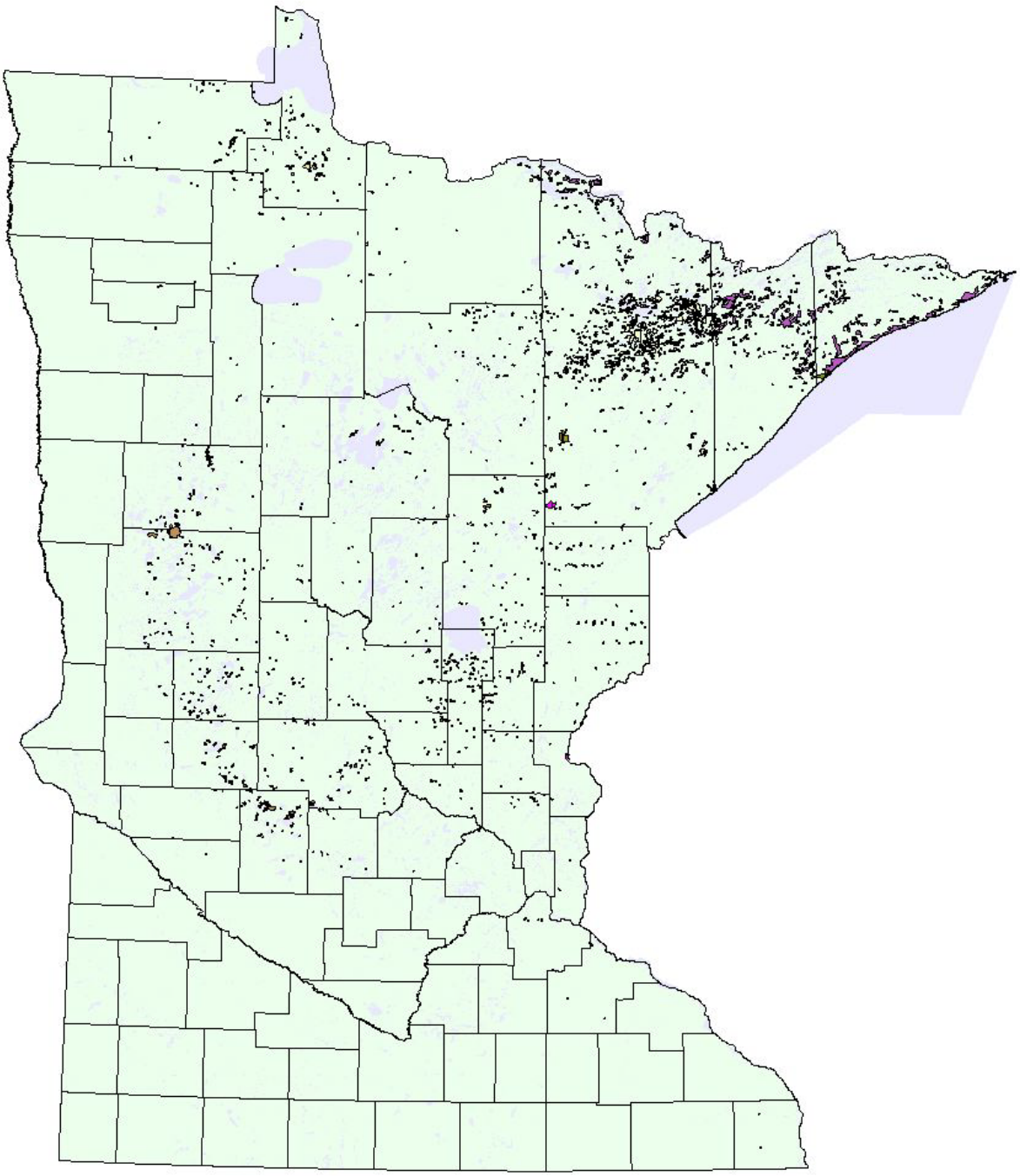
2010
Minnesota
Forest Health Highlights



Prepared by Minnesota Department of Natural Resources,
Division of Forestry, Forest Health Unit

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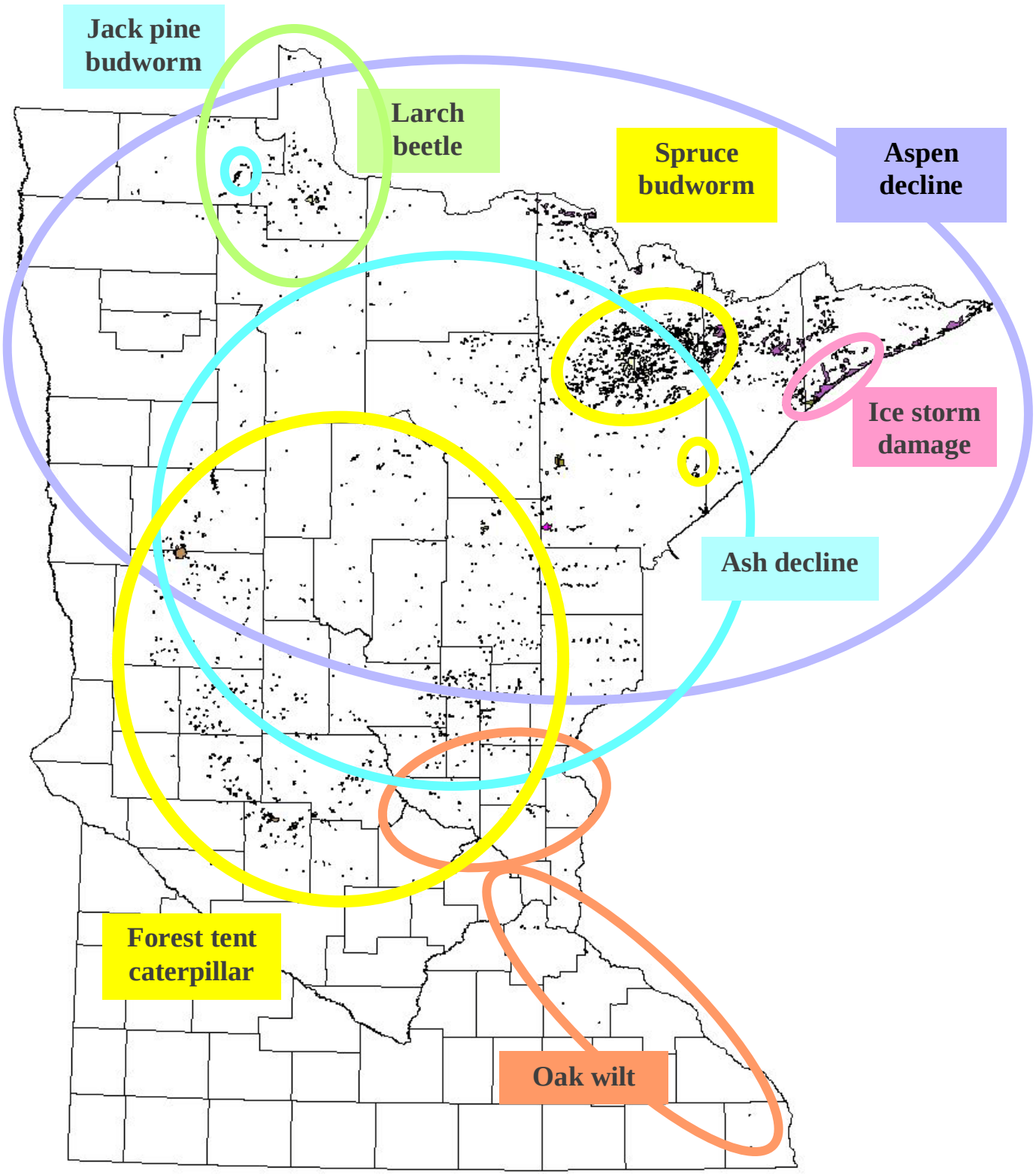
Aerial Survey Results 2010



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 DNR Forest Health and Resource Assessment Units and USFS, State and Private Forestry. 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 USFS's national database since our procedures and products comply with national standards.

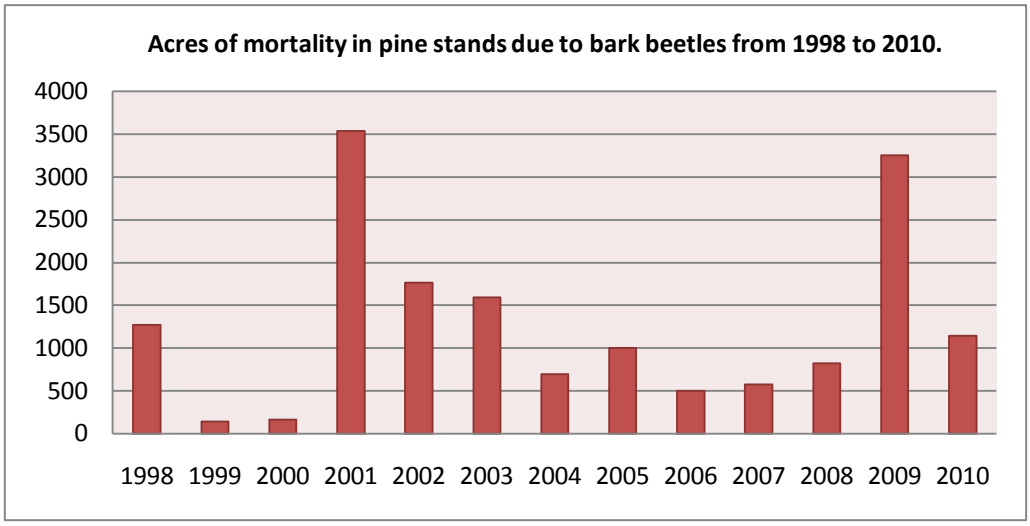
Thanks to Mike Hoppus, Pat Churak and Larry Hoyt, Resource Assessment's sketch-mappers, who accomplished this year's aerial survey. Thanks also to Marc Roberts, USFS-S&PF, for mapping the federal lands and to Quinn Chavez, USFS-S&PF, for post-flight map rectification.

Agent	Number of polygons	Number of acres
Ash decline	566	23,092
Aspen decline	245	68,050
Hardwood decline	499	198,304
Bark beetles	175	1143
Dutch elm disease	532	406
Eastern larch beetle	1648	18,817
Fire	20	753
Flooding	81	478
Forest tent caterpillar	829	70,665
Jack pine budworm	16	1,052
Larch casebearer	105	15,387
Oak wilt	2065	3,397
Snow/ ice damage	16	12,618
Spruce budworm	440	121,370
Two-lined chestnut borer	81	56
Wind damage/ tornado	45	2,007
Winter injury	1	197
Totals	**7364**	**537,792**

Year	2010
State	Minnesota
Forest pest	
Common name	**Bark beetles**
Scientific names	*Ips* spp. and *Dendroctonus* spp.
Hosts	Red and jack pines
Setting	Rural and urban forests
Counties	See map below
Survey methods	Aerial and ground detection
Acres affected	1,143 ac

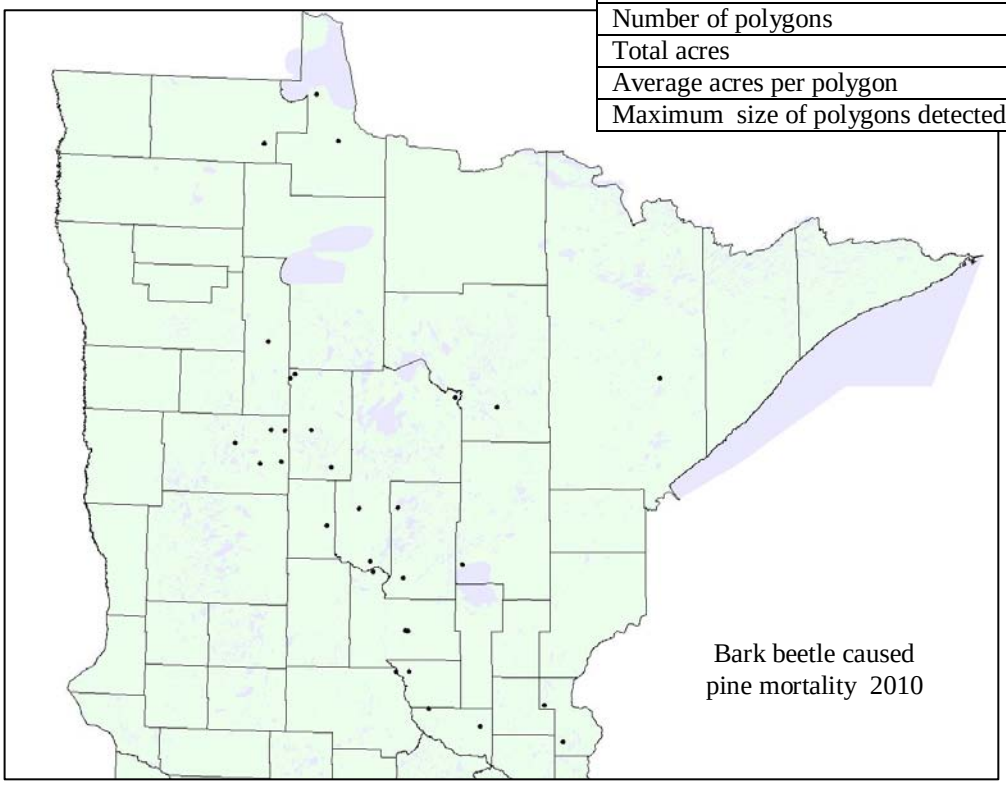
Narrative

This summer 1,143 acres of bark beetle caused mortality were detected during the aerial survey. See table and map. This was less than a third of the acreage found last year. See table for other comparisons. This decrease can be attributed to the abundant rainfall during the spring and summer in most of the state.



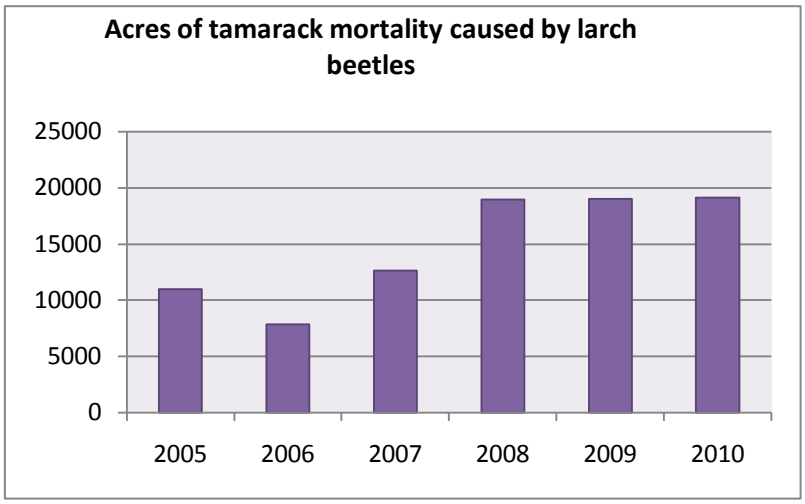
Comparison of bark beetle polygons between 2009 and 2010.

	2009	2010
Number of polygons	218	175
Total acres	3,657 ac	1,146 ac
Average acres per polygon	21.7 ac	6.5 ac
Maximum size of polygons detected	953 ac	70 ac



Year	2010
State	Minnesota
Forest pest	
Common name	**Eastern larch beetle**
Scientific names	*Dendroctonus simplex*
Hosts	Tamarack
Setting	Rural forests
Counties	See map.
Survey methods	Aerial detection
Acres affected	18,817
Narrative	

In 2010, an additional 18,817 acres with tamarack mortality were mapped during the aerial survey. This is about equal to the number of acres mapped in 2009. Most of the mortality mapped this year was in northwestern Minnesota in Lake of the Woods, Roseau and Beltrami Counties. Scattered mortality was also found throughout the range of tamarack in the state. See chart and map.



Larch beetle adults, larvae, and pupae, overwinter in attacked trees. Adults emerge in the spring, seek out and bore into suitable live trees or fresh logging slash. There they construct galleries and lay eggs. Larvae hatch from the eggs, feed on the phloem and eventually pupate and change into adults about 4 mm long. There is only one generation per year but female larch beetles may produce up to 3 broods per year.

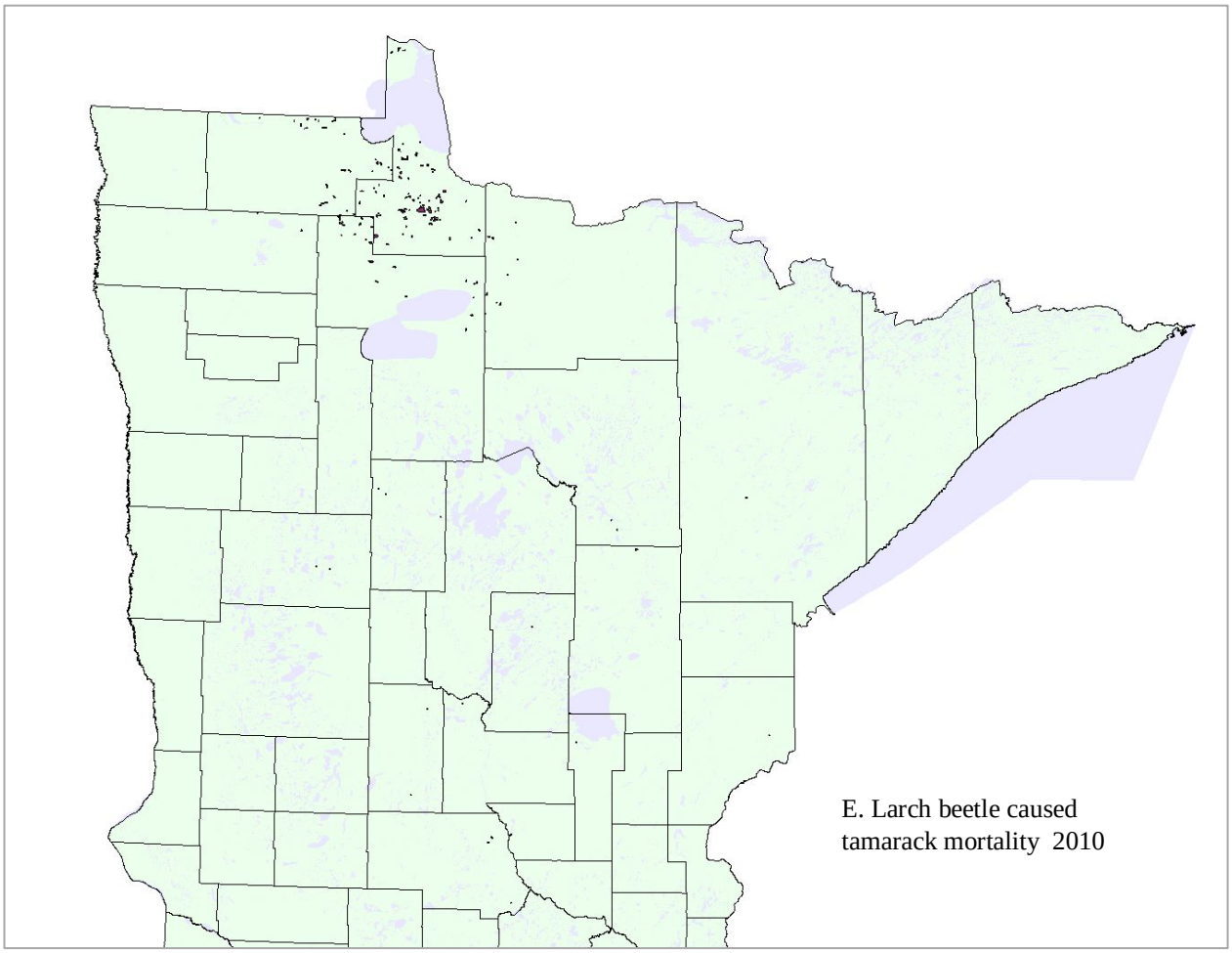
An outbreak of larch beetle has been occurring in Minnesota since 2000. During this same time period we have also experienced an unusual outbreak of larch casebearer and it has been suggested that the larch casebearer defoliation has been stressing the tamarack leading to attack and mortality from eastern larch beetles. However, this does not appear to be the case in Minnesota. Less than 5 percent of the acres with larch beetle mortality have also been defoliated by larch casebearer.

A number of stress factors are likely contributing to the current mortality. Droughts and resulting fluctuating water levels in 2002-2003 and 2006-2009 are likely involved. Warmer winter temperatures may also be involved. Since the larch beetles overwinter in the above ground parts of the tree warmer winter temperatures appear to allow more to survive the winter building up larger populations resulting in more tree mortality.

Dr Rob Venette, USDA FS NRS and Abby Walter, UMN Graduate student at U of MN, investigated the seasonal changes in supercooling points of the eastern larch beetle and related these to historical winter temperature records in Minnesota. Eastern larch beetle adults, larvae and pupae are freeze intolerant. They survive winters by supercooling. Suprisingly, the larvae were found to be more winter hardy than the adult beetles. In December, larvae supercooled at a lower temperature (-56F) than adults (-43F).

Over the past 40 years, winters have become less severe. Venette and Walter found that the low temperatures in Isle, MN have increased by approximately 0.25C per year from 1964 - 2004. Since eastern larch beetle larvae are extremely cold-tolerant the warming winter temperatures have had very little impact on their overwintering success. However, warming has had a substantial impact on adult overwintering success. They predicted that on average, adult survival has increased by 0.7% per year from 1964-2004. So adult overwintering success in the early 2000's, was predicted to be about 25 to 30% higher than in the mid-sixties. Larger overwintering populations of adult larch beetles could produce larger populations of offspring the following summer that may be able to overwhelm the defenses of tamarack trees and kill them.

While the causes of the eastern larch beetle outbreak in Minnesota are not fully understood, combinations of drought, stand, and site conditions likely contribute to the resulting mortality in individual stands. Warmer winters resulting in greater overwintering success by eastern larch beetle adults may also play a role.



E. Larch beetle caused tamarack mortality 2010

Year	2010
State	Minnesota
Forest pest	
Common name	**Emerald ash borer**
Scientific names	*Agrilus planipennis*
Hosts	All ash species
Setting	Urban and rural forests
Counties	Houston (new find), Ramsey and Hennepin Counties
Survey methods	Trapping, girdled trees and general observation
Acres affected	Not determined.
Narrative	

As we expected in 2009, the Minnesota Department of Agriculture (MDA) confirmed the presence of emerald ash borer (EAB) in Houston County in late April this year. The infested trees were in the Upper Mississippi River Fish and Wildlife Area, about one mile from the infestation that was found in 2009 in Victory, Wisconsin. Houston County was already under state and federal quarantine because of the expectation it would be found in Minnesota after its discovery in nearby Victory.

To monitor populations of EAB, MDA staff placed 2,840 purple prism traps statewide, with placement in three categories: risk-based, grid-based and quarantine trapping. Risk-based traps were placed at campgrounds, compost or environmental waste sites and at various other locations considered high-risk. See maps that follow. Grid-based traps were placed to monitor the front line of EAB movement in seven counties along the St. Croix and Mississippi Rivers. Traps were placed based on 1.5 square-mile grids covering Anoka, Washington, Dakota, Goodhue, Wabasha, Winona, and Houston counties.

Quarantine trapping in Hennepin and Ramsey counties focused on detecting EAB movement in the known infested areas of St. Anthony Park in St. Paul and Prospect Park in Minneapolis. Using EAB population densities and ash tree inventories provided by the cities of Minneapolis and St. Paul, traps were hung in an attempt to measure how far these infestations have grown so that mitigation strategies can be employed. Traps were also placed in suburbs and in other outlying communities of Hennepin and Ramsey Counties.

Fourteen EAB adults were found on traps throughout the survey season, all from the known infested areas. Four adult beetles were collected from traps placed by MDA: two in Houston County and two in the St. Paul-Minneapolis infested area. Ten beetles were collected from traps placed by U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) staff in the St. Paul-Minneapolis infested area.

In addition, 135 trees found positive for EAB were removed in the St. Paul-Minneapolis infested area.

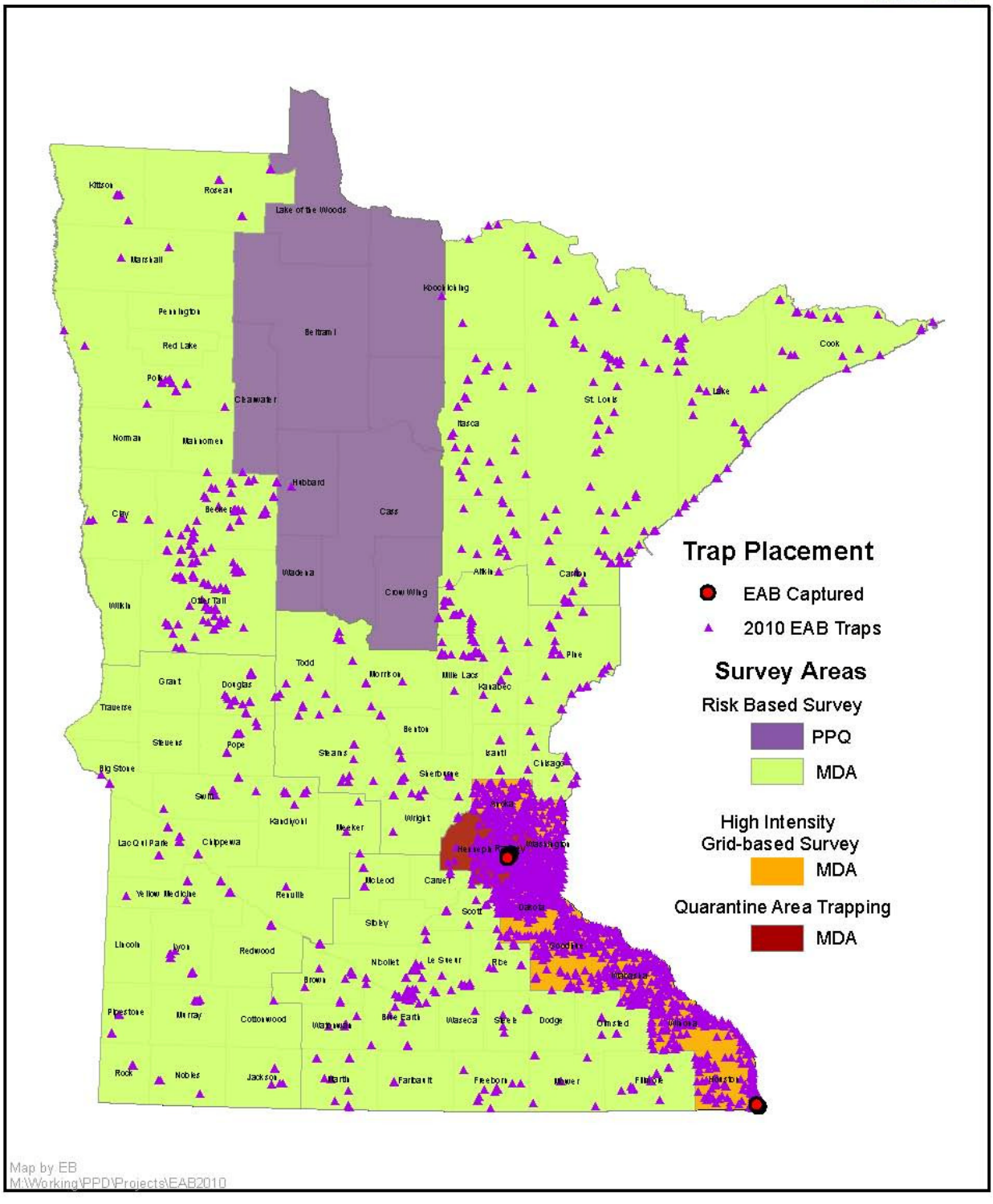
In September, MDA and partners including APHIS, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and the Minnesota DNR conducted the state's first release of parasitic wasps as a biological control effort to slow the spread of EAB. The release took place in the infested area of Houston County. See last map. The two species of larval parasites were approved for release and reared by APHIS in Brighton, Michigan. *Tetrastichus planipennisi* adults find and insert their eggs into EAB larvae. With *Spathius agrili* , the wasp eggs and developing wasps are attached to the outside of EAB larvae. The developing wasps feed on and eventually kill the EAB larvae. MDA released the wasps after extensive testing confirmed they will not harm people, other animals or the environment.

Geir Frisoe, MDA, releases EAB parasites.

2010 EAB Trap Placement

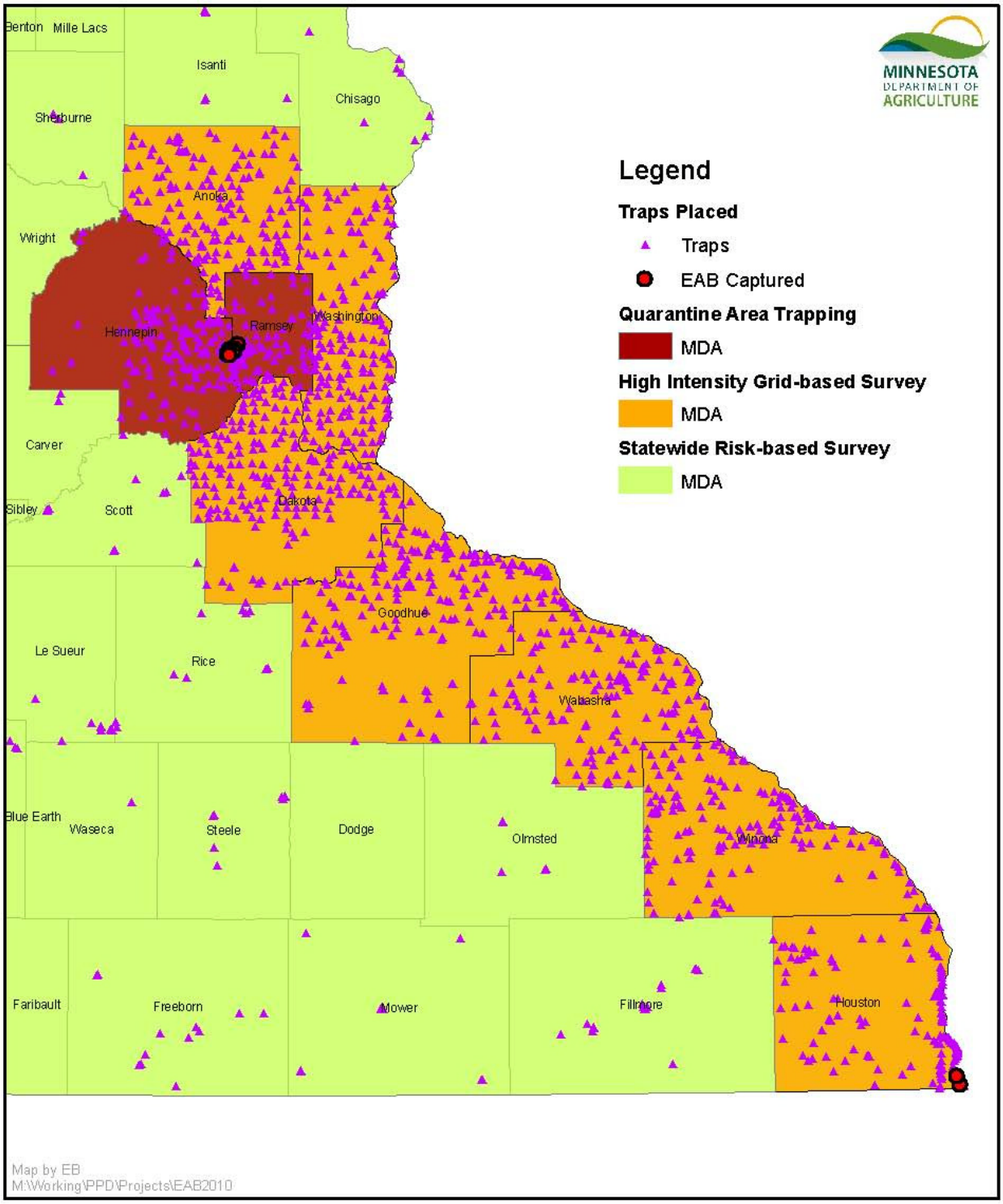
Updated: September 23, 2010

MINNESOTA DEPARTMENT OF AGRICULTURE



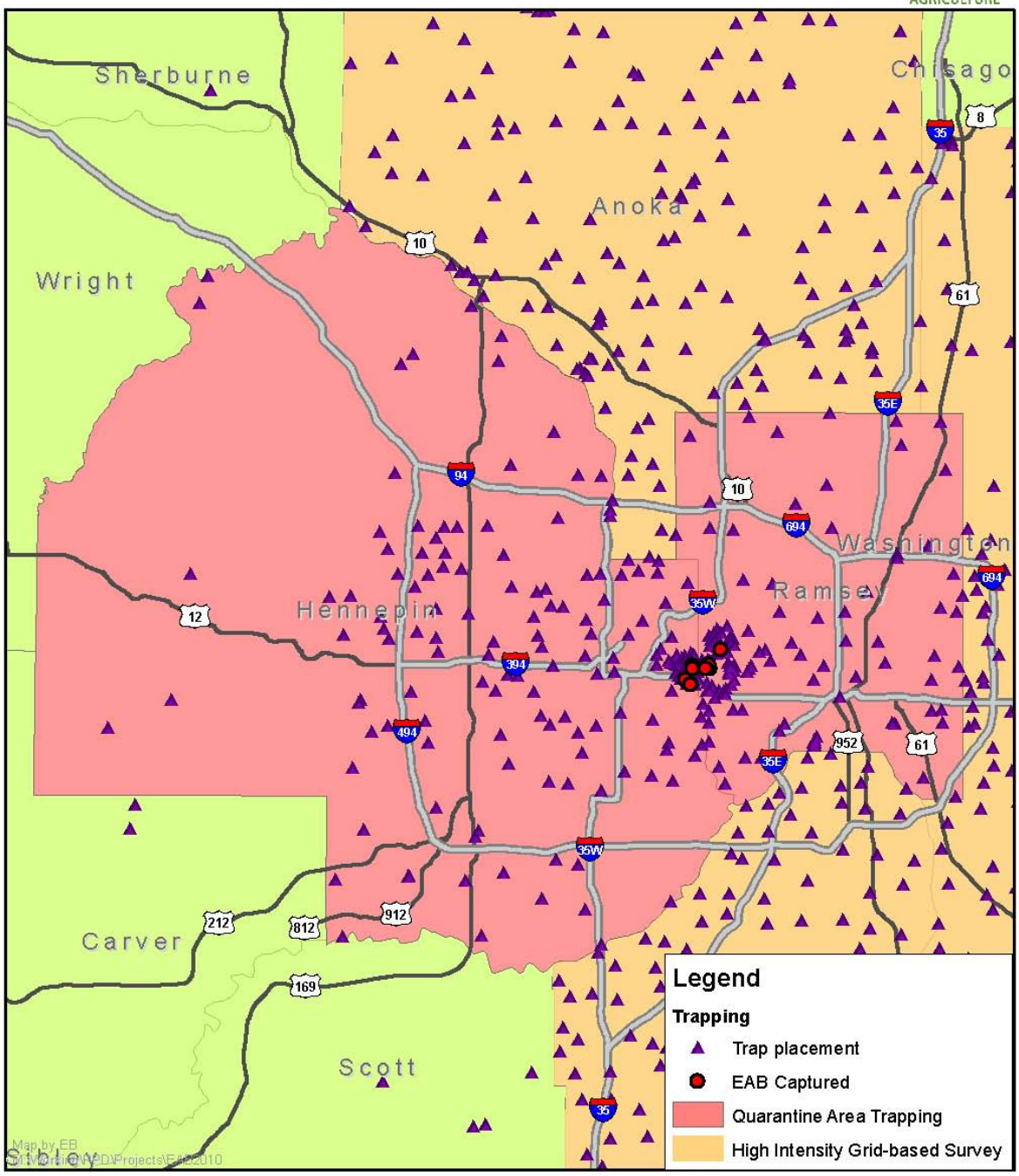
2010 EAB MDA High Risk Grid Based Survey Trap Placement

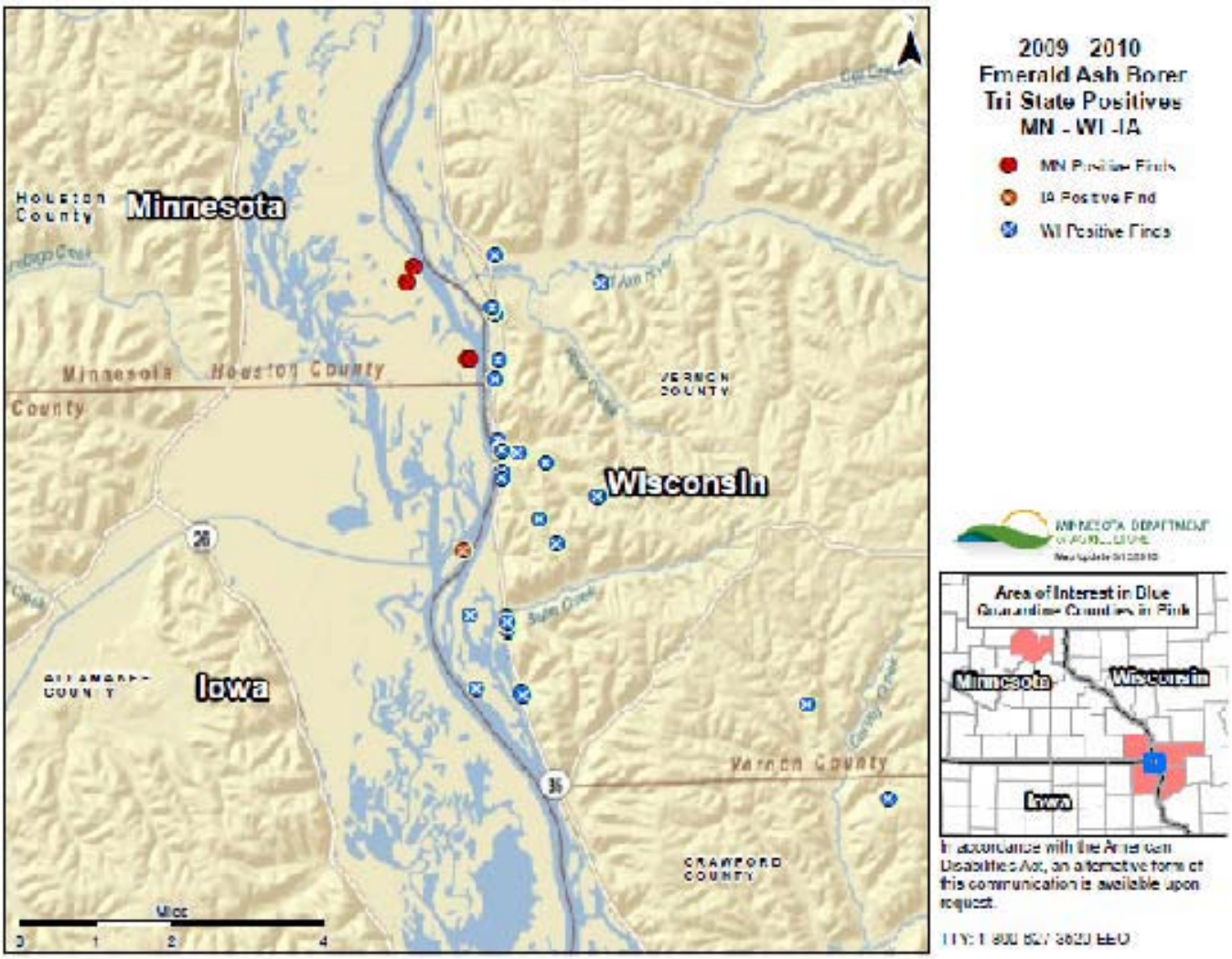
Updated: September 23, 2010

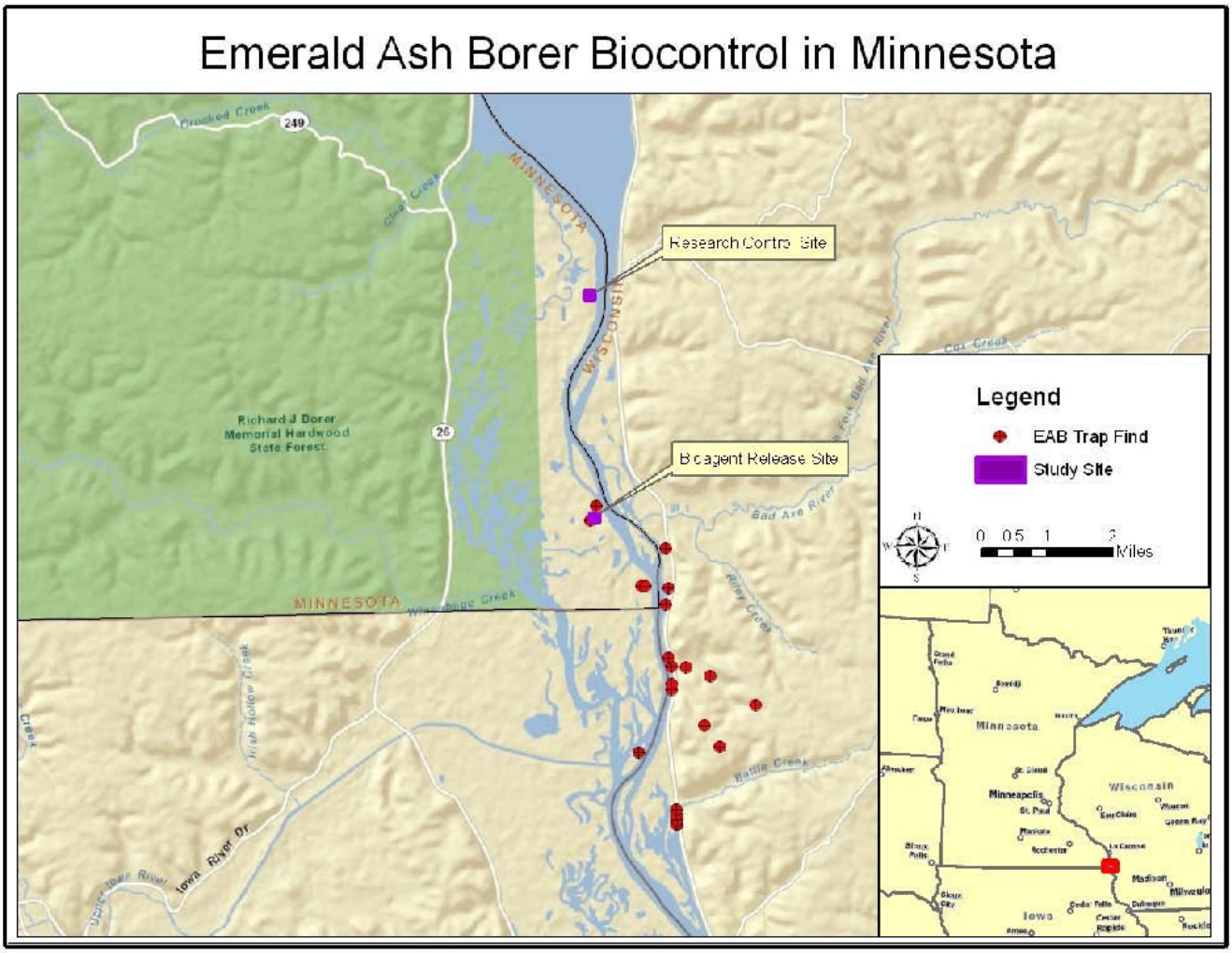


2010 EAB Quarantine Area Trap Placement

Updated: September 23, 2010

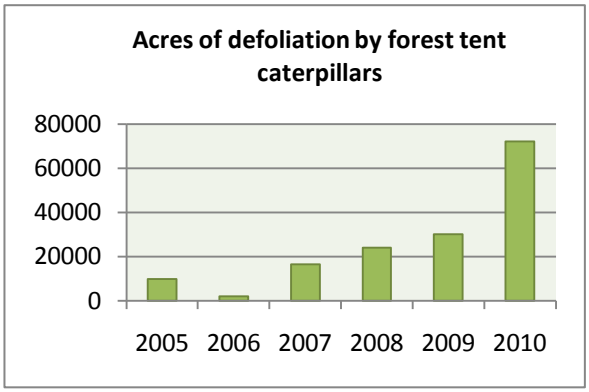


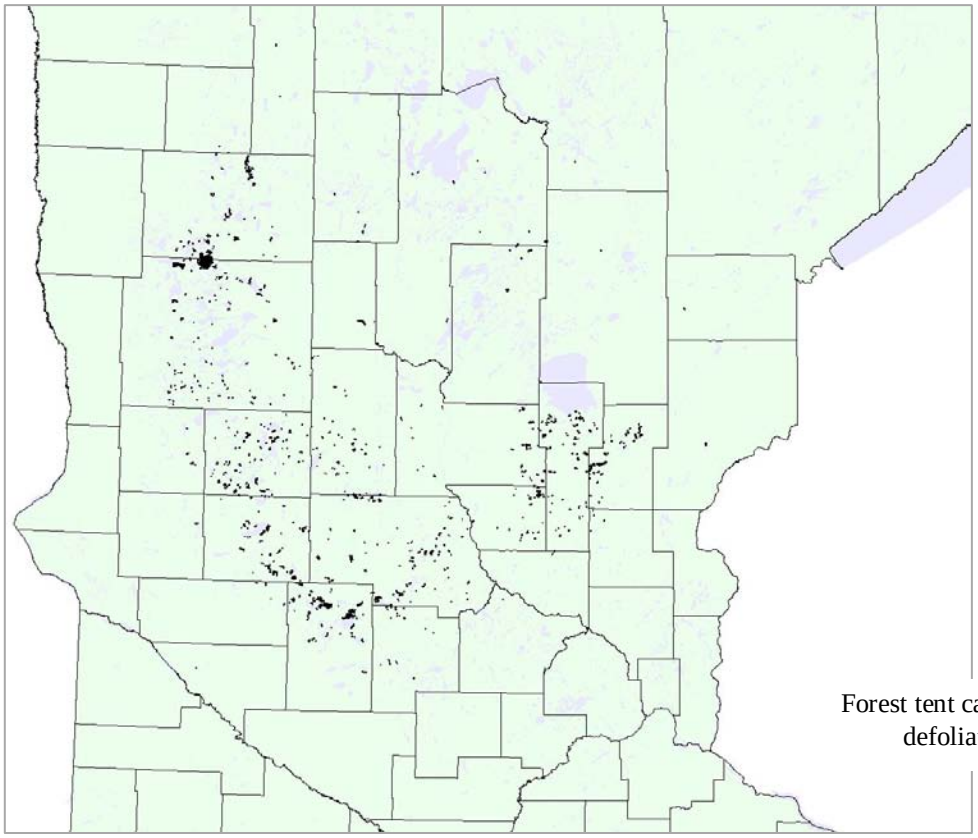

2009 2010
Emerald Ash Borer
Tri State Positives
MN - WI -IA
MN Positive Finds
IA Positive Find
WI Positive Finds
Houston County
Minnesota
Houston County
Vernon County
Wisconsin
Iowa
Vernon County
Crawford County
Miles
0 1 2 4
Area of Interest in Blue
Minnesota
Wisconsin
Iowa
In accordance with the American Disabilities Act, an alternative form of this communication is available upon request.


Emerald Ash Borer Biocontrol in Minnesota
Research Control Site
Bioagent Release Site
Richard J Dorer Memorial Hardwood State Forest
MINNESOTA
WISCONSIN
MINNESOTA
Legend
EAB Trap Find
Study Site
0 0.5 1
Miles
Minnesota
Wisconsin
Iowa
Minneapolis
St. Paul

Year	2010
State	Minnesota
Forest pest	
Common name	**Forest tent caterpillar**
Scientific names	*Malacosoma disstria*
Hosts	Aspens, oaks, birches and other hardwoods
Setting	Rural forests
Counties	See map
Survey methods	Aerial survey
Acres affected	70,665 ac
Narrative	

In May and early June, there were many sightings and reports of forest tent caterpillars in the western and central counties of MN and a few new locations to the north were found, too. Based on defoliation that occurred last year, there are a few noteworthy "outlier" populations that caused noticeable defoliation in 2010 which ranged from trace to severe levels. See map. These occurred in Hubbard County, southern Cass County on the north shore of Gull Lake, in Waukenabo Township in Aitkin County, and in the Twin Cities. Several areas along the Mississippi River in the southern part of the Twin Cities metro area were defoliated. FTC populations seem to be intensifying in Ottertail and Kanabec Counties, too.





Forest tent caterpillar caused defoliation 2010

FTC populations are building in central Minnesota. The number of acres defoliated is climbing steadily with increases being found in all of the central counties. This year, 70,665 acres of aspen and hardwoods were defoliated. See chart. The number of additional sightings of individual caterpillars and small pockets of trace defoliation from the northern counties is also increasing. Taken together, these observations usually portend a north-wide outbreak in the near future.

Year	2010
State	Minnesota
Forest pest	
Common name	**Gypsy moth**
Scientific names	*Lymantria dispar*
Hosts	Oaks, aspen and other hardwoods
Setting	All settings
Counties	Map not available at this time
Survey methods	Pheromone trapping
Acres affected	Not yet determined
Narrative	

Preliminary Report for Gypsy Moth Program

Prepared by Lucia Hunt, MN Dept. of Agriculture

General Survey

The Minnesota Department of Agriculture's (MDA) has been the lead agency undertaking the annual gypsy moth detection survey since 1973. The trapping survey is the data source for determining where gypsy moth management strategies should be implemented. Gypsy moth collection data from all participating agencies in Minnesota is routed through MDA for inclusion in annual reports.

In 2010, MDA filled positions for 33 trapping routes and 6 lead workers to oversee field operations. Trap data in Minnesota is collected and recorded using Gypsy Moth Slow the Spread (STS) Foundation protocols. Trappers were responsible for setting, checking, and removing a preliminary count of 19,171 gypsy moth traps during the field season.

MDA's trapping area was divided into northern and southern regions, as the latitudinal climatic range of the state creates a delayed moth emergence in the north. Traps were all set between May 20 and July 15 and removed by October 21. Preliminary trap data for this season totals approximately 4,201 moths, down about 93% from the 27,870 moths trapped in 2009.

Alternate life stages were found this year at sites in Coon Rapids, Stillwater, Hopkins, and Duluth, where planning is underway for 2011 treatments.

Treatment

MDA's gypsy moth treatment projects this year covered over 100,000 acres of the state's North Shore in slow the spread (STS) projects. Planning work on the treatments began in the fall of 2009 when individual blocks were defined, and areas were finalized in February, 2010. See map.

Three sites totaling 2,176 acres in Lake and St. Louis Counties were treated with the organic formulation of Btk (Foray 48B). The remaining 98,694 acres were treated with Disrupt II, pheromone flakes. Products were chosen for each site based on management goals and efficacy.

A multi-agency Incident Command System was used throughout the spray projects. Personnel from state, federal, and local organizations were involved throughout the planning process which led to a successful spray program with minimal turbulence.

The environmental assessment component of the project was completed by our cooperating federal agency. This was the first year we proposed using Btk on Superior National Forest lands and extra cooperative efforts were required to satisfy their concerns and public notification needs.

Biocontrol

To mitigate gypsy moth damage, a multi-agency decision was made to implement biocontrol with the fungal pathogen *Entomophaga maimaiga*, which is very specific to gypsy moth caterpillars. Other states have successfully established *E. maimaiga* in areas with newly established gypsy moth populations and maintained populations below outbreak levels.

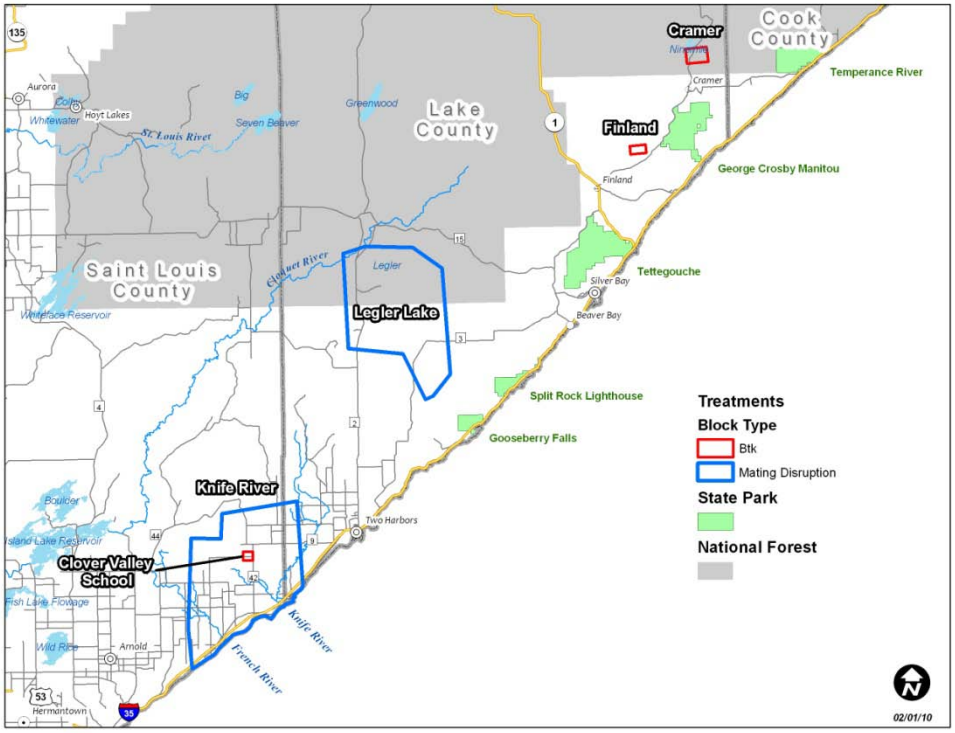
Northeastern Minnesota has widespread low-level populations and thus far, prescribed treatments have all been successful. As gypsy moth populations increase and treatments become less effective, the goal is that *E. maimaiga* will be established and consequently lessen the economic and environmental impact from gypsy moth outbreaks.

Our strategy was to release *E. maimaiga* in areas that would facilitate broad pathogen dispersal and where trap catches indicated gypsy moth populations. Releases in northeastern Minnesota included the Hovland, Gran Marais, Finland, Two Harbors, Ely, and Duluth areas. In addition, *E. maimaiga* was released in the Stillwater and Coon Rapids areas in response to finding egg masses and pupae at these locations. We will use a bioassay to monitor *E. maimaiga* populations both pre- and post-release for sites in northeastern Minnesota. This monitoring will indicate whether *E. maimaiga* is present pre-release at some or all sites. These findings may guide whether additional pathogen releases will be made and if so, where.

We released the resting spore stage of *E. maimaiga.* We collected spore filled caterpillar cadavers in Madison, WI in cooperation with the Wisconsin Department of Natural Resources and the University of Wisconsin. Cadavers were blended with potting mix then spread at the base of 10 trees per site. Prior to release, we collected soil samples for the bioassay. We need to use a bioassay because gypsy moth numbers are too low to find caterpillars in the field, which is generally the most sensitive means to detect *E. maimaiga.* For the bioassay, we will receive non-infected caterpillars from the APHIS Pest Survey Detection and Exclusion Laboratory, OTIS Air National Guard Base, MA. Caterpillars will be exposed to soil samples and if the pathogen is present, it will infect the caterpillars. This method will also be utilized for post-release monitoring for 5 years unless caterpillar collection from the field is possible.

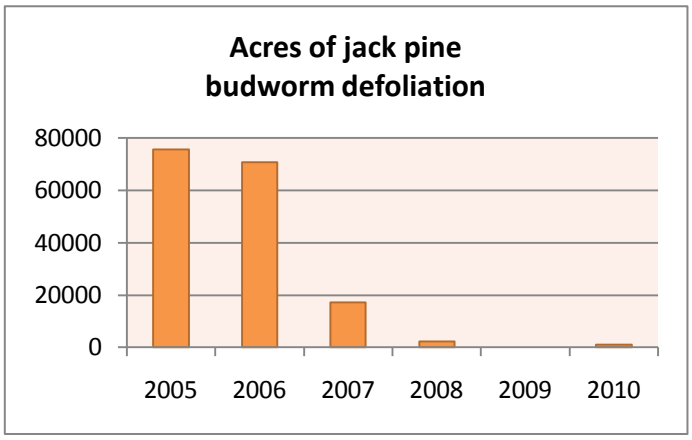
Biocontrol is one management tool integrated with other treatments such as the biopesticide Btk and mating disruption. Developing a strategy for deploying *E. maimaiga* is one part of MDA's proactive gypsy moth program.

Gypsy moth treatments along the North Shore in 2010



Year	2010
State	Minnesota
Forest pest	
Common name	**Jack pine budworm**
Scientific name	*Choristoneura pinus pinus*
Hosts	Jack pine; rarely red pine, white pine and white spruce
Setting	Rural forests
Counties	Roseau, Cass and Mahnomen Counties
Survey methods	Aerial survey
Acres affected	1052 acres

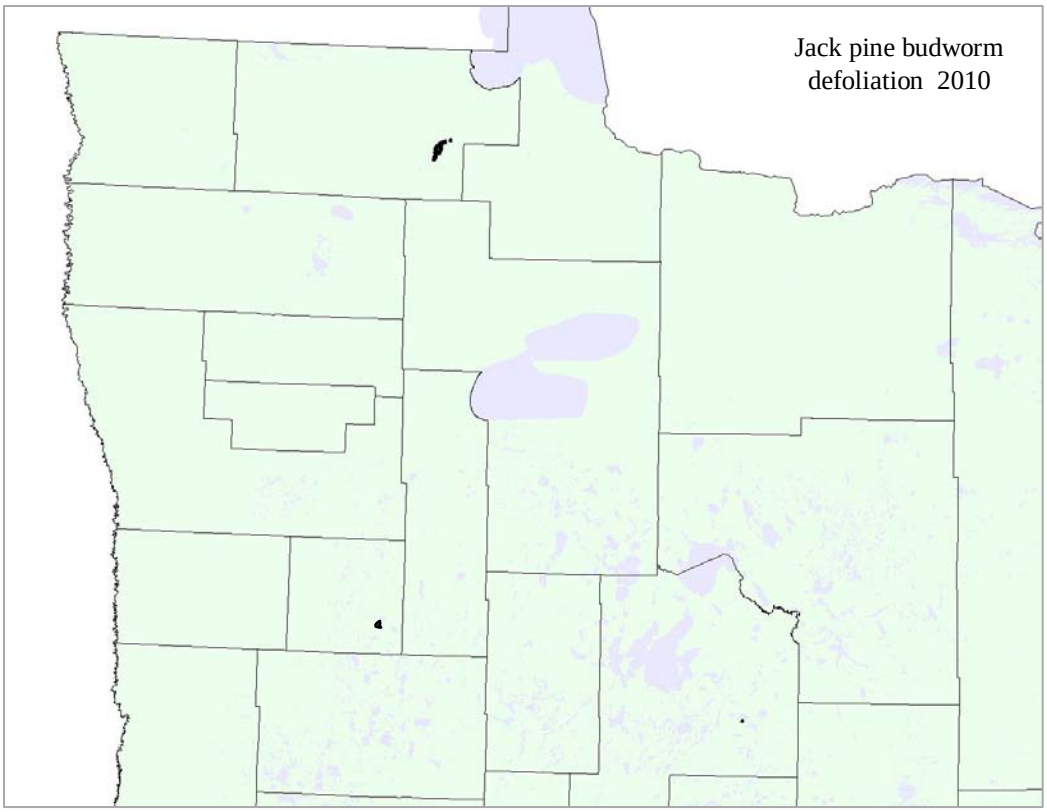
Narrative



After a hiatus lasting one year, jack pine budworm defoliation was observed and mapped on 1,052 acres in northern Minnesota. See chart and map. Two small polygons were found in Mahnomen and Cass Counties.

Only one budworm larva was found on 21 sites across the western range of jack pine budworm in Minnesota in early June during the early larval survey. However, during aerial survey, 1044 acres of light to moderate defoliation was found, primarily in Roseau County near Bemis Hill. Interestingly, defoliation was confined to an area of mostly federal lands in the Beltrami Island State Forest. Two egg mass studies were conducted in early August. No egg masses were found on the branches during the formal protocol, but perusal of the remaining foliage on 12 branches (36 inches long) found 8 egg masses. This indicates that budworm larvae will be present in 2011, likely causing less than 25% defoliation of the jack pine in the area.

From the ground, jack pine budworm larvae were found damaging red and jack pines in the Sand Dunes State Forest (sec 20 and 29) where similar damage was observed in 2004 and 2005.



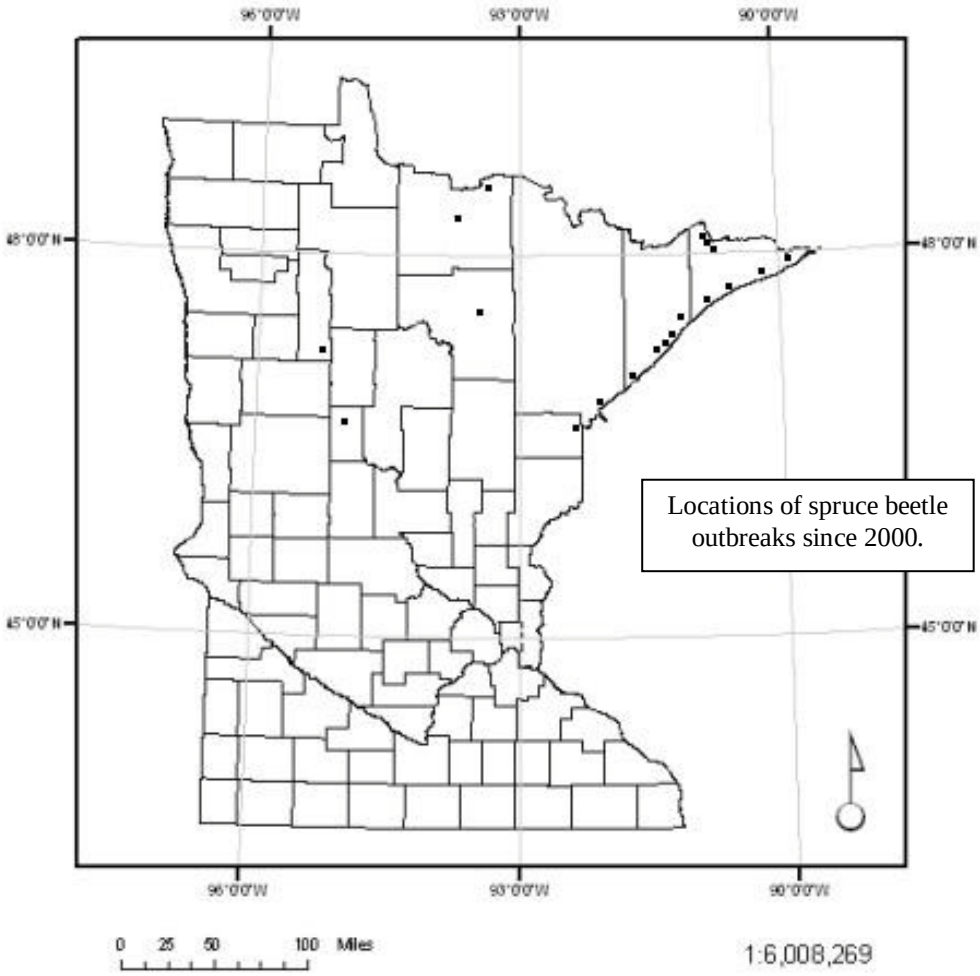
Year	2010
State	Minnesota
Forest pest	
Common name	**Pine shoot beetle**
Scientific name	*Tomicus piniperda*
Hosts	*Pinus* spp.
Setting	Christmas tree plantations
Counties	Dakota, Ramsey, Anoka
Survey methods	Pheromone baited funnel traps
Acres affected	None reported.

Narrative

In December 2004, the USDA found pine shoot beetle in pheromone baited funnel traps set at industrial shipping sites in Dakota, Ramsey and Anoka Counties. USDA APHIS quarantined these three counties under the federal pine shoot beetle quarantine. In 2005 the quarantine was expanded to include all of Minnesota. Additional trapping surveys for Pine shoot beetle were discontinued at that time.

Year	2010
State	Minnesota
Forest Pest	
Common name	**Spruce beetle**
Scientific name	*Dendroctonus rufipennis*
Hosts	White spruce
Setting	Rural forests, campgrounds, windbreaks
Counties	Cook, Lake, St Louis, Carlton, Itasca, Koochiching, Wadena and Clearwater
Survey methods	No surveys were conducted for spruce beetle in 2010. In the past, survey methods used included ground, funnel traps and general observation.
Acres affected	No estimate
Narrative	

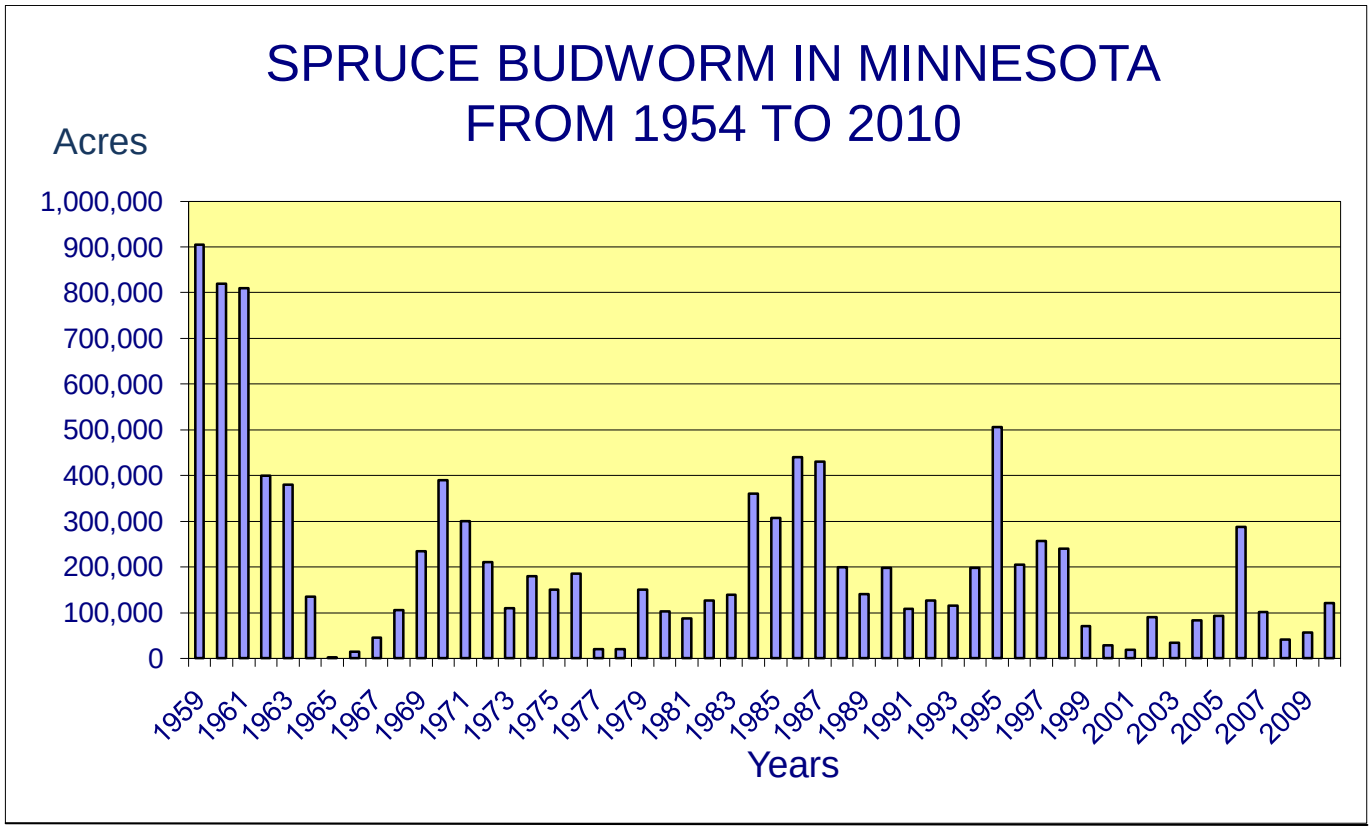
Spruce beetle occurs naturally in northern Minnesota. Significant mortality has been found in State Parks and campgrounds along the shore of Lake Superior where slightly over 10% mortality was found some years in the early 2000's. Low levels of scattered mortality continue to occur in campgrounds. Significant mortality was found in a couple white spruce plantations in Koochiching County also in the early 2000's. Mortality due to spruce beetle was estimated at approximately 20%. The beetle population was thought to have built up on blown down white spruce and then spread to live standing trees.

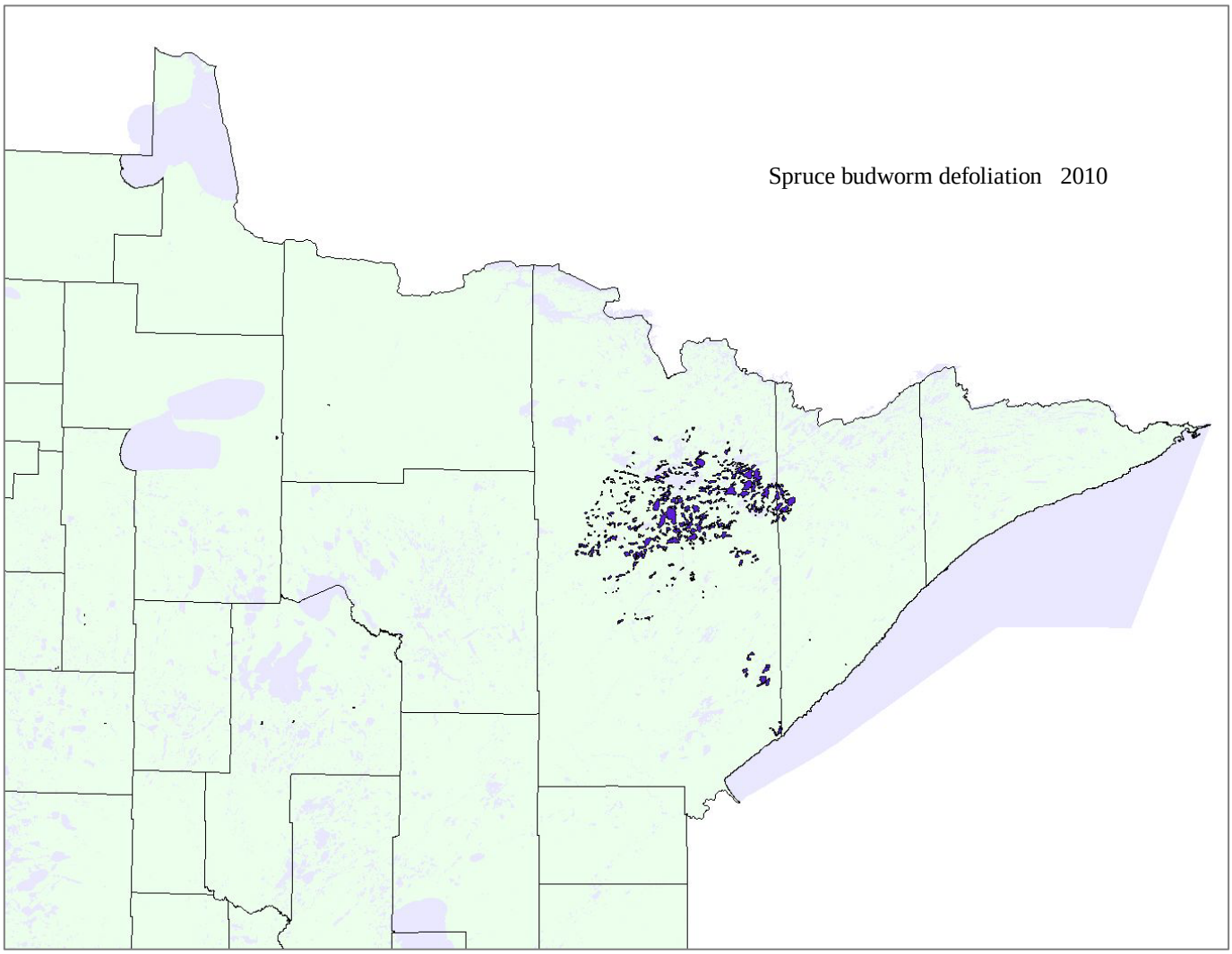


Locations of spruce beetle outbreaks since 2000.

Year	2010
State	Minnesota
Forest pest	
Common name:	**Spruce budworm**
Scientific name:	*Choristoneura fumiferana*
Hosts	Balsam fir and white spruce
Setting	Rural forests
Counties	Koochiching, St Louis, Lake, Beltrami, Clearwater, Hubbard, Cass, Mahnomen, Becker
Survey methods	Aerial survey
Acres affected	121,370 ac
Narrative	

Spruce budworm is a native insect in 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, 121,370 acres of defoliation were observed in northeastern counties. See map. This is slightly more than double last years' defoliation. Defoliation was greater than 50% on 114,800 of the acres. The major area of defoliation has shifted to the east and south and now extends from the western edge of Lake Vermillion to east of Ely into Lake County on the north and from Buhl to Hoyt Lakes on the south. An area of almost 5,000 acres of defoliation showed up near Pequaywan Lake in the Cloquet Valley State Forest in southeastern St Louis County and another 1,200 acres showed up near the Knife River in extreme in southeastern St Louis County. Mortality and topkill begin to occur after 3 to 4 years of heavy defoliation in balsam fir. Defoliation on the western end of Lake Vermillion has been occurring since at least 2003.

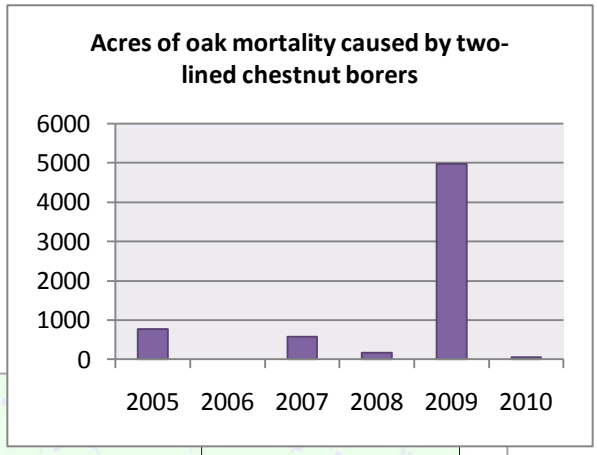


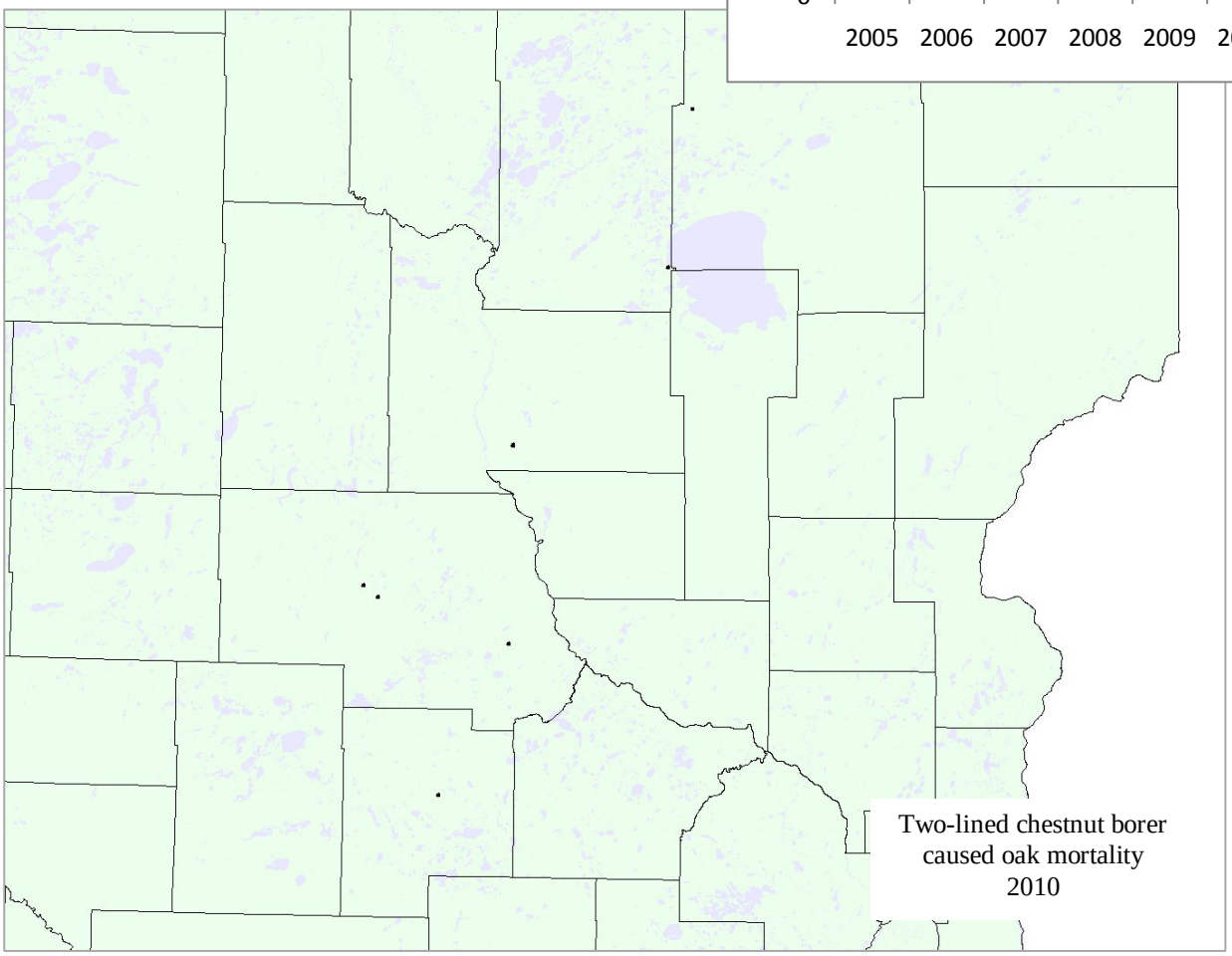

Spruce budworm defoliation 2010

Year	2010
State	Minnesota
Forest pest	
Common name	**Two-lined chestnut borer**
Scientific name	*Agrilus bilineatus*
Hosts	Oaks
Setting	Rural and urban forests
Counties	See map
Survey methods	Aerial survey
Acres affected	56 ac
Narrative	

This insect has had a fairly constant presence over the last decade, the weather of which has been warmer and drier than most. This year, new damage caused by two-lined chestnut borers was detected on only 56 acres in west-central and central counties. All of the polygons were less than an acre in size.

After three summers of drought and high levels of oak mortality, the spring and summer rains received this summer apparently caused the local populations to collapse. See map and chart.





Year	2010
State	Minnesota
Forest pest	
Common name	**Bur oak blight**
Scientific name	An unnamed species of *Tubakia*
Hosts	Bur oak
Setting	Rural and urban forests
Counties	4 NEW counties: Mille Lacs, Sherburne, Hennepin and Ramsey
Survey methods	Ground sampling
Acres affected	Unknown
Narrative	

The first bonafide case of bur oak blight, confirmed by Dr. Tom Harrington of Iowa State University, has been identified in Minnesota. Previously, symptoms of BOB were reported to occur in portions of southern Minnesota, however, the disease was then called Tubakia leafspot and was cited to be caused by the fungus, *Tubakia dryina.* Since then, Dr. Harrington, Professor at Iowa State University, has completed DNA and pathogencity testing that confirms this disease is caused by a new, and yet unnamed, species of *Tubakia,* and he has named the disease bur oak blight (BOB).

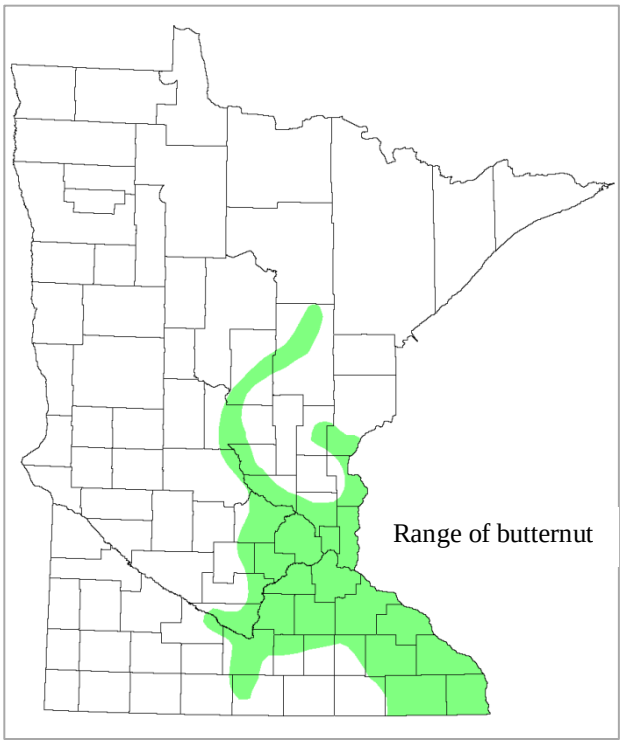
It is not clear if this new species of *Tubakia* is a recent arrival to this region or if a shift in climate (more early-season rain events) have made this disease more noticeable over the last two decades. To date, BOB is known to occur from eastern Nebraska to central Minnesota and southwestern Wisconsin, and it appears to be spread across all of Iowa .

Plant pathologists and arborists have been on the lookout for the new BOB *Tubakia* species in Minnesota, particularly in central and more northern counties. Jill Pokorny, plant pathologist with the US Forest Service located symptomatic bur oak trees in Mille Lacs and Sherburne counties, collected leaf samples, and identified the fungus, *Tubakia*, to be present. To determine if it was the new species of *Tubakia* that causes BOB, she submitted samples to Dr. Harrington for further laboratory testing. The samples tested positive for BOB.

In recent weeks, symptoms of BOB have also been reported on bur oaks located in Hennepin and Ramsey counties. These samples have also been submitted for species-level DNA testing, and we are awaiting test results. Jill Pokorny predicts, “As we continue to investigate symptomatic bur oak trees and more samples are tested, it is expected that BOB will be found in additional Minnesota counties.”

Year	2010
State	Minnesota
Forest pest	
Common name	**Butternut canker**
Scientific name	*Sirococcus clavigigneti-juglandacearum*
Hosts	Butternut
Setting	All
Counties	See attached list.
Survey methods	General observation
Acres affected	Unknown
Narrative	

Butternut canker has spread throughout the range of butternut species in Minnesota, with the exception of a few outlier locations in Aitkin County. It is generally estimated that more than 99% of the trees currently are infected or dead. It is a fatal disease.



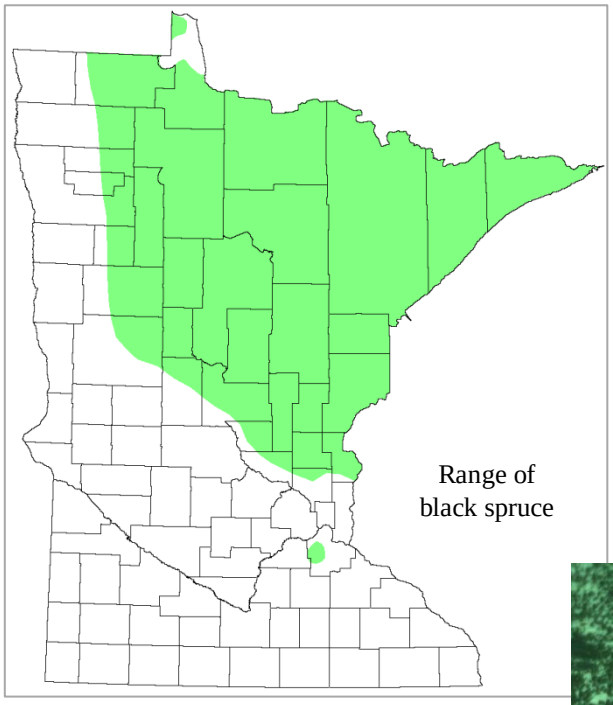
Forest pest:	**Butternut canker**	
Minnesota County	Present	New County
Aitkin	Y	
Anoka	Y	
Becker		
Beltrami		
Benton	Y	
Big Stone		
Blue Earth	Y	
Brown	Y	
Carlton		
Carver	Y	
Cass		
Chippewa		
Chisago	Y	
Clay		
Clearwater		
Cook		
Cottonwood		
Crow Wing	Y	
Dakota	Y	
Dodge	Y	
Douglas		
Faribault	Y	
Fillmore	Y	
Freeborn		
Goodhue	Y	
Grant		
Hennepin	Y	
Houston	Y	
Hubbard		
Isanti		
Itasca		
Jackson		
Kanabec	Y	
Kandiyohi		
Kittson		
Koochiching		
Lac Qui Parle		
Lake		
Lake of the Woods		
Le Sueur	Y	
Lincoln		
Lyon		
Mahnomen		
Marshall		
Martin		
McLeod	Y	
Meeker	Y	
Mille Lacs		
Morrison	Y	
Mower	Y	
Murray		

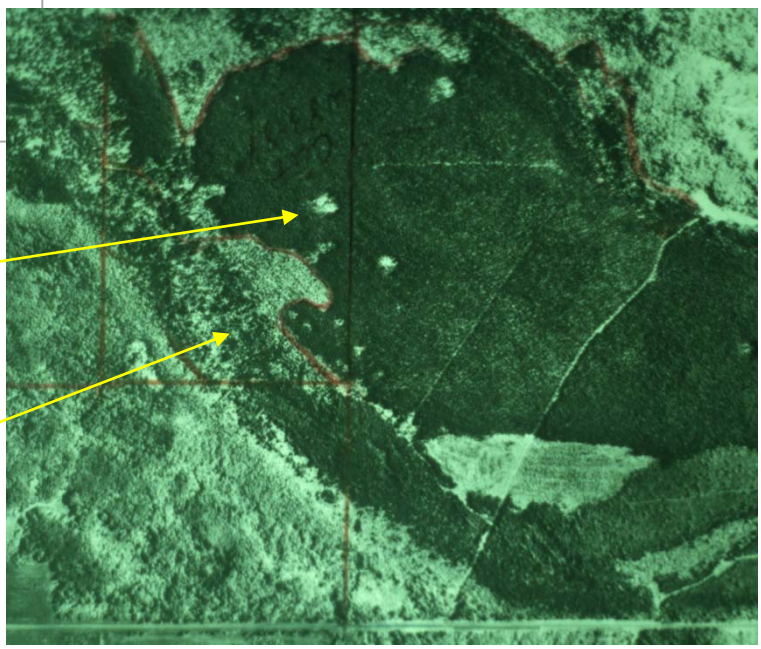
Nicollet		
Nobles		
Norman		
Olmsted	Y	
Otter Tail		
Pennington		
Pine	Y	
Pipestone		
Polk		
Pope		
Ramsey		
Red Lake		
Redwood		
Renville		
Rice	Y	
Rock		
Roseau		
Scott	Y	
Sherburne		
Sibley		
St. Louis		
Stearns	Y	
Steele	Y	
Stevens		
Swift		
Todd		
Traverse		
Wabasha	Y	
Wadena		
Waseca	Y	
Washington	Y	
Watonwan		
Wilkin		
Winona	Y	
Wright	Y	
Yellow Medicine		

Year	2010
State	Minnesota
Forest pest	
Common name	**Eastern dwarf mistletoe**
Scientific name	*Arceuthobium pusillum*
Hosts	Black spruce
Setting	Rural forests
Counties	Range of black spruce; see map below.
Survey methods	General observation and ground survey
Acres affected	Based on NA-TP-01-04, the mortality rate ranges between 0 and 2% per year.

Narrative

Eastern dwarf mistletoe is a native disease and is always fatal. The primary host is black spruce and we have approximately 1,551,000 acres of black spruce in the state (Based on NRS-6). Losses are not spread equally over the forest. Infections can be found in unmerchantible stands and along stand edges where it has been active for decades or centuries and in new infection centers that are roughly circular. Losses range between 0 and 2% annually.





Pockets of mistletoe-killed black spruce in even-aged black spruce stand.

Continuous distribution of mistletoe infections in an all-aged black spruce stand that renders the stand unmerchantible.

Forest pest: Dwarf mistletoe		
Minnesota County	Present	New County
Aitkin	Y	
Anoka	Y	
Becker	Y	
Beltrami	Y	
Benton	Y	
Big Stone		
Blue Earth		
Brown		
Carlton	Y	
Carver		
Cass	Y	
Chippewa		
Chisago	Y	
Clay		
Clearwater	Y	
Cook	Y	
Cottonwood		
Crow Wing	Y	
Dakota	Y	
Dodge		
Douglas		
Faribault		
Fillmore		
Freeborn		
Goodhue		
Grant		
Hennepin		
Houston		
Hubbard	Y	
Isanti	Y	
Itasca	Y	
Jackson		
Kanabec	Y	
Kandiyohi		
Kittson		
Koochiching	Y	
Lac Qui Parle		
Lake	Y	
Lake of the Woods	Y	
Le Sueur		
Lincoln		
Lyon		
Mahnomen	Y	
Marshall	Y	
Martin		
McLeod		
Meeker		
Mille Lacs	Y	
Morrison	Y	
Mower		
Murray		
Nicollet		
Nobles		
Norman		
Olmsted		
Otter Tail	Y	
Pennington	Y	
Pine	Y	
Pipestone		
Polk	Y	
Pope		
Ramsey		
Red Lake	Y	
Redwood		
Renville		
Rice		
Rock		
Roseau	Y	
Scott		
Sherburne	Y	
Sibley		
St. Louis	Y	
Stearns		
Steele		
Stevens		
Swift		
Todd	Y	
Traverse		
Wabasha		
Wadena	Y	
Waseca		
Washington		
Watonwan		
Wilkin		
Winona		
Wright		
Yellow Medicine		

Year	2010
State	Minnesota
Forest pest	
Common name	**Hickory decline**
Scientific names	*Ceratocystis smalleyi* and *Scolytus quadrispinosus*
Hosts	Bitternut hickory
Setting	Rural forests
Counties	Fillmore, Houston, Olmsted, Wabasha and Winona Counties
Survey methods	Survey 2006-2008 and research studies on the ground
Acres affected	Unknown
Narrative	

UPDATE ON HICKORY DECLINE RESEARCH

Jennifer Juzwik[1], Ji-Hyun Park[2], and Linda Haugen[1]
U.S. Forest Service[1] and University of Minnesota[2], St. Paul, MN
October 2010

Research continued through the 2010 field season on the etiology of hickory decline that is characterized by thinning crowns with small, yellow leaves and hickory bark beetle attack on the upper main stem. This research is part of a larger project initiated in 2006 to assess the distribution and determine the cause(s) of Forest Health Monitoring reported decline and death of hickories in the north central and northeastern regions of the USA.

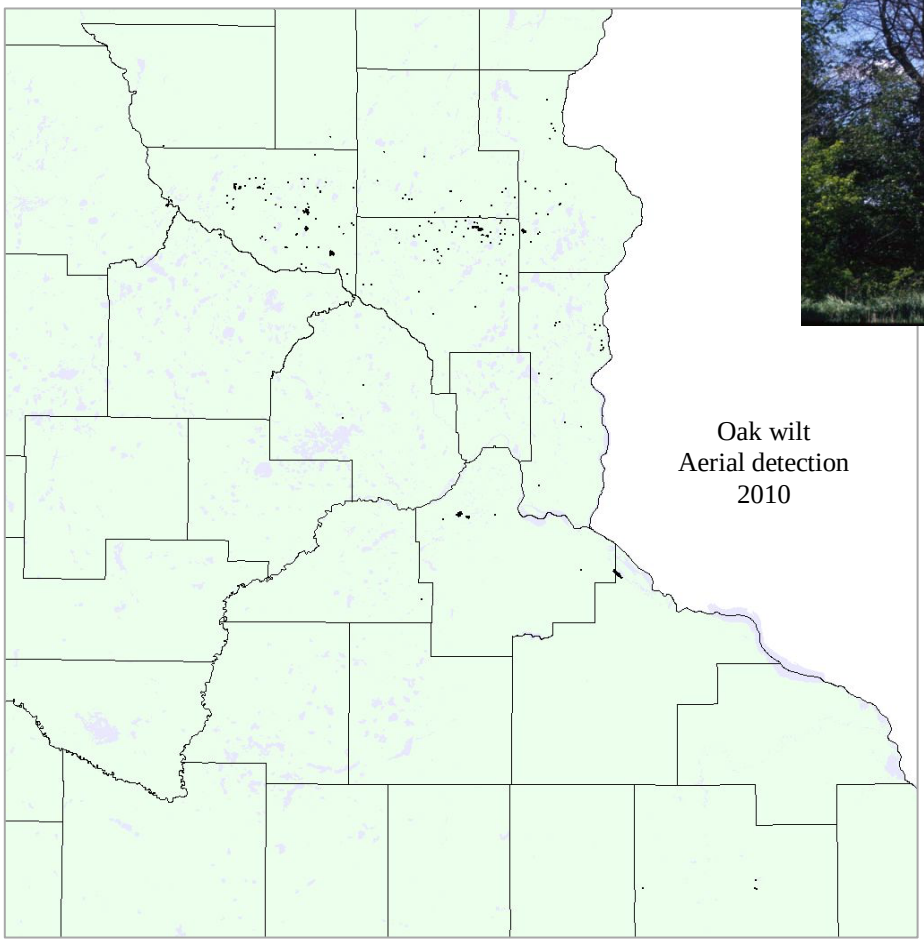
Pathogenicity trials were conducted in Minnesota and Wisconsin with *Fusarium solani* and *Ceratocystis smalleyi* obtained from actively declining bitternut hickory in those states. The overall goal is to determine the role of selected fungi in the decline and death of hickory. *C.smalleyi* was shown to be a virulent pathogen based on large, elongate cankers found within 14 months of artificial inoculation on poletimber sized bitternut hickory. *F. solani* proved to be a weak pathogen with small cankers produced within 12 months of inoculation.

The interaction between hickory bark beetles (*Scolytus quadrispinosus*) and *C. smalleyi* was investigated. Three actively declining bitternut hickories from two Wisconsin locations were felled and bark stripped from the entire main stem of each. Hundreds of inner bark and sapwood lesions were found on the stems. Over 90% of these were associated with hickory bark beetle attack. The bark beetles emerged from infested trees between late June and late July. *C. smalleyi* was commonly isolated from beetles collected during their construction of entry holes. In contrast, the fungus was seldom (3 of 41) isolated from adults manually collected from bark beetle galleries on declining trees just prior to beetle emergence. Furthermore, the fungus was not isolated from 40 beetles emerged from logs in rearing tubes. Thus, hickory bark beetles are likely involved in initiation of cankers on beetle colonized stems. It is not clear, however, whether bark beetles only provide the entry hole (i.e. infection court) for the fungus or whether they are vectors as well.

Field studies also were conducted to more precisely determine the role *C. smalleyi* plays in causing hickory decline. The fungus colonizes the sapwood as well as the bark in naturally and artificially inoculated trees. The effect of multiple inoculations (50 per tree between 6 and 12 ft. on main stem) on within tree water transport was evaluated by monitoring sap flow rate and documenting tylose production in the sapwood of trees that had been inoculated 14 months before in two locations. Only one of eight inoculated trees showed any symptoms of decline in the crown when sap flow was monitored; however, extensive, elongate cankers were evident. Bitternut hickory with numerous cankers showed significantly reduced mean sap flow rates compared to non-infected trees ($P = 0.005$) in the 2009 evaluation conducted in southeastern Minnesota (Figure 1). Sap flow rates were inversely related to the extent of inner bark tissue death associated with *C. smalleyi* inoculations ($P < 0.01$) (Figure 2). Lastly, sap flow rates were inversely related to the numbers of tyloses found in xylem vessels of the study trees (Figure 3). A prior anatomical study found that tyloses are produced in response to *C. smalleyi* infection. These preliminary results suggest that multiple stem infections of *C. smalleyi* impair water transport in bitternut hickory. These preliminary findings also support the overall hypothesis that the synergistic interaction of hickory bark beetles and *C. smalleyi* lead to tree decline and mortality.

Year	2010
State	Minnesota
Forest pest	
Common name	**Oak wilt**
Scientific name	*Ceratocystis fagacearum*
Hosts	Primarily red oaks, white oaks occasionally
Setting	Rural and urban forests
Counties	See map and attached list.
Survey methods	Aerial survey in 2010; see map.
Acres affected	3,397 acres
Narrative	

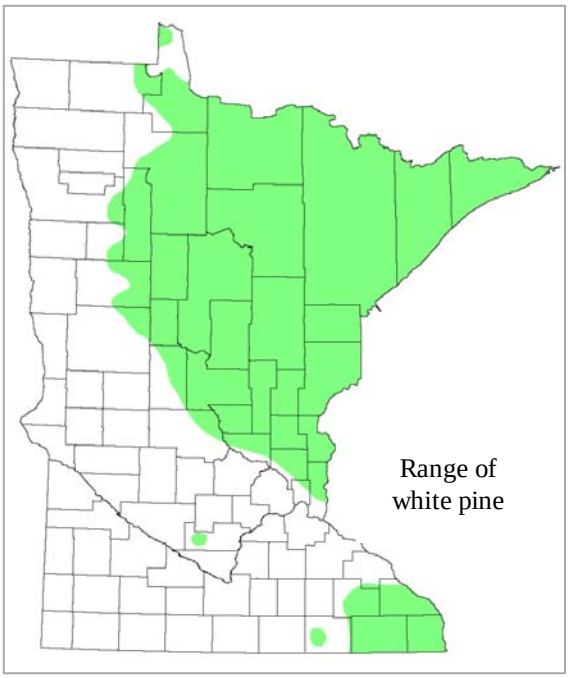
Oak wilt is an invasive fungal disease. During the federally funded oak wilt control program in the Metro area, new infestations "spread" north at about 7 miles per decade and west at 10 to 14 miles per decade. Since the program's end was so recent, we do not have a recalculation of the rates of spread. Control actions are now land-owner initiated and funded, so we expect oak wilt in the currently infested areas to increase in size and abundance.



Forest pest: Oak wilt		
Minnesota County	Present	New County
Aitkin		
Anoka	Y	
Becker		
Beltrami		
Benton		
Big Stone		
Blue Earth		
Brown		
Carlton		
Carver		
Cass		
Chippewa		
Chisago	Y	
Clay		
Clearwater		
Cook		
Cottonwood		
Crow Wing		
Dakota	Y	
Dodge		
Douglas		
Faribault		
Fillmore		
Freeborn		
Goodhue	Y	
Grant		
Hennepin	Y	
Houston		
Hubbard		
Isanti	Y	
Itasca		
Jackson		
Kanabec	Y	
Kandiyohi		
Kittson		
Koochiching		
Lac Qui Parle		
Lake		
Lake of the Woods		
Le Sueur		
Lincoln		
Lyon		
Mahnomen		
Marshall		
Martin		
McLeod		
Meeker		
Mille Lacs	Y	
Morrison		
Mower		
Murray		
Nicollet		
Nobles		
Norman		
Olmsted	Y	
Otter Tail		
Pennington		
Pine		
Pipestone		
Polk		
Pope		
Ramsey	Y	
Red Lake		
Redwood		
Renville		
Rice		
Rock		
Roseau		
Scott	Y	
Sherburne	Y	
Sibley		
St. Louis		
Stearns	Y	
Steele		
Stevens		
Swift		
Todd		
Traverse		
Wabasha		
Wadena		
Waseca		
Washington	Y	
Watonwan		
Wilkin		
Winona		
Wright	Y	
Yellow Medicine		

Year	2010
State	Minnesota
Forest pest	
Common name	**White pine blister rust**
Scientific name	*Cronartium ribicola*
Hosts	White pine; Currants,gooseberries
Setting	All
Counties	All counties in natural range of white pine and wherever planted. See attached list.
Survey methods	General observation
Acres affected	Unknown
Narrative	

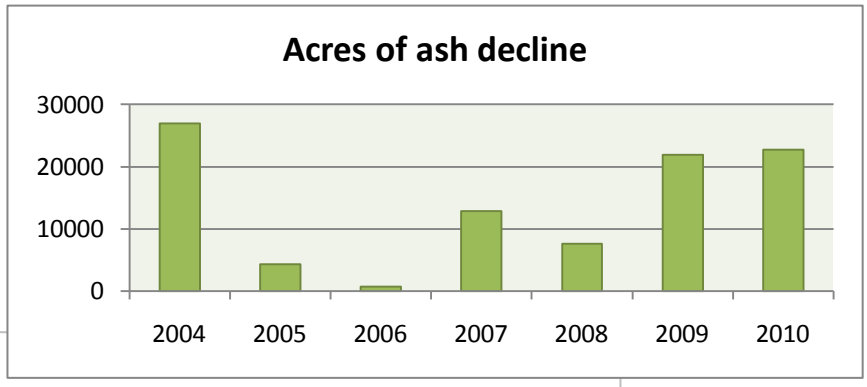
An introduced and invasive species, this disease has disrupted and, in some places, crippled natural and artificial regeneration of white pine and caused topkill in mature white pines since the 1930's. If climate change predictions are correct, less white pine blister rust could be expected all across Minnesota in the future.

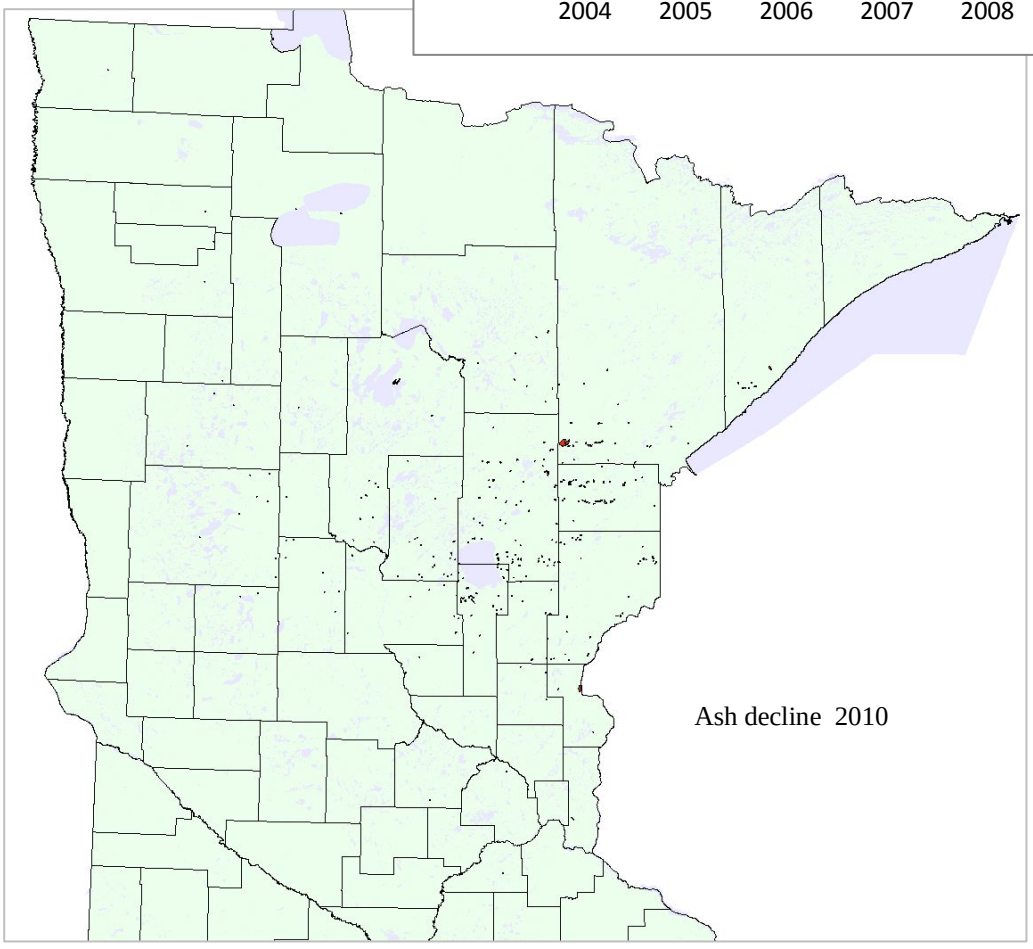


Forest pest: White pine blister rust		
Minnesota County	Present	New County
Aitkin	Y	
Anoka	Y	
Becker	Y	
Beltrami	Y	
Benton	Y	
Big Stone		
Blue Earth		
Brown		
Carlton	Y	
Carver		
Cass	Y	
Chippewa		
Chisago	Y	
Clay		
Clearwater	Y	
Cook	Y	
Cottonwood		
Crow Wing	Y	
Dakota		
Dodge		
Douglas		
Faribault		
Fillmore	Y	
Freeborn		
Goodhue		
Grant		
Hennepin		
Houston	Y	
Hubbard	Y	
Isanti	Y	
Itasca	Y	
Jackson		
Kanabec	Y	
Kandiyohi		
Kittson		
Koochiching	Y	
Lac Qui Parle		
Lake	Y	
Lake of the Woods	Y	
Le Sueur		
Lincoln		
Lyon		
Mahnomen	Y	
Marshall		
Martin		
McLeod		
Meeker		
Mille Lacs	Y	
Morrison	Y	
Mower	Y	
Murray		
Nicollet		
Nobles		
Norman		
Olmsted	Y	
Otter Tail	Y	
Pennington		
Pine	Y	
Pipestone		
Polk	Y	
Pope		
Ramsey	Y	
Red Lake		
Redwood		
Renville		
Rice		
Rock		
Roseau	Y	
Scott		
Sherburne	Y	
Sibley	Y	
St. Louis	Y	
Stearns	Y	
Steele		
Stevens		
Swift		
Todd	Y	
Traverse		
Wabasha	Y	
Wadena	Y	
Waseca		
Washington	Y	
Watonwan		
Wilkin		
Winona	Y	
Wright		
Yellow Medicine		

Year	2010
State	Minnesota
Forest pest	
Common name	**Ash decline**
Scientific names	None
Hosts	Black ash
Setting	Rural forests
Counties	See map
Survey methods	Aerial detection
Acres affected	23,092 ac
Narrative	

Ash decline occurred in 544 stands and was detected on 23,092 acres in 2010. Acres of ash decline were similar to last year's tally. See map and chart.





Ash decline 2010

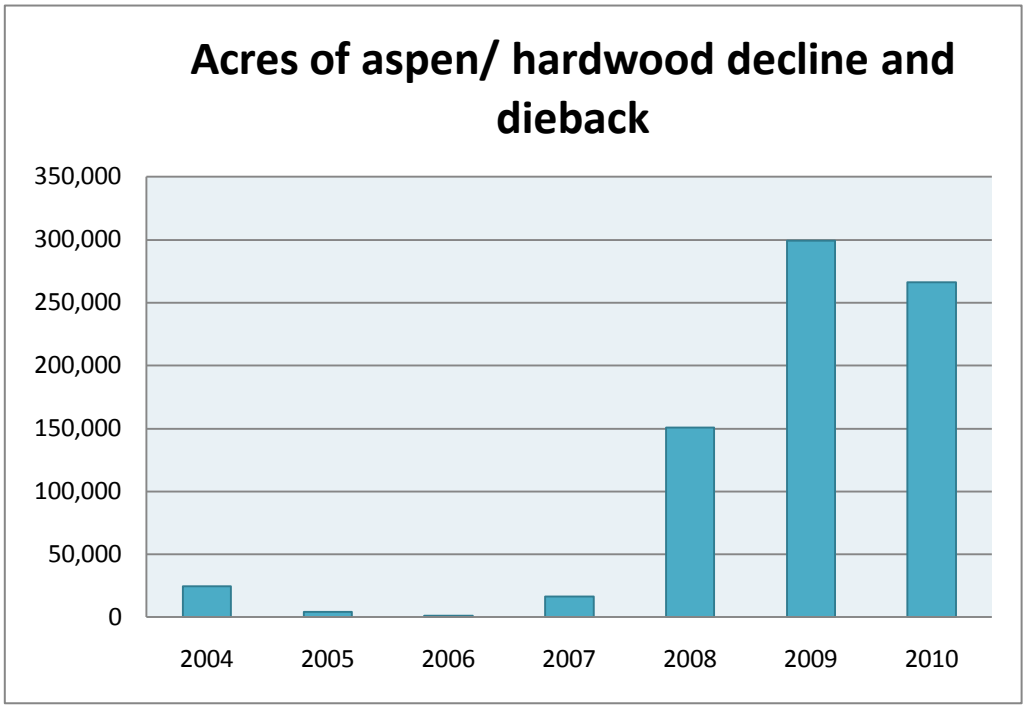
Year	2010
State	Minnesota
Forest pest	
Common name	**Aspen/ hardwood decline**
Scientific names	Unknown agent(s)
Hosts	Quaking aspen, some Paper birch.
Setting	Rural forests
Counties	See list on next page
Survey methods	Aerial surveys
Acres affected	266,354 acres
Narrative	

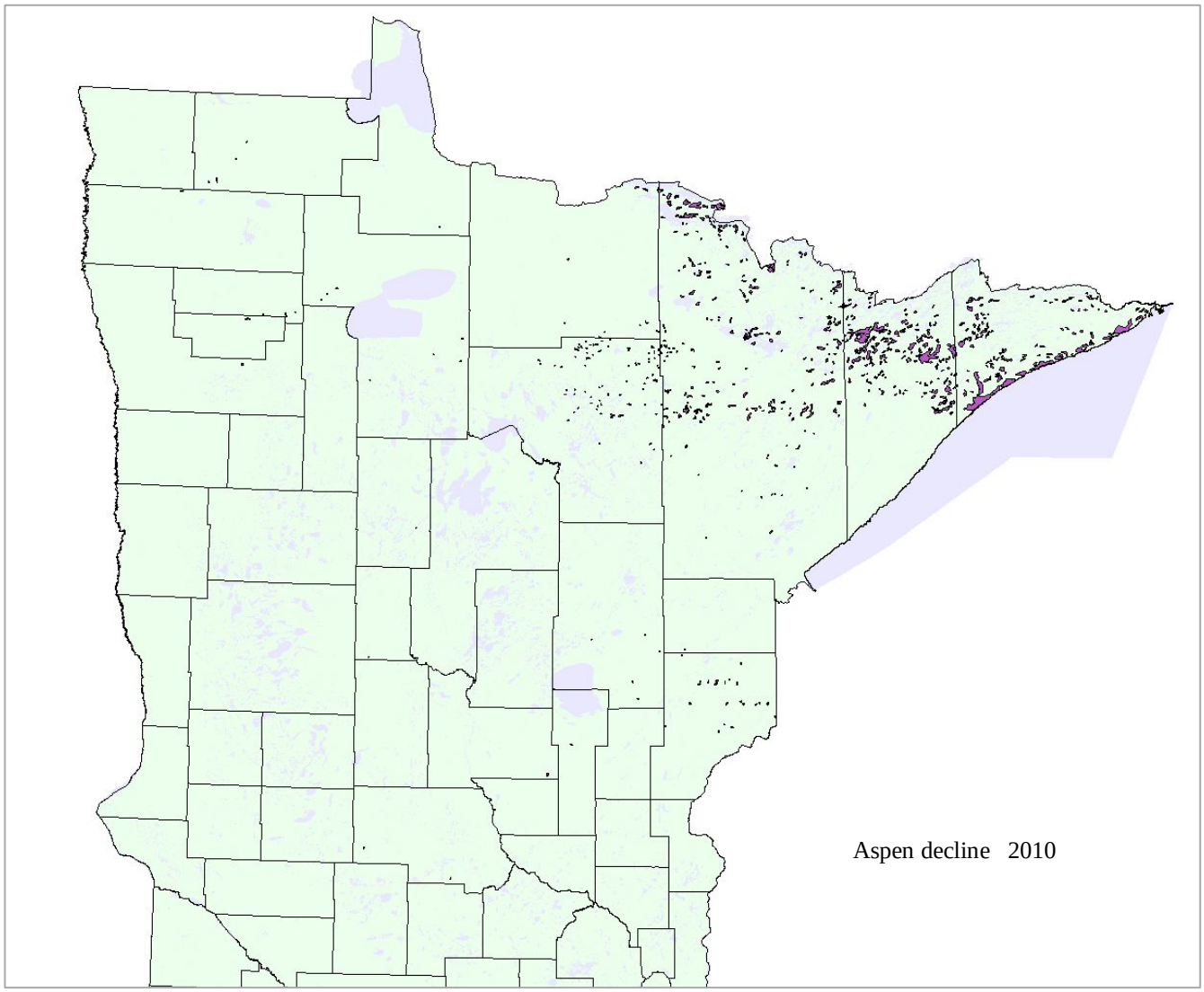
Since 2004, aspen with symptoms of decline has been mapped by aerial survey sketch mappers. Symptoms have included combinations of defoliation, discoloration, dieback and/or mortality.

Dieback is the most common symptom but tree mortality has also occurred. Mortallity 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 in the past decade stressed the aspen resulting in attack by secondary pests.

The attached map shows polygons of aspen with current symptoms of aspen decline. Most of the polygons in the northern parts of Itasca, St Louis Lake and Cook Counties are from the 2009 federal aerial survey map. Aspen decline in these areas were only mapped in 2010 if they were new areas of decline beyond what was mapped in 2009. So, of the 266,354 acres mapped in the north eastern counties in the aspen/hardwood decline category, about 7,500 acres were new locations that were found in 2010.

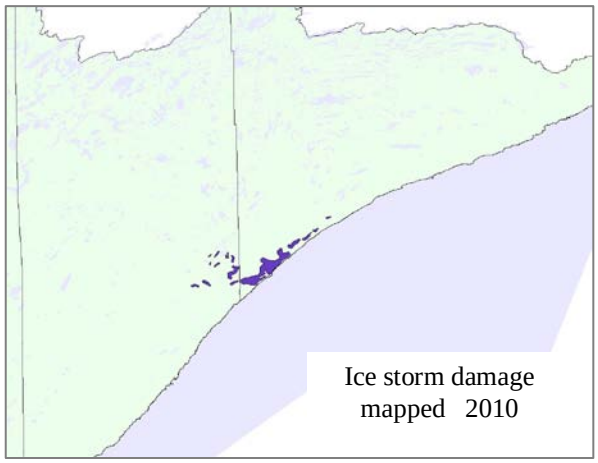



Aspen decline 2010

Forest pest: Aspen decline		
Minnesota County	Present	New County
Aitkin	Y	
Anoka		
Becker		
Beltrami	Y	
Benton		
Big Stone		
Blue Earth		
Brown		
Carlton	Y	
Carver		
Cass		
Chippewa		
Chisago		
Clay		
Clearwater		
Cook	Y	
Cottonwood		
Crow Wing		
Dakota		
Dodge		
Douglas	Y	Y
Faribault		
Fillmore		
Freeborn		
Goodhue		
Grant		
Hennepin		
Houston		
Hubbard	Y	
Isanti		
Itasca	Y	
Jackson		
Kanabec		
Kandiyohi		
Kittson	Y	
Koochiching	Y	
Lac Qui Parle		
Lake	Y	
Lake of the Woods	Y	
Le Sueur		
Lincoln		
Lyon		
Mahnomen		
Marshall		
Martin		
McLeod		
Meeker		
Mille Lacs	Y	
Morrison	Y	
Mower		
Murray		

Nicollet		
Nobles		
Norman		
Olmsted		
Otter Tail		
Pennington	Y	
Pine	Y	
Pipestone		
Polk	Y	Y
Pope		
Ramsey		
Red Lake	Y	
Redwood		
Renville		
Rice		
Rock		
Roseau	Y	
Scott		
Sherburne		
Sibley		
St. Louis	Y	
Stearns	Y	Y
Steele		
Stevens		
Swift		
Todd	Y	Y
Traverse		
Wabasha		
Wadena	Y	Y
Waseca		
Washington		
Watonwan		
Wilkin		
Winona		
Wright		
Yellow Medicine		

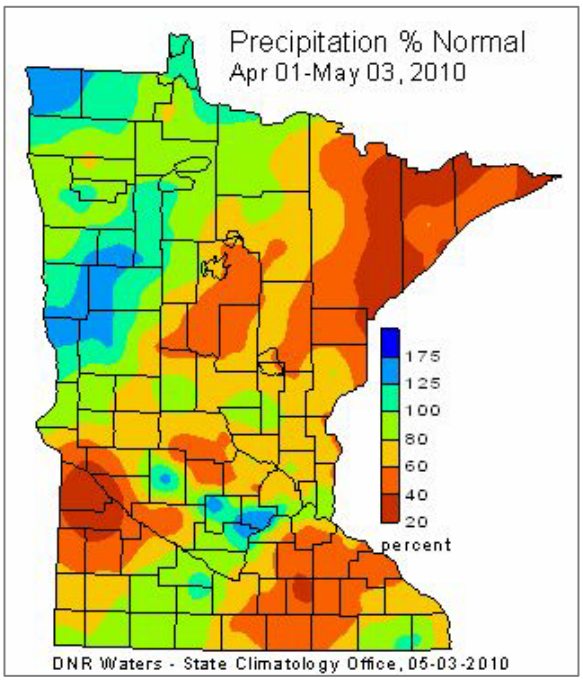
Year	2010
State	Minnesota
Forest pest	
Common name	**Ice storm damage**
Scientific name	None
Hosts	Conifers and hardwoods
Setting	Rural forests
Counties	Lake and Cook Counties
Survey methods	Aerial survey
Acres affected	12,618 ac
Narrative	

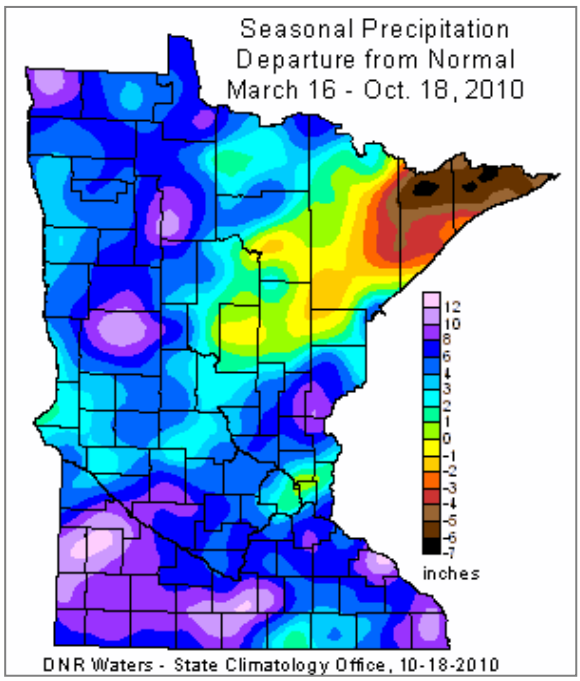


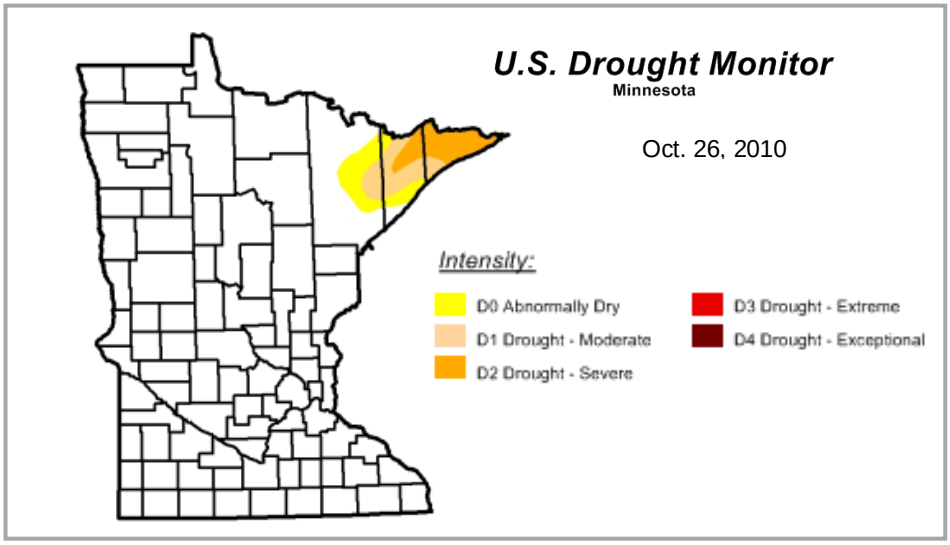
On March 16, 2009, Lake and Cook Counties suffered an ice storm that became a federally-listed disaster. All stands in the ice storm area received damage but much of it was to trees scattered throughout the stands. Stands with very light damage, visible from the ground were not easily mapped from the air. The 2010 aerial survey mapped 12,618 acres where 26 to 50% of the trees had main stem breakage or were uprooted.

Year	2010
State	Minnesota
Forest pest	
Common name	**Spring drought and summer deluge**
Scientific name	Same
Hosts	All
Setting	All forests
Counties	Statewide
Survey methods	Rainfall and temperature monitoring stations
Acres affected	Entire state
Narrative	

2010 was a welcome change from the previous four growing seasons, although it did start out with a very dry spring and early summer. In the northwest corner of the state, rainfalls were heavy starting on May 3rd. Elsewhere in the state, abundant to heavy rains started during the last week of June and continued until the last weeks of September. Then, a warm and dry spell lasted until late October. The exception was in the Arrowhead region where severe drought was reported in Cook, Lake and northeastern St. Louis counties during mid-summer and has lasted through October.







Year	2010
State	Minnesota
Forest pest	
Common name	**Sirex woodwasp**
Scientific name	*Sirex noctilio*
Hosts	Pines
Setting	Urban and rural forests
Counties	See table below
Survey methods	Funnel traps
Acres affected	None
Narrative	

In Minnesota, USDA-APHIS-PPQ set out Lindgren funnel traps in pine stands and near industrial sites this year. Three traps were set out per site and each trap contained alpha-pinene, UHR ethanol and ipsdienol. Traps were checked periodically through the summer. No Sirex woodwasps have been found but final trap checks have not been completed at this time.

Sirex woodwasp/ Exotic bark beetles survey 2010 Survey by APHIS-PPQ		
County	*Number of traps*	*Number of sites*
Anoka	6	2
Carver	3	1
Dakota	27	9
Goodhue	6	2
Hennepin	30	10
Olmsted	6	2
Ramsey	21	7
Scott	9	3
Stearns	6	2
Washington	12	4
Totals	*126*	*42*

NOT known to be in Minnesota for 2010 FHH Report.

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

The Minnesota Department of Agriculture's nursery inspection program inspected and certified 9,221acres of Minnesota nursery stock to facilitate sale of trees, shrubs and perennials within the state, interstate and internationally. A total of 314 nursery stock growers and 2,274 nursery stock dealers were certified in 2010. Along with growers, retail nursery operations are also inspected and MDA audits certification documents for stock originating outside of Minnesota thus assuring that stock offered for sale in Minnesota is free of plant pests. When injurious plant pests are detected, stock is removed from sale pending successful treatment and control. In cases where no effective treatment is available, stock may be ordered destroyed or returned to the shipper.