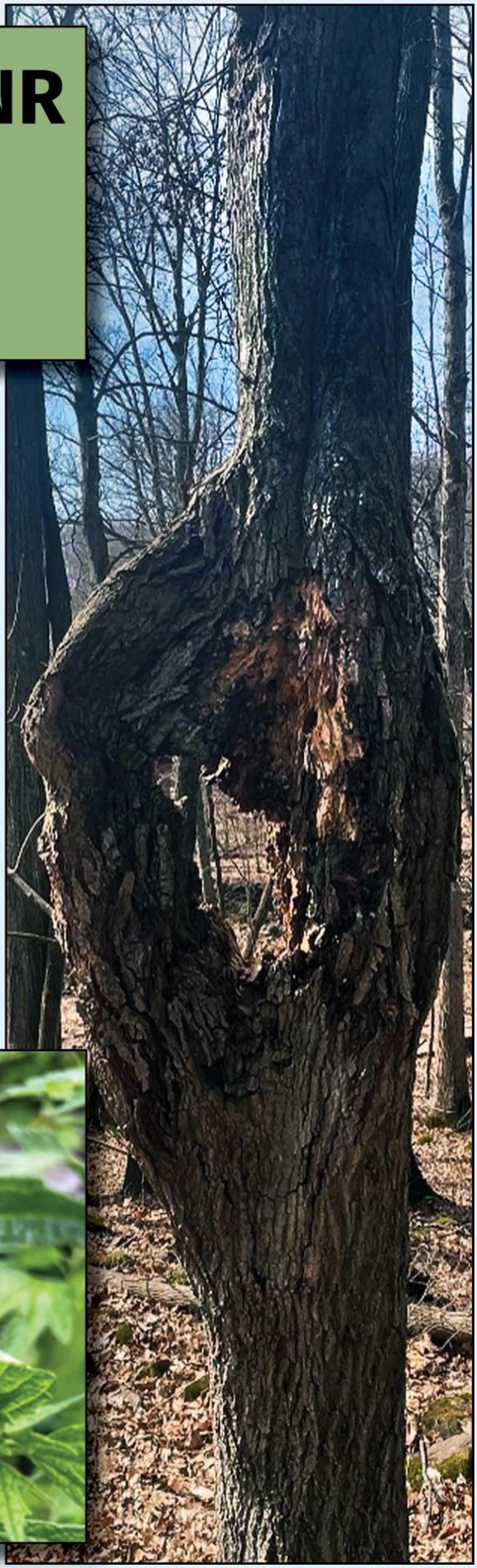
2024 Wisconsin DNR Forest Health Annual Report



2024 Wisconsin DNR
Forest Health Annual Report

FR-861

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Cover photos

- **Top left:** Spongy moth caterpillar feeding on white pine needles. / **Photo Credit:** Wisconsin DNR
- **Right:** Tree stem with a large hole. / **Photo Credit:** Wisconsin DNR
- **Bottom left:** Periodical cicada on a plant. / **Photo Credit:** Wisconsin DNR

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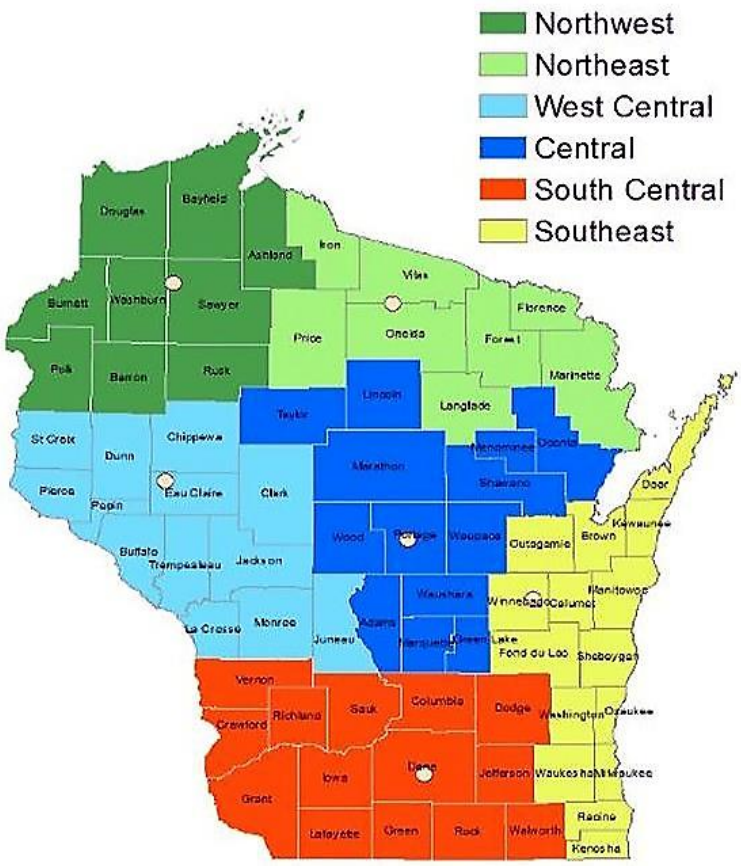

Figure 1. *Areas of responsibility and location of offices for Wisconsin Department of Natural Resources Forest Health specialists. /* ***Map Credit:*** *Wisconsin DNR*

Wisconsin DNR Forest Health Staff

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Staff Updates

Hillstrom Transitions To Invasive Forest Pest Coordinator

Mike Hillstrom *(Fig. 2)* started in his new role as the Invasive Forest Pest Coordinator in September 2024. He took over for Andrea Diss-Torrance, who retired earlier in the year. Mike will continue to cover his Forest Health specialist zone until that vacancy is filled.

Mike will serve as Wisconsin's representative on the Northeast Midwest State Foresters Alliance Forest Health Committee as well as several DNR teams. Mike's first major task will be to create a hemlock woolly adelgid strategy for Wisconsin in collaboration with partners.

Figure 2. *New Wisconsin Department of Natural Resources Invasive Forest Pest Coordinator Mike Hillstrom.* / ***Photo Credit:*** *Wisconsin DNR*

The Forest Resource In Wisconsin

Wisconsin's forests *(Fig. 3)* are critical for providing wildlife habitat, supplying clean air and water, reducing erosion and improving the quality of life in urban and rural areas. Forests are also important to Wisconsin's economy for wood products, recreation and tourism. Current information on the forest resource in Wisconsin is available on DNR's Forestry webpage.

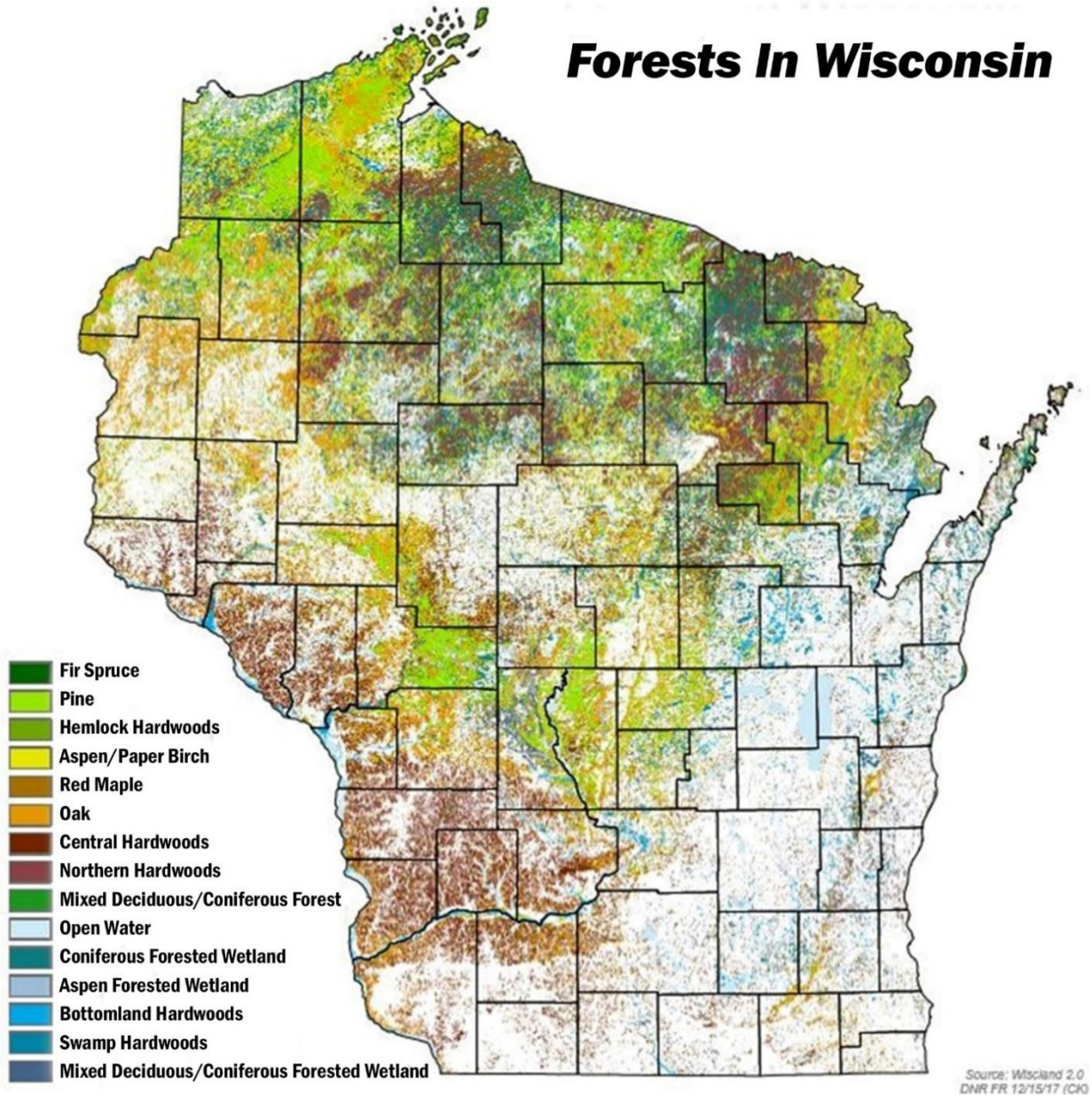


Figure 3. *Wisconsin forest cover map.* / ***Graphic Credit:*** *Wisconsin DNR, from WISCLAND land cover map*

Forest area in Wisconsin has steadily increased in recent decades and currently stands at approximately 17 million acres. This total marks an increase of 1.6 million acres since 1983. Wisconsin now has more forested area than at any time since the first forest inventory was conducted in 1936. More than 46% of the state's land area is forested, primarily in the northern and western regions.

Wisconsin's forests are composed primarily of hardwood species. The most abundant forest types are oak-hickory (26% of total forested acreage); maple-beech-birch (22%); and aspen-birch (17%) *(Fig. 4)*. Lowland forest, dominated by elm and ash, account for 10%. Conifer types, mainly pine and spruce-fir, represent about 18% of the forested area.

Wisconsin forests are mostly mature, with the greatest proportion of stands in the 61-80-year class. The decline in acreage of the early successional aspen-birch forest type is related to the maturing of Wisconsin's forests. About 70% of Wisconsin's forest lands are privately owned, 10% are federally owned and the remaining percentage is split among state, local government and tribal ownership.

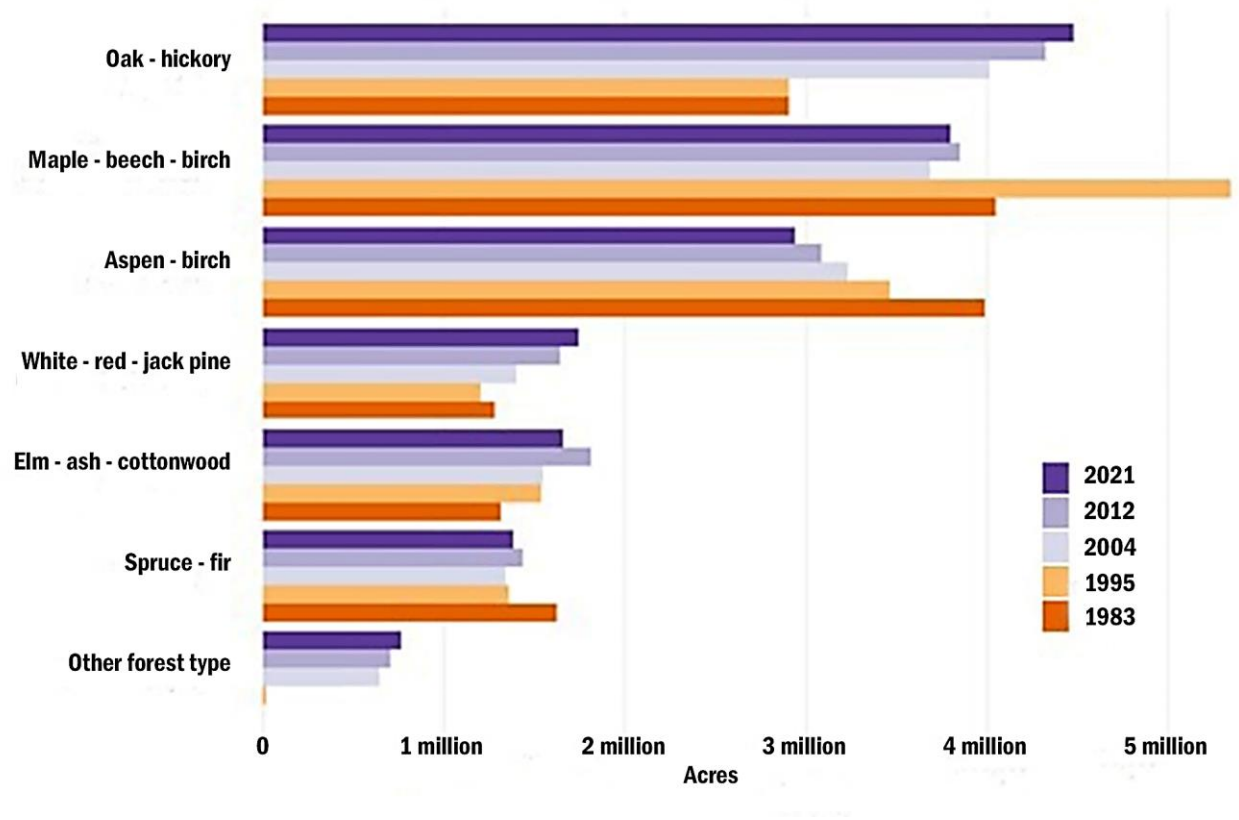


Figure 4. *Acres in Wisconsin forest types, 1983-2021. /* ***Graphic Credit:*** *Wisconsin DNR*

Outreach And Education

The Forest Health Program achieved multiple milestones during the year, improving the quality and scope of regularly planned communications and digging in when special projects came up. Through a variety of media and messages, Forest Health communications were received by an estimated audience of 396,123 external customers between Oct. 1, 2023, and Sept. 30, 2024. In addition, 53 Forest Health-related posts on social media sites Facebook, Instagram, NextDoor and LinkedIn received 3,111,310 impressions.

Nonnative Forest Health Threats

Beech Bark Disease: Beech Scale (*Cryptococcus fagisuga*) And *Neonectria* spp. Fungi

In 2024, several additional sites with moderate and high populations *(Fig. 5)* of the non-native insect beech scale were reported outside of Door County. Beech scale is believed to have spread through the range of American beech in Wisconsin (in the eastern counties). But until the spring of 2023, the insect had only been seen at low levels outside of Door County *(Fig. 6)*.

Beech scale and beech bark disease were first detected in Wisconsin in Door County in 2009, and the scale has been abundant in this county for about a decade.

Reported 2024 sites with moderate or high populations:

- **Kewaunee County:** Town of Ahnapee
- **Manitowoc County:** Towns of Two Rivers and Centerville
- **Marinette County:** Town of Peshtigo
- **Menominee County:** Menominee Forest (information provided by Menominee Tribal Enterprises)

Figure 5. *High beech scale populations ("white wool") and a tar spot on a beech tree at LaSalle County Park in Door County, June 2024. /* ***Photo Credit:*** *Wisconsin DNR*

In April and May 2023, high scale populations were detected at a site in Kohler-Andrae State Park in Sheboygan County *(Fig. 7)* and in the towns of Beecher and Silver Cliff in Marinette County. Beech scale was lab-confirmed in both counties in 2010, but for an unknown reason the scale population remained very low for more than a decade.

The population buildup was determined to have occurred in 2022 because the insect had not yet produced eggs in the spring of 2023, when the high populations were found.

Beech bark disease is a complex of a scale insect and a fungal pathogen that kills many beech trees. The fungus typically does not arrive until several years after the scale population becomes very high, because scale feeding wounds are necessary for disease-causing fungi to enter the tree.

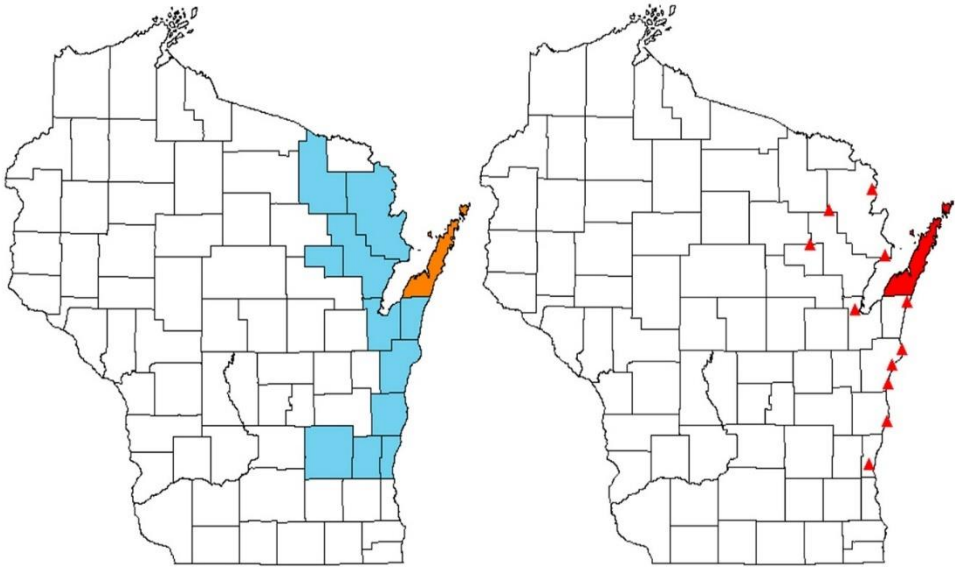


Figure 6. Left: *Counties with beech scale detections are shown in blue; counties with beech bark disease are shown in orange.* ***Right:*** *Red triangles denote sites outside of Door County where high beech scale populations have been observed or reported.* / ***Map Credits****: Wisconsin DNR*

As of late 2024, Door County remains the only Wisconsin county where beech bark disease is known to occur. The high-scale sites in other counties will be monitored to see if beech bark disease develops in coming years.

More information about beech bark disease can be found on the DNR Forest Health Beech Bark Disease webpage.

Figure 7. *Dramatic beech scale population increase from May 2023 to May 2024 on a pair of trees at Kohler-Andrae State Park in Sheboygan County.* / ***Photo Credit:*** *Wisconsin DNR*

Beech Leaf Disease (*Litylenchus crenatae* ssp. *mccannii*)

The Wisconsin DNR, together with the Indiana DNR and the Michigan DNR, received federal funding (Bipartisan Infrastructure Law High-Priority Regional Invasive Species Projects) to conduct a beech leaf disease detection survey. It is a three-year project; sample collection started in October 2023.

Bud samples were collected from saplings and suppressed beech *(Fig. 8)*. Selected trees were visually examined for the presence of beech leaf disease symptoms. No symptomatic trees were found. One hundred samples were collected from 35 locations in 10 counties in 2023.

Samples were shipped and processed at the Plant and Pest Diagnostic Lab at Purdue University. The DNA of the nematode *Litylenchus crenatae* spp. *mccannii* was not detected from any of the samples. Fall 2024 data collection is in progress, with samples being collected throughout eastern Wisconsin where American beech is distributed.

Figure 8. *Beech trees are examined for symptoms of beech leaf disease and bud samples collected for molecular testing. /* ***Photo Credit:*** *Wisconsin DNR*

Cottony Ash Psyllid (*Psyllopsis discrepans*)

Cottony ash psyllid was first identified in Wisconsin in 2006 and reconfirmed in 2023. In 2024, cottony ash psyllid was identified in additional counties, mostly in the northern part of the state *(Fig. 9)*.

Feeding by cottony ash psyllid causes leaves to curl and twist and appear in clumps on the tree *(Fig. 10)*. Cottony ash psyllid feeds on black ash and closely related ash species such as Manchurian ash. Infestations can cause tree decline and mortality.

There are two generations of the insects per year, so when leaves are damaged early in the season, the tree sends out additional leaves that are then damaged as well.

Figure 9. *Known locations of cottony ash psyllid in Wisconsin. /* ***Map Credit:*** *Wisconsin DNR*

Figure 10. *Feeding by cottony ash psyllid causes leaves to curl and twist. /* ***Photo Credit:*** *Wisconsin DNR*

Emerald Ash Borer (*Agrilus planipennis*)

In 2024, emerald ash borer (EAB) was found in the three remaining counties without a previously confirmed detection (Taylor, Washburn and Burnett counties). Burnett County, in northwest Wisconsin, was the 72nd and final county to have a detection. DNR Forest Health staff responded to a report of EAB at a private residence in the town of Meenon on June 13 and collected life stages that were subsequently confirmed as EAB.

Local detections of EAB also continued in 2024, primarily in the northern counties. There are no municipalities remaining to be confirmed EAB-positive in nearly half of Wisconsin's 72 counties, primarily in the south and east *(Fig. 11)*.

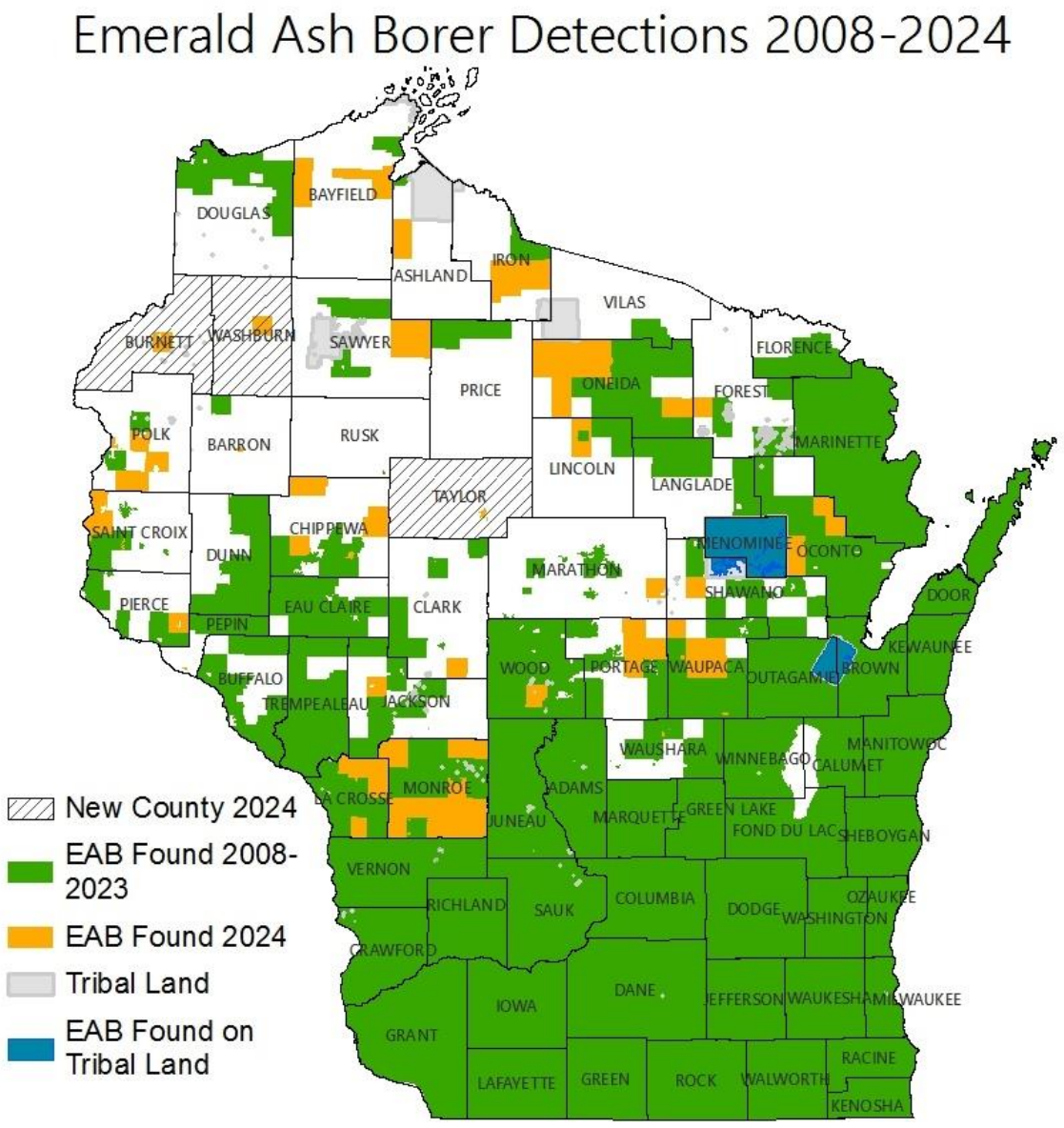


Figure 11. *Municipal detections of emerald ash borer found through 2023 are shown in green, with 2024 detections in orange and detections on tribal lands in blue. /* ***Map Credit:*** *Wisconsin Department of Agriculture, Trade and Consumer Protection.*

Wisconsin's first detection of EAB took place in Ozaukee County in July 2008 *(Fig. 12)*. Although the ash tree-killing beetle is less established in northern Wisconsin than in other parts of the state, this year's detections indicate that the pest is expanding its foothold in the region. EAB is most commonly transported to new areas when it hitches a ride inside firewood.

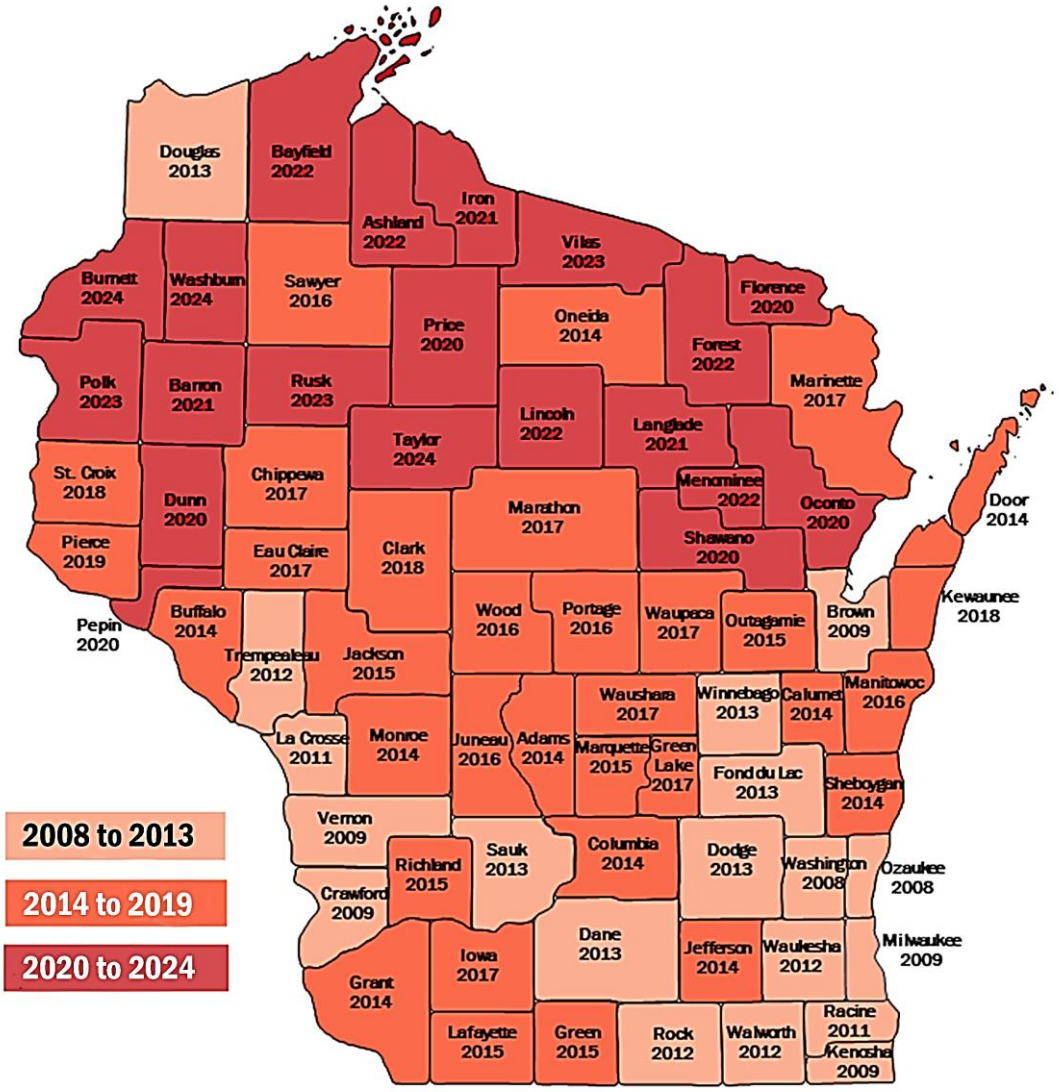


Figure 12. *Map of first emerald ash borer county detections by year. /* ***Map Credit:*** *Wisconsin DNR*

EAB larvae bore into ash trees and carve winding, S-shaped galleries beneath the trees' bark, typically starting in the upper canopy and progressing down the tree. The galleries restrict the movement of water and nutrients, leading to branch dieback, canopy thinning and tree death within a few years.

EAB is expected to eventually kill more than 99% of susceptible Wisconsin ash species (white, black and green ash and their ornamental varieties). In much of southern Wisconsin, the large, dead ash continue to fall over and snap in increasing numbers *(Fig. 13)*. Ash mortality has increased as EAB populations expand across the state, with greater than 90% mortality

now reported across southern Wisconsin *(Fig. 14)*. More information about tree mortality is available on the DNR Forest Health EAB webpage.

Figure 13*. Fallen ash trees killed by emerald ash borer block a trail at Harrington Beach State Park in Ozaukee County in late May 2024. /* ***Photo Credit:*** *Wisconsin DNR*

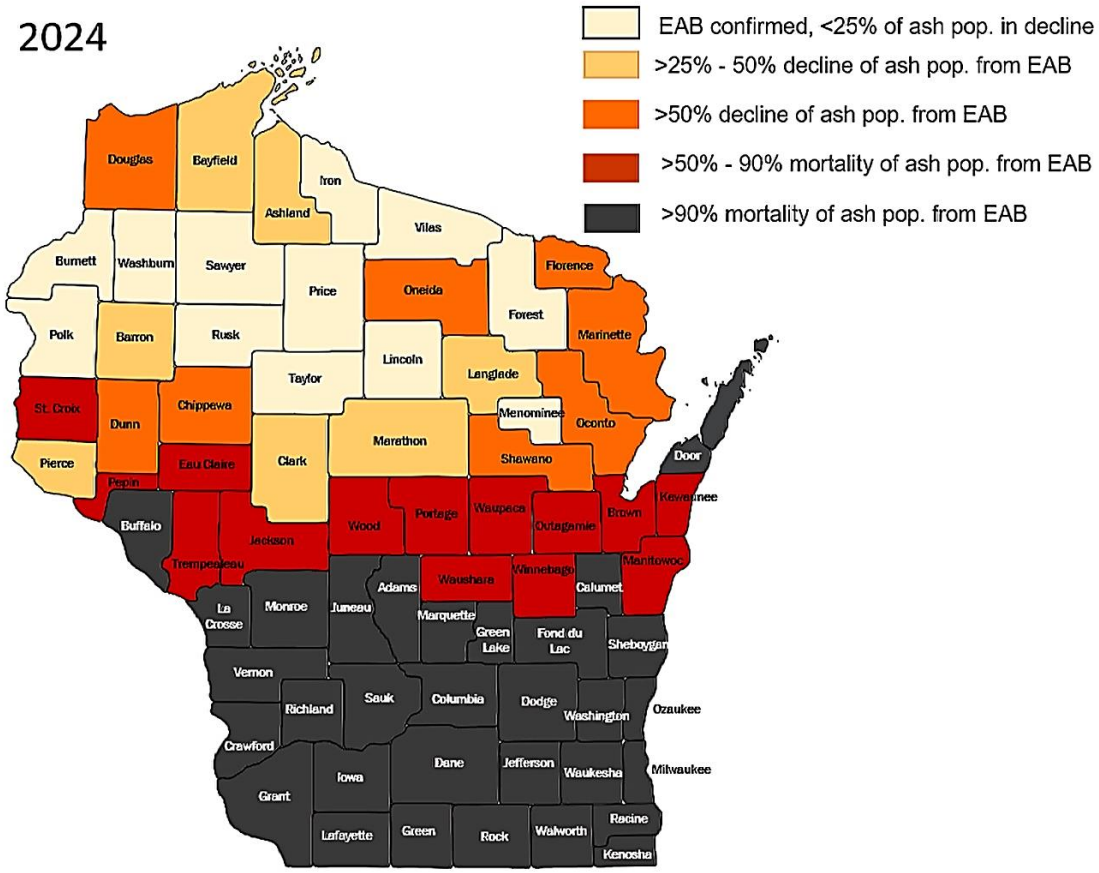


Figure 14. *Map of percentages of ash decline and mortality by county in Wisconsin. /* ***Map Credit:*** *Wisconsin DNR*

EAB Biological Controls

EAB biological control releases were done at 13 sites in eight counties in 2024 *(Fig. 15)*. A total of 43,066 wasps were released. By species, they were: *Tetrastichus planipennisi,* 42% *(Fig. 16)*; *Oobius agrili,* 35%; and *Spathius galinae,* 23%.

This was the second year of biological control releases in northern Wisconsin. These wasps were first released in Ozaukee County in 2011 and have been released annually since. Going forward, most of the Wisconsin releases will occur in the northern half of the state, due to the age and severity of infestations in the southern counties.

These small wasps help to keep down EAB numbers in young ash regeneration, increasing likelihood of ash reproduction and survival. The wasps do not sting people or animals and are highly host-specific to EAB life stages. Wasps are supplied by the USDA-APHIS Plant Protection and Quarantine EAB Parasitoid Rearing Facility in Brighton, Michigan, and were released by USDA-APHIS staff. EAB-infested ash trees from Wisconsin are commonly used to produce these wasps.

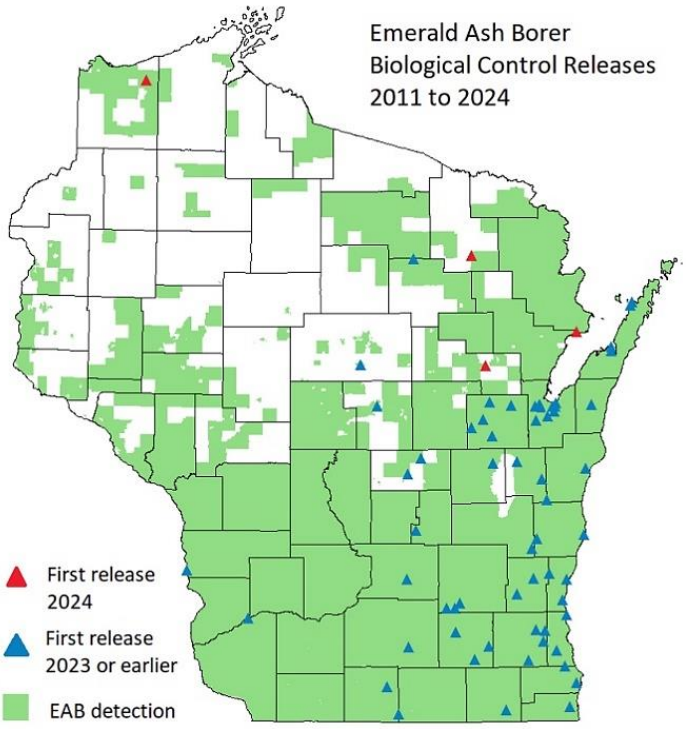


Figure 15. *Map of EAB biological control releases in Wisconsin from 2011 to 2024. /* ***Graphic Credit:*** *Wisconsin DNR*

Figure 16. *An adult Tetrastichus planipennisi wasp on a finger. /* ***Photo Credit****: Wisconsin DNR*

A former release site in Green Lake County was retrapped by USDA APHIS in 2024 using yellow pan traps that are attractive to flying insects. Wasp specimens were sent to a USDA expert for identification, but results have not yet been received. This site was previously trapped in 2023, but all specimens collected then were identified as native wasps and not the introduced species.

At Big Foot Beach State Park in Walworth County, a cluster of *Tetrastichus* wasp larvae was recovered from a small ash tree in June 2024 *(Fig. 17)*. The wasps were released at this park 11 years earlier and have persisted. An EAB larva and adult beetle were also present.

Figure 17. *Cluster of* Tetrastichus *pupae (circled) found inside an emerald ash borer gallery at Big Foot Beach State Park in June 2024. An unparasitized EAB larva is present at the top of the photo. /* ***Photo Credit:*** *Wisconsin DNR*

Ash Regeneration

Ash regeneration of both seed and sprout origin, smaller than 3 inches in diameter, continues to be abundant in areas of Wisconsin where the large ash trees have been dead for at least several years *(Fig. 18)*.

Figure 18. *A regenerating 3-inch diameter ash tree stands in front of older ash mortality at Harrington Beach State Park in Ozaukee County on May 29, 2024. /* ***Photo Credit:*** *Wisconsin DNR*

A heavy seed year for ash was observed in the eastern counties (with varying levels of large ash mortality). Small ash trees smaller than 3 inches in diameter were commonly observed to have a good seed crop. The most recent seed year for ash in this area was 2022. Stems smaller than 1 inch in diameter were seen with a seed crop in a monitoring site at Richard Bong State Recreation Area in Kenosha County *(Fig. 19)*. Peak mortality of larger ash occurred at this property more than five years ago, yet reproducing ash are still present as smaller stems.

Figure 19. *A ¾-inch diameter ash stem with a seed crop at Richard Bong State Recreation Area in Kenosha County, Sept. 27, 2024. No signs of EAB infestation were observed on this tree. /* ***Photo Credit:*** *Wisconsin DNR*

Several small, live ash were observed to have both older EAB galleries and a 2024 seed crop at two monitoring sites in Kenosha and Washington counties *(Fig. 20)*. One small ash in Washington County was observed to have old EAB galleries, a current EAB gallery and a seed crop. These observations support the expectation that ash will persist on the landscape in the presence of EAB, although as smaller trees than in pre-EAB times.

Figure 20. *An old EAB gallery (circled) on a small ash stem that was producing a seed crop at Richard Bong State Recreation Area in Kenosha County on Sept. 27, 2024. /* ***Photo Credit:*** *Wisconsin DNR*

Lingering Ash Surveys And Hyperspectral Imaging Project

The Wisconsin DNR Forest Health Program continued to collaborate with the Townsend Lab (University of Wisconsin-Madison Environmental Spectroscopy Laboratory) and U.S. Forest Service (USFS) to develop and test methods for mapping lingering ash from hyperspectral imagery taken from an airplane. In 2024, imaging surveys were again flown over sites scattered across southeastern Wisconsin, comprised mostly of southern hardwood communities of floodplains and swamps.

Sites were proposed for survey by DNR and USFS Forest Health specialists based on previous dominance of ash, high mortality from EAB and ownership. Public lands were preferred because of easier approval for entry and sampling. Because further refinement of the method is needed, several sites with known lingering ash were suggested for evaluation.

A more efficient method than surveying from the ground is needed to identify potential EAB-resistant ash among acres of post-EAB mortality forests. These trees are critical for a breeding program to produce EAB-resistant ash for eventual forest recovery.

Heterobasidion Root Disease (*Heterbasidion irregulare*)

Heterobasidion root disease (HRD) was found in Door County for the first time in 2024. In fall, several suspected HRD fruiting bodies were spotted in a white spruce plantation on privately owned land in the Town of Sevastopol. One cluster of fruiting bodies located at the base of a dead spruce was confirmed as *Heterobasidion irregulare*, the fungal pathogen causing HRD.

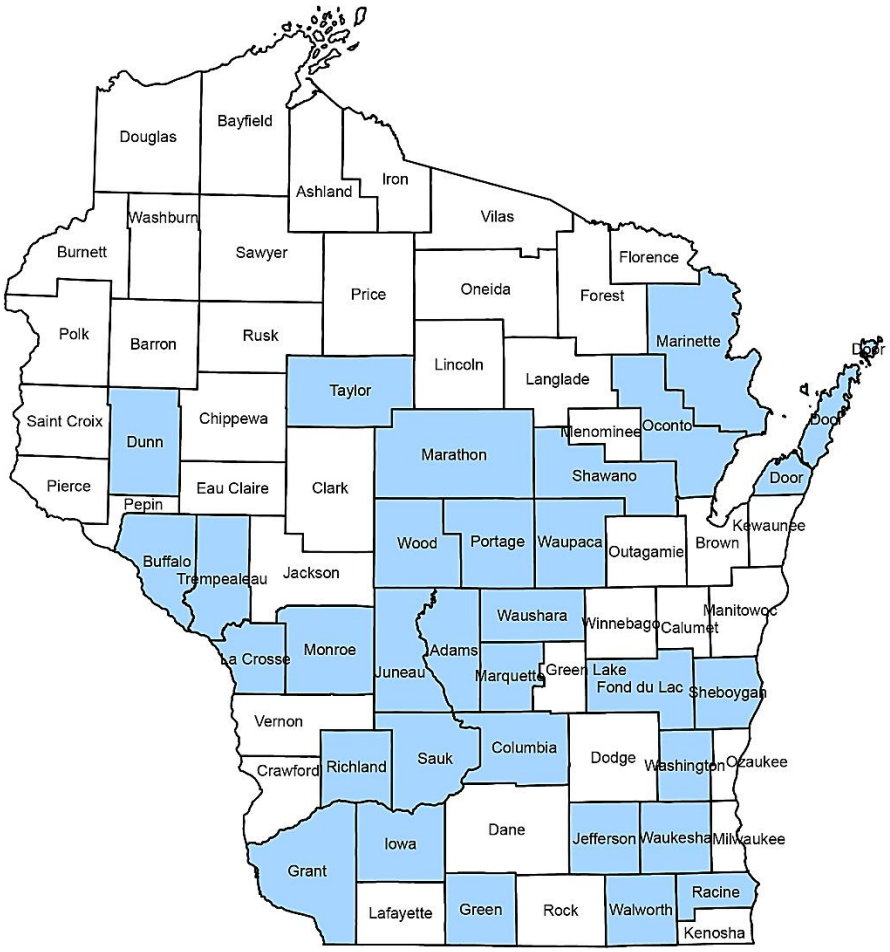


Figure 21. *Map of counties with Heterobasidion root disease detections, including the new find in Door County in 2024. /* ***Map Credit:*** *Wisconsin DNR*

The identity of the pathogen (*H. irregulare*) was confirmed with DNA sequencing. With this new find in Door County, HRD is now known to occur in 31 of 72 Wisconsin counties *(Fig. 21)*. Aside from the new county find, HRD was also found in new locations in counties where the disease had previously been confirmed.

Research On HRD

In fall 2024, a study was initiated to compare chemical and biological soil characteristics, in relation to susceptibility to HRD, between natural red pine forests and red pine plantations. The study also evaluates the effect of historical agricultural land use of these pine stands on fungal/mycorrhizal communities. Soil and plant root samples will be collected in two state forests (Northern Highland-American Legion State Forest and Black River State Forest). Samples will be processed at the University of Wisconsin-Madison Biotechnology Center (UWBC) and its Next Gen DNA sequencing facility.

Introduced Basswood Thrips (*Thrips calcaratus*)

Moderate to severe thrips damage was first observed on basswood in Wisconsin in 1980, and research identified the culprit as an exotic thrips species, the introduced basswood thrips. Since identification, the invasive thrips population has resulted in two outbreaks causing extensive defoliation in the mid-1980s and late 1990s.

The first population outbreak caused the most damage and lasted 5-6 years. The second outbreak, in the mid-1990s, affected fewer acres and lasted only two years. Since then, the population and the amount of damage have remained low, but recently noticeable defoliation has been observed *(Fig. 22)*.

In 2024, more than 1,100 acres of severe defoliation were mapped, a total that was down slightly from the 2,000 acres of severe defoliation detected in 2023. The wet spring weather in 2023 may have been less favorable to the thrips than the droughty conditions later in 2023, which were more favorable to thrips survival.

Figure 22. *Significant damage from basswood thrips early in the spring causes very thin crowns. /* ***Photo Credit:*** *Wisconsin DNR*

Invasive Plants

The Forest Health Program administers three funds that support statewide terrestrial invasive plant control efforts:

- The Weed Management Area-Private Forest Grant Program (WMA-PFGP)
- Priority Implementation Funds (PIF) for control of invasive plants on the northern state forests
- The Forest Health program's invasive plant suppression fund

The WMA-PFGP provides funding to groups for invasive plant management on nonindustrial private forest land of 500 acres or less. Projects funded by the WMA grant completed by September 2024 included control and monitoring of invasive plants on private lands, restoration and replanting of native plants, and outreach and education events at conferences, workshops and schools. Various social media and web campaigns reached more than 13,000 visitors. For FY25 (July 2024-June 2025), the WMA-PFGP funded seven projects, which will be completed in the coming year(s).

Species controlled with program funds included buckthorn, Japanese knotweed, false spirea, wild parsnip, honeysuckle, Japanese barberry and Japanese stilt grass. The total amount of area treated for these species combined was 59 acres. While some of these plants are common in southern counties, they are rare on the northern state forests, so action is taken to prevent their introduction and spread. In addition to control, 176 miles of state forest were surveyed for the presence of various invasive plant species.

Amur cork tree was discovered at Big Foot Beach State Park this year. This large infestation was mapped to aid in future control efforts.

A new county detection of the prohibited species giant hogweed was documented in Marathon County this year. The infestation is on private property, but the landowner worked with Wood County Land and Water Conservation staff, with some assistance from the Wisconsin DNR, to treat the population and prevent further spread.

Control of wild parsnip on the Bearskin State Trail continued this year in north central Wisconsin, where wild parsnip remains less common. DNR Parks staff assisted with this treatment. This is the sixth year of control along the recreation trail, which is considered a high-priority area to prevent the spread of this invasive plant that damages natural communities and poses a threat to human health. Contracting for ongoing control on the trail will continue into next year.

The Forest Health Program's invasive plant suppression fund covered an updated design of boot brushes used to remove invasive plant seeds and debris *(Fig. 23)*. These handy tools are given out during invasive species training as part of an outreach effort to prevent the spread of invasive plants and promote best management techniques.

In addition, new aluminum signs with information on illegal dumping and wild parsnip were designed and funded by this this account. Signs will be set up in areas already known to be used for yard waste, to educate the public on this topic and discourage others from dumping their yard waste in forests. The wild parsnip signs will be posted in locations where this species is actively growing to make the public aware of the negative impacts this plant has on human health.

A research project on the phenology of Japanese stilt grass found on the Coulee Experimental State Forest has been completed. Researchers at the University of Wisconsin-La Crosse first placed cages in September 2023, to allow for monitoring of the plant through the period of seed shattering. The work wrapped up at the end of spring 2024 and the researchers are working on a publication.

This research provided valuable insight for the late summer and fall treatments of this aggressive grass. Trails and parking areas were surveyed on five occasions between Aug. 19 and Oct. 31 *(Fig. 24)*. Japanese stilt grass was discovered on four of these occasions. Between the five surveys, 47 individual populations were found and controlled using a butane torch *(Fig. 25)*.

Figure 23: *New boot brushes featuring a DNR logo and the quote "Brush Off Invasives" will serve as a reminder to be proactive in stopping the spread of invasive plants. /* ***Photo Credit:*** *Wisconsin DNR*

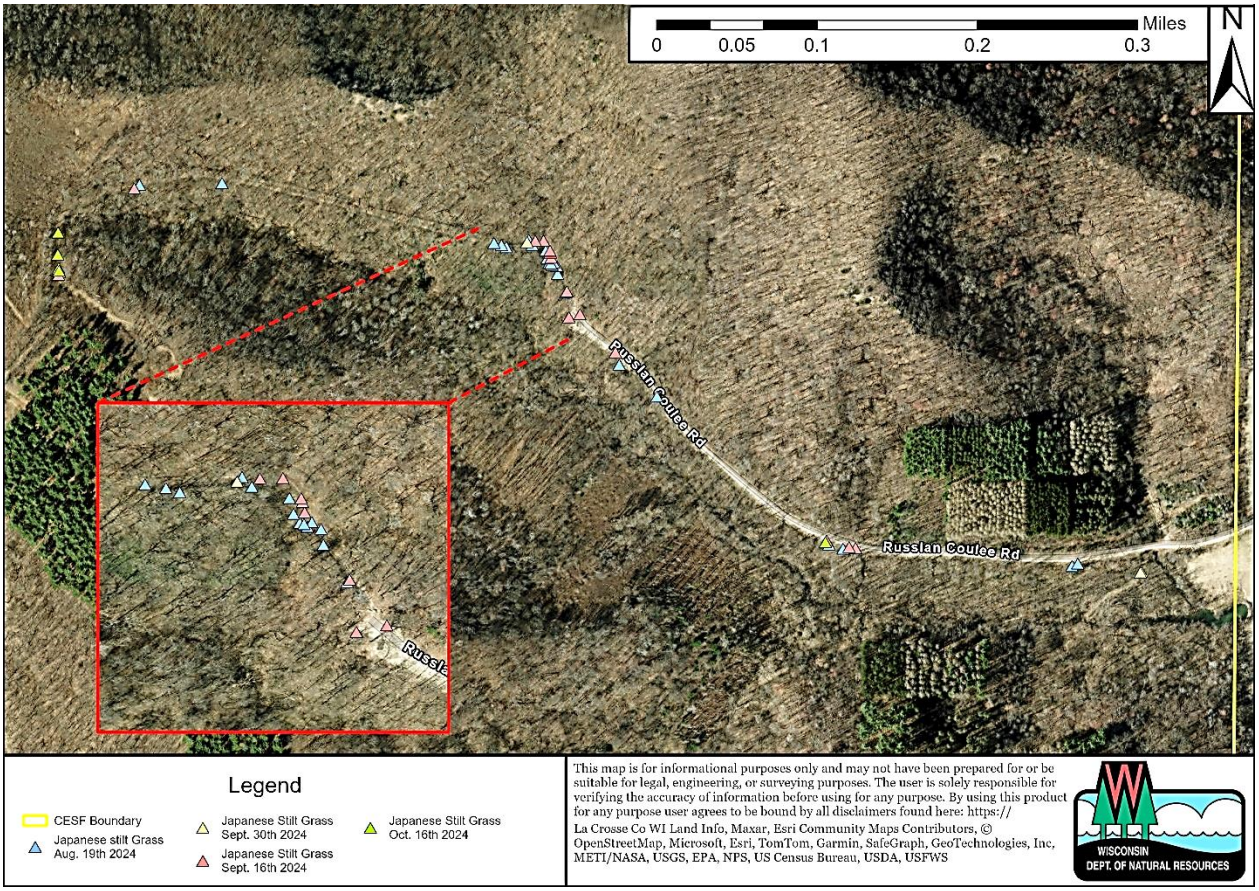


Figure 24: *Map of all Japanese stilt grass populations found on the Coulee Experimental State Forest between Aug. 19 and Oct. 31, 2024, when the grass has the highest detectability. /* ***Graphic Credit:*** *Wisconsin DNR*

Figure 25: *A DNR forester uses a butane torch to control Japanese stilt grass populations that were discovered during surveys at the Coulee Experimental State Forest. /* ***Photo Credit:*** *Wisconsin DNR*

Invasive Worms (*Amynthas* spp.)

Forest communities in Wisconsin evolved following glaciation, which eliminated worms from soils across the state. As a result, many of our native tree and herbaceous species depend on a thick layer of slowly decomposing leaf litter atop the soil, which can persist only in the absence of worms.

European worms have slowly been spreading in Wisconsin for more than two centuries, inadvertently brought by early colonists and spread by human activities. The movement of worms into woodlands has accelerated in recent decades, as more people move into and recreate in the forest. Where present, European worms slowly consume the leaf litter layer, resulting in reduced survival of native tree seedlings and wildflowers.

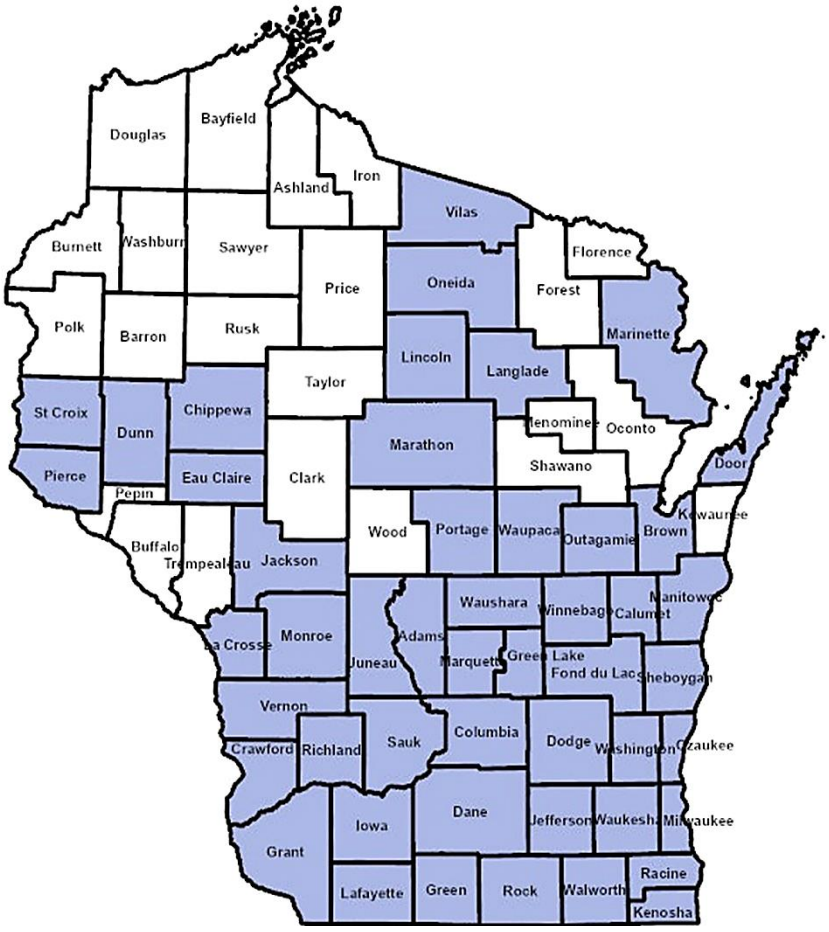


Figure 26. *Wisconsin counties (blue) with Amynthas worm detections. /* ***Map Credit:*** *Wisconsin DNR*

In recent years, new non-native worms from Asia, *Amynthas* species, have been found in Wisconsin. This group of related species is referred to as "jumping worms." Unlike the European worms, the jumping worms are parthenogenetic, which greatly increases their ability to successfully establish from a small starting population or even one individual. Population growth is rapid, as is the consumption of leaf litter, and it is this accelerated consumption of leaf litter that is cause for concern. Research also suggests that in forests dominated by sugar maple, jumping worms are capable of replacing all species of European earthworms. This has unknown consequences for forest plants and soil.

Jumping worms continue to be a concern for forest managers in Wisconsin. Jumping worms were first identified in Dane County in 2013. They have now been reported in 49 of the state's 72 counties *(Fig. 26)*. The public is encouraged to submit findings to EDDMapS to continue tracking jumping worms. The species found in Wisconsin are *Amynthas tokioensis*, *A. agrestis* and the closely related *Metaphire hilgandorfi*. *A. tokioensis* is the most common of the three species, and *A. agrestis* typically appears in combination with *A. tokioensis*.

Oak Wilt (*Bretziella fagacearum*)

Storm damage during the high-risk period for oak wilt infection in Wisconsin resulted in many new infections in 2024. In addition, underground linework in north central counties to extend broadband to the Northwoods caused injuries on trees along many roads and contributed to oak wilt introduction.

While there were no new county finds in 2024, oak wilt was confirmed in new townships:

- Parrish Township in Langlade County
- Franzen Township in Marathon County

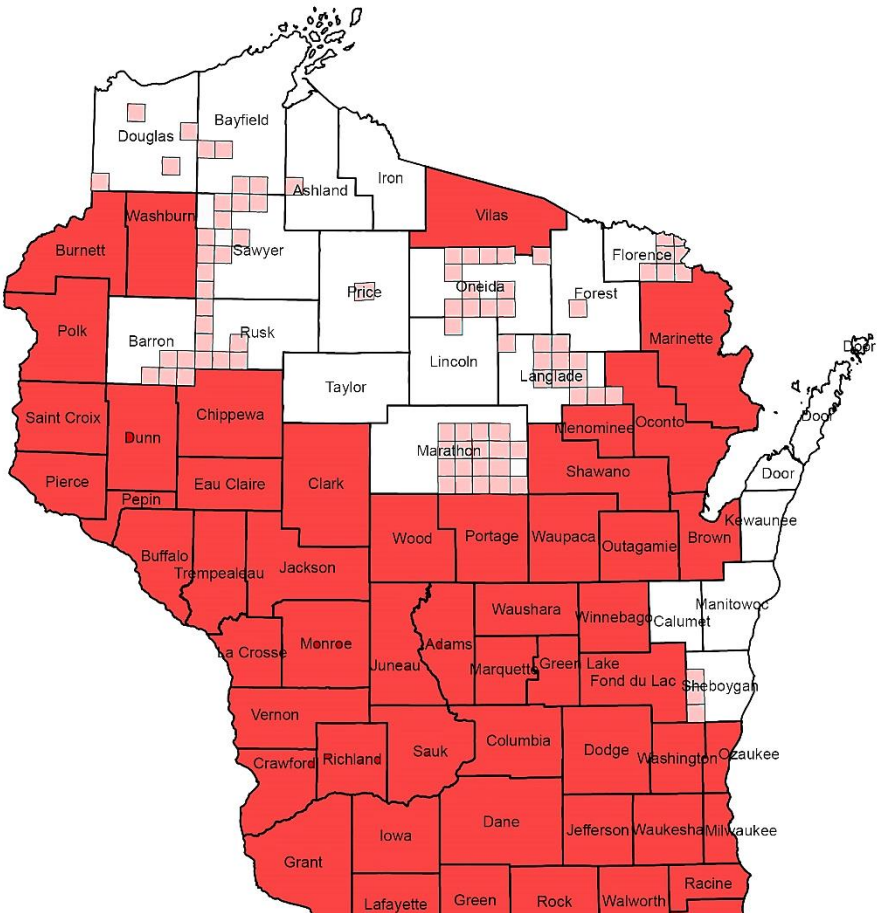


Figure 27. *Oak wilt is generally established in counties tinted red in the map. Townships tinted pink have confirmed oak wilt cases but are in counties where oak wilt remains rare. Oak wilt has not been found in untinted areas. /* ***Map Credit:*** *Wisconsin DNR*

Currently, oak wilt is known to be present in 66 of Wisconsin's 72 counties *(Fig. 27).*

Samples submitted to the DNR Forest Health Lab that tested negative for oak wilt in 2024 were often diagnosed with twolined chestnut borer and/or Armillaria root disease. This was anticipated, given that many trees had been stressed by drought and insect defoliation in recent years.

Oak Wilt Suppression Program

Oak wilt is actively managed throughout Wisconsin at the private and state level. Since 2021, a grant from the U.S. Forest Service to suppress oak wilt along the leading edge of its range has been used to control oak wilt pockets in northeastern and northwestern Wisconsin. In 2024, the Forest Health Program received a fourth year of funding from the U.S. Forest Service to financially assist qualifying private landowners with oak wilt control.

The program covered 100% of the cost of performing oak wilt control measures that directly mitigate above- and below-ground disease transmission, while allowing landowners to optionally cover the costs of elective work related to the disease control process (e.g., brush chipping and stump removal).

Oak Wilt Research

Oak wilt is introduced to a new area by insect vectors moving spores from infected wood to fresh wounds on an uninfected oak. Once a tree is infected, the disease spreads throughout its vascular system and can move into neighboring oaks through root grafts.

To contain new oak wilt infections in a stand, foresters at Menominee Tribal Enterprise have been killing oaks by girdling them and applying herbicide as soon as they show any wilting branches. The intent is to prevent the spread of the fungus into the root system and adjacent oaks connected by root grafts. Their monitoring suggests that they have successfully prevented the underground spread of oak wilt using this "rapid response" technique.

Figure 28. *A Wisconsin DNR employee girdles an oak tree dying of oak wilt to test the effectiveness of the rapid response method for oak wilt management. /* ***Photo Credit:*** *Wisconsin DNR*

To formally test this approach, the Forest Health Program is collaborating with Michigan and Minnesota DNR Forest Health programs, along with scientists from the U.S. Forest Service, on an eight-year study funded by the Forest Service. In 2023, 41 mature oak trees were artificially inoculated with an oak wilt pathogen (*Bretziella fagacearum*) spore suspension.

Of these, 34 trees developed wilting symptoms, which were confirmed as oak wilt in the laboratory, and were subsequently treated with the rapid response method (either girdle only or girdle-and-herbicide). Treatments took place in July, August, September or October.

The process: A single tree is infected with oak wilt and then treated with the rapid response method. Nearby trees are checked for five years after the rapid response treatment to determine if oak wilt fungus has spread to the neighboring oaks. If so, the treatment was not successful. If, after 5 years, no breakout has occurred, the treatment is deemed successful.

In 2024, an additional 16 mature oak trees were inoculated with the oak wilt pathogen. Of these, 13 trees exhibited wilting symptoms and were confirmed through laboratory analysis to have oak wilt. Twelve of these wilting trees were treated with the rapid response method (all girdle-and-herbicide) on July 25, 2024 *(Fig. 28),* and one tree was treated on Aug. 5, 2024. In 2025, treated trees from 2023 and 2024 will continue to be monitored for breakouts throughout the growing season, with no further inoculations planned.

Spongy Moth (*Lymantria dispar dispar*)

Wisconsin experienced its fourth consecutive mild winter in 2023-24, followed by a slightly warmer but wetter-than-average spring. Wisconsin's first known spongy moth egg hatch in 2024 was reported on April 17 at Big Foot Beach State Park in Walworth County.

Figure 29. *Spongy moth caterpillars killed by Nucleopolyhedrosis virus (NPV) hang in an inverted "V" orientation; caterpillars killed by the Entomophaga maimaiga fungus hang vertically, head down. /* ***Photo Credit:*** *Wisconsin DNR*

DNR staff saw and received many reports of spongy moth caterpillar mortality from both Nucleopolyhedrosis virus (NPV) and the fungus *Entomophaga maimaiga*, which benefits from rainy conditions *(Fig. 29)*. This increase in mortality was expected, given the age of the outbreak and the above-average rainfall seen in the spring. The two differing types of dead caterpillars were commonly seen on the same tree; both were often filled with a brown, foul-smelling liquid.

Reported larval mortality levels ranged from moderate to heavy, with some landowners reporting near 100% mortality. Heavy caterpillar mortality was seen in counties where defoliation was observed, as well as in counties where populations were at sub-defoliation levels (e.g., Vilas County). The outbreak was reported to have collapsed in the northwest counties and most of southern Wisconsin.

Defoliation Mapped In 2024

Aerial surveys conducted in June and July recorded about 334,000 acres of spongy moth defoliation (where greater than 10% of the mapped polygon was defoliated), using Digital Sketchmapping tablets *(Fig. 30)*. This total was down from the 2023 record defoliation total of 375,000 acres *(Fig. 31)*. More than 80% of this defoliation was observed in northern Wisconsin (primarily Bayfield, Florence and Marinette counties), with about 20% observed in southern counties. The last few summers have shown that spongy moth can do very well in the colder climate of far northern Wisconsin when weather conditions are favorable.

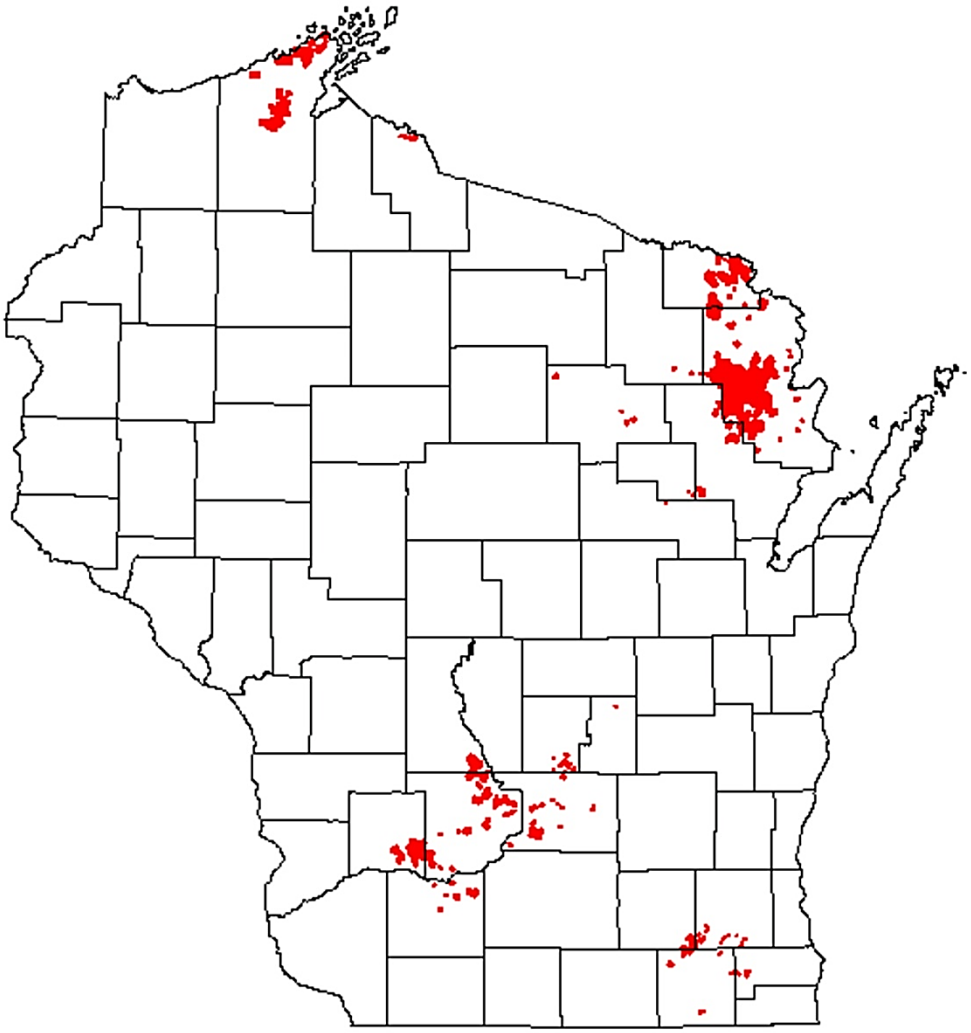


Figure 30. *Map of the recorded spongy moth defoliation in 2024. Map is enhanced to show small areas of defoliation. /* ***Map Credit:*** *Wisconsin DNR*

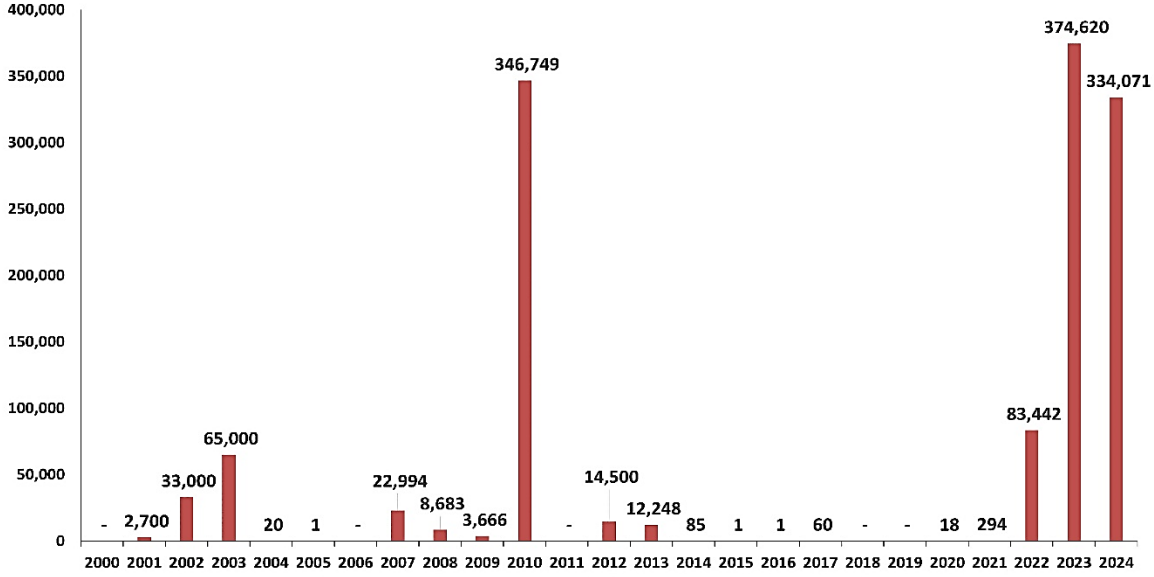


Figure 31. *Wisconsin acres defoliated by spongy moth, 2000-2024. /* ***Graphic Credit:*** *Wisconsin DNR*

Figure 32. *Spongy moth defoliation in Marinette County in mid-June 2024.* / ***Photo Credit:*** *Wisconsin DNR*

Counties with the most observed defoliation in 2024 were Marinette (180,606 acres) *(Fig. 32)*, Bayfield (43,145 ac.), Florence (34,258 ac.), Sauk (21,573 ac.) and Richland (16,148 ac.). In 2023, Bayfield County had the most recorded defoliation (144,841 ac.) with Marinette County in second place (96,053 ac.)

Defoliation was generally less severe than in 2023. The most affected tree species were oak in the south and aspen and oak in northern counties. Aerial survey data found that oak defoliation was generally recorded as more intense (trees greater than 75% defoliated) than aspen defoliation (trees 50-75% defoliated).

Other defoliating insects, such as oak leafroller, were also active on oak and other tree species this summer, increasing the total area of forest defoliation. Some of the trees that were heavily defoliated in 2023 have a full canopy this summer; some show partial dieback and some are completely dead.

The Wisconsin Dells area and Marinette/Florence counties remain the most heavily infested areas of the state as of late 2024. It is likely that there will be a greatly reduced outbreak next year, and it may come to an end in 2025. Current-year egg masses are commonly dime-sized and smaller, indicating that a site is late in the outbreak cycle. Pockets of high populations are likely to linger in both southern and northern counties.

2024 Aerial Suppression Treatments

In May, 928 acres of high-value trees at DNR properties in Columbia, Marinette, Sauk and Walworth counties were sprayed by airplane.

Treatments used Foray, a bacterial insecticide containing *Bacillus thuringiensis* var. *kurstaki*.

Spraying occurred May 13 in Columbia and Sauk counties, May 15 in Walworth County and May 24 in Marinette County. Temperatures were somewhat above average during spray season and spraying occurred a little earlier than average.

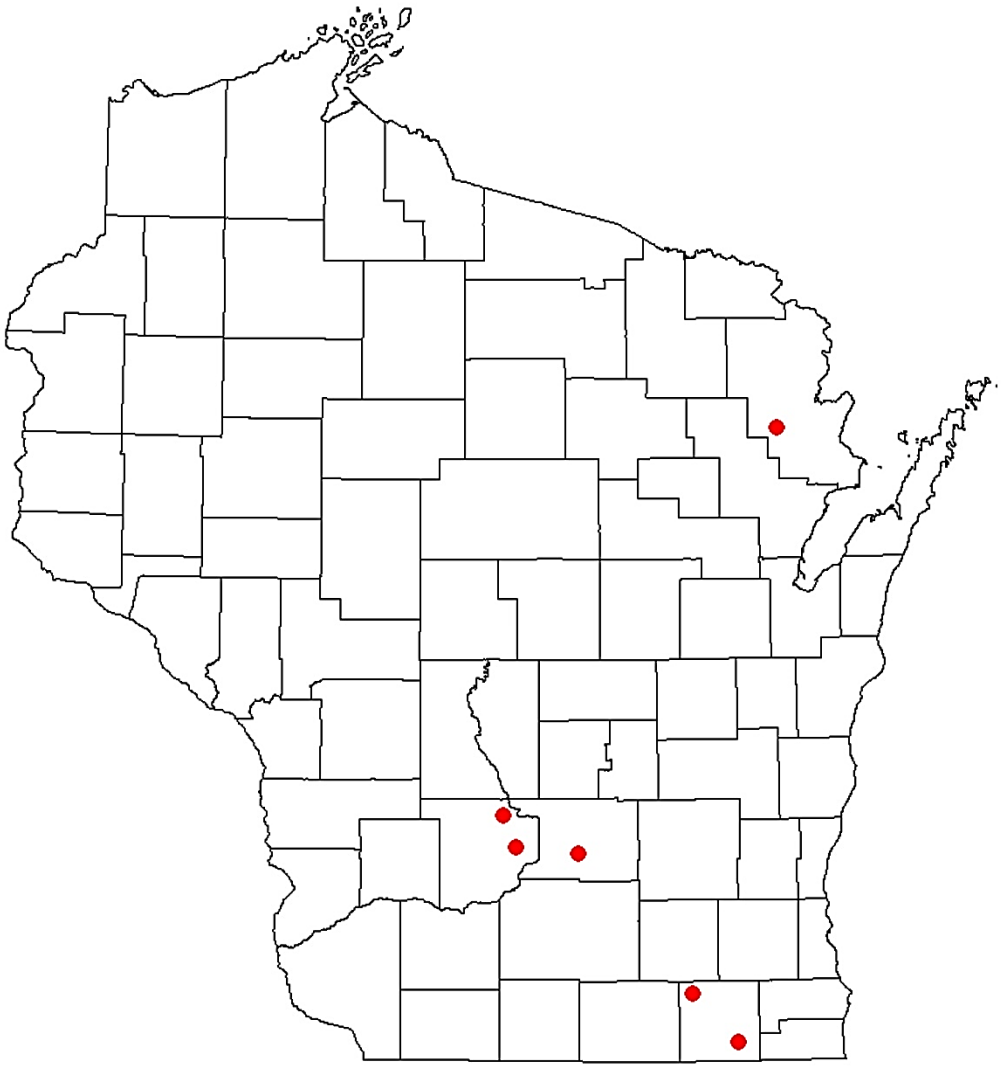


Figure 33. *Map of DNR properties with 2024 aerial suppression treatments.* / ***Photo Credit:*** *Wisconsin DNR*

The DNR treatment sites *(Fig. 33)*:

- **Columbia County:** 101 acres at MacKenzie Center.
- **Marinette County:** 255 acres at Governor Earl Peshtigo River State Forest.
- **Sauk County:** 212 acres at Devil's Lake State Park and 187 acres at Mirror Lake State Park.
- **Walworth County:** 124 acres at Big Foot Beach State Park and 49 acres at Kettle Moraine State Forest-Southern Unit.

All state land treatments were completed as part of the state contract with Al's Aerial Spraying of Ovid, Michigan. Protection was successful across DNR suppression sites, which was not surprising given the insecticide application and heavy larval mortality from diseases.

State suppression treatments were also conducted by the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) at two Department of Transportation (DOT) rest areas in Juneau County, totaling 62 acres. Approximately one dozen non-DNR suppression sites were treated by other applicators using aircraft or drone application.

The state of Wisconsin does not offer a state-sponsored or cost-share program for treating private property to prevent defoliation by spongy moth. Those interested in organizing a spray program at their own expense are encouraged to read "Organizing An Aerial Spray For Forest Pests," a helpful guide from the DNR.

In Columbia County, supplemental trunk injections (containing emamectin benzoate) were applied to several ornamental oaks around the MacKenzie Center lodge building while larvae were small. These oaks were in a heavily infested forest that is very close to privately-owned land that was not treated. The combination of aerial and ground treatment provided good protection at this property, in combination with larval diseases. (**Please note:** DNR does not endorse any product, nor one product over another.)

Decline And Mortality In Previously Defoliated Trees

Generally, healthy hardwoods can endure one or two years of heavy defoliation before tree mortality occurs. A replacement set of leaves (known as "refoliation") is typically produced a few weeks after defoliation. However, this process uses energy reserves and weakens the tree, making it more vulnerable to mortality in combination with other insects, diseases or drought stress. Heavy defoliation of already-weakened trees often leads to tree mortality in a single year *(Fig. 34)*.

Figure 34. *Heavy oak mortality near Palmyra in Jefferson County, July 2024. The area was heavily defoliated in 2022 and 2023. /* ***Photo Credit:*** *Wisconsin DNR*

Aerial surveys conducted in summer 2024 mapped approximately 2,400 acres of heavy oak mortality in five southern counties *(Fig. 35)*. These oak stands had endured several droughty summers plus one to two years of heavy spongy moth defoliation. Additional oak mortality is likely present in areas not surveyed.

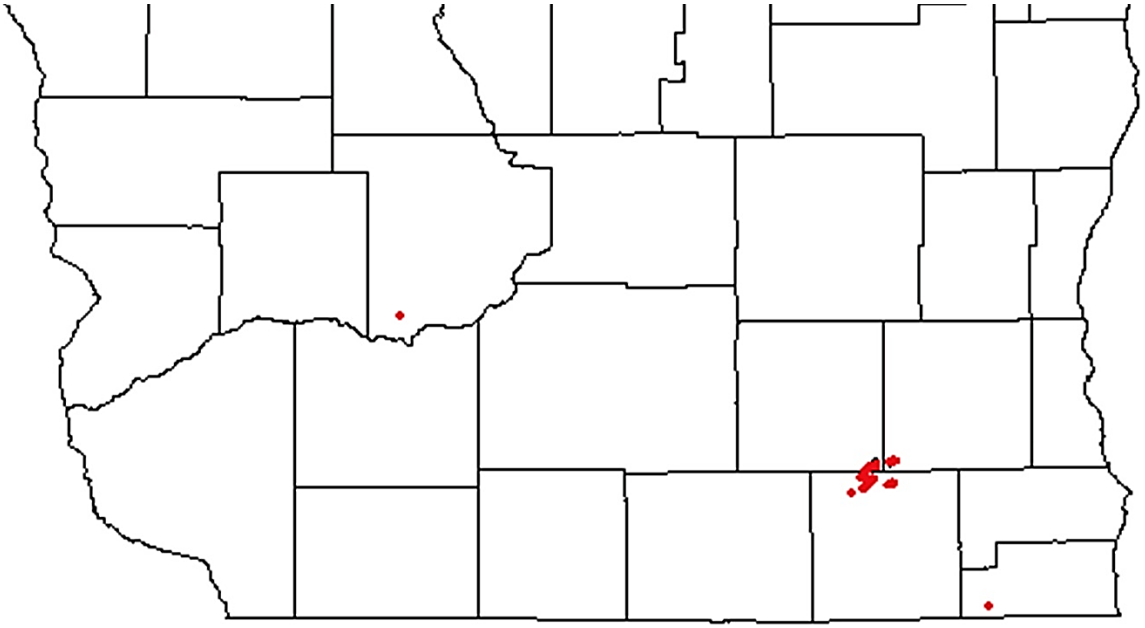


Figure 35. *Locations of mapped oak mortality in 2024.* / ***Map Credit:*** *Wisconsin DNR*

Monitored oak sites in southeast Wisconsin found variable impacts of drought and defoliation once the outbreak ended. Impacts ranged from few observable signs to heavy tree mortality of trees that were not defoliated in 2024 but had been previously defoliated once or twice. Increases in oak decline and mortality are expected in several regions of the state over the next few years following several summers of defoliation and drought *(Fig. 36)*.

Figure 36. *Refoliating oaks in late June 2023 (left photo) and crown dieback/mortality of the same trees (right photo) in early July 2024 near Whitewater Lake in Walworth County.* / ***Photo Credit:*** *Wisconsin DNR*

Spongy Moth Outreach

The online Spongy Moth Resource Center *(Fig. 37)* was revised in 2024 to include additional information and FAQ resources. Increased emphasis was placed on the treatment options available for yard trees. Since revision, the landing page had received nearly 11,000 visits as of the end of September 2024.

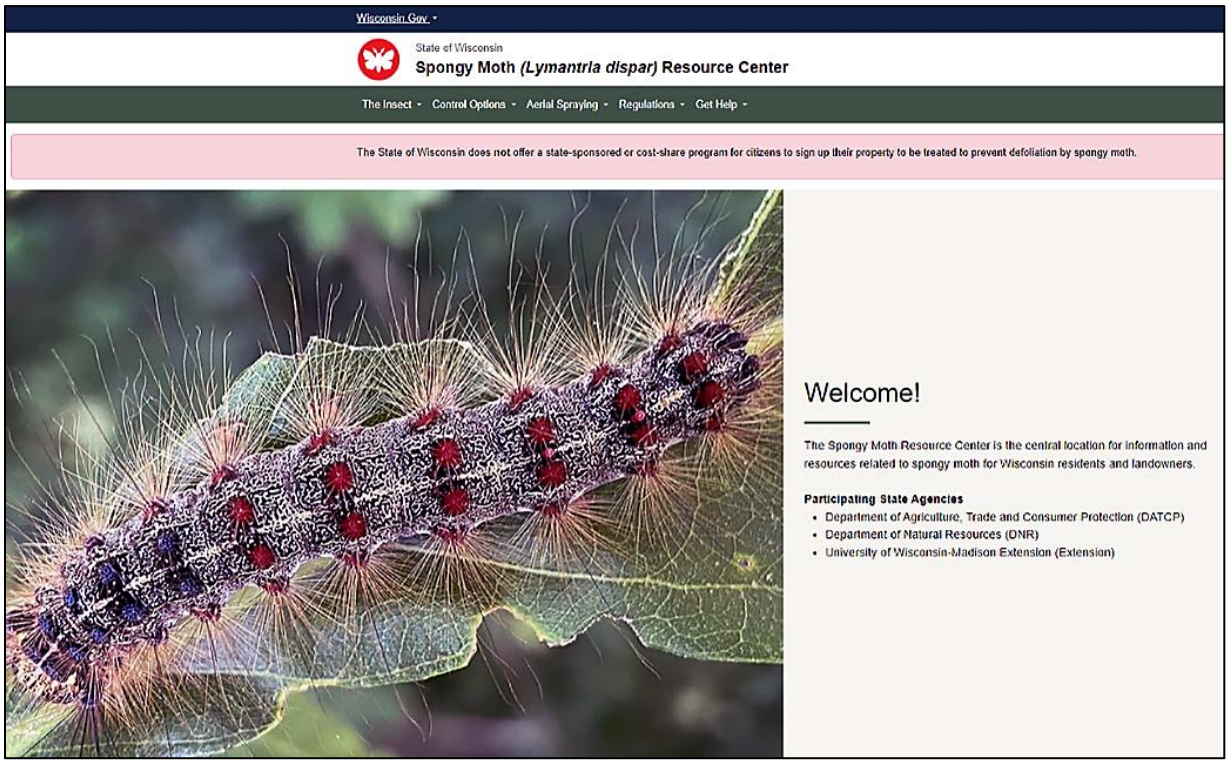


Figure 37. *Screenshot of the online "Spongy Moth Resource Center" (spongymoth.wi.gov) which was revised in 2024. /* ***Graphic Credit:*** *Wisconsin DNR*

In June 2024, a "Protect Your Trees From Spongy Moth" video was made available online to assist property owners in conducting predictive egg mass surveys. It joins companion videos produced in 2023 to help property owners prepare burlap collection bands and remove egg masses.

Several statewide news releases and DNR newsletter articles were released in 2024. These focused on DNR aerial treatments, looking for egg masses, managing life stages and the caterpillar-killing diseases seen in June and July.

A Forest Health fact sheet on "Twolined Chestnut Borer" was completed in May 2024 to provide identification and management advice to property owners who had oak trees impacted by spongy moth defoliation and recent droughty conditions.

Social media outreach continued in 2024. A May 2024 Facebook post titled "*Start thinking about spongy moth protection*" received 368,100 impressions (initial views).

Slow-The-Spread And Regulatory Quarantines

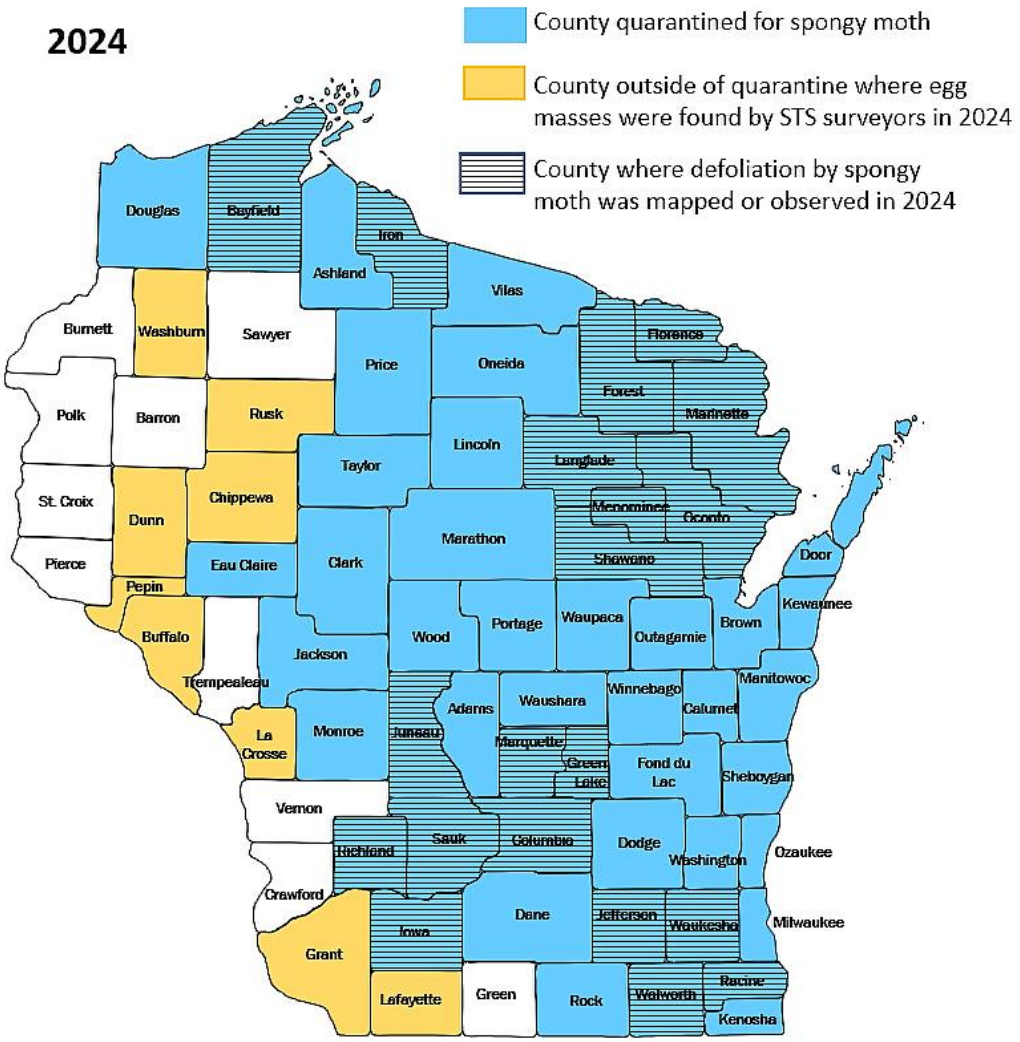


Figure 38. *A 2024 map of counties within the Wisconsin spongy moth quarantine area where defoliation was mapped (striped, blue coloration), and counties outside the quarantine area where alternate life stages (eggs, pupae or larvae) were found (yellow shading).* / ***Map Credit:*** *Wisconsin DNR*

In 2024, no counties were added to the regulatory quarantine administered by the Wisconsin Department of Agriculture, Trade and Consumer Protection. Douglas County is the most recently added county (in 2023). Fifty-three of Wisconsin's 72 counties are included in the spongy moth quarantine area. More information can be found on the DATCP Spongy Moth website.

Wisconsin DATCP's Slow the Spread (STS) program found reproducing but isolated populations of spongy moth in nine non-quarantined counties *(Fig. 38)*, approximating the leading edge of westward spread. Some of the non-quarantined counties were not surveyed, and additional isolated populations may be present. Most of those known locations will be treated to reduce populations to levels where they cannot contribute to spread.

Native Health Threats To Hardwoods

Oak Decline And Mortality

An ongoing series of compounding biotic and abiotic factors led to an observed increase in the decline and mortality of all oak species throughout the state in 2024. Southern and southeast Wisconsin experienced expanding decline and mortality of white and bur oaks following several years of drought stress, coinciding with two consecutive years of heavy spongy moth defoliation; 2,500 acres of oak mortality was mapped in the state's far southeast counties (see Spongy Moth section).

Northern Wisconsin experienced increased oak mortality and decline of red and northern pin oak throughout multiple counties following several consecutive years of drought stress, three consecutive years of oak leafroller defoliation (which was heavy in the spring of 2022 and 2024), an outbreak of twolined chestnut borer, infection from Armillaria root disease and heavy spongy moth defoliation in Bayfield and Ashland counties *(Fig. 39)*.

Figure 39. *Typical appearance of a declining northern red oak in northern Wisconsin that is suffering from prolonged drought stress, several years of oak leafroller defoliation, Armillaria root disease infection and twolined chestnut borer infestation. /* ***Photo Credit:*** *Wisconsin DNR*

A drought cycle of roughly three years (2021-2023) yielded temporarily to abnormally wet conditions during the first half of the 2024 growing season. However, moderate to severe drought returned to the state in late September.

Decline and mortality were more frequently observed in stands with mature oak trees that were at or past rotation age. Declining and recently killed oaks typically displayed advanced crown dieback affecting 20% or more of the crown and temporary retention of dead leaves on affected twigs and branches.

Dozens of recently killed oaks, sampled for oak wilt testing due to inconclusive field diagnosis, tested negative for oak wilt but displayed galleries of twolined chestnut borer, Armillaria root disease mycelia and occasional indications of recent defoliation.

While the role and impact of such predisposing (i.e., old age), inciting (i.e., drought stress, defoliation) and contributing (i.e., TLCB, Armillaria) factors are a highly typical, interrelated group of factors that create a well-documented mechanistic pathway to oak decline and mortality, what is notable is that a similar decline cycle in the oak genus has not been observed at this scale in the state in more than 10 years.

Additional oak decline and mortality are expected until the current drought cycle is fully reversed, and oaks have several seasons to recover from the onslaught of these compounding biotic and abiotic factors.

Hardwood Defoliators

Forest Tent Caterpillar (*Malacosoma disstria*)

Forest tent caterpillar defoliation was light and isolated in northern Wisconsin in 2024 *(Fig. 40)*. Observations of caterpillars were more frequent than of defoliation itself, but some trees and stands sustained light defoliation in the Lincoln County towns of Tomahawk, Harding, Schley and Russell.

A persistent question that remains is when the next outbreak of forest tent caterpillar will occur. In Wisconsin, this native caterpillar species has historically undergone rapid population growth phases every six to 16 years, with outbreaks lasting two to six years. These outbreaks often lead to millions of acres of tree defoliation, concentrated most heavily on aspen, birch and sugar maple. Repeated heavy defoliation over several years causes tree stress and mortality of low vigor, suppressed and drought-stressed trees.

The last outbreak in Wisconsin occurred from 1999 to 2002, making the current interval between outbreaks 22 years, the longest recorded in Wisconsin. Abnormally warm and dry spring weather typically favors population growth, but even in the recent drought cycle beginning in 2021, the insect has shown no immediate sign of an impending population outbreak.

However, the increased frequency of caterpillar observations has trended upward in the last couple of years, so a continued focus will be placed on assessing defoliation and performing routine spring egg mass surveys in northern Wisconsin.

Figure 40. *A cluster of forest tent caterpillars feeding in early June near Stone Lake. /* ***Photo Credit:*** *Wisconsin DNR*

Oak Leafroller (*Archips semiferanus*)

The oak leafroller outbreak, primarily in northern Wisconsin, continued in some areas for a third consecutive year. Oak leafrollers are native, early-season defoliators of oak.

More than 438,000 acres of moderate and severe defoliation was mapped in Barron, Burnett, Oneida, Rusk, Sawyer, Vilas and Washburn counties. The defoliated acreage total increased significantly from 2023, when just 6,600 acres were mapped; and almost doubled the acreage from 2022, when 228,000 acres were mapped. The continued defoliation is noteworthy since this is not a pest that has previously caused issues at this level in Wisconsin.

Oak leafroller defoliation showed up a few weeks prior to spongy moth defoliation *(Fig. 41),* and in some cases occurred in the same areas as spongy moth defoliation. Severely defoliated trees sent out additional leaves if they were healthy enough to do so.

Figure 41. *Significant defoliation due to oak leafroller in early spring 2024. /* ***Photo Credit:*** *Wisconsin DNR*

Elm Zigzag Sawfly (*Aproceros leucopada*)

Figure 42. Elm zigzag sawfly larva feeds on an elm leaf in Oshkosh, July 2024.

The nonnative elm zigzag sawfly *(Fig. 42)* was detected in Wisconsin for the first time in 2024. The pest was first found on July 4 in Portage County by a Wisconsin Department of Agriculture, Trade and Consumer Protection employee and has since been detected in 20 additional Wisconsin counties *(Fig. 43)*.

Elm zigzag sawfly, native to parts of eastern Asia, was first detected in Europe in 2003 and in North America in 2020 (in Quebec, Canada). It was first found in the United States in Virginia in 2021 and has been moving westward, with detections confirmed in at least 10 states.

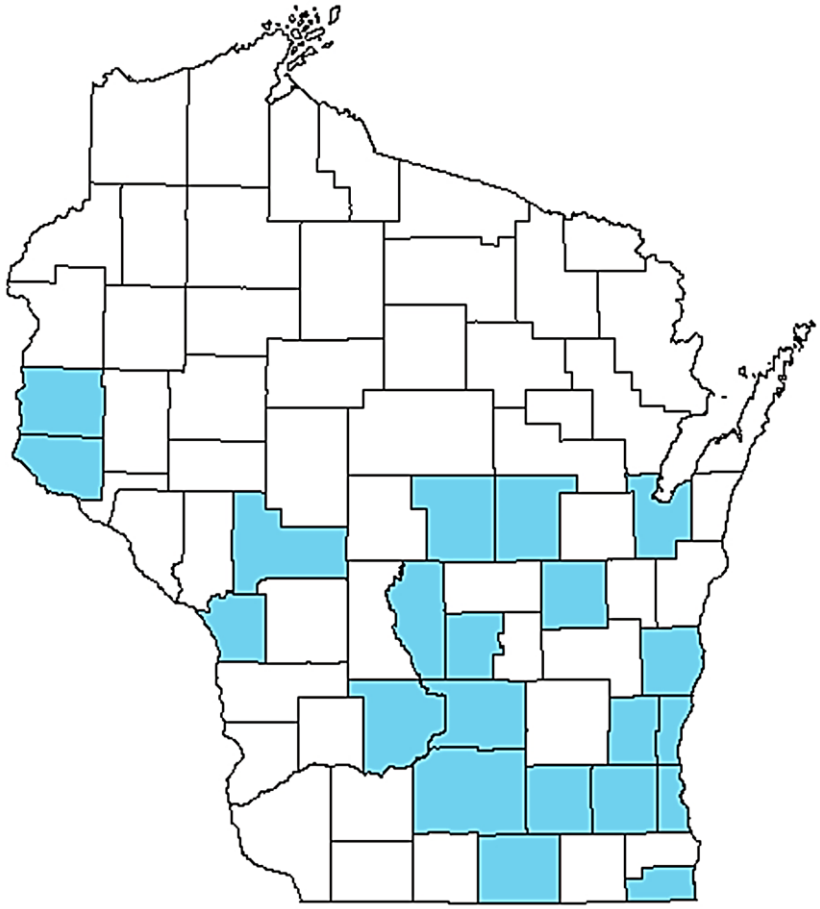


Figure 43. *Map of counties with elm zigzag sawfly detections as of Oct. 30, 2024. /* ***Map Credit:*** *Wisconsin DNR*

A distinctive trait of early instar elm zigzag sawfly larvae is the meandering zigzag pattern chewed in elm leaves *(Fig. 44).* At low population levels, feeding by this pest was often hidden among much more abundant leaf feeding by Japanese beetles and other insect species feeding on elm leaves *(Fig. 45).*

Figure 44. *Characteristic zigzag feeding pattern on an elm leaf in Oshkosh, July 2024. /* ***Photo Credit:*** *Wisconsin DNR*

Figure 45. *Signs of elm zigzag sawfly feeding (right side) and Japanese beetle feeding (left side) show on the same leaf in Oshkosh, October 2024. /* ***Photo Credit:*** *Wisconsin DNR*

In most cases, this feeding causes minor cosmetic damage to both landscape and forest trees. However, the insect does have the potential to cause significant defoliation *(Fig. 46)*. Repeated severe damage can weaken trees and lead to branch dieback or possible tree mortality. Management may be warranted to help preserve the health of high-value trees.

Figure 46. *Heavy defoliation by elm zigzag sawfly in Waupaca, August 2024.* / ***Photo Credit:*** *Wisconsin DNR*

The elm zigzag sawfly population consists entirely of females. They reproduce through parthenogenesis, laying viable eggs without mating. The insect can produce several generations of offspring per year, and each generation can contribute to the defoliation of a single tree.

Adults are capable of long-distance dispersal and have been observed moving up to 56 miles per year on their own. Cocoons are sticky and can attach to items such as vehicles and outdoor furniture, creating a nuisance and further facilitating long-distance movement. Regulatory quarantines are not expected because of the rapid dispersal of this pest.

Additional information about elm zigzag sawfly and management options is available on the University of Wisconsin-Madison Extension website.

Periodical Cicadas (*Magicada* spp.)

The spring and summer of 2024 saw the return of Brood XIII periodical cicadas in parts of Wisconsin, Iowa, Illinois, Indiana and Michigan *(Fig. 47)*. Periodical cicada species are similar in appearance to the species of cicada that are seen every year but have a distinctive orange coloration on their wings.

By the end of June, the brood disappeared. Brood XIII periodical cicadas will not re-emerge until 2041.

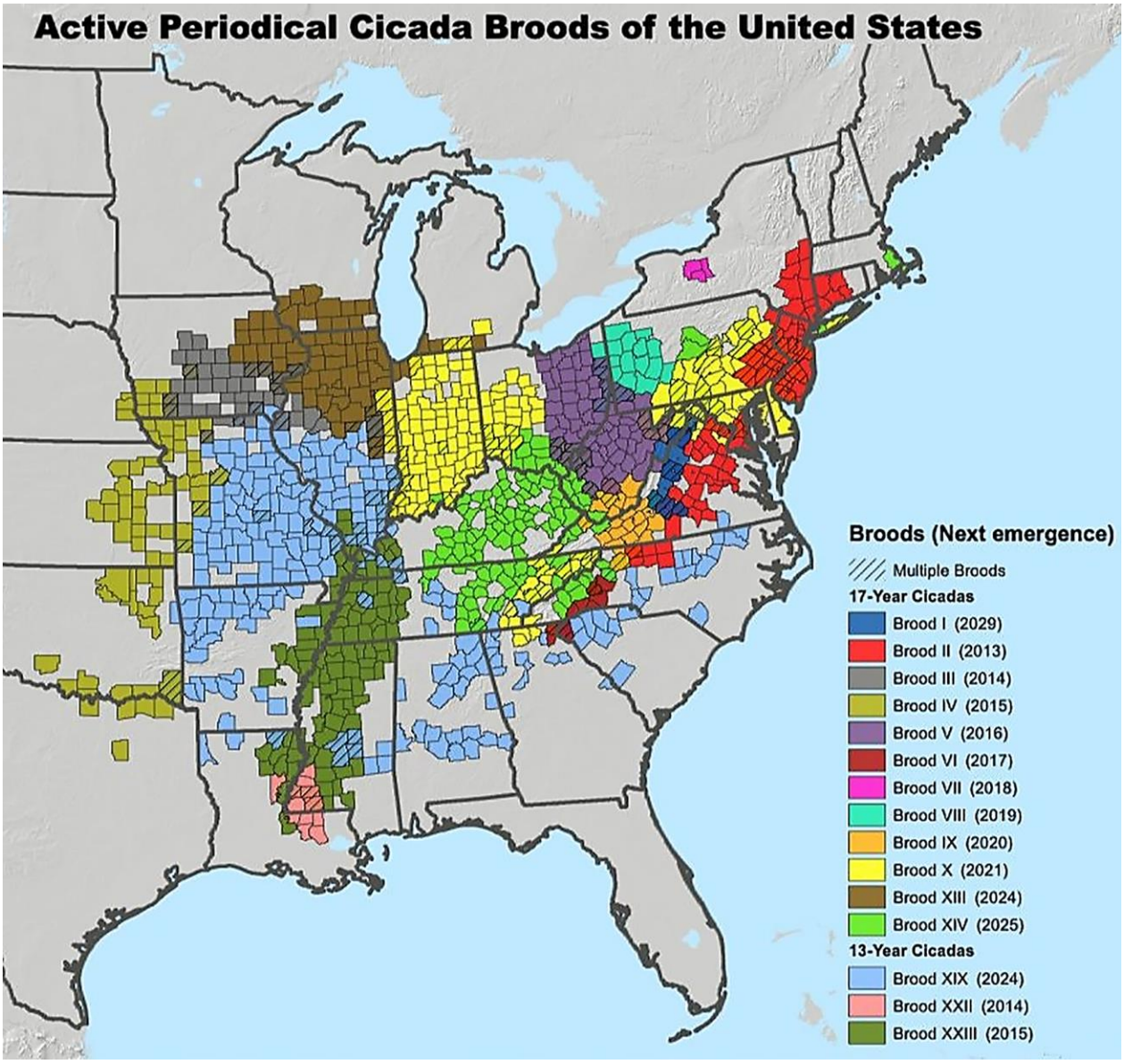


Figure 47. *Map of periodical cicada broods.* / ***Map Credit:*** *U.S. Forest Service.*

Wisconsin experiences a 17-year period between mass emergence of the cicadas. Brood XIII is the only brood of periodical cicadas observed in Wisconsin *(Fig. 48)*. Its emergence has been documented in 11 southern counties since the earliest observations were recorded in the state in 1837.

Adult females create a slit in the twigs of tree and shrub species before ovipositing (laying eggs) in the slit. After hatching, the immature nymphs drop into the ground and feed on the sap of underground tree roots until emerging many years later to transform into adults.

Figure 48. *Periodical cicadas on an ornamental tree at Big Foot Beach State Park in Walworth County, June 12, 2024. /* ***Photo Credit:*** *Wisconsin DNR*

Severe branch damage and twig death, commonly known as "flagging," was observed at Big Foot Beach State Park in Walworth County *(Fig. 49)*, where large numbers of 17-year periodical cicadas were documented. Oviposition was reported on oak, black locust, buckthorn and Amur cork tree twigs.

This damage was also reported nearby in the City of Lake Geneva, at Wyalusing State Park (Grant County), and in Iowa, Rock and Sauk counties. The damage to oak trees is expected to contribute to mortality in trees that have been stressed over the last few years by spongy moth defoliation, drought stress and twolined chestnut borer infestation.

Figure 49. *Severe flagging (twig death and foliage discoloration) due to periodical cicada oviposition (egg laying) in the City of Lake Geneva, Walworth County, July 2024. /* ***Photo Credit:*** *Wisconsin DNR.*

The presence of periodical cicada adults coincided with a mass die-off of spongy moth caterpillars at Big Foot Beach State Park and a handful of other sites in southern Wisconsin *(Fig. 50)*.

The University of Wisconsin-Madison Insect Diagnostic Lab has created a periodical cicada website that offers more information about the periodical cicada outbreak.

Figure 50. *Seventeen-year periodical cicadas and dead spongy moth caterpillars seen on the same tree at Big Foot Beach State Park, June 12, 2024. /* ***Photo Credit:*** *Wisconsin DNR*

Native Health Threats To Conifers

Caliciopsis Canker Disease (*Caliciopsis spp.*) And White Pine Bast Scale (*Matsucoccus macrocicatrices*)

Caliciopsis canker (*Caliciopsis pinea*) is native to North America. In Wisconsin, the disease was first observed causing damage in 2018 to pole-sized white pine in the northern part of the state. It causes small cankers on both branches and stems.

As the number of cankers increases, needle discoloration and branch dieback occur, and young trees can be killed. The fruiting structures of the fungus grow out of the cankers and resemble tiny eyelashes *(Fig. 51)*.

Figure 51. *Caliciopsis fruiting structures look like tiny eyelashes and indicate the presence of a canker.* / ***Photo Credit:*** *Wisconsin DNR*

Northeastern states have reported mortality of saplings and degradation of wood quality of saw timber since the late 1990s. In Wisconsin, damage includes branch mortality and stem cankers.

Caliciopsis has now been detected on white pine in many counties in north and central Wisconsin *(Fig. 52)*. In 2024, Caliciopsis was found on jack pine for the first time in Wisconsin.

Samples were sent to Becky Harkness, a graduate student at Michigan State University who is researching this emerging disease in the upper Midwest. She identified the canker on jack pine as caused by *Caliciopsis moriondi*.

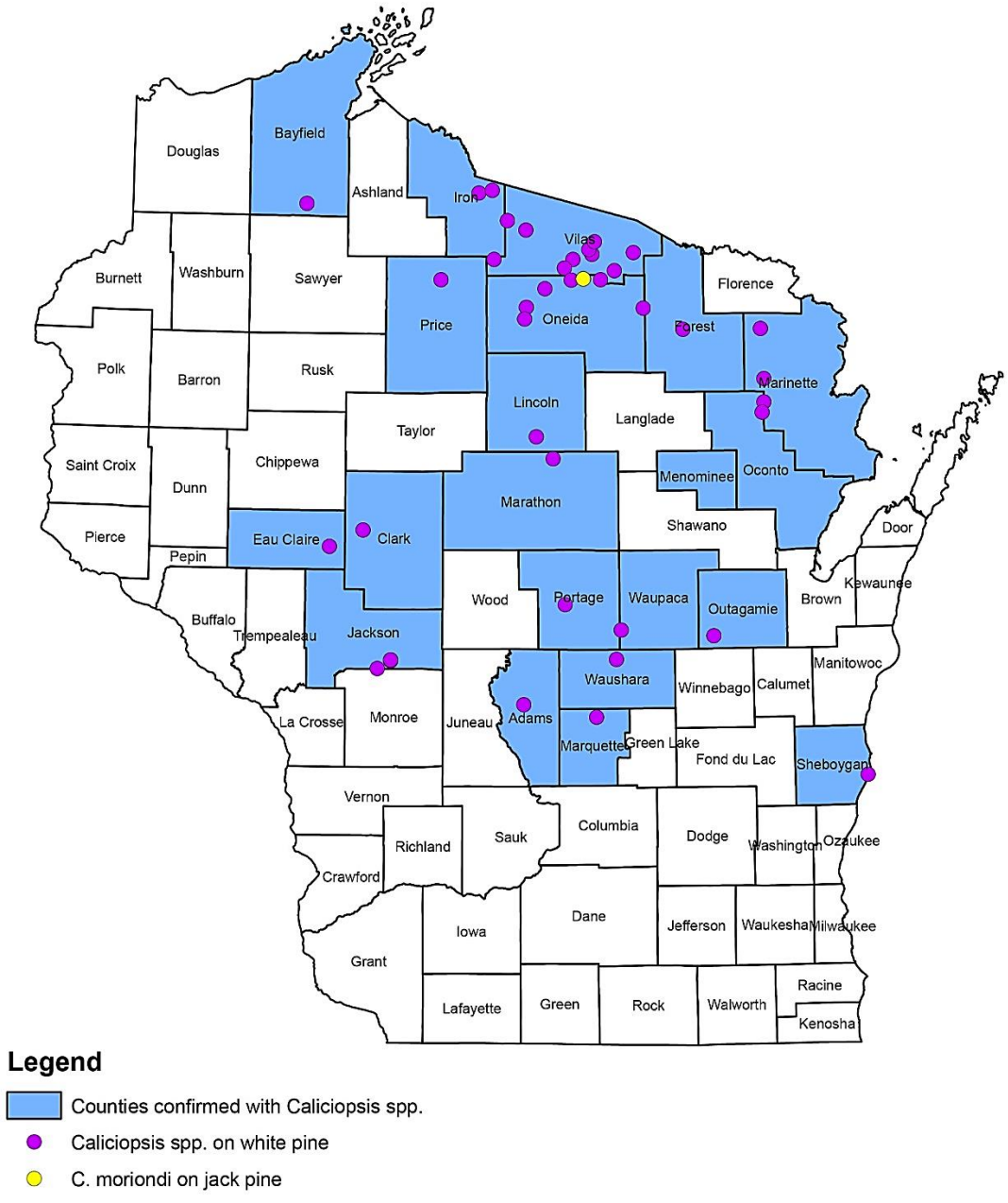


Figure 52. *Counties with confirmed presence of Caliciopsis on white pine. The yellow dot indicates the new find of* C. moriondi *on jack pine. /* ***Map Credit:*** *Wisconsin DNR*

Eastern Larch Beetle (*Dendroctonus simplex*) And Larch Casebearer (*Coleophora laricella*) On Tamarack

Limited activity from eastern larch beetle (ELB) and larch casebearer (LCB) were documented in 2024. No ELB damage was mapped in 2024. LCB was mapped in one large stand that sustained stress from flooding due to high water during the early growing season in Burnett County, totaling 267 acres *(Fig. 53)*.

Figure 53. *A tamarack with bright brown foliage caused by larch casebearer feeding injury in Burnett County. /* ***Photo Credit:*** *Wisconsin DNR*

Conifer Bark Beetles

Conifer mortality caused by bark beetles and Armillaria was observed during site visits throughout 2024 in south central and southwest Wisconsin. The mortality was most prominent at sites with very sandy soils.

White pine was the conifer species most commonly impacted *(Fig. 54)*, but spruce and red pine also were affected. This mortality is likely linked to the severe drought that occurred in summer 2023. With abundant rainfall for most of 2024, followed by drought later in the summer, it is unclear whether damage will continue in 2025.

Figure 54. *Bark beetle exit holes and galleries are visible in a white pine branch. /* ***Photo Credit:*** *Wisconsin DNR*

Jack Pine Budworm (*Choristoneura pinus*)

Following a major outbreak in 2023, jack pine budworm (JPBW) populations crashed in northwest Wisconsin in 2024, leaving most jack pine stands unaffected. The only area with significant defoliation recorded was Jackson County, where moderate to heavy defoliation occurred on 509 acres of jack pine on state and county forest land *(Fig. 55)*. This was a drastic decrease from the 79,000 acres mapped in 2023.

In 2023, regionally building JPBW populations were favored by exceptionally dry and relatively warm spring conditions during egg hatch and larval development. Populations that year rapidly irrupted, leaving tens of thousands of acres of jack pine with moderate to heavy defoliation. Mortality was not readily mappable but was occasionally observed on forest edge trees and in stands with low canopy vigor.

Spring weather conditions in 2024 were the opposite of 2023, with frequent and heavy precipitation from April through June. This likely played a primary role in muting what was expected to be a continued outbreak carrying over from 2023.

Figure 55. *Severe damage from jack pine budworm feeding in Jackson County in 2024.* / ***Photo Credit:*** *Wisconsin DNR*

Spruce Budworm (*Choristonuera fumiferana*)

For the 12th consecutive year in Wisconsin, spruce budworm caused significant defoliation in many northern areas of the state.

Spruce budworm outbreaks occur about every 30-50 years and typically last about 10 years. The current outbreak, which started in 2012, may continue for a few more years before collapsing. Our last outbreak in Wisconsin occurred from 1970-1980, with 180,000 acres impacted in the final year of the outbreak.

Literature indicates that some budworm populations will collapse once they have exhausted the food source in an area. This is happening in some areas of northern Wisconsin, including Bayfield, Forest, Marinette and Vilas counties, where trees that have been moderately or severely defoliated for consecutive years are now dead or dying.

An area of more than 6,000 acres of significant defoliation was mapped in 2024 in Florence, Forest, Iron, Marinette, Oneida and Vilas counties, although heavy rainfall made it difficult to map damaged areas and more acreage was defoliated than mapped.

Most defoliation occurred on spruce and balsam fir as the primary hosts, but once again some localized areas of defoliation in tamarack were seen. However, hemlock that was defoliated in 2023 was not defoliated in 2024.

Damage From Abiotic Causes

Wisconsin's weather impacted forest health again over the past year. Severe drought occurred during summer 2023 but alleviated somewhat in fall. Then, winter 2023-2024 was quite dry. The combination of low precipitation and above-freezing temperatures meant a major seasonal snowfall deficit, particularly in northern Wisconsin, where accumulations were 20 to 60 inches below normal.

The winter (December to February) also was the warmest since recordkeeping began in 1895, by a full 2 degrees (the statewide average temperature was 28.3 degrees). Wisconsin set its all-time February and winter high temperature of 77 degrees on Feb. 27, 2024, and saw its first two tornadoes ever to take place during February *(Fig. 56)*. The February heat caused early bud break of trees across the state.

The transition to spring resulted in a dramatic shift with warm weather (seventh warmest on record) and very wet conditions (the fourth wettest), greatly reducing drought impacts *(Fig. 57)*. Throughout the spring every month was wetter than normal, which was pivotal in promoting *Entomophoga* activity that resulted in dramatic spongy moth caterpillar mortality.

Unfortunately, severe storms produced tornadoes on May 7, 21 and 26 (22 total), the second most during any May since 1950. The May storm damage during the high-risk oak wilt period resulted in many new infections.

As summer started, June continued the wet pattern. The period from May to June 2024 was the wettest on record, in sharp contrast with May to June of 2023, which was the third driest on record. However, the weather became considerably drier in late July and August. Despite the highly varying precipitation pattern both spatially and temporally, meteorological summer (June to August) ended as the sixth wettest on record. Severe weather was relatively limited. This year's meteorological summer (June to August) featured temperatures very close to normal throughout Wisconsin.

September continued the drought pattern of late summer and was the sixth driest on record. In combination with September being the third warmest ever recorded, it was certainly an extreme month of weather. Dry conditions persisted into the fall, resulting in early leaf drop on some trees *(Fig. 58)*.

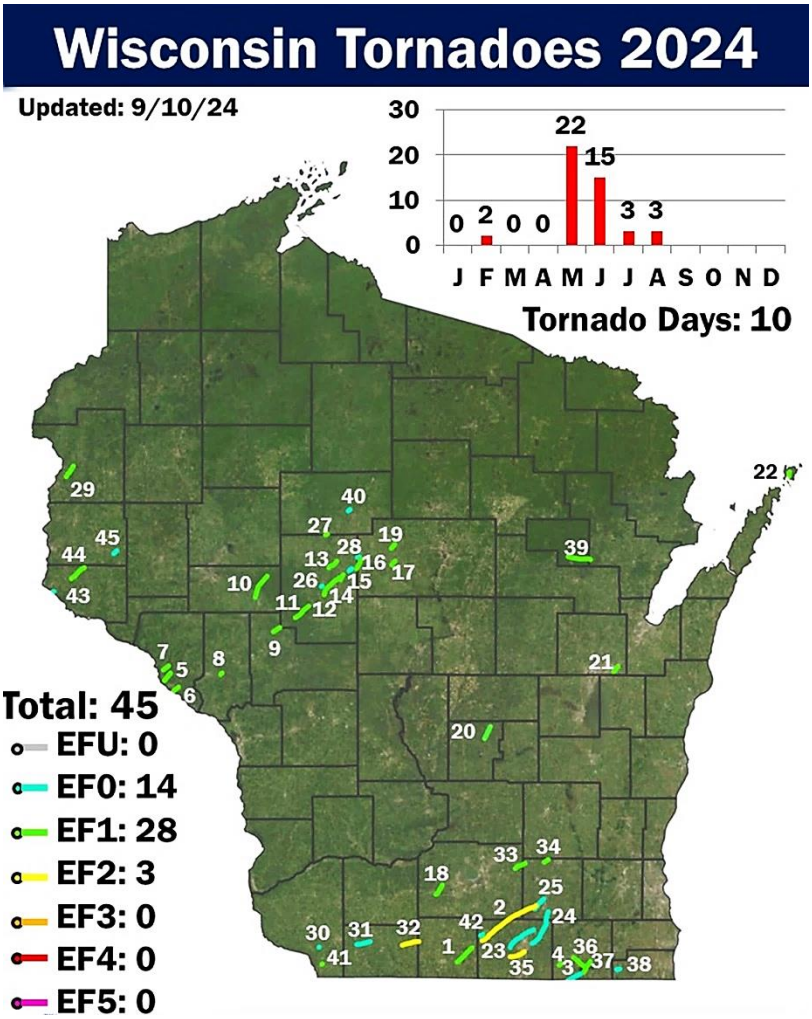


Figure 56. *Wisconsin tornadoes in 2024, through Sept. 10. /* ***Map Credit:*** *National Weather Service, Sullivan*

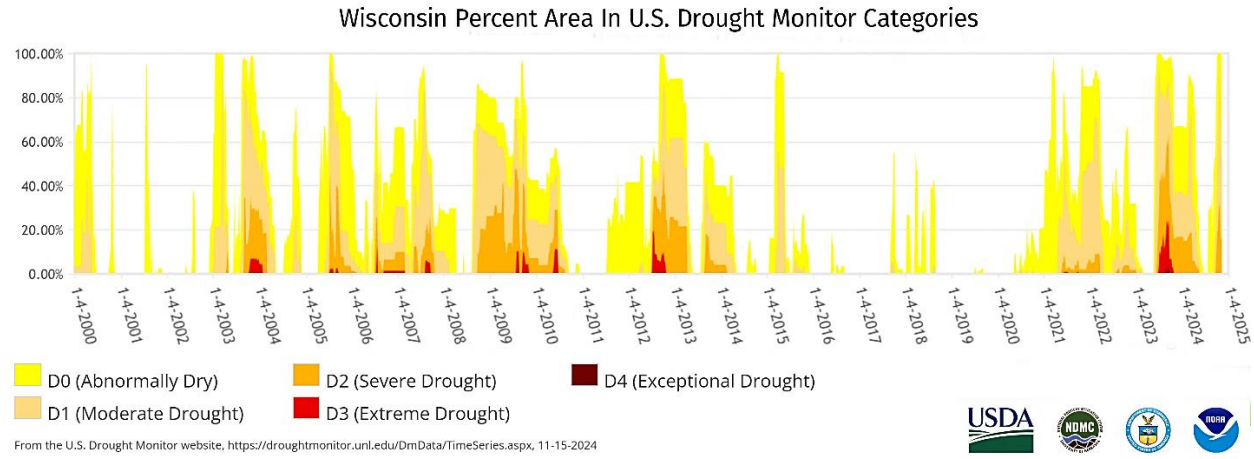
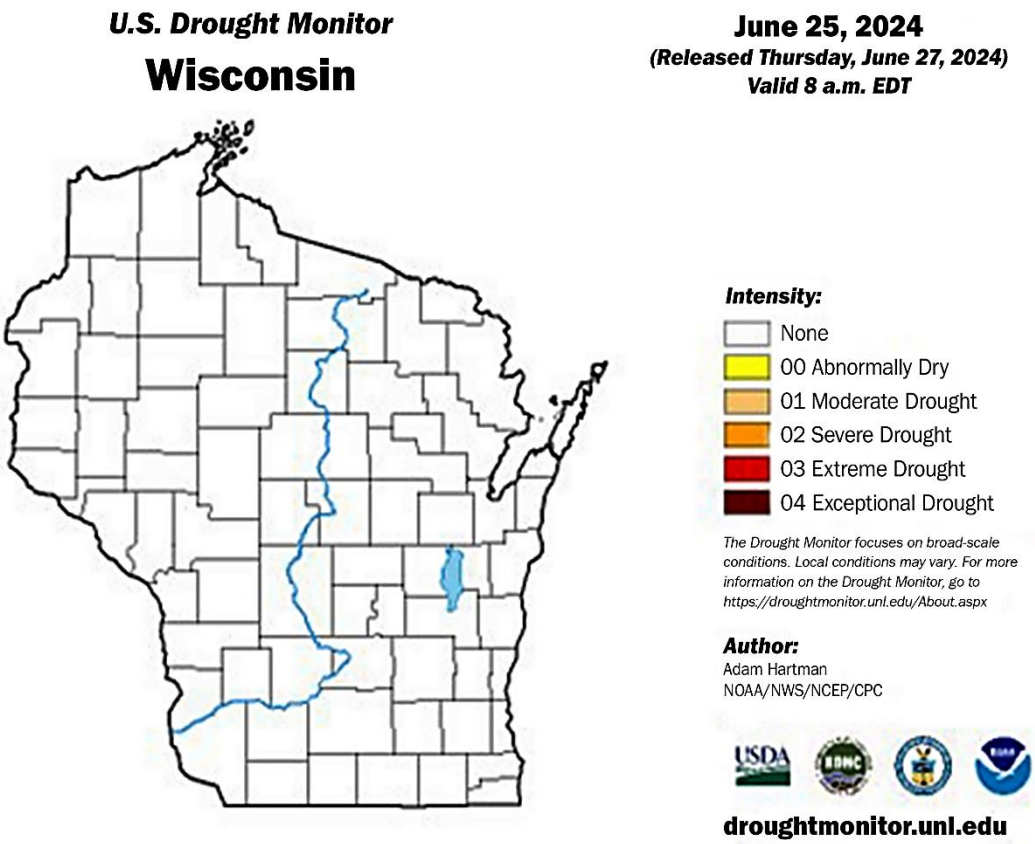


Figure 57. *U.S. Drought Monitor data for Wisconsin from 2000 through October 2024. /* ***Graphic Credit:*** *NOAA at Drought.gov.*



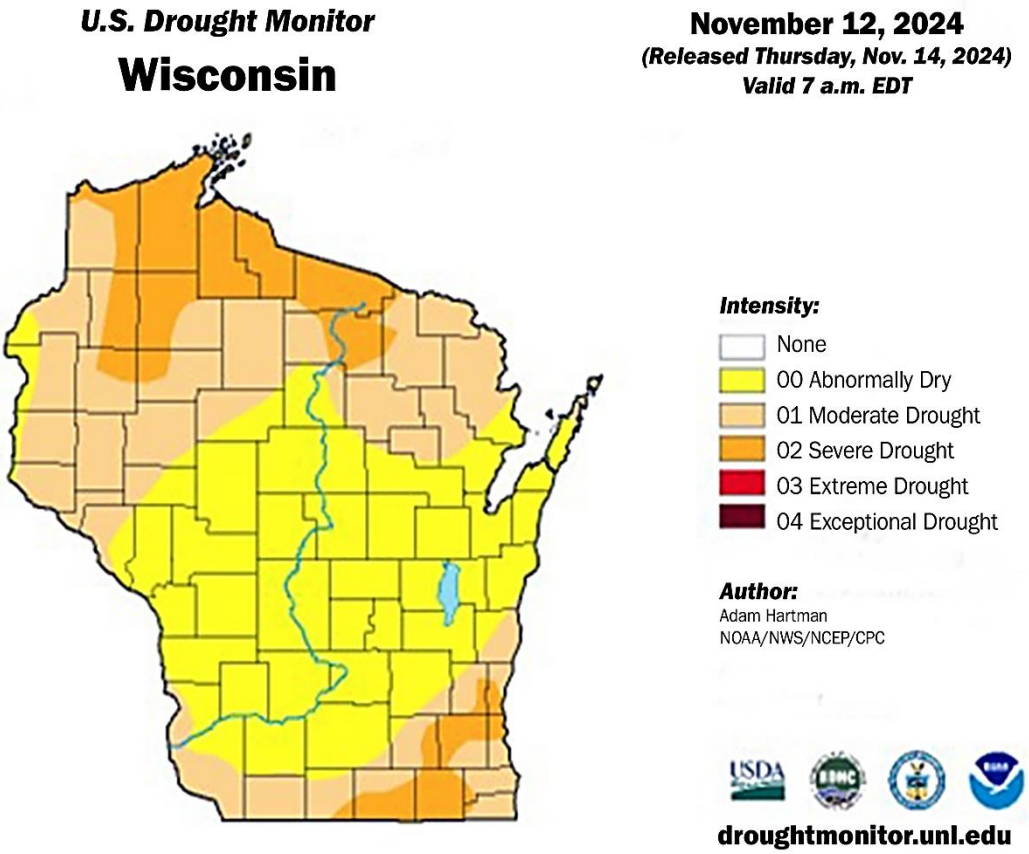


Figure 58. *U.S. Drought Monitor data for Wisconsin on June 25 and Nov. 14, 2024, showing the major increase in drought conditions.* / ***Graphic Credit:*** *NOAA at Drought.gov.*

Health Issues At State Nurseries

Asymptomatic Infection By *Diplodia sapinea* In State Nursery Stock

Asymptomatic infections by *Diplodia sapinea* on red pine seedlings can lead to plantation failure if the disease becomes symptomatic after planting. To mitigate this risk, healthy red pine seedlings from Wilson State Nursery undergo annual testing *(Fig. 59)* to assess for asymptomatic infections before they are approved for sale to the public.

It was decided to discontinue testing one-year-old red pine seedlings this year and in future years, unless deemed necessary. Previous data indicate that infection rates in one-year-old seedlings are comparable to those in two- and three-year-old seedlings; in addition, one-year-old seedlings are not sold. In 2023, one-year-old red pine seedlings had an asymptomatic infection rate of 0.4%, compared to 0.8% in 2022.

For two-year-old seedlings, the 2024 infection rate was 1.1% (267 seedlings tested). This was comparable to the 0.8% rate observed in 2023 (252 seedlings tested).

The infection rate for three-year-old seedlings in 2024 was 0.7% (270 seedlings tested). This was slightly lower than the 1.1% infection rate recorded in 2023 (271 seedlings tested). Monitoring for *Diplodia sapinea* will continue in 2025.

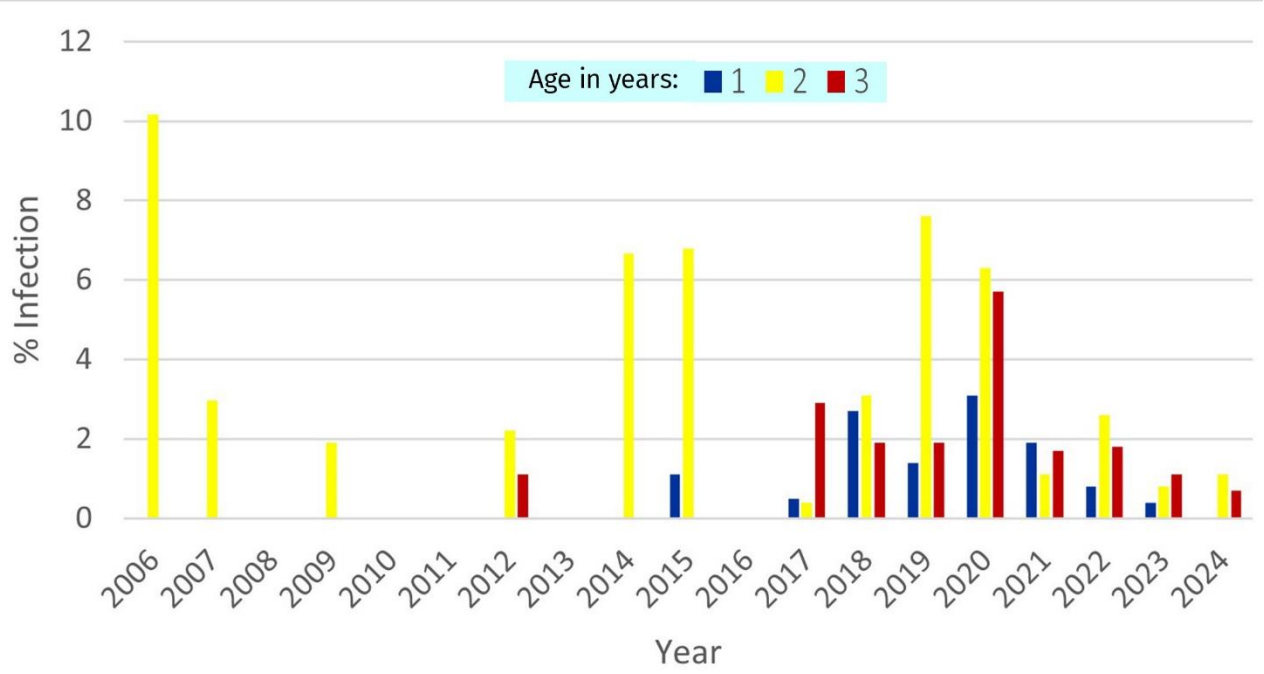


Figure 59. *Yearly Diplodia infection rates of red pine seedlings at Wilson State Nursery from 2006 to 2024. Missing data indicates seedlings of an age were not sampled in that year. /* ***Graphic Credit:*** *Wisconsin DNR*

Survey of Galls On Jack Pine Seedlings At Wilson State Nursery

The incidence of galls on jack pine seedlings caused by rust fungi has historically been very low at the Wilson State Nursery *(Fig. 60)*. To date, only one rust fungus species, *Cronartium quercuum* (pine-oak gall rust) has been identified. In spring of 2024, 783 one-year-old and 859 two-year-old jack pine seedlings were visually inspected for galls after being lifted from the nursery beds.

In 2024, no visible galls were found in the one-year-old cohort (consistent with the findings from 2023). A 0.2% incidence of galls was observed in the two-year-old cohort, marking a slight decrease from the 0.3% incidence recorded in 2023. Monitoring for galls will be conducted again in the spring of 2025.

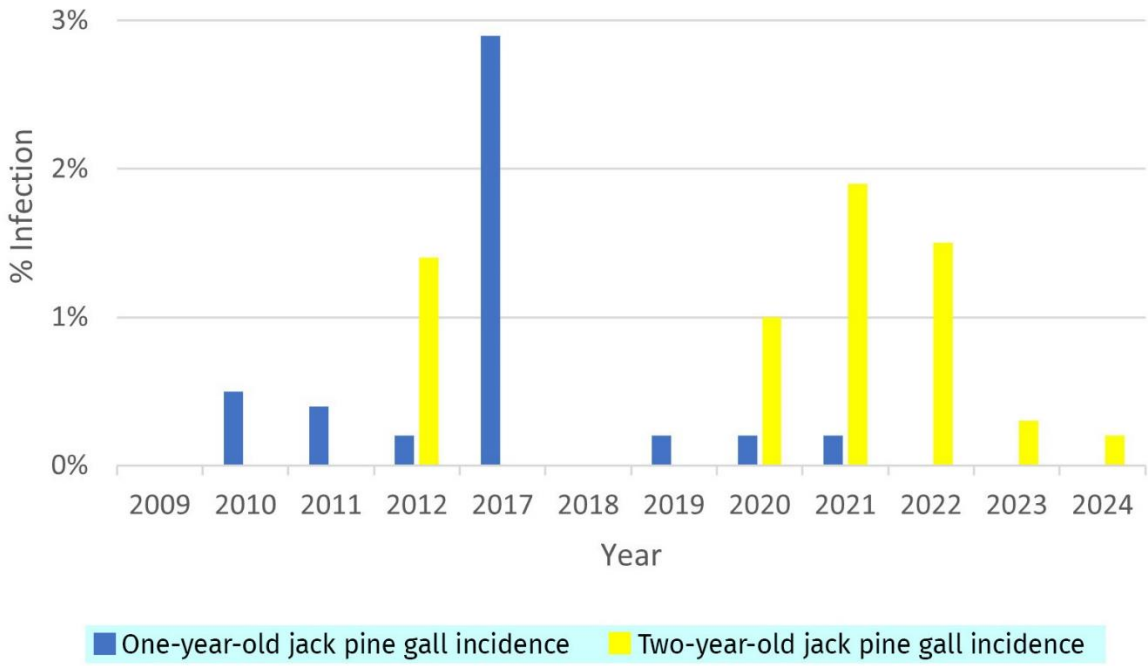


Figure 60. *Yearly jack pine gall rust infection rates of jack pine seedlings at Wilson State Nursery from 2009 to 2024. Missing data indicates seedlings of an age were not sampled in that year. /* ***Graphic Credit:*** *Wisconsin DNR*

Acknowledgements

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