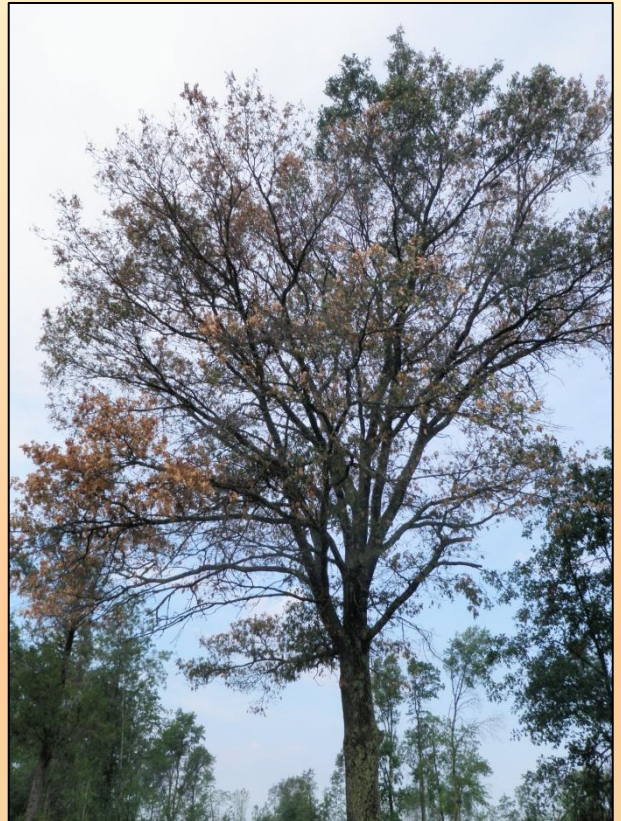


Forest Health Highlights Minnesota 2012



**Prepared by
Minnesota Dept. of Natural Resources
Forest Health Unit
Dec. 31, 2012**



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Aerial Survey Results

Since the early 1950's, aerial survey has been a valuable tool for monitoring the activities of forest insects and pathogens across the 16 million acres of forest land in Minnesota. For the past fourteen years, these surveys have been accomplished through the collaboration of the Minnesota Department of Natural Resources (DNR) Forest Health and Resource Assessment Units and USDA Forest Service (USFS) Northeastern Area State and Private Forestry (S&PF). The Forest Health staff plans the scope, timing and intensity of the surveys, trains Resource Assessment staff, provides ground-truthing, analysis and dissemination of survey data. Resource Assessment staff conducts the aerial sketch-mapping, digitizes the data and produces digital shape files. In addition to being used in Minnesota, the survey results are incorporated into the USUSFS national database since our procedures and products comply with national standards.

The state portion of the survey began on June 12 and was completed on August 7. The federal portion of the survey was delayed because all USFS Region 9 aircraft were grounded starting on June 25. The survey began on July 31 and was completed on August 8. The lateness of this portion of the survey made mapping spruce budworm and forest tent caterpillar defoliation more difficult, but a good map was still produced. A map with the portion of the survey by quad showing intended start dates along with actual start and completion dates is provided on page 4.

The survey was flown on 6-mile flight lines except for the extreme northwestern part of the state where flight lines

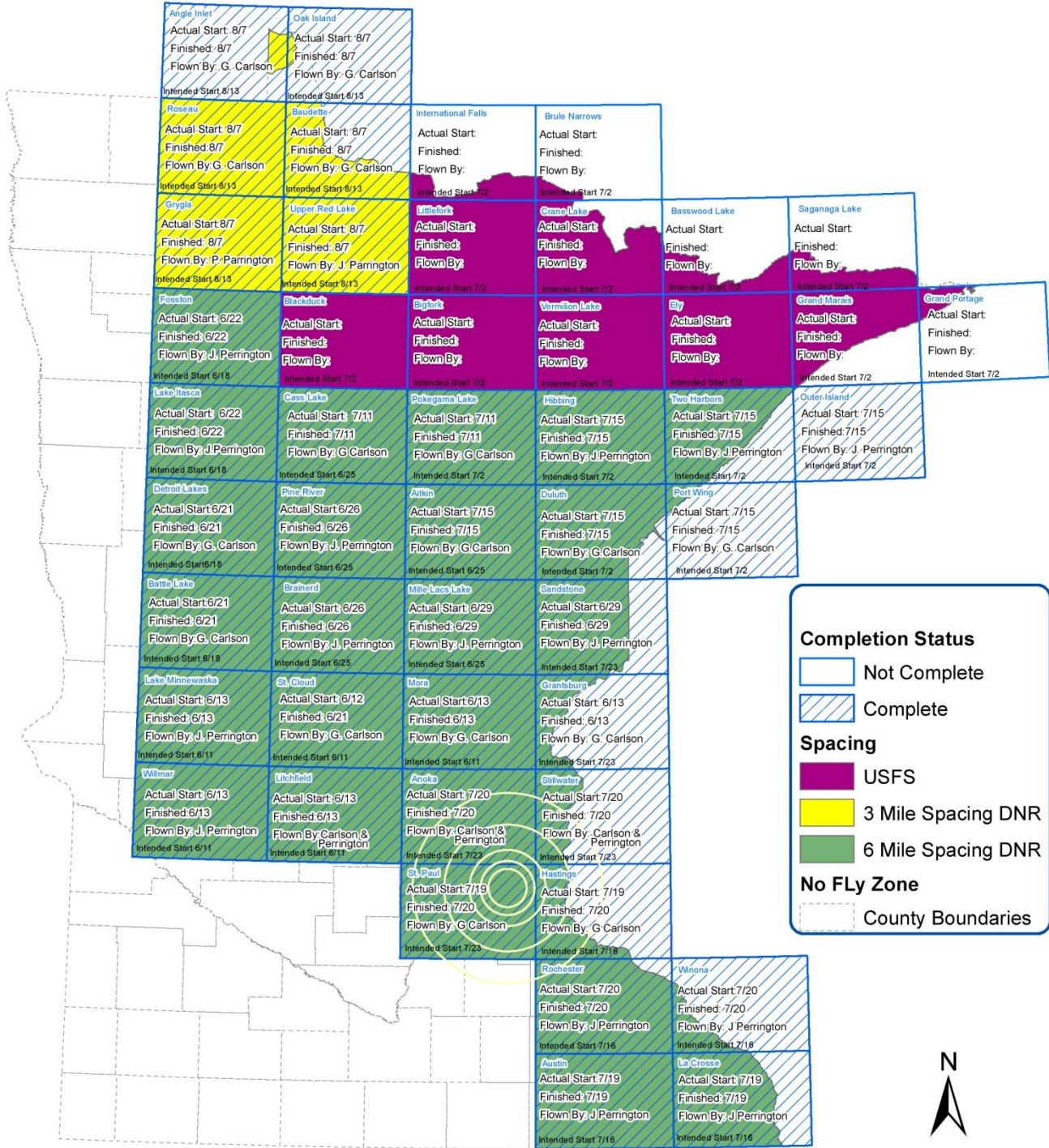
Agent	Number of polygons	Number of acres
Ash decline	374	23,152
Aspen decline	277	89,842
Other decline	2	12
Bark beetles	24	317
Dutch elm disease	659	3,004
Fire	5	553
Flooding	78	1,955
Forest tent caterpillar	1,636	274,688
Jack pine budworm	1	7
Larch beetle	927	42,263
Larch casebearer	120	18,443
Spruce budworm defoliation	330	82,770
Spruce budworm mortality	270	79,250
Two lined chestnut borer	52	1,227
Unknown	182	6,626
Wind damage	150	15,884
Grand Totals	4,817	560,743

Note: Number of polygons and acres for spruce budworm mortality are not included in the acreage grand total as it would be double-counting the number of acres for spruce budworm damage.

were spaced at three miles in order to get a more detailed map of tamarack mortality due to eastern larch beetle. The flights in the northwestern portion of the state were also delayed until August in order to be able to more easily see trees being attacked by the larch beetle.

Thanks to Resource Assessment's sketch-map team Mike Hoppus, Joel Perrington, and Gentry Carlson, who accomplished this year's aerial survey and data processing. Thanks also to Marc Roberts, S&PF, for mapping the federal portion of the survey and to Quinn Chavez, S&PF, for post-flight map rectification and final review meeting.

Minnesota Sketch Mapping Project 2012



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Bark beetles

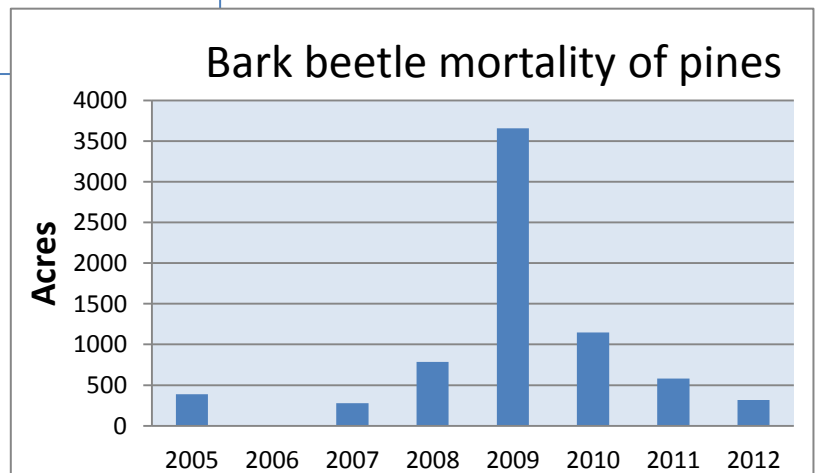
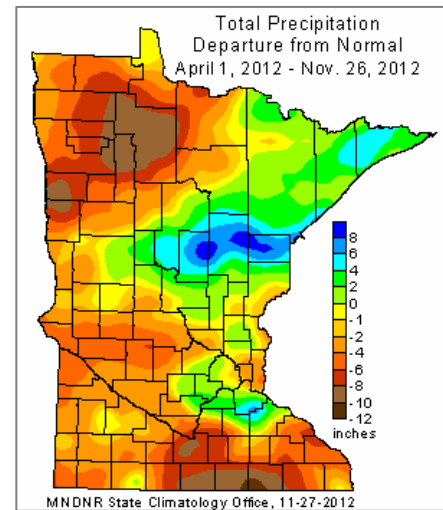
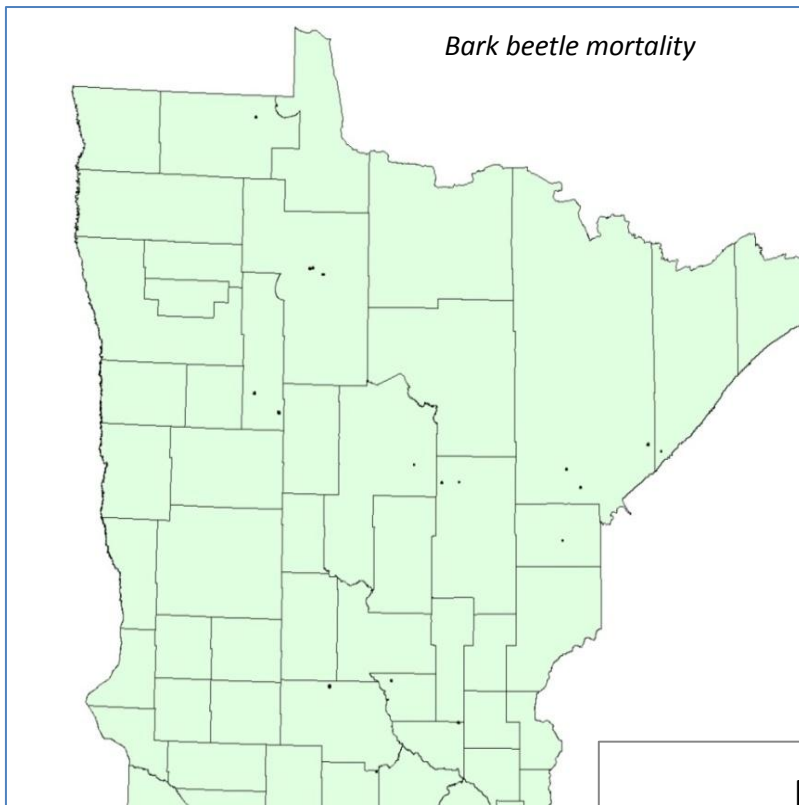
Ips pini, *Ips* spp.

Hosts	Red, jack, and white pines
Setting	Rural forests
Counties	See map
Survey methods	Aerial detection
Acres affected	310 acres
Damage	Mortality



Pupa, larva and callow adult in galleries.
Texas A&M AgriLife Extension Service Archive,
Texas A&M University, Bugwood.org

Trend is decreasing from 580 acres in 2011 to 310 acres in 2012. This year's acreage is only 1/10 that of 2009, the peak year. This is fairly surprising given that both 2011 and 2012 were droughty. However, the central portion of the state, where most bark beetle outbreaks occur, apparently had adequate rainfall this year or the vulnerable stands lost trees earlier in the decade.



Eastern larch beetle

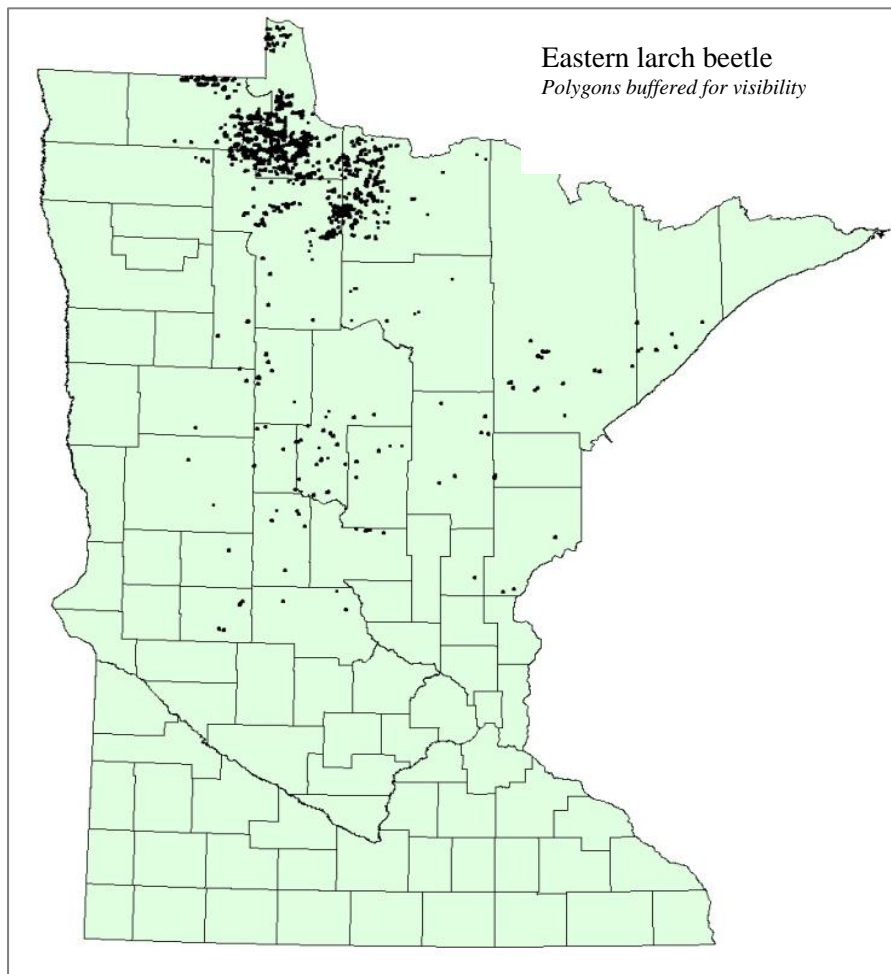
Dendroctonus simplex

Hosts	Tamarack
Setting	Rural forest
Counties	See map
Survey methods	Aerial detection
Acres affected	42,200 acres
Damage	Mortality

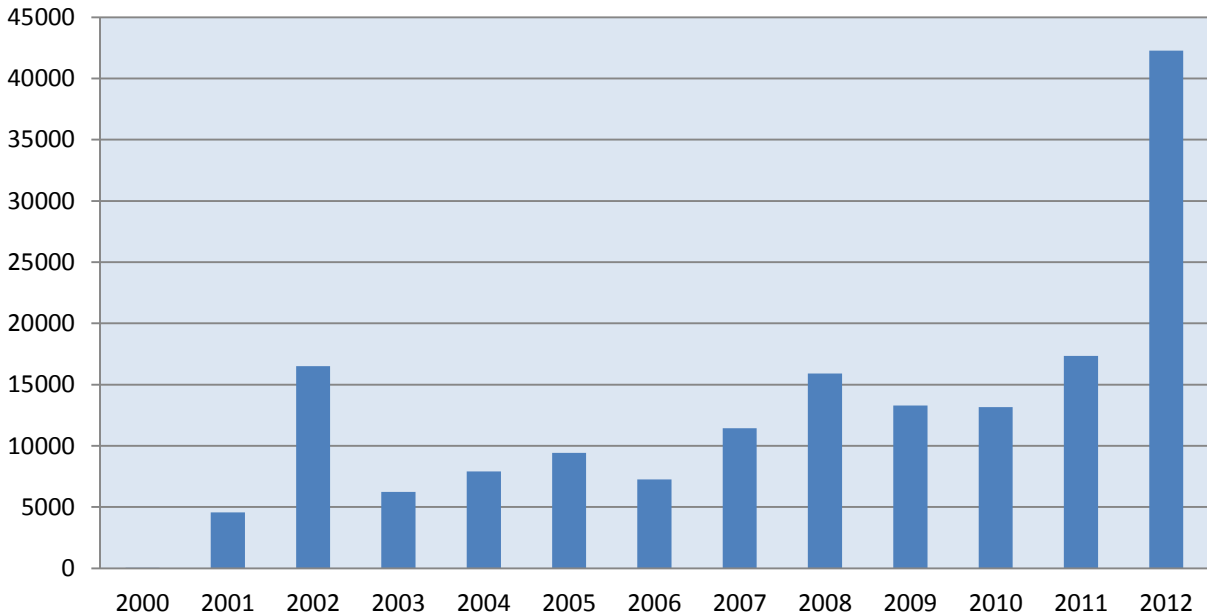


August foliage discoloration in Itasca County occurs on half of attacked tamaracks.

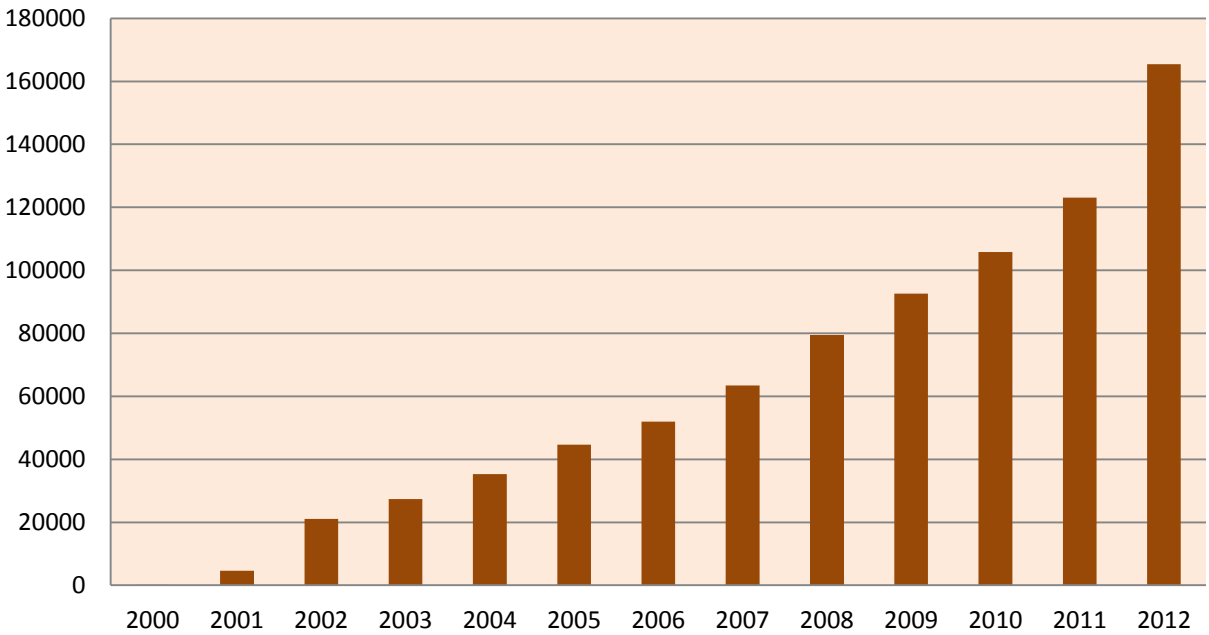
This is the 13th year of the eastern larch beetle outbreak in Minnesota, with a cumulative mortality of 165,000 acres. This year new mortality acres jumped to 42,200 acres, 2.4 times more than in 2011 (see page 7). For the past few years, most damage has occurred in two extreme northern counties, but pockets of infestation and mortality can be found anywhere tamarack grows in the rest of the state. DNR foresters report that within five years of aerial or ground detection, more than 95 percent of the tamarack is dead in these stands.



Acres of new tamarack mortality caused by eastern larch beetle from 2000 to 2012



Cumulative acres of tamarack mortality caused by larch beetle in Minnesota from 2000 to 2012



Emerald ash borer

Agrilus planipennis

Hosts	All ash species
Setting	Urban and rural forests
Counties	Houston, Winona, Ramsey and Hennepin
Survey methods	Trapping, girdled trees, and ground survey
Acres affected	Not determined
Damage	Mortality



Adult EAB emerging from ash tree

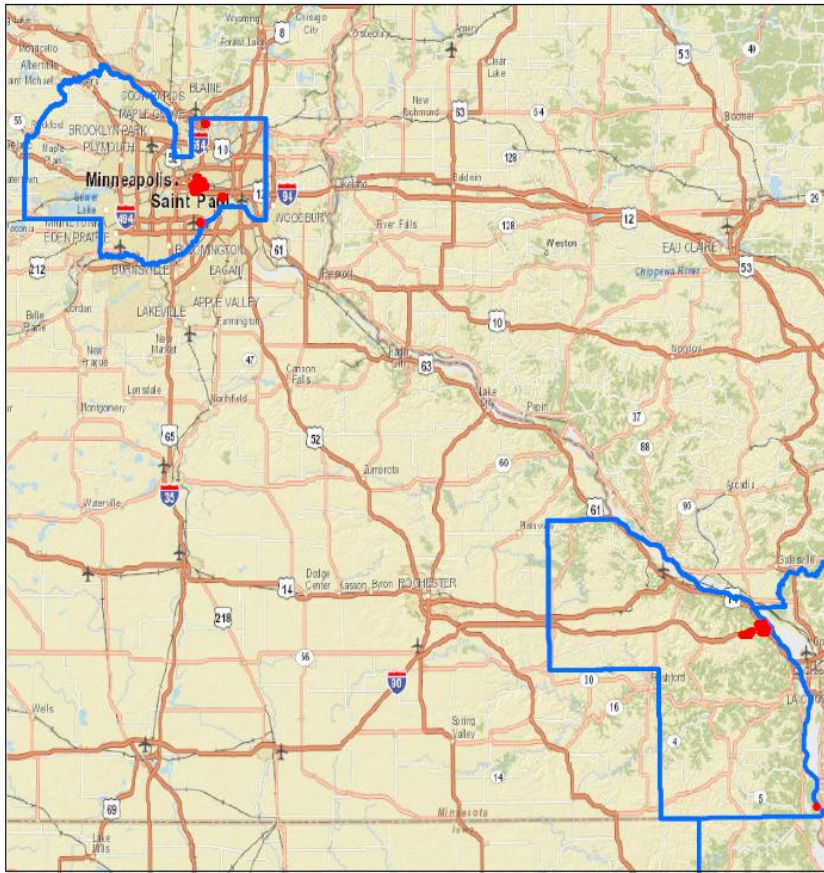
Emerald ash borer (EAB) was first detected in Minnesota on May 13, 2009, by a private arborist in St. Paul (Ramsey County). On February 28, 2010, a separate infestation was discovered in a nearby park in Minneapolis (Hennepin County). On April 28, 2010,

EAB was confirmed in Houston County on the Upper Mississippi Fish and Wildlife Refuge. The MDA enacted an emergency quarantine of Hennepin, Ramsey and Houston Counties on May 15, 2009, followed by a formal quarantine on August 17, 2009. The United States Department of Agriculture Animal and Plant Health Inspection Service, Plant Protection and Quarantine (APHIS PPQ) imposed a parallel federal quarantine.

In August, 2011, three EAB traps were found positive along Highway 61 in Houston and Winona Counties. As a result, the quarantine was extended to Winona County. On September 14, 2011, a large infestation of EAB was discovered at the I90 / CR12 interchange in Winona County, and infested trees were subsequently found in Great River BlufUSFS State Park less than two miles away. Additional small infestations have been discovered in 2012, including in Shoreview (Ramsey County), St. Paul, Minneapolis, Houston County, and at the Fort Snelling Golf Course in Hennepin County near the Minneapolis-St. Paul International Airport.

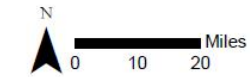
In most cases, state or city officials continue to remove and destroy infested trees during the winter months; however, this is no longer possible at all locations due to site access issues. Some trees have been taken to the University of Minnesota quarantine facility to support state funded research to explore the spread rates and cold tolerance of EAB and three biological control agents. These biological control agents, including one egg parasitoid and two larval parasitoid species, have been released by the Minnesota Department of Agriculture (MDA) near most known infestations.

MDA is the lead agency responsible for the detection and management of regulated pests, and the DNR serves a support role in all planning and implementation efforts involving pests impacting Minnesota's natural resources. In 2011, an agreement was made with MDA that DNR Forestry would be available to take a lead role in incident command for EAB infestations found in rural Minnesota outside the seven-county metro area when requested. This year, the DNR assembled an incident command team led by members of county and municipal governments in addition to DNR Forestry and MDA to lead the long-term response to EAB in Winona County.

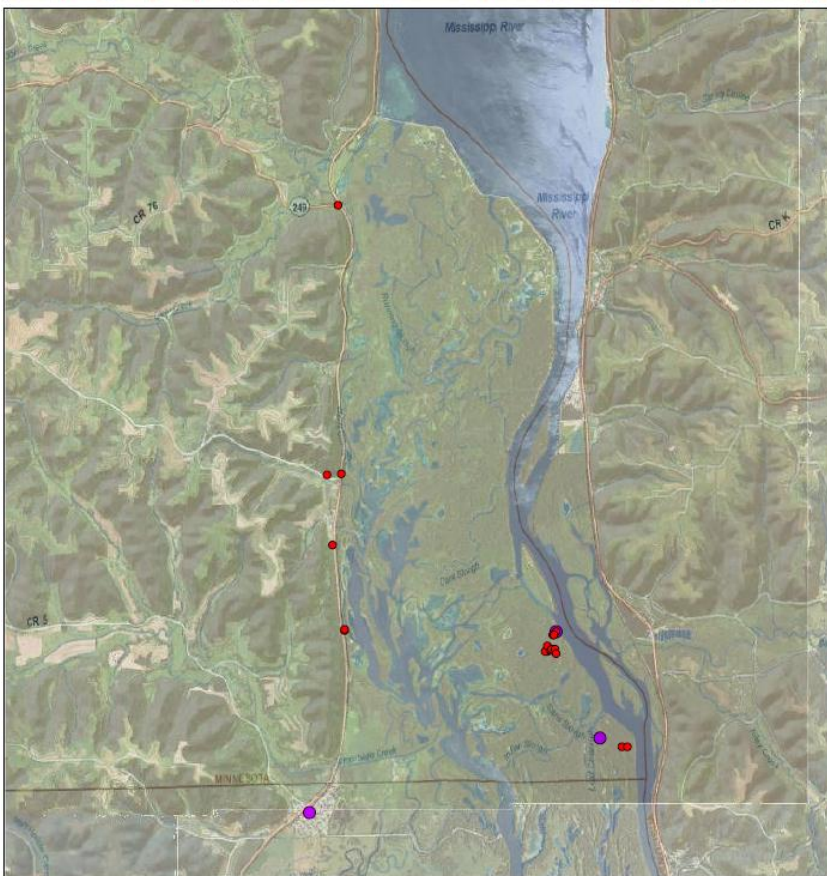
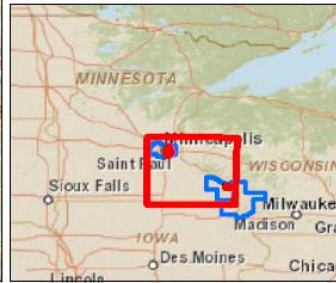


EAB Status August 15, 2012

- Infested Tree
- Quarantine Counties



Area of detail highlighted in red



EAB Status December 5, 2012

- EAB Positive Tree
- EAB Positive Trap



Area of detail highlighted in red



Forest tent caterpillar

Malacosoma disstria

Hosts	Aspen, basswood, oak, birch, willow and other hardwoods, tamarack.
Setting	Rural forests
Counties	See map
Survey methods	Aerial detection
Acres affected	274,600 acres
Damage	Defoliation

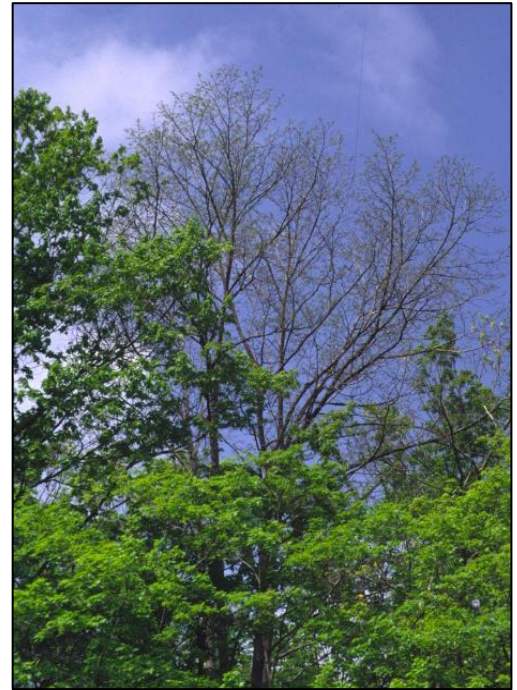
Forest tent caterpillar (FTC) populations peak every ten to sixteen years in Minnesota. Looking at the pattern and amount of defoliated acres this year, it looks like these populations could be building towards a 2014 or 2015 peak of millions of acres (see map below and chart on page 11).

Here are some notes about FTC:

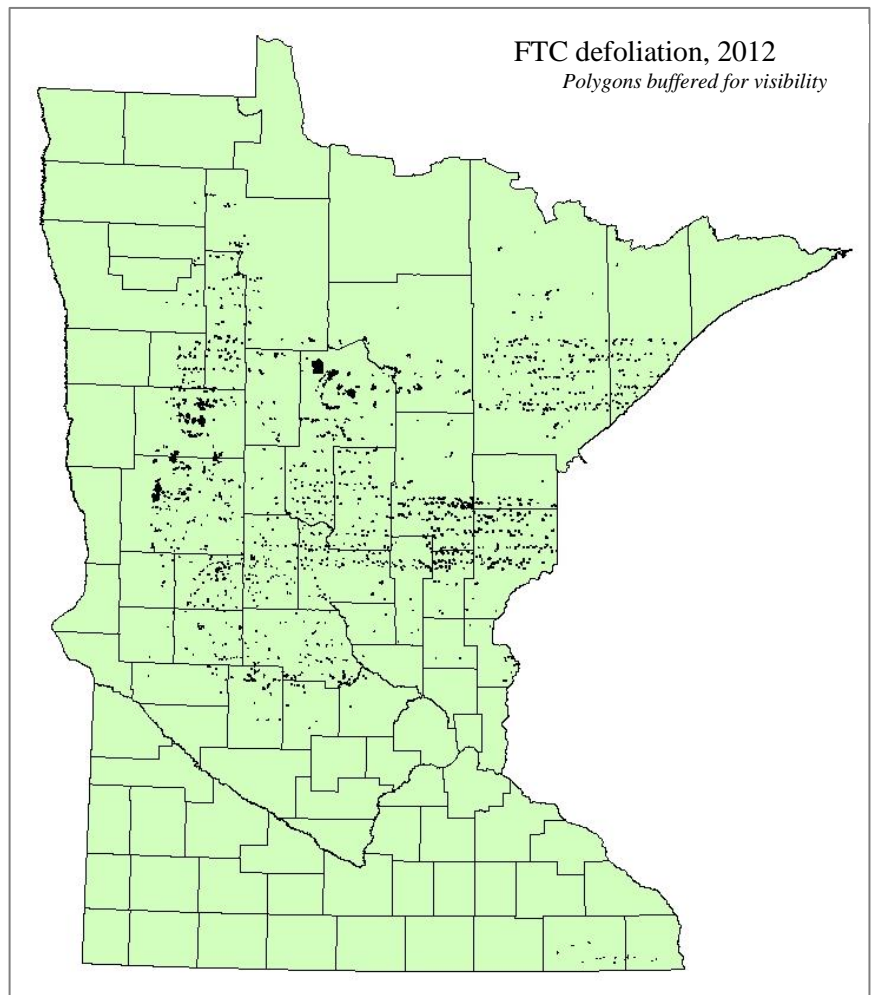
From Beltrami and Lake of the Woods Counties to Cook County, aerial survey was delayed by two months and very few acres with FTC were mapped, so we really don't know how extensive FTC populations were in the northern counties. We'll have to wait until next year to fill in this gap.

A dozen 60-acre pockets of defoliation were mapped in Fillmore and Houston Counties; a rare occurrence in southeastern Minnesota.

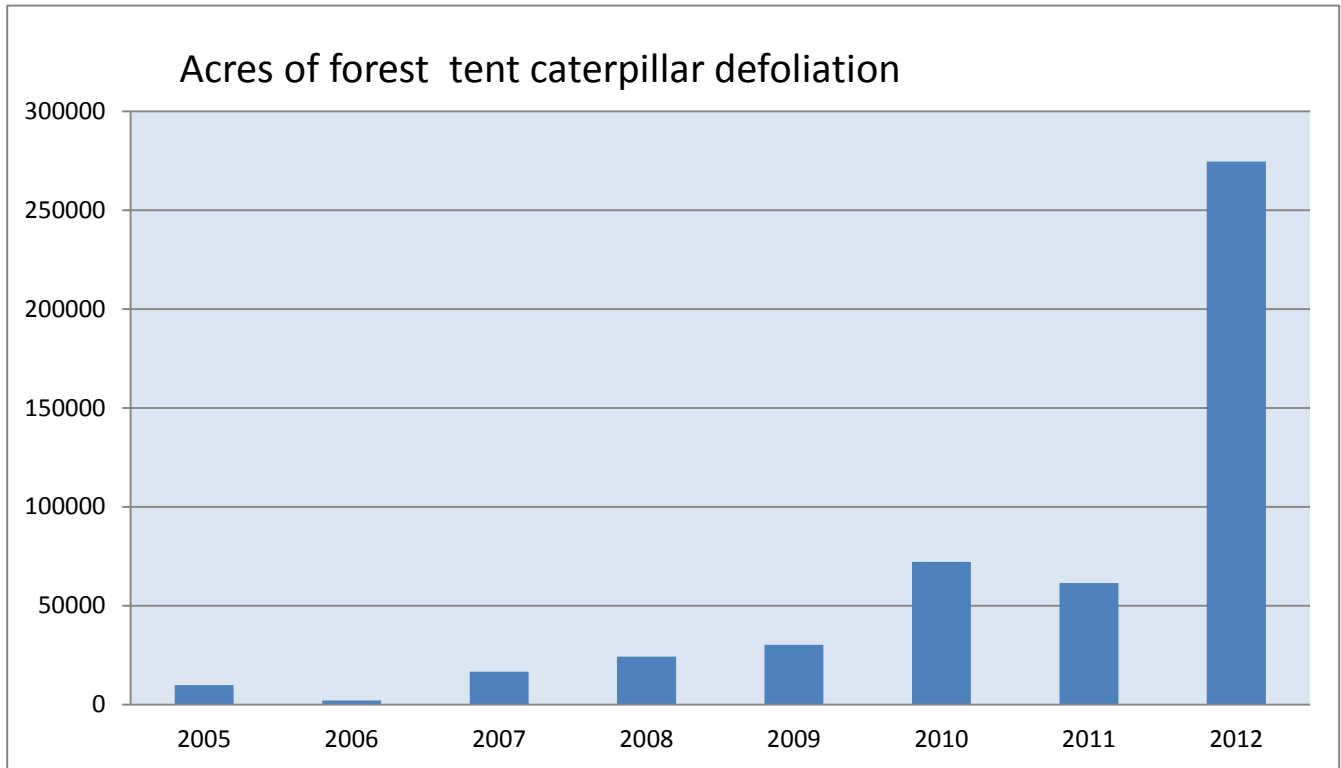
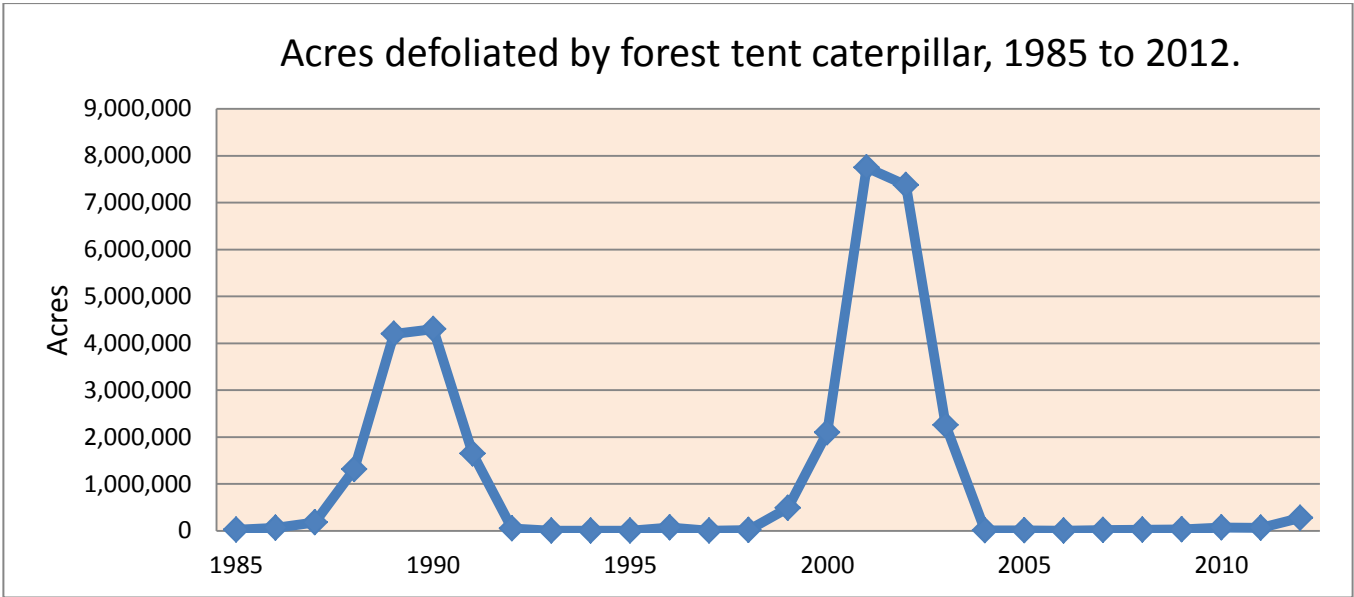
Far from declining, the FTC populations in west-central counties are going strong. 2012 was the fifth year of the outbreak there, and 127,000 acres were defoliated compared to 41,400 acres last year. Basswood and oaks are the primary targets and both species might be in trouble of declining in 2013 due to the duration of the local outbreaks and severity of the drought for the last few growing seasons. Normally, FTC populations build up in small areas and decline rapidly, often within two years. That's not the case this time; some localities have had three and four years of defoliation.



Oak defoliation in west-central counties.
Photo credit unknown.



We expect to see continued FTC activity in 2013. Looking at recent trends in the chart below, acreages are building in the west central counties as well as the north central and northeast counties.



Gypsy moth

Lymantria dispar

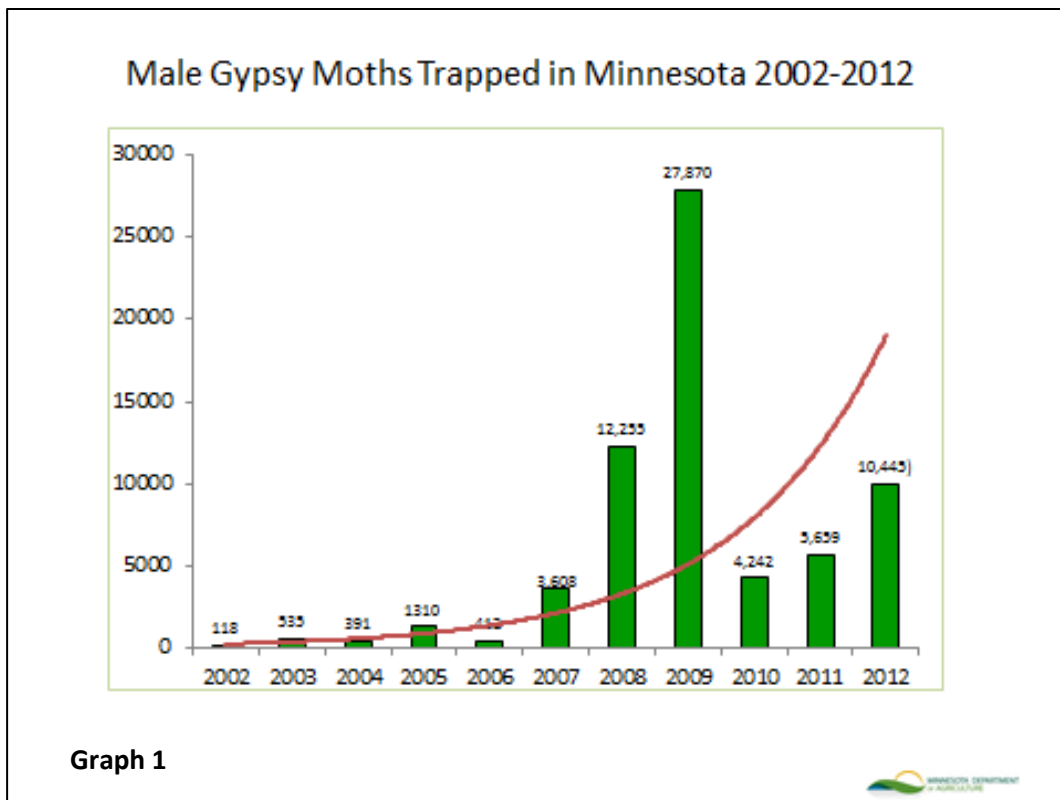
Hosts	Oaks, aspen and other hardwoods
Setting	Rural and urban forests
Counties	See table
Survey methods	Pheromone traps and ground surveys
Acres affected	No defoliation acres
Damage	Defoliation



The gypsy moth detection program is a cooperative effort between state and federal agencies including MDA, DNR, the USDA Animal and Plant Health Inspection Service (APHIS), USFS, and the University of Minnesota. With state regulatory authority over invasive species, MDA is the lead agency overseeing the state’s gypsy moth effort.

In 2012, MDA and partners placed 17,422 traps around the state using a combination of delta and milk carton-styled traps. The larger milk carton traps were used in the areas with a history of high moth captures (primarily Cook and Lake Counties), while the delta traps were used at varying grid densities elsewhere in the state. Grid densities vary based on the risk of introduction and relative distance to the national Slow-The-Spread (STS) action zone boundaries.

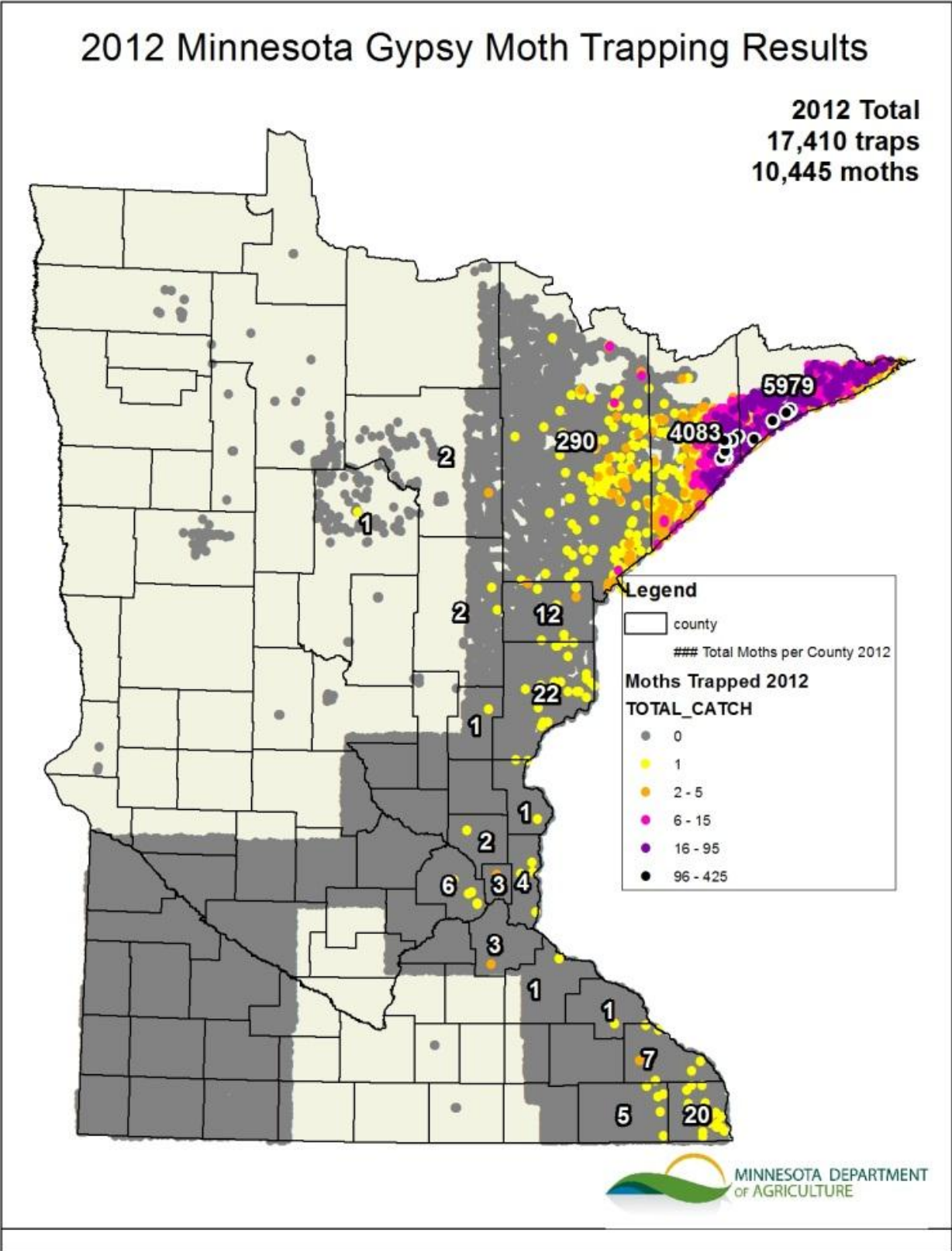
The traps caught 10,445 moths, almost all of which were in the northeastern most counties (Map 1, page 13). That total is down from the record 27,870 moths caught in 2009, but up from the count in 2011 (Graph 1, below). The overall trend suggests that low density populations are beginning to build in the Arrowhead region. As a result of the pattern of trap captures and alternate life stages found in Cook County, the STS “action zone” will move slightly westward for the next trapping season (Maps 2 and 3, page 14).



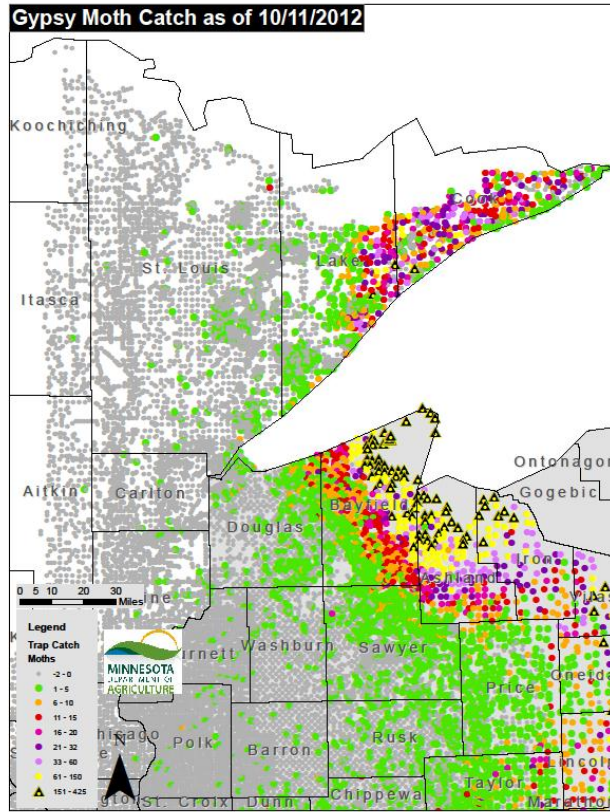
Graph 1



Map 1



Map 2



Map 3

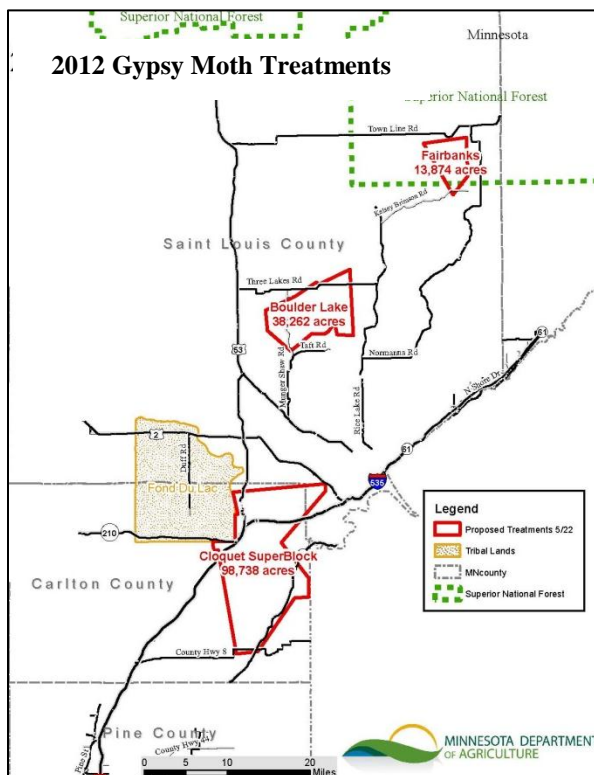


Additional trapping was done to monitor the efficacy of the treatments carried out in 2011. The treatment block of most concern was in Grant Township (Washington County), where a large number of alternative life stages (egg masses, pupal and larval skins) were found. Treatment success was assessed through additional trapping in the area.

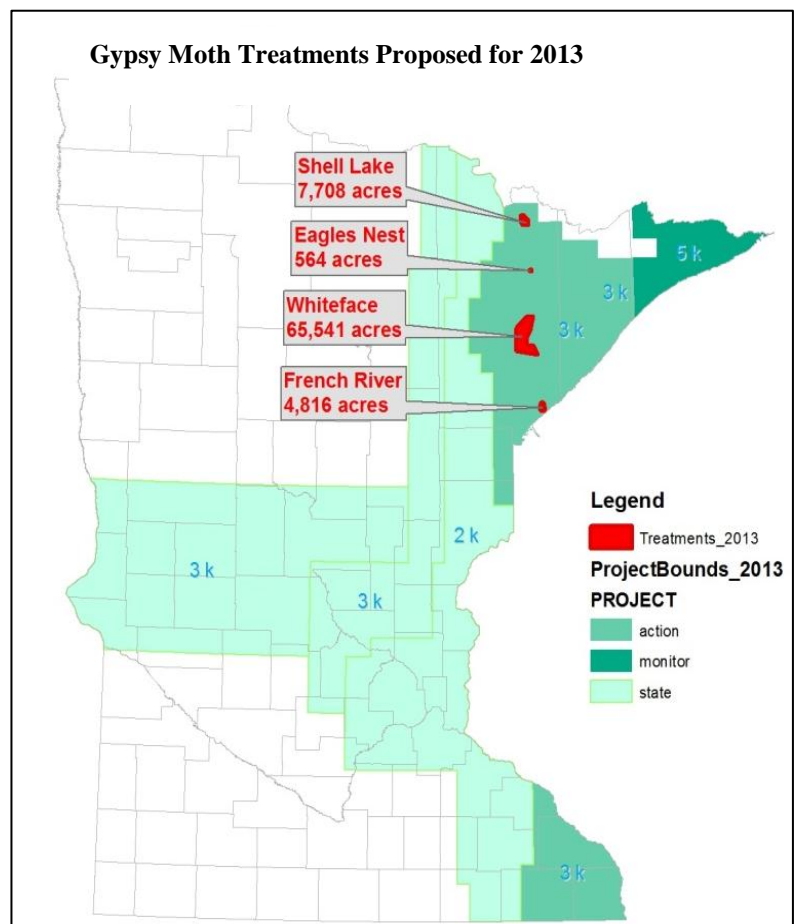
There were three blocks of land treated in 2012 based on 2011 trap captures (Map 4, below). All three blocks were treated with pheromone flakes designed to disrupt gypsy moth mating (roughly .5 cup of flakes per acre). These areas will be heavily trapped next year to monitor treatment success.

Based on this year's trapping results, four blocks of mating disruption treatment are being recommended for 2013, all in St Louis County (Map 5, below). Because of the westward shift of the STS action zone, none of the areas of concern in Cook and Lake Counties will be treated; those areas will be trapped to monitor population levels.

Map 4



Map 5



Larch casebearer

Coleophora laricella

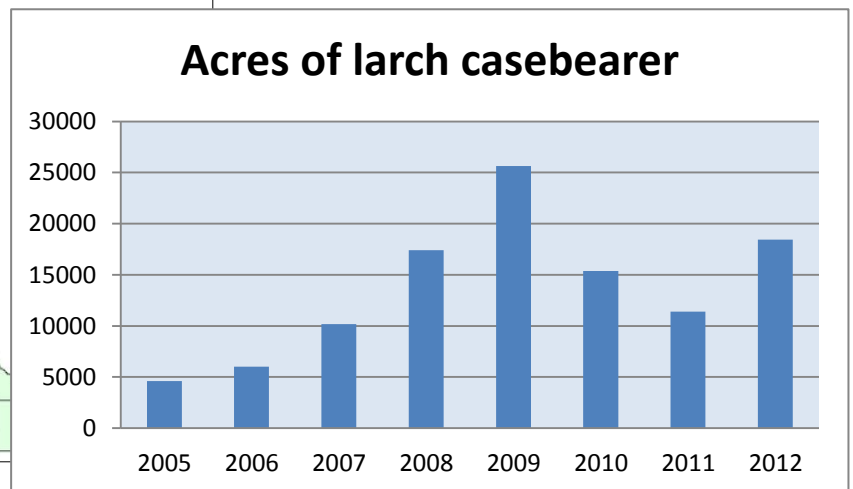
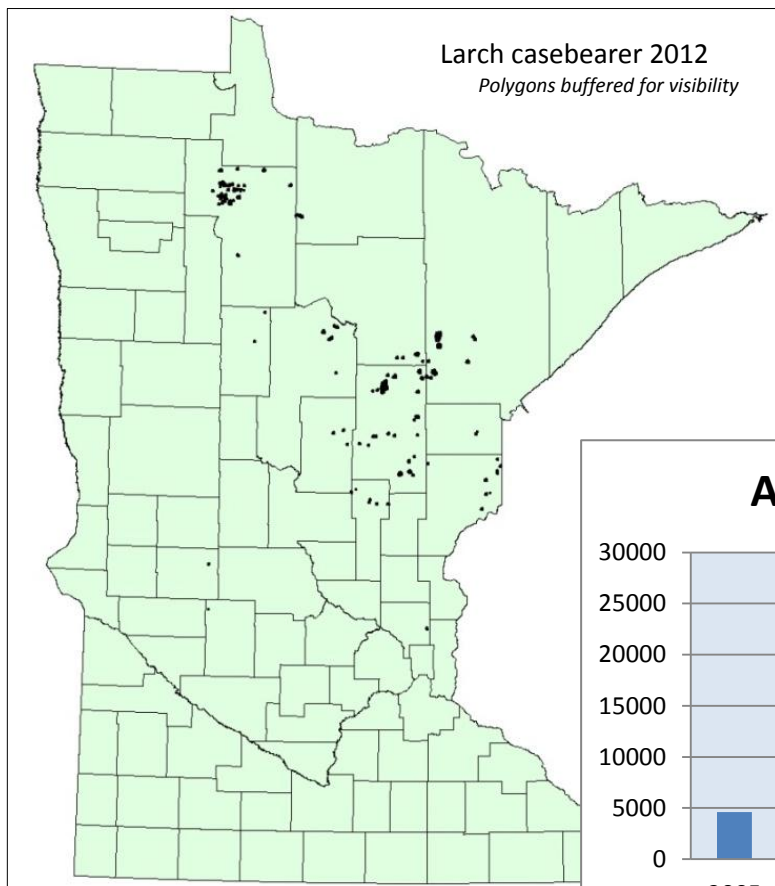
Hosts	Tamarack
Setting	Rural forests
Counties	See map
Survey methods	Aerial survey
Acres affected	18,443 acres
Damage	Defoliation

Larch casebearer defoliation occurred on 18,443 acres this year. This is a significant increase compared to 11,404 acres in 2011 (see chart and map, below).

Larch casebearer defoliation has been mapped on the aerial survey every year since 2000 (no mortality has been observed due to casebearer defoliation). Between 1977 and 2000, casebearer damage was not noticeable or mapped and was only occasionally found on isolated trees. The reason for the increase starting in 2000 and its persistence has not been determined.



Discolored foliage due to larch casebearer feeding



Spruce budworm

Choristoneura fumiferana

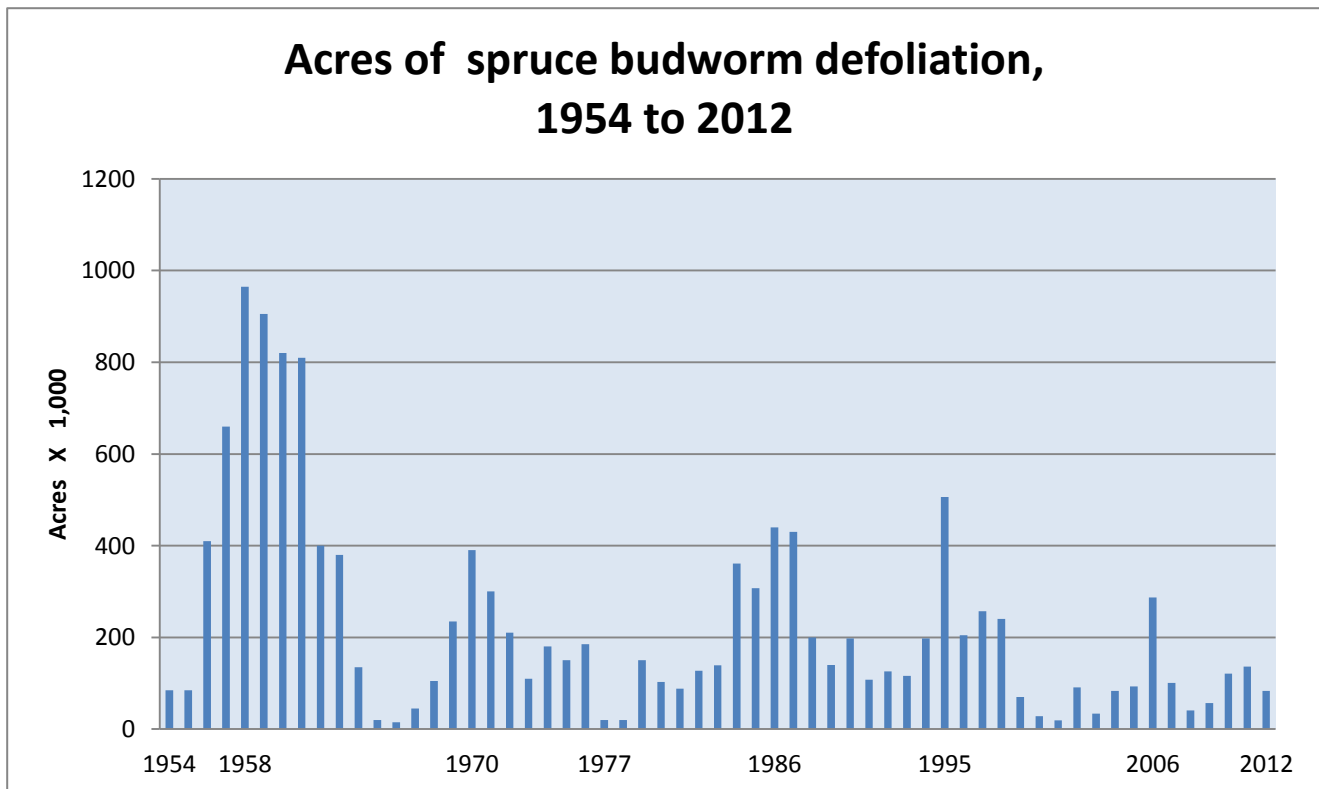
Hosts	Balsam fir and white spruce
Setting	Rural forests
Counties	See map
Survey methods	Aerial survey
Acres affected	82,770 acres of defoliation 79,250 acres of mortality

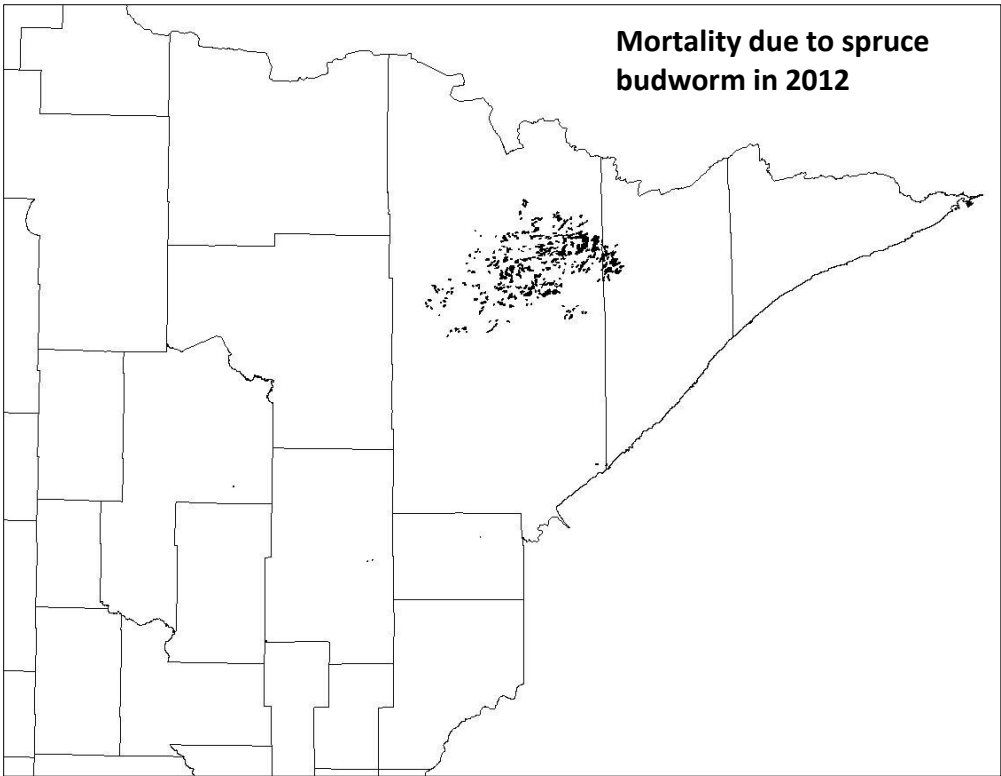
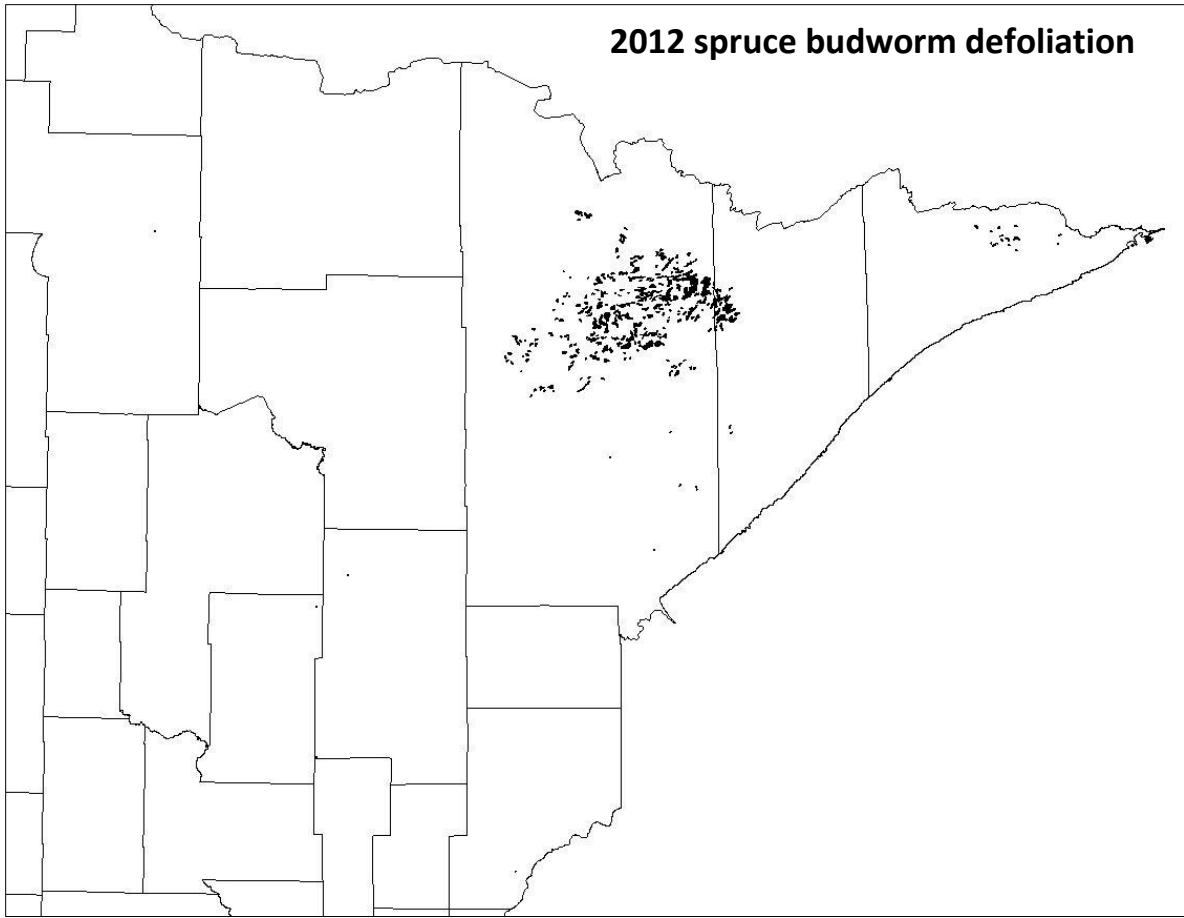
Spruce budworm is native to North America. Massive outbreaks periodically occur in spruce-fir forests of eastern Canada and the United States. Since 1954, when annual aerial sketch-mapping began, spruce budworm has caused defoliation of balsam firs and white spruces every year in Minnesota. This year, 82,770 acres of defoliation occurred in northeastern counties (see map, page 18). This year, defoliation was mapped in north central Cook County for the first time since 1996.

The USFS mapped 79,250 acres of spruce budworm mortality in St. Louis and Lake Counties during the general detection survey (see map, page 18). This likely represents the cumulative impact of the last three to four years of defoliation in those counties.



Dead balsam fir due to prolonged budworm defoliation





Two-lined chestnut borer

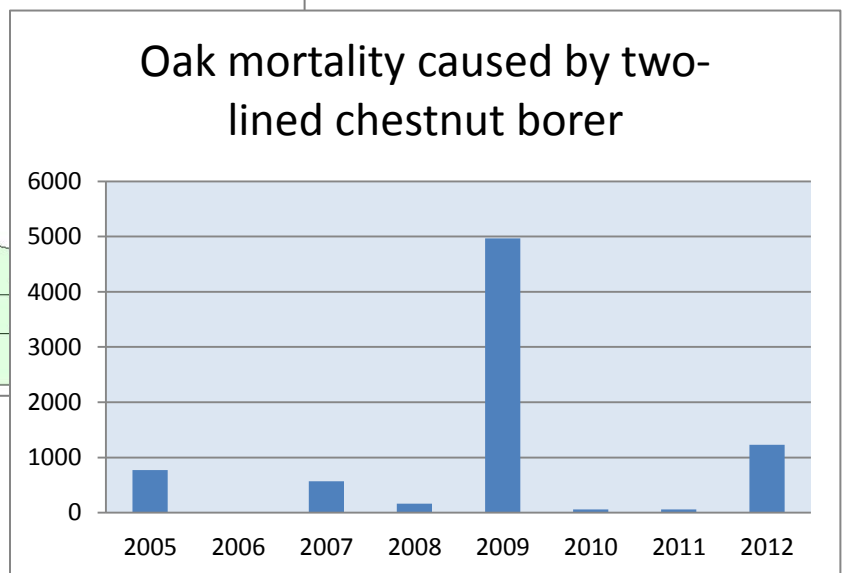
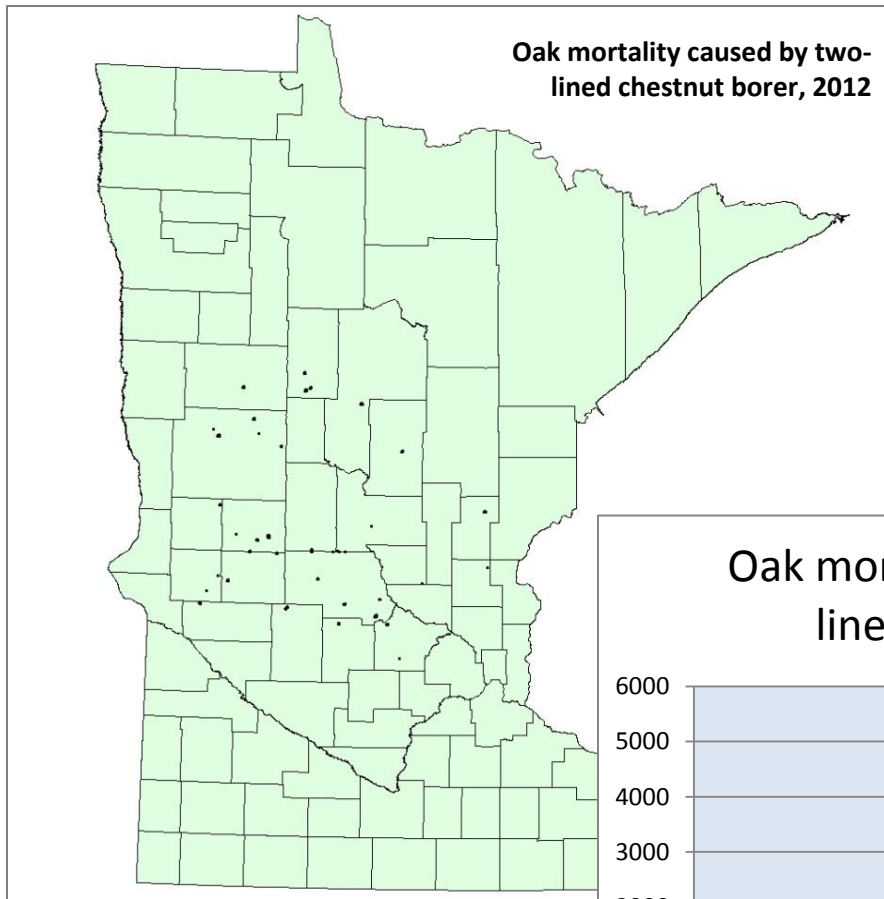
Agrilus bilineatus

Hosts	Red, bur and white oaks
Setting	Rural and urban forests
Counties	See map
Survey methods	Aerial detection
Acres affected	1,200 acres
Damage	Mortality

The acreage trend increased 20-fold compared to 2011 (see below), likely due to the prolonged drought and persistent FTC defoliation experienced in the central and west-central counties for the past four or five years.



Oaks in Itasca County killed by two-lined chestnut borer



Bur oak blight

Tubakia species

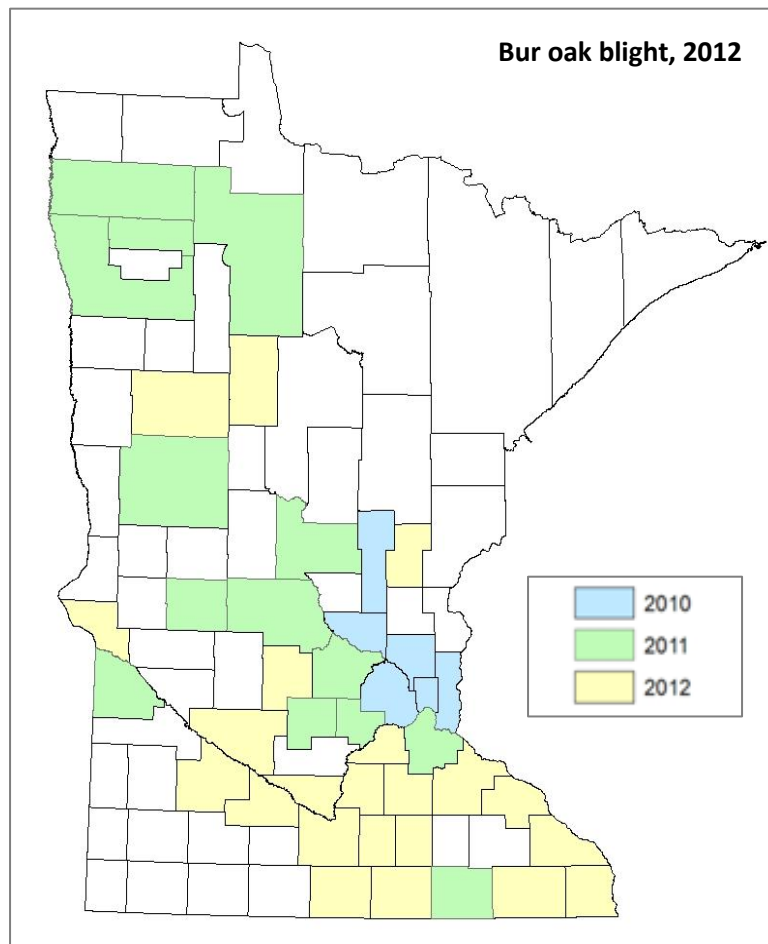
Hosts	Bur oak
Setting	Rural and urban forests
Counties	See map
Survey methods	Ground survey
Acres affected	Undetermined
Damage	Dieback and decline



Symptomatic branch on bur oak in Pope County

In 2012, bur oak blight was found in 22 new MN counties (yellow on map below) and confirmed by the University of Minnesota Plant Disease Clinic and by Jill Pokorny, Plant Pathologist, USFS.

Diagnosticians in Iowa and Minnesota have found that the presence of four signs or symptoms (necrotic veins, large wedge-shaped leaf lesions, hyphal shields and spores on symptomatic leaves, and petiole pustules) are sufficient for a positive diagnosis of this disease.



Dutch elm disease

Ophiostoma ulmi, *Ophiostoma novo-ulmi*

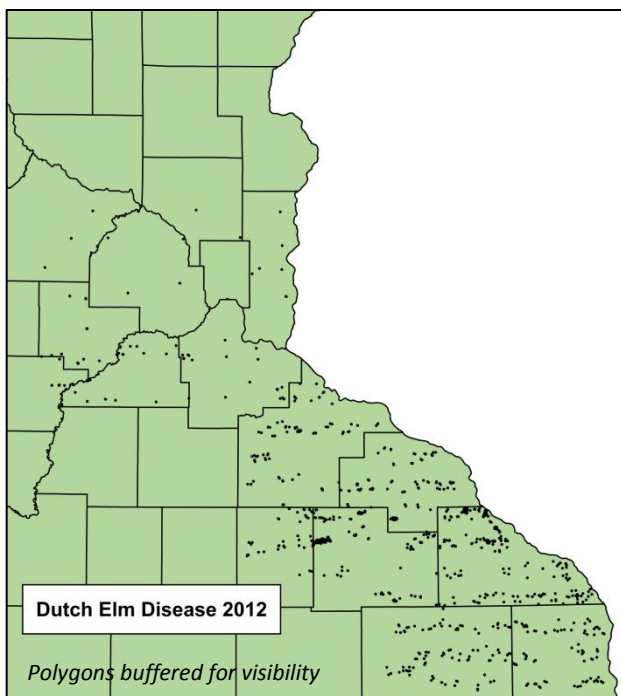
Hosts	Elm including American, Siberian, red, and rock
Setting	Rural and urban forests
Counties	See table below
Survey methods	Aerial survey
Acres affected	3,000 acres

Dutch elm disease, introduced to North America in the 1930's, is considered to be the most important disease of elms in the U.S. The fungus invades the water-conducting elements of the tree's vascular system causing wilting and death in all native and non-native elm species commonly found in Minnesota. American elm, once the most commonly planted shade and street tree in North America, is particularly susceptible.

First reported in Ramsey County in 1961, the disease initially spread slowly through the state, possibly due to poor cold tolerance of the most common vector, the European elm bark beetle (*Scoytus multistriatus*). While the disease spread rapidly in the southern third of the state where the non-native vector was more prevalent, the native elm bark beetle (*Hylurgopinus rufipes*) slowly assisted in northward spread. By the early 1980's Dutch elm disease had been recorded in 84 of Minnesota's 87 counties.

Since that time, losses in urban and suburban areas have decreased substantially, due in part to a drastic decrease in the number of surviving trees, but also due to community Dutch elm disease management programs and the development of systemic fungicide injections for remnant, high-value landscape trees. While most large specimens have disappeared from the natural landscape, losses in rural and forested areas continue steadily as elm regeneration seems to keep pace with the disease. Today, Dutch elm disease incidence is highest in the southeastern part of the state where *Ulmus* species are most abundant.

During aerial surveys in 2012, over 3000 acres were identified as being affected by Dutch elm disease. This represents a six-fold increase from 2011. In addition, the average size of affected areas increased significantly. We suspect that these increases reflect surveyor bias and a change in surveyor methodology rather than a very significant increase in disease incidence. In addition, persistent drought conditions resulted in symptoms that could be confused with Dutch elm disease during aerial surveys. While a drastic increase in disease incidence cannot be ruled out, we will await 2013 aerial survey data before confirming any short term trends.

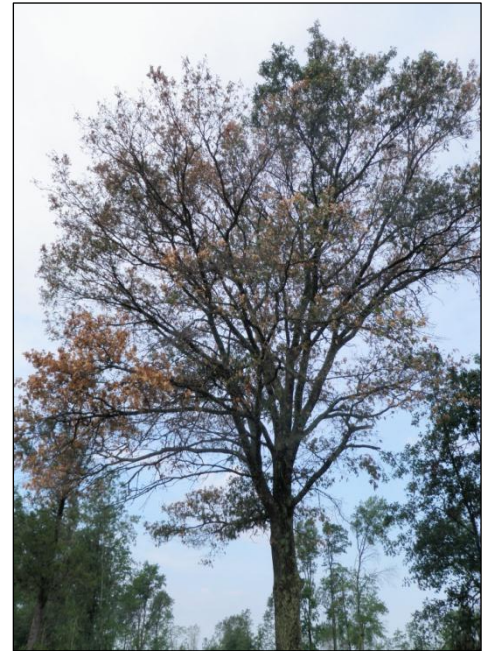


Counties with Dutch Elm Disease in 2012				
Anoka	Dodge	Hennepin	Scott	Winona
Carver	Fillmore	Houston	Wabasha	Wright
Dakota	Goodhue	Olmstead	Washington	

Oak wilt

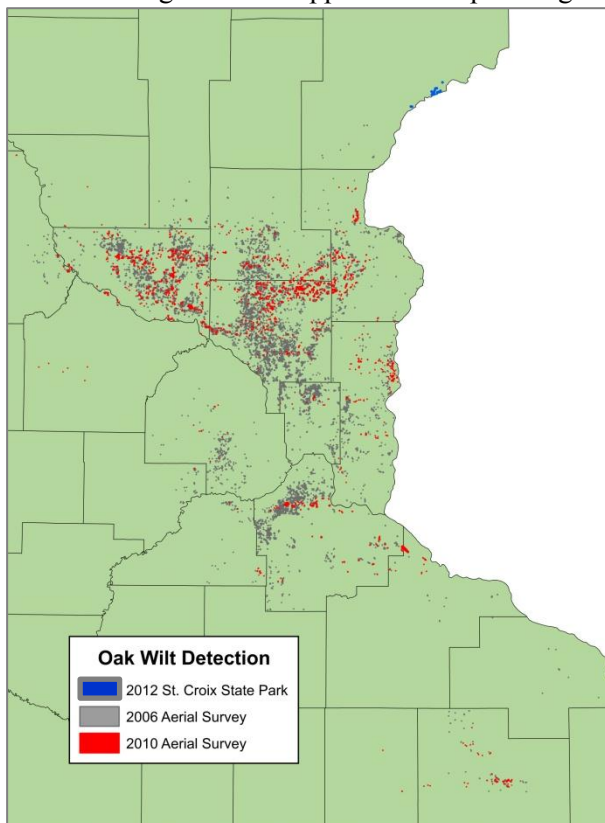
Ceratocystis fagacearum

Hosts	Red oaks and occasionally white oaks
Setting	Rural and urban forests
Counties	See map and table below
Survey methods	Aerial survey/ground detection
Damage	Mortality
Acres affected	3,500 acres



Oak wilt is a devastating disease of oaks caused by the non-native fungus *Ceratocystis fagacearum*. The fungus invades the water-conducting elements of the tree's vascular system causing rapid wilting and death, particularly in red oak species. First reported in five southeastern Minnesota counties in the early 1940's, the disease has spread north and west and can currently be found in 22 counties. During the federally funded oak wilt control program in the Metro area, new infestations "spread" north at about 7 miles per decade and west at 10 to 14 miles per decade. Control actions are now strictly land-owner initiated and funded, so we expect oak wilt disease centers in the currently affected areas to increase in size and abundance.

In July 2012, oak wilt was discovered in St. Croix State Park in eastern Pine County along the St. Croix River. This is the northernmost confirmed report of oak wilt in Minnesota (details, page 23). While oak wilt is known to occur and is prevalent in many areas of the southern and central part of the state, the new finds indicate that oak wilt is continuing to spread. This highlights the need to be vigilant about oak wilt prevention and detection even in areas where oak wilt has not historically been known to occur. Therefore, we plan to intensify monitoring and education efforts along the leading edges of the known distribution of oak wilt, particularly in the northern portion of the disease's range where it appears to be spreading more quickly.



During aerial surveys in 2012, over 3,500 acres were identified as being affected by oak wilt. This acreage is twice that noted in 2011. In addition, the average size of the disease centers increased dramatically. We suspect that these increases reflect a change in surveyor methodology rather than a very significant increase in oak wilt incidence; in particular, large continuous areas of discontinuous disease distribution were noted this year and individual disease centers were not identified. Since the resulting data portrays an inaccurate reflection of oak wilt distribution, the 2012 data is not shown.

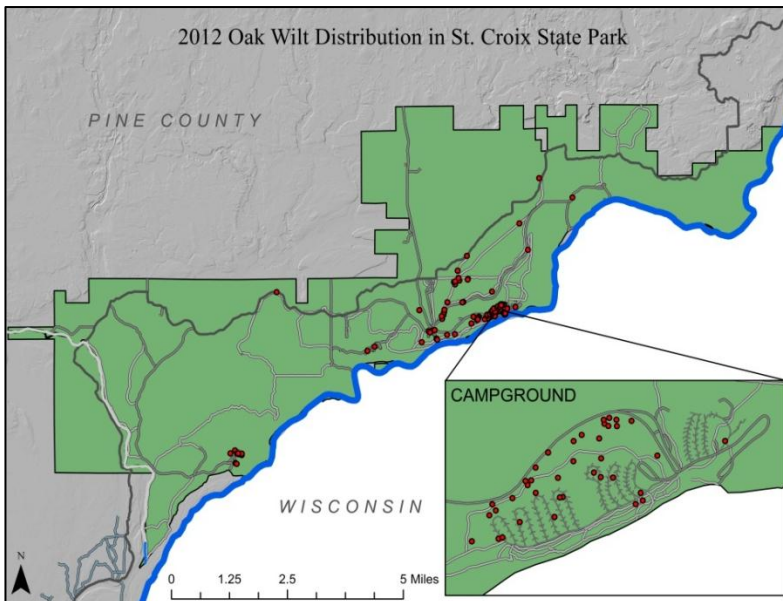
Oak Wilt Positive Counties 2012					
Anoka	Dodge	Isanti	Pine	Sherburne	Washington
Benton	Goodhue	Mille Lacs	Ramsey	Stearns	Wright
Dakota	Hennepin	Olmstead	Scott	Wabasha	

Northern-most oak wilt find in Minnesota

In July 2012 oak wilt was discovered throughout St. Croix State Park in eastern Pine County, the northern-most find of this vascular wilt disease in Minnesota. While oak wilt is known to occur and is prevalent in many areas of the southern and central part of Minnesota, this new find indicates that the range of oak wilt is continuing to expand in the state. Oak wilt was likely introduced to St. Croix State Park following a large storm and blowdown event in July 2011 that destroyed thousands of acres of forests. During the storm, many oaks were severely damaged and an abundance of fresh exposed wounds were available for infection. However, the insect vectors of the fungus usually travel less than a mile in search of fresh wounds, indicating that oak wilt was likely already present in the area, albeit at relatively low levels that escaped detection prior to the blowdown event.

Oak wilt is likely distributed over a larger area than currently reported, and under the right circumstances it can become a very serious issue. Currently St. Croix State Park is attempting to control over 30 known oak wilt disease centers. Disease centers form after a tree is killed and the fungus spreads into the root system and into neighboring trees through root grafts, resulting in an expanding pocket of dead and dying trees. Control of root graft transmission is costly and labor intensive. Therefore it is best to prevent the introduction of oak wilt into an area rather than attempting to manage a much larger problem.

Oak wilt management in the park began in the summer of 2012 when staff from the Division of Parks and Trails and the Division of Forestry conducted a thorough survey of the park to identify all symptomatic trees. Staff from the Forest Health Unit confirmed those trees positive for oak wilt in addition to those that needed to be monitored further. Park staff removed all confirmed positive oaks in late fall of 2012 to eliminate potential sources of inoculum, and will be installing root graft barriers lines with vibratory plows prior to the spring of 2013.



There is a significant risk that movement of firewood from infected trees could accelerate the spread of oak wilt across the state. Firewood permits are commonly issued on many state lands, including at St. Croix State Park. Many firewood harvesters are not aware of the risk posed by oak wilt, and may therefore inadvertently contribute to its spread by cutting and transporting wood from diseased trees. It was essential therefore that permit holders be educated to reduce the risk of spreading oak wilt to new areas. The Forest Health Unit prepared an alert addressing what precautions should be taken when planning to harvest oak firewood. In addition it explains what actions should be taken if oak firewood has already been harvested from an area where oak wilt is known to occur.

Black ash decline

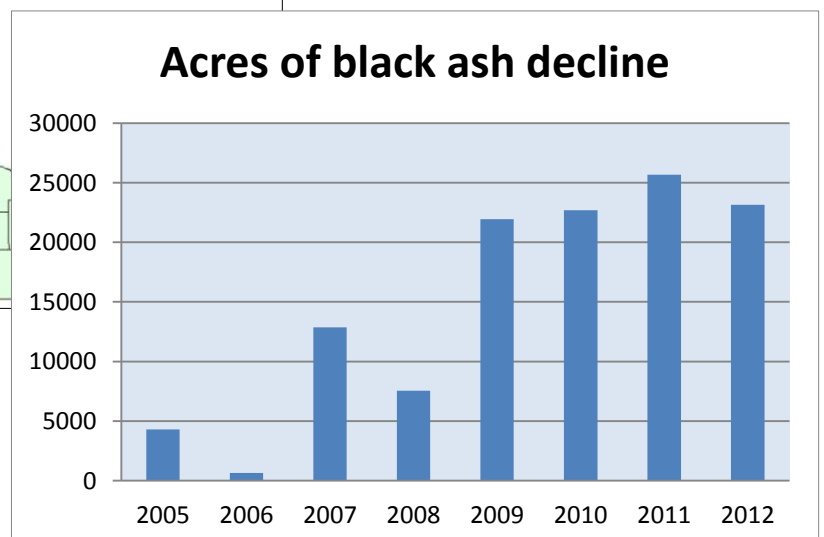
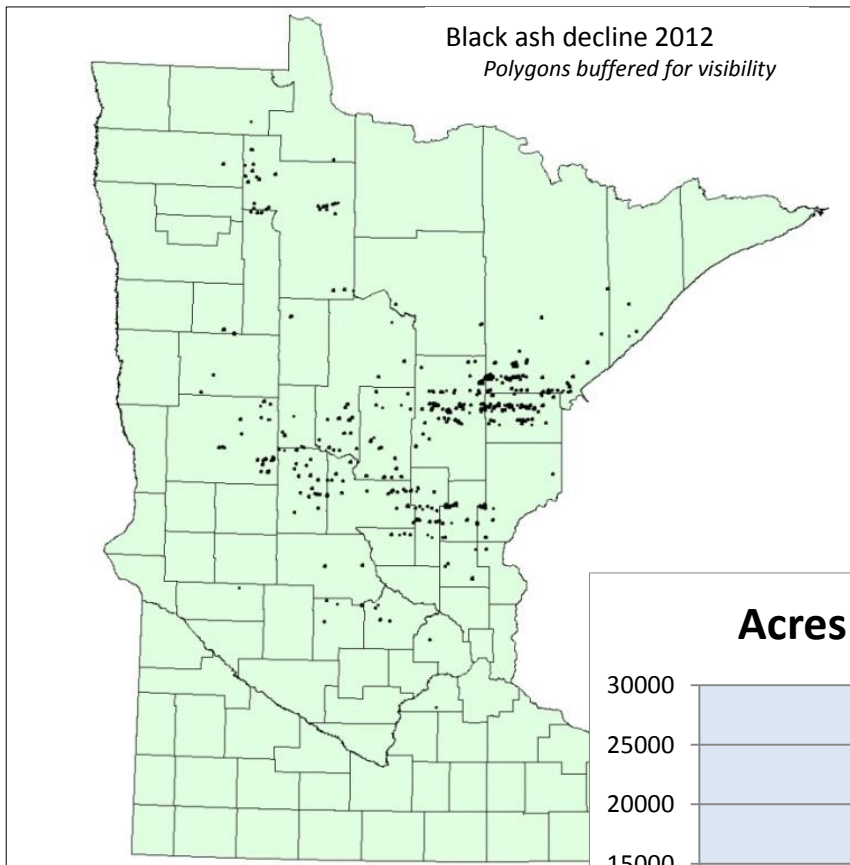
Hydrology changes and stress

Hosts	Black ash
Setting	Rural forests
Counties	See map
Survey methods	Aerial detection
Damage	Dieback and decline
Acres affected	23,152 acres

Ash decline occurred in 374 stands and was detected on 23,152 acres in 2012. Acres of ash decline were similar to last two year's tallies (see map and chart below). This is an ongoing problem in Minnesota. The most significant damage occurs in closed depressions and is thought to be related to bounces of the water table that occur on these sites, affecting rooting depth and available water for the trees. No significant insect or fungi are consistently found associated with declining trees.



Dieback in black ash, Aitkin County

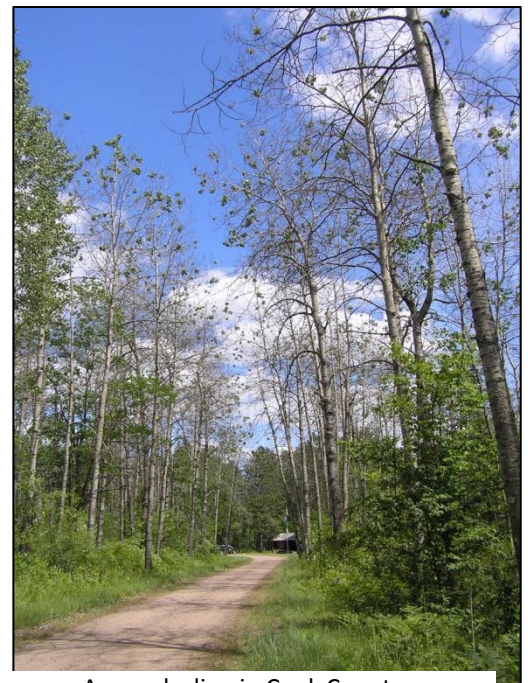


Aspen decline

Unknown agent(s)

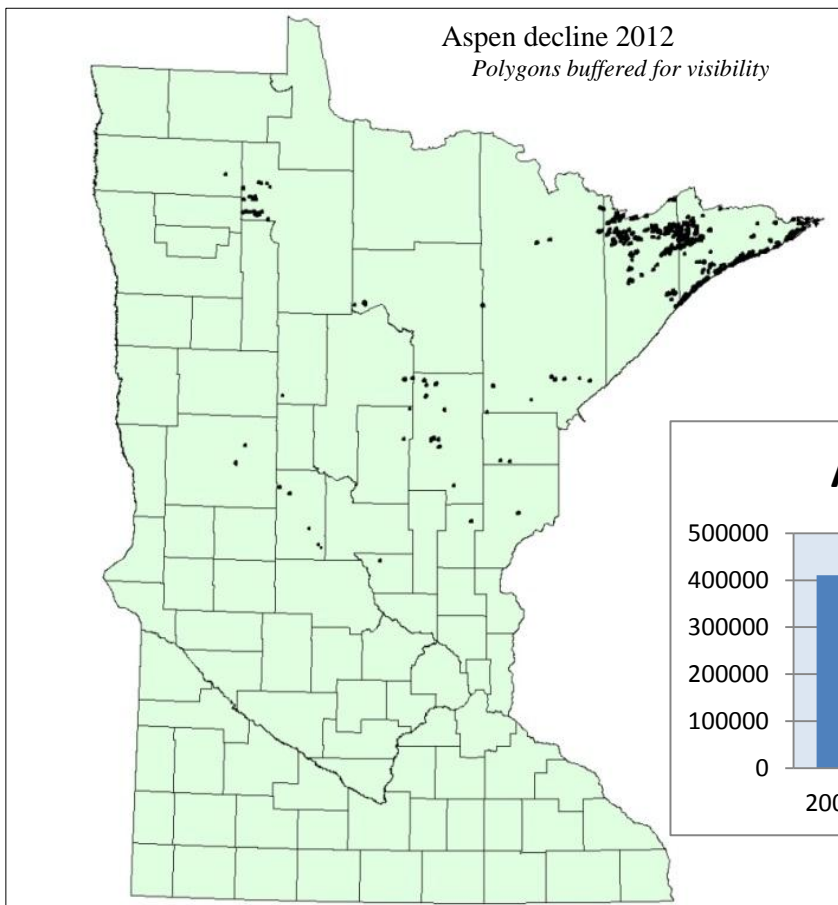
Hosts	Quaking aspen, paper birch
Setting	Rural forests
Counties	See map below
Survey methods	Aerial surveys
Acres affected	89,842 acres

Since 2004, aspen with symptoms of decline has been mapped by aerial survey sketch mappers (see acreage chart below). Symptoms have included combinations of defoliation, discoloration, dieback and mortality. The map below shows 277 polygons of aspen with current symptoms of aspen decline. More acres were mapped with aspen decline this year than last year.

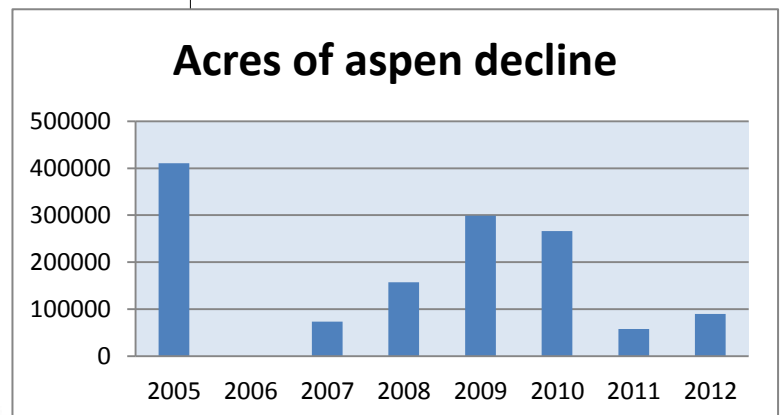


Aspen decline in Cook County

Dieback is the most common symptom but tree mortality has also occurred. Mortality can vary from scattered trees throughout a stand to patches of 30 to 40 dead trees scattered through stands. Trees with dieback often also exhibit small, off-color foliage in the live parts of the crown. Ground surveys have found serpentine galleries of bronze poplar borer on dead trees as well as in trees with extensive dieback.



Most of the dieback has been mapped in the northern tier of counties, especially in St. Louis, Lake and Cook Counties. It is thought that severe summer droughts, as well as three to four years of heavy forest tent caterpillar defoliation early in the decade stressed the aspen, resulting in attack by bronze poplar borers.



Drought

Lack of soil moisture

Hosts	All species
Setting	Rural and urban forests
Counties	Statewide; see maps below
Survey methods	Ground survey
Acres affected	88 percent of all lands
Damage	Dieback, decline and mortality caused by opportunistic pests



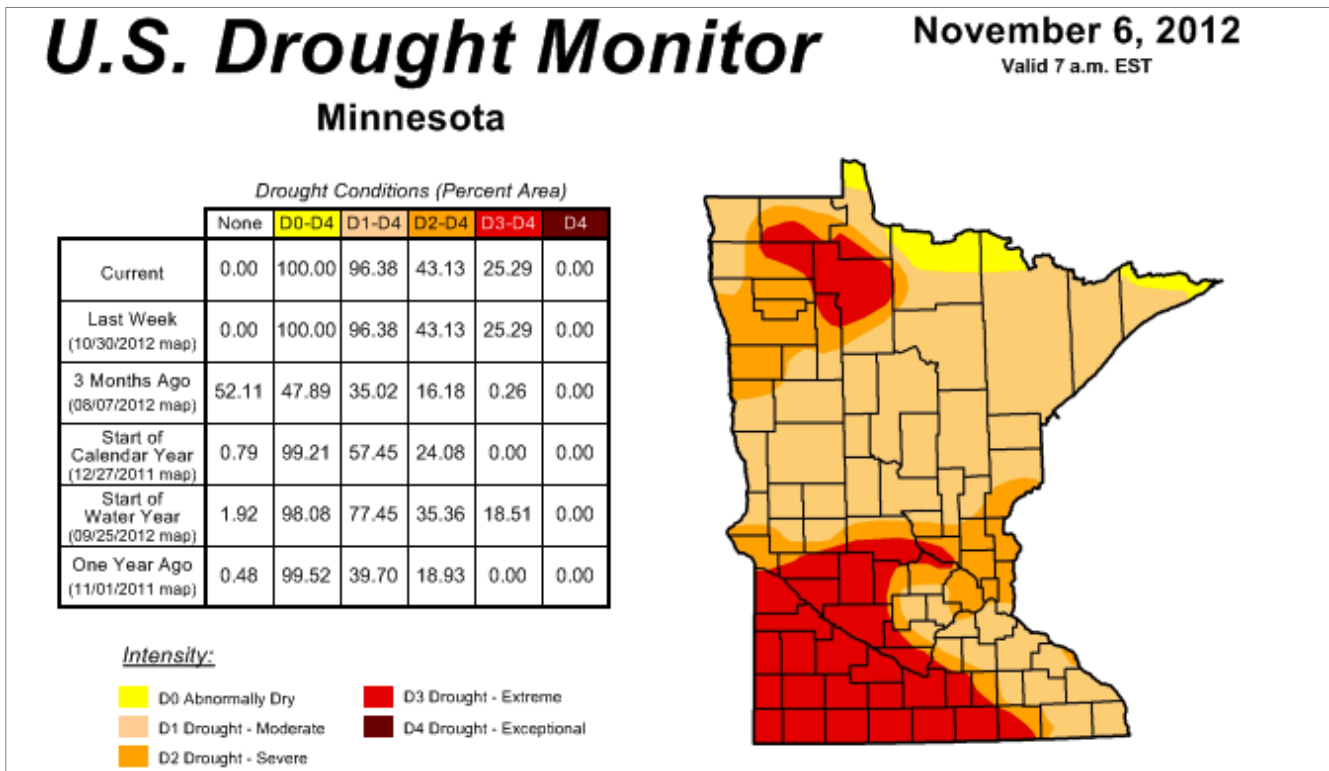
Leaf desiccation due to drought conditions

“It is reasonable to assume that the present drought status will remain relatively unchanged throughout the winter. The historical average precipitation over the next three months is a meager two and one-half inches and the topsoil will soon be sealed by frost. Without abundant spring rains, a number of critical drought issues involving public water supply, agriculture, horticulture, and tourism will rapidly emerge in the spring.” Greg Spoden, Minnesota State Climatologist.

Drought conditions

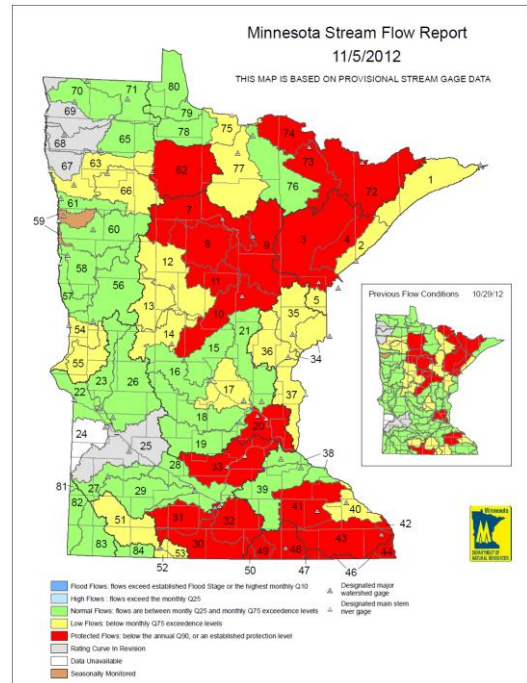
By Minnesota Climatology Working Group

http://climate.umn.edu/doc/journal/drought_2012.htm



The U. S. Drought Monitor, released on November 29, places large portions of northwest, west central, southwest, and south central Minnesota in the Extreme Drought category (map below). Over 80 percent of Minnesota's landscape is in Extreme Drought or Severe Drought. Subsoil moisture across 88 percent of Minnesota's landscape was said to be *Short* or *Very Short* as of October 31.

Stream flow measurements at reporting stations in the driest areas of the state rank below tenth when compared with historical data for the date. Those units are mapped in red on the Minnesota Stream Flow Report map at right.

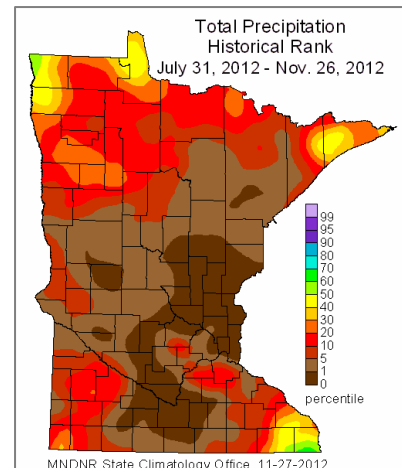
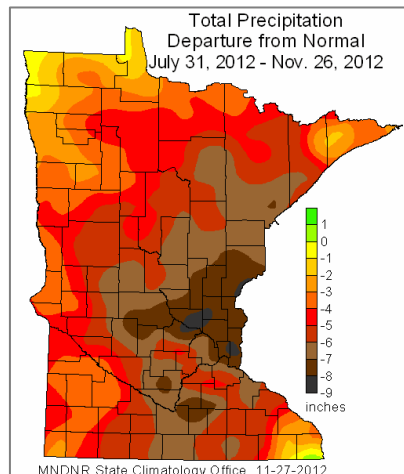
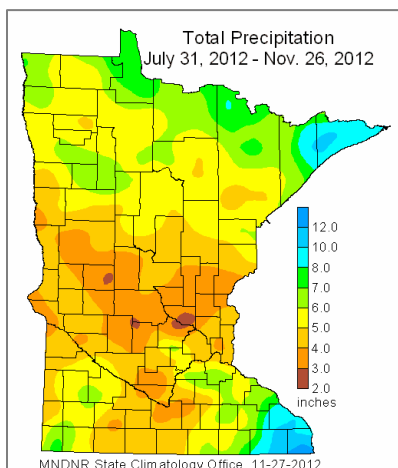


Minnesota's drought situation is the result of abnormally dry weather over three distinct time periods (maps below). In some communities, precipitation deficits amplified the drought situation during each of these spells of dry weather. In other communities, dry periods were interrupted by wet weather in spring 2012, only to have precipitation shortfalls degrade the situation yet again.

Here are the three drought-producing scenarios:

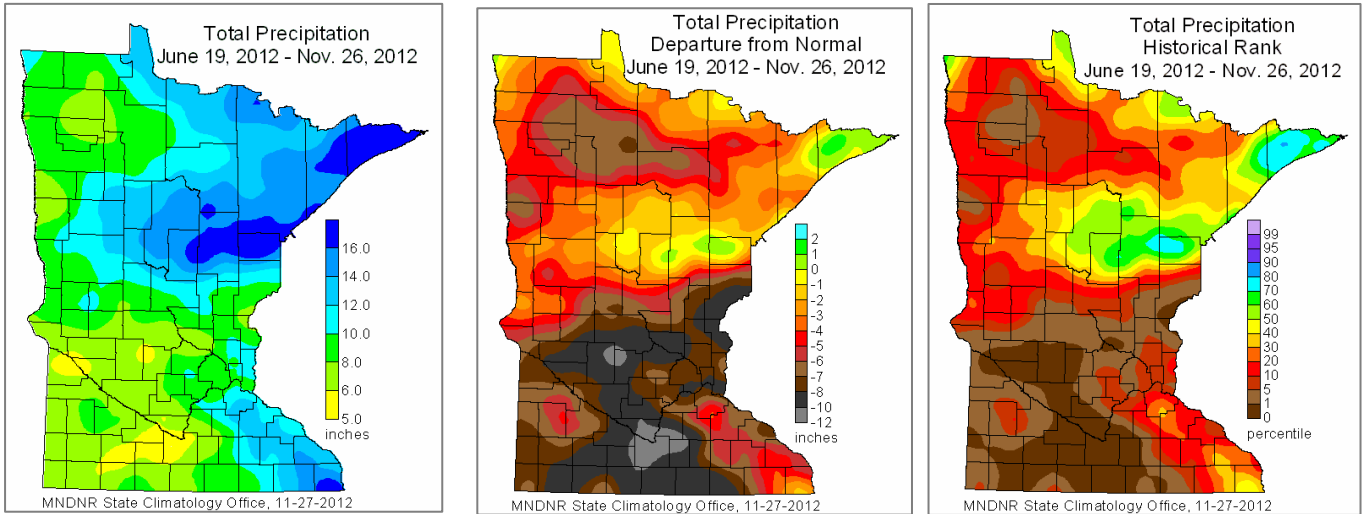
Drought Situation #1 - August 2012 through November 2012

Extraordinarily dry conditions during the months of August, September, October, and November caused rapid drought development in areas of Minnesota previously outside of the severe drought regions that developed earlier in the growing season. For those areas already undergoing significant drought, the late-summer/autumn extreme dryness exaggerated pre-existing conditions. Many locations reported less than four inches of precipitation over the four-month month period. For large portions of Minnesota, August through November 2012 rainfall totals ranked at or below the lowest on record.



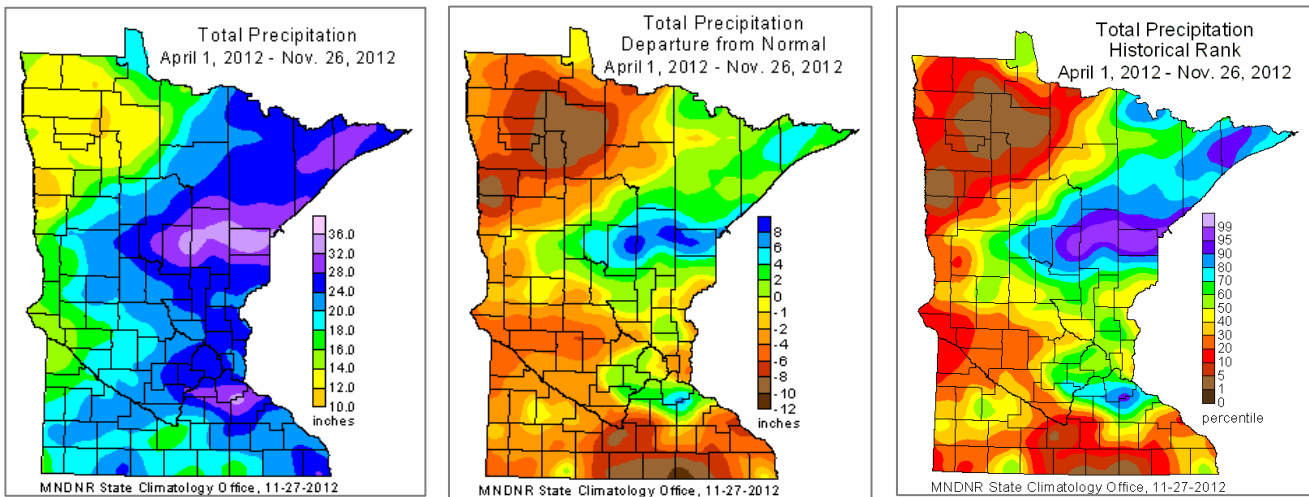
Drought Situation #2 - Late June 2012 through November 2012

The moisture deficits in southern Minnesota developed rapidly due to very hot and very dry conditions during the mid-summer and through the autumn. Over the period, rainfall totals in many Minnesota counties fell short of average by six or more inches. This is the climatological equivalent of missing nearly two months of growing season precipitation. In some southern Minnesota communities, mid-summer through autumn rainfall deficits were in excess of eight inches.



Drought Situation #3 - Autumn 2011 through November 2012

The drought situation in northwest Minnesota and in far southeast Minnesota is the result of an historically dry autumn 2011, a snow-sparse winter, and amplified by the dry intervals described above.



Winter Drying

Hosts	Conifer species
Setting	Rural forests
Counties	Cook, Lake and St. Louis
Survey methods	Ground surveys
Acres affected	Not determined
Damage	Discoloration, dieback, possible mortality



Some winter-burn or winter injury of conifers occurs every year. The buds are almost always healthy and by July the damage is covered up by the new growth and mostly forgotten. This year, however, some very severe winter injury including some mortality occurred in the northern portions of St. Louis, Lake and Cook Counties.

The damage in northern Cook County was most severe on white spruce with less amounts of damage on balsam fir, jack, white and red pines. The buds on most of the pines were healthy and produced new shoots and needles. The needles on white spruce with the most severe winter burn all turned brown and fell off the trees. A lot of these white spruce had live, healthy buds; however, on some trees, all of the buds were dead. This resulted in some scattered mortality of white spruce.

Parts of NE Minnesota went through the summer of 2011 and into the winter in drought. Warm temperatures during the winter contributed to needle desiccation. On top of that, record-setting warm weather began in March when the ground was still frozen, causing more needle and bud drying. In early May, affected parts of the state were still listed as being in severe drought by the Long Term Palmer Drought Severity Index, reducing the available moisture for trees to start new growth in the spring. This resulted in unusually severe winter-burn and tree mortality in some locations.



Winter-burn in Cook County, early spring

Blowdown

Hosts	All species
Setting	Rural forests
Counties	See map
Survey methods	Aerial detection
Acres affected	15,800 acres
Damage	Stem breakage, windthrow, and mortality

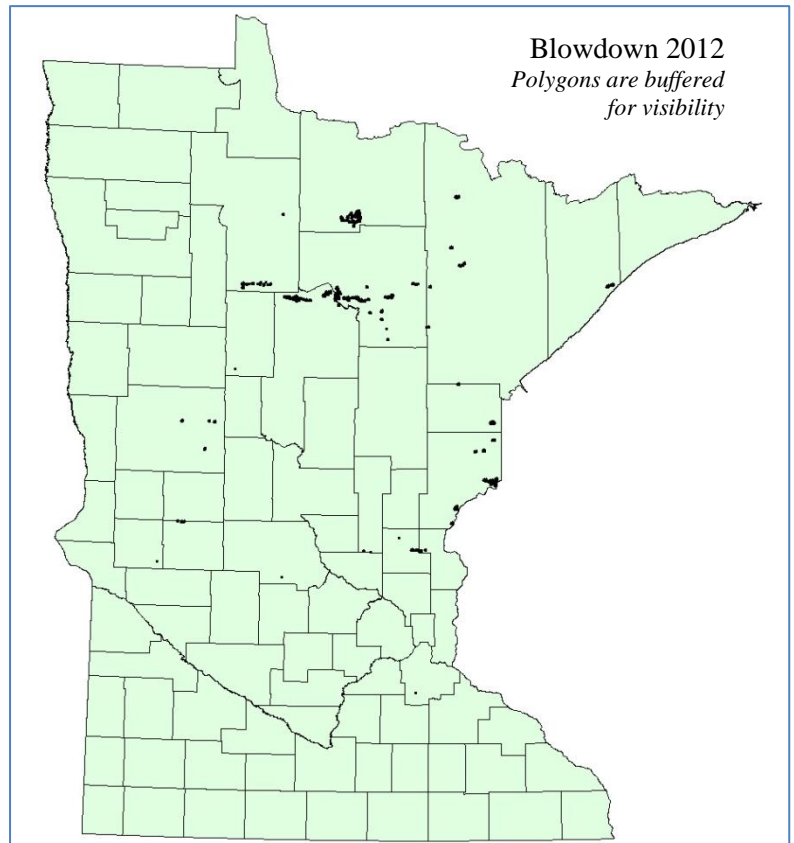
The largest event, a derecho, occurred in early July. The storm started west of Bemidji, traveled through three heavily-wooded counties and went past Grand Rapids. From aerial survey, 7700 acres were mapped immediately after the event. The other large event occurred in Koochiching County and affected 2800 acres. In areas affected by blowdowns, the build-up of opportunistic insects can be a mortality problem for the following two years in pines, oaks and birches. Rapid and thorough salvage of the downed trees and snapped-off trees is recommended.



Slash pile and surviving trees from windstorm in Beltrami County



DNR foresters with pine log deck salvaged from fallen trees



List of invasive species not known to be in MN

Asian long- horned borer
Beech bark disease
Dogwood anthracnose
Fusiform rust
Hemlock wooly adelgid
Laurel wilt disease
Sirex woodwasp
Sudden oak death

Invasive Species Grant Projects

Every year, both the USFS and the DNR Division of Ecological and Water Resources (EWR) distribute requests for proposals for work on invasive species. The Division of Forestry has been successful in obtaining three USFS competitive grants in as many years, as well as funding through EWR in each of the last several years. As our budgets continue to decline, we are grateful for their contributions. The following is a summary of the work this year funded through those organizations.

EWR Grants

In Fiscal Year (FY) 12 (ending June 30, 2012), Forestry received \$41,000.00 from EWR, down from a high of \$276,000 in 2009. With that we were able to fund six field projects and a portion of an outreach project. Two field projects were devoted to buckthorn detection and management based on detection methods developed under earlier EWR grants. Aerial photography was taken over approximately 19,000 acres in the Sand Dunes and Fond du Lac State Forests, and Jay Cooke State Park. The areas were flown in early November after oak leaf drop, but before buckthorn had turned fall color. Buckthorn plants as small as four to five feet tall can be detected from the air, even under pine plantations, if the weather cooperates. Spring ground-truthing helped eliminate the false positives so fall management practices can be planned and prioritized.

Twenty acres were treated with herbicides in two (Aitkin and Littlefork) road-side noxious weed projects. Seventy-five acres were treated for buckthorn management. Aitkin area used a cut-stump approach on roughly 40 acres, while Lake City grazed goats on a rotation basis on 32 acres of woodlands. Monitoring during FY13 will help determine treatment success.

EWR outreach funding supplemented Forestry funding to develop a brand identity for **PlayCleanGo**, a new outreach campaign developed for the purpose of disrupting the link between outdoor recreation and the spread of terrestrial invasive species. The Forestry division was able to hire the same contractor who developed the *Stop Aquatic Hitchhikers!* brand for the Fish and Wildlife Service many years ago. Together with an interagency team, Forestry developed the campaign identity, an array of brand messaging and the initial website needed to reach recreational trail users and campers. Visit www.playcleango.org to learn more about the program and read below about the USFS grant to formally launch the program during FY13.

The division received another EWR grant in FY13 of \$35,000.00. Three of the projects started this year will focus on buckthorn management at the area level. One will again tackle noxious weeds along forest rights-of-way and one will supplement USFS grant funding for a large buckthorn project.

Forest Service Grants

In 2010, a three-year grant was received from the USFS to address woody invasive species along the Kettle and St. Croix scenic waterways. Because of the 2011 blow down and 2012 flood, the three-year project was extended to June 30, 2013. In 2012, the last of the state lands within a 100-mile buffer of either river was inventoried along with fourteen tracts of community or privately-owned land within the Scenic River boundaries. At times using river accesses to shuttle from spot to spot, crews of two to five walked side-by-side up each section of the river that could be walked (major bluffs were excluded), to map all woody invasive species and garlic mustard infestations. County staff did the same for the various community and private land participants. Federal funds were then matched through management projects carried out on those state, city and private lands found to be infested.

Two new USFS grants were received in FY12 and the projects started in FY13. The first is a large buckthorn project to survey and map buckthorn on state lands along a wide swath of the state running roughly between Sandstone and Detroit Lakes. Based on existing data, this area seems to be the “leading edge” or transition zone between areas heavily infested with buckthorn and areas with little to no buckthorn within their native plant

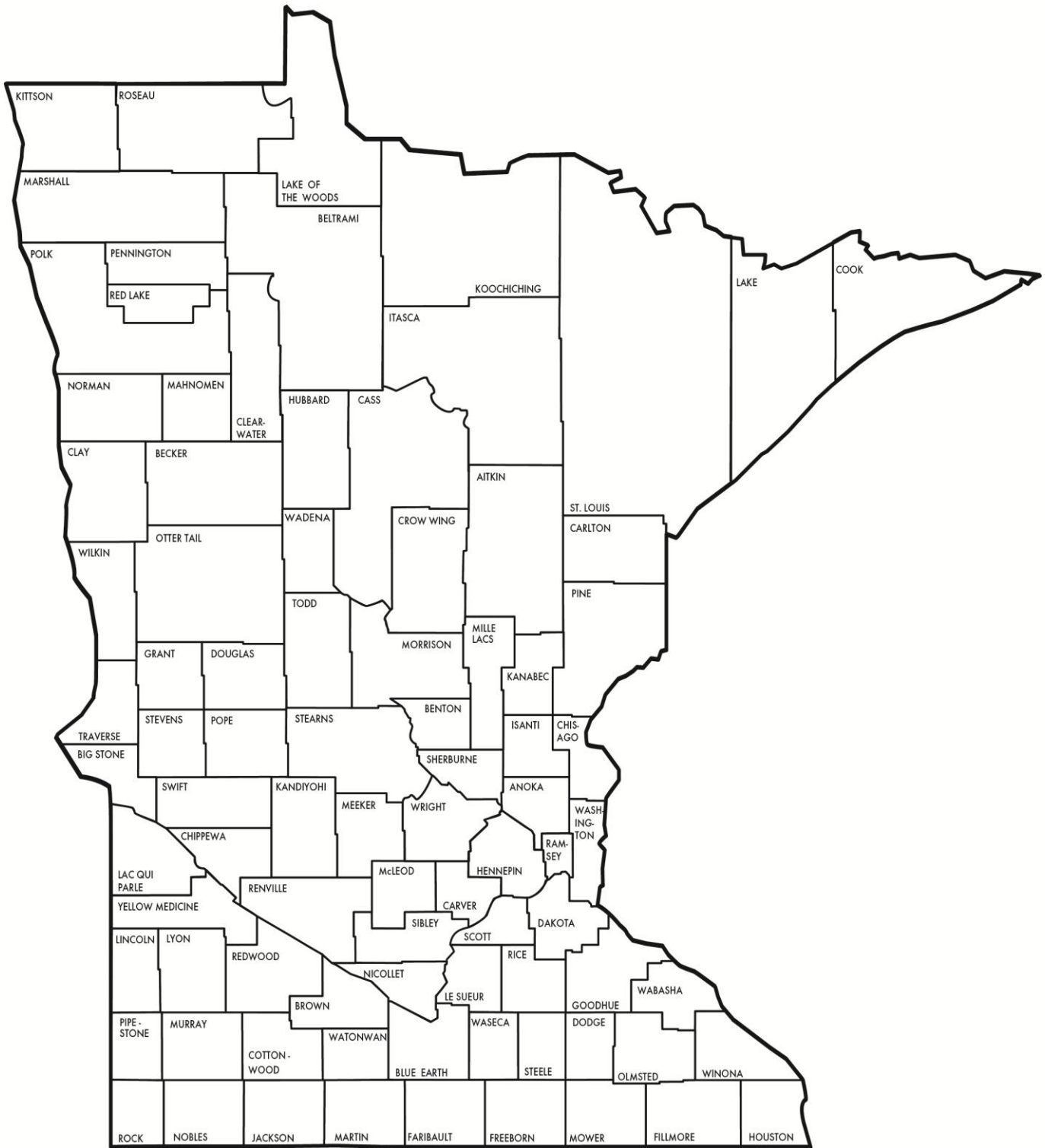


communities (community forests are another matter and a source of infestation for neighboring lands). Approximately 300,000 acres of state forest and wildlife lands were flown in October. Photo interpretation will continue through early spring, with management projects to start next fall.

The second project is the formal launch of **PlayCleanGo**. An initial “soft” launch was done in FY12 when the website went live. Several TV ads were aired on channels 5 and 45 and the program was featured in a large new invasive species exhibit in the Minnesota State Fair DNR building. Through a broad mailing to cooperators in forest health and invasive species management, organizations were invited to become **PlayCleanGo** partners. Partners, given full access to **PlayCleanGo** graphic and media resources, now include several state and federal agencies and two recreational organizations. The USFS grant will be used for a formal launch this next spring. A marketing plan will be developed and executed over the next two years, and then in the third year, a large phone survey will be conducted to assess knowledge and behaviors among Minnesota recreationists. The survey results will be compared with baseline survey data obtained in 2009 under an earlier USFS grant to determine the success of the outreach campaign and how it can be expanded in the future.

Acronyms

APHIS PPQ	USDA Animal and Plant Health Inspection Service, Plant Protection and Quarantine
DNR	Minnesota Department of Natural Resources
EAB	Emerald ash borer
EWR	DNR Division of Ecological and Water Resources
MDA	Minnesota Department of Agriculture
MNDOT	Minnesota Department of Transportation
S&PF	USDA Forest Service State and Private Forestry
USFS	USDA Forest Service



Minnesota Counties