Wisconsin DNR Forest Health 2016 Annual Report

Photo by Linda Williams

WISCONSIN DEPT. OF NATURAL RESOURCES

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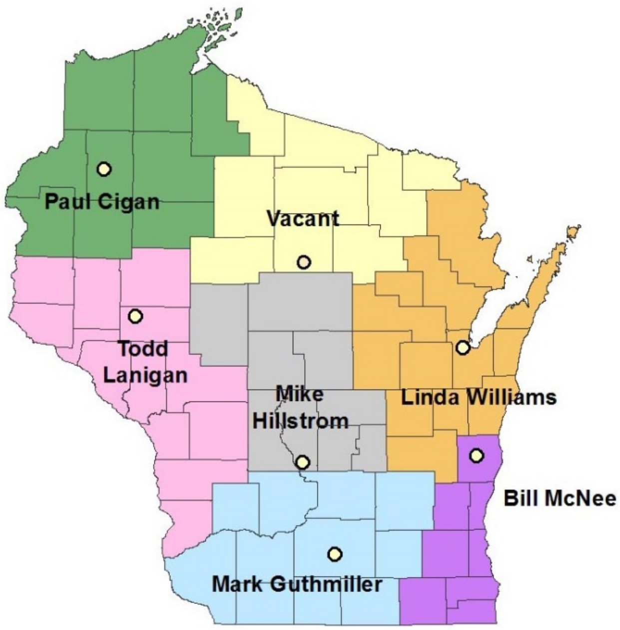
Wisconsin DNR Forest Health Staff

District staff



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Staff Update

After 26 years in the forest health program, Mark Guthmiller retired on Oct 30. Mark started with the program as a part time surveyor of phytoplasma-caused ‘ash yellows’ disease in 1990 and it continued to be an interest through his career. His final summary of the spread of phytoplasma across the state and in many species other than ash is included in this report. It was always a pleasure to work with Mark; whether roaming with him through a forest examining tree issues, or working with him in the lab or office. He was detailed and thorough and always happy to share his knowledge or a hand with a project.

The Forest Resource in Wisconsin

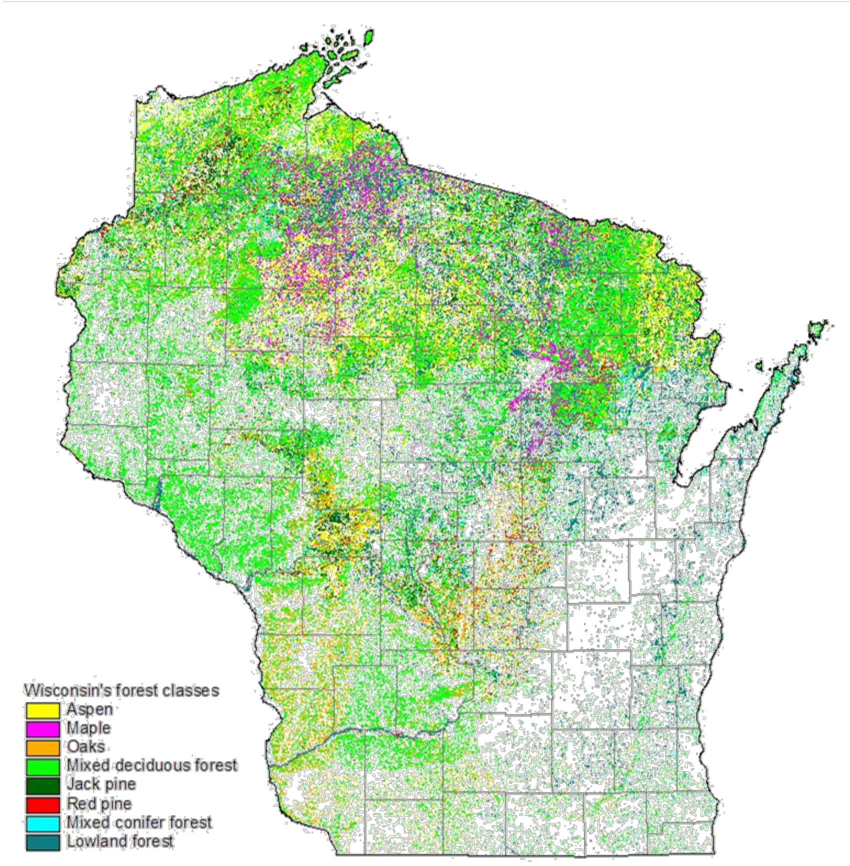


Figure 1 Wisconsin forest cover map, Source: WISCLAND land cover, Wisconsin Dept. of Natural Resources, 1998

Wisconsin's forests are critical for providing wildlife habitat, clean air and water, reducing erosion, and improving the quality of life in urban and rural areas. Forests are also important to the economy of Wisconsin for wood products, recreation and tourism. Current information on the forest resource in Wisconsin is available at dnr.wi.gov.

The area of forestland in Wisconsin has steadily increased in recent decades and currently stands at approximately 16.5 million acres (Figure 1). This is an increase of 1.8 million acres since 1983 and 845,000 acres since 1996. Wisconsin now has more forested area than at any time since the first forest inventory in 1936, and over 46% of the state's land area is forested, primarily in the northern and western areas of the state.

Wisconsin's forests are predominantly hardwoods, and the most abundant forest types are oak-hickory at 27% of total forested acreage, maple-beech-birch at 23% and aspen-birch at 19% (Figure 2). Conifer types, mainly pine and spruce-fir, represent about 19% of the forested area. Wisconsin forests are for the most part mature with the greatest proportion of stands in the 61-

80 year class. About two thirds of Wisconsin's forest lands are privately owned. The remaining third is split between federal, state, local government and Tribal ownership.

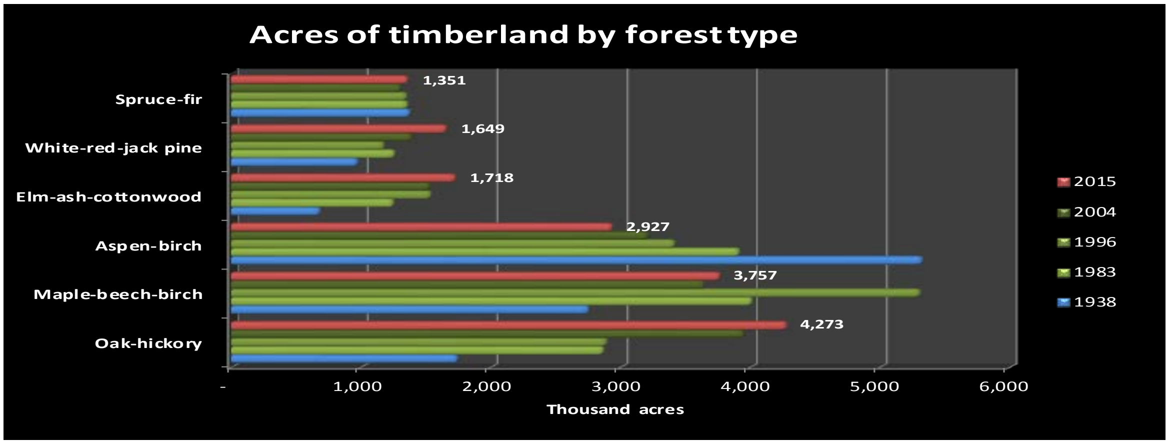


Figure 2. Wisconsin timberland area by forest type (FIA data, US Forest Service).

Exotic Species Issues

Beech Bark Disease

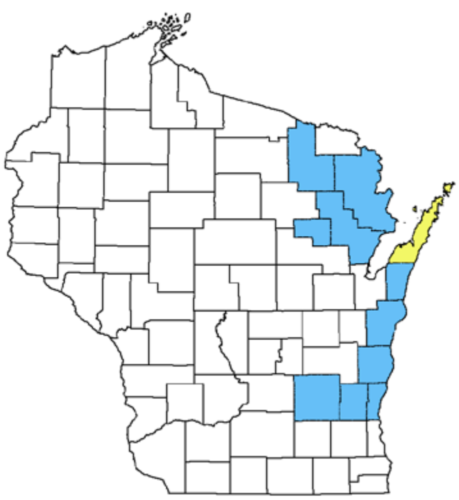


Figure 3 Counties with beech scale detections are shown in blue. Door County (yellow) is the only county with tree mortality assumed to be due to beech bark disease.

In 2016, populations of beech scale (*Cryptococcus fagisuga*) remained very low across the range of American beech in Wisconsin and signs of tree decline or mortality associated with beech bark disease continue to be limited to Door County (Figure 3). Sites where beech scale was confirmed in 2010 in Ozaukee (Highland Woods City of Mequon Park, Cedarburg Beech Woods State Natural Area), Sheboygan (Kohler-Andre State Park), Washington (Congress Dr. in Trenton Township), and Manitowoc (Point Beach State Forest and Lincoln Park in the city of Manitowoc) counties were revisited and though the scale was found, populations of the scale had remained stable and very low. In Door County, an aerial survey was done of declining beech trees. Decline and mortality of beech had moved north from the epicenter of known beech scale infestation. Additional beech decline was mapped northeast of Sturgeon Bay and on Rock and Washington islands around areas where beech scale had previously been found.

Field assays of beech scale resistance were conducted in Wisconsin for the first time in 2016. Three potentially resistant trees have been identified in the stand where beech scale was first found in Wisconsin in 2009 and this assay should confirm this resistance. For each assay, approximately 500 scale eggs were collected from heavily infested beech trees in Door County and placed on foam pads. The pads were applied directly to the bark, and sealed with house wrap. Pads were placed on two sides of each potentially resistant tree and three nearby control trees. These control trees were infested with scale prior to the assay and were for that reason known to be susceptible. In summer 2017, the pads will be inspected and the number of established adults, nymphs, and eggs that occur under each sealed pad will be recorded. Dormant stems of the potentially scale resistant trees were collected in 2015 and sent to the USDA Forest Service, Northern Research Station in Delaware, Ohio for grafting.

Jumping worms (Amynthas spp.)

Wisconsin's first detection of jumping worms (*Amynthas spp.*) occurred in Madison in October 2013. Since then, infestations have been reported from additional communities (Figure 4). Finds are concentrated in urban areas though they have been recorded in two forested areas: the UW Madison Arboretum and a rural forest in Waukesha County. In 2016 two species were identified, *Amynthas agrestis* and *A. tokioensis* and other species are suspected but not yet confirmed.

Urban development, construction, and the introduction of green material through multiple means and human activity play a key role in the spread of these worms. Nursery stock, informally exchanged plants, mulch and compost have all contributed to transport of *Amynthas sp*. The role of these pathways became evident when investigating newly detected populations in this and previous years.

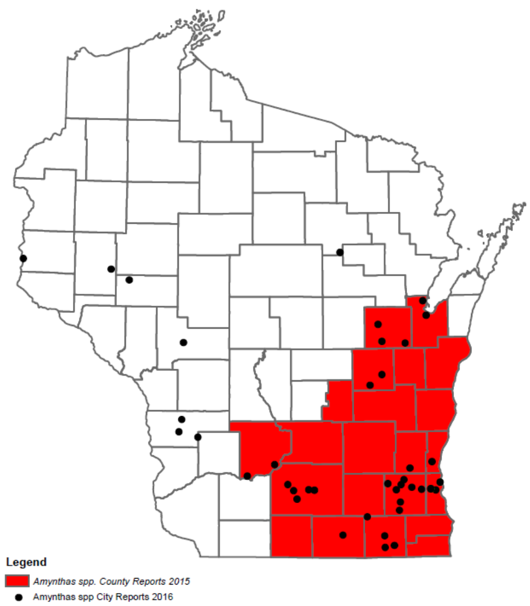


Figure 4 Distribution of *Amynthas species* in WI. Points indicate where jumping worms were found in 2016, red counties are those where the worms were found 2013-2015

WDNR staff continue to work with other stakeholders affected by *Amynthas sp*. to prevent spread and develop management tools. Partners include the Green Industry, local governments, public gardeners and researchers. Together, this stakeholder group has developed and continues to refine Best Management Practices (BMPs). Stakeholders voluntarily use the BMPs to reduce the risk of spreading these invasive worms and to satisfy the state statute NR 40 prohibition of knowingly transporting this restricted genus. The stakeholders and DNR staff also work together to increase public awareness of *Amynthas sp.*, how to avoid introducing them and how to minimize damage from them. DNR staff facilitate research on the use of a turf fertilizer to reduce numbers of these worms in limited landscape situations.

Emerald Ash Borer (EAB, *Agrilus planipennis*)

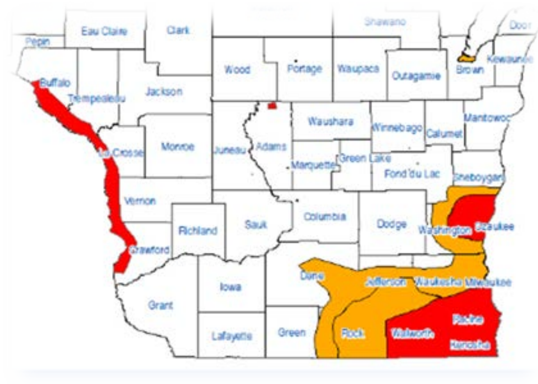


Figure 5 areas where ash mortality was predominant in 2016 are indicated in red, areas where ash decline predominated are indicated in yellow

The area of southeast Wisconsin where heavy ash mortality was observed in 2015 did not expand much in 2016 (Figure 5). However, the band surrounding this core, where woodpecker flecking, thinning canopies and scattered mortality could be commonly observed, did expand significantly. Increasing signs of EAB activity were most noticeable in eastern Fond du Lac, northern Milwaukee, southern Shebogyan, southern Waukesha, most of Washington, southeastern Jefferson and eastern Rock counties. Signs of infestation by the pest and trees in early stages of decline were scattered in Dane and western Rock counties. Declining trees and mortality were also observed along the Mississippi River where EAB has been confirmed, similar in area to what was seen in 2015.

EAB continues to spread in Wisconsin. The pest was found for the first time in three counties which were subsequently quarantined: Portage and Wood in central Wisconsin and Sawyer in the northwest (Figure 7). It was also found for the first time in Juneau and Manitowoc counties but these had been quarantined earlier as they were surrounded by the quarantined area.

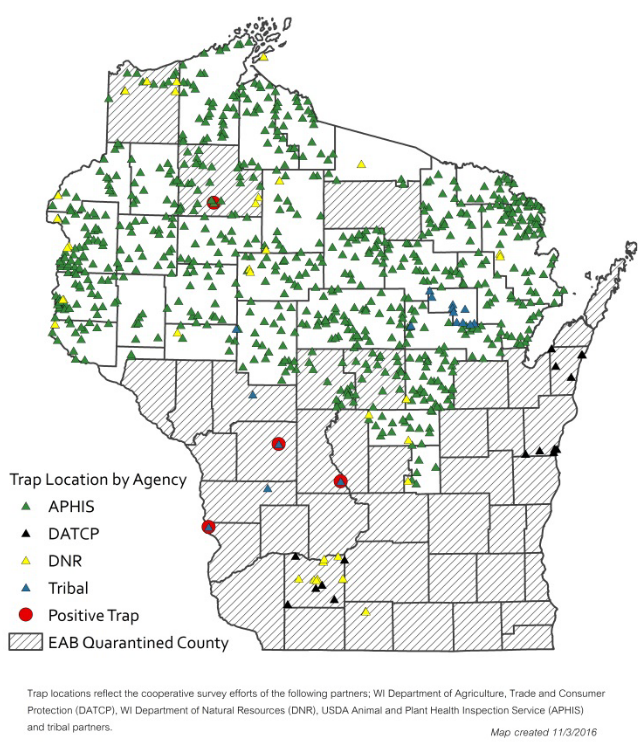


Figure 6. 2016 emerald ash borer detection survey, locations and results

USDA APHIS continued detection trapping in counties not quarantined at the start of 2016. Trap locations are selected using an algorithm to identify areas where EAB are likely to be introduced and establish. DATCP set traps at high risk locations in counties that were quarantined but where EAB had not yet been confirmed. DNR placed traps at state properties for use in management and as part of a public education effort. State agencies continue to cooperate to take reports, make identifications and keep a list of all municipalities where EAB has been confirmed (Figure 6). A current list and map of all locations where EAB has been confirmed is available online at http://emeraldashborer.wi.gov.

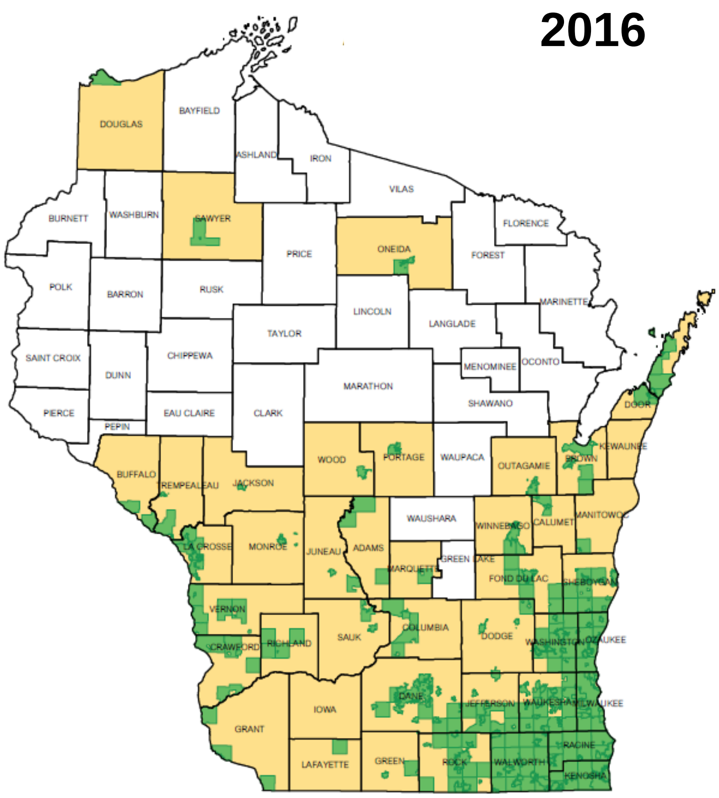


Figure 7 EAB distribution and quarantine as of Dec 2016. Counties in yellow are quarantined for EAB. Municipalities within the quarantined area where EAB has been detected are indicated in

At the end of 2016, 42 out of 72 counties in Wisconsin were quarantined for EAB. Kewaunee and Iowa counties are included as they are surrounded by quarantined counties. Figures 7, 8 and 9 provide historical context to the current distribution of EAB in the state. Expansion and merging of outlying populations seems most rapid in the southeastern counties compared with other early confirmed populations in Green Bay and along the Mississippi River. Factors that may influence this this apparent difference in spread include 1) continuity of the ash dominated southeastern urban landscape with the greater Chicago area infestation, 2) a warmer climate (growing zone 5b) in the greater Milwaukee area compared with the colder Green Bay area (zone 5a) and the western border with Minnesota (zone 4b), and 3) differing ages of the infestations..

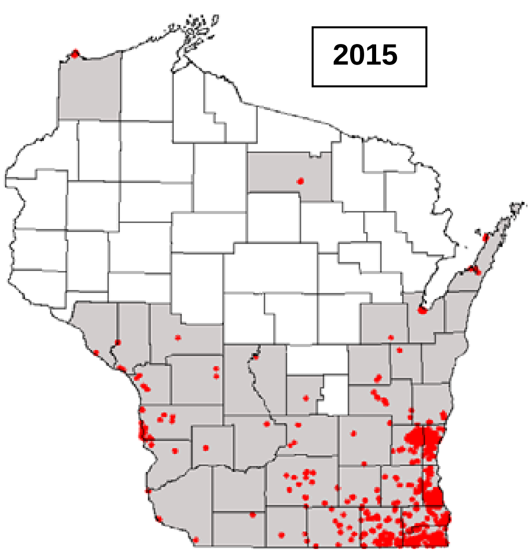
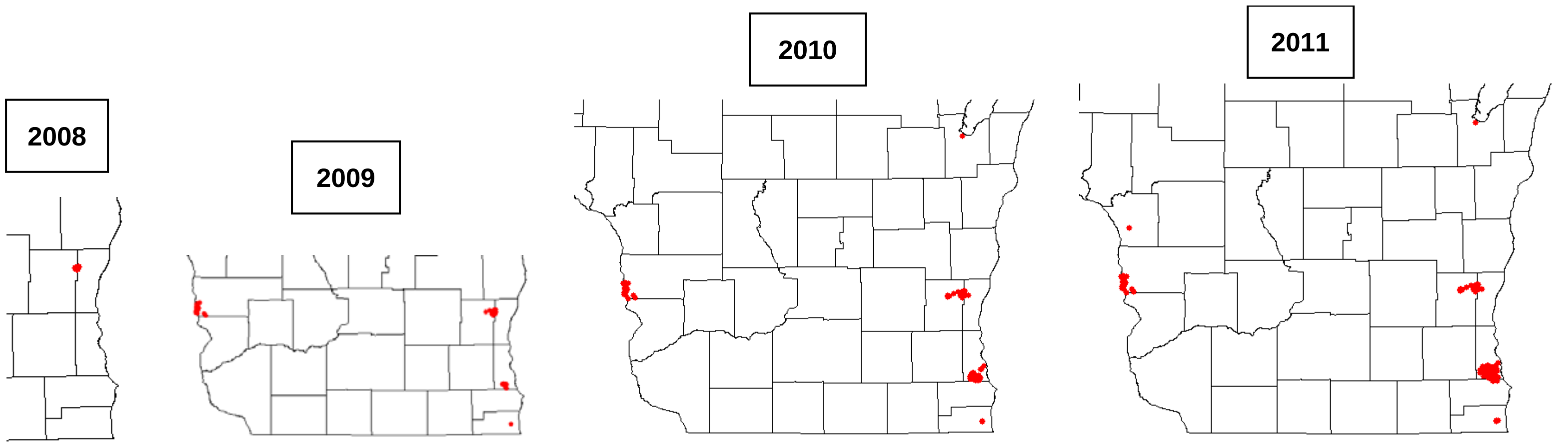
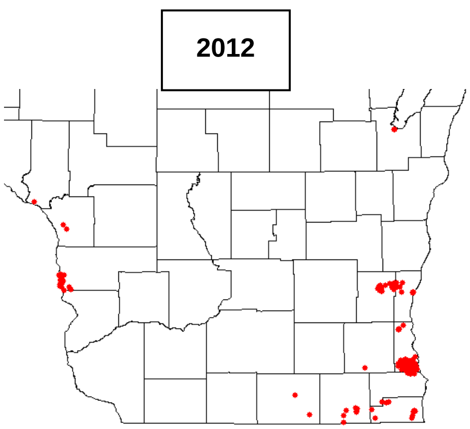


Figure 8 Red dots indicate locations of cumulative detections up to the end of 2015. Counties quarantined for EAB as of Dec. 2015 are shaded.





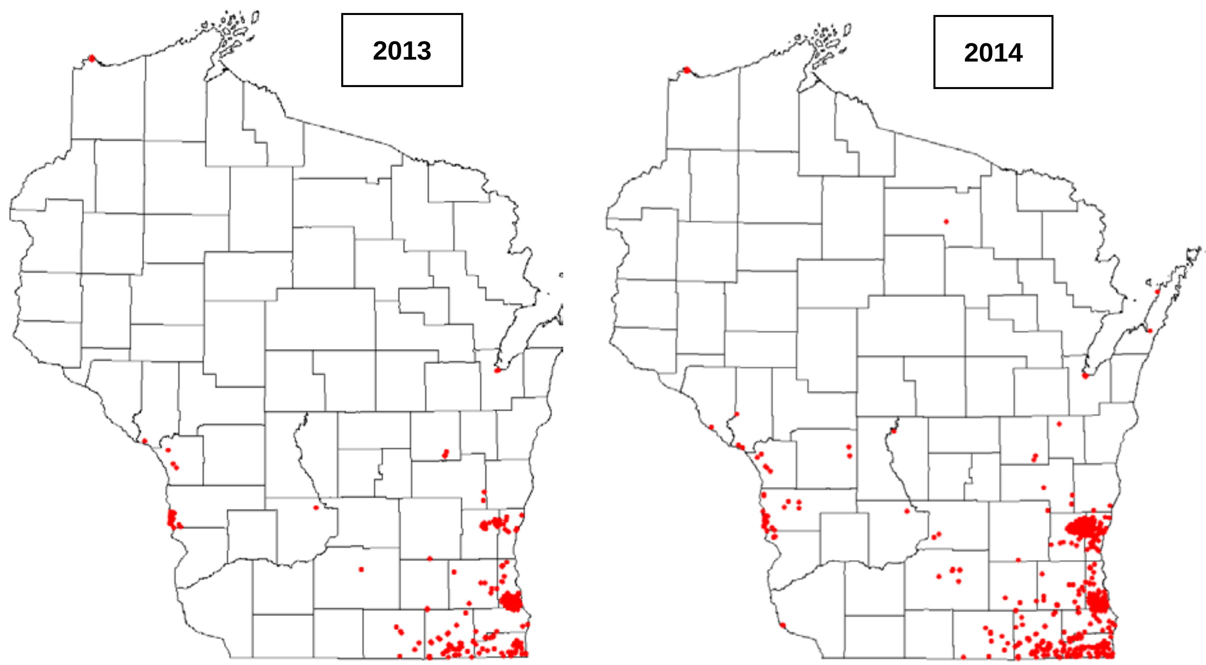


Figure 9: History of spread of EAB in Wisconsin, 2008-2014. Red dots indicate locations of cumulative detections up to the end of that year.

Biological Control of EAB

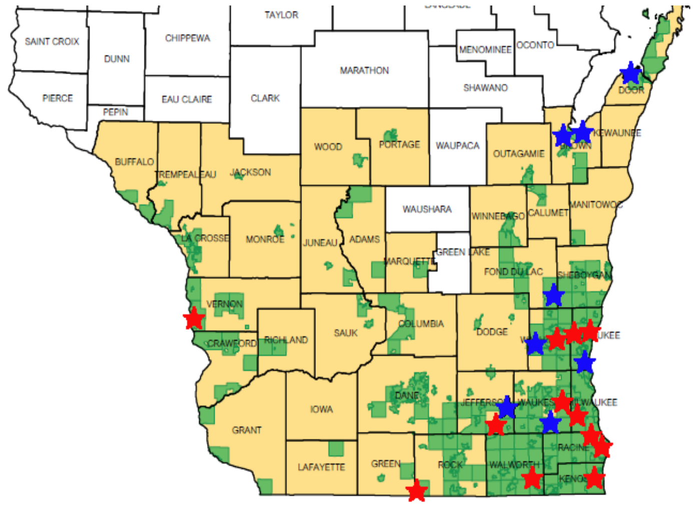


Figure 10. 2016 natural enemy wasp release sites are shown in blue. Releases done in previous years (2011-15) are shown in red. Counties quarantined for EAB are shown in yellow and communities with EAB detections are shown in green.

Non-native specialist parasitoid wasps are being introduced as part of an integrated pest management approach to EAB. Four species have been introduced to sites in 13 counties: *Spathius agrili, Tetrastichus planipennisi, Oobius agrili*, and for the first time in 2016, *S. galinae* (Figure 10). *S. galinae* is now released in colder climates instead of *S. agrili*, which was not reliably successful in establishing in northern states. The total number of wasps released in Wisconsin this year was 12,373 *T. planipennisi*, 13,400 *O. agrili* and 697 *S. galinae*. The parasitoids were produced and supplied by the USDA APHIS Plant Protection and Quarantine EAB Parasitoid Rearing Facility in Brighton, Michigan.

Tetrastichus planipennisi (Figure 11), a larval parasitoid, was successfully recovered by DNR staff at three sites in Kenosha, Racine and Walworth Counties, confirming that this species released in 2013 had successfully established. Voucher specimens were deposited with the Wisconsin Insect Research Collection in the UW-Madison Department of Entomology. This brings the number of sites in Wisconsin where *T. planipennisi* has been recovered to four, joining the first recovery in Ozaukee County in 2013 from a 2011 introduction. A 2014 release site in Milwaukee County was also revisited to look for this species, but none were recovered at that time. Tree bark samples from the four sites surveyed in 2016 were collected and incubated to recover *Oobius agrili* but this species was not found. Further recovery surveys are planned at release sites starting two to three years after introductions are made.

Figure 11. *T. planipennisi* wasps found inside an EAB gallery in Walworth County, May 2016. This species attacks EAB larvae beneath the bark. Photo by Bill McNee

Gypsy Moth (*Lymantria dispar*)

In mid-May, the DNR gypsy moth suppression program treated 18 acres in the Town of Beloit in Rock County and 84 acres at Mirror Lake State Park in Sauk County. Foliage was successfully protected in both treatment areas. No counties were added to the gypsy moth quarantine area in 2016 (Figure 12) .

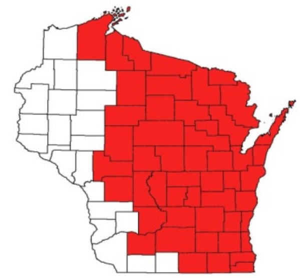


Figure 12 Counties quarantined for gypsy moth, 2016

2016 is the fifth year where the suppression program served less than 200 acres in one or two spay blocks (Figure 13).

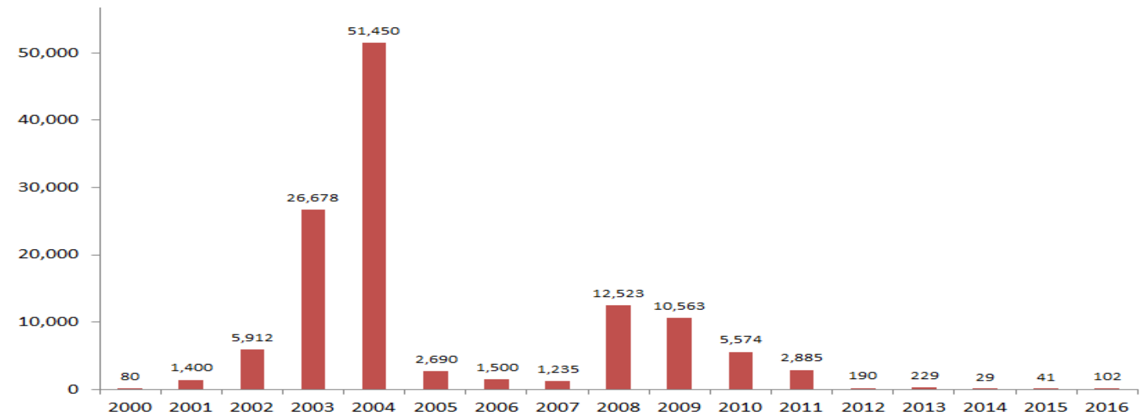


Figure 13. Acres treated in Wisconsin to suppress gypsy moth, 2000-2016

Defoliation acres have been low since 2010 when 347,000 acres of damage were recorded: 320,000 acres of moderate defoliation and 25,000 of heavy defoliation (Figure 14). Mortality from fungal and viral disease was heavy in the late instars and the high population of 2010 collapsed. Six years earlier, in 2004, the fungus *Entomophaga maimaiga* also brought an early end to an outbreak that threatened eastern counties of the state and had encouraged communities in the area to arrange for aerial spraying to prevent expected defoliation over 51,450 acres. In 2004, constant rains in May allowed an early development of the fungal epizootic and the outbreak collapsed before caterpillars could cause much damage, only 20 acres were recorded as defoliated.

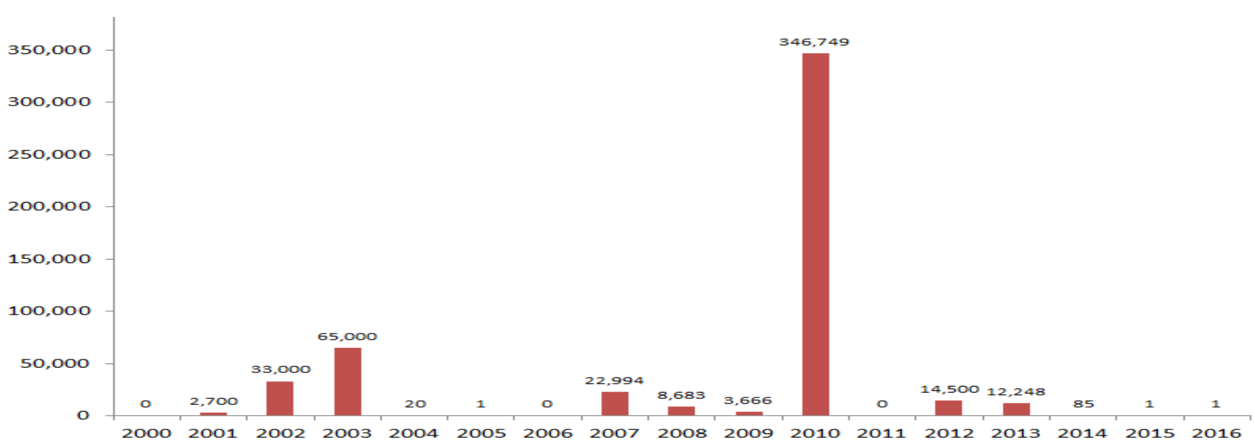


Figure 14. Acres defoliated in Wisconsin by gypsy moth 2000-2016

Heterobasidion Root Disease (Annosum Root Rot, *Heterobasidion irregulare*)

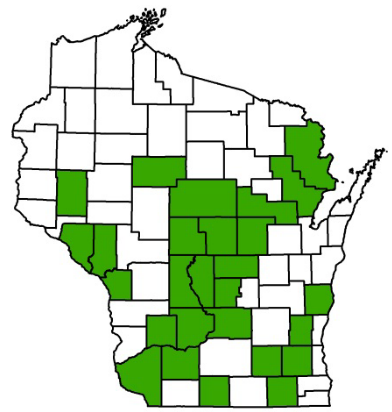


Figure 25 Wisconsin counties where HRD has been confirmed (Dec. 2016)

Heterobasidion root disease (HRD) is considered to be one of the most destructive conifer diseases in the northern hemisphere. HRD, caused by the fungus *Heterobasidion irregulare*, was first detected in Wisconsin in 1993 in Adams County. Most infections in Wisconsin have been in red and white pine plantations. The disease has since been found in 27 counties (Figure 15). HRD was found for the first time in Sheboygan and Washington counties in 2016 and in Marathon County in 2015.

In 2016, Forest Health staff found HRD infecting Norway spruce (Picea abies) for the first time in Wisconsin. DNA testing by the Forest Pathology Laboratory at the University of Minnesota confirmed that the pathogen was *H. irregulare*.

Invasive plant Suppression Grant Program

During fiscal year 2016, the Division's suppression grants program distributed 20 grants to control 16 terrestrial invasive plant species on private and public lands in 14 counties. Included in these totals are grants to six DNR State Natural Areas for invasive plant control.

Species controlled were Amur cork tree, black locust, black swallowwort, European marsh thistle, garlic mustard, giant hogweed, common buckthorn, greater celandine, hemp nettle, Japanese hedgeparsley, lesser celandine, Oriental bittersweet, wild chervil, yellow archangel and yellow bedstraw.

The suppression grants supported control work by cooperative invasive species management groups, private contractors and DNR field staff. New partners are the Chippewa and Dunn County highway departments that used suppression grants to purchase herbicide to control wild chervil along their forested roadsides but provided the vehicles, equipment and personnel.

DNR's Forest Health Team secured a $20,000 Forest Health Protection grant from the U. S. Forest Service that doubles the Suppression Grant funds available for controlling Prohibited and early detection invasive plants in the State's private and public forests for fiscal year 2017.

Oak Wilt (*Ceratocystis fagacearum*)

Oak wilt is caused by the pathogenic fungus *Ceratocystis fagacearum*, and is lethal to northern pin, northern red and black oaks in Wisconsin. Oak wilt is widespread in the southern two-thirds of the state, but is uncommon in northern Wisconsin (Figure 16). However, DNR forest health staff continue to find isolated disease centers in northern Wisconsin each year.

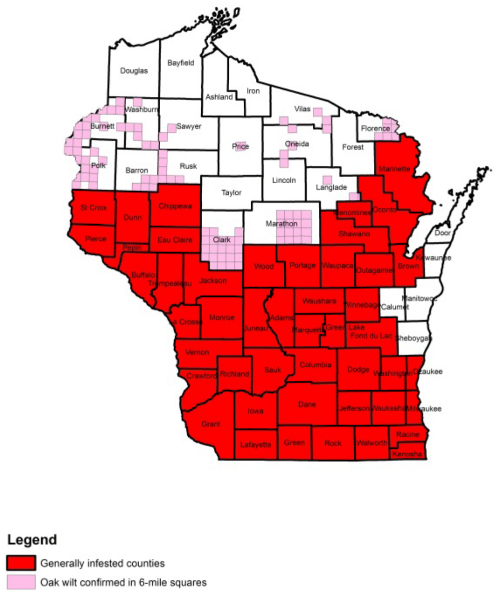


Figure 16 2016 Distribution of oak wilt in Wisconsin

In 2016, Oak wilt was confirmed for the first time in central Price County. Forest health staff track the first detections of oak wilt in townships of counties where the disease is not generally present. First detections at the township level were made in multiple northern counties: Rusk (Burnett Co.), Stubbs and Wilkinson (Rusk Co.), Edgewater and Sand Lake (Sawyer Co.), Beaverbrook, Birchwood, Evergreen, Long Lake and Minong (Washburn Co.), and Arbor Vitae (Vilas Co.).

<u>Oak wilt herbicide barrier update</u>

In 2015, Forest Health initiated a research project with federal grant funding to evaluate the effectiveness of a girdle herbicide method of containing below-ground spread of oak wilt. Containment includes treating all trees within grafting distance to newly infected trees (via Johann Bruhn's model) by girdling and applying a solution of 1/3 Triclopyr herbicide, 2/3 diesel. Girdle herbicide containments have been in use since 2003 in Marathon County and this research is expanding on those and similar efforts.

From 2015-2016 the project has collected data in 55 oak wilt pockets (Figure 17), of which 47 were treated pockets and 8 were controls (i.e., 4 pockets that were measured only, and 4 that were measured and girdled without herbicide application). Counties included in the study include: Chippewa (*n* = 3), Jackson (*n* = 18), La Crosse (*n* = 1), Marathon (*n* = 2), Marinette (*n* = 22), Monroe (*n* = 2), Oconto (*n* = 6), and Vilas (*n* = 1). Over 3,000 trees have been treated within these containment pockets.

Pockets were grouped by soil type (i.e., sand vs. loam model) using standard texture field assessments (ability to form ball/ribbon). Subsequent lab analyses of soil samples illustrated a limited capacity to determine soils by field assessment or soil maps (e.g., NRCS Soil Survey data). Our 2016 field season assessments were given the correct treatment (sand vs. loam) only 15 out of 30 times.

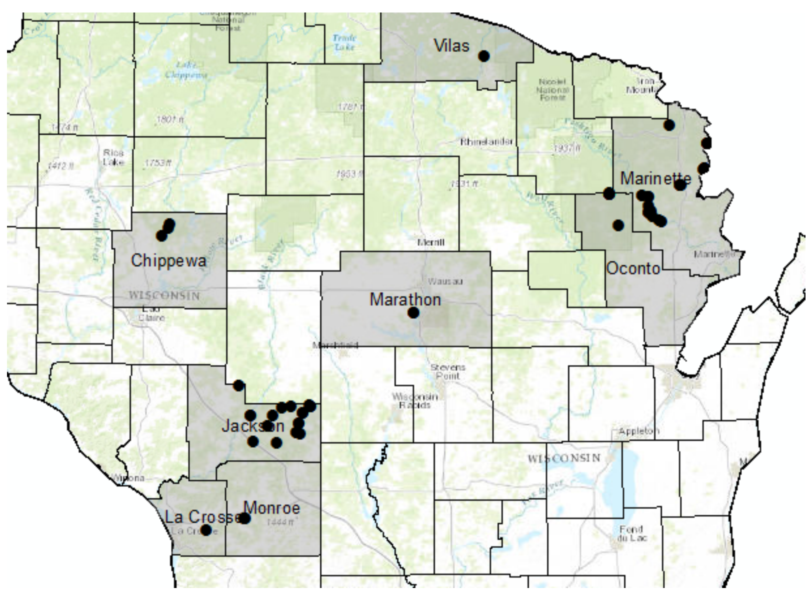


Figure 17. Oak wilt pockets (n = 55) included in the girdle herbicide containment study in 2015-2016.

Of the 15 pockets assigned the incorrect model, 9 were aggressive (sand model with a wider barrier on a loam site). Two of our 2015 control pockets had newly infected trees in 2016 (6 additional infected trees) and one of our treated pockets had spread beyond the containment (one newly infected tree). This pocket was one where we used a loam model where it should have been sand (we were too conservative). We made an adjustment to treat all pockets with a more aggressive sand model in 2016. This is already what is most common operationally with managers implementing girdle herbicide containments. We will continue to monitor these pockets and analyze results for the next 4 years.

Molecular testing for oak wilt in the Forest Health Lab

In the 2016 growing season, the Forest Health Lab began using polymerase chain reaction (PCR) technology to aid in the detection of the oak wilt pathogen, *Ceratocystis fagacearum* (Fig 18). PCR technology reduces the amount of time needed to positively confirm the presence of pathogens from the 2~3 weeks it takes to grow and identify the fungus using the culture-based method to only 1~2 days to process and analyze samples to detect DNA of the pathogen using PCR. It also offers increased detection sensitivity relative to culture methods as pathogen DNA can be detected from dead wood samples and samples that may have been handled under high temperatures during the sample delivery process.

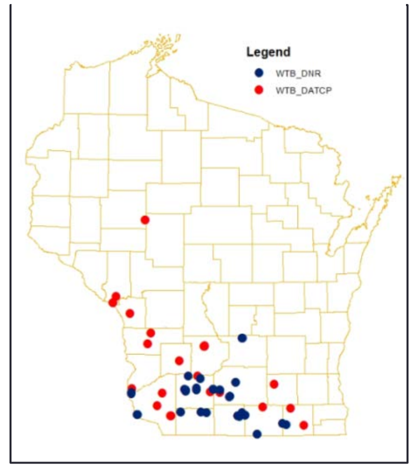
Figure 18. Lab technician, Colton Meinecke, examines the size of PCR products to determine the presence of the oak wilt pathogen in a sample.

As this was our first year to offering the PCR test for the oak wilt pathogen, samples were tested both by the molecular and culture methods. An in-depth analysis to compare the two methods is in progress. However, preliminary results show a much higher detection rate of the pathogen using the molecular method over the culture method. The Forest Health lab plans to expand its suite of molecular technique to diagnose a wide variety of forest pathogen issues in the future.

Survey for Walnut Twig Beetle (*Pityophthorus juglandis*) and Thousand Cankers Disease of Walnut (*Geosmithia morbida*)

Walnut twig beetle, *Pityophthorus juglandis*, is native to the southwestern US and is the main vector of thousand cankers disease of black walnut (*Geosmithia morbida)*. To date, neither walnut twig beetle nor thousand cankers disease have been found in Wisconsin. In 2016, DNR and DATCP staff continued monitoring for the beetle and disease in 16 counties of southern and west central Wisconsin (Figure 19). DNR forest health program staff set 40 Lindgren funnel traps at black walnut stands in state park and wildlife properties and a few county park properties. DATCP staff set 25 traps for WTB at municipal wood waste sites and sawmills. Traps were checked and samples collected three times during the growing season. One sample of black walnut was submitted for testing and the result was negative.

Figure19. Walnut twig beetle traps set in 2016.



Hardwood Issues

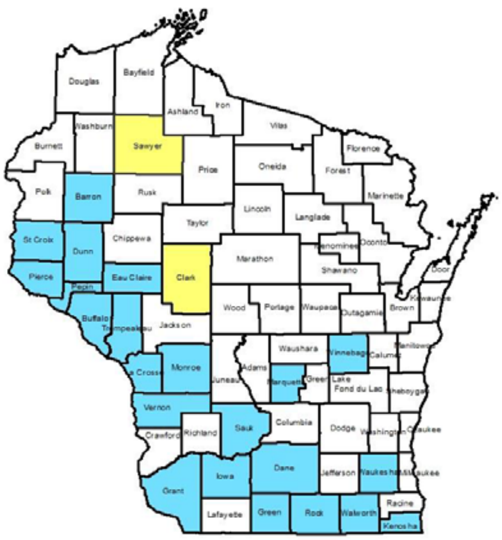


Figure 20. Counties in Wisconsin where bur oak blight has been confirmed: counties added in 2016 are yellow, previously confirmed counties are blue.

Bur Oak Blight (BOB, *Tubakia iowensis*)

Bur oak blight was confirmed for the first time in Clark and Sawyer counties in 2016 (Figure 20). The number of reports of symptoms of this disease was low in 2016 across its range in Wisconsin.

Dead Oak Leaves Retained

Northern red oak trees have been observed retaining dead leaves from the previous year since 2014. Dead leaves are found throughout the crown. Previous lab testing identified no fungi in the dead twigs or petioles. This symptom was first noted as widespread in 2014 in Forest, Marinette, Oconto, Oneida, and Vilas Counties. In 2015 a few localized areas showing this symptom were noted in Florence, Forest, Oneida, and Vilas Counties. This year these symptoms were minimal in northeastern counties but found in western counties of Chippewa, Dunn, Eau Claire, Jackson, La Crosse, and Monroe. It is hypothesized that the severe winter of 2013-14 played a part in the large number of oaks that had this problem in 2014 and the milder winter of 2014-15 resulted in less leaf retention.

Hickory Mortality and Broom Formation

Mortality of bitternut hickory from 100 cankers disease continued in Dane, Green Lake, Iowa, Marathon, Shawano and Waupaca Counties in 2016. At one site in Sarona Township, Washburn Co., hickory bark beetle, *Scolytus quadrispinosus,* and Armillaria root disease were determined to be the cause of mortality. Phytoplasma was confirmed on dead bitternut hickory in a woodland site in Dane and one in Iowa County. It is uncertain what role, if any, the phytoplasma is playing in observed hickory mortality at these two sites.

Brooms on trunks and branches and woody phomopsis gall-like growth were observed on shagbark hickory in a number of sites in Dane, Iowa, Rock and Sauk Counties. Branch dieback was associated with brooms at some sites but no mortality was observed. The first report of brooms and growths on hickory trunks similar to phomopsis galls with brooming was in 2014 in Rock County. Phytoplasma was confirmed from one sample in an outer branch broom in 2015. Samples taken from brooms forming on the woody, gall-like growth in 2015 were negative for phytoplasma. In 2016, samples of outer branch brooms and the woody gall-like trunk growths from other sites were tested for phytoplasma but all were negative. Given these contradictory results from several sites, it is uncertain what role phytoplasma may be playing with broom and gall formation in hickory.

Phytoplasma (*Candidatus* Phytoplasma fraxini)

Phytoplasmas are small bacteria that lack cell walls and live as obligate parasites and pathogens of plants. In trees they cause small and yellowed foliage, slow growth, thin crowns, branch dieback and vertical bark cracks. Infected trees and stumps may produce clusters of spindly shoots that are known as a 'witches broom'. Broom formation is highly variable and often absent in infected trees depending on the host species.

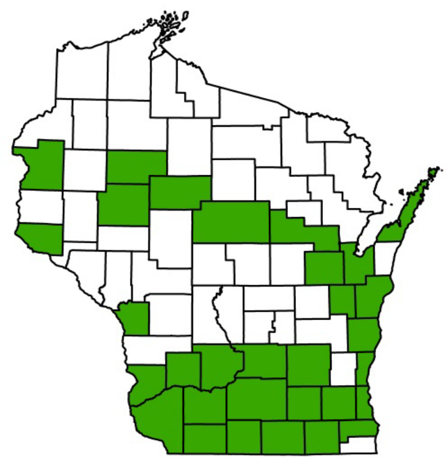


Figure21. Counties where phytoplasma has been confirmed in green, Oct. 2016

Phytoplasma was first confirmed in white ash in 1987 in Wisconsin and since has been confirmed in numerous other species using the genetic test, Polymerase Chain Reaction. Thirty one counties have now been confirmed for the presence of phytoplasma on one or more host tree species in Wisconsin (Figure 21). In previous years, phytoplasma has been found in samples from green, white and black ash (*Fraxinus pennsylvanica, F. americana, andF. nigra*), black walnut (*Juglans nigra*), butternut (*J. cinerea*), red maple, shagbark and bitternut hickory (*Carya ovata* and *C. cordiformis*). In 2016, a total of 69 samples of 32 symptomatic tree and shrub species were tested with PCR for the presence of phytoplasma. Phytoplasma was confirmed for the first time in American beech (*Fagus grandifolia*), hazelnut (*Corylus sp.*), mulberry (*Morbus sp.*), white spruce (*Picea glauca*), swamp white oak (*Quercus bicolor*), lilac (*Syringa sp.*), and elm (*Ulmus sp*). In addition, an alder spittle bug, (*Clastoptera obtusa*) collected from a phytoplasma positive bitternut hickory, tested positive for phytoplasma. It is unclear if infection of other host species by phytoplasma is a new trait or just not previously recognized. It is also uncertain if it is the same species (*Ca.* P. fraxini), on all hosts as the PCR test performed does not identify phytoplasma to a specific group/subgroup.

European Fruit Lecanium scale (*Parthenolecanium corni*) and European Elm Scale (*Gossyparia spuria*)

Figure 32 European fruit lecanium scale on ash

Populations of Lecanium scale continue to be high in a number of counties around the state. In many areas this is a repeat of the high populations we saw in 2015, although in central Wisconsin the populations of Lecanium scale appear to have crashed. In Brown, Door, Kewaunee, Langlade, Marinette, Oconto, Oneida, Shawano and Vilas Counties, where the populations remain high, scales were found on oak, cherry, ash, maple, beech, dogwood, musclewood, basswood and hazel brush. Samples were collected this spring and sent to a scale ID expert at the Plant Pest Diagnostics Center at California Department of Food & Agriculture, where they were identified as European Fruit Lecanium (*Parthenolecanium corni*). Some lower branch mortality due to heavy Lecanium scale is occurring on ash and basswood in Door and Kewaunee counties (Figure 22).

Samples were submitted this summer from a municipality in Sauk County with the non-native European elm scale infesting the branches. Scale populations appeared high enough to be causing some localized damage to twigs and branches. Twigs and branches can also be covered with black sooty mold growing on “honeydew” excreted by this scale. Typically, branch foliage would turn yellow and there would be premature leaf drop. In the sample submitted, foliage was showing inter-veinal necrosis. It is possible this inter-veinal necrosis is not related directly to scale feeding impacts. European elm scale are primarily found on American elm but can also be found on other elms and Celtis species such as hackberry.

Two-Lined Chestnut Borer (*Agrilus bilineatus*)

Localized mortality of oaks caused by TLCB was observed in western and central Wisconsin. In several counties in northcentral Wisconsin, TLCB caused mortality of red and white oaks in stands that were both thinned and experienced severe frost damage from 2014 to 2016. Southcentral Wisconsin experienced mortality due to TLCB in oak stands in several counties but the damage appears to be declining in this part of the state. In northwestern and western Wisconsin several individual stands had mortality of oaks caused by TLCB.

Conifer Issues

Balsam fir branch tip dieback and Valsa canker

In 2014 and 2015 balsam fir with large numbers of dead twig tips were observed in northern Wisconsin. The dead twigs were scattered throughout the crown, typically killing one to two inches of the twig tip, and the dead twigs and needles remained on the tree for at least a year. Balsam fir along stand edges, deep inside a stand, in the understory, or far from any road or other disturbance were all impacted. All sizes of trees were affected although pole and sapling sizes seemed most affected. Occurrence of new symptoms decreased significantly in 2016.

After studying numerous samples from a number of locations around Vilas and Oneida Counties, the fungus causing the branch tip mortality was identified as Valsa sp., in the genus Cytospora. According to Tree Diseases of Eastern Canada, Valsa has the potential to kill young shoots. Although this apparently won't kill the tree it can deform small trees due to branch tip mortality. The Field Guide to Tree Diseases of Ontario, calls this disease "Cytospora dieback of balsam fir" and states that control is not necessary other than on urban ornamentals, but cautions to avoid pruning when it's wet out and to sterilize equipment after pruning.

It's unclear what prompts the infection, whether it's a wet spring or fall when infection is more likely to occur, or whether it's in response to stress in the tree from harsh winters or droughty periods. Weather data for the previous two years were examined and not only were colder than average temperatures observed in the 2013/14 and 2014/15 winters prior to symptoms showing up, which could have stressed the trees making them more susceptible to fungi, but there was also higher than normal rainfall in the spring of 2014 and 2015.

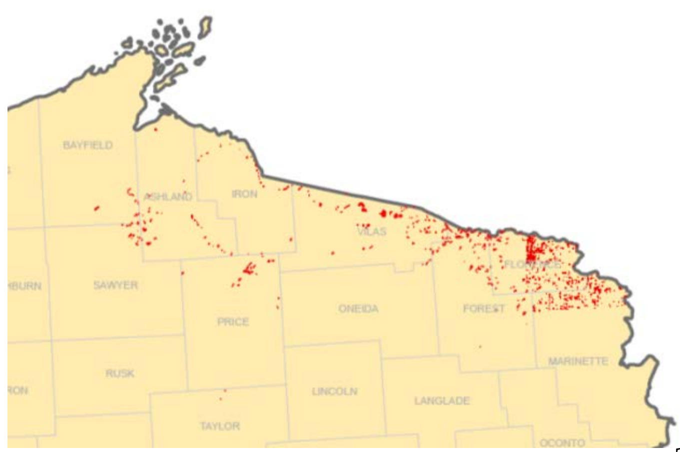
Eastern Larch Beetle (*Dendroctonus simplex*)

Eastern larch beetle is a native bark beetle species that attacks and occasionally kills tamarack over widespread areas during outbreak periods. In northern Wisconsin in 2016, staff observed minor expansion and additional tamarack mortality in some stands with existing infestations, primarily in the counties of Oconto, Oneida, Taylor, Vilas and Waupaca. This insect attacks stressed tamaracks and once eastern larch beetle starts causing mortality in a stand it is common to see further mortality in that stand or area. Damage and mortality from eastern larch beetle have been mapped since 2012 in Wisconsin and drought in 2012-2013 and larch casebearer defoliation in 2014 have favored continuation of attack from this pest.

Spruce budworm (*Choristoneura fumiferana*)

Regional budworm outbreaks occur every 30-50 years and can last 10-15 years. Wisconsin's previous outbreak ran from 1970 to 1980. The current outbreak began in 2012 with localized severe defoliation of balsam fir and spruce occurring in the counties bordering Michigan's Upper Peninsula. Areas of defoliation have expanded significantly and defoliation has been moderate to severe across many areas

Figure 23. Defoliation by spruce budworm in 2016



of northern Wisconsin each year since. Defoliation of spruce and balsam fir due to spruce budworm in 2016 was similar to defoliation in 2015 and was focused in northern counties (Figure 23). Due to multiple storms with heavy rains and strong winds in the spring of 2016, most of the clipped needles and webbing which make the defoliation more noticeable were washed off the trees, so reports of defoliation were greatly reduced this year. Areas of Ashland, Florence, Iron, Marinette, and Vilas Counties had widespread moderate defoliation, with localized areas of severe defoliation. One site in Portage County showed light to moderate defoliation again this year. Counties with some scattered defoliation were Price, Forest, Bayfield, Sawyer, Oconto and Taylor.

Diplodia shoot blight, (*Diplodia sapinea,* formally *D.pinea*)

Asymptomatic infection by *Diplodia sapinea* in state nursery stock

Asymptomatic infection by Diplodia shoot blight in red pine seedlings can result in failure of the plantation when the disease becomes symptomatic after planting. In Wisconsin state nurseries, healthy-looking red pine seedlings have been tested annually to assess for asymptomatic infection prior to sale. Infection rate must be 10% or less or the stock will not be sold. In 2016, the forest health lab tested seedlings from Griffith (280, three year-old seedlings) and Wilson (272 two year-old seedlings and 256 one year-old seedlings) state nurseries. Asymptomatic infection rates were 12.1% for the Griffith State Nursery and 0% for seedlings from the Wilson State Nursery. Based on the lab results, the three year-old red pine seedlings in the Griffith State Nursery will not be sold.

Yellowheaded spruce sawfly (*Pikonema alaskensis*)

In 2015 defoliation of spruce by Yellowheaded Spruce Sawfly was noted in several counties. This year additional defoliation was noted in Bayfield, Door, Marinette, Outagamie, Portage, Shawano, Vilas, Waupaca and Waushara Counties. In many stands the areas impacted were less than one acre in size, but within those areas defoliation ranged from 0-100% Figure 24). Several sites in Outagamie, Portage and Waushara Counties had mortality associated with repeated defoliation affecting up to 25% of the trees. Two areas in Taylor County and one area in Shawano County that were defoliated in 2015 were treated by landowners for Yellowheaded Spruce Sawfly and no defoliation was reported in 2016 at these sites.

Figure 24. defoliation by yellowheaded spruce sawfly

Abiotic Issues

2016 Weather

Temperatures and precipitation were above average statewide throughout 2016 (Figure 25) and no parts of the state experienced drought this year. Trees that grew up on exposed lakeshores during the last 10 years of low water levels of Lake Michigan died as the lake level rose in 2016. Abundant rains in summer 2016 also led to higher water levels in Oneida and Vilas Counties, where tree mortality occurred in localized areas of saturated lowlands.

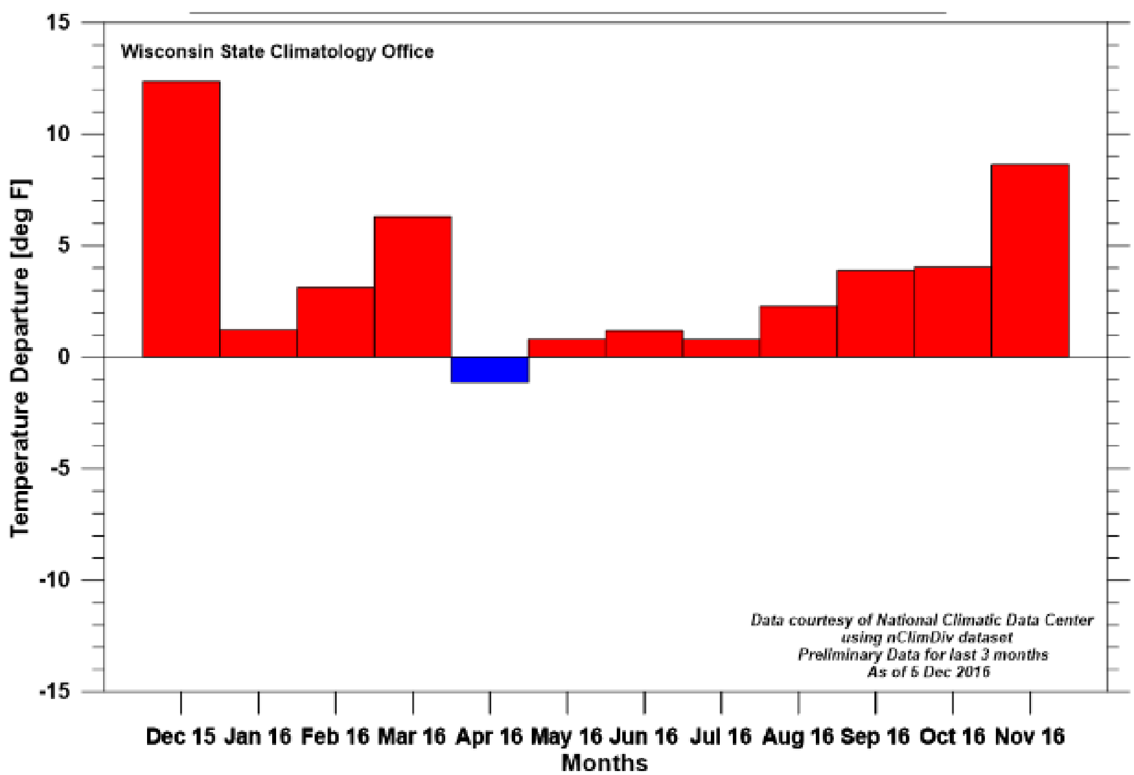


Figure 25. Statewide monthly temperature (°F) departure from normal for 2016. Source: Wisconsin State Climatology Office.

Frost Damage

A mid-May frost event caused widespread, scattered damage to multiple hardwood species across most of the state. When frosts occur during plant early developmental stages—bud swell and break, and leaf expansion—it may cause damage and mortality to buds, leaves, flowers and new shoots (Fig. 5). Healthy trees will put out a second set of leaves to replace killed leaves and a single incidence of frost damage is generally a minor tree stressor. But multiple frosts in a single year or consecutive years of moderate to severe frosts may lead to significant stress and incite tree health disorders. In northwest Wisconsin, moderately severe frost damage was scattered throughout the region in 2016, with severe damage observed on oaks in portions of Sawyer, Washburn and Douglas Counties. The same counties had been badly damaged in 2015 by frost events that occurred in April, May and June. In west central and central Wisconsin, frost damage was patchy and moderately severe on ash and oak. In southern Wisconsin, moderate to severe damage was observed on oaks near Mirror Lake State Park in northern Sauk County. There, mid to upper elevation areas sustained greatest damage, with an overall impacted of 980 acres.

Figure 26 Severe frost injury to oaks, Sauk County

Storm Damage

- A storm event on July 5th, 2016 caused 15,000 acres of uprooted trees and other damage over an area of 26,000 acres of mixed agriculture and forest in Buffalo, Pepin and Pierce counties.
- On the Nicolet-Chequamegon National Forest in Bayfield County, storms caused three parallel tracks of damage totaling 1,938 acres; about 400 acres of which were severely damaged (data from Forest Service).
- Red, white and jack pine, and black and red oak were impacted by up to 2" hail in Adams County in July. There was also scattered blowdown from this storm. Variable levels of damage over 4,379 acres.
- Scattered blowdown of red and white pine over 2,268 acres on Wood County Forest land in August.
- Scattered damage from storms: on the Northern Highland American Legion State Forest in July, 472 acres in Door Co., 209 acres in Rusk Co, unspecified acres and locations in Brown, Oneida, Outagamie, Waupaca, and Vilas counties.

Sept 2014 hail damage, final evaluation

In 2015 we reported on a catastrophic hailstorm that occurred in September 2014 and damaged trees across approximately 30,000 acres in Langlade, Oneida, Price, Sawyer, Vilas and Washburn Counties. Storm trackers reported quarter-sized and larger hail in areas across the storm path, resulting in scattered tree damage of moderate to high severity. In some areas strong winds also broke the main stems and branches of many trees while uprooting others and this damage was immediately noticeable in fall 2014. Delayed impacts of the hail injury, such as branch flagging, top kill and mortality, became visible in affected areas in the spring of 2015. Follow-up on those sites severely impacted by the hail found some interesting trends.

In the most severely impacted areas, older white pines were heavily impacted, and in some cases suffered mortality. Extensive dieback in white pine appears to be due to the number of hail wounds occurring just prior to winter, and those open wounds then had all winter to dry out and crack further, killing branches up to ½" in size. This was different than some past observations related to spring hail storms where white pine fared better than red pine.

Older red pine trees, while as severely damaged as the older white pines, survived much better. Although crowns were often severely damaged, the bark did not dry out or crack further like we saw on the white pine, so more branches survived with some amount of green foliage remaining. It was also predicted that Diplodia would enter the hail wounds on red pine and that severe Diplodia infections in the crowns of red pine could cause mortality. Perhaps due to the late fall timing, the incidence of Diplodia in the red pine crowns of mature trees was minimal. This again was different than some observations related to spring hail storms, in which Diplodia has been observed taking full advantage of hail wounds, infecting trees very heavily.

Understory white pine, red pine and balsam fir are still retaining dead needles and dead branch tips due to the storm damage. In some instances recovery is going well while in many cases the understory trees seem to have stagnated and are not growing well and do not appear to be recovering from the damage. Hardwoods in the area seem to have fared much better than any of the conifer species.

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