pick up spores and carry them to wounds on nearby oak trees. In Michigan, the majority of infections occur April 15 to July 15, due to a number of factors including beetle activity, viable spore availability, and tree vulnerability. For this reason, it is important to avoid wounding oak trees during this time frame. To protect valuable oak trees from any risk of infection outside the high-risk infection period, some people may elect to avoid wounding oaks through the growing season.

Oak wilt also can inadvertently spread to new areas of the state when people move firewood that contains active spore mats.

Efforts to treat oak wilt infection pockets continue. Using a vibratory plow, forest health program staff continue to sever root grafts between oak trees, stopping the underground spread from tree to tree. This year, the forest health program continued to collaborate with Huron-Manistee National Forest staff to treat six infection pockets and with Sleeping Bear Dunes National Lakeshore to treat eight infection pockets. Six infection pockets were trenched on state forest lands in the northeast Lower Peninsula. In total, 7,897 feet of trench line was installed on federal land, and 8,608 feet on state forest land with DNR Forest Resources Division involvement. On DNR Parks and Recreation Division lands, oak wilt was managed on 120 acres with a vibratory plow or chemical control (double girdle and triclopyr herbicide application). Chemical control is used by PRD in sensitive landscapes like critical dunes habitats or where cultural resources are present.

A forester controlling oak wilt with herbicides

The DNR and other agencies continue to explore new ways to kill root systems as a means of preventing spread, primarily through the use of herbicides to kill underground grafted root systems. Other options include silvicultural treatments to diversify stands to reduce the potential for spread.

Oak wilt detection efforts are an important ongoing activity. In the Upper Peninsula, oak wilt was first detected along the Wisconsin border in the early 1980s and detections continued to be confined along the Wisconsin border until this year, when oak wilt was detected in Marquette County. Mortality pockets were observed during aerial survey activities. Treatment of these outlying infections has been prioritized and began this year. On lands managed by The DNR's Parks division, nearly 1,700 acres representing high-risk locations were actively surveyed for oak wilt. Trained field staff also passively survey during the course of their work. A new technology for remote early detection, drone-collected multispectral aerial imagery and machine learning, was explored through partnership with Grand Valley State University's Center for Applied Computing.

Oak wilt infection pocket.


Foresters looking for oak wilt spore mats.

How can you identify oak wilt? An oak stand experiencing oak wilt will have distinct pockets of dead and dying trees. An infected tree will die within a few weeks, rapidly dropping leaves between mid-summer and early fall. There are two ways to know for sure if you have oak wilt; 1) locate an active pressure pad or 2) send a sample to a diagnostic lab. An oak stand experiencing oak wilt will have pockets of dead and dying trees. You may find many leaves that look freshly dropped mid-summer. Oak decline is different than oak wilt and will exhibit a more random pattern within a stand with the oaks possibly having dead and dried leaves still attached.

See the interactive online oak wilt map created by the DNR for confirmed and suspected locations. It is important to note that many oak wilt infections go undetected, and the map does not reflect the full extent of oak wilt in Michigan. Visit Michigan.gov/ForestHealth and click on "View and report oak wilt locations."

Need help? A variety of programs address the threat of oak wilt and oak decline on private land.

- MDARD's Forestry Assistance Program has foresters associated with county conservation districts to help private landowners with oak wilt and oak decline outreach, confirmation and treatment. Click here to learn who to contact in your area.
- The DNR's Forest Health Program provides oak wilt advice. Contact the program by emailing DNR-FRD-Forest-Health@Michigan.gov.
- MSU Extension can provide valuable insight on oak wilt.
- Private arborists offer fee-based oak wilt assistance. Find a list of oak wilt qualified arborists.

White pine in decline: How do we keep Michigan's state tree healthy?

White Pine Problems:

Eastern white pine (Pinus strobus), is Michigan's official state tree and a symbol of the state's rich forestry heritage. Vast forests of this towering tree -- known for its height, straight trunk, soft needles, and long lifespan -- played a crucial role in shaping Michigan's economy. Today, it continues to be a key component of northern Michigan forest ecosystems. Interest in greater management of this species is increasing, given its historic production capacity. However, over the past few decades, the health of white pine populations has declined in some areas of the state. This is a complex issue with multiple causes.

Diseases and Insects

Needle diseases: Every fall, the oldest needles on white pine trees turn yellow and drop. Once the old needles have fallen, the tree should look healthy again. However, a needle disease may be present when younger needles at branch tips turn brown, brown needle tips are observed, or sparse tufts of needles are present. While pine needle diseases have recently been a problem in the northeastern states, there are also increasing reports in midwestern and lake states. Needle diseases have rarely been reported in Michigan. However, this year we had reports in the central northern Lower Peninsula. A sample was collected from Crawford County and identified by the Michigan State University Plant and Pest Diagnostics lab as Dooks needle blight (Lophophacidium dooksii). Other needle diseases may also be causing some

Stressed white pine with needle disease.

damage in Michigan, such as Septorioides needle blight, which has also been confirmed. There is research that suggests increased precipitation in the spring when needles are elongating correlates with higher levels of needle diseases, with symptoms becoming obvious one year later. It's important to consider other factors that may cause similar symptoms, such as a needle scorch after droughty conditions or damage from salt spray along roadways.

Root diseases: Symptoms of root diseases can vary. Some trees may have sparse, off-color needles; others may wilt and die more quickly. The bark at the base may be cracked and oozing sap. When bark of affected trees is removed at the base, forest health staff frequently find a white layer of fungus underneath, called the "mycelial fan" indicating Armillaria root rot, a common cause of mortality. White pine also is susceptible to Heterobasidion root disease (HRD), and dead white pine seedlings are often observed in HRD infection pockets within planted red pine. In Michigan, we have not observed HRD in stands of natural white pine, perhaps due to factors that limit the likelihood of infection and spread. Root diseases are primarily managed by reducing tree stress and promoting vigor through good stand management practices such as thinning dense stands.

Canker diseases: These may be apparent when cankers, or stem infections, girdle branches preventing the flow of water and nutrients, causing the branches to die. Cankers may appear sunken and sap ooze or dried resin deposits may be present. White pine blister rust cankers begin with infections through the needles, the fungus then spreads down into twigs and branches. On young trees, the fungus may spread into the bole (trunk) of the tree causing a girdling canker to form. White pine blister rust is most common in areas where the alternate hosts for the fungus (gooseberries and currants) are common and the local microclimate favors cool moist conditions in late summer. Caliciopsis canker is typically identified by pitching from small cracks or sunken lesions in the bark and tiny "eyelash-like" fruiting bodies. Removing bark reveals wood discoloration. In Michigan, damage resulting from Caliciopsis canker has primarily been observed on white pine stressed by drought, poor soil, competition with other trees, etc. Caliciopsis canker is currently being studied at Michigan State University

Dead central leaders or forked trunks:
On young spruce and pine trees, white pine weevil may feed extensively on healthy central leaders (terminal leaders) on vigorous young conifers, causing a look known as a “shepherd’s crook.” While feeding, females will lay one to four eggs in the wound. The eggs hatch in a few weeks and the young chew their way out through the bark. Over time, as remaining branches compete for dominance, this leads to crooked or forked trunks and diminished timber value and growth rates. Growing young white pine under an overstory or at high densities can reduce damage.


Caliciopsis canker (direct view).


Caliciopsis from the side showing "eyelash-like" fruiting bodies.

Forest spruce, yard spruce are susceptible to budworms, blight and more

Stressed, dying, or dead spruce trees are a common sight in Michigan. Several different issues may play a role.

When branch tips are most affected, the eastern spruce budworm, commonly referred to as just spruce budworm (Choristoneura fumiferana) may be responsible. The current outbreak in Michigan appears to be winding down, but defoliation continued in several areas of the northern Lower and Upper peninsulas. Limited damage was mapped during aerial surveys, but damage was apparent along roads and during on the ground surveys.

Spruce budworm damage at the tip of branches.

Spruce budworm is a native insect that feeds on the current year's growth of white spruce (Picea glauca) and balsam fir (Abies balsamea), causing trees to take on a rust color in the late spring. When insect populations are especially high, damage has been observed on black spruce (*Picea mariana*), tamarack (Larix laricina) and pines (Pinus spp.). Spruce budworm is always present at low levels in forested settings across the state and reaches outbreak levels every 30 to 40 years. In Michigan, outbreaks tend to last 10 to 15 years.

After three to five years of defoliation, trees may die. Balsam fir is most vulnerable. Mortality is most likely in old (over 50 years), densely stocked stands. Infested stands may lose 60 to 80 percent of fir and 20-40 percent of spruce. In some cases, mortality from spruce budworm can increase fuel loads and, thus, wildfire risk.

In Michigan, insecticide treatment is usually cost prohibitive on a large scale but can be done to protect high-value yard trees. Where stand management is possible, several silvicultural techniques may reduce impacts of spruce budworm. First, promote spruce over fir, the budworm's preferred host. Second, thin vigorous spruce stands when appropriate to reduce density-related stress. It is important to note that thinning should not be conducted when stands are stressed, as in during periods of drought, if an outbreak is already underway or if the stand has lost vigor due to age. Mixed stands with a spruce component may respond better to thinning than spruce-dominated forests. Third, final harvest spruce-fir stands when they approach rotation age or if a salvage harvest is desirable. If a regeneration harvest is conducted, avoid leaving scattered, mature spruce and fir that can spread caterpillars to the regenerating stand. If keeping spruce and fir is desirable, retention pockets are preferable to individual, scattered trees.

Stressed spruce trees are not always the result of spruce budworm. Needle diseases are also common. In contrast with spruce budworm damage, these diseases cause a needle drop on the lower branches and interior of the tree. Two fungal pathogens are often involved: Rhizosphaera needlecast (Rhizosphaera kalkhoffii) and Stigmina needle blight (*Stigmina lautii)*. While non-native Colorado blue spruce is most susceptible, native white spruce can also be affected.


Rhizosphaera needlecast symptoms.


Progression of Rhizosphaera needlecast symptoms 5 years after the removal of lower branches.

Both Rhizosphaera needlecast and Stigmina needle blight result in the discoloration and loss of year-old needles. This causes the tree to appear brown and bare except for an outer shell of living, current year foliage. The underside of shed needles may exhibit tiny black specks (fungal fruiting structures) along the central vein. Several sequential years of infection can result in branch dieback, loss of value as a landscape tree or decline in a spruce stand.

For high-value landscape specimens, Rhizosphaera needlecast and Stigmina needle blight can be prevented with well-timed fungicide applications; coverage can be challenging and works best before the diseases build up. A few simple cultural practices can also greatly reduce the likelihood of damage by these diseases. First, avoid planting spruce species that are not well-adapted to the local environment. White spruce (Picea glauca), for example, is more tolerant of Michigan's humid growing season than Colorado blue spruce. No matter what species of spruce is chosen, plant individual trees with spacing that will amply accommodate their mature size. Promote air flow by mowing weeds around the base of the tree and trimming off lower branches. Finally, avoid shearing spruce trees. Shearing produces dense foliage that increases humidity and, thus, promotes fungal infection.

HRD infection detected in a new county; efforts to subdue the disease continue

Heterobasidion root disease can be one of the most damaging diseases in North American forests, both environmentally and economically. Generally referred to as HRD, the disease could limit the ability to grow planted red pine in the future, in addition to driving further losses in currently planted red pine stands.

Underside of a Heterobasidion fruiting body showing the pore surface.

Besides red pine, white and jack pine, along with other conifer species, are susceptible to HRD infection. Due to the potential threats from HRD, forest health staff have prioritized survey efforts in high-risk locations. Knowing where this disease is present helps forest managers implement practices to protect nearby planted pine stands from infection.

HRD is caused by the fungus Heterobasidion irregulare and is thought to be native to Michigan forests. However, it acts more like an invasive species in planted stands as natural red pine stands tend to have lower densities of red pine with less potential for root grafting. Infections most commonly occur when fungal spores released from Heterobasidion fruiting bodies land on freshly cut stumps nearby. After the spores germinate, the fungus slowly grows through roots at a rate of 3 to 6 feet per year reaching nearby trees through connected root systems. This causes pockets of dead trees over time.

While thinning dense stands is important for tree vigor and health, actively thinning or harvesting also opens pathways for HRD to spread. Recent detections in Michigan have occurred in actively managed red pine plantations at least five years after thinning operations, although crown symptoms typically appear 3 to 8 years after a thinning. Once a stand is infected, HRD will persist as long as stumps, roots or woody material remain. Over time, the impact becomes significant, particularly when fresh stumps are not protected after thinning operations near existing infections.

Fruiting bodies at the base of stumps or infected trees.

HRD is most easily identified in the fall when the fruiting bodies, or mushroom-like growths, are more obvious at the base of affected stumps and trees. The fruiting bodies are leathery brown on top and white on the bottom with elongated pores or tiny holes, not gills, like many other common fungi. The risk of infection to nearby areas through fresh-cut stump surfaces increases with the abundance of fruiting bodies and spore production. Once the disease is present, it may become impossible to grow susceptible species on that site for several decades or longer. Many detections occur when pockets of dead pine are reported by DNR field staff, private foresters or the public. Landowners and managers are encouraged to watch for and report slowly expanding pockets of dead pines.

Currently, on state-managed lands, an advisory zone of 5 miles around known HRD sites is considered at increased risk for infection. When planted pine is scheduled for harvest within the advisory zone, forestry staff marking timber report any mortality pockets to forest health staff for follow-up. In addition to surveying reported mortality pockets, surveys based on the presence/absence of the fungus may occur in stands without reports and nearby areas to determine the risk for infection. If the risk is high, restrictions are placed on the timber sale. These sale restrictions include winter logging only, from Jan. 1 to March 31, when spore production is suppressed, or specify a stump treatment to prevent new infections. It's important to note that winter harvest or stump treatment will not prevent existing pockets of infection from continuing to expand. Restrictions for national forest lands are slightly different from state land restrictions but also provide protection from infection. Restrictions should also be considered on private lands in high-risk locations to protect red pines.

In 2024, HRD was detected in Montmorency County for the first time. DNR forestry field staff reported the suspected infection, and it was confirmed by forest health staff. In addition, HRD was also found at a few additional locations in previously positive counties. Ongoing survey activities confirm HRD in 17 Lower Peninsula counties and two counties in the eastern Upper Peninsula.

Heterobasidion fruiting body.

An interactive, online map shows confirmed locations of the fungus in Michigan and the 5-mile advisory zone as well as locations where surveys did not detect HRD. The map also includes information on identification and tools for reporting new or suspected locations of the disease for follow-up by DNR forest health staff.

To use the map, visit michigan.gov/foresthealth and click on “View and report Heterobasidion root disease locations.” Reporting potential infection pockets helps protect our forests.

Invasive plants

On the Lookout: Lesser Celandine

Lesser celandine (Ficaria verna), an invasive plant that has been popping up in floodplain forests in mid-Michigan, has been added to the state's invasive species watch list. The designation recognizes the threat the plant poses to native habitats and encourages public reporting of lesser celandine sightings.

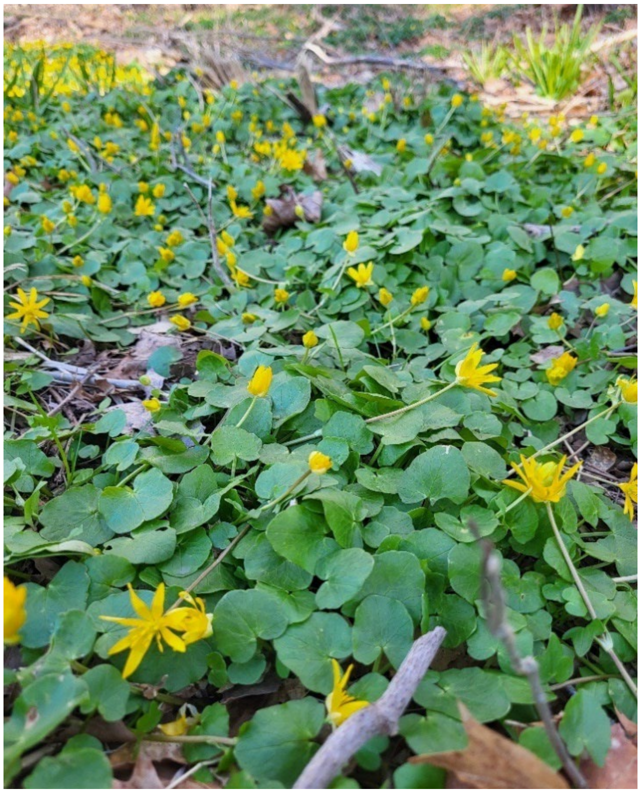
Lesser celandine (pronounced SEL·luhn·dine) is a non-native, low-growing perennial plant in the buttercup family, most often found along streams and in forested floodplains. Characterized by heart-shaped leaves and glossy yellow flowers, it can spread by seeds, rhizomes (underground stems) and bulbils (tiny bulblike structures where the leaf meets the stem). These three methods of reproduction allow the plant to spread rapidly in areas with disturbed soils, including banks scoured by flooding, paths and open areas, crowding out native plants that inhabit similar spaces such as spring beauties and trilliums.

Flowering Lesser celandine plant.

As a spring ephemeral – a short-lived species that sprouts early in spring, flowers, goes to seed and then completely dies back and disappears for the season well before summer begins – lesser celandine is particularly difficult to control.

Report sightings of lesser celandine, visible in early spring, through the Midwest Invasive Species Information Network or on the free MISIN app. Note that Michigan's native marsh-marigold can be confused for lesser celandine, but it is often two to four times the size of lesser celandine, growing up to 2 feet tall, with larger flowers and leaves that last throughout the summer. Celandine is:

- Low-growing (generally 3 to 6 inches but up to 12 inches), spreading perennial plant found in floodplains in early spring.
- Small (1 inch wide) bright yellow flowers with 8 to 12 petals.
- Shiny, dark-green leaves are kidney- or heart-shaped and often borne in a central rosette.
- May be found singly, but forms a thick carpet in densely-infested areas, especially along trails and in forested river floodplains.
- Spreads by seeds, rhizomes, and bulbils (tiny bulb-like structures found where leaves connect to the stem).
- Grows in moist forests before trees leaf out (March/April); entire plant disappears by the end of May.



Several flowering Lesser celandine plants.

Native: Lesser celandine is native to central Europe, north Africa, and the Caucasus Mountains. View map from ResearchGate.

U.S. Distribution: Found mainly in floodplain forests, lesser celandine populations have spread to many areas of the northeast U.S., with expansions into the Midwest and Southeast. View EDDMapS distribution data.

In Michigan: First collected in Clinton County in 1982, this plant has escaped cultivation and is now found commonly, sometimes in large monocultures, in the Grand River watershed in originally introduced — and still occasionally re-introduced — as an ornamental landscape planting. Lesser celandine can spread by seeds but also is spread when rhizomes (thick, short underground stems) and bulbils (tiny bulb-like structures found where leaves connect to the stem) break off the plant and are deposited somewhere else. These structures can be moved by floodwaters, human movement and animal activity.

Additional Resources:

- Report lesser celandine (and other invasive species): https://www.misin.msu.edu/report/misin/
- Find your Cooperative Invasive Species Management Area (CISMA): https://www.michigan.gov/invasives/take-action/local-resources

Forest opening overgrown with lesser celandine plant.

Laboratory research and monitoring

Grand Valley State University lab investigates new tool for invasive species detection

Spider webs are durable, naturally sticky, and made for capturing things. Because of these natural properties already inherit in webs, the Partridge Lab at Grand Valley State University's Annis Water Resources Institute is evaluating whether they can be used as a natural, passive environmental DNA (eDNA) trap for monitoring invasive forest pests.

Spiderweb.
Photo credit: Karen A. Rawlins, University of Georgia, Bugwood.org.

What is eDNA? It is DNA that is left behind in the environment by individual organisms. It has quickly been incorporated into many management practices. It can be used to assess community composition, track species of concern, and help with invasive species monitoring.

This summer, Partridge and an undergraduate student, Kathryn Geller, explored whether invasive species DNA could be detected from naturally occurring spider webs in a forested environment. They sampled 20 spider webs from an area with a known hemlock woolly adelgid (Adelges tsugae) infestation in Muskegon County and used an amplicon sequencing approach to determine DNA present within the webs from arthropods, which include insects such as HWA.

They were able to successfully sequence DNA from 17 webs and identified 114 different arthropod genera. All 17 of the webs contained DNA from HWA, and three webs contained DNA from spongy moth (Lymantria dispar dispar), which is also present in the area. While this is only a first step in assessing the capability of this approach, the researchers are excited about the potential for it to enhance invasive species monitoring in coastal forests.

Collaborative efforts focus on breeding pest and disease-resistant trees

Rachel Kappler and Anna Funk, Holden Forests and Gardens

In January 2021, ecologists, foresters and other conservation professionals from across the Great Lakes Region launched a new collaborative effort to save the ash and other trees currently affected by invasive pests.


Holden Arboretum resistant ash plantation.

The Great Lakes Basin Forest Health Collaborative's goal is to unite efforts to breed ash, American elm, American beech and eastern hemlock trees that are pest/disease-resistant and can be widely used to restore our forests.

"We're relying on the help of private citizens to help locate the suspiciously healthy trees. Our hope is that tree breeding programs will allow restoration and reforestation efforts to save the species — and save our forests," said Dr. Rachel Kappler, forest health coordinator for the Great Lakes Basin Forest Health Collaborative.

As word has spread, some landowners have begun sending Kappler reports about their trees. But many more are using the popular citizen science app, TreeSnap, to submit their observations. By downloading the app onto their smartphones, any person can submit an observation. TreeSnap data is used for a wide variety of research projects nationwide. The GLB Forest Health Collaborative watches specifically for observations of native, naturally growing American elm and various ash species. When someone submits a healthy, mature tree in an otherwise pest-infested area — what they call a lingering tree — they take notice.

Once a healthy tree, like an ash or elm, has been reported, a visit is planned for priority trees to confirm that it's truly a lingering tree. If it is, either seeds or a branch cutting can be brought back to local partners who will propagate it for pest/disease resistance testing and potentially to add it to the breeding programs.

In Michigan, while American beech may be lingering in areas with beech bark disease, extensive efforts to breed beech bark disease resistant trees are currently delayed while work progresses to identify lingering trees in areas of Ohio affected by beech leaf disease so both diseases can be addressed simultaneously. In addition, eastern hemlock trees are not likely to be lingering in many areas with hemlock woolly adelgid as that pest is not yet widespread in the state. The Michigan Invasive Species Program reviews reports of suspected hemlock woolly adelgid infestations and beech leaf disease through the Midwest Invasive Species Information Network, available online at MISIN.MSU.edu. The GLB Forest Health Collaborative works to share knowledge of ongoing pest/disease resistance research in these species, especially in our quarterly newsletters. Sign up on our webpage holdenfg.org/great-lakes-basin-forest-health-collaborative/

6 Steps to restoring the forests.

What is the Great Lakes Basin Forest Health Collaborative

The Great Lakes Basin Forest Health Collaborative is an initiative co-sponsored by Holden Forests & Gardens and the USDA Forest Service, funded through the Great Lakes Restoration Initiative. It supports a network of partners in tree resistance breeding activities for forest species that are threatened by invasive insects and diseases. We serve as liaison between research facilities, agencies, organizations, and members of the public, providing training and resources to help these groups reach our common goal: sustainable forests.

Michigan Technological University – Forest Health Lab

Bal Lab Research Updates

Tara L. Bal

Our lab continues with various research projects in forest health monitoring and applied management. We wrapped up a second season of field work specifically evaluating springtime oak phenology with nitidulid trapping and wound attractiveness. This work is part of an international collaboration evaluating nitidulids as potential vectors of oak wilt since 2021. Field sites are mainly north of the current range of oak wilt, spanning the Upper Peninsula, Ontario and New Brunswick, Canada. Preliminary analysis indicates that nitidulids were not interested in fresh oak wounds until the buds begin to open or leaf out. We expect our results to help better understand and prioritize risk assessments of northern oak wilt range expansion in Upper Michigan and Canada.

Nitidulid beetles attracted to an intentional wound made in an oak.

We also continue propagating beech bark disease-resistant trees by grafting resistant scions in our greenhouse facilities in Houghton, outside of the current range of American beech and beech leaf disease. None of the trees we've propagated, or any of the counties where scions were collected, have had beech leaf disease symptoms or positive lab tests. The beech bark disease-resistant beech trees are being planted back into the National Parks Service's national lakeshores, where the resistant scions came from.

Additional projects related to beech involve trials for out-planting and greenhouse propagation methods to improve survival rates. In collaboration with the Michigan DNR, we also initiated a project this year to determine if we could induce root suckering around known beech bark disease-resistant trees using minimal root injury. Stands with disease-killed trees often respond with excessive root sprouting and “dog hair thickets,” with saplings that are also susceptible to BBD. If beech suckers could be induced around known, disease-resistant trees in places without thickets, this may reduce or eliminate the need for difficult and costly scion grafting.

A trial to induce root suckering around a beech bark disease-resistant tree in Upper Peninsula, MI.

Overall, results from these studies and others will help understand long-term forest health management strategies and better risk assessments for forest managers.

Contact and acknowledgements

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Cover photo: USFS staff climbing red oak in northern Michigan.

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