Minnesota Department of Natural Resources
Division of Forestry

2015 Forest Health Report

The Minnesota Department of Natural Resources Forest Health Report was created by the Division of Forestry Forest Health Unit.

Cover photos: Top, four-eyed spruce beetle in galleries; right, fall webworm damage; bottom left, oak leaf showing oak wilt.

Photo credits: Photos are from DNR forest health staff unless indicated otherwise.

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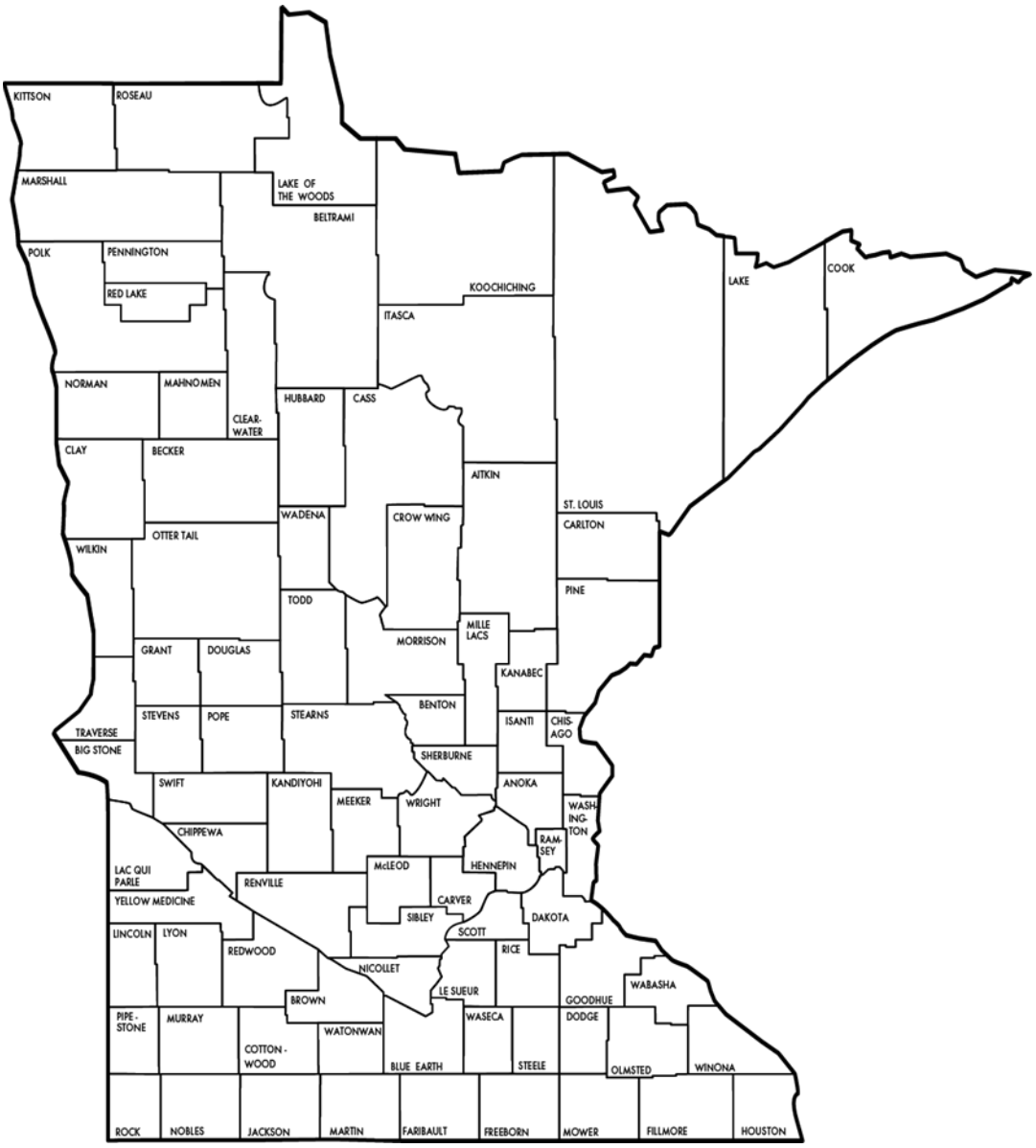

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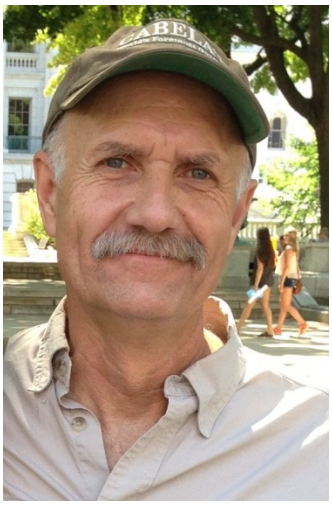
Jana Albers, Northwest Region Forest Health Specialist
Retired, June 2015

Mike Albers, Northeast Region Forest Health Specialist
Retired, June 2015

Thank you, Mike and Jana Albers

The DNR forest health staff was reduced by two-thirds this year when Mike and Jana Albers bid farewell and entered the world of retirement. Recognized leaders in Midwestern forest health issues, Mike and Jana provided state service for a combined total of 71 years: Mike, 38 years, and Jana, 33. Probably their most significant contribution was in staff training, from entry-level foresters to seasoned field foresters at all levels. Highly sought-after as speakers, they went beyond DNR borders to make presentations to a wide variety of interest groups and partner agencies wanting information about current forest pest issues.



Mike Albers

It's difficult to summarize all their good works in a few paragraphs, but I'll list a few accomplishments for which the Albers are well-known. Jana and Mike contributed much of what we currently know in Minnesota about forest pests and their management. Collaboration with cooperators at the University of Minnesota, the US Forest Service, and the Minnesota Department of Agriculture, for example, resulted in important discoveries and many published studies.

Mike led the annual aerial insect and disease surveys, interpreted the data, and reported results in a variety of venues. It has been said that he collected more data on spruce budworm defoliation than anyone in the world! Mike was also instrumental in establishing timber sales guidelines for managing bark beetle populations during pine operations, and for managing dwarf mistletoe in black spruce.

Jana was the editor of the much-loved *Forest Insect and Disease Newsletter* editor for more than 25 years, leading it from the familiar yellow paper copy to a more efficient on-line delivery. Jana's work with *Diplodia* red pine disease in the state nurseries eliminated the disease there, and she developed guidelines to minimize further losses from the disease. Jana also authored work on hazard trees for both state and federal guidelines.

Jana Albers

Work accomplished by the Albers is a legacy in the DNR Division of Forestry that will continue to inform program decisions for many years to come. Jana and Mike, we thank you for your dedication, service to Minnesota, and your friendship!

Val Cervenka
MNDNR Forest Health Program Coordinator

Minnesota Forest Resources Summary

Minnesota is home to three major ecosystems: prairies in the west, boreal forests in the northeast, and hardwoods running between the two from the Canadian border to the southeastern area of the state. The forests of Minnesota are many and varied.

Changes in the early years of the 21st century pale compared to the dramatic changes of the late 1800s and early 1900s. During that period, nearly half of Minnesota's forest land was converted to agriculture and other land uses in the wake of widespread logging that peaked in 1905. Since then, the state's forests have been a remarkable story of resiliency and recovery.

Today, Minnesota's forests sustain damage from a combination of abiotic stressors and native and non-native pests. Many of the native pests are recurring and cyclic and play an integral role in the ecology of Minnesota forests. With the increasing effects of climate warming, some native pests are causing more losses in both hardwood and softwood forests.

Historically, invasive insects and pathogens have had a large impact on Minnesota's forest health. Diseases such as white pine blister rust and Dutch elm disease greatly altered the health and makeup of Minnesota's forests in the 20th century. Oak wilt has proven difficult to manage even though we have the tools available to prevent and control this tree killer.

The early detection and treatment of gypsy moth outbreaks and emerald ash borer, both non-natives, have slowed the introduction and spread of these two destructive insects in our state. More threats loom in the continuing fight against non-native pests such as mountain pine beetle and Asian longhorned beetle. Monitoring forest health and surveying for insects and pathogens remain crucial to minimizing old and new threats to Minnesota's forests.

Results of the 2015 Aerial Survey

Since the early 1950s, aerial survey has been a valuable tool for monitoring forest insects and pathogens across 13 million acres of forest land in Minnesota. Since 1996 these annual surveys have been accomplished through the collaboration of the Minnesota Department of Natural Resources Division of Forestry Forest Health team, the Division of Forestry Resource Assessment team, and the U.S. Forest Service (USFS) Northeastern Area State and Private Forestry (S&PF) team. The Forest Health staff coordinates the surveys, trains survey staff, ground-checks surveys, and analyzes and disseminates aerial survey data. From the air, Resource Assessment and USFS staff delineates unhealthy forests and converts that data into digital format for interpretation. Aerial survey results are incorporated into the USFS national database. The summary table below shows the amount of acres of damage caused by various insects, disease, and other factors.

Damage agent	Acres affected	# Polygons	Notes
Abiotic cause	55	7	
Armillaria	30	3	
Aspen and birch decline	38,948	303	
Bark beetles	3,150	444	Excludes bark beetles of hardwoods and tamarack
Black ash decline	30,483	793	
Eastern larch beetle	33,786	2,917	
Emerald ash borer	156	625	Includes ¼-acre buffered points from 2013-2015
Fire	7,507	3	
Flooding	1,066	19	
Forest tent caterpillar	65,750	515	
Jack pine budworm	5,210	47	
Larch casebearer	14,220	211	
Northern hardwood decline	4,768	17	Includes mixed forests of primarily maple and basswood with components of oak, birch, and aspen
Oak wilt	1,145	1,256	Includes 3/4 acre buffered points from 2014 and 2015 (but not overlapping territory)
Spruce budworm	105,520	567	
Two-lined chestnut borer	106	63	
Unknown agent	905	60	
Wind damage	3,232	31	

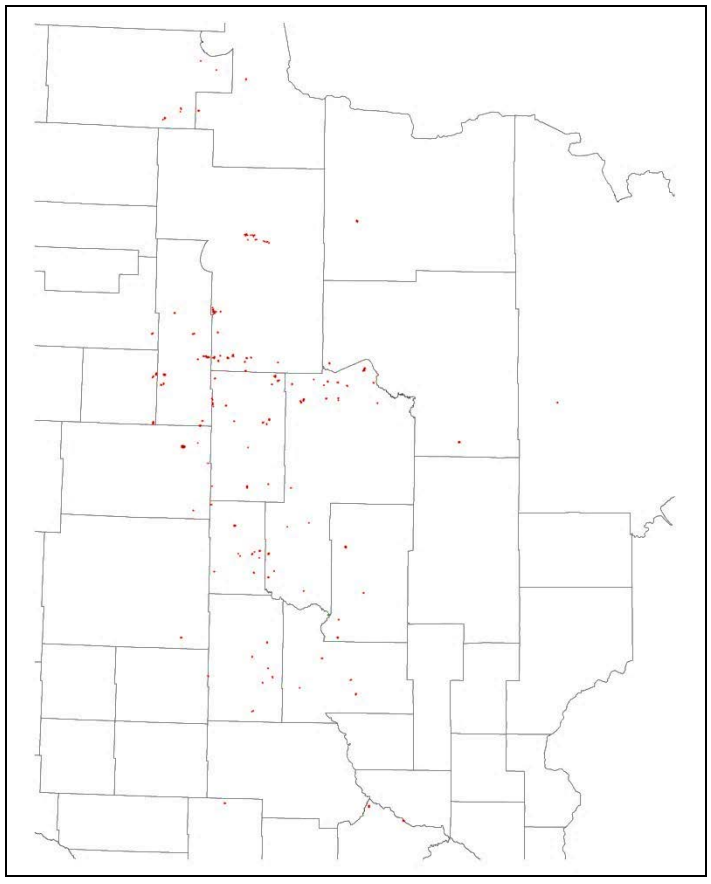
Forest Pest Conditions Report

This report contains pest information from a national list of the major forest insects and diseases that occur within the state and any other pests that cause recordable host damage during the year. Data collected in the aerial survey is entered into the federal Pest Event Reporter database used to produce the National Forest Insect and Disease Conditions Report.

Insects

Conifer bark beetles

Bark beetles included in this article are red turpentine beetle (*Dendroctonus valens*), engravers (*Ips* species), balsam fir bark beetle (*Pityokteines sparsus),* four-eyed spruce bark beetle (*Polygraphus rufipennis*), and spruce beetle (*Dendroctonus rufipennis*).



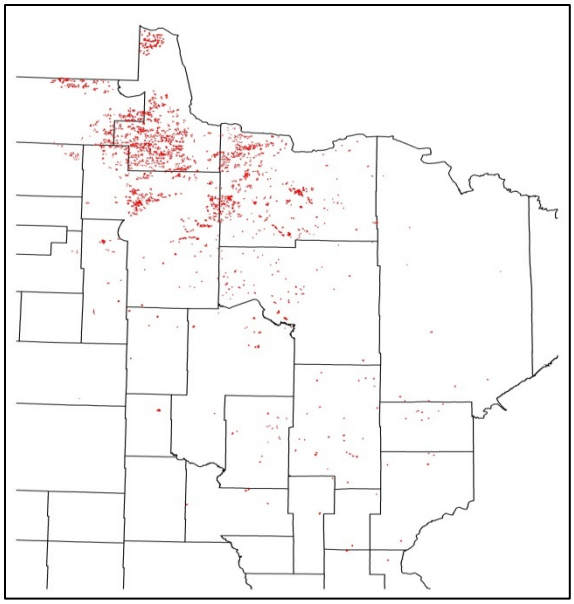
Rarely do conifer bark beetles cause significant damage in a stand or across the landscape. Significant landscape damage from bark beetles can occur after a lengthy drought or after consecutive years of defoliation; damage in an isolated stand is usually due to management activity. For example, thinning pines in summer and leaving logs decked in or near the stand for more than five weeks could result in many residual pines killed by the pine engraver (*Ips pini*) after they have fed on the decked logs.

In 2015, our aerial surveys recorded roughly 1700 acres of coniferous forests that sustained significant mortality from bark beetles (not including tamarack). We define significant mortality as over 50 percent of the affected area killed by bark beetles.

Bark beetle damage was clustered in a few areas of the state (see map above). The total amount of acreage impacted by bark beetles in 2015 is down 40 percent over 2014. Total precipitation from April through September was slightly lower than average in 2012, 2013, and 2015 for the generally affected areas. It is likely we are seeing bark beetle damage due to these drier-than-normal growing seasons, and infestations could be tapering off as we get further away from the serious drought in 2012.

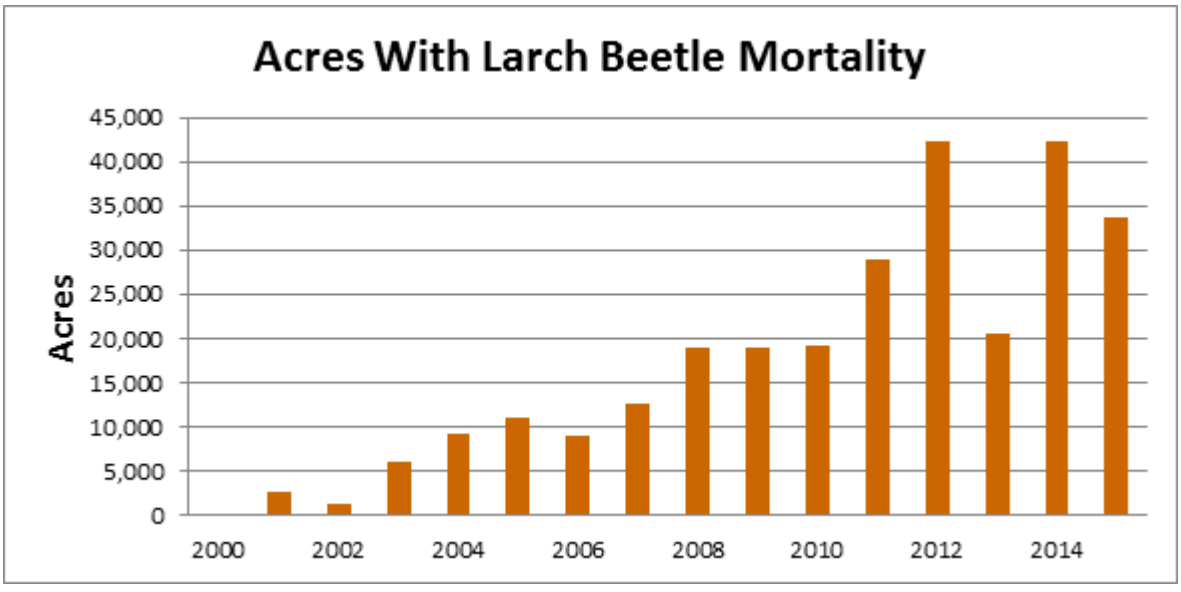
Eastern larch beetle continues its assault on Minnesota's tamaracks

Heavy losses of tamarack due to eastern larch beetle (*Dendroctonus simplex*) continued for the sixteenth consecutive year in Minnesota, primarily in the north-central part of the state (see map, right). Since 2001, aerial surveys have mapped mortality caused by eastern larch beetle on 233,400 acres in Minnesota, 50 percent of which is on state land. This is an underestimate, since damage was not mapped in 2000 and the cause of the mortality was not elucidated in 2001.



Not all the impacted acres are pure tamarack or heavily impacted forest. Our aerial surveyors identify the percentage of trees dying in any given area. In 2015, approximately 12,500 acres of forests affected by eastern larch beetle had over 50 percent of mature trees dying from eastern larch beetle.

Aerial surveyors mapped twenty percent fewer acres of larch beetle damage in 2015 than in 2014 (see chart below), but it's doubtful this is a trend. According to University of Minnesota researchers, the likely reason eastern larch beetle was abundantly active over the last 16 years is because warm springs and summers allowed them to increase the number of generations they produce in a year, increasing their population and adding intolerable pest pressure to tamaracks. It's likely these conditions will continue. We recommend that currently un-infested mature tamarack stands be regenerated before they are infested, aiding in seed production for future regeneration. Fortunately, very young tamarack is not susceptible to eastern larch beetle.



Emerald ash borer

There was a significant increase in the number of known EAB-infested counties in Minnesota during 2015, from six in 2014 to 11 quarantined counties at the end of 2015. This has been particularly notable after a long period with no new EAB finds. The recent expansion of known infested counties is troubling because this pattern of slow growth followed by rapid population growth and spread is a recurring pattern for EAB.

The Minnesota Department of Agriculture (MDA) identified emerald ash borer (EAB) in ash trees on Park Point in the city of Duluth this year. The find was discovered as part of a three-year branch-sampling study the MDA is conducting in partnership with the city. MDA staff found evidence of EAB in four of 35 trees sampled in this way. The trees were lightly infested and did not display any visual symptoms of EAB. The oldest tunneling that could be found on any of the trees was likely from 2014. Due to the unique location of the find, the MDA implemented an emergency state quarantine of Park Point in Duluth.

Emerging emerald ash borer

MDA also conducted a visual survey from January through April in areas considered high-risk for EAB infestation bordering known infested areas. A total of 289 points were visited in the Duluth area, and 16 trees were marked as suspect and re-evaluated at a later date. No EAB-infested trees were found during the survey. Two hundred ten points were visited in the Twin Cities area, and one new EAB infestation was discovered near Lebanon Hills Regional Park RV Campground in Dakota County. This was the first documented occurrence of EAB in Dakota County and the quarantine was expanded as a result. Visual survey was also conducted in southeast Minnesota, and an EAB infestation in Rushford was discovered, resulting in an expansion of the quarantine to Fillmore County.

Four MDA survey staff set 1,196 purple prism traps in 63 counties. Seven EAB adults were trapped in six traps in four counties during 2015. It was the first time EAB infestations were discovered in Chisago and Washington counties and both counties were added to the quarantine.

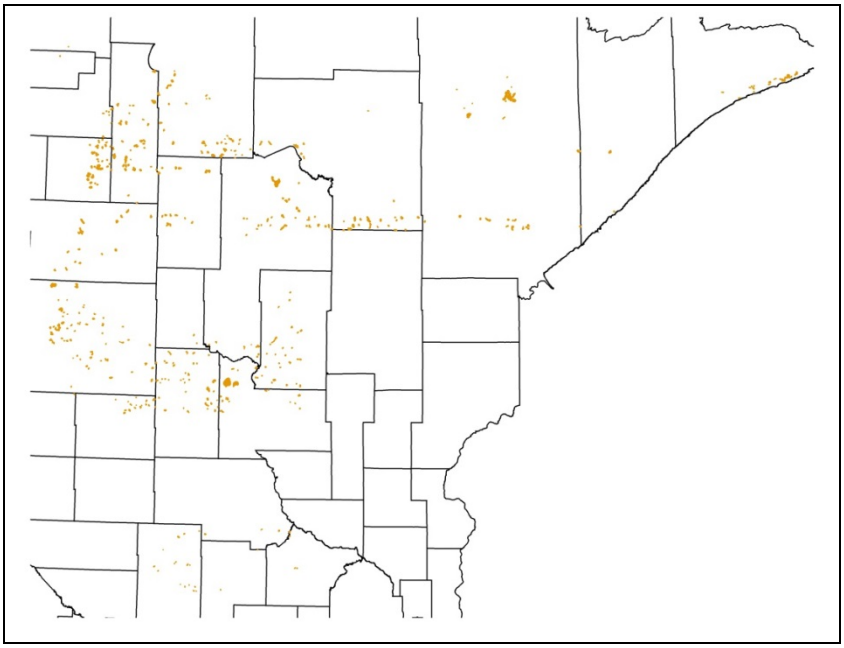
During 2015, MDA released 182,512 parasitoid wasps (151,022 *Tetrastichus planipennisi*; 31,490 *Oobius agrili*) at eleven sites located in the Twin Cities and southeast Minnesota. Of the eleven current sites, seven were in the Twin Cities and four in southeast Minnesota. 2015 marked a significant increase in release numbers from past years, with 5,000 more parasitoid releases than the previous four years combined. Recoveries of *T. planipennisi* continue to be made through branch sampling efforts at Great River Bluffs State Park where releases ended in 2013. Branch sampling efforts in the fall of 2015 resulted in 29 recoveries of *T. planipennisi*, an increase of 24 from the previous year. These finds are significant as this is evidence the parasitoid wasps are attacking EAB, reproducing, increasing in numbers, and able to overwinter successfully in Minnesota.

Forest tent caterpillar

Approximately 205,000 acres were defoliated by forest tent caterpillar (FTC) in 2015. Nearly 70 percent of those acres were labeled with trace levels of defoliation, meaning less than 25 percent of the canopy was eaten. Seventy-five percent of the heavily-impacted forest is on private land in Vermillion Lake Township in north-central St. Louis County. The remainder is in southern Beltrami County (see map below). The amount of defoliation increased by 30 percent from 2014 to 2015, indicating the general population trend is likely increasing (see chart on following page). However, it was still far from any peak typically seen with forest tent caterpillar outbreaks.

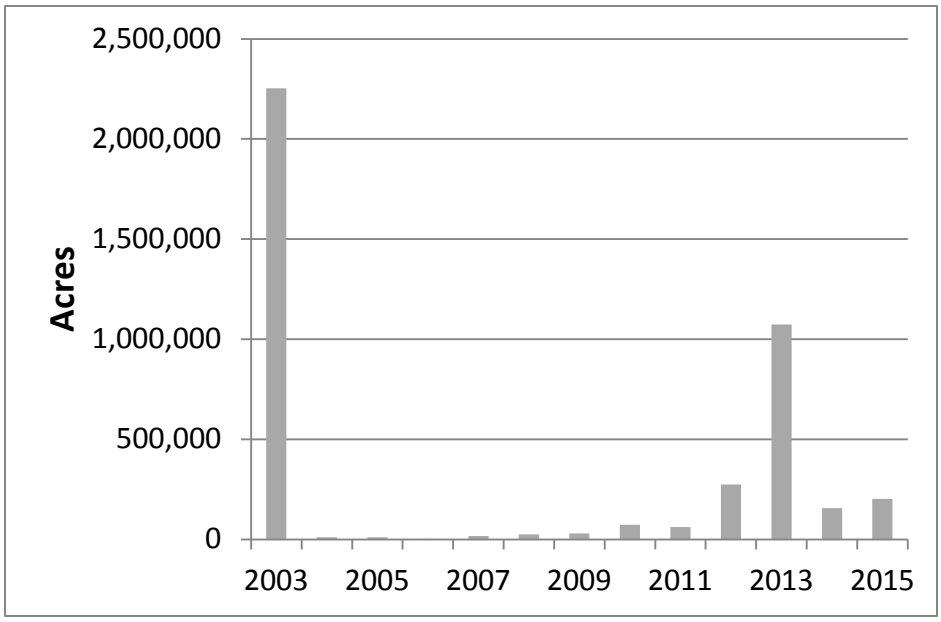
Forest tent caterpillar cocoon

Trembling aspen is the primary species affected by forest tent caterpillar. The loss of 25 percent of leaves or less is not a significant problem for aspen (or deciduous trees in general). About 50,000 acres of forests affected by FTC had more than 50 percent of the canopy eaten. When a deciduous tree loses over half of its leaves early in the growing season it produces a second set of leaves, an energy-intensive process that is stressful to the tree if it happens for several years in a row. Forest tent caterpillar defoliated about 2,000 acres of forest at a moderate or higher severity for the last three years.



In forests managed for timber and pulp production that are approaching typical rotation age, forest managers should consider regenerating stands that have been defoliated by forest tent caterpillar for three or more years in a row. By doing this, they will salvage the value of timber that will otherwise die with additional defoliation or stress such as drought.

Forest tent caterpillar populations can be predicted on a stand level with egg mass surveys. Surveys during the winter of 2014-2015 accurately predicted 2015 FTC defoliation 80 percent of the time. Currently we are not at staffing levels where we can predict FTC populations for 2016.


2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
Acres
2003
2005
2007
2009
2011
2013
2015

Gypsy moth

The Minnesota Department of Agriculture (MDA) captured approximately 1,049 adult gypsy moths this year in traps around the state, up from last year's 523 moths but still a major shift from a 2013 count of over 71,000 moths. Researchers say the 2014 population drop reflected a severe winter, especially in northern Minnesota. However, predictions of a warmer-than-average winter this coming season bring concern that gypsy moth numbers could once again surge. Fluctuating insect populations are not uncommon. Since 2002, MDA trapping data shows gypsy moth numbers have swung up and down across the state.

"Populations often take some time to rebound after drastic crashes such as the one caused by the winter of 2013-14," said Dr. Brian Aukema of the forest insect laboratory at the University of Minnesota. "But while moth populations may be knocked down, they are not knocked out. They have doubled in the past year, for example, and a normal winter will provide the cold requirement egg masses need to hatch in the spring without killing them."

Female gypsy moth and egg mass

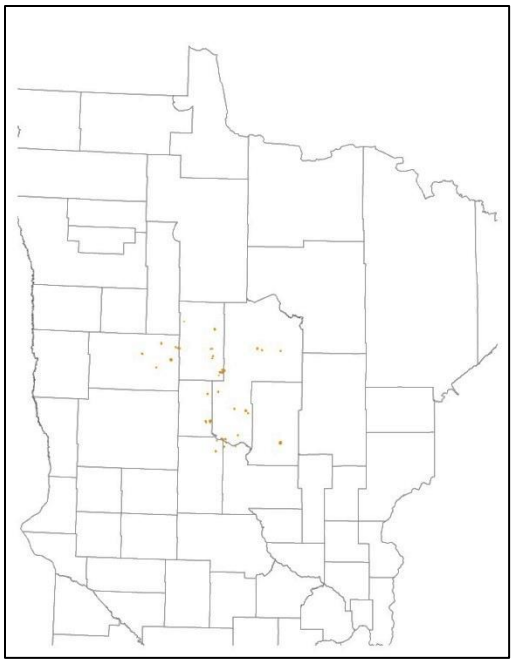
State and federal officials implemented a quarantine of gypsy moth in 2014 for Lake and Cook counties after data showed a low-level reproducing population in the area. The quarantine helps ensure gypsy moths aren't being transported by human activity. Outdoor items in the quarantined counties that could be infested with gypsy moth, such as logs, firewood, camping equipment, and patio furniture must be inspected and certified as gypsy moth-free before moving to a non-quarantined area.

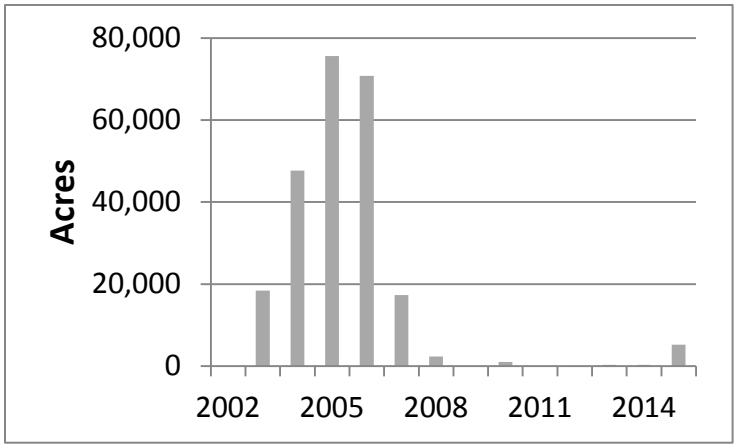
Jack pine budworm on the upswing in western Minnesota

Jack pine budworm heavily defoliated trees in Minnesota's west-central counties in 2015 (see map below). The number of acres of defoliation in 2015 drastically increased from the 2014 total and likely indicates the first year in a multi-year outbreak. In some spots in northwestern Morrison County, budworms consumed all new needles and some 2014 needles. Some of these heavily defoliated jack pines will have dead tops in 2016.

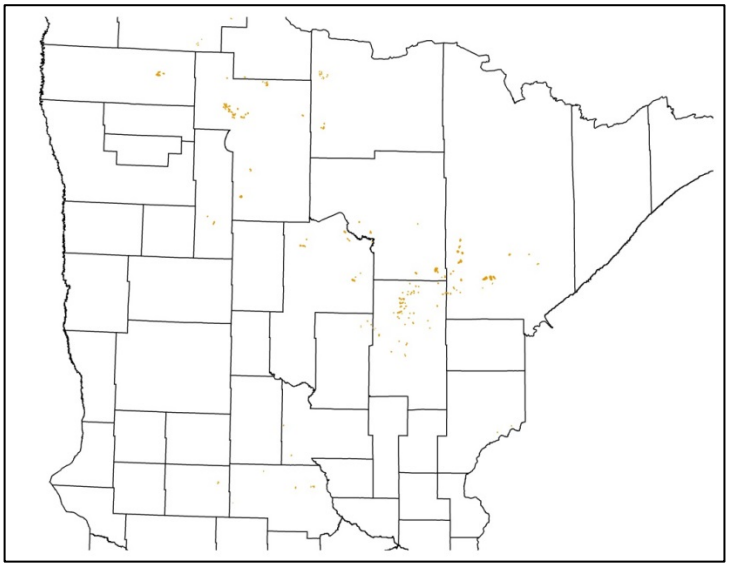
Eighty-five percent of the defoliated areas lie in the ecological subsection called the Pine Moraines and Outwash Plains. The last time this area experienced jack pine budworm defoliation was in 2008. Historically the period between outbreaks is eight years in most of the ecological systems in that subsection. Forest managers can expect most of the defoliated jack pine stands in this part of Minnesota to be further damaged by jack pine budworm for two to three more years. Some stands, particularly those approaching 50 years old, will experience mortality and provide management opportunities for regeneration.

The chart below at right shows the acreage affected by jack pine budworm based on aerial surveys since 2002. The increase in population in 2015 was expected, based on historical population cycles in west-central Minnesota.





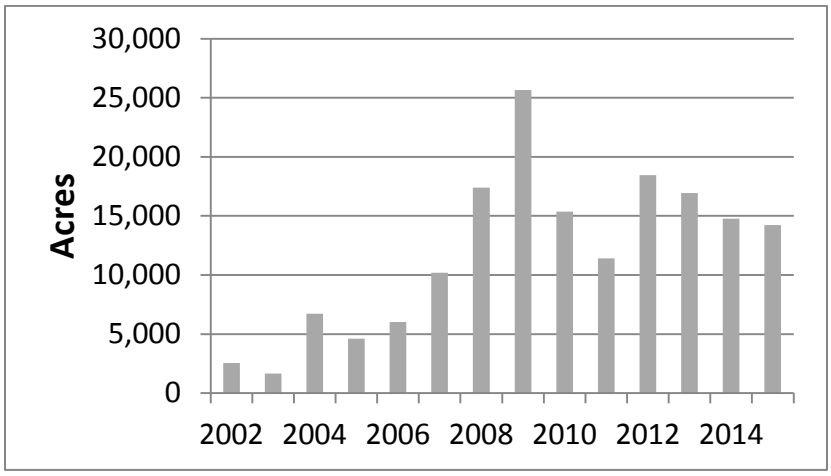
Larch casebearer



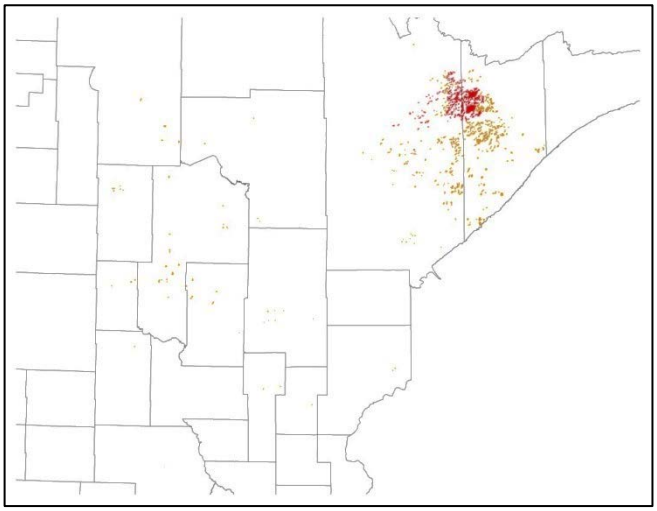
2015 represents the 16th consecutive year where larch casebearer noticeably defoliated tamaracks in Minnesota. About 70 percent of the 2015 defoliation was in Beltrami, Aitkin, and southwest St. Louis counties (see map, right). The total amount and locations of larch casebearer defoliation this year was nearly identical to that of 2014. About 20 percent of this defoliated acreage was defoliated by larch casebearer for the last four years.

If a tamarack loses a large percentage of its needles from feeding in the early summer, it will produce a second flush of foliage. That is an energy-demanding process, but tamaracks can produce a second flush for a number of consecutive years. About 1000 acres of tamarack heavily affected by larch casebearer in 2015 were also heavily impacted in 2014. These areas are in eastern Marshall and southwestern Koochiching counties. Any such stands near typical rotation ages would ideally be set up for a regeneration harvest, since they are weakened by defoliation and threatened by impending eastern larch beetle infestation.

The chart below illustrates acres of defoliation by larch casebearer from 2000 to 2015.



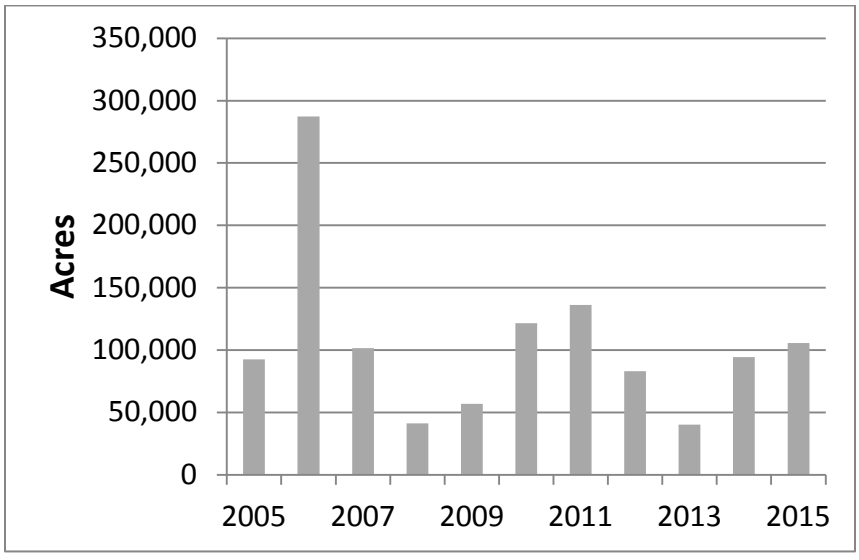
Spruce budworm



Defoliation by spruce budworm has been mapped in northeast Minnesota since 1954, and 2015 was not an exception. Almost 95 percent of the 105,520 acres of defoliation by spruce budworm was in Lake and St. Louis counties, as it was in 2014. Areas shown in red on the map at right represent defoliated spruce and fir plus trees that died from previous defoliation. Areas in orange show only defoliated trees. Mortality from past defoliation was noted on 45 percent of the impacted acreage in 2015, and approximately 15 percent of the 2015 acreage was defoliated by spruce budworm in each of the last six years. The total amount of defoliation in 2015 was up about 10 percent over that in 2014, and the same area will likely experience significant defoliation next year.

Since 2014, the heaviest area of spruce budworm activity has been southeast of Ely in west-central Lake County (Stony River Township). Managers should expect spruce budworm to be in this area for about eight years. The majority of mature balsam firs will die eventually from repeated defoliation. Mortality in a given spruce-fir stand will not begin until the new shoots of firs have been significantly defoliated for about 5 years in a row. This predictable mortality suggests timber managers should start establishing regeneration harvests in the area's spruce-fir stands to capture timber value before it diminishes due to projected mortality.

The chart below illustrates acres of spruce budworm since 2005 based on aerial survey data.



White-spotted sawyers abundant in northwestern Minnesota

At the end of June and early July 2015, concerned citizens made a rash of calls to the DNR reporting unprecedented and annoying numbers of longhorned beetles. Most reports came from Roseau County, but these beetles were noticeably abundant in Park Rapids too. Photographs provided by callers showed at least some of these longhorned beetles were white-spotted sawyers (*Monochamus scutellatus scutellatus,* photo at right). A widespread event creating abundant freshly-killed or stressed conifers in 2013 or early 2014 could have promoted numbers of white-spotted sawyers; the eastern larch beetle outbreak has certainly produced large amounts of stressed and dead tamarack and could have produced the abundant food necessary for a build-up of white-spotted sawyers. Alternatively, a winter storm sometime from 2013 to 2014 may have damaged conifers widely to provide abundant food for the beetles.

White-spotted sawyer photo by W. Ciesla, Forest Health Management International, Bugwood.org

White-spotted sawyer larvae feed in recently-killed or dying conifer trunks and limbs, and they mature in one or two years. Adult white-spotted sawyers may feed on conifer shoots, which can kill the tips of the branches. This feeding damage is almost never a problem for mature trees. In past years, abundant branch flagging from this feeding has been reported, but no such reports were made in 2015.

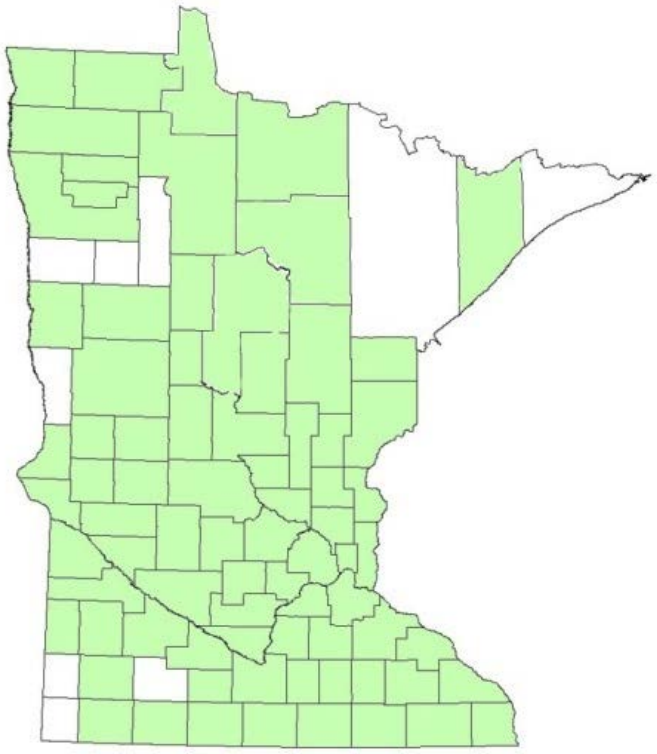
Diseases

Bur oak blight has another banner year

Bur oak blight (BOB) is a common native disease of bur oak over most of its range in Minnesota. In 2015, the U.S. Forest Service confirmed BOB for the first time in Cass, Itasca, and Lake of the Woods counties, leaving just nine of 87 counties unconfirmed (see map, next page). In some areas of the state, BOB appears to be causing severe symptoms on a noticeable portion of the bur oak population. Severe symptoms include more than 60 percent premature leaf-drop, scattered production of a second set of leaves, abundant epicormic sprout development, and dieback. Severe symptoms appear after at least five consecutive years of heavy leaf infection. DNR staff noticed heavily impacted areas around St. Cloud and Albert Lea; there are likely other areas in the state where a noticeable percentage of bur oaks are showing severe symptoms of BOB, particularly those growing on the forest edges.

There are other areas in Minnesota with little visible damage from BOB. Even in areas sustaining abundant disease, many bur oaks were minimally impacted. Forest and savannah managers should preserve bur oaks that do not appear infected in heavily impacted landscapes. Ornamental bur oak owners and managers should know that a given bur oak can tolerate heavy infection for several consecutive years before the tree becomes weakened and susceptible to other disease and insect problems. Bur oak blight can be successfully managed in healthy bur oaks as the city of Hutchinson and Iowa State University demonstrated in a 2013 study. In theory, control can be achieved on city trees with injections once every several years.

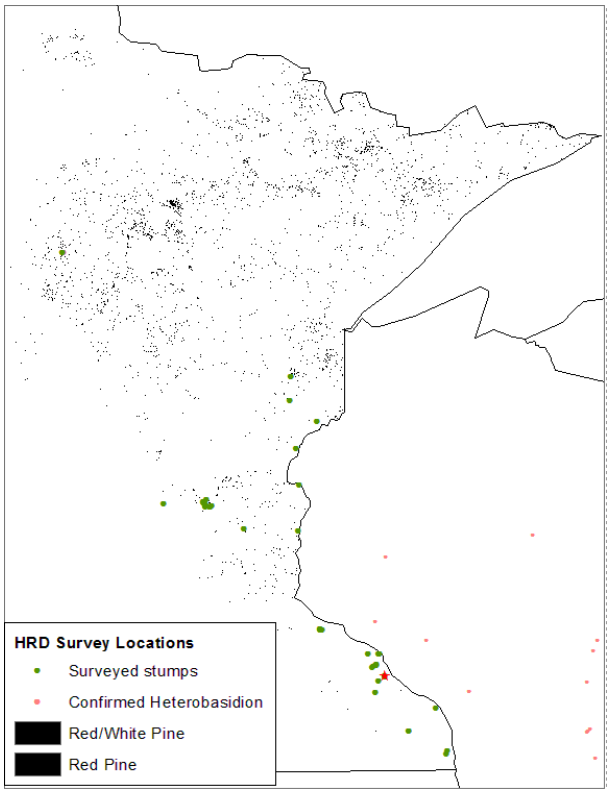
The impact of BOB to Minnesota's bur oak resource is unknown. As long as Minnesota continues to have above-average precipitation during leaf emergence in the spring, the disease will probably continue to weaken many of the state's bur oaks. To better understand the tolerance bur oak has to BOB, DNR Forest Health has established long-term monitoring plots at Sibley State Park and Sand Dunes State Forest. As shown in the photos below of a bur oak in Sibley State Park, bur oaks can tolerate heavy leaf loss for at least two years in a row (and likely many more). The photo at left was taken in 2014; the photo on the right was from 2015.



Minnesota counties confirmed with bur oak blight

Heterobasidion root disease

Heterobasidion root disease (HRD) was first confirmed in Minnesota in 2014 (see map below: green dots represent areas surveyed in 2015; the red star in the southeast corner is the only confirmed location of HRD in Minnesota; black specks are susceptible pine forests). It is a root disease that kills pine, balsam fir, spruce, and eastern red cedar. It is most devastating on sandy soils in plantations that have been thinned. The disease enters a plantation when spores land on and infect freshly cut stumps. Once at a site, HRD remains for decades in decaying stumps and roots, killing a portion of susceptible seedlings and saplings regenerating on the site.



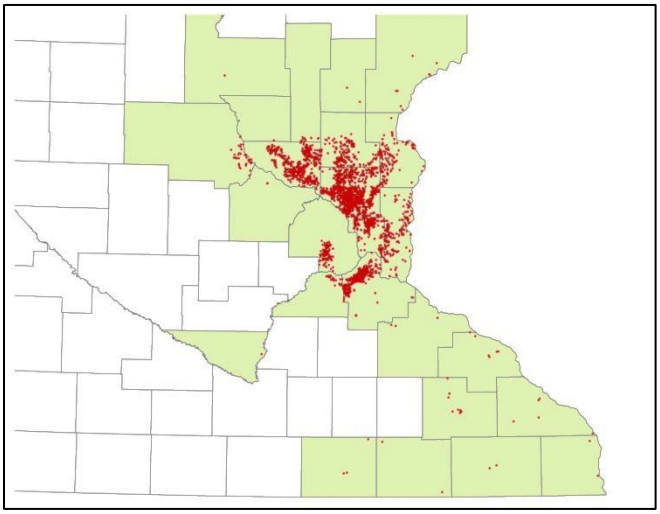
The DNR, University of Minnesota (UM), and University of Wisconsin (UW) surveyed for this disease in 2015 over a large part of Minnesota using three techniques. No additional confirmed locations of the disease were found in 2015. A confirmed HRD location requires discovery of the fruiting body (conk) or a successful Heterobasidion culture isolated from tree tissue.

We did not find additional locations of the disease, but some concerning findings arose from these surveys. One concern was the UW study (unpublished) showed many infective spores of *Heterobasidion* were in the air at four sites in Goodhue, Wabasha, and Winona counties. Since the survey implied that infective spores are present throughout much of southeast Minnesota, we recommend that land managers prevent HRD during thinning in southeast Minnesota if they desire to preserve pines or grow pines in the future on a current plantation site. See our forest health webpage to learn how to prevent this disease. On state land in southeast Minnesota, we are currently not preventing *Heterobasidion* since most if not all current pine plantations will be converted to more natural forest cover types (i.e., deciduous trees) in the future, which are not susceptible to HRD.

In addition to the surveys, DNR forest health staff created an informational webpage on HRD, including an identification guide for foresters. We also wrote an outreach article about HRD and delivered several trainings on HRD status, identification, and prevention to forest managers.

Oak wilt creeps north

Oak wilt is a non-native, fatal disease to all oak species in Minnesota. It was first discovered in Minnesota around 1940 in the Twin Cities area and has been spreading naturally and with the help of humans ever since.



Oak wilt was confirmed in two previously unconfirmed counties in Minnesota in 2015: Morrison and Mower (see map at right: red dots are confirmed oak wilt from 1987 through 2015; shaded counties have oak wilt confirmations). The Morrison Co. oak wilt center has been there for at least two years. It's concerning as it is part of 2,500 acres of nearly continuous red oak canopy into which houses have recently been built and where two-lined chestnut borer is causing significant dieback and mortality. A two-lined chestnut borer infestation in the landscape camouflages oak wilt symptoms well. There are ample populations of two-lined chestnut borer in northern Morrison and southern Crow Wing counties, so oak wilt could be in those locations for several years without detection.

There were several other noteworthy oak wilt confirmations in Minnesota in 2015:

- Oak wilt was confirmed in Pine Co. north of State Highway 48. One of these oak wilt centers covered a half-acre, an indication that oak wilt had been in this part of Pine County for several years.
- A visual oak wilt confirmation by DNR staff was made in Kanabec County about six miles farther north than the previously confirmed spot in that county. Fortunately, it is not greatly threatening as it was on a bur oak in a city with ample tree species diversity.
- Oak wilt was confirmed in a bur oak forest in Myre Big Island State Park in Freeborn County. Large mortality centers and lots of dead oaks indicated oak wilt had been causing substantial mortality in the park for several years.
- There is little documentation of oak wilt severely impacting white oaks. Oak wilt was found causing substantial dieback and mortality in a cluster of 15 white oaks north of La Crescent.

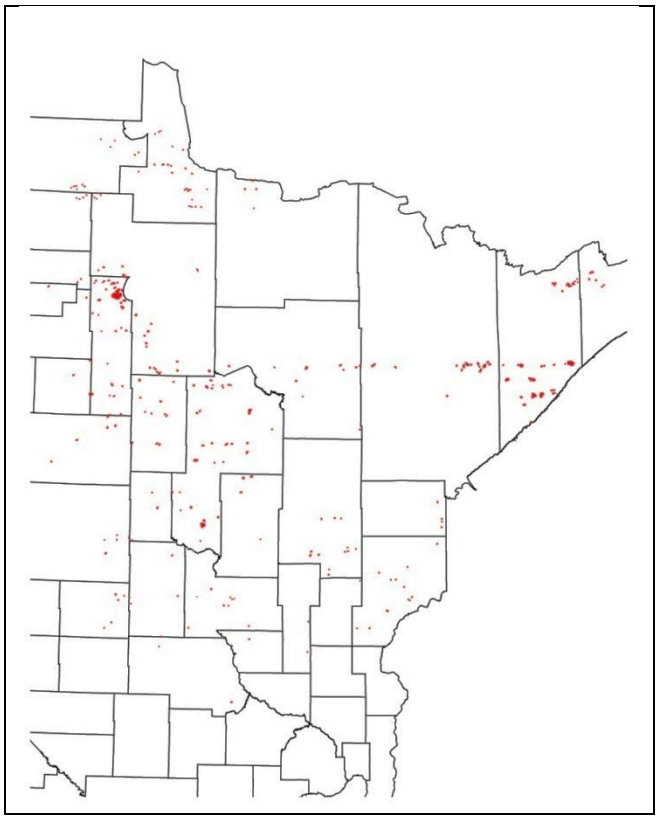
White oak with oak wilt

Environmental stress agents

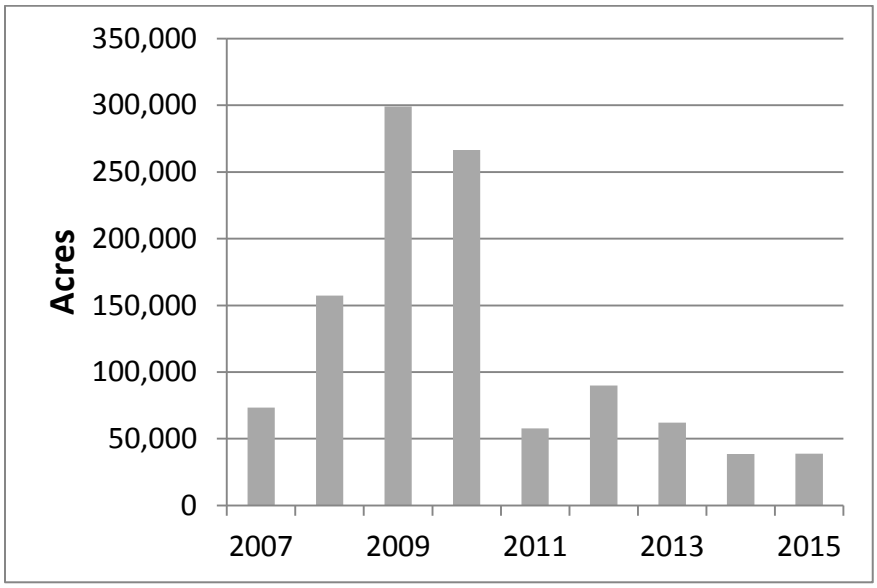
Aspen and birch decline

Decline in aspen and birch is usually caused by a combination of stressors such as drought, insect pests, and diseases in trees that are already under stress from unfavorable site conditions or old age.

Symptoms of decline include stunted leaves, dying twigs, dying limbs, and dead trees. Decline in aspen crowns is reversible with abundant rainfall. The amount of aspen and birch decline and locations impacted (see map, right) were about the same in 2015 as in 2014. Aspen makes up roughly 85 percent of this area on state lands, and the remaining acreage is birch.

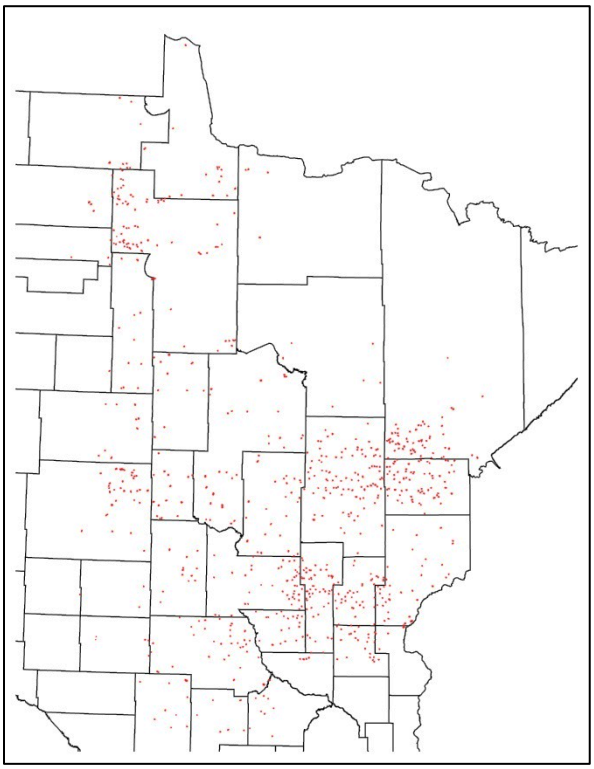


The chart below shows the number of acres with declining aspen and birch based on aerial surveys since 2007.

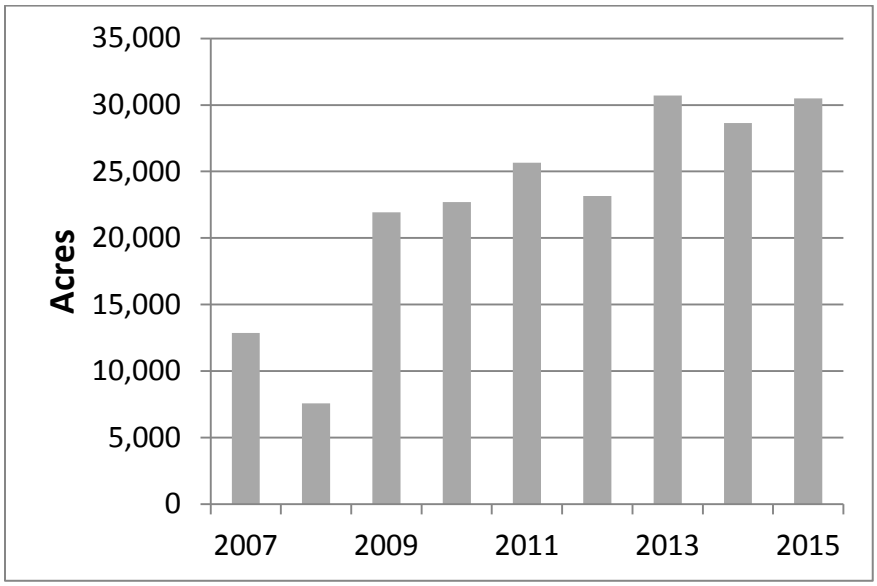


Black ash decline

Decline in black ash is common on trees growing in extremely wet conditions, and is caused by a combination of weather events, insect pests, and diseases. Symptoms include stunted leaves, dying twigs, dying limbs, epicormics shoots, and dead trees. The 30,480 acres of black ash decline and locations impacted (see map, right) were roughly the same in 2015 as in 2014 and 2013. Black ash decline is so common in the northern two-thirds of Minnesota that early detection of emerald ash borer (EAB) in rural black ash swamps will be almost impossible. Only after EAB has been in a black ash swamp for many years will it become apparent through aerial surveys that EAB is present.

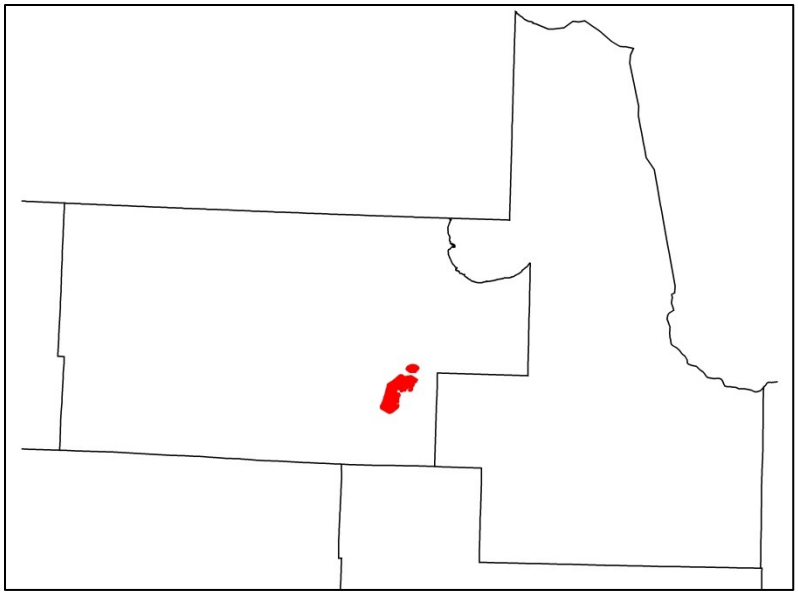


The chart below shows acres of black ash decline from 2007 to the present.



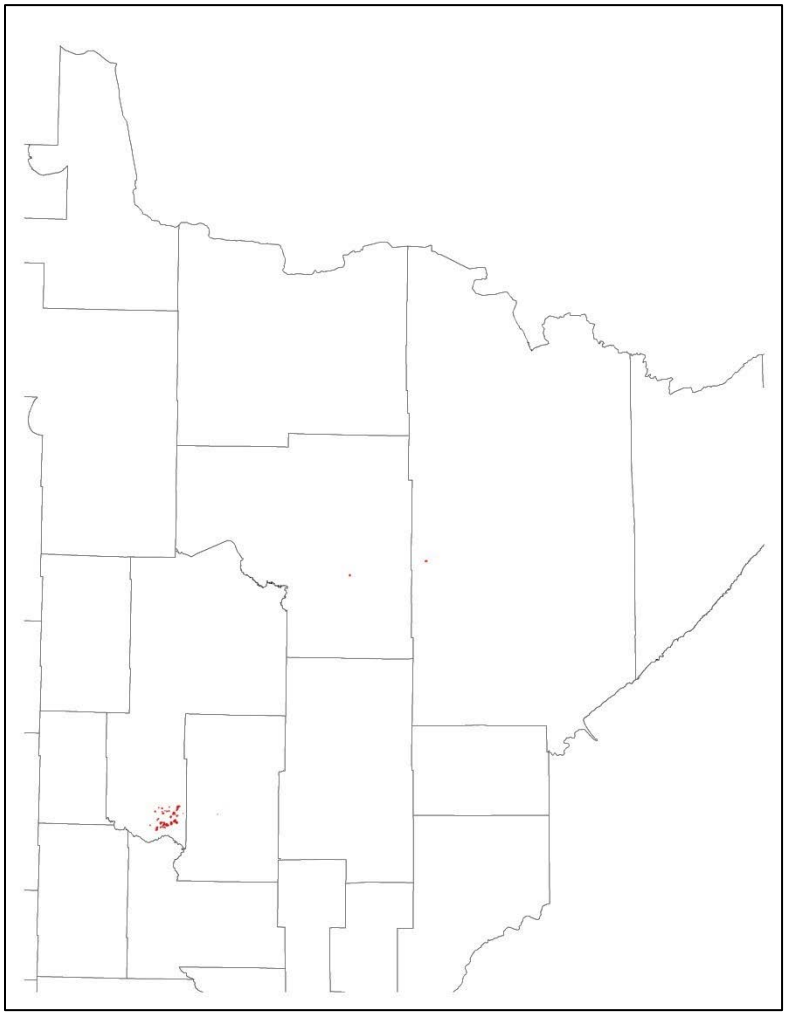
Fire damage

The Palsburg fire burned 4,550 acres in Roseau County in April (see map below). This fire started from a slash pile burned the previous autumn that escaped with weather conditions favoring fire. Unsalvaged, damaged pine could provide a large food source for population growth of the white-spotted sawyer (already abundant in the area) and pine engraver in 2016.



Wind damage

Large hail and straight-line winds likely reaching more than 100 miles per hour significantly damaged 3,320 acres of forest in far southern Cass Co. in early July (see map below). This storm was responsible for 95 percent of the wind damage mapped from the air by the DNR. Oaks weakened by this storm that weren't removed could be targets of attack in 2016 by local populations of two-lined chestnut borer, whose damage was noticeable before the wind event.

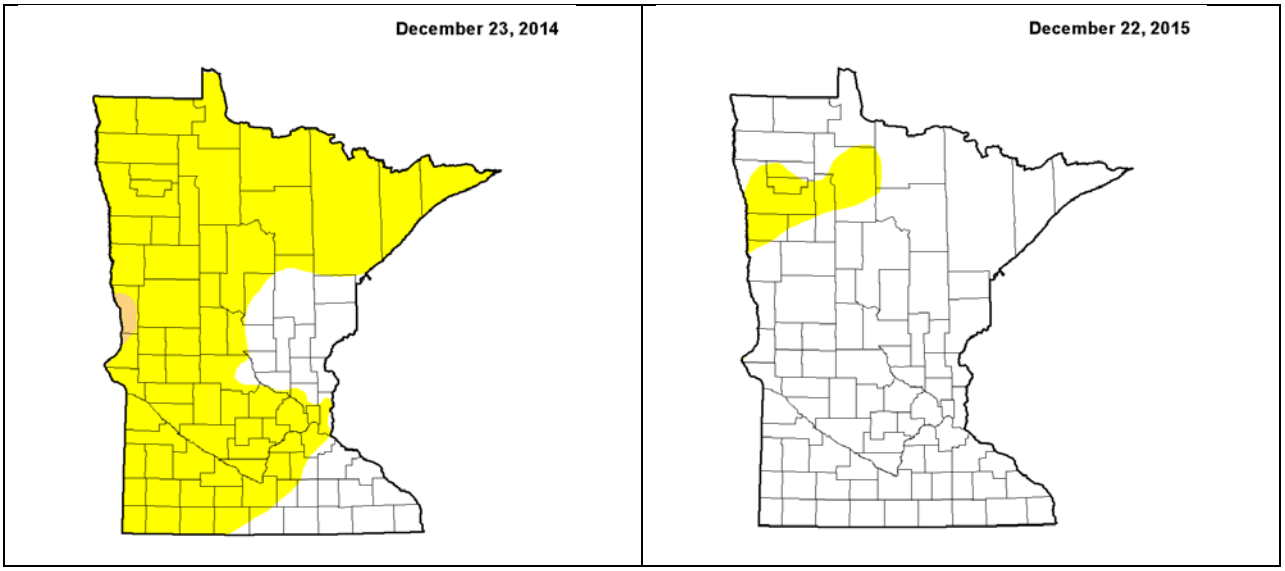


Drought

As of April 2015, Minnesota was still "abnormally dry" over much of the state (left, below), due to a dry 2014 autumn, below-average snowfall during the 2014-2015 winter, and a dry spring. Only Wilkin County was placed in the drought category. During May, however, precipitation totals were above historical averages across most of the state, ending a dry pattern originating in mid-summer 2014 and continuing into early spring 2015. In some communities the precipitation totals were one to three inches above historical average. Only a small portion of northern Minnesota was placed in the drought category in May.

In July, no counties in Minnesota fell into the drought category and only a few in the northwest were in the "abnormally dry" category (below right); that trend continued through November. In November, precipitation totals were again above average over most of the state. Preliminary data indicate that state-averaged precipitation totals for November will rank among the 10 wettest on record. Autumn, 2015 will also rank among the warmest ever.

Climate information comes from the HydroClim Minnesota newsletter published by the DNR State Climatology office. Maps are taken from US Drought Monitor from December 23, 2014 and December 22, 2015.



Trees stressed by abundant seed production

Scattered silver and red maples and Siberian elms across a large geographical area produced an immense seed crop in 2015, leaving them partially leafless with dead branches. This phenomenon occurred from Minnesota to at least Ohio on silver maples. Though no one knows what caused this widespread seed production, it is known that some of the silver maples in the Twin Cities area that produced the most seed were stressed in recent years from physical root damage. That stress may have contributed to abundant seed production. Some branches died because the individual tree put all growth into flower buds and not vegetative buds. Some of their canopies will look sparse for a few years. They will be stressed while recovering the amount of leaves they normally have, but almost all the affected trees should survive.

The photo below left shows a silver maple in St. Paul in June after immense seed production. The same tree is shown on the right in October; some canopy has died. The tree sustained significant root damage in 2013.

Phenology of tree pests and tree health events in 2015

Date	Pest or Event	Pest Stage or Cause	County
April 16	white pine blister rust	aecial blisters	Sherburne
May 5	*Ips* species	adult females laying eggs	Wabasha
May 5	pine bark adelgids	eggs	Wabasha
May 11	oak wilt	fresh spore mats	Ramsey
May 13	*Ips* species	adult females laying eggs	Houston
May 16	forest tent caterpillar	early instar caterpillars	Itasca
May 26-27	sudden ash leaflet drop	anthracnose (likely)	Dakota, Fillmore, Isanti, Kanabec, Kandiyohi, Morrison, Sherburne
May 28	June beetles	adults	Dakota
June 2	Lecanium scale	adult females	Kandiyohi, Meeker, Wright
June 3	tortricid defoliator on black locust	caterpillars	Ramsey
June 5	tortricid defoliator on black locust	caterpillars	Kanabec
June 9	*Ips* species	pupae	Pine
June 9	jack pine budworm	second or third instars	Pine
June 10	forest tent caterpillar	later instars (1-1 ½ inches)	Pine
June 11	forest tent caterpillar	later instars	Becker
June 15	forest tent caterpillar	later instars	Crow Wing
June 18	spruce budworm	later instars (½-¾ inches)	St. Louis
June 29	bur oak blight	leaf vein and tissue death	Benton
June 30	white-spotted sawyer	adults	Roseau
June 30	giant ichneumon wasp	adults mating and laying eggs	Ramsey
July 1	forest tent caterpillar	pupae	Pine
July 2	white-spotted sawyer	adults	Hubbard
July 13	forest tent caterpillar	adults	Itasca
July 30	hickory bark beetle	female adults laying eggs	Mower
August 3	fall webworm	caterpillars	Ramsey
Sept. 1	giant ichneumon wasp	adults	Steele
Sept. 1	oak wilt	spore mats	Freeborn
Dec. 3	leaf emergence from a boxelder	above-average autumn temperatures	Houston
Dec. 14	leaf emergence from an elderberry	above-average autumn temperatures	Sherburne
Dec. 21	leaf emergence from honeysuckles	above-average autumn temperatures	Kanabec, Ramsey

Terrestrial Invasive Species Program

Terrestrial Invasive Species Program Update, 2015

Prior to 2015, the terrestrial invasive species (TIS) program consisted of a single position with limited funding for field projects. In 2015, annual work plan targets were established for all areas for invasive species survey work and management practices. Also in 2015, program leads were identified for each of the areas and regions. The resulting structure resembles other forestry program such as the roads, timber and silviculture programs. Being new to everyone, 2015 was a year of exploration and learning.

As directed by the Director's Management Team (DMT), field staff are to incorporate invasive species survey work into their normal work load, meaning that whenever they are in the field they are to be watching for invasive species. However, the most opportune times are during regeneration checks done from the ground, summer stand exams and native plant community mapping. So these three activities are the basis of the acres associated with the annual TIS survey work targets.

None of the existing forestry data management systems had previously been adapted for reporting invasive species work. So a program enhancement was approved for the Silviculture and Roads Module (SRM) of the FORest Information System Technology (FORIST) software. While those software upgrades are taking place, a manual system of tracking and reporting area accomplishments was devised. The first area accomplishments were reported in September, 2015. Eleven of fifteen areas reported having surveyed more than their work target. See table 1.

Funding for management projects was through general fund grants administered by the Division of Ecological and Water Resources (EWR), state Fish and Game funds administered by the Division of Forestry (FOR) and unexpected payroll savings in FOR general funds. Seven area projects totaling $35,000 were funded by EWR in addition to a $13,000 contribution to the outreach campaign PlayCleanGo managed by FOR. Buckthorn management took most of the dollars allocated to the areas, with wild parsnip taking the rest. FOR funds covered approximately $62,000 in expenses, mostly going to buckthorn control, or equipment and supplies for in-house treatment operations. Even so, all but two areas reported treating considerably less than their annual treatment work target. See table 2.

Several lessons were learned in this first year of accomplishment reporting. The survey results suggest the areas reported acres for field work completed at other times of year, when many invasive species are not be visible and are generally not being reported. The treatment results suggest the division could do a better job of tracking TIS treatment projects and related expenses. The treatment results also suggest the areas could use more help in implementing needed TIS treatment practices.

Given the number of staff members new to invasive species management a series of regional workshops were organized and presented in December, 2015. Each workshop had 20 or more participants and were well received. Based on participant feedback, the chemical update, and discussion of program roles, responsibilities and funding were the most informative. In the future, participations would like more information on management strategies in cases where sites conditions limit treatment options and success.

In 2016, all guiding documents will be updated. The SRM enhancements will be complete so all accomplishments will be reported through SRM. For occurrence data, the Department will be switching to an on-line data management service, EDDmaps. In response, the program will shift to using tablets to report TIS occurrences. Developing a new program manual will be the third major 2016 project undertaken to support statewide invasive species management on state forest land.

TABLE 1			Survey Method or Activity During TIS Survey								
Area	Annual Work Target in Acres	% of Target Completed	NPC	Regen plot	Regen ocular	Stand exam	Other	Total Acres Surveyed	Numer of Observations Reported	Infested Acres Reported	Other survey methods used
Bemidji	1533	986	3000			5710	6413	15123			stand inventory
Warroad	1656	6					103	103	7	180	rd work
Baudette	1193	164		1802		154	0	1956	9	38.6	rd work
Backus	692	117		16.1		795.9		812	0	0	
Park Rapids	1009	453	40	404		390	3736	4570	31	189	stand inventory
Region 1 Totals	**6083**	**371**						**22564**	**47**	**407.6**	
Deer River	944	665	1353	639	765	2059	1465	6281	0	0	
Aitkin	1327	20		269.5				269.5	0	0	
Hibbing	704	107		680		76		756	3	8	
Tower	1116	501	1080	3490	140	881		5591	2	0.5	
Cloquet	717	26				149	40	189	7.3	27	rd work
Two Harbors	1367	179		540	85	1201	626	2452	9	6	NPC & regen
Little Folks	1241	242	3009					3009	5	26.5	
Region 2 Totals	**7416**	**250**						**18547.5**	**26.3**	**68**	
Little Falls	443	146				598	50	648	0	211	timber sale
Lewiston	407	5					19	19	3	5	I&D or inventory
Sandstone	933	1128	2431	467		2682	4947	10527	0	0	stand inventory
Region 3 Totals	**1783**	**628**						**11194**	**3**	**216**	
State Totals	**15282**	**342**	**10913**	**8307.6**	**990**	**14695.9**	**17399**	**52306**	**76**	**692**	

TABLE 2					Treatment Costs				
Area	Trtmt Targets (5% of surv) in acres	Herb vs Woody Spp	Acres Treated	% of Trtmt Target Completed	Contract (in-house work not incl)	Supplies	Equip	Cost	Ave cost per acre reported
Bemidji	77		0	0				$ -	
Warroad	82.8	Herb	49.1	59	$ 7,150.50			$ 7,150.50	$ 145.63
Baudette	59.65	Herb	37.6	63	$ 2,800.00			$ 2,800.00	$ 74.47
Backus	34.6		0	0				$ -	
Park Rapids	50.45	Woody	17	34		$2,663.93		$ 2,663.93	$ 156.70
Region 1 Totals	**304.5**		**103.7**	**34**				**$12,614.43**	**$ 121.64**
Deer River	47.2		0	0				$ -	
Aitkin	66.35	Herb	19.8	30	$ 973.90	$ 294.71		$ 1,268.61	$ 64.07
Hibbing	35.2	Herb	3	9	$ -			$ -	$ -
Tower	55.8		0	0				$ -	
Cloquet	35.85	Herb	7	20		$ 115.00		$ 115.00	$ 16.43
Two Harbors	68.35		0	0				$ -	
Littlefork	62.05	Herb	54.35	88		$3,212.51		$ 3,212.51	$ 59.11
Littlefork							$3,981.09		
Region 2 Totals	**370.8**		**84.15**	**23**				**$ 4,596.12**	**$ 54.62**
Little Falls	22.15		89	402	$ 528.00	$2,639.00	$ 315.00	$ 3,482.00	$ 39.12
Lewiston	20.35		127	624	$ 26,659.73	$ 828.52	$ 336.60	$27,824.85	$ 219.09
Sandstone	47		0	0				$ -	
Region 3 Totals	**89.5**		**216**	**241**				**$35,902.97**	**$ 166.22**
State Totals	**765**		**404**	**53**	**38112**	**$9,753.67**	**$4,632.69**	**$53,113.52**	**$ 131.52**

Addressing the Leading Edge of Buckthorn Invasion

Forest Service Grant Number: 12-DG-11420004-185

Final Report

I Project Overview (from original grant application):

The invasive plant, common buckthorn (*Rhamnus carthartica)*, has been in Minnesota for over one-hundred and fifty years. During that time it has spread into many of the state's forests, pushing out native species, reducing forest regeneration by competing for space and nutrients, contributing to soil erosion and helping spread certain pests and pathogens. Detecting and mapping buckthorn in a timely and cost effective way is essential to the effort to slow its spread and mitigate its negative effects in high value forests.

Over the past four years, Minnesota Department of Natural Resources (MNDNR) Division of Forestry (DoF) has developed and tested an aerial detection method that has been found effective for mapping the existence of buckthorn by taking advantage of the fact that buckthorn leaves remain bright green and attached to branches for one to two weeks after most over story species have dropped their leaves. Aerial photos at relatively small scales can then be acquired and interpreted for buckthorn. The interpreted detail is then transferred to an ortho-rectified photo which provides both a photo image and an accurate map of buckthorn location suitable for navigation in the forest to locate and remove the invasive buckthorn plants. Once confirmed, survey results can be incorporated into a set of shape files shared with partners through the MNDNR's data deli.

This project aims to utilize those methods to describe the leading edge of buckthorn invasive. With that data, we propose to identify infestations along the leading edge where treatment success is likely and slowing the spread of invasive is possible. A combination of state and private funds would be used to implement management practices.

II Accomplishments

Goal 1

Planned: Fly over roughly 600,000 acres and take true color photography at a 1:22,000 scale; print stereo paired photographs and interpret the photos for possible buckthorn infestations; digitize the mapped polygons and share the data with resource managers.

Actual: 591,024 acres were flown and photographed; 637 polygons were mapped; photographs and shape files were shared with resource managers. An additional 95,000 acres were flown as part of the state Conservation Partnership project managed by the MNDNR Fish and Wildlife Division (FAW), part of our state match. Those figures are not included in the unit costs. **See Map 1.**

Unit Costs: $.147/acre or $87,000.00 total.

Goal 2

Planned: With matching dollars, visit and verify the status (ground-truth) of a sub-set of the mapped polygons to verify the presence/absence of buckthorn and to estimate the rate of accuracy.

Actual: 180 polygons with a total of 145 acres were ground-truthed. Sixty nine percent of the mapped polygons (or 124 of 180 sites) were plants other than buckthorn, i.e. false positives. See Tables 2 and 3 below. Most of the mapped polygons from the state FAW project have not yet been ground-truthed, and are not included in the unit costs. **See Tables 1 and 2.**

Unit Costs: $186.19/acre or $26,998.24 total.

Goal 3

Planned: With matching dollars, identify infested sites of high priority and treat as many of them as possible.

Actual: 1,704 acres were treated using state funds. Field costs, including treatments completed within the state FAW project, are included in unit costs.

Unit Costs: $105.77/acre or $180,072.02 in matching funds.

Goal 4

Planned: Use the data gathered to describe the distribution of buckthorn along the leading edge of invasion.

Actual: Included.

Unit Costs: Included.

III Difficulties Encountered:

Goal 2:

Ground-truth a sub-set of the mapped polygons to verify the presence/absence of buckthorn and to estimate the rate of accuracy

Problem: Previous aerial detection projects had been south and east of this project area. As we expanded our detection efforts, we ran into more and more false positives – meaning other plants, mostly native, were holding their leaves into the flight window, confounding our efforts to interpret the stereo paired photographs.

Resolution: All of the lowland forests we visited were false positives, so we deleted the remaining lowland forest sites from our list of sites to be ground-truthed. While common buckthorn is not likely to be present in these stands, glossy buckthorn could be. So there is a chance that we failed to detect some populations of glossy buckthorn.

Goal 3:

Identify infested sites of high priority and treat as many of them as possible.

Problem: The intention was to treat as many of the infested acres as possible in the fall of 2014 and 2015. Division of Forestry intentions were side-tracked by several severe weather events. The extreme winter of 2013-2014 kept loggers out of the woods resulting in a severe shortage of wood for mills and firewood vendors. That spring, a special project was initiated to rapidly mark and sell a large volume of aspen to keep the mills open. The flood in June 2014 produced $32M in damage and a state of emergency in 35 or 87 Minnesota counties. The intense 2015 fire season usurped field time for other projects, as did the other two events mentioned

Resolution: To come up with sufficient state matching funds, the project had to utilize other sources of funding, not previously considered. General funds administered by the MNDNR Ecological and Water Resources paid for buckthorn work in the project area on state forests, wildlife areas and Scientific and Natural Areas. The state Conservation Partnership grant managed by FAW paid for buckthorn work on several additional wildlife management areas. **See Table 3.**

Goal 4:

Use the data gathered to describe the distribution of buckthorn along the leading edge of invasion.

Problem: In gathering the resource managers together at the end of the first year, it became clear that our existing occurrence data was incomplete. So while the existing data suggested a clear zone of advancing invasion, population densities were more variable than suggested.

Resolution: State management units to be flown the first year were selected based on the perceived front of buckthorn invasion. State management units to be flown the second year were more scattered to cover a broader range of native plant communities and soil types in that "zone of invasion" in an attempt to identify possible interactions. While the data suggestions a possible interaction (some soil types appeared to have much less buckthorn), more research is needed to describe what the interaction might be.

IV Activity Anticipated for Next Reporting Period

None, this is the final report for this grant project.

Map 1. Buckthorn Detection Project Area, 2012-2015

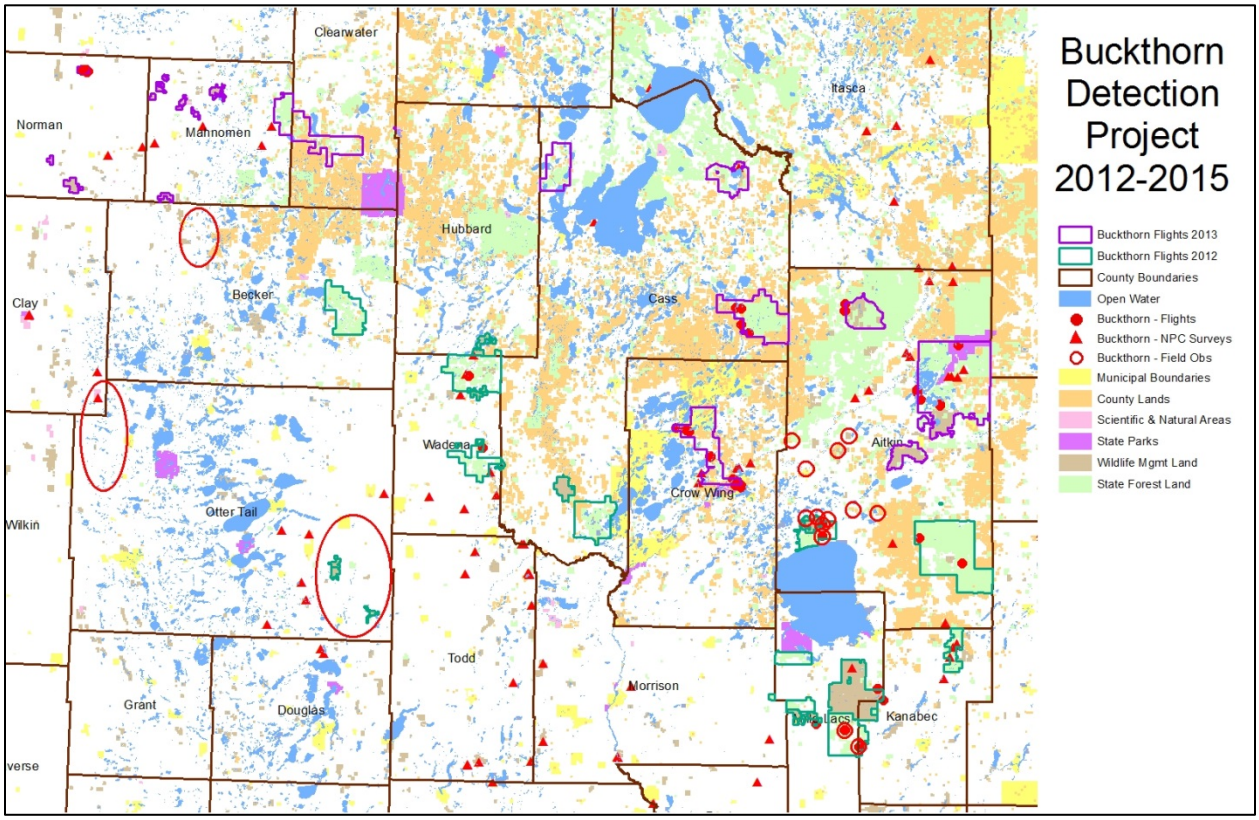


Table 1. Number of Suspected Infestations Mapped Using Aerial Photography

Mgmt. Area	Not Verified	False Positives	Infested	Area Total
Aitkin	190	76	38	304
Bemidji	8	3		11
Cambridge	225	16	6	47
Cloquet	1 (+1 FAW*)		(+1 FAW*)	1 (+2 FAW*)
Detroit Lakes	144	17	9	170
Fergus Falls	3			3
Grand Rapids	7			7
Mille Lacs WMA	12	1		13
Park Rapids	67	11	3	81
Grand Total	**439 (+1 FAW*)**	**124**	**56 (+1 FAW*)**	**637 (+2 FAW*)**

*** MNDNR Fish & Wildlife (**FAW) survey results from Conservation Partnership project

Table 2. Number of Acres Mapped as Possibly Infested With Buckthorn

Mgmt. Area	Not Verified	False Positives	Infested	Area Total
Aitkin	214.84	67.23	23.15	305.21
Bemidji	2.81	0.98		3.80
Cambridge	6.98	15.75	1.29	24.02
Cloquet	2.72 (+28 FAW*)		(+40 FAW*)	2.72 (+68 FAW*)
Detroit Lakes	84.27	15.14	15.30	114.72
Fergus Falls	2.07			2.07
Grand Rapids	23.00			23.00
Mille Lacs WMA	1.91	0.77		2.69
Park Rapids	16.31	4.47	0.76	21.54
Grand Total	**333.12 (+28 FAW*)**	**104.34**	**40.50 (+40 FAW)**	**499.77 (+68 FAW*)**

***** FAW survey results from Conservation Partnership project

Table 3. Project Funding Including Matching Funds

Federal Grant Funds	Matching Funds	Source of Matching Funds	Mgmt. Area	Acres Surveyed	Acres Treated	Fiscal Year
$ 87,000.00				591,024		12-13
	$ 5,000.00	MNDNR, EWR	Mille Lacs WMA		40	2013
	$ 3,500.00	MNDNR, EWR	Maplewood SP		1051	2013
	$ 8,923.00	MNDNR, EWR	Rum River SF		123	2013
	$ 5,750.00	MNDNR, EWR	Project wide		Incl.	2013
	$ 2,136.11	MNDNR, EWR	Big Woods WMA		9.2	2014
	$ 7,250.00	MNDNR, EWR	Buffalo River SP		92	2014
	$ 13,540.71	MNDNR, EWR	Prairie Smoke SNA		42.4	2014
	$ 4,250.00	MNDNR, EWR	Project wide		Incl.	2014
	$ 50,000.00	Conserv. Partners	Cloquet Area WMAs	95,000	178	2014
	$ 2,500.00	MN Deer Hunters	Cloquet Area WMAs		Incl.	2014
	$ 2,000.00	Wild Turkey Fed	Cloquet Area WMAs		Incl.	2014
	$ 2,500.00	Rough Grouse Soc.	Cloquet Area WMAs		Incl.	2014
	$ 3,000.00	St Louis County	Cloquet Area WMAs		Incl.	2014
	$ 8,000.00	MNDNR, EWR	Maplewood SP		Incl.	2015
	$ 2,520.00	MNDNR, EWR	Father Hennepin		12	2015
	$ 1,749.96	MNDNR, EWR	Crocus Hill		11	2015
	$ 8,500.00	MNDNR, EWR	Rum River SF		90	2015
	$ 3,000.00	MNDNR, FOR	Rum River SF		Incl.	2015
	$ 13,444.00	MNDNR, EWR	Little Falls		55	2015
	$ 16,968.24	MNDNR, FOR	Project wide		Incl.	12-15
Total	**Total**			**Total**	**Total**	
$ 87,000.00	**$ 180,072.02**			**686,024**	**1,703.6**	

PlayCleanGo Progress Report

Grant Title: Disrupting Pathways of Spread for Terrestrial Invasive Species – A Hard Launch of **PlayCleanGo: Stop Invasive Species in Your Tracks** (PCG)

Report Period: September 30, 2014 to December 31, 2015
Grant Project Period: July 1, 2012 to September 30, 2016
Grant Recipient: MNDNR, Division of Forestry
Grant Number: 12-152
Recipient Contact Person: Susan Burks
Principal Investigator/Project Director: Susan Burks

Progress Achieved in Accomplishing Project Goals & Objectives

Goal/Objective 1: Launch the campaign

Planned: Develop a marketing and communications plan; develop and publish website and social pages (Facebook,Twitter and Pinterest), develop and distribute media as outlined in the marketing plan.

Actual: Plan was written; website and social pages were created and are on-going; table top displays and banners were designed, created and distributed around the state where PCG partners and other organizations can borrow them; an annual event was scheduled and organized (PlayCleanGo Day at 6 sites in 2013, 13 sites in 2014 and 15 sites in 2015); volunteers distributed boot brushes and literature to park visitors on PlayCleanGo, at the state fair and at 4-6 sports shows per year around the state.

Unit Costs: $ 26,542.00 = 1/3 of 3yr marketing contract, rest covered in-house

Difficulties Encountered: State purchasing procedures are not well suited to managing on-line media. State agencies are generally not involved in registering trademarks.

Resolution/Corrective Action Plan and Schedule: Social media took several meetings with state and department fiscal agents. The resolution was special credit cards (two per department) through which all social media is to be charged. We worked with the Attorney General and an in-house lawyer to submit trademark registrations.

Goal/Objective 2: Grow the partner base to increase recreationists' exposure to outreach materials and likelihood of creating a new social norm of recreational accountability

Planned: Develop a potential partner packet; reach out to like-minded organizations

Actual: Packet was designed, developed and distributed to FH counterparts, National Forest information officers, MN visitor centers and chambers of commerce; gave presentations to a number of associations and organizations within MN and elsewhere. Enrolled 20 new partners in 2012, 19 in 2013, 64 in 2014, 127 in 2015 and have 60 new partners so far in 2016 for a total of 290 partner organizations

covering 35 states and 4 Canadian provinces. See map attached. Organized a steering committee with 10 representatives (including as rep for each: natl orgn, private orgn, public orgn, land mgmt, eastern state, western state, motorized rec, non-motorized rec, Canada, and at-large); started a quarterly newsletter for current partners; created a large graphic library shared with current partners through a Dropbox account.

Unit Costs: $ 26,542.00 = 1/3 of 3yr marketing contract, rest covered in-house or by partner organizations

Difficulties Encountered: The only problem has been the rapid increase in partners, much more than expected, with requests for materials and support. An average of 10 new partners per month has signed up since late 2014.

Resolution/Corrective Action Plan and Schedule: A welcome kit was designed and distributed to all existing and new partners to provide an example of several key pre-printed products. The kit is now being used as a thank you for all new partner sign-ups. An order form was developed for pre-printed supplies not included in the welcome kit, with products priced just above our costs to cover postage and handling. A special account was set up to manage partner order payments. A Dropbox account was established and the PCG graphic library set up such that partners can access the digital files without having to pay for extra cloud storage space. The state is beginning to look for national partners in both the United States and Canada to help sponsor the campaign going into the future.

Goal/Objective 3: Repeat the base-line phone survey of MN recreationists to help measure outreach success.

Planned: Repeat the baseline survey completed in 2011; using MNDNR contact lists, survey 1200 recreationists (400 per three areas of the state) splitting the sample evenly between men and women, and those equal to or less than 45 years of age or greater than 45 years of age

Actual: Survey was completed, but the sample was slightly smaller in all categories than desired. Statistics are not yet complete.

Unit Costs: $ 26,542.00 = 1/3 of 3yr marketing contract, rest covered in-house

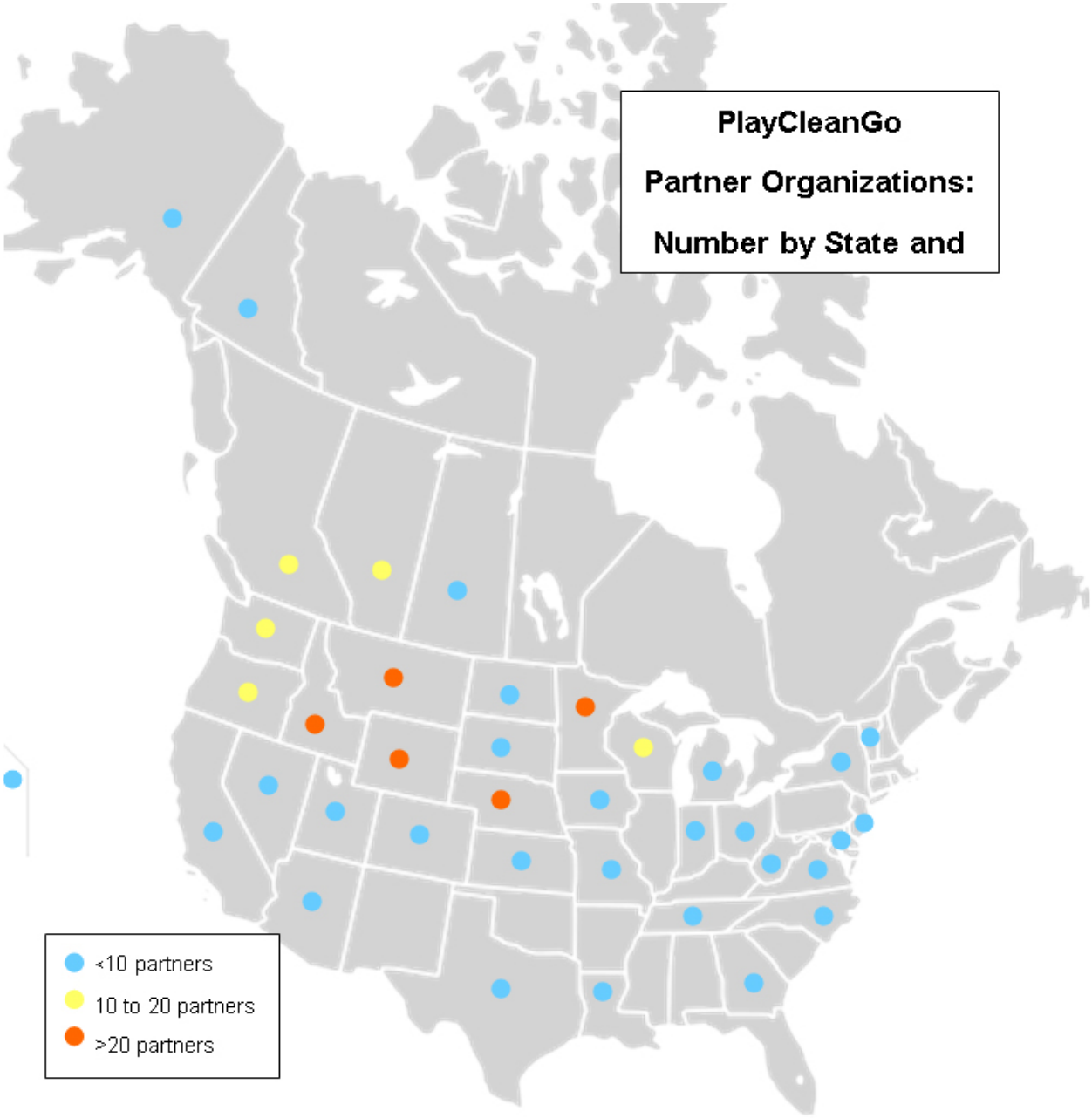
Difficulties Encountered: The new federal data privacy act was passed after the base-line survey was completed. Based on the new requirements, our programs were not willing to give us the same lists of recreationists we used before. They also wanted some form of verification that our surveyor was familiar with the federal requirements and met those standards. The state does not have its own review board, so has gone to using the University of Minnesota's review board. That created concerns for our surveyor.

Resolution/Corrective Action Plan and Schedule: After much delay and several meetings attended by our internal lawyers, social scientists and division administrators, it was decided that we would get a random sample of some of our lists of recreationists, but not others lists (those that might have contain

minors). Our marketing contractor and surveyor both had to sign a certification letter, but were allowed to skip the University approval process. The change in sample sources means we can't do a one-to-one comparison between the two data sets. But we can describe general trends and the inferences we can make from those.

Activity Anticipated Next Reporting Period

The statistics for the survey will be run this May and to the extent possible compared to the prior base-line survey data. Outreach in Minnesota will focus on hikers and bikers with expanded outreach across the northern part of the state. We will continue to work with our steering committee to identify, support and where possible expand our base of PCG partners. Next to our brand assets, our partners are our greatest asset.


PlayCleanGo
Partner Organizations:
Number by State and
<10 partners
10 to 20 partners
>20 partners

Forest Pest First Detector Workshops

After eight years, the Forest Pest First Detector program continues to train dozens of volunteers to respond to reports of exotic forest insects and diseases called in by the public to the Minnesota Department of Agriculture (MDA). Trained First Detectors are contacted by MDA to connect them to a caller located in their part of the state, and the First Detector responds to help diagnose the issue and report their findings to MDA.

Four workshops were held in locations around Minnesota, in Alexandria, Cloquet, Hutchinson, and Shoreview. Training topics in 2015 included emerald ash borer, gypsy moth, brown marmorated stink bug, thousand cankers disease of walnut, oak wilt, Oriental bittersweet, quarantines, firewood identification, and pathways for invasive species. Continuing education credit is offered for the International Society of Arboriculture, the Society of American Foresters, and Minnesota Tree Inspectors.

The First Detector team consists of agency partners who organize registration, take turns giving presentations, and proctor the Tree Inspector Certification exam at the various workshop locations. Currently the team includes Mark Abrahamson, Angie Ambourn, Monika Chandler, and Kathy Kromroy, (MDA); Brian Aukema (Department of Entomology, University of Minnesota); Val Cervenka and Ken Holman (DNR); and Mary Kay Ferguson, Angie Gupta, Jeff Hahn, Dean Herzfeld, Gary Johnson, Mike Reichenbach, and Gary Wyatt (University of Minnesota Extension). This year the team trained 98 individuals.

Other Accomplishments

Updated Pine Thinning Specs on State Lands

The Forest Health and Timber programs improved a specification in the DNR's harvest guidelines to minimize bark beetle damage. The revised specification better addresses the biology of the pine engraver (*Ips pini*), our most threatening pine bark beetle. It also reduces constraints on logging companies during certain periods in the year. The new specification for all pine thinning operations on state lands is as follows:

"The Timber Sale Administrator (TSA) can allow or stop permit operations to minimize rutting, root damage, bark slippage, beetle infestations or wildfire risk. If excessive damage is occurring, the TSA will stop operations until site conditions improve. For pine thinning operations, the following restrictions apply to cut pine greater than 3 inches diameter:

- December 1 to May 31: Pine cut in this period must be hauled or destroyed by June 1.
- June 1 to August 31: Pine cut in this period must be hauled or destroyed within 3 weeks.

- September 1 to November 30: No special restrictions for pine cut in this period."

Presentations On-line

Oak Wilt versus Bur oak blight, retrieved 11/30/2015 from MyMinnesotaWoods

News Releases

Silver Maples Showing Signs of Stress. Retrieved 11/30/2015 from DNR news article

DNR offers advice for dealing with storm damaged trees. Retrieved 11/30/2015 from DNR news article

Oak wilt confirmed in Morrison County for the first time. Retrieved 11/30/2015 from DNR news article

New DNR Forest Health Internet Outreach Material

Heterobasidion root disease, March 2015: Forest Health website

Heterobasidion root disease (a picture guide), March 2015: Forest Health website

Diplodia shoot blight webpage, May 2015: Forest Health website

Contributions to Scientific Papers

Russell MB, D'Amato AW, Albers MA, Woodall CW, Puettmann KJ, Saunders MR, VanderSchaaf CL. 2015. Performance of the forest vegetation simulator in managed white spruce plantations influenced by eastern spruce budworm in northern Minnesota. For. Sci. 61(4):723-730. Forest Science 61 (4)

Smith DR, Stanosz GR, Albers J. 2015. Detection of the Diplodia shoot blight and canker pathogens from red and jack pine seeds using cultural methods. Can. J. of Plant Pathol. 37(1): 61-66. Canadian Journal of Plant Pathology 37(1)

Stanosz GR, Smith DNR, Albers J. 2015. [presentation abstract] The shoot blight and canker pathogen *Diplodia scrobiculata* and asymptomatic seedlings in natural stands of *Pinus banksiana*. Joint IUFRO Working Party Meetings, June 7-12, Uppsala, Sweden, accessed on-line 11/30/2015.

Crocker, S.J.; Liknes, G.C.; McKee, F.R.; Aukema, B.H.; Albers, J.S. 2015. Assessing regional variation in tamarack mortality from eastern larch beetle in the Great Lakes Region, USA. At: 2015 Entomological Society of America Annual Meeting; 2015 November 15-18; Minneapolis, MN.