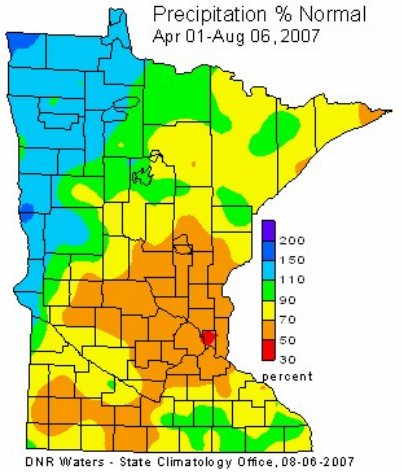
Minnesota Forest Health Annual Report

2007

DNR-Forestry
Forest Health Unit



The Forest Resources of Minnesota

In Minnesota there are approximately 16.3 million acres of forested land, of which 14.9 million acres are classified as “timberland” or lands capable of producing timber. An additional 960,000 acres are not included in productive timberland due to their inclusion in the Boundary Waters Canoe Area Wilderness or other reserved land category. Forest land ownership is 46% private, 27% state, 14% county, 12% National Forest and 1% other federal ownership. (Source of data is the Minnesota 2001Eastwide Database provided by the USFS-NCFES.)

Two major industries depend on Minnesota’s forested lands: forest industry and tourism. The forest industry is Minnesota’s second largest manufacturing industry employing more than 55,000 people. The value of the forest products manufactured in Minnesota exceeds $7 billion and accounts for 16% of all manufacturing dollars generated in Minnesota. The tourism industry is Minnesota’s second largest employer employing over 140,000 people and accounting for a payroll in excess of $3 billion. Gross receipts from tourism exceed $6 billion. Over 70% of people who took at least 1 spring or summer trip in Minnesota rated “observing natural scenery” as the most important activity of their trip.

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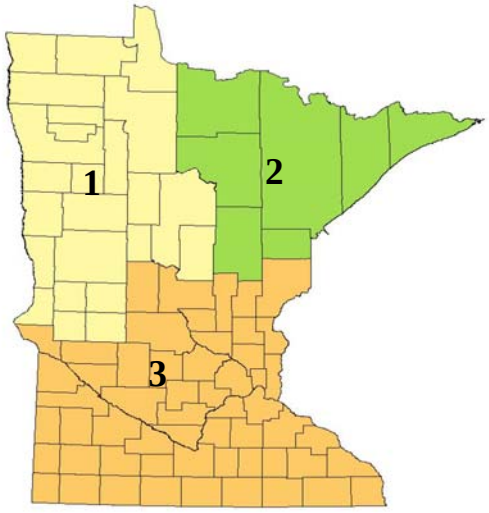

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Staff changes

In the past year, there have been lots of changes to the Forest Health Unit.

In January, Val Cervenka was hired as the new Forest Health Unit Coordinator and she will also be the Forest Entomologist for the Division of Forestry. Val comes to us from the MN Department of Agriculture where she was involved in everything from emerald ash borer to honey bees. While at the Department of Agriculture, Val developed and designed detection surveys for invasive species exclusion programs, managed the gypsy moth trapping program, and provided oversight of the apiary program. Because of her experience working with MDA and invasive species, Val will also help develop an invasive species program for the Division of Forestry.

In late July, Olin Phillips returned as Section Manager as our Unit was moved from the Resource Management Section headed by Tom Baumann to the Fire Section headed by Olin Phillips. As of December, Olin will now manage the Fire Program, Forest Nursery Program, State Land Management, Timber Sales, Utilization and Marketing, and the Forest Health Program.

In December, Susan Burks accepted a position as Invasive Species Program Coordinator for Forestry, a new position in the State Land Management Section. She moves up to the central office in St.Paul. Ed Hayes will now cover all of Region 3.

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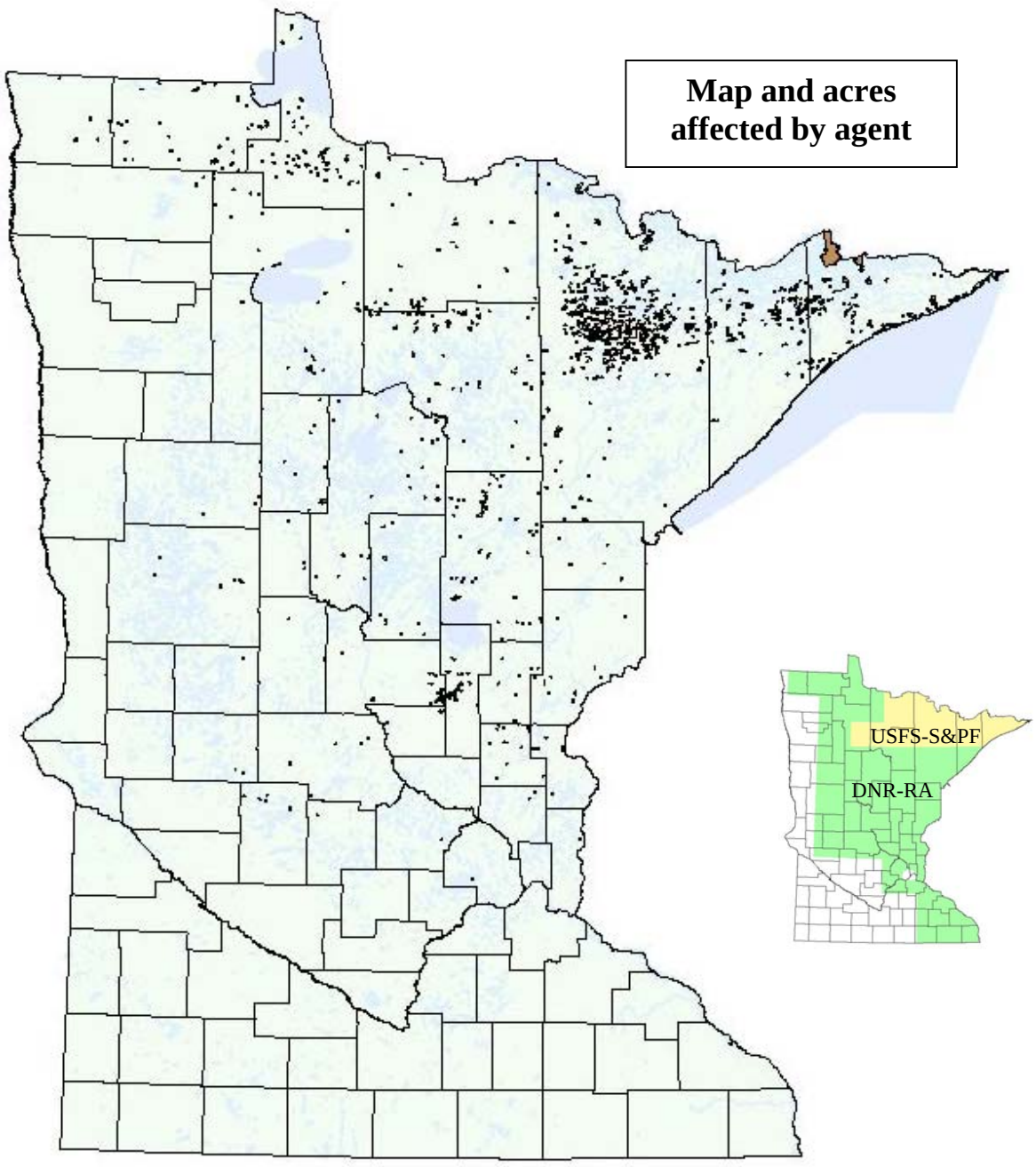
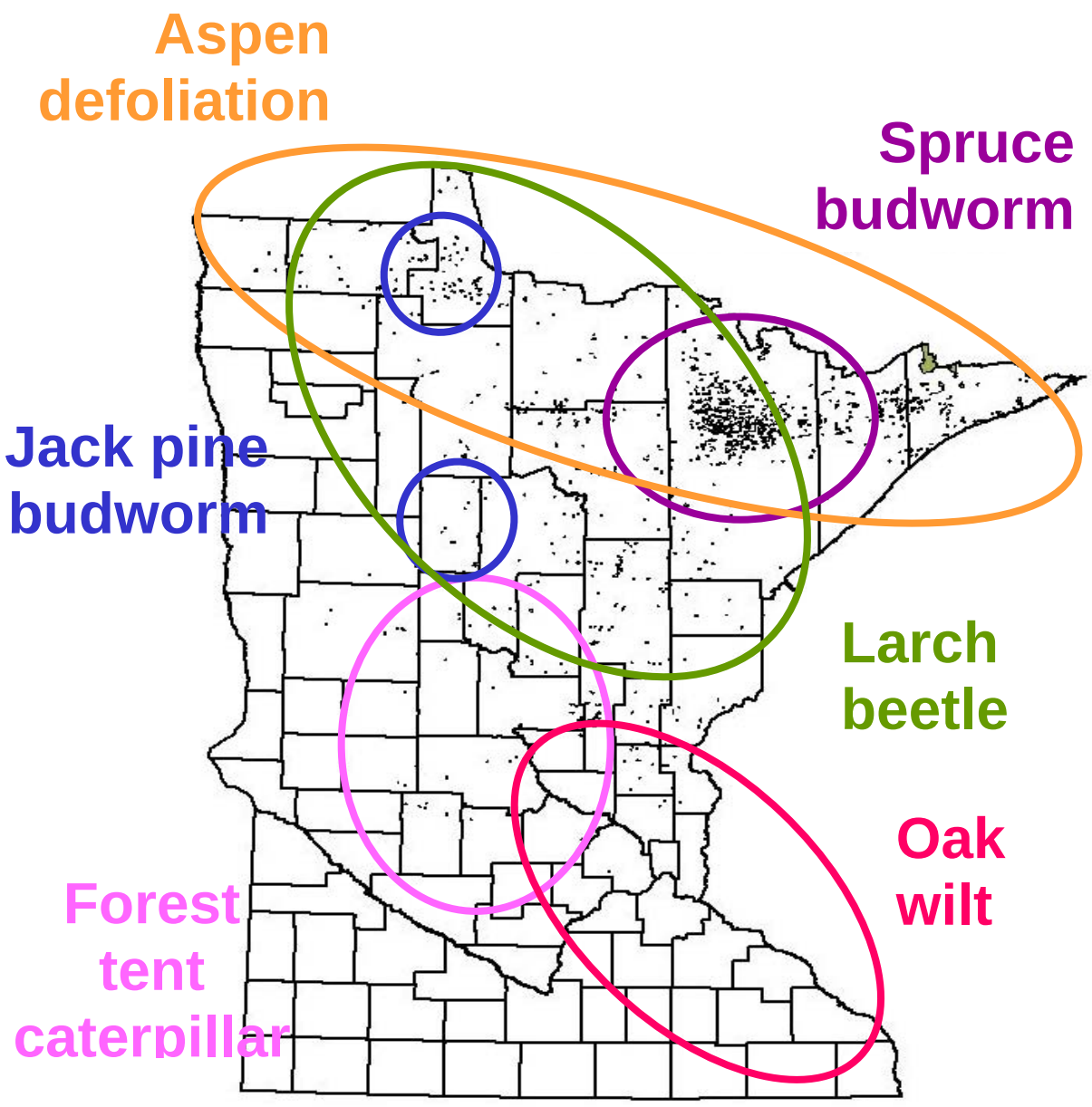
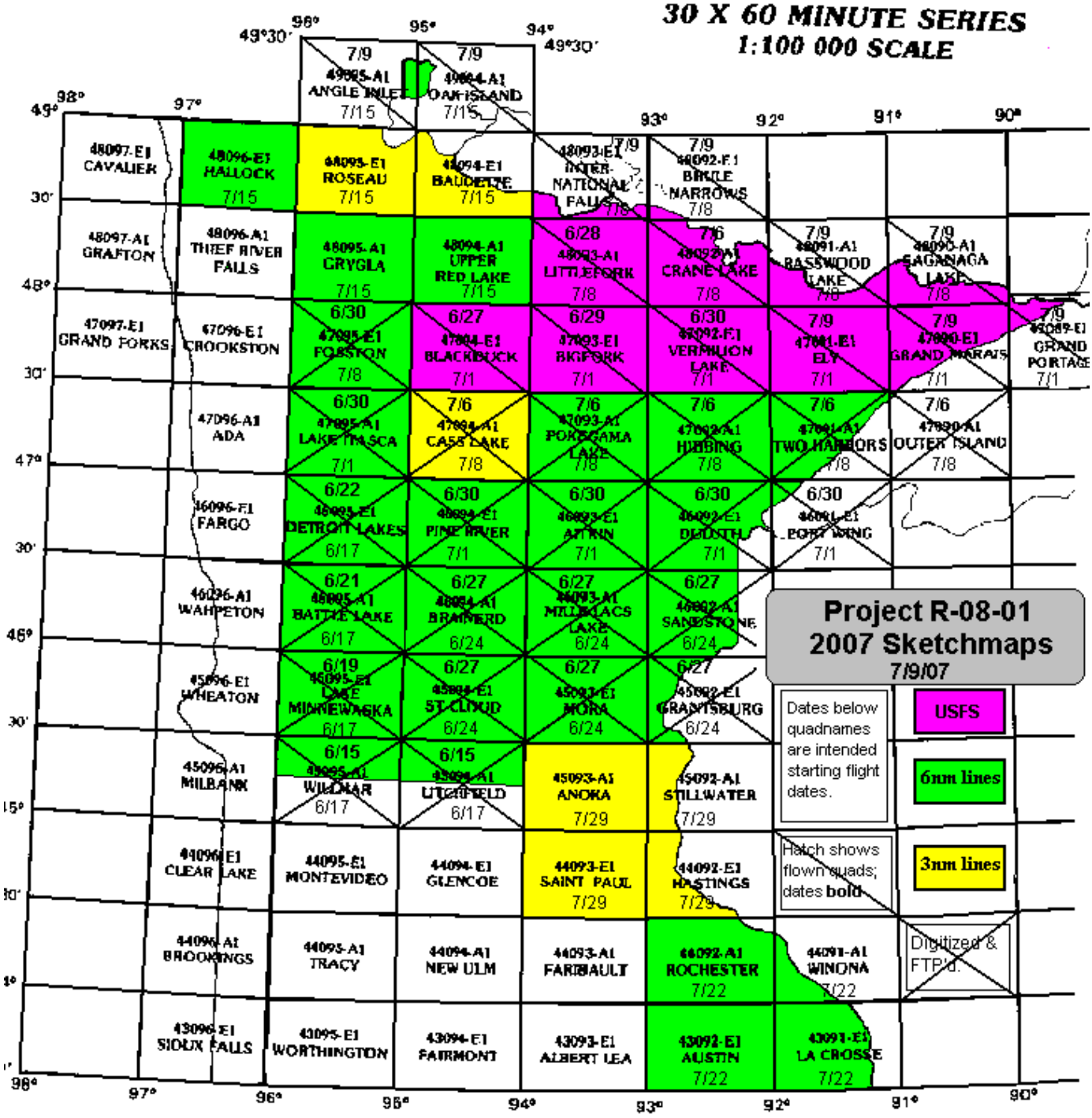
AERIAL SURVEY - 2007



Agent	Number of stands	Acres
Ash decline	159	12,870
Aspen defoliation, dieback and mortality	296	73,280
E. larch beetle mortality	143	12, 660
Fire – wildfire, primarily Ham Lake, Cook Co.	6	39,716
Forest tent caterpillar defoliation	131	16,620
Jack pine budworm defoliation	106	17, 310
Larch casebearer discoloration	87	10,190
Linden looper and cankerworm defoliation	3	570
Oak wilt (old and new locations) mortality	1,600	1,170
Spruce budworm defoliation	395	101,390

Generalized map showing major outbreak areas as detected by aerial survey in 2007.



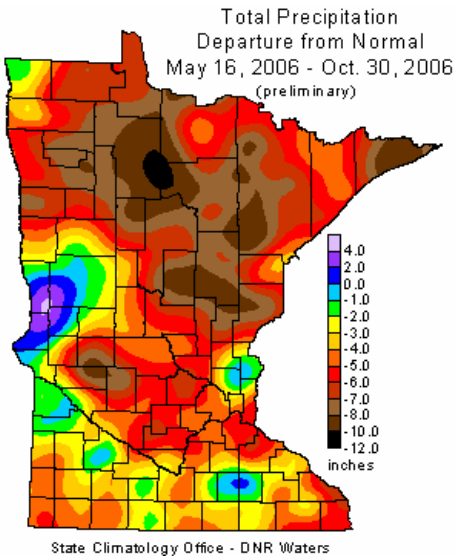

30 X 60 MINUTE SERIES
1:100 000 SCALE
Project R-08-01
2007 Sketchmaps
7/9/07
Dates below quadnames are intended starting flight dates.
Hatch shows flown quads; dates bold
USFS
6nm lines
3nm lines
Digitized & FTP'd.
48097-E1 CAVALIER
48096-E1 HALLOCK 7/15
48095-E1 ROSEAU 7/15
48094-E1 BAUDETTE 7/15
48097-A1 GRAFTON
48096-A1 THIEF RIVER FALLS
48095-A1 CRYGLA 7/15
48094-A1 UPPER RED LAKE 7/15
47097-E1 GRAND FORKS
47096-E1 CROOKSTON
6/30 47095-E1 FOSSTON 7/8
6/27 47094-E1 BLACKDUCK 7/1
47096-A1 ADA
6/30 47095-A1 LAKE ITASCA 7/1
7/6 47094-A1 CASS LAKE 7/8
46096-E1 FARGO
6/22 46095-E1 DETROIT LAKES 6/17
6/30 46094-E1 PINE RIVER 7/1
46096-A1 WAHPETON
6/21 46095-A1 BATTLE LAKE 6/17
6/27 46094-A1 BRAINERD 6/24
45096-E1 WHEATON
6/19 45095-E1 LAKE MINNEWASKA 6/17
6/27 45094-E1 ST. CLOUD 6/24
45096-A1 MILBANK
6/15 45095-A1 WILLMAR 6/17
6/15 45094-A1 UTICA/FELD 6/17
44096-E1 CLEAR LAKE
44095-E1 MONTEVIDEO
44094-E1 GLENCOE
44096-A1 BROOKINGS
44095-A1 TRACY
44094-A1 NEW ULM
43096-E1 SIOUX FALLS
43095-E1 WORTHINGTON
43094-E1 FAIRMONT
7/9 48095-A1 ANGLE INLET 7/15
7/9 48094-A1 OAK ISLAND 7/15
7/9 48093-E1 INTER-NATIONAL FALLS 7/8
7/9 48092-F1 BIRCH NARROWS 7/8
6/28 48093-A1 LITTLEFORK 7/8
7/6 48092-A1 CRANE LAKE 7/8
7/9 48091-A1 BASSWOOD LAKE 7/8
7/9 48090-A1 SAGANAGA LAKE 7/8
6/29 47093-E1 BIGFORK 7/1
6/30 47092-E1 VERMILION LAKE 7/1
7/9 47091-E1 ELY 7/1
7/9 47090-E1 GRAND MARAIS 7/1
7/9 47089-E1 GRAND PORTAGE 7/1
7/6 47093-A1 POKEGAMA LAKE 7/8
7/6 47092-A1 HUBBING 7/8
7/6 47091-A1 TWO HARBORS 7/8
7/6 47090-A1 OUTER ISLAND 7/8
6/30 46093-E1 ATTKIN 7/1
6/30 46092-E1 DULUTH 7/1
6/30 46091-E1 PORT WING 7/1
6/27 46093-A1 MILLSLACS LAKE 6/24
6/27 46092-A1 SANDSTONE 6/24
6/27 45093-E1 MORA 6/24
6/27 45092-E1 GRANTSBURG 6/24
45093-A1 ANOKA 7/29
45092-A1 STILLWATER 7/29
44093-E1 SAINT PAUL 7/29
44092-E1 HASTINGS 7/29
44093-A1 FARIBAULT
44092-A1 ROCHESTER 7/22
44091-A1 WINONA 7/22
43093-E1 ALBERT LEA
43092-E1 AUSTIN 7/22
43091-E1 LA CROSSE 7/22
49°30'
98°
97°
96°
95°
94°
93°
92°
91°
90°
49°
48°
47°
46°
45°

DROUGHT OF 2006 & 2007

2006 and 2007 were back-to-back drought years.

In December of 2006, the State Climatology Office reported:

- Dryness has been entrenched across northern and central Minnesota for nearly eight months. Eight-month precipitation totals have deviated negatively from historical averages by more than six inches across most of the northern one half of Minnesota.
- The end-of-year rain/snow events somewhat improved the topsoil moisture situation in locations where partially frozen soils were receptive to infiltration. Nonetheless, with the absence of significant fall recharge, Minnesota's soils will rely heavily upon early spring rains to bring moisture levels up to sufficient levels.
- Stream discharge in northern Minnesota watersheds remains low. Mississippi River flow conditions are very low due to long-term precipitation deficits in the headwaters area.
- Lake levels are very low in northern and central Minnesota. Some northern Minnesota lakes are at their lowest levels in many years. Lake Superior is approaching its lowest January water level in 80 years.



In April of 2007, the State Climatology Office reported:

- Dryness has been entrenched across northern Minnesota for nearly eleven months. While a welcome site, snowfall and rainfall from the early-March and late-March storms only partially eased the situation in the far north. Eleven-month precipitation totals have deviated negatively from historical averages by more than six inches across much of the northern one half of Minnesota.
- The National Drought Mitigation Center - U. S. Drought Monitor continues to indicate that most northern Minnesota counties remain in the "Extreme Drought", "Severe Drought", or "Moderate Drought" categories. The map does not reflect the late-March rains. While this late-March rainfall may improve the drought situation somewhat, a substantial portion of northern Minnesota continues to experience serious drought.
- The U.S. Geological Survey reports that stream flow in north central and northeastern Minnesota watersheds remains low. Elsewhere, many stream discharge values are well above the median for this time of year.

U.S. Drought Monitor
Minnesota

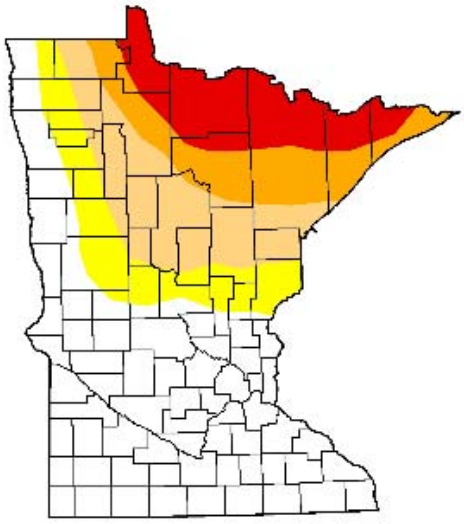
April 3, 2007
Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	49.3	50.7	39.0	23.3	12.5	0.0
Last Week (03/27/2007 map)	39.3	60.7	50.6	39.9	25.5	0.0
3 Months Ago (01/09/2007 map)	3.8	96.2	58.8	48.1	40.9	0.0
Start of Calendar Year (01/02/2007 map)	4.0	96.0	58.8	48.1	40.9	0.0
Start of Water Year (10/03/2006 map)	38.9	61.1	56.3	48.1	42.2	0.0
One Year Ago (04/04/2006 map)	100.0	0.0	0.0	0.0	0.0	0.0

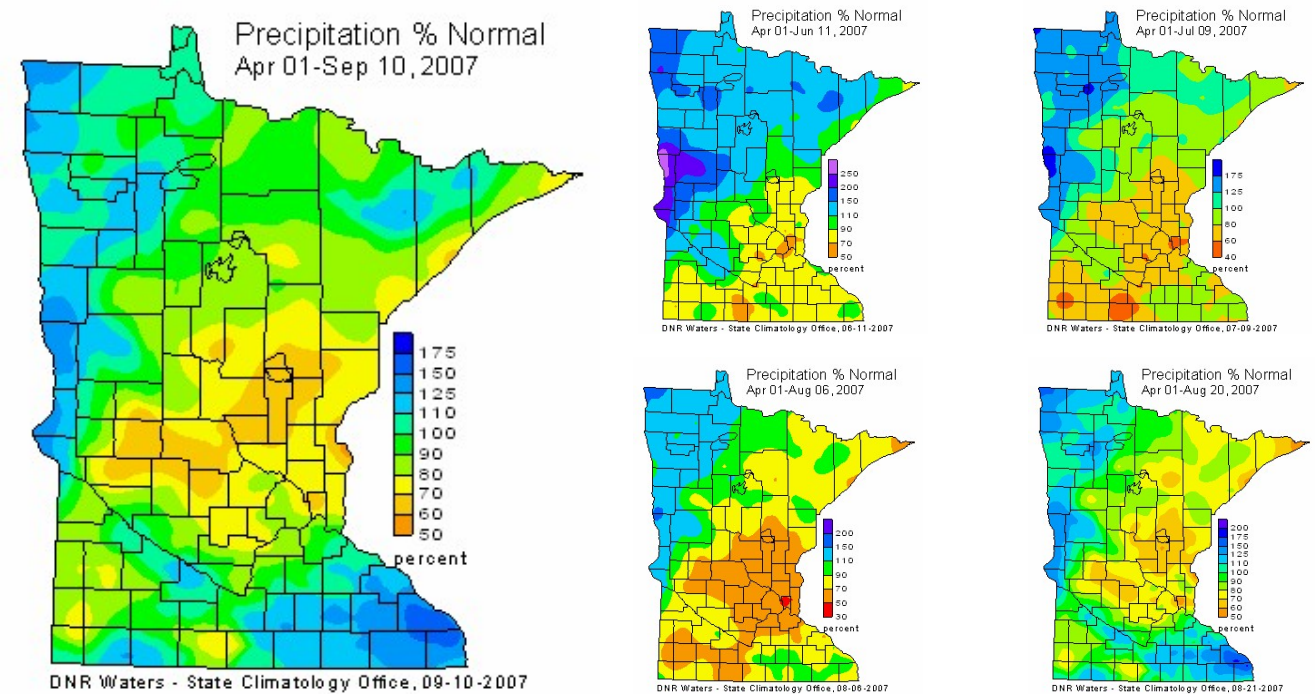
Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional



In May, Dr. Mark Seeley, Professor of Meteorology/ Climatology at the University of Minnesota, stated that the 2006 drought would end if 150% of the normal precipitation would fall in June, July and August of 2007. At that time, spring rainfall was plentiful and the weather was promising.

During the growing season, rainfall patterns followed the old adage "when it rains, it pours". Initially dry, the southern counties received abundant rains in August. Many areas in the extreme southeast experienced flash floods that month. The east-central counties remained dry throughout the growing season. In the north, significant early season rainfall occurred and then ceased for much of the growing season. The northwestern counties had plentiful rains all season long.



In Sseptember of 2007, the State Climatology Office reported:

- Growing season rainfall totals (April 1 - early September) are less than ten inches in many central Minnesota counties and in Minnesota's Arrowhead region. In these areas, seasonal rainfall totals have deviated negatively from historical averages by more than four inches. This is roughly the equivalent of missing all of June's normal rainfall. When compared with other seasonal rainfall totals-to-date in the historical database, this year's rainfall for the growing season ranks near the 10th percentile (one year in ten occurrence) in many of the drought-stricken counties. In a demonstration of the state's size and climate variability, rainfall totals in portions of northwestern and southeastern Minnesota are well above historical averages for the April 1 to present time frame. Because of the extraordinary August rains, and despite a very dry June and July, sections of Fillmore, Winona, and Houston counties are near or above all-time seasonal rainfall records, with totals topping 30 inches since April 1st.
- The U. S. Drought Monitor released on August 28 places Minnesota's Arrowhead region and portions of central Minnesota in the "Extreme Drought" category. Much of the rest of the northern two-thirds of Minnesota falls in the "Severe Drought" or "Moderate Drought" designation. Most of northwestern Minnesota is described as being "Abnormally Dry". Substantial August rains led to the elimination of drought designations in the southern three tiers of Minnesota counties. The drought situation in the northern one third of Minnesota is the result of the lingering impacts of a very dry 2006, a snow-sparse 2006-2007 winter, and dry 2007 mid-summer weather. The drought situation in the central third of Minnesota is due to an extremely dry 2007 growing season.
- The U.S. Geological Survey reports that stream discharge values in roughly 30% of Minnesota's rivers and streams rank below the 25th percentile when compared with historical data for this time of year. Flow rates in many north central, northeastern, central, and east central Minnesota watersheds fall below the 10th percentile for the date. Mississippi River flow conditions remain very low along the upper reaches of the river. Mississippi River discharge near Anoka is at roughly the same flow rate as it was during the 2006 drought, but significantly above the all-time record low for the date set in 1934.
- Water levels are very low on many Minnesota lakes, exposing shoreline, and in some cases, making water access difficult. Anecdotal reports indicate that many lakes in northern, central and east central Minnesota are a foot or more

below average levels for the date. The Lake Superior water level is near an all-time low for the date and the mean monthly value will likely be declared as the all-time August low when statistics are finalized.

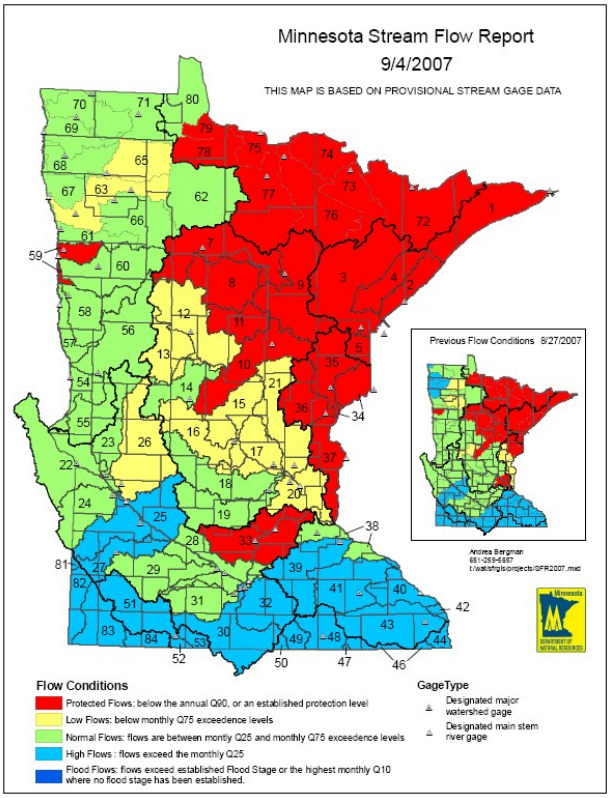
- The Minnesota Agricultural Statistics Service reports that as of August 31, topsoil moisture across nearly 40% of Minnesota's landscape was "Short" or "Very Short". This is a substantial improvement from the conditions reported in early August when nearly 85% of the state reported less than adequate soil moisture conditions. 45% of Minnesota's corn acreage is considered to be in "Good" or "Excellent" condition. This is up from 25% in early August. A federal agricultural disaster was declared on August 7 for 24 Minnesota counties suffering from drought. Farmers and ranchers in an additional 32 adjacent counties are also eligible for drought recovery assistance.
- The DNR Division of Forestry classifies current wildfire danger as "High" or "Very High" across all of the northern one half of Minnesota. "Moderate" fire danger exists from St. Cloud and the Twin Cities westward to the South Dakota border. The southern one quarter of the state is depicted in the "Low" danger category. Burning restrictions are in place in many northern Minnesota counties.

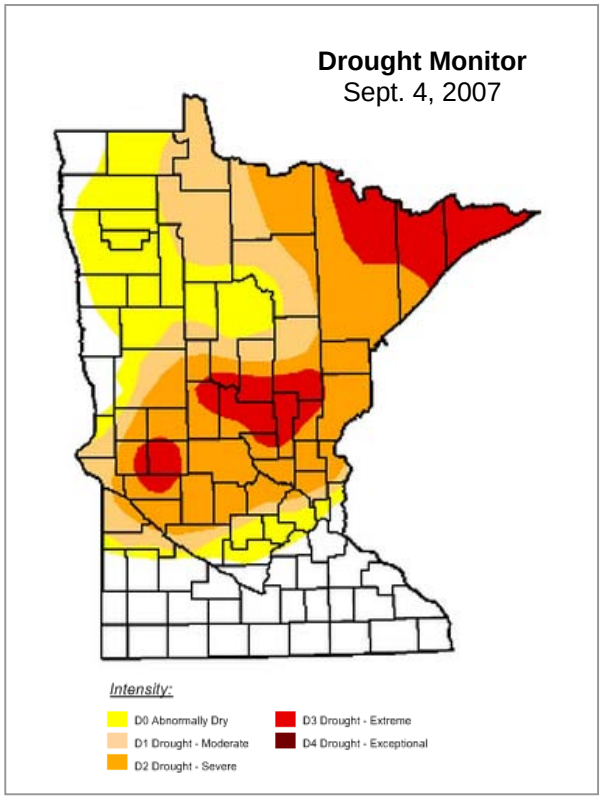
The depths of the 2007 drought compared to the drought of 2006:

Similar or Worse Conditions

X — Stream flow in 24 of 82 watersheds was below the 10% level (below the Protection Level for those streams) on Sept. 4, 2007. See map below.

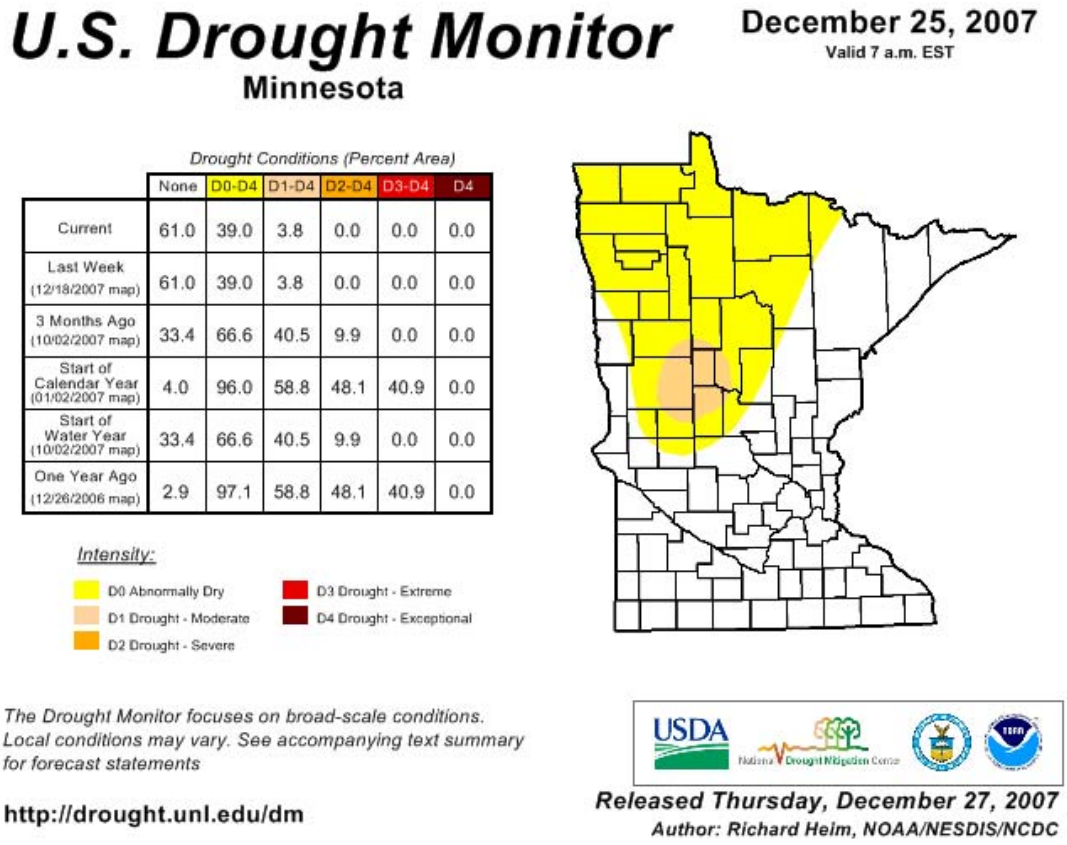
X — Nearly all counties north of the Minnesota River were in some stage of long term drought in the federal Drought Monitor Map on Sept. 4, 2007. See map below.





By early November, the State Climatology Office was reporting:

- Substantial September and October rains flushed away drought concerns in most Minnesota counties. Only three months ago, one half of Minnesota was considered to be experiencing "Severe" or "Extreme" drought. The U. S. Drought Monitor, released on October 30, now places a relatively small area of west central and central Minnesota in the "Moderate Drought" category. Portions of northwestern and north central Minnesota remain designated as "Abnormally Dry", an acknowledgement of some lingering precipitation deficits. All other Minnesota locales are deemed to be free of drought conditions.
- The U.S. Geological Survey reports that discharge values for roughly one half of the state's rivers rank in the highest 25th percentile historically. Only five percent of Minnesota's rivers rank below the 25th percentile when compared with historical data for this time of year. This is a substantial improvement from early September when stream flow in one third of the state's rivers ranked in the lowest quartile.
- Water levels remain below average on some Minnesota lakes. However, the wet autumn caused most Minnesota lakes to rebound to within a range of levels commonly found at this time of year. In some cases, lake levels soared past mid-range in October and are now well above average. The Lake Superior water level is up five inches from early October. While the Lake Superior water level is no longer near the all-time seasonal low, it remains well below the long-term average.
- The Minnesota Agricultural Statistics Service reports that as of November 2, topsoil moisture across 79% of Minnesota's landscape was "Adequate". This is a substantial improvement from conditions reported in early August when nearly 85% of the state reported less than adequate soil moisture conditions.



INSECTS

Aspen blotch miner

Phyllonorycter spp.

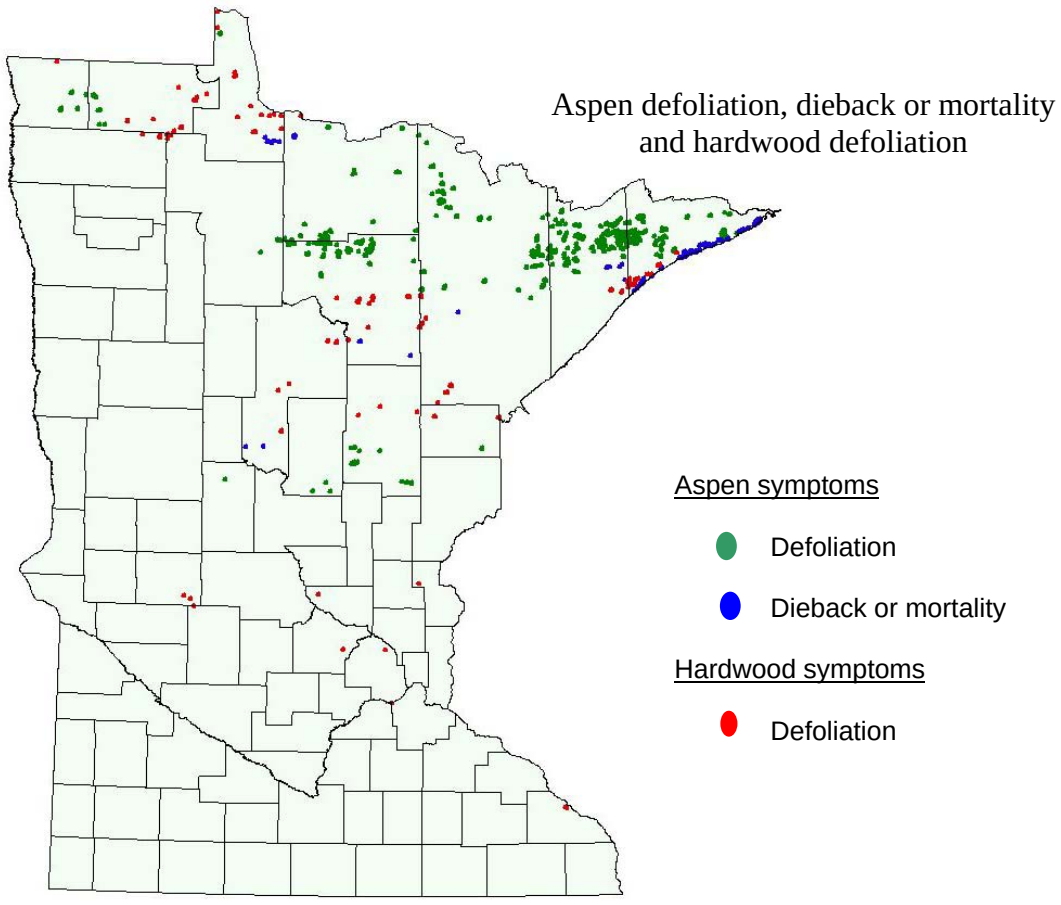
During a late August visit to State Parks along the North Shore, we observed that a number of aspen trees had white blotches on their leaves. Some leaves had black remnants of moth pupal cases extending from their lower epidermises. Next year's buds were well formed, but many appeared smaller than usual. It's likely that the aspen blotch miner had caused some reduction of photosynthesis and thus bud size. These blotch miners are caterpillars of the moth genus *Phyllonorycter*. *P. tremuloidiella* moths overwinter under the bark of red and jack pines and, sometimes, other conifers. Our smaller winter birds pull off these bark scale edges to fed on these moths, leaving heaping piles of bark scales on the ground below. Larval competition in infested leaves and the presence of parasites have terminated past outbreaks.

Aspen defoliation, dieback or mortality

Cause unknown

Aerial surveyors found 73,200 acres of aspen defoliation and 16,666 acres of dieback and mortality in aspen Ground checking, which was done late in the season, was not able to determine a cause. There was evidence of some leaf rollers and leaftiers but not enough to explain all of the defoliation. It is possible an early season defoliator, like the large aspen tortrix, was involved but pupal cases were not found. To the north, Ontario reported a couple large areas of defoliation by large aspen tortrix. They also found many smaller areas of defoliation and speculated that an early, aspen-leafroller complex was involved.

Aspen dieback and mortality appeared to involve the larger, overstory trees on the sites. A cause has not been determined. It's likely that a combination of factors were involved including drought in 2002-2003 and 2006-2007, forest tent caterpillar defoliation in 2000-2003, site factors and age. Further investigations will be conducted in 2008.



Bark beetles

Ips pini

The drought that continued from mid-summer 2006 through the growing season of 2007 created conditions favorable for bark beetle activity in pines. Examples of observed bark beetle activity are described below.

In a 6 acre plantation located in NE1/2 of Sec 18- T51-R22W, a few red pine trees were killed by bark beetles during the summer of 2006. The bark beetle-attacked trees were not noticed by foresters until the foliage turned red in late winter. In the mean time the stand was thinned for the second time, in November and December of 2006. In the spring of 2007, an examination of the thinning slash showed it to be heavily infested by *Ips pini.* Because of the continuing drought it was decided that the slash should be removed from the stand and burned. This was completed by May 31st. This stand slopes on the north side towards lowland tamarack. Water filled the bottom of an 18 inch hole that was dug in the low part of the plantation, even though it was extremely droughty. This indicates that the north edge of the plantation was planted in soil that did not have enough rooting depth for red pine. Red turpentine beetles were found in many trees along the north edge of the plantation indicating that the trees had been under stress for some time. Turpentine beetles have spread from this edge into the rest of the stand. It is thought that the turpentine beetles added to the stress of the trees eventually resulting in the *Ips pini* attack and mortality. The trees attacked and killed in 2006 resulted in the high numbers of bark beetles in the slash in 2007.

Pockets of bark beetle caused mortality were observed in a red pine plantation in stand 40 Sec 7-T55 R12W, 2 miles north of Brimson south of county rd 54. This 40 acre stand was thinned 5 years ago. It is not known if factors other than the drought have contributed to this mortality. Further investigation of this site should be done in 2008.

Ips pini were found killing red pine trees on DNR Forestry office property in Floodwood. Mortality has obviously been occurring for a couple years. Trees along the western edge facing the DOT site often winterburn indicating the trees are growing on a site not very favorable to red pines. The repeated winter injury coupled with the drought are assumed to have stressed the trees enough for bark beetle attack to occur.

A red pine stand in NE SW S16-T60N-R18W on the Laurentian Environmental Learning Center suffered bark beetle mortality in 2006. This attack was the result of a pre-commercial thinning in October 2006 where all the slash was left in the stand. Bark beetles were able to build up high populations in this slash during the drought in 2006. This resulted in pockets as well as scattered tree mortality. Up to 25 trees were killed in some of the bark beetle pockets. It was feared that the elevated bark beetle populations would result in continued mortality in 2007 with the continuing drought. A few scattered individual trees were attacked in 2007 but the pockets generally did not increase in size and the bark beetle population appears to have declined.

A bark beetle pocket was found near Side Lake in Sec 16-T60N-R20W in late August. A half dozen or so 80 to 90 year old red pines were killed by bark beetles in 2007 on the edge of the stand. Another dozen trees had green needles but very thin crowns. *Ips pini* and *Dendrotonus valens* had attacked and killed the trees. *D. valens* was found in the base of many of the trees with thin crowns. It was also suspected that this was likely a root rot pocket as well. The dead trees, trees with thin crowns and a buffer of apparently healthy trees were harvested and removed from the site in early September. This site should also be examined again in 2008.

Douglas-fir beetle

Dendroctonus pseudotsugae

In the past, Douglas-fir beetles have been transported to north-central Minnesota on western larch logs from Montana and Idaho. MDA issued compliance agreements with the local business. MDA and DNR trap catches decreased from 140 beetles in 2002 to zero beetles in 2006. The status of this pest in Minnesota continues to be evaluated. In 2007, MDA and DNR coordinated an effort to place nine traps in Itasca County around the area where the beetle was first detected in 2001. Three funnel traps were placed in Arbo Township in Sec 7-T56N-R25W by the DNR on April 19, 2007. The traps were baited with commercial Douglas-fir beetle baits. Traps were emptied once a week and collections placed in a freezer. Traps were removed July 9, 2007. MDA also trapped for Douglas-fir beetles on the Lonza (formerly Larex) site. No Doug-fir beetles were trapped.

Eastern larch beetle

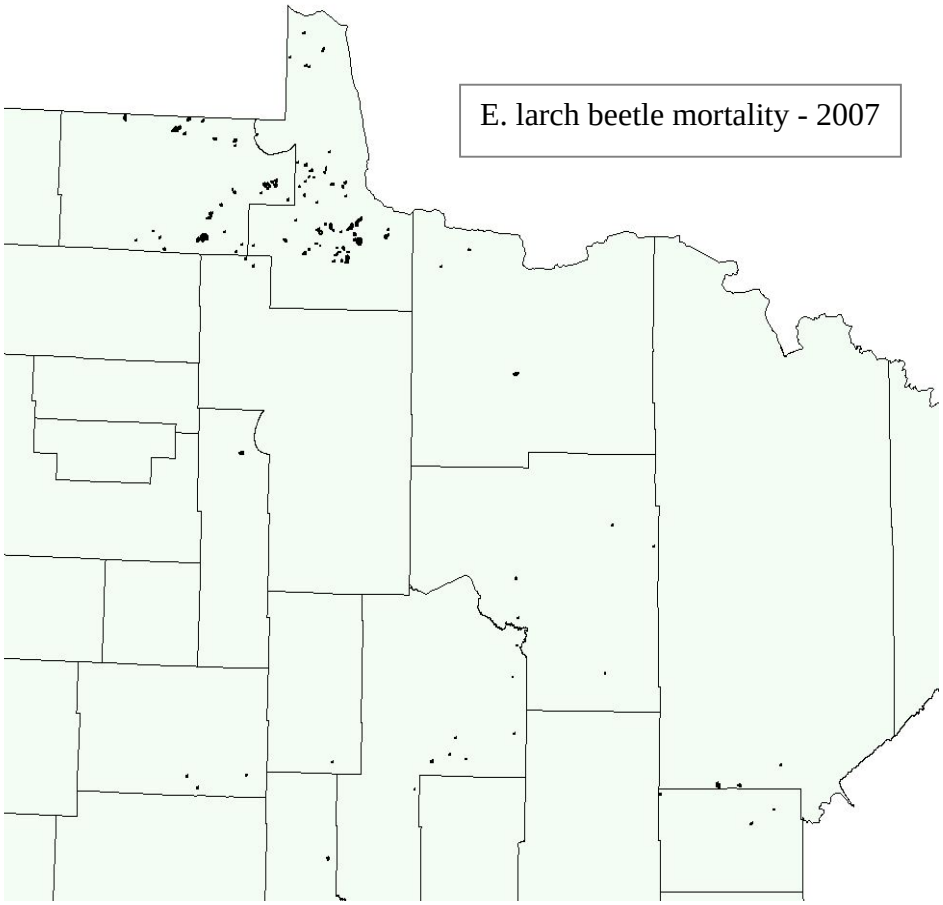
Dendroctonus simplex

In the past 6 years (2001 to 2006), over 53,000 acres of tamarack have had significant levels of mortality due to eastern larch beetle. This year, an additional 12,600 acres of mortality damage were added to the list, 10,600 acres of which were in Roseau and Lake of the Woods Counties.

No consistent stress factor contributing to the current mortality by eastern larch beetle has been found. Trees ranging from 40 to 160 years old have been killed by the beetle. Mortality has occurred on upland as well as lowland sites and in mixed species stands as well as in pure stands.

Researchers (Langor and Raske, 1987) in Newfoundland found that only adult beetles were able to survive overwinter and that freezing temperatures caused complete mortality of overwintering larvae. Overwintering survival has been followed on a few trees just north of Grand Rapids the past four years. Eastern larch beetle larvae were excavated from tamarack trees in Itasca County in Sec 20-T54N-R25W and in Sec 7 –T56N-R25W to check overwinter survival. Larvae were collected in late March and also in mid-April. Larvae as well as adults have been surviving the mild winters we have been experiencing. The lowest temperature in Grand Rapids this past winter was –27 F and larvae survived again. Perhaps the current outbreak of larch beetle is a result of the mild winters allowing the immature stages as well as the adults to overwinter resulting in larger populations than normal.

The droughts of 2006 and 2007 and the resulting stress on tamarack trees may have contributed to a continuation of the outbreak.



European pine sawflies

Neodipron sertifer

Photo courtesy of Jeff Cordes, Eden Prairie

Sawfly larvae and the damage they can inflict in a matter of one or two days can cause dismay and panic in even the most stalwart individuals. The Twin Cities metro and surrounding areas experienced a higher than normal occurrence of European pine sawfly this spring and calls started coming in late April reporting infestations on red, scotch, and mugo pines. Many homeowners reported severe defoliation of last year's growth and there were reports during the first week of June of feeding on current year's growth. Heavily defoliated trees will look scraggly this year but with a little special care this summer, very few trees should be lost.

Forest tent caterpillar

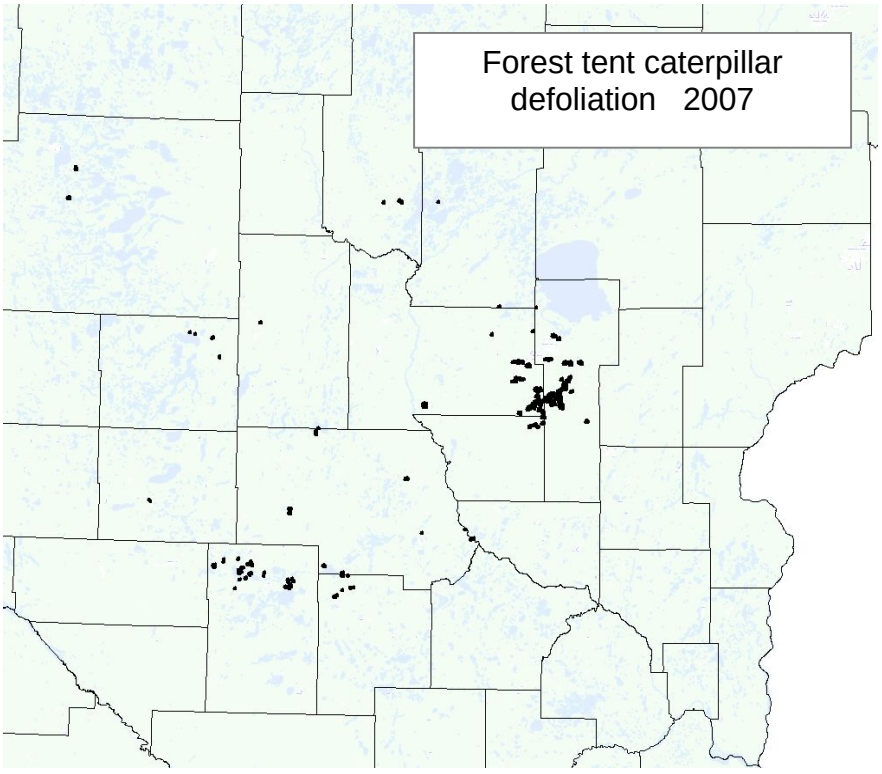
Malasoma disstria

Photo courtesy Shane Delaney, DNR

Forest tent caterpillars were found in Mille Lacs, Stearns, Kandiyohi, Ottertail, Douglas and Beltrami Counties on 12, 550 acres defoliating basswood, oaks, birch and aspen. Birch Lake State Forest in Stearns County had areas with severe hardwood defoliation.

Forest tent caterpillar usually builds a statewide outbreak by starting on the south shore of Mille Lacs Lake and in the Rum River Forest to the south. In both northern regions, there were sightings of individual caterpillars. So, taken together, these signs may portend a northern outbreak in the near future.

On June 6th, a drive through Birch Lake State Forest Campground in western Stearns County revealed some areas with severe defoliation from forest tent caterpillar. Oak, ash, aspen, basswood - just about any deciduous tree - had been targeted by these voracious feeders. The campground had experienced an extensive infestation of FTC in 2005 with the basswood taking the brunt of the defoliation at that time. A survey in 2006 revealed no appreciable mortality of basswood due to the outbreak. But, with many *Populus* species already experiencing crown dieback due to environmental stress, we may see appreciable mortality in these species because of defoliation from FTC.



Jack pine budworm

Choristonerua pinus

Photo courtesy of Mike Albers, DNR

In 2007, jack pine budworm defoliated 17,320 acres across the northern third of the state, down from 70,790 acres last year. The Northwest Region saw only 7,770 acres of defoliation, both in Baudette/ Roseau country and in the traditional outbreak areas of Beltrami, Hubbard, Cass and Crow Wing Counties. In the Northwest Region the outbreak is winding down.

In the Northeast Region, 2007 was the second year of the outbreak and defoliated acreage is also declining. Last year, budworms defoliated 37,496 acres. In the current outbreak, the largest area of defoliation is in northern St Louis county mostly within the Boundary Waters Canoe Area Wilderness and Voyageurs National Park. Smaller acreages defoliated in northeastern Itasca, central Koochiching, central St Louis and scattered stands in Lake and Cook Counties.

Early larvae surveys were conducted in late May and early June near Big Falls in Koochiching County, near Wolf Lake in Itasca County and near Esquagama Lake in Central St Louis County. See table below. On June 21st, larvae near Wolf Lake were from 12 to 22 mm long.

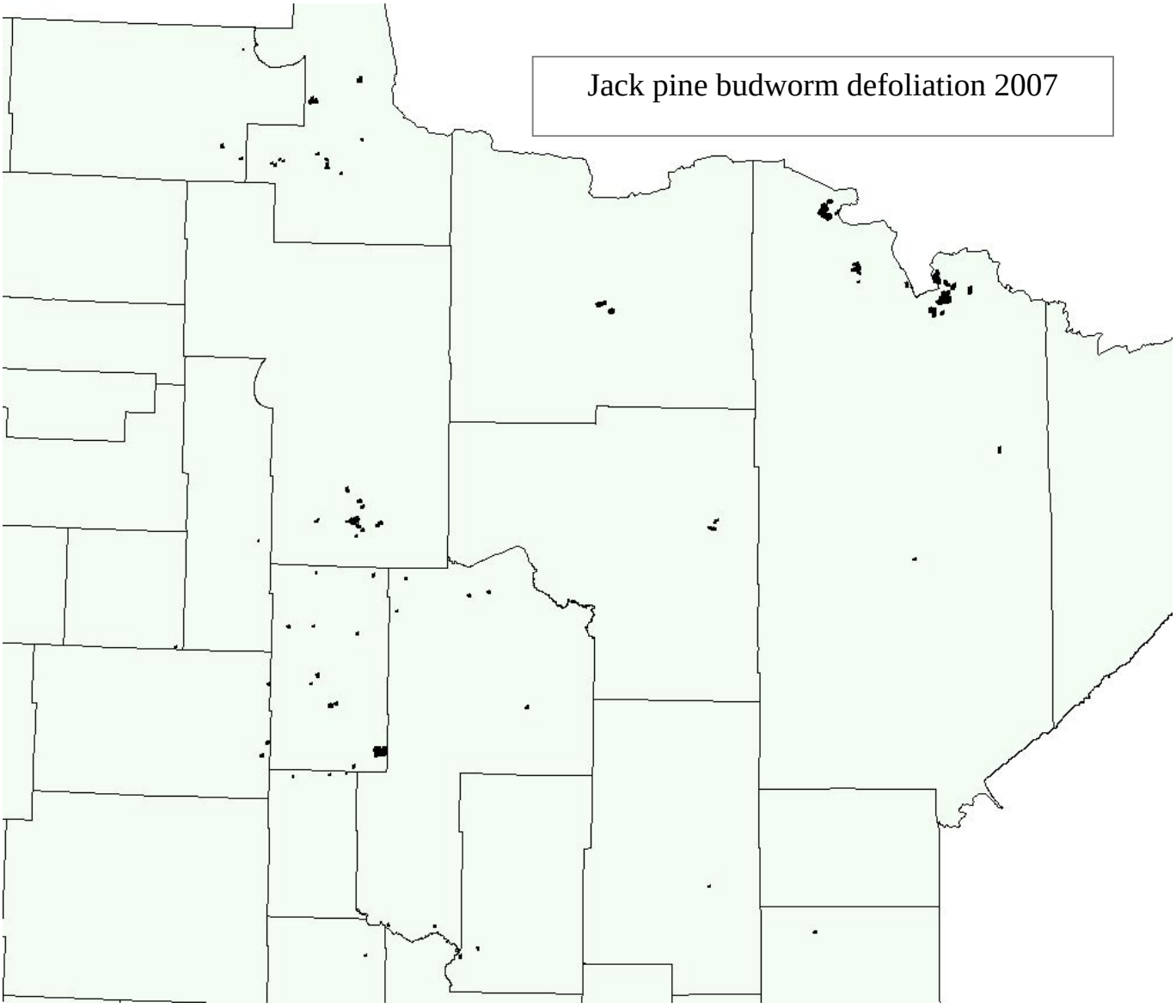
Summary of Jack pine budworm early larvae plots in NE Region - 2007

Location	**Larval size/ Date**	**Number of plots predicting Low to Moderate Defoliation**	**Number of plots predicting Moderate to Heavy Defoliation**	**Notes**
Big Falls/ Koochiching Co.	2-5 mm/ May 29	5	1	On all plots, male jack pine flowers were rare indicating that young larvae will have a difficult time surviving.
Wolf Lake/ Itasca Co.	3-5 mm/ June 5	4	2	Male flowers were very abundant on all but the plot in SWSE S28-R59N-R23W.
Esquagama Lake/ St. Louis Co.	4-7 mm/ June 5	5	2	Male flowers were abundant on all plots indicating the early larvae should have a high rate of survival.

Photo courtesy of Mike Albers, DNR

An outbreak of Jack pine budworm has been occurring in Canada for the past two years. Defoliation on 219,000 acres was reported on the Fort Frances District in Ontario in 2005. This increased to 1,859,000 acres in northwestern Ontario in 2006 in the Fort Frances, Kenora, Sioux Lookout and Red Lake Districts. The Fort Frances District had the largest amount of defoliation and most of it was in the moderate-to-severe range. A large aerial spray operation was conducted in the Kenora and Fort Frances Districts for jack pine budworm from June 1 to June 7th 2006. The biological insecticide, Bt.K was sprayed on 544,000 acres of forestland. Surveys of overwintering larvae indicate a collapsing population in the Fort Frances District but a possible increase in populations to the east in Quetico Provincial Park.

When jack pine budworm populations show up in northeastern Minnesota we tend to blame it on Canadian moths blowing over the border. Canadians tend to blame their problems on Minnesota moths blowing into Canada, so it works out well for both sides. It's handy to have good neighbors to point a finger at, eh!



Larch casebearer

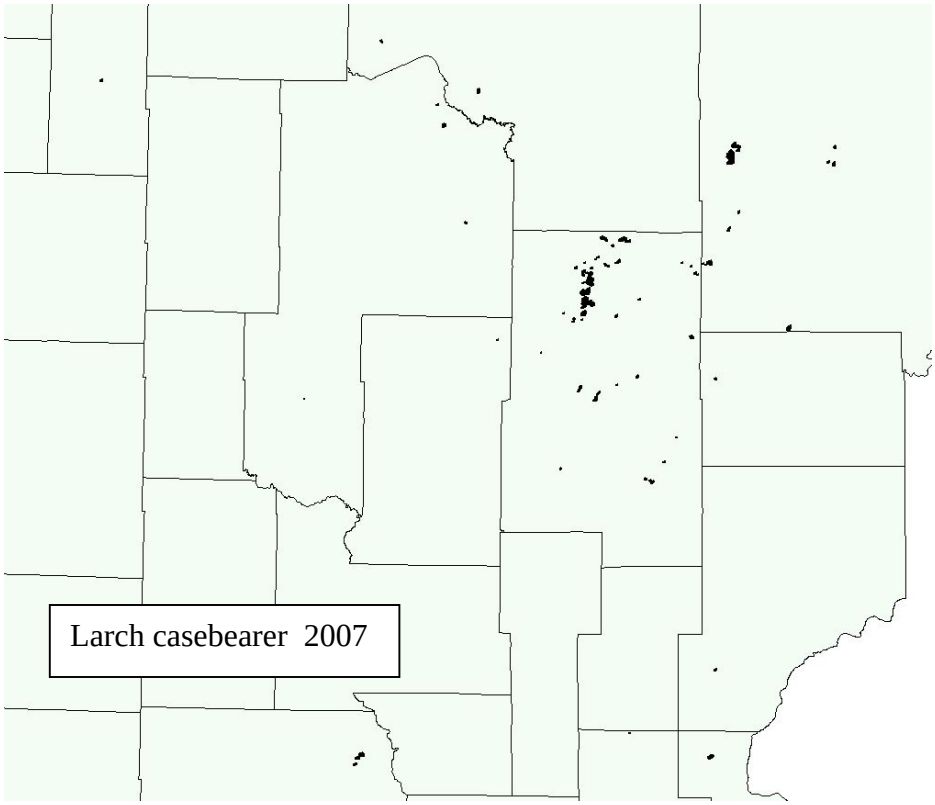
Coleophora laricella

Photo by Mike Albers, DNR

Larch casebearer is an exotic insect that was introduced to North America in the 1880's. Casebearer populations reached the Lake States in the 1950's and the species is now considered to be naturalized. This year, slightly more than 10,000 acres of discoloration/ defoliation was found during the aerial survey.

Release of European parasites of larch casebearer began in the US and Canada in the 1930's. Two introduced parasitic wasps, *Agathis pumila* and *Chrysocharis laricinellae*, along with at least 25 native insects that parasitize or feed on various life stages usually keep larch casebearer populations at low levels.

Larch can withstand defoliation better than most other conifers because they drop their needles each fall and produce a new set of needles each spring. Repeated defoliations by casebearers result in shorter needles and can lead to dead branch tips, dead branches, dead tops and eventually dead trees. While we have been seeing elevated populations of casebearer since about 1999, so far we have not seen any mortality associated with it. The most obvious casebearer defoliation seems to be on younger or stagnant tamarack.



Linden loopers and fall cankerworm defoliation

Erannis tiliaria and *Alsophila pometaria*

In late May, caterpillars of two moth species, linden loopers and fall cankerworms, defoliated more than a thousand acres of hardwood trees and shrubs in the Brainerd/ Baxter area and in isolated spots in Cass, Crow Wing and Itasca Counties. Aerial survey did not map this defoliation because trees refoliated before the survey was flown.

In the Brainerd/ Baxter area in Cass County, road construction and suburban improvements along highways 210 and 371 created a small two-lined chestnut borer (TLCB) population due to root system injuries generated by these activities in the past few years. Subsequent drought stress, complete defoliation by linden loopers and fall cankerworms and refoliation this spring allowed the TLCB population to buildup and spread locally. The drought intensified and TLCB were able to cause significant topkill and mortality in the oaks in the Brainerd/ Baxter area which is entirely suburban developement.

Photo by Jana Albers, DNR

Pales weevil

Hylobius pales

White spruce seedlings in a newly established plantation a short distance to the south west of Big Falls appear to have been killed by feeding of adult pales weevils. The recently cut over site was planted to white spruce container seedlings in spring of 2007. In early August, 30 to 40% of the seedlings had died. Bark was missing from around the stems of dead seedlings just above the soil line and looked characteristic of adult weevil feeding. No weevils were found so positive identification was not possible.

Bark removed from stem of white spruce seedling by adult weevil feeding.

Photo by Mike Albers, DNR

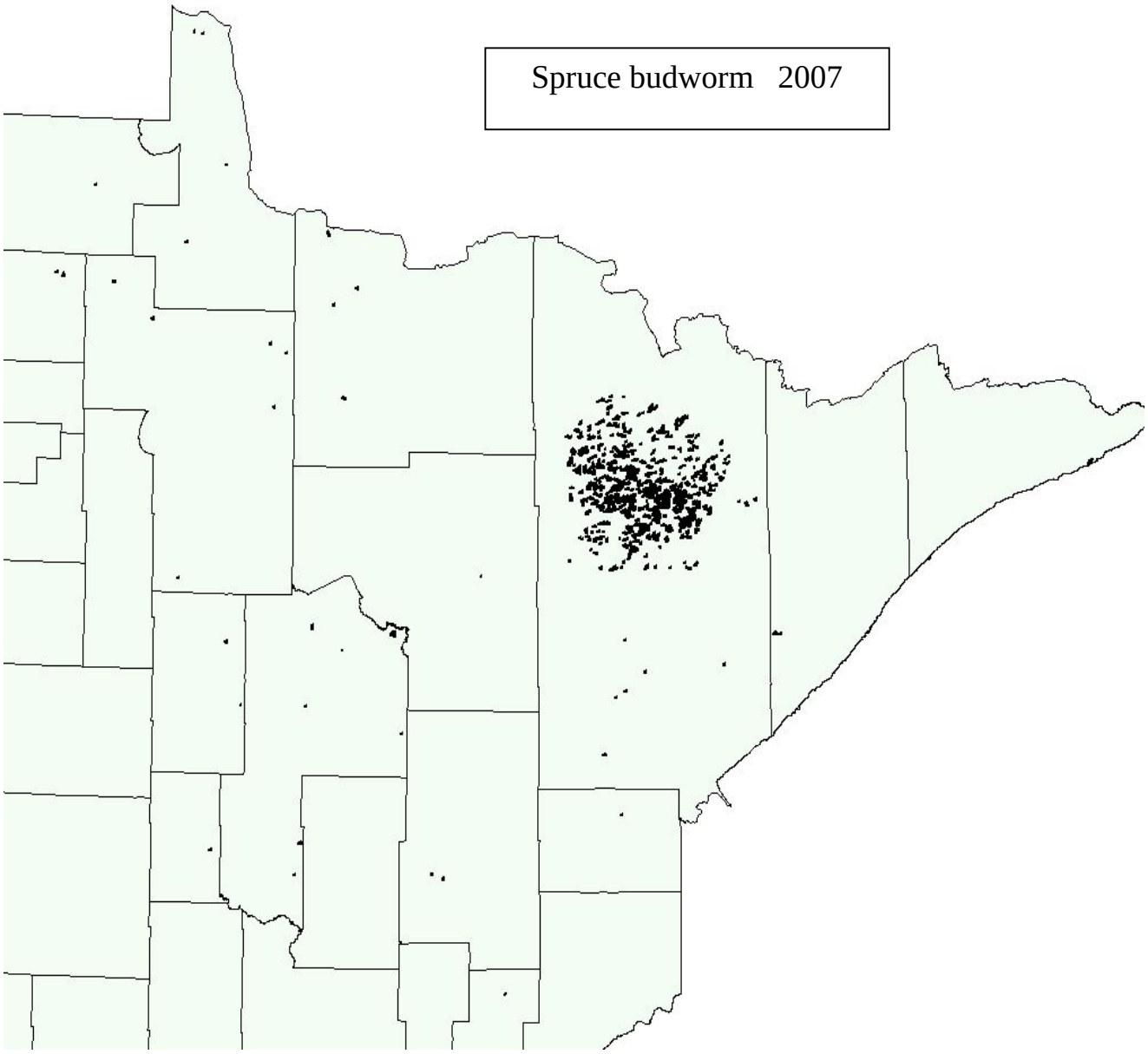
Forty percent of the dead seedlings examined had only a small number of live roots. Live roots were confined to the upper portion of the plug and all the lower roots had been dead for a while and likely were dead at the time of planting. It looked as if the roots in the lower portion of the plug had died due to water logging or a fungal infection prior to planting.

Spruce budworm

Choristoneura fumiferana

Spruce budworm defoliation occurred on 101,400 acres, primarily in St. Louis County. Last year, more than 287,000 acres of balsam fir and white spruce were defoliated in the same area. Outlying areas of defoliation are primarily white spruce plantations.

Photo courtesy of Mike Albers, DNR



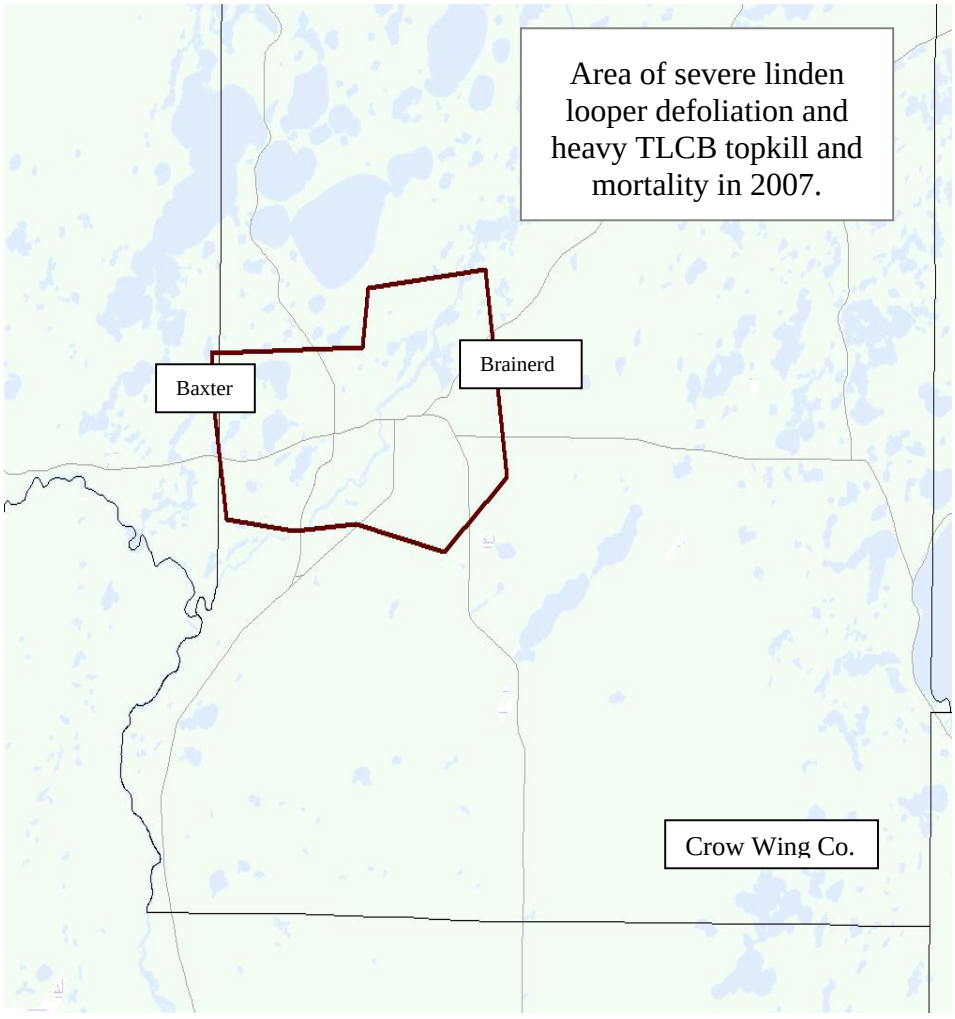
Two-lined chestnut borer

Agrilus bilineatus

Photo by Jana Albers, DNR

History does repeat itself, especially when opportunistic insects or pathogens are involved. In this case, two-lined chestnut borers (TLCB) caused topkill and mortality of oaks this year in much the same area that they did in 1989 and 1990, and under the same circumstances that occurred during the 2003 outbreak in Itasca County. Two-lined chestnut borers can only successfully attack oak trees that are weakened by complete defoliation, root system injuries, storm damage or recent thinning which occur in tandem with droughty weather. Usually more than one type of stressor is involved.

In southern Crow Wing County, road construction and suburban improvements along highways 210 and 371 created a small TLCB population due to root system injuries generated by these activities in the past few years. Subsequent drought stress and complete defoliation by linden loopers and fall cankerworms this spring allowed the TLCB population to buildup and spread locally. As the drought intensified in 2007, TLCB were able to cause significant topkill and mortality in the oaks in the Brainerd/ Baxter area.



DISEASES

Hickory mortality

Fungi and insects

Photo by Ed Hayes, DNR

For decades hickory mortality has been attributed to periods of drought, poor sites, and natural range issues, followed by infestations of the hickory bark beetle. Field surveys in cooperation with the USFS in both 2006 and 2007 have found a more complex situation than was previously thought. The situation is best characterized as a classic decline with long-term and short-term impacts of climate, site conditions, droughts, genetics, and the insects and fungi. In 2007 five sites were surveyed in Olmsted, Fillmore and Winona Counties. In southern Winona County site, one shagbark hickory was affected, while on all the other sites, bitternut hickory was the main species affected.

Studies of entire dissected trees have revealed stem cankers, galls, and abundant signs of bark and wood-feeding insects. Individual tree decline and mortality in affected stands appears to be caused by more than just hickory bark beetles and drought. A variety of insect damage was found including the hickory bark beetle (the most common type of insect damage observed), other borers, and one or more species of ambrosia beetles. The fungi now include *Fusarium solani*, (interestingly the same fungus as found associated with black walnut canker disease). Ambrosia beetles may be bringing in the fungi causing cankers. It is supposed that fungal infection may eventually pre-dispose the hickories to bark beetle attacks.

Brief summary of 2007 Hickory Decline survey results

Prepared by: Dr. Jenny Juzwik, USFS, September 7, 2007

Field Evaluations – Surveys were conducted in 14 stands in 3 states (IA, MN, WI) between 14 May and 28 August 2007. Based on basal area estimates, 12 of the stands are currently overstocked (> 60 m^2/ac). In general, abundant hickory regeneration is occurring in all but two stands. A range of variability was found in frequencies of declining and of dead hickory in the surveyed stands based on the condition of each hickory within 10 m of systematically determined points on three transects (10 points per transect) in each stand. Frequencies of each condition class ranged from 83% apparently healthy with 10% declining and 7% dead to 0% apparently healthy with 15% declining and 85% dead.

Processing of Field Samples – Fungi obtained from trees sampled in 10 declining hickory stands in the three states in summer 2006 were identified as *Ceratocystis smalleyi* (19 isolates), *Fusarium solani* (15 isolates), and *Phomopsis* spp. (4 isolates). *C. smalleyi* was commonly isolated from trees with evidence of hickory bark beetle activity; *F. solani* was associated with sunken, annual cankers. To date (31 August) in the 2007 survey, *C. smalleyi* and *F. solani* have been isolated from similar numbers of trees (11 and 13, respectively) and isolates commonly obtained (25 and 29, respectively) from 6 stands.

Role of *Ceratocystis* spp. and Other Fungi – Main stems and/or branches of sapling and pole-size bitternut hickory were inoculated with two isolates of each fungal taxon in late May 2007. The first evaluation for lesion or canker development will occur in October 2007. The contamination frequency of hickory bark beetles carrying *C. smalleyi* is being determined for adults captured in window flight traps during June and July in a stand of declining bitternut hickory. Frequencies of ambrosia beetles carrying *Fusarium* spp. and of hickory bark beetles carrying *C. smalleyi* will also be determined for adults emerging from logs from declining trees in the same stands.

Insect Trapping – a) *Window flight traps* were used to trap dispersing hickory bark beetles in crowns of four clusters of two to three declining, pole-size bitternut hickory between late April and early August 2007. Of 8 traps deployed, 39 hickory bark beetles were trapped in 7 between 15 June and 27 July. Highest weekly catches were during the last two weeks of July. b) *Emergence traps* were used to capture insects exiting log sections taken from trees sampled as part of the field survey. For logs processed to date (9 stands), the most common insects emerging were hickory bark beetles (373 from 6 sites) and an ambrosia beetle-like scolytid (31 from 4 sites). At least five different species of wood-borers (not yet identified) emerged in much lower numbers from the same set of logs.

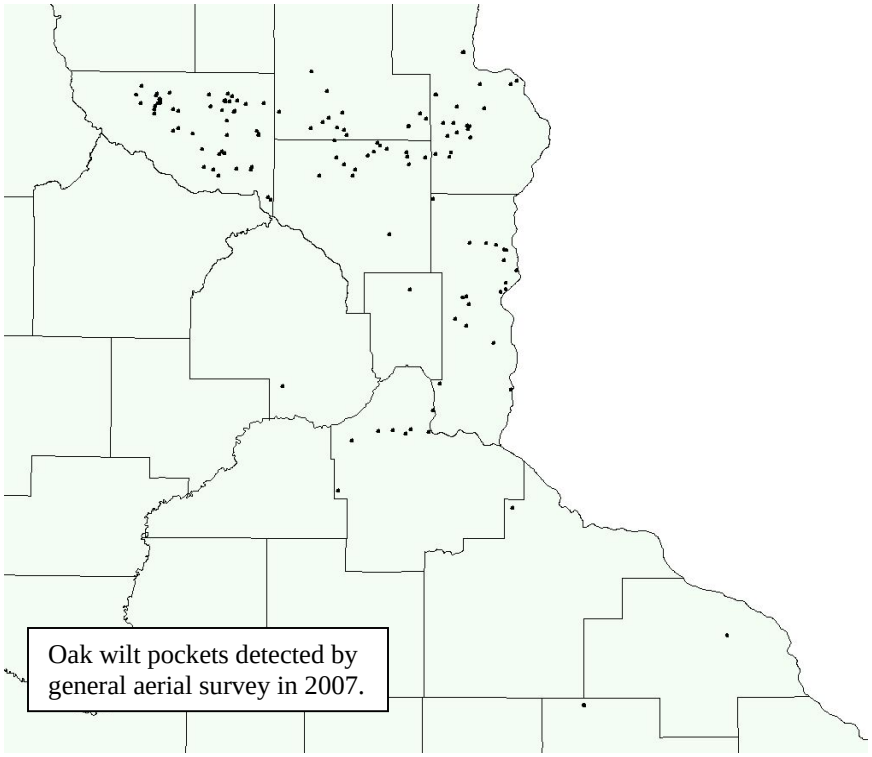
Summary – Although hickory decline and mortality were found in all stands, healthy hickory regeneration was found in all but two stands. The fungus *F. solani*, with no known report of causing cankers on *Carya* spp., was commonly isolated from sunken, annual cankers that were often numerous on affected hickory stems. We hypothesize that hickory mortality in IA, MN and WI is due to a decline complex of interacting predisposing, inciting and contributing factors whose biotic and/or abiotic agents are interchangeable.

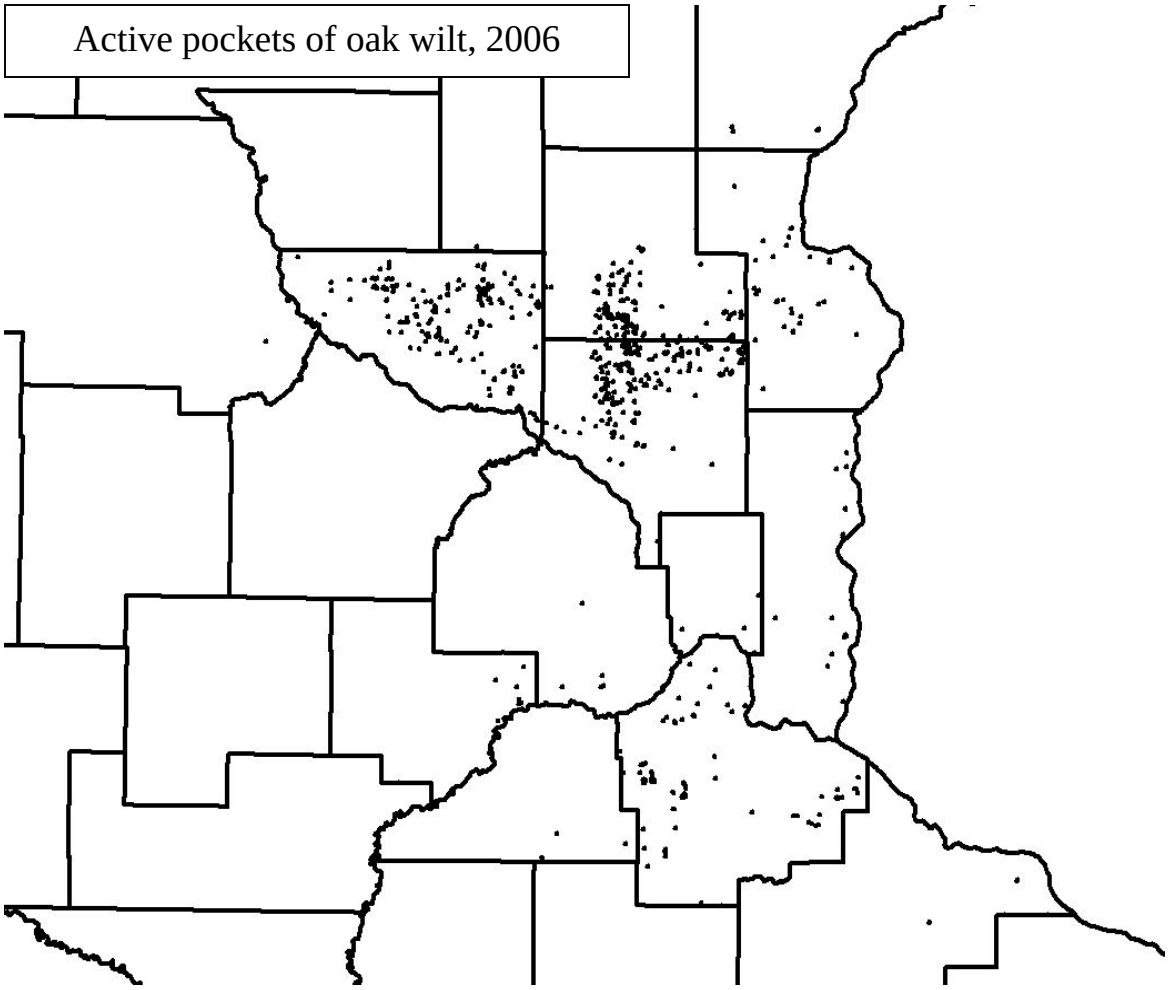
Oak wilt

Ceratocystis fagacearum

The incidence of oak wilt has continued to intensify in Sherburne, Anoka and Isanti Counties over the past few years. Only 3,500 pockets of active oak wilt remain since the inception of the federal/ state oak wilt suppression program which began 18 years ago. 8,839 pockets have been successfully treated.

See report in Special Projects Section concerning oak wilt suppression in the Lake States.





INVASIVES AND EXOTICS
NOT
ESTABLISHED IN MINNESOTA

Gypsy moth

Lymantria dispar

By Minnesota Department of Agriculture - Gypsy Moth Unit

The gypsy moth detection program is a cooperative effort between state and federal agencies. Minnesota has been a federal cooperator in the gypsy moth program since 2001. A strategic plan was developed by representatives of the State Departments of Agriculture and Natural Resources, USDA Animal and Plant Health Inspection Service, Plant Protection and Quarantine (USDA APHIS-PPQ), USDA Forest Service (USDA-FS). The plan describes the objectives and administrative structures necessary to manage the gypsy moth in Minnesota. It provides a mission statement, a framework for decision making, and outlines the strategies and mechanisms to implement the plan. On a biennial basis, these four agencies and the University of Minnesota come together to discuss issues related to gypsy moth management. It is this cooperative effort that has built a strong gypsy moth program in the state of Minnesota.

2007 Survey Program

The Minnesota Department of Agriculture (MDA) is the lead agency undertaking the annual gypsy moth detection survey. Other cooperators setting detection traps include the Three Rivers Park District (77 traps) in the Twin Cities metro area. Together, 21,599 delta traps were set across the state and a total of 3608 male moths were caught.

Since 2004 Minnesota has been a formal member of the Slow the Spread (STS) Foundation. Two southeast counties, Winona and Houston, were included initially but after increased moth captures in the northeast, Lake and Cook counties were added. Despite some west-east movement of the STS Action Area in recent years, it seems that the line of action is back on a westward trend. Variations in moth size and the unusually long adult flight season in Lake and Cook counties led MDA to request further research into the biology and behavior of northerly populations.

Extreme northeast Minnesota (commonly referred to as the North Shore) remains a challenge to survey because available maintained roads are few and far between. Previous to 2004, traps were concentrated around areas with human activity. As moth numbers rose in the northeast, trapping routes were constructed to be hiked rather than driven. Although hiking field staff can only achieve about 40% of the traps set compared to driving staff, the extra attention to trapping on a pre-determined grid has enabled the program to gather more complete data on the existence of moth populations across the landscape. Tourism is a large part of the local economy in Lake and Cook counties, and popular camping and outdoor recreation sites are still trapped heavily. Trap catch data since 2004 has filled in the data gaps on moth populations and has led the program to sites generally devoid of human activity.

In 2007 MDA filled positions for 39 routes and 7 lead workers to oversee local operations. Field staff was divided into two geographic regions, northern and southern, to account for the climatic range across the state. Southern trappers set traps between June 4 and July 6. The northern season was delayed by three weeks to account for climate differences with trap set beginning on June 18 and ending on July 26. Traps remained in the field for five weeks in the south and seven weeks in the north. Trap removal in the south began on August 13 and was completed by August 30. Trap removal in the north began on September 17 and was completed by October 11.

All trap data in Minnesota is collected and recorded using STS protocols. To gather comparable data, trapped areas beyond the STS Action Area do not follow the APHIS/PPQ-recommended trap density but rather use equivalent metric grids to achieve similar results. The entire state is not surveyed every year. The eastern border is routinely trapped but western areas are rotated on a three- to four-year cycle.

A determination of risk for the introduction and establishment of gypsy moth is based on human activity levels, preferred habitat for gypsy moth, and the advancing gypsy moth front from the east. Standard grid densities differ according to the risk of

introduction: smaller grid sizes yield higher trap densities which result in higher resolution of actual moth populations. The STS Action Area was trapped on at least a two-kilometer grid. Several areas of concern along the North Shore were trapped at a higher density to increase accuracy and pinpoint occurring populations. Urban areas (Twin Cities metro, St. Cloud and Rochester) outside of the STS Action Area were considered high-risk for gypsy moth introduction by human movement and were subsequently trapped on a 1500-meter grid. The west-central portion of the state was trapped on a three-kilometer grid due to low risk factors.

Isolated traps with high numbers in 2006 were surveyed intensively in 2007 through delimits and mass trapping. These survey techniques allow cooperators to narrow down a large area to find out if gypsy moth populations are persisting and if treatments should be administered. In 2007, field staff attended to 74 delimits across the state, trapped at a grid density varying between 37m-1000m.

High-risk sites

The standard trapping grid overlaid many high-risk sites such as state parks, mills, and nurseries. MDA supplemented the standard grid with random traps to increase the chance of detection. Field staff had the liberty of setting the traps anywhere within the designated property but were instructed to space traps evenly. Forty-four of Minnesota's 80 state parks were covered by the standard grid and had an additional 1-2 random traps placed at each. Eighty-five moths were caught, but only 2 were outside of the STS Action Area.

Wholesale nursery dealers and nursery growers that report stock sources from gypsy moth-quarantined areas or have a history of pest problems are considered high risk. Each of these sites received 2-12 random traps depending on acreage in production. Nursery sites in 2007 yielded less than 1% of the total moths captured this year. MDA staff set traps at 279 nurseries in 2007 and moths were recovered from only 11 sites. Twelve positive traps resulted in 49 moths caught, but only 8 were outside of the STS Action Area.

The substantial outreach campaign MDA has undertaken may have paid off as more businesses are contacted about proper sanitation of imported stock. MDA continues to work with the industry to minimize their risks of transporting gypsy moth into the state.

Sawmills and Pulp mills are considered high-risk if it is known or likely that they have out-of-state sources and if they are within 100 miles of counties that trap fifty or more moths. These sites received two random traps. MDA trapped 125 mill sites in 2007 and 9 sites (4 in the southeast and 5 in the northeast) returned positive traps. Forty-nine moths were caught at mills but only 1 of those moths was outside the STS Action Area.

Compliance agreements for two mills and two nurseries in Minnesota were drafted and reviewed by both state and federal officials this year. The two mills import saw logs and pulp logs from the gypsy moth quarantine area and were instructed in methods to mitigate the risk of introduction. One nursery under compliance was released from the agreement after successfully treating the property for gypsy moth in the spring of 2007. The other nursery was found in violation of the gypsy moth quarantine and was ordered under compliance to continue their business practice of consigning nursery stock to a store inside the quarantined area and at the end of the season, returning all stock to a central holding lot in Minnesota. Each facility under compliance is monitored by placing a higher density of traps in the vicinity.

Trap Results

Trapping for the Asian strain of gypsy moth continued in 2007. Forty-eight traps from pathway sites (ports of entry, warehouses or sites that receive/store containers)**,** and around sites where heterozygous strains were identified previously were sent to OTIS Laboratories for DNA analysis. The traps contained a total of 238 moths to be tested. No Asian gypsy moths have been identified at this time.

The Forest Service was unable to continue funding the state to trap all National Forest and Bureau of Indian Affairs land within MDA's standard trapping grid. Superior National Forest and portions of the Fond du Lac and Boise Forte Reservations were within the state's standard detection grid in 2007. The Superior National Forest lands received 1330 total traps. Of those, 188 were positive and yielded 444 moths. One trap was set on Boise Forte Reservation, and 12 traps were set on the Fond du Lac Reservation, collecting no moths from either site. However, Grand Portage Reservation, within the STS Action Area, had 142 traps set and a staggering 1175 moths caught. Grand Portage, in the extreme northeast tip of Minnesota, was the only Reservation covered under STS Foundation funding in 2007.

Moth numbers were much higher in the southeast part of the state where 3 counties (Houston, Winona, and Wabasha), accounted for 249 moths (7% of the statewide total, 52% of the southern). In recent years, moth numbers have been extremely low and the increase may be attributed to increasing population pressure from western Wisconsin.

Five areas of concern arose out of the southern trap data. A single standard trap in Wright County caught 14 moths but it was located adjacent to a nursery now under compliance. The site will be treated by the company and delimited in 2008. Two other sites are located in Hennepin County. One standard trap in Richfield caught 19 moths. The surrounding area will be delimited in 2008. In an existing delimit in Minnetonka, 24 moths were caught. Future surveys will determine if treatment will be warranted in 2008. One trap in Dakota County, south of the Twin Cities, caught 4 moths. This site will be delimited in 2008.

The bulk of the moth catch in Minnesota, an unanticipated 84%, was captured in Lake and Cook Counties in the far northeast corner of the state. Immediately after the 2006 treatments, moth populations plummeted and only 281 were captured in 2006. Moth counts jumped back to 3031 in 2007 in these two counties. One hundred seventy moths were caught within the treatment blocks; however, 82% of those were in the Grand Portage *Btk* block. Fifteen areas of concern were identified within Lake and Cook Counties. MDA will be working closely with the land stewards within these areas to align management strategies with increased moth populations. Most of these isolated traps will be further delimited and treatments will be proposed for Lake and Cook Counties in 2008.

General Treatment Program

The Minnesota Department of Agriculture was extremely fortunate to have no large-scale treatments in 2007. One regulatory site was treated as a condition of a compliance agreement. As the gypsy moth front moves closer to Minnesota, treatment acreage is expected to increase to meet the statewide objective of decreasing natural spread rates from 15 miles per year to less than 6 miles per year. Last year's treatment of over 137,000 acres bought some time for gauging success at those sites and to identify new populations that mark the front of infestation from the east. MDA is expecting gypsy moth treatments in 2008 to be much more substantial as current trap data indicate several areas of concern.

2007 Eradication: (303 total acres)

One site just south of the St. Paul/Minneapolis metropolitan area received an eradication treatment. Late summer in 2006, live female gypsy moths were found at the site and, as a consequence, the nursery was required to treat their growing fields and the surrounding environs this spring using their own funding sources. The growing fields total 223 acres plus 80 acres along a riparian corridor that cuts through the property. The prescribed sequence of events was choppy due to remarkably windy conditions. Dimilin was aerially applied to the nursery stock for the first time on May 8, 2007. Follow-up treatments were conducted on May 20, 21, and 25. Nursery stock was held off-sale until a treatment could be made. While waiting for winds to subside, quarantined stock (22.5 acres) was treated by ground applications and subsequently released from stop sale. A second treatment of Btk was never achieved because of continued strong winds, so MDA placed burlap bands on 10 trees in the corridor. The bands were checked twice weekly until July 6 and no gypsy moth caterpillars were recovered. Over 550 acres around this nursery were delimit-trapped this season, and results over the next two years will be used to determine treatment success. No moths were caught in 2007 at this site.

Site Name	Acres	Product	Rate/Acre	Application Equipment	Date of First Application	Date of Second Application	Cost/Acre
Bachman's Nursery Growing Range	223	Dimilin	2 oz.	Aerial-Helicopter	5-8-07	5-25-07	$10.00
	80	Btk	1 lb.	Aerial-Helicopter	5-25-07		$10.00
	22.5	Dimilin	2 oz.	Ground		5-20-07, 5-21-07	Unknown

Egg mass surveys

Two surveys were planned in 2007 and one has already been conducted. On September 11, 2007, 20 people from several agencies responded to a relatively high number of moths (19) trapped in one standard trap in the Minneapolis suburb of Richfield. No egg masses were found at the site. This site will receive intensive trapping during the 2008 season. The second site is just to the west of Minneapolis and has not been surveyed at this time. A survey is planned for November, 2007.

In addition to the egg mass survey conducted in the Twin Cities metro area, several site surveys were conducted in Cook and Lake Counties surrounding high-find locations. No egg masses or alternate life stages were identified.

2007 Summary Tables:

Management Zones	Total Traps	% of Total Traps	Total Moths	% of Total Moths
Eradication Area	18,537	85.82	485	13.44%
STS Action Area	3062	14.18%	3123	86.56%
TOTAL	**21,599**		**3608**	

Traps set by agency	Traps Set	Positive Traps	Moth Count
MDA	21,522	1198	3607
Three Rivers District	77	1	1
TOTAL	**21,599**	**1199**	**3608**

Trap Type	Number of Traps Set	Positive Traps	Moth Count
Standard	18,188	977	2627
Delimit	1734	131	520
Reactive	129	34	264
Nursery	1002	12	49
Mill	356	21	49
State Park	89	19	83
Campground	61	1	1
Firewood Dealer	40	4	15
TOTAL	**21,599**	**1199**	**3608**

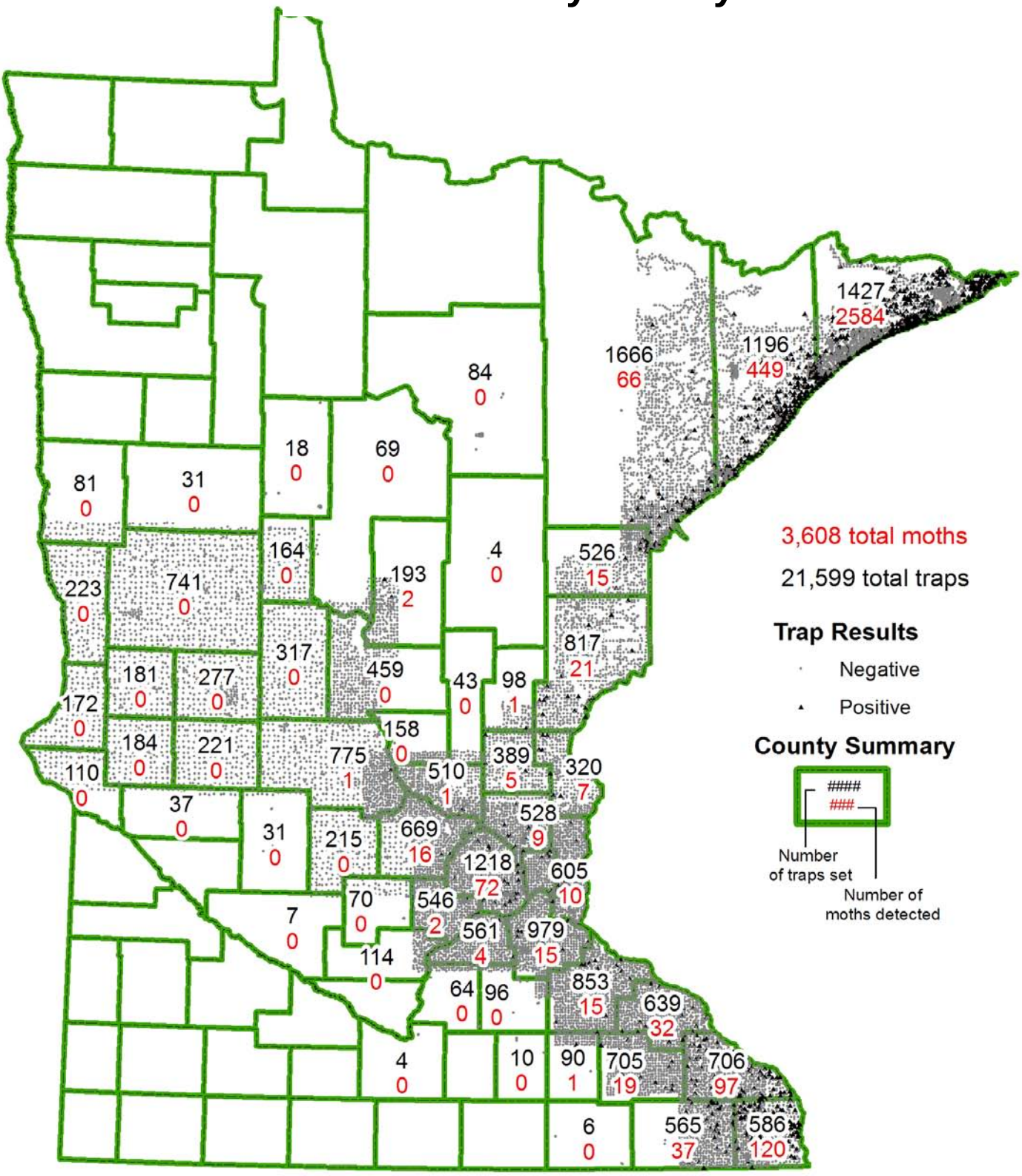
Reservations	Number of Traps Set	Positive Traps	Moth Count
Fond Du Lac	12	0	0
Grand Portage	142	126	1175
Vermillion (Boise Forte)	1	0	0

Treatment Monitoring (2006 Treatments)	Treatment	Total Traps (2006 Total)	Total Moths (2006 Total)	Total Delimit Traps	Total Delimit Moths
Brooklyn Park	Btk-Foray 48B	158 (166)	0 (3)	192	1
Grand Portage Reservation	Btk-Foray 48B	11 (33)	140 (1)	43	631
Farquar Peak	Disrupt II	14 (7)	2 (0)	21	12
Tom Lake	Disrupt II	121 (29)	5 (0)	158	54
Schroeder Complex	Disrupt II	361 (92)	21 (2)	517	285
Kadunce River	Disrupt II	6 (4)	2 (0)	7	5

2007 Gypsy Moth Results by County:

County	Traps Set	Moth Catch	%
Aitkin	4	0	0.00
Anoka	528	9	0.25
Becker	31	0	0.00
Beltrami	0	0	0.00
Benton	158	0	0.00
Big Stone	110	0	0.00
Blue Earth	4	0	0.00
Brown	0	0	0.00
Carlton	526	15	0.42
Carver	546	2	0.06
Cass	69	0	0.00
Chippewa	0	0	0.00
Chisago	320	7	0.19
Clay	81	0	0.00
Clearwater	0	0	0.00
Cook	1427	2584	71.62
Cottonwood	0	0	0.00
Crow Wing	193	2	0.06
Dakota	979	15	0.42
Dodge	90	1	0.03
Douglas	277	0	0.00
Faribault	0	0	0.00
Fillmore	565	37	1.03
Freeborn	0	0	0.00
Goodhue	853	15	0.42
Grant	181	0	0.00
Hennepin	1218	72	2.00
Houston	586	120	3.33
Hubbard	18	0	0.00
Isanti	389	5	0.14
Itasca	84	0	0.00
Jackson	0	0	0.00
Kanabec	98	1	0.03
Kandiyohi	31	0	0.00
Kittson	0	0	0.00
Koochiching	0	0	0.00
Lac Qui Parle	0	0	0.00
Lake	1196	449	12.44
Lake of the Woods	0	0	0.00
Le Sueur	64	0	0.00
Lincoln	0	0	0.00
Lyon	0	0	0.00
Mahnomen	0	0	0.00
Marshall	0	0	0.00
Martin	0	0	0.00
McLeod	70	0	0.00
Meeker	215	0	0.00
Mille Lacs	43	0	0.00
Morrison	459	0	0.00
Mower	6	0	0.00
Murray	0	0	0.00
Nicollet	0	0	0.00
Nobles	0	0	0.00
Norman	0	0	0.00
Olmsted	705	19	0.53
Otter Tail	741	0	0.00
Pennington	0	0	0.00
Pine	817	21	0.58
Pipestone	0	0	0.00
Polk	0	0	0.00
Pope	221	0	0.00
Ramsey	241	7	0.19
Red Lake	0	0	0.00
Redwood	0	0	0.00
Renville	7	0	0.00
Rice	96	0	0.00
Rock	0	0	0.00
Roseau	0	0	0.00
Saint Louis	1666	66	1.83
Scott	561	4	0.11
Sherburne	510	1	0.03
Sibley	114	0	0.00
Stearns	775	1	0.03
Steele	10	0	0.00
Stevens	184	0	0.00
Swift	37	0	0.00
Todd	317	0	0.00
Traverse	172	0	0.00
Wabasha	639	32	0.89
Wadena	164	0	0.00
Waseca	0	0	0.00
Washington	605	10	0.28
Watonwan	0	0	0.00
Wilkin	223	0	0.00
Winona	706	97	2.69
Wright	669	16	0.44
Yellow Medicine	0	0	0.00
TOTALS	**21599**	**3608**	**100**

2007 Gypsy Moth Trapping Results by County



Map prepared by the MN-DoA, Gypsy Moth Unit, Fall 2007.

REPORT ON MINNESOTA'S SURVEY ACTIVITIES FOR EXOTIC FOREST PESTS IN 2007

Minnesota Department of Agriculture (MDA),
Minnesota Department of Natural Resources (DNR),
&
United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine (PPQ)

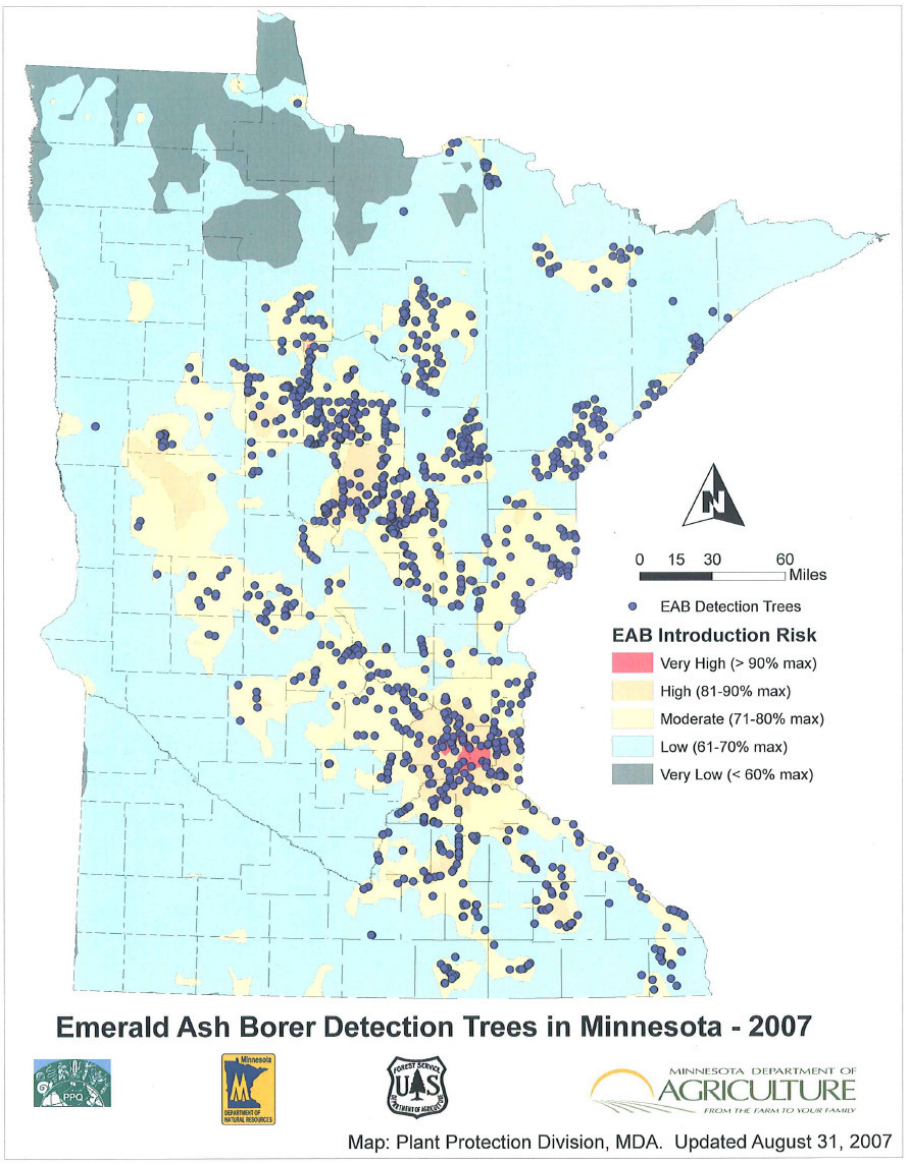
By Robert Koch, MDA

Emerald ash borer

Agrilus planipennis

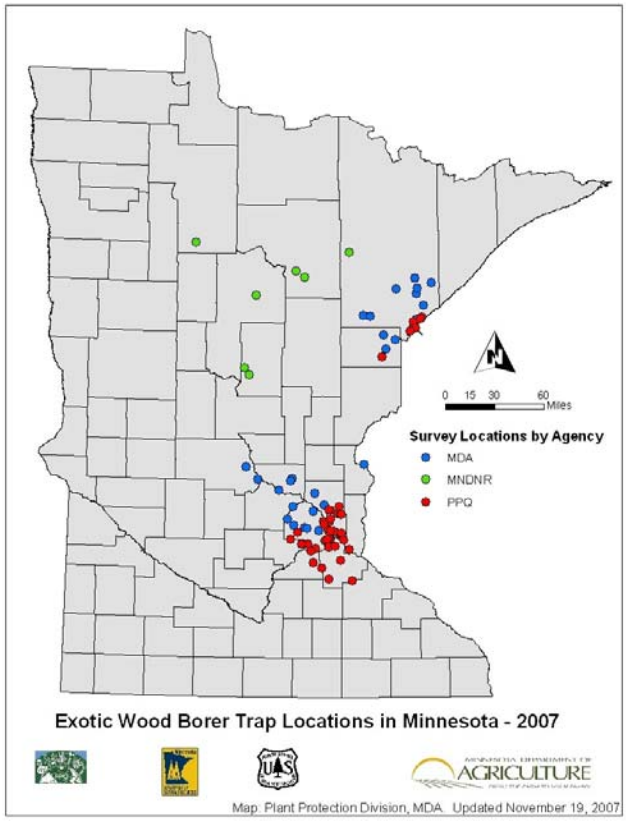
Allocation of detection trees (trap trees) has been optimized by MDA efforts to model and map areas of Minnesota with the greatest likelihood for introduction of this pest. MDA has 1,350 detection trees in place (1,225 from 2007 and 125 from 2006). Of these, all the detection trees from 2006 and up to 800 of the detection trees from 2007 will be peeled in autumn 2007 to look for signs of emerald ash borer infestation. The remainder will be peeled in 2008 with additional detection trees set that year. PPQ and USDA Forest Service provided funding to MDA to support the state detection tree operations.

DNR detection trees are established on state land, specifically in state parks, in areas of declining ash, and in areas where there is a significant component of ash in the stand. Twelve detection trees on four sites established in spring 2006 were felled and peeled in fall of 2007. No evidence of borers was found.



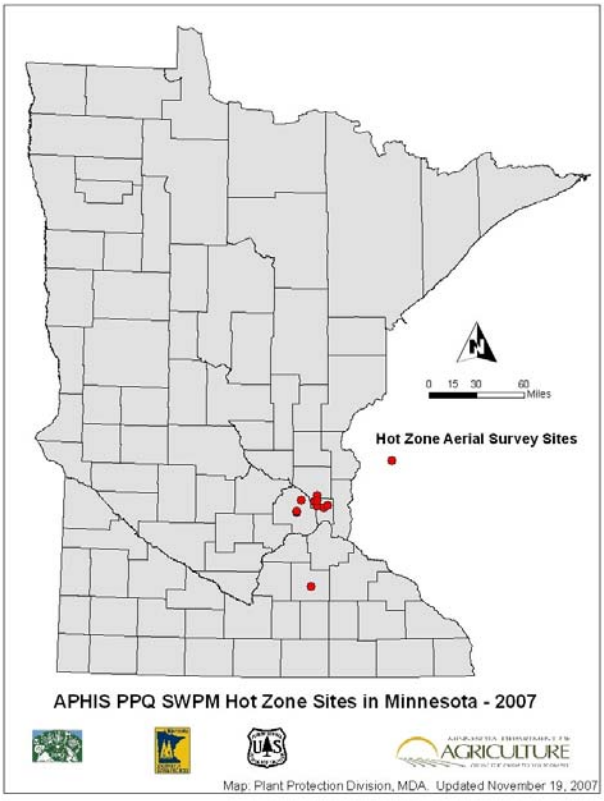
Exotic bark beetles

MDA traps for exotic bark beetle survey were placed at 26 locations, with two traps per location (Lindgren funnel traps baited with ethanol, *Ips* 3-part, alpha-beta pinene lures), near the Twin Cities, St. Cloud and Duluth. Traps for the DNR survey were placed in seven locations in north-central Minnesota, with three traps per location (traps baited with alpha pinene and ethanol, ethanol, or *Ips* 3-part). PPQ placed traps at 45 locations, with one to three traps per location (Lindgren funnel traps baited with alpha pinene, chalcoprax, ethanol, *Ips* 3-part, or alpha-beta pinene lures) near the Twin Cities and Duluth. Trap samples continue to be processed



Hot Zone Survey

PPQ targeted 77 sites, at which solid wood packaging material (SWPM) was possibly being received from locations outside the United States, for site visits. During the site visits information was recorded concerning actual receipt of SWPM. PPQ selected 10 of the highest risk sites for aerial survey by DNR. Near the selected sites a total of 32 areas were noted with possible forest problems. Each of the areas was surveyed to determine the nature of the problem. A number of the sites were apparent Dutch Elm Disease or Oak Wilt sites. However, several areas had declining ash. All 32 areas will be further assessed in the 2008 season.



Sirex wood wasp

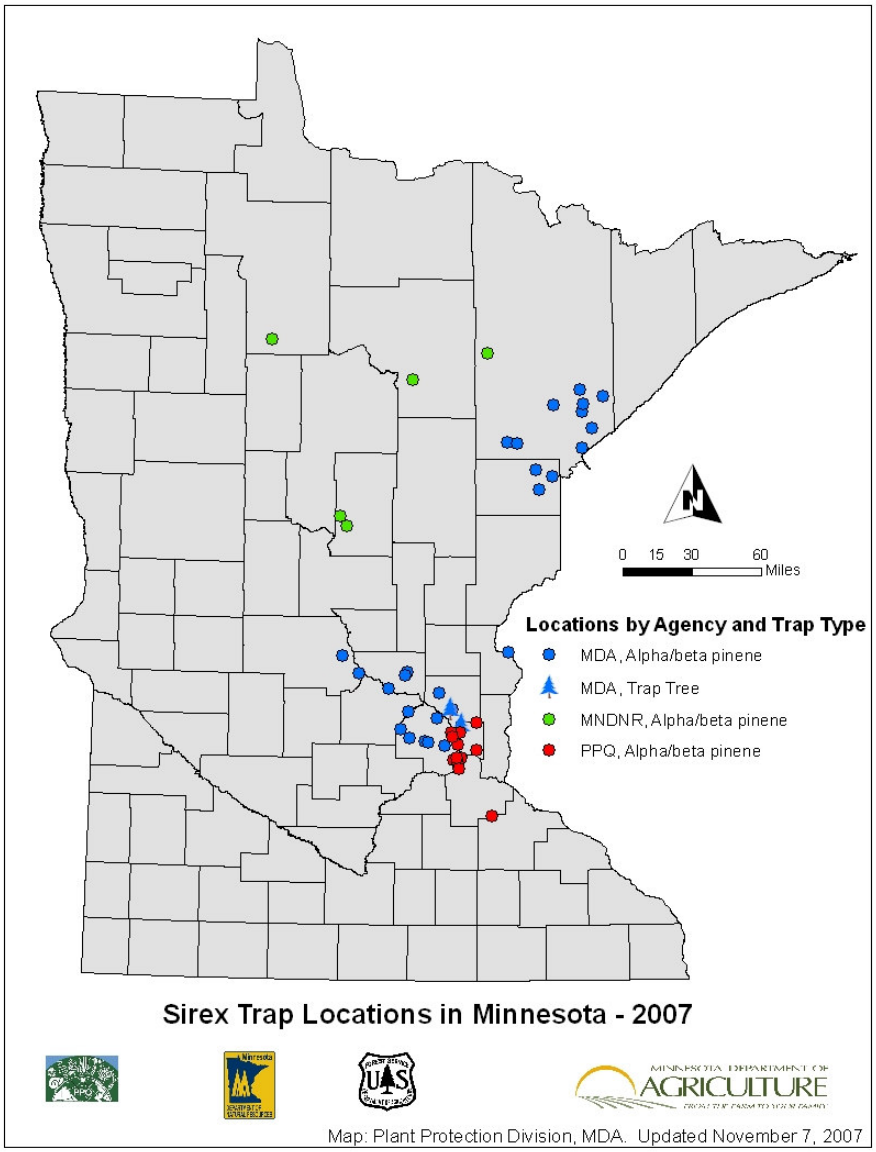
Sirex noctilio

The *Sirex* woodwasp survey was conducted using Lindgren funnel traps baited with the *Sirex* lure (alpha pinene / beta pinene [70%:30%]). MDA traps for the *Sirex* wood wasp survey were placed at 27 locations, with three traps per location, near the Twin Cities, St. Cloud and Duluth (Figure 3). DNR traps were placed at five locations in north-central Minnesota, with one trap per location (Figure 3). PPQ set single traps for the *Sirex* woodwasp at 12 locations within five Twin Cities Metro counties. Four traps surrounded the Lindbergh International Airport, four traps were placed near rail yards/importers and four traps were placed near import warehouses (Figure 3). In addition, MDA established two trap trees at two locations (four trap trees total) near a facility that imports untreated pine poles from New York (Figure 3). These trees will be felled in spring 2008, with some bolts dissected and others taken to the laboratory for rearing.

To date, the *Sirex* wood wasp (*S. noctilio*) has not been detected in Minnesota (Table 1). Interestingly, the only siricids collected in DNR traps were from exotic bark beetle traps baited with alpha pinene plus ethanol; however, sample processing remains in progress. The majority of siricids collected by MDA were from traps baited with the *Sirex* lure, but the ethanol and *Ips* 3-part lures each caught one siricid.

Table 1. Siricidae identified from the 2007 *Sirex* wood wasp survey (as of 8 May 2008)

Sirex edwardsii
Sirex nigricornis
Tremex columba
Urocerus cressoni
Urocerus albicornus
Xeris spectrum spectrum



Ash decline

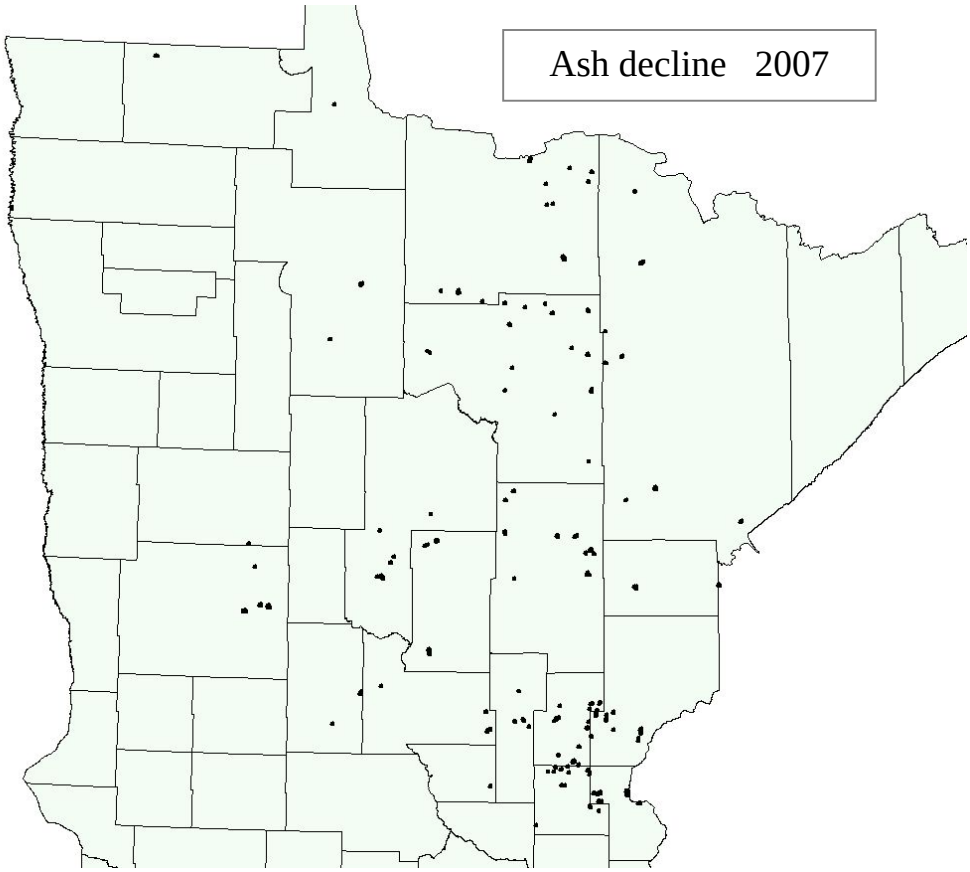
Physiological problem

Fluctuating water tables during the last few years is thought to be playing a major role in ash decline in flood-plain plant communities. There are a number of other factors involved with some variation from site to site. This year, ash decline occurred on 12, 800 acres. The map only shows 2007 polygons.

Aerial sketch mappers started seeing a lot of ash decline in the summer 2004; 27,000 acres were mapped. This year ash decline was observed all the way from the Canadian Border to the Metro. If the Emerald Ash Borer had caused damage so widespread and severe, it would certainly be considered a disaster.

Ash decline is difficult to map, because it has no eye-catching visual symptoms like those of vascular wilts, defoliating insects or bark beetle infestations. The affected trees simply fail to leaf out in spring; they're hard to see unless you know what you're looking for, boundaries of the affected area are often indistinct, and you can't tell from its appearance whether a given outbreak area is "active" or represents past years' damage. For these reasons we aren't particularly confident that the cumulative 2004-2007 sketch mapping of ash decline (44,780 acres) accurately shows the development or the present extent of the problem. Aerial sketch mappers suggested that a special survey be conducted next season.

Photo by Mike Albers, DNR



Winter injury

There was significant '06-'07 winter injury in ash species across southern Minnesota, especially, green, black, and blue ash. Maple and birch also showed some signs of winter injury. The weather data from January to April 2007 across southern Minnesota tells the story. The January temperatures were warmer than normal followed by lower than normal February temperatures. The pattern repeated again in March and April. See table below.

Temperature Summary, Winter 2007, in degrees Fahrenheit.
State Climatology Office; DNR Waters. http://climate.umn.edu

	January		February		March		April	
	Average	Departure from normal	Average	Departure from normal	Average	Departure from normal	Average	Departure from normal
Southwest	17.5	5.1	11.3	-7.8	36.2	5.2	43.5	-1.7
South Central	18.0	6.1	10.3	-8.1	35.2	4.6	44.7	-0.3
Southeast	20.1	7.1	11.5	-8.1	36.2	4.2	45.5	-0.7

Last year's drought, the lack of snow cover during much of the past winter, deep frost in the ground, strong dry winds, many days of bright sunshine and low relative humidity all contributed to more winter injury in 2007 than normal in the northern counties. A lot of the winter injury was on red pines along roads. De-icing salts undoubtedly played a role on a lot of sites.

Normally red pine trees that have suffered winter injury survive the injury and by mid- summer have produced new growth and look pretty close to normal. This was also true this year however there were locations where bark beetles attacked the injured trees and killed them.

Winter injury was also observed on black spruce near roads and many of these trees actually died. See photos next page. This is very unusual. Entire black spruce trees turned a purplish brown by late winter and produced no new growth in the spring. This was only observed along road edges. It was observed along gravel roads as well as along paved roads. The damage was observed only on trees on the edge of stands along roads and sometimes extending up to 100 feet into the stands. The damage was scattered throughout St Louis, Carlton and Itasca counties. No insects or fungi were found to be contributing to the injury and mortality.

Black spruce trees killed by winter injury along Hwy. 22 near Bear River in St. Louis County. *Photos by Mike Albers, DNR*

PHENOLOGY 2007

Date	Event	Location
12 March	Above freezing today and yesterday. Saw 3 kinds of insects flying (midges and moths)	Cass Co.
12 April	Aspen flowering 100%	Pine Co.
	Aspen flowering 10%	Itasca Co. – Grand Rapids
24 April	Red maple is early in flowering and boxelder starting to bloom.	Crow Wing
30 April	Aspen leaves < 1 inch long and only on a few clones. Birch catkins present. Vegetative buds of red pine are beginning to elongate.	Itasca Co.
3 May	Most aspen clones look green and leaves > 1 inch.	Itasca Co.
	Red oaks in bloom. Some aspen clones are still bare. Balm of gilead leaves are expanding. *Amelanchier* blooming and leaf buds expanding. Birch trees all have catkins.	Southern Cass Co.
4 May	Lilac in bloom.	Crow Wing - Brainerd
5 May	A few *Amelanchier* are in bloom. Birch catkins present. A few aspen clones with leaves > 1 inch. Red maples are flowering. Balm of gilead is flowering.	Northern Cass Co.
	Can faintly see green in bur oak crowns. Hazel buds are bursting and leaves are unfurling.	Beltrami
	Lilac bloom spikes are 3-4 inches tall. Sugar maple blooming.	Itasca Co. – Grand Rapids
6 May	White pine vegetative buds are just starting to show elongation.	Itasca Co. – Grand Rapids
7 May	In bloom: *Trillium*, pin cherry, yellow violets, *Amelanchier*, large bellwort. Just starting to bloom: red osier dogwood and bloodroot.	Itasca Co. – Grand Rapids
	Marsh marigolds blooming and dandelions in full force. *Amelanchier* still blooming. Balm of gilead leaves < 1 inch long.	Aitkin Co.
8 May	White pine weevil adults are flying today. Really great weather today!!	Itasca Co. – Grand Rapids
9 May	33% of aspen clones have 2 inch long leaves and a few are barely budded out. Red oak leaves are 1 and ¼ inch long. In bloom: both Hepaticas, pin cherries, Anemone. Aspen's fluffy seed is falling. Large dragonflies and big mosquitoes are out. Red and pink crabapples are blooming in Pine River.	Northern Cass Co.
	Lilacs and crabapples are in bloom. Marsh marigolds still blooming.	Crow Wing Co. – Brainerd
12 May	Starting to bloom: red elder, *Trillium*, wild plum, marsh marigolds, Jack-in-the-pulpit. Lady slipper orchid plants are 4-6 inches tall.	Itasca Co. – Grand Rapids
13 May	Bigtooth aspen leaves are 1 inch long. Chokecherry, *Trillium* and marsh marigolds are blooming.	Itasca Co. – Grand Rapids
16 May	Lilacs starting to bloom. Mountain ash blooming.	Itasca Co. – Grand Rapids
18 May	In bloom: Anemone, *Actea rubra*. Twinflower not blooming yet.	Itasca Co. – Grand Rapids
21 May	Jack pine pollen shed is just finished. Hoary puccoon is blooming. Sawfly larvae present near Badoura. Bigtooth aspen has catkins. In Akeley, black ash is breaking bud. Blooming: yellow rocket, cottongrass.	Aitkin, Cass, Hubbard Cos.
22 May	Marsh marigolds in bloom.	Northern Itasca Co.
	In bloom: marsh marigolds, chokecherries and *Trillium*. Saw Monarch butterflies.	Northern Beltrami Co.
	In bloom: Lilacs and crabapples (in Baudette), chokecherry, bearberry, anemone, wild strawberry, sand violet and short pussytoes.	Lake of the Woods Co.
23 May	*Maianthemum* starting to bloom.	Itasca Co. – Grand Rapids
24 May	High bush cranberry starting to bloom. Still blooming: Trillium, choke cherry.	Northern Cass Co.
	Cotton grass, lilacs, high bush cranberry and yellow rocket still blooming. Blooming: *Trientalis*, large bellwort, anemone, *Maianthemum*, *Thalictrum*, bluebead lily, *Aralia nudicaulis*, dog violet.	Southern Cass Co.
25 May	Linden looper and fall cankerworms active in Brainerd/ Baxter area.	Crow Wing Co.
28 May	Peak jack pine pollen shed.	Itasca Co. – Grand Rapids
31 May	Ash leaves ¼ to fully expanded. In bloom: gaywings, wild strawberry, blue-eyed grass, yellow moccasin flower, bush honeysuckle.	Cass, Hubbard Cos.
	Peak honeysuckle bloom.	Itasca Co. – Grand Rapids
1 June	Jack pine budworm larvae are 4-5 mm long. In bloom: green *Euphorbia*.	Itasca Co. – Grand Rapids

	Labrador tea in full bloom.	Cass Co.
1-3 June	Peak red pine pollen shed.	Itasca Co. – Grand Rapids
5 June	Jack pine budworm larvae are 4-7 mm long; 3rd and 4th instars present.	St. Louis Co. – Esquagama Lake
	Spruce budworm larvae are 15-17 mm long.	St. Louis Co. Laurentian ELC
7 June	White pine shedding pollen. Blooming, goat's beard, *Aesculcus ovalifolia*, white meadowsweet.	Itasca Co. – Grand Rapids
8 June	Forest tent caterpillar active near St. Cloud.	Stearns Co.
12 June	In bloom: rose, balsam ragwort, bunch berry, pink Aster, Indian paint brush, orange hawkweed, blackberries, oxeye daisy.	Cass Co.
11-13 June	Linden looper pupated. Brainerd.	Crow Wing Co.
20 June	Jack pine budworm larvae are 5-10 mm long.	Koochiching Co. – Rainy Lake
20-21 June	Pupae and moths of spruce budworm found.	Roseau Co.
21 June	Spruce budworm 95% pupated. Moths have emerged from 50% of pupae.	St. Louis Co. - Orr
	Jack pine budworm budworm larvae are 10-15 mm long. A few pupae.	Itasca Co. – Wolf Lake
	Some Jack pine budworms have pupated.	Hubbard Co.
5 July	A single Forest tent caterpillar pupa was found in Brainerd.	Crow Wing Co.
8 July	Basswood blooming in Grand Rapids. Has been blooming in Brainerd for last three weeks.	Itasca Co. – Grand Rapids

SPECIAL PROJECTS

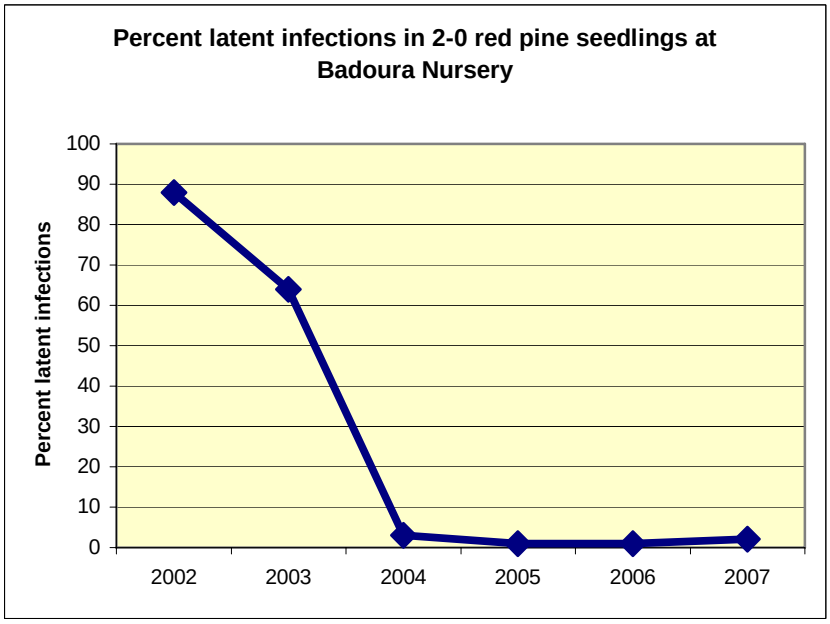
Latent *Diplodia* infections in red pine seedlings from Badoura and Gen. Andrews Nurseries

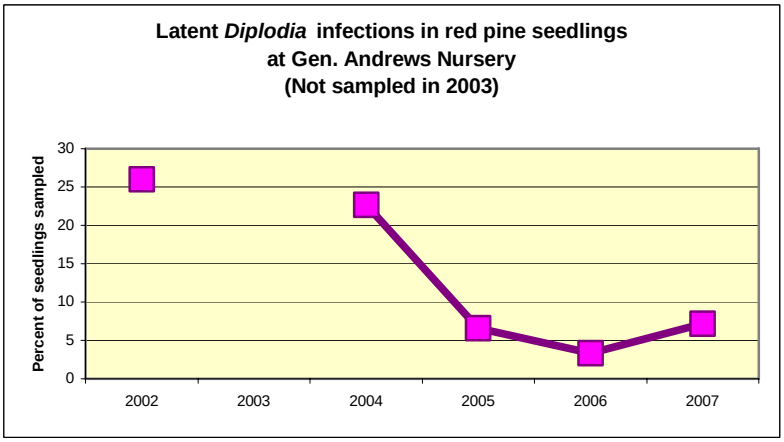
In an effort to monitor the amount of latent *Diplodia* infections that occur in red pine seedlings produced by the State Nurseries, surveys were completed at Badoura and Gen. Andrews Nurseries. The 2-0 and 3-0 seedlings were sampled in a systematic design and were assayed for the presence of *Diplodia* spp. by Dr. Stanosz's lab at the University of Wisconsin.

From Badoura Nursery, 200 2-0 seedlings and 100 3-0 seedlings were collected on August 23rd. From Gen. Andrews Nursery, 375 seedlings were collected on September 10th; 225 were 2-0's and 150 were 3-0's. See Tables and Charts below. Infection levels of 2-0 seedlings have remained fairly constant over the last three years at both nurseries. Latency in 3-0 seedlings has varied considerably when comparing levels between nurseries and when comparing levels between years.

Badoura	# positive	# sampled	% infected
2-0	4	190	2.1
3-0	15	105	14.2
All RP	19	295	6.4

Gen. Andrews	# positive	# sampled	% infected
2-0	20	225	8.8
3-0	7	150	4.7
All RP	27	375	7.2





Badoura Nursery: 300 seedlings collected (August 23) and assayed						
Field	**Beds sampled**	**Number of seedlings assayed**	**Seedling size**	**Field, bed and location**	**Total # positive**	**Ave. percent latent infection per field**
A7	10,13,15,17	20	2-0	NA	0	0
A8	9	5	3-0	A-8-9S	1/5	20
A9	19,21	10	3-0	A-9-19N	3/5	30
A10	2,5,7,9,11	25	2-0	NA	0	0
A11	2,5,7,9,11	25	3-0	A-11-2N	1/5	16
				A-11-5M	1/5	
				A-11-7S	1/5	
				A-11-9N	1/5	
A12	10,13,15	15	2-0	NA	0	0
B3	3,7	10	2-0	NA	0	0
B5	5,10,15,20	20	2-0	B-5-5N	1/5	15
				B-5-15N	2/5	
B7	1,3,5,7,9,11,13,15, 16,19,21	55	2-0	NA	0	0
B9	3,5,7	15	2-0	B-9-7S	1/5	6
B10	13,15,17,19,21,23	30	2-0	NA	0	0
E11	1,1A,1B,3,5,7,9,11, 13, 15,17,19,21,23	65	3-0	E-11-3M	1/5	11
				E-11-9M	1/5	
				E-11-13N	1/5	
				E-11-15M	1/5	
				E-11-17S	1/5	
				E-11-23S	2/5	
JP B-9	10,15,20	12	2-0	NA	0	0

General Andrews Nursery: 375 seedlings collected (Sept. 9) and assayed						
Field	**Beds sampled**	**Number of seedlings assayed**	**Seedling size**	**Field, bed and location**	**Total # positive**	**Ave. percent latent infection per field**
C4	1,2,3,4,5,7,8,9,10,11, 13,14,15,16,17,19,20, 21,22,23,25	105	2-0	C4-1N	1/5	9.5
				C4-5M	4/5	
				C4-9M	2/5	
				C4-10S	1/5	
				C4-15N	1/5	
				C4-25S	1/5	
C5	1,1A,1B,3,4,5,7,8,9,1 0,11,13,14,15,16,17,1 9,20,21,22,23,25	105	2-0	C5-2M	2/5	8.5
				C5-8N	1/5	
				C5-9M	3/5	
				C5-14S	1/5	
				C5-16M	1/5	
				C5-19N	1/5	
E3	15,16,17	15	2-0	E3-16M	1/5	7.2
F8	1,2,3,4,5,7,8,9,10,11, 13,14,15,16,17	75	3-0	F8-5M	1/5	8.8
				F8-11E	2/5	
				F8-13W	1/5	
F9	4,5,11,12,13,14,21,22 ,23,25,26,27,29,31,32	75	3-0	F9-10W	1/5	6.6
				F9-17W	2/5	

Diplodia-caused mortality in red pine seedlings from new plantations

As a part of our on-going effort to assure red pine regeneration from bare-root seedlings, we did a small *Diplodia* mortality survey in Region 1 during the fall of 2007. During the summer of 2007, mortality "observed" in new plantations exceeded the "expected" losses based on the occurrence of 1% latent *Diplodia* infections in Badoura Nursery stock that was planted. The extreme drought during most of 2007 followed close on the heels of the "flash drought" in 2006, so we expected high levels of drought-caused mortality. In order to determine the cause of death in the seedlings, a small study was initiated.

Eleven plantations were chosen and visited by Foresters in the Area. Plots were tallied and dead seedlings were dug up and sent to the Forest Health lab in Grand Rapids for further examination (See Box: Field instructions). In the lab, each dead seedling was inspected for the presence of *Diplodia* pycnidia and conidia in order to determine the cause of mortality.

Field instructions:

Plantation selection criteria:

1. Plantation is 100% red pine bare-root stock and all seedlings were planted in 2007.
2. Plantation is not bordered by cone-bearing red pines or jack pines.
3. Plantation size is more than 5 acres.
4. Planting data is available for the site. Please enter that information below.

Plot selection criteria:

1. Plot is > 2 chains away from any cone-bearing red pines or jack pine inside the plantation or along the plantation edge.
2. The plots do not "follow" along a single trench or scalping row.
3. Plots are systematically scattered over the acreage.

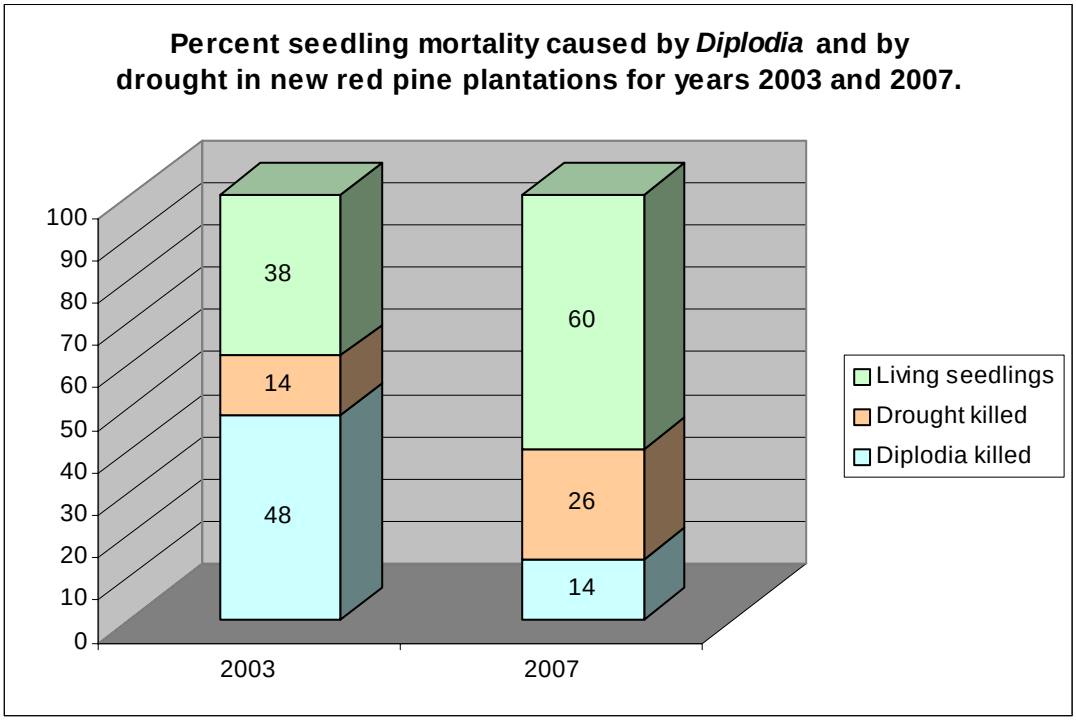
Plot tally and sampling:

1. Establish 10 plots per plantation. Plot size is 1/100th acre (radius = 11.8 ft.).
2. Record location of first plot in decimal degrees.
3. Tally the number of live and dead seedlings on this form.
4. Carefully dig up all the dead seedlings in the plot, pack them loosely in paper bag(s). Label each bag.

Results

Losses from Diplodia infection amounted to 14%, which was much higher than anticipated. Losses from other causes amounted to 26% and were likely related to drought stress. See chart.

In 2003, a similar study was conducted in ten newly planted red pine plantations. 2002 and 2003 were droughty years in Region 1, so the 2003 and 2007 studies were analogous in size, location and seedling stress levels. Overall, seedling survival was much improved; the *Diplodia* toll was reduced by 70% from 2003 to 2007. However, we expected a much greater reduction in 2007 based on the knowledge that our seedlings only harbored 1% latent infections. These results and expectations lead to further studies and additional cultural work at both nurseries to find the sources of inoculum and to eliminate them.



Investigating possible sources of *Diplodia* inoculum in the state nurseries

Having removed 99% of the pines at both state nurseries during 2002-2005 and watching the latency levels drop precipitously since then, a puzzle still remained. Why had latency levels in red pine seedlings plateau-ed at each nursery? This question prompted further investigations. Do the nurseries need to get at the last few pines in and around the nursery? Are there other sources of inoculum, like contaminated pine seed or the presence of additional *Diplodia* hosts at both nurseries?

Cultural work to reduce *Diplodia* inoculum

During the fall of 2007, both nurseries and their surrounding Forestry Area Staff discussed methods for reducing pine species within 1000 feet of pine seedling beds at each facility. Comprehensive plans were developed with the stated goal of managing lands in and around the nurseries so that *Diplodia* and other invasive insects and pathogens do not adversely affect conifer seedling production. Details of the plans can be found in the nursery meeting minutes
along with maps depicting planned actions. See attached plans. Most of the work will be completed prior to seeding in 2008, so results of the cultural work should be evident by 2010.

Occurrence of *Diplodia* inoculum in windbreak species

About the only conifer with a significant presence in the nurseries is white cedar (arbor vitae) that comprises the windbreaks. Collections were made in the fall of 2007 and are scheduled for the spring of 2008. The incidence of *Diplodia* in spent white cedar cones will be assessed during 2008.

Testing red pine seed for *Diplodia* infestation

Since the survey of cones from 92 red pine stands across northern Minnesota showed that *Diplodia pinea* is widespread and well established, we know that collected red pine cones are likely contaminated with *Diplodia* conidia and by implication, red pine seed from those cones may be infested or infected. In this study, three lots of pine seed from northern Minnesota (04-104-55, 05-104-55 and 99-104-10)were assayed at the Stanosz lab at the Univ. of Wisconsin.

Seeds of each of three lots were assigned to one of the treatments indicated below. Disinfestation was accomplished using hydrogen peroxide and inoculation by placing a small droplet of conidia on the seed. Seeds were placed in a tube of tannic acid agar with red pine needles. After incubation, tubes were examined for *Diplodia* pycnidia and spores that form on these needles and/or the seedlings resulting from seed germination. Results are in Table 1.

1) Not disinfested and not inoculated. Results for these seeds give an *estimate* of the total frequency of contamination, whether internal or external to the seed coat. Note, however, that this estimate is likely to be low due to competition in culture from other seedborne fungi (demonstrated by results for treatment 4 below).

2) Disinfested and not inoculated. Results for these seeds give an *estimate* of the total frequency of contamination internal to the seed coat (assuming effectiveness of the surface disinfestation treatment).

3) Disinfested and then inoculated. Results for these seeds give an *estimate* of the efficiency of the assay for surface disinfested seed. In other words, because these frequencies are high (close to 90%), *Diplodia* spp. were readily culturable under assay conditions, at least in the absence of those fungi removed by the surface disinfestation treatment.

4) Not disinfested but then inoculated. Results for these seeds give an *estimate* of the efficiency of the assay for seed incubated with their natural microflora. In other words, the decrease in frequencies compared to treatment 3 above indicate that proliferation of other fungi inhibit our ability to culturally detect *Diplodia* spp., even when placed on the seed. Thus, because results for this treatment were only just over 50%, we can assume that actual frequencies of presence of *Diplodia* species may be up to approximately twice that observed for results of treatments 1 and 2 above.

Table 1. Number of seeds from which *Diplodia* was cultured/number of seeds tested (data for three seedlots in two trials are pooled)

Disinfestation and inoculum treatments			
Not disinfested and not inoculated	Disinfested and not inoculated	Disinfested and then inoculated	Not disinfested but then inoculated
8/600	2/300	265/300	159/300

These results support the conclusion that red pine seed can bear viable *Diplodia* spp. propagules. In this study, contaminated seed was present at very low levels, 1.4 to 2.6 %. Because it is known that some pathogens can transfer from the seedcoat of a germinating seedling to cause seedling disease, contaminated seed *might* represent a threat to nursery seedling health. However, whether this possibility exists for *Diplodia* spp. and whether this risk can be diminished by seed treatment is not known. Currently, both nurseries treat their pine seed with a topical fungicide prior to planting so that potentially harmful fungi can be controlled.

Testing red pine seedlings for surface infestations of *Diplodia*

Photo by Jana Albers.

Diplodia pycnidia and conidia can be produced on dead cotyledons and needles, dead side shoots, pruned shoots and blighted shoots while seedlings are resident in the nursery beds. Earlier research by the USFS showed that, in older seedlings, inoculum from within the bed was about 10,000 times more abundant than from windbreak trees. Some seedlings become latently infected and others show symptoms, shoot blight or collar rot, while other seedlings must be uninfected but have *Diplodia* conidia on their surfaces.

This study sought to determine the abundance of *Diplodia* pycnidia and conidia on necrotic tissues still attached to healthy-looking seedlings and to determine the abundance of *Diplodia* conidia on the surface of health-looking seedlings. 120 red and jack pine seedlings were assayed by the Glen Stanosz lab at the University of Wisconsin.

Methods: Red and jack pine seedlings received from Badoura Nursery in fall 2007 were stored at -20ºC. For processing seedlings were thawed briefly, two seedlings were arbitrarily chosen from the five in each bag (all from one location), roots were cut off, and dirt shaken off the foliage. Each seedling was cut in sections, with the first year's growth (i.e., that portion of the stem and needles that arose the first growing season after seeding) kept intact, and placed in a 1 liter plastic beaker with 800 ml deionized water with 2 drops Tween 80 surfactant/liter. The beakers were agitated on a rotary shaker at 110 rpm for 3 hrs at room temperature. The first year's growth, usually bearing primary needles, from each seedling was saved in a plastic bag and stored at -20ºC until it could be inspected. All other parts of the seedlings were discarded. Fifty ml (i.e., one sixteenth of the total) of wash water was removed from each beaker while being stirred on a stir plate and filtered through a cellulose membrane with 0.8 µm pores. A small number of samples were extremely dirty so 25 ml was filtered through two filters for a total of 50 ml. The number of *Diplodia* spores on each filter was counted using a dissecting microscope. This number was multiplied by 16 to estimate the total number of spores that might have been present in the wash water from each seedling. At a later date, the first year growth for each washed seedling was examined using a dissecting microscope for presence of *Diplodia* pycnidia and spores.

Results: EVERY seedling yielded some *Diplodia* spores (100% incidence). There was a tendency for 3-yr-old seedlings to yield more spores than the younger seedlings. The mean spore count for the 38 3-0 red pine seedlings was 515.0 (range 16 to 4,944) while the mean spore count for the 76 2-0 red pine seedlings was 166 (range 16 to 2,464). The mean spore count for six 2-0 jack pine seedlings was 112 (range 16 to 224).

Diplodia pycnidia were found on 7 of 120 seedlings (5.8%) as follows: pycnidia were found on dead primary needles on only two seedlings (A-9-19-1 and A-11-9-1), on dead side shoots three times (A-11-2-1, A-11-5-2, and E-11-9-1), and on dead first year secondary needles twice (E-11-7-1 and E-11-7-2). Thus, on most seedlings, no *Diplodia* pycnidia were detected.

Conclusions: The methods used will detect *Diplodia* conidia, but is tedious and extremely time-consuming. If further investigation is desired, some thought to sampling seedlings in specific locations and conditions (e.g., bearing dead primary needles, bearing dead secondary needles, etc.) might be beneficial.

If seedlings examined are representative of those in the nursery, it is likely that presence of *Diplodia* spores on seedlings is common. In addition, relatively large numbers of spores may be present, even when we detected no pycnidia. Whether large or small in number, these spores may have been deposited from some external source, may have been produced on needles that fell of these seedlings prior to collection or during handling, or may have been produced on adjacent seedlings.

In conclusion, these results support the conclusion that apparently healthy red pine seedlings can bear *Diplodia* spp. spores on their surfaces. It is evidence of continued presence of these fungi in the nursery and presence of inoculum that could later affect seedling health.

State Nursery plans to address *Diplodia* and other potential threats to conifer production

In late August, the Nursery and Forest Health Section Manager, Olin Phillips, met with Nursery, Region, Area and Forest Health staff to address the continuing concerns over latent *Diplodia* infections in nursery stock. At this meeting, it was agreed that all conifers (except white cedar) will be removed from within the nurseries and within a 1000 foot buffer around the nurseries. Although our emphasis at this time is Diplodia, it is important that we are proactive and remove conifers (other than red and jack pines) that may harbor pathogens that might infect other nursery products in the future. Comprehensive plans were produced for each nursery, as follows:

Badoura Nursery Planning Meeting

October 2, 2007

By Craig VanSickle, Mark Carlstrom, Mike Locke, Terry Novak, Mike Lichter and Jana Albers.

Purpose: Develop a comprehensive plan to manage lands in and around Badoura Nursery so that *Diplodia* and other invasive insects and pathogens do not affect conifer seedling production. A phase-in plan was adopted:

1. Initially, all red, jack and scots pine trees will be harvested or felled, both inside and adjacent to the west and south of the nursery. Other conifers, particularly white pine and white spruce, will be retained as windscreens for the next 5 – 10 years.
2. Along 50% of the fence line where the hardwood buffer doesn't exist now, a narrow band will be site prepped and planted to a mixture of hardwood species to create a windscreen to keep out weeds and *Diplodia* spores and to prevent wind-scouring of seedlings.
3. After the hardwood species are tall enough (5-10 yrs), the white pines and white spruces will be harvested.
4. Acquire adjacent lands, where possible.

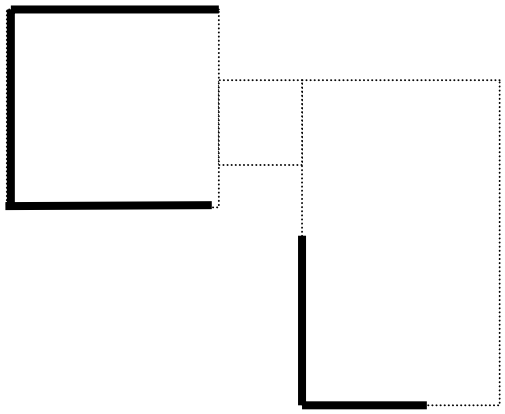
Long-term goals: Adjacent to the nursery, create a 1000 foot buffer on land that is under DNR control and that is not occupied by conifers. See map. Mark Carlstrom will lead.

A. Pursue a land exchange with Potlach. Three state 40's will be exchanged for land on the Park Rapids Land asset plan.
B. Pursue a land exchange of 80 acres with Hubbard County.
C. Purchase the 4 acre cabin site which is currently for sale on SESW of section 9.
D. Pursue purchasing a portion of the land owned by Hemerick in section 17, just west of the Nursery. If that is unacceptable, then work a plan with Hemerick to create a pine free buffer on the boundary.
E. Following the acquisition of the above lands, harvest all red, jack and scots pine within 1000' of the Nursery and establish species to be determined Area and Nursery. These may be good sites for prairie species.
F. Remove white pines and white spruces inside the fence and inside the 1000' buffer to prevent other invasive insects and pathogens of conifers from becoming established.

Short term goals: Remove all jack, red and scots pines inside the fence and around the residence while leaving the WP and WS for the next few years as wind protection for the seedling fields. Joint effort between Area and Nursery.

Location	Planned actions	Who	When expected
All windbreaks, individual stems and woodlots inside the Nursery and around the residence	Remove all jack, red and scots pines inside the fence and leave WP and WS for the next few years as wind protection for the seedling fields. Area will handle merchantable trees and Nursery will handle smaller trees.	Nursery and Area	Completion anticipated by March 1, 2008.
Stand 55	Clearcut north half of stand now and establish a hardwood covertype there in 2008. Thin south half of stand, retaining WP and WS and balsam fir. Return in 5 years, determine if hardwoods are established in north half. If so, clearcut and establish a hardwood covertype there.	Area	Winter of 2007-2008.
Stand 59	Ditto. 2008.	Area	Winter of 2007-2008.
NE corner: DNR buildings and home site on corner.	Remove all JP, RP and Scots pine using timber sales. Retain all sound WP and WS and Bf.	Area	Winter of 2007-2008.
Windbreaks near A4 and A9	Remove WP and WS windbreaks. Winter of 2007-2008.	Area	Winter of 2007-2008.

A. Establish a windbreak of hardwoods around 40% of the Nursery to prevent *Diplodia* spores from traveling into the Nursery and to provide wind protection for seedling beds (weed seed and blowing sand). The Area will site prep and plant the trees in 2008. Species that would be suitable are hybrid aspen, trembling aspen, bigtooth aspen, cottonwood, ash, paper birch and cherry. Oak is not preferred due the fact that oak is an alternate host for jack pine gall rust. Joint effort between Area and Nursery.



B. Lands outside the fence and owned by DNR.

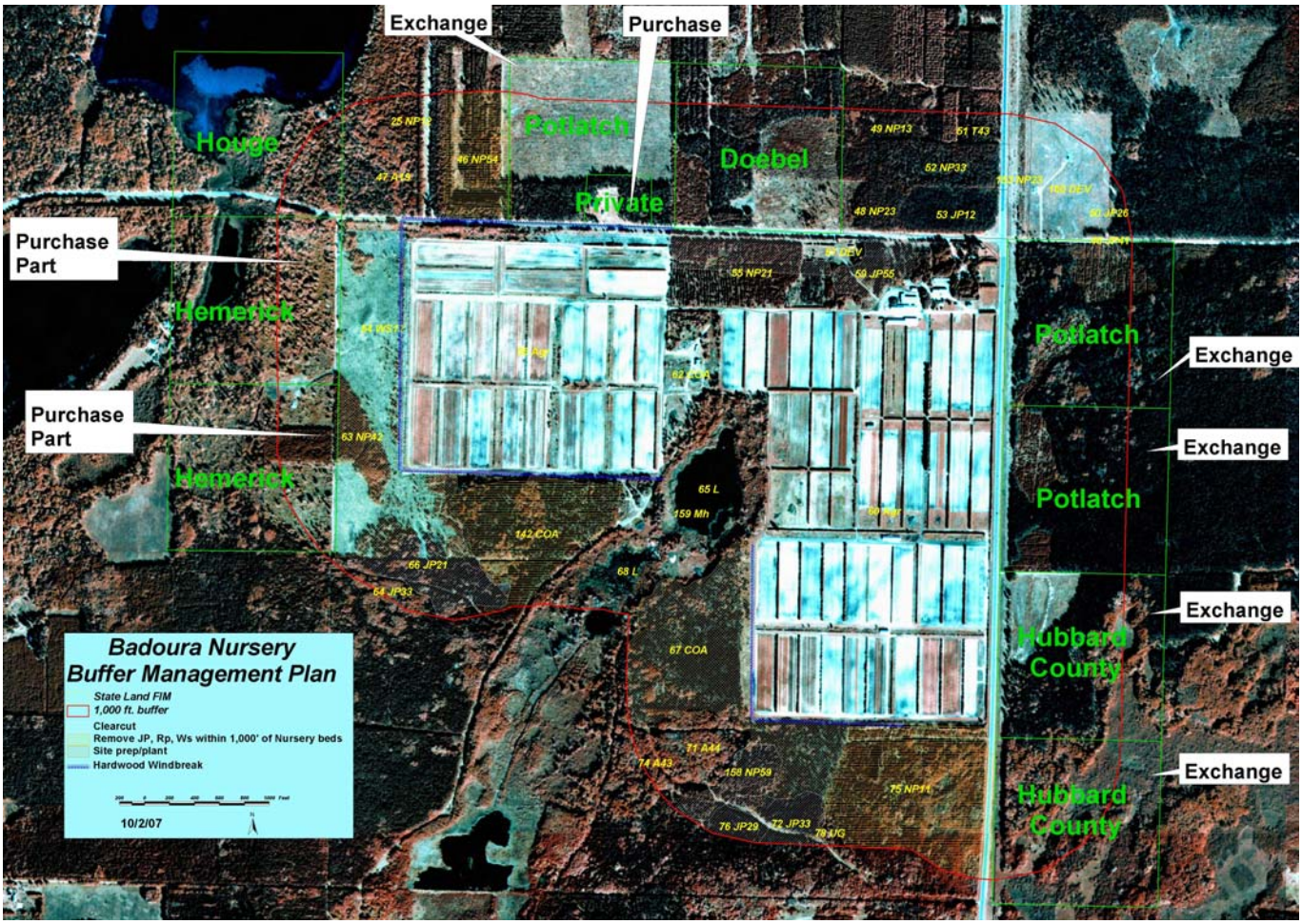
Stand #	Planned actions	Who	Anticipated completion date	Actual completion
Along Hwy 87	Along south side of road: Remove all RP, JP and scots pine regardless of size.	Nursery	March 1, 2008.	
54 (WS12)	Site prep and plant in 2008. *	Area	Fall 2008	
63 (NP42)	Ditto.	Area	Fall 2008	
142 (COA)	Eliminate WS seedlings (hand cut or hand pull) within 1000' of nursery fence. Plant/ establish hardwood seedlings. *	Nursery and Area	March 1, 2008. Spring 2008.	
67 (COA)	Plant in 2008. * Remove mature JP in extreme NE tip of stand. Retain WP and WS.	Area	Summer 2008	
68 (COA)	Plant in 2008. *	Area	Summer 2008	
66 (JP21)	Harvest winter 07-08. Expect aspen regeneration.	Area	March 1, 2008.	
158 (NP 59)	Harvest winter 07-08. Site prep in 2008 and plant/ establish in 2009.	Area	March 1, 2008. Done in 2009	
76 (JP 29)	Ditto.	Area	March 1, 2008. Done in 2009	
72 (JP 33)	Ditto.	Area	March 1, 2008. Done in 2009	
75 (NP11)	Harvest all pine species winter 07-08. Retain aspen clumps where possible. Retain aspen and other hardwood species along E/W road. Aspen regeneration expected.	Area	March 1, 2008.	
46 (NP54)	Where this stand is adjacent to the Nursery, it is mostly WP and WS. Along the road, there is mature RP. Cut all RP for 1000" starting at the southern boundary of the stand (along # 87). Retain the remainder.	Area	March 1, 2008.	
47 (A19)	Do nothing.	NA		
48 (NP23)	Do nothing now. May harvest in 5 years.	NA		
53 (JP12)	Ditto.	NA		

* = Hardwood species selected for planting/ establishment will be made by Novak and VanSickle.

C. Lands outside the fence and not owned by DNR.

Contact Potlach about mature NP just NE of nursery gate to see if they will harvest it this winter. (Already contacted and they agreed to harvest them this winter.)

E. When possible, spade-in some larger hardwood trees to replace conifers that were removed on office grounds and home site in order to provide shade.



General Andrews Nursery Planning Meeting

Nov. 29, 2007

By Steve VonGroven, Deb Moritz, Steve Maniak, Rick Dunkley, Doug Hecker, Mike Dahl, Brian Haugen, Greg Russell, Jean Mouelle and Jana Albers.

Purpose: Develop a comprehensive plan to manage lands in and around the Nursery so that *Diplodia* and other invasive insects and pathogens are less likely to affect conifer seedling production.

This plan is proposed:

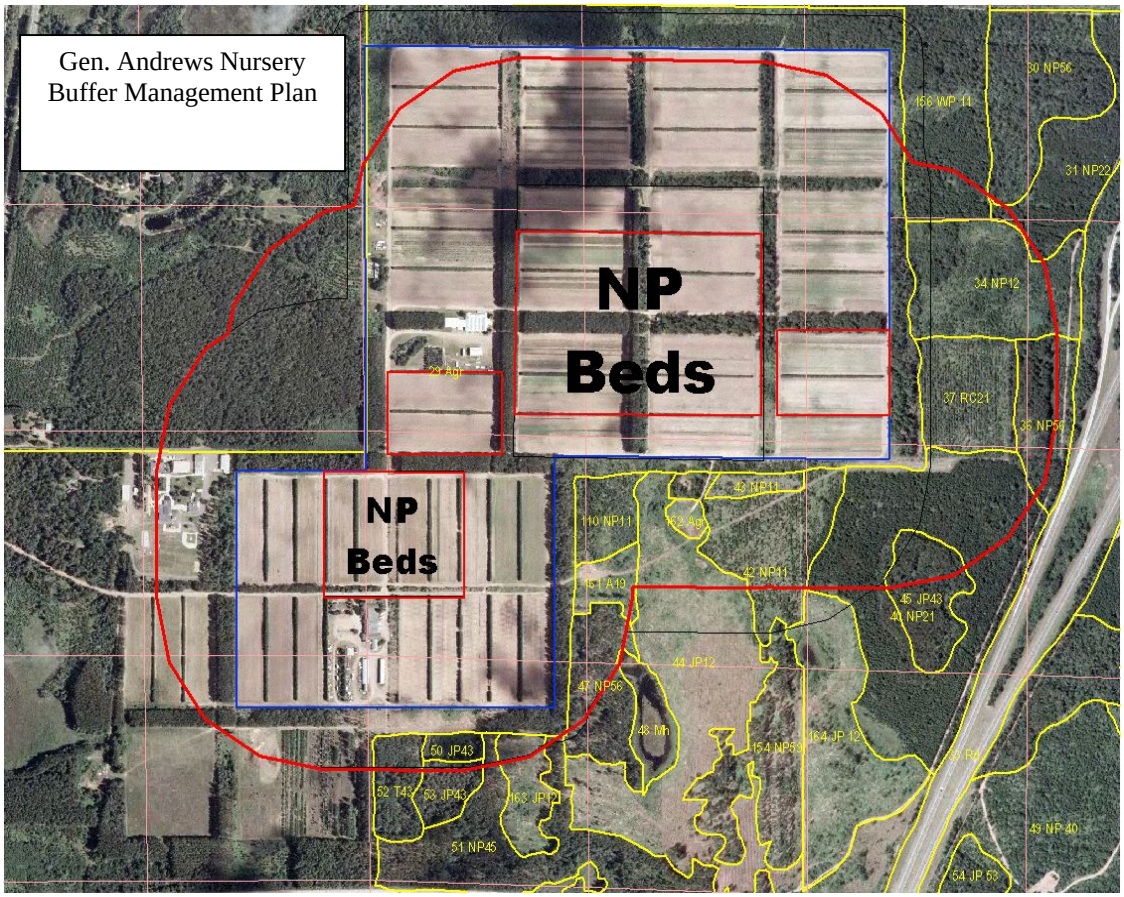
1. Inside the nursery fence, all small and merchantable pines and spruces will be felled or harvested.
    a. Steve V. and Mike D. will contact loggers and biomass chippers. This contract will be combined with the harvesting outside the nursery fence (see # 4 below).
    b. Clearing and piling of small trees may be done by the Camp residents or possibly through a biomass timber sale effort.
2. A shelterbelt/ buffer of hardwood trees will be planted immediately outside the nursery fence, ranging from 50 to 200 feet wide. 8 X 8 foot spacing is recommended.
    a. Closest to the fence, establish seedless cottonwood, hybid poplar and amur maple for 50 feet, then a combination of paper birch, bigtooth aspen, seedless green ash, tamarack and shrubs. Bur oak may be included along the north shelterbelt.
3. Certain blocks in the interior of the nursery will be used for pine and spruce regeneration, so the 1000 foot buffer line was redrawn to reflect this change. The new buffer line does not encompass as much land outside the nursery fence as the original line did. See map.
    a. Central Region Forestry feels that after future discussions with Eco, WL and other partners during the SFRMP process, the 1000 foot buffer may be expanded to its original position.
    b. These stands include all or part of FIM stands 22, 56, 30, 31, 34, 37, 36, 40, 45, 154 and 51.

c. Greg R., Jean M. and Rick D. will facilitate those discussions.

4. The state-owned lands inside the new buffer line will be considered one stand in the future. It will be designated AGR. Pines and spruces will be felled or harvested, tamarack and other hardwoods retained. The area will be site prepped and planted to hardwoods and suitable conifers.
    a. This area will be marked by Steve M. and Mike Dahl for a timber sale. All pines and spruces will be removed.
    b. The FIM stands include: 156, 34, 37, 42, 43, 161, 110, 162, 44, 47, 163, 50, 53, and part of 51.
    c. There are existing timbers sales for FIM stands 40 and 45. Mike D. will contact the logger to see if he would do a complete harvest in stand 40, not just thin it.
    d. Tamarack, balsam fir, bigtooth aspen, green or white ash, ginnala maple and wildlife shrubs will be established inside the AGR and supplied by the Nursery.
5. A road will be established either along the interior of the shelterbelt or along the AGR's edge.
6. Annually, saleable red pine seedlings will be assessed for latent *Diplodia* infections.
7. Pursue acquisition of adjacent private lands so that the pines and spruces within 1000 feet of the buffer line/ nursery fence line can be removed for pathological protection of nursery seedlings. Both pieces of land are occupied by young and mature red pines.
    a. The western property may be acquired by the state as early as late next year.
    b. The northern property is not for sale at this time. This limits production in the northern compartments.

Time line:

Item	*Planned action*	*Who*	*When expected*
1	Fell/ harvest inside the fence	Steve V. and Mike D.	Winter 07-08
2	Create a shelterbelt; site prep and plant	Area	Summer 08, Plant 09
4	Harvest the AGR, site prep and plant tree and shrub species	Area and Steve M.	Winter 07-08, Summer 08, Plant 09
5	Establish a maintenance road	Area and Nursery	Summer 08
6	Assay RP seedlings for 2008	Jana A.	Fall 07
7	Pursue acquisitions. Lands packet sent to Central RMT on Nov. 29, 2007.	Area	Unknown



Early detection and rapid response for non-native bark beetles

Non-native bark and ambrosia beetles are a serious threat to our nation's urban and rural forests. In 2007, the USFS-Forest Health Protection will begin implementation of an early detection and rapid response project for non-native bark and ambrosia beetles. An Early Detection and Rapid Response Team (consisting of Forest Service, APHIS, university and state representatives) has developed a framework for implementing a national, interagency detection, monitoring, and response system for these insects. This framework involves the cooperation of state partners, regional taxonomists and regional Forest Service staff. Participating states will be responsible for following project protocols with funding from the Forest Service. The EDRR project for non-native bark beetles will begin national implementation this growing season.

The goals of the national EDRR project are to detect, delimit and monitor newly introduced exotic bark and ambrosia beetles at selected high-risk forest areas and, if necessary, quickly assess and respond to newly detected infestations.

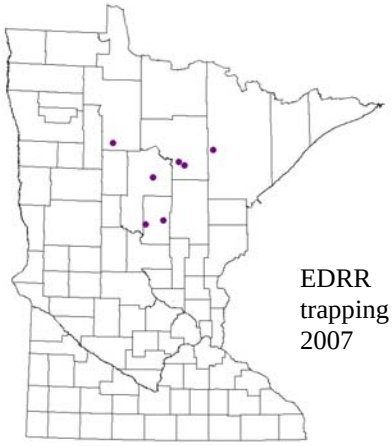
Background

In 2001, with the support of the National Plant Board and the National Association of State Foresters, the Forest Service and APHIS Plant Protection and Quarantine initiated a Memorandum of Understanding to establish an Exotic Forest Pest Early Detection and Rapid Response (EDRR) Pilot Project. The Pilot Project was conducted from 2001-2006 to: develop and test a prototype national survey; identify potential exotic pests and likely pathways; identify detection and management guidelines; address gaps in detection protocols and taxonomic resources; and use the information collected to set agency protocols and priorities. Ten nonnative bark beetle species were specifically targeted, although all bark beetles captured were identified. The target species are among the most common and threatening species intercepted during port inspections.

Since pilot project implementation in 2001, five exotic bark and ambrosia beetles have been detected for the first time in North America: *Hylurgops palliatus* (Erie, PA, 2001); *Xyleborus similis* (Houston, TX, 2002); *Xyleborus glabratus* (Port Wentworth/ Savannah, GA, 2002); *Scolytus schevyrewi* (Denver, CO and Ogden, UT, 2003); and *Xyleborus seriatus* (Southboro, MA, 2005).

Plan for National Implementation

The EDRR Pilot Project demonstrated the feasibility of a nationally-coordinated survey for bark beetles. The Team has developed guidelines for state participation and selected target species. Protocols developed during the pilot project will be utilized in the national survey. Based upon anticipated funding levels approximately 17 states will be surveyed in 2007, including Minnesota. Funding will be made available to states to select high risk sites, approximately 7-9/state, such as urban parks, forests and wooded areas in the wildland-urban interface in coordination with state regulatory officials or APHIS. Taxonomists will identify all bark and ambrosia beetles in trap samples. See Minnesota trapping results in the Invasives and Exotics Section.



EDRR trapping sites 2007

A national, web-based database will be used for data entry, sample tracking and as the reporting system for the project. If a new, non-native species is found, a team will be assembled to develop assessment and response strategies. States and the national EDRR Team will coordinate detection and response activities with APHIS and the Cooperative Agriculture Pest Survey to ensure these programs complement each other.

Emerald ash borer readiness plan for Minnesota

The purpose of this document is to provide a centralized plan of action for all organizations involved with the delay of entry of, establishment of, and recovery from the impact of the emerald ash borer (EAB) in the state of Minnesota. To accomplish this, the plan outlines four primary objectives:

1. Delay the introduction and establishment of EAB in Minnesota.
2. Identify and prepare outreach, education and training.
3. Provide the basis for long-term forest sustainability.
4. Develop political support to ensure adequate funding and regulation.

Several teams were created whose members include staff from MDA, DNR-Forestry, University of Minnesota-Extension and S&S Tree Service. Many of the actions identified in the Readiness Plan are already in motion and the plan helps to organize those efforts to a common purpose. The Readiness Plan is a living document that changes as circumstances change - the most recent draft will always be posted here.

See http://www.mda.state.mn.us/news/publications/pestsplants/pestmanagement/eabreadinessplan.pdf

Firewood restrictions on DNR-lands

The State Legislature passed a law in early May that restricts all firewood entering DNR-administered lands to firewood which has been approved by the Commissioner of the DNR. Approved firewood would include wood sold by the DNR, wood obtained from an approved vendor or clean, dimensional lumber. An on-line process was developed for anyone interested in being put on the "approved DNR vendor" list. Private individuals and vendors can apply as long as the wood comes from within Minnesota and within 100 miles of the DNR facility where it will be used. Campers, anglers, hunters and others can search on-line for firewood vendors at or near their recreational destination.

Firewood can serve as a vehicle for a variety of forest insect and disease pests, including the fungi causing oak wilt and Dutch elm disease, wood stain fungi and insects including gypsy moths, Sirex wood wasps, ambrosia beetles, bark beetles, and long-horned beetles. Although the movement of forest diseases and pests in firewood has been an ongoing concern, the approach of the emerald ash borer (EAB) has brought the issue to the forefront in Minnesota and nearby states. Keeping invasive insects and pathogens out of Minnesota provides a long time for research, planning and forest management to limit future impacts. That makes it's well worth the effort to keep it from being accidentally introduced.

Minnesota campgrounds are one place where pests like gypsy moth and EAB can be introduced because of the transport of personal firewood supplies from infested areas. There are 637 campgrounds in Minnesota, 85 percent privately owned and 15 percent managed by DNR. In 2005, as part of a one-day survey of state park campers, we found that:

- 56% of all campers brought their own firewood to State Parks, and,
- 35% of out-of-state campers brought their own firewood.

Parks and Recreation Division reservation data indicates that about 14 percent of reservations come from out-of-state. So, in 2005, nearly 8000 vehicles came into MN campgrounds carrying firewood from out-of-state.

Since most commercial pathways are being covered by the regulatory agencies, the thing the DNR, residents and recreational visitors can do is address how we think about firewood. Unlike other raw wood products, firewood is moved primarily by home owners and campers who do not fall under state and federal regulations meant to limit accidental introductions of these bad bugs. So the point of this legislation is to change how we think about firewood and the precautions we take to protect trees and forests.

The DNR manages 15% of the campgrounds in the state. So restrictions on DNR lands only address a fraction of the recreationally used firewood being moved around the state. It's important to note that DNR restrictions wouldn't touch firewood being used for home heating. So what do we hope to accomplish? While it's a big undertaking, the DNR hopes to change public behavior with aggressive outreach program and faith in Minnesota residents to "do what's right". We plan to take every opportunity to educate campers:

when they make reservations or check into their campsite for the night,
when campground hosts stop by for a chat or
when folks go to buy their fishing permit.

Recreational firewood users will be seeing materials that explain the risks associated with firewood and what to do to help protect their favorite campsite. So like Smokey Bear and the litterbug education campaigns of past decades, the DNR hopes to use the proposed restrictions to gain public attention and convey the critical role campground visitors play in protecting our natural resources.

The DNR also hopes to enlist the support of other agencies, private resorts and private campground owners, so that recreationists throughout the state get the same message. Toward that goal, the DNR hosted stakeholders meetings and talked to other public and private campground owners. As is already being done in Wisconsin, they are being encouraged to put similar restrictions in place to protect their own resources. And as is being done in Wisconsin, the emphasis in Minnesota will be on education, not enforcement. Public outreach and the honor system will be the foundation of the Minnesota

Firewood restrictions in 2007: Legislation, implementation and outreach

"The program is actually the simplest to use I've seen in 20 years." Craig Schmid, Deer River Area Forester

For the last few years, natural resource managers have had a heightened awareness of damages caused by exotic pests in the US. In 2005, Michigan found that 80% of the introductions of emerald ash borer (EAB) to new areas were the result of firewood movement. Other exotic pests, such as oak wilt, Dutch elm disease and gypsy moths, can also be transported to new locations by firewood movement. Interstate movement of commercial firewood is regulated by USDA-APHIS, but movement of recreational firewood is unregulated. Like other states in the Midwest, Minnesota sought to slow the spread of exotics into the state and within the state by enacting legislation designed to restrict the movement of recreational firewood. DNR staff provided testimony, talking points and fact sheets to the state legislature and the Minnesota Forest Resources Council. In January the MFRC approved a resolution that supported allocation of funding for the implementation of firewood restrictions and for the identification of steps for the interagency rapid response to the introduction of exotic forest pests.

In May, the state legislature amended a statue that banned all bulk and recreational firewood in state-owned camping facilities unless approved by the DNR (M.S. 89.551, Sec. 2, Approved Firewood Required). In everyday language, it is now illegal to bring firewood into state parks, state forest campgrounds or day-use areas unless purchased from a vendor that is approved to sell it. Approved firewood is wood that was harvested in Minnesota, not more than 100 miles from the state-administered lands where it will be burned. Kiln-dried, unpainted dimensional lumber is also approved for use on state lands.

Concurrently, DNR Parks and Forestry held meetings with other agencies, USFS, Corps of Engineers, Tribal governments, counties and Voyageurs National Park, which maintain recreational facilities to keep them abreast of firewood issues and pending legislation. The DNR also held joint meetings with MDA to inform firewood producers and assess their concerns. DNR staff held a total of 14 out-state meetings to inform all firewood producers, local governments, private campgrounds, resorts and Chambers of Commerce about the firewood issue and what the new legislation would entail.

As a result, the USFS, Corps of Engineers, Voyageurs National Park and some counties developed similar policies for recreational firewood use on their properties. DNR staff helped train some of their staff. Many private campgrounds instituted firewood policies. One campground owner noted that people go camping to enjoy the woods, so why would campground owners allow exotic pests opportunities to harm the trees when it's preventable.

As part of the legislative direction, a centralized list of approved firewood vendors was created from scratch. Each Forestry Area was charged with contacting potential firewood vendors in their Areas and with approving them. The DOF developed an Access-database listing of approved vendors that is posted to the DNR website. That way, the camping public can find local sources of firewood near their camping destinations. In 2007, more than 400 vendors throughout Minnesota were approved. Duties and tasks needed to implement this program were coordinated between Parks and Forestry. See memo below.

Getting the word out to the camping public was a gargantuan task. The DNR set up internal and external communications groups headed by the Information and Education Bureau to coordinated outreach efforts. A multitude of avenues and venues were accomplished in the Twin Cities and in out-state locations, such as, press conferences, video news releases, website banner ads, radio bites, sports shows, State Fair, cyber news releases, direct mailings to Parks reservations, inserts into hunting and fishing regulations and other media events.

To: Division of Forestry Regional Managers and Area Supervisors
All Division of Parks and Recreation Staff

From: Bob Tomlinson, Deputy Director, Division of Forestry
Chuck Kartak, Deputy Director, Division of Parks and Recreation

Date: May 16, 2007

Subject: Firewood Restrictions: Duties and Responsibilities

On May 3, Governor Pawlenty signed into law legislation that places restrictions on firewood coming onto state lands. Much discussion has taken place in the department on how these restrictions will be put in place, specifically as to what tasks will fall to the divisions of Forestry and Parks and Recreation. We hope this memo will define the responsibilities of each division concerning the firewood initiative. What isn't answered here should be covered in the attachments that accompany the memo.

Responsibilities:

Division of Parks and Recreation field staff will:

- Ensure DNR firewood contracts are in place to provide quality firewood in adequate quantities to visitors to state parks and other recreational facilities.
- Require new DNR firewood contracts after February 23, 2007, to supply only wood that originates from within Minnesota and does not contain any ash.
- Provide "known" local vendors with application forms so they can get on the list of approved vendors and visitors to state parks and recreational areas have a variety of options for purchasing their firewood.
- Field all questions concerning firewood restrictions asked by the public.
- Supply a barrel or bin or designate a collection point at unstaffed recreational areas where surrendered, unapproved firewood can be deposited.
- Provide signage at all state parks and recreational areas (including unstaffed sites) that informs visitors about firewood restrictions, where approved firewood can be purchased, and where to place surrendered, unapproved firewood.
- Verify, to the extent possible, that visitors to state parks and other staffed recreational facilities have firewood from an approved vendor. Visitors will show staff a sales receipt or "DNR Approved Vendor Ticket." The vendor name on the receipt or ticket can then be checked against the master list of approved vendors provided to staff.
- Dispose of unapproved firewood surrendered at state parks and other recreational areas (staffed and unstaffed) within 48 hours.

Division of Forestry field staff will:

- Identify potential firewood vendors for the public.
- Provide potential firewood vendors with an application form they can complete and return to their local DNR Forestry office.
- Verify information on completed application forms and sign and date them.
- Provide approved vendors with "DNR Approved Firewood Vendor" tickets.
- Submit names of approved vendors to the central office in St. Paul so a master approved firewood vendor list can be maintained.
- Field all questions from vendors concerning the "approved firewood vendor" process.
- Help Parks dispose of wood at unstaffed recreation sites. This may involve a rotating schedule of site visits to collect and dispose of any surrendered wood.
- Help Parks dispose of wood collected over large holiday weekends (Memorial Day, Fourth of July, Labor Day, etc.).

We hope all the information provided here will help define the responsibilities assigned to each division regarding firewood restrictions. More information will be distributed as details continue to be worked out, including when items such as the vendor application form and "DNR Approved Vendor Ticket" form will be available on-line. Education and outreach efforts will also continue to help inform people about the firewood restrictions and how they and their outdoor experience will be affected. If you have questions not answered with the materials provided here, contact Meg Hanisch in Forestry at (651) 259-5265 or meg.hanisch@dnr.state.mn.us or Ed Quinn in Parks at (651) 259-5594 or ed.quinn@dnr.state.mn.us.

Development of Best Management Practices for invasive species

Invasive species have the potential to adversely affect the resources the Division of Forestry manages and protects, and increase management costs. It is in the best interest of the division to limit the introduction of invasive species onto Forestry-administered lands, limit their rate of geographical spread, and reduce their impact on the forest resource.

An invasive species operation order (# 113) was developed that provides guidelines for Department staff to:

- Prevent or limit the introduction, establishment and spread of invasive species,
- Exercise site-level management to limit the spread and impact of invasive species

The term "invasive species" was defined as any aquatic or terrestrial species that "may cause economic or environmental harm, pose human health risks, or threaten natural resources and their use in the state." Current invasive species of concern are listed in the appendix of the operational order.

The operation order requires that discipline guidelines be "developed and maintained…to accompany (the) operational order. The guidelines will contain procedures specific to each discipline that are necessary to implement (the) operational order. Activities likely to cause the introduction or spread of invasive species include but are not limited to: management activities (field work, moving equipment, construction, site management, etc.) and actions DNR regulates, permits, or funds (grants). This includes, but not limited to, activities carried out by contractors, volunteers, and cooperators working on the agency's behalf.

A Division of Forestry team consisting of personnel representing Forest Health, Silviculture, Timber Sales Programs, and Area Forest Supervisors began developing Division of Forestry invasive species guidelines. The methodology used to develop the guidelines was:

A. Identification of Division of Forestry Activities;
B. Risk rating each activity as to the potential to introduce and spread invasive species;
C. An analysis of how each activity can potentially introduce and spread invasive species; and
D. Development of mitigation strategies that can be practically adopted to reduce the potential of invasive species introduction and spread. The mitigation strategies focus on:
    a) Procedures of intentional movement of equipment
    b) Procedures for intentional movement of organisms, organic, and inorganic materials

The final version of the Division of Forestry guidelines is scheduled to be completed in 2008.

DIVISION OF FORESTRY ACTIVITIES			
Activity	**Risk**	**Activity**	**Risk**
Harvesting	H	Gravel crushing/spreading	H
Roads	H	Planting	M
Recreation: OHV & firewood	H	TSI	M
Site prep	H	Land transactions: leases, exchanges, acquisitions	M
Seeding	H	Access permits	M
Special events	H	Stand exams	L
Nursery	H	FIM inventory	L
Fire suppression	H	Other commodities	L

Jack pine regeneration difficulties in Bemidji Area: SWAT team final report

January 25, 2007

During the 2005 field audit for SFI certification, the following minor Corrected Action Request (CAR), in part, was given:

"…*the five year regeneration target is not always met in Jack Pine regeneration treatments [in Bemidji Area],...."*

The DNR response to the CAR was:
By July 1, 2006, form a regeneration "SWAT" team to analyze the regeneration program and results in the Bemidji Area where jack pine regeneration efforts have not met the 5-year regeneration goals. The swat team would consist of region and area silviculturists who have experience in jack pine regeneration, forest ecologist, forest health specialist, and a wildlife manager experienced in managing deer in forested areas in northern Minnesota. By March 31, 2007, produce a report as to cause and recommended actions based on SWAT team's analyses.

Team formation and approaches

The SWAT Team was formed in May, 2006. Team members are:

- Mike Locke – Region Silviculturist, DNR Forestry - Bemidji
- John Almendinger – Statewide Forest Ecologist, DNR Forestry –Grand Rapids
- Jana Albers – NW Region Forest Health Spec. DNR Forestry – Grand Rapids
- Nick Severson – DNR Forester, Bemidji Area - Bemidji
- Blane Klemek – Assistant Area Wildlife Manager, Bemidji Area - Bemidji
- Rick Klevorn – State Silviculturist, DNR Forestry- St. Paul
- Steve Ludwig – Retired Silviculturist, Chippewa National Forest- Lake George
- Greg Snyder – Beltrami County Resource Management -Bemidji

The Team first gathered and analyzed records of harvest, site preparation, planting and regeneration surveys on sites planted from 1990 to 2002. Data covered 167 red and jack pine plantations that included failures (multiple attempts at regeneration) and successes (full stocking within 2-3 years of site preparation). Unfortunately, this was a very time consuming process because the vast majority of the data were on hand-written documents filed in local offices. When it was finally assembled, the data was too inconsistent to analyze statistically, except for a few variables.

Major difficulty with pine regeneration was identified in primarily ten different townships around Bemidji. However, the poor success rate for jack pine and red pine is much more widespread, including State and County sites in Hubbard, Cass, Wadena, Mahnomen and Clearwater Counties.

- Most regeneration problems occur in the Central Floristic Region.
- Bemidji DNR Forestry Area jack pine lower survival problems were recognized starting about 1998.
- Beltrami County District 3 had 11 out of 15 jack pine sites fail in the last 15 years. Mostly east of Lake Bemidji.

The Team then selected twenty sites for "case study" reviews. On-site, teams either determined or validated the causes of failure (or success) based on observations and review of the site data.

Causes of pine plantation failure

Planting and survival records for the pool of 167 stands were reviewed and ten site evaluations were completed before field season ended. Site preparation methods seemed adequate on most sites.

Diseased planting stock

In the late 1970's, what is now known to be an exotic fungus, *Diplodia pinea*, was found causing shoot blight in red and jack pine seedlings in General Andrews and Badoura State tree nurseries. Shoot blight symptoms were controlled with fungicides and cultural techniques. However, sporadic mortality due to an unknown problem occurred after red and jack pine seedlings were outplanted, especially during droughty weather. In 2001, Stanosz et al, reported that *Diplodia pinea* caused latent infections in red pine seedlings that were manifested as collar rot infections and mortality once they were outplanted. Stanosz et al (2006) reported that jack pine seedlings also carry latent infections of *Diplodia pinea*. In 2003, 65% of the red pine seedlings in new plantations in western Minnesota died due to Diplodia collar rot that resulted from latent infections. Stanosz et al (2005) reported that *Diplodia pinea* latently infected up to 88 % of the 2-0 red pine seedlings at Badoura Nursery during 2003. Subsequently, removing the pine windbreaks at Badoura Nursery have reduced the latent infections down to 1% for two consecutive years and no losses have been reported due to Diplodia collar rot in new red pine plantations since 2004.

Low rainfall
There has been below average annual precipitation for nine out of the ten years around Bemidji. Lack of moisture is an additional stress on seedlings and can exacerbate the effect of latent Diplodia infection.

Woodland system had majority of failures
All four Native Plant Community (NPC) classes within the Central Floristic Region for Fire-dependent Forest/Woodland System (FDc) vegetation showed significant failure rates. From a pool of 167 plantations in the Bemidji Area, failure of pine plantations on FDc sites was 68% compared to 25% for northern (FDn) sites (Table 1.).

Table 1. Plantation failure/success by Native Plant Community Class

NPC Class	Failed percent	Succeeded percent	Number of plantations
FDc12	60	40	25
FDc23	71	29	45
FDc24	57	43	44
FDc34	92	8	37
FDn33	25	75	16
Total			**167**

FDc34, which is true forest, had the highest failure rate at 92%. Of the FDc communities, FDc34 has the tendency to succeed to mesic hardwood forest (MH) trees such as red maple, basswood, ironwood, and sometimes sugar maple in the absence of fire. Competition from these trees probably contributes to the failure of pine plantations because modern logging operations don't kill the MH trees. Also, jack pine has only modest success naturally on FDc34 sites. Planting jack pine on sites better suited to red and white pine might have also contributed to the high failure rate.

The remaining NPCs are physiognomically and floristically similar and likely have ecological susceptibility to plantation failure. All three – FDc12, FDc23, and FDc24 – were historically dominated by jack pine and modern sites with old trees still are, yet plantation failure is between 57% and 71%. All three of these communities were naturally woodlands, which present very different post-harvest conditions compared to true forests. In woodlands, grasses and brush naturally dominate sites after a regenerative disturbance. SWAT Team interpretation of Public Land Survey records for these woodlands is that they were naturally slow to recruit pine and that they never achieved the dense stocking of pine forests on FDn sites. Based upon casual counts of stump rings after clearcutting such woodlands, it is typical for most trees to have been established within about 10-15 years of each other and for the range of ages to be about 30 years. Also, the sparsest stocking of jack pine trees in the historical (Public Land Survey) records is generally centered on the Bemidji Area.

Deer browse
Almost all regeneration surveys reviewed mentioned deer browse on seedlings and leads to the conclusion that deer browse is a major contributor to planting failures. Deer browsing has been a significant reason why plantations have not been able to meet the current 5-year regeneration target. Deer populations in the Bemidji Area are some of the highest in the State, ranging from 28 to over 60 deer per square mile. Statewide, average deer populations are 35-45 deer per square mile.

Recommendations to address past pine regeneration failures

Most sites with inadequate stocking can be re-planted. The effectiveness of original site preparation needs to be evaluated and further site preparation may be needed on some of the sites. Each site has its own treatment history, however, and prescriptions will have to be tailored to the site. A thorough site evaluation must be made, including a complete survey of acceptable seedlings and trees on the site. Each site must be classified as to its NPC. A comparison of suitable species for the NPC and the results of the regeneration survey must be made. Acceptable species and desired stocking levels may be adjusted following identification to woodland systems.

Mitigation of pine regeneration losses in the future
Specific recommendations the Team is confident will improve regeneration success.

- Use of disease-free planting stock. Windbreak removals at the nurseries have eliminated the risk of latent *Diplodia* infections and subsequent collar rot in red and jack pine seedlings since 2004.
- Protection. Early in the prescription process, bud protection needs to be considered for artificially regenerated pine sites within the Bemidji Area. This should be done regardless of current deer populations. It is also recommended that local deer populations be kept at level that will ensure pine species can regenerate and grow within the Bemidji Area.
- Evaluation of sites for silvicultural opportunities. In the Bemidji Area, the following could increase pine seedling survival by:

    - Determining each site's Native Plant Community in order to identify stand condition and competitive ability of pine seedlings on those sites,
    - When natural regeneration is desired time harvest activity so that site disturbance in June/July coincides with a large red or white pine cone crop, and,
    - Creating very large harvest sites (100 to 1000 acres in size) so that deer browse and *Diplodia* impacts are minimized.
- Site Preparation**:** Determine whether scarification and/or herbicide are necessary in establishment of jack and red pine. If used, delay both practices until late summer or fall so that they do not promote cool-season sod-forming grasses on sites where jack and red pine will be planted.
- Expect some drought-induced mortality of pine seedlings in drought-prone NPC classes such as FDc23.
- Records: Record keeping is an important component of forest regeneration for several reasons. First among them is the ability to troubleshoot stand regeneration in the event of a partial or full failure. In the future stand history likely will be better served because of Silviculture and Roads Module (SRM) advancement as a statewide record keeping system. However, it is important that stand information be entered completely. Critical information regarding planting actions is:
    - Stock details - type, age, size, source, weather after planting
    - Site details - soils, previous crop, previous insect and disease (I&D) problems, previous animal damage problems
    - Ecological Classification System (ECS) - class to NPC

Other Recommendations and Observations

- Silviculture Interpretations: The official tasks of the SWAT Team, related to the CAR and charge to the Team, will be completed upon final report acceptance. However, the Team is willing to stay together and develop silviculture interpretations for 1-3 NPCs relating to the pine regeneration issue.
- Administrative Road Blocks: Administrative restrictions should be modified so Forest Managers have all the options needed to successfully regenerate pine species in the Bemidji Area.
- Forestry Research Group: Within the DNR, it would be useful to establish a Forestry Research Group similar in form and function to Wildlife Research and Fisheries Research Groups that currently exist within the DNR.
- Prescription Timing, Review and Communication: It became apparent to the Team that there often is a disconnect between treatments applied to a site. This primarily occurs between the timber sale and following site preparation. It is important that site objectives are identified before any treatments, including timber harvest, are proposed.
- Case Studies: A site evaluation protocol and form was developed by the Team attempting to capture and validate site conditions related to seedling survival and treatment history. The Team feels this procedure is valuable if used in conjunction with designed case studies. There is a need to seek successes and figure out why. A forum for communicating experiences with regeneration techniques and results needs to be developed.
- Stock Condition: Existing guidelines for handling seedling stock need to be followed and reviewed for effectiveness.
- Seeding/Seed Source Studies: Regeneration success is measured by the number of trees that survive and grow to rotation age. Little information was available regarding the geographic origin of the regeneration material used on the studied sites. Had this information been available, the degree of importance of seed source could have been determined. Seed source of regeneration materials is readily available now, and is taken directly from the shipping container label. It is important in regeneration projects that seed source be entered as a permanent part of the project records. Observations by ecologists suggest that there may be differences among floristic regions relative to seedling physiology. These observations should be formally investigated further and coupled with existing studies to better define pine seed transfer zones.

Minnesota hosted the North Central Forest Pest Workshop in 2007

The North Central Forest Pest Workshop is an annual gathering of persons interested in forest health in the North Central portion of North America. It is usually attended by plant pathologists, entomologists, foresters, and other scientists and students.

Each year the workshop is held in a different location. The main participating States or Provinces take turns hosting. Each year, forest health specialists from the host State or Province develop an organizing committee and plan the meeting. This year, Minnesota DNR and the USFS-S&PF and USFS-NCRS hosted the meeting in Shoreview, MN.

Monday, September 24

4:00 – 9:00 Registration table open and poster set-up

3:00 – 5:00 Fungal foray – Informal field trip to collect and identify fungi – meet in Hampton Inn lobby and car pool to a nearby location

6:00 – 9:00 Social hour at the Hampton Inn

Tuesday, September 25

7:00 Registration table open

8:00 – 8:15 Welcoming remarks (Olin Phillips, MN DNR)

Influence of weather and climate on forest pests (moderator – Mike Ostry, US Forest Service)

8:15 – 9:00 Climate change in Minnesota: Detection, evidence, and implications
Mark Seeley, Dept of Soil, Water, and Climate, Univ. of MN

9:00 – 9:45 Global atmospheric change and forest insects: Ruminations over a beer.
Bill Mattson, US Forest Service, Northern Research Station

9:45-10:00 BREAK

Invasive Species (moderator – Dennis McDougall, US Forest Service)

10:00 – 10:25 Investigating the establishment and spread of emerald ash borer in North America through tree-ring analyses. N.W. Siegert, D.G. McCullough and F.W. Telewski, Michigan State Univ.; A.M. Liebhold, US Forest Service, Northern Research Station

10:25 – 11:00 Moving towards an EAB slow the spread strategy: what are the pieces of the puzzle? D.G. McCullough, Michigan State Univ.

11:00 – 11:30 A comparison of detection tools for emerald ash borer in three Midwestern states. J. Marshall and A. Storer, Michigan Tech Univ.; I. Fraser and V. Mastro, USDA-APHIS

11:30 – 12:00 Sirex Woodwasp - Risk, Status, & Surveys in North America.
Dennis Haugen, US Forest Service, Forest Health Protection

12:00 – 1:00 Lunch

Forest and Tree Declines (moderator – Joe O'Brien, US Forest Service)

1:00 – 1:30 Red pine decline in Ontario: Biotic and abiotic factors and interactions.
John McLaughlin, Ontario Forest Research Institute

1:30 – 2:00 Black ash decline, extent and possible causes.
Mike Ostry and Robert Venette, US Forest Service, Northern Research Station

2:00 – 2:30 White spruce plantation decline.
Holly Petrillo and Sarah Brewster, Univ. of WI – Stevens Point

2:30 – 2:45 Break

Root Systems and Tree Health (moderator – Jana Albers, MN DNR)

2:45 – 3:30 Annosum root disease in the Great Lakes region - is something old new again!
Glen Stanosz, Univ. of WI - Madison

3:30– 4:15 Dysfunctional Root Systems and Brief Landscape Lives.
Gary Johnson, Univ. of MN

4:15 Adjourn (Dinner on your own)

Wednesday, September 26

8:30 – 5:00 Field Tour – Oak wilt at Carlos Avery Refuge (Propiconazole, Management in urban areas), hazard tree management at Interstate State Park, tour of an urban wood-waste processing facility (Utilization of DED and OW infected mulch), and pine bark beetles, girdling roots and Firewise issues in Andover.

5:00 Dinner - outside barbeque

Thursday, September 27

8:00 – 8:20 Business meeting

Urban/Suburban forest health issues (moderator – Linda Haugen, US Forest Service)

8:20 – 8:50 Preparing for EAB in Minneapolis.
Ralph Sievert, Minneapolis Park and Recreation Board

Miscellaneous and state, federal and provincial reports (moderator – Val Cervenka, MN DNR)

8:50 – 9:05 Are incidence and abundance of inoculum of the Diplodia shoot blight pathogens influenced by site characteristics that defined pre-settlement vegetation?
Isabel Monck and Glen Stanosz, Univ. of WI - Madison

9:05 – 9:45 Dispersal of gypsy moth pathogens into areas newly colonized by the gypsy moth.
Patrick Tobin, US Forest Service: Ann E. Hajek, Laura M. Blackburn, Joshua J. Hannam, Andrea Diss-Torrance, Kenneth F. Raffa and Charlotte Nielson

9:45 – 10:00 Break

10:00 – 10:40 What's going on with the honey bees?
Marla Spivak, Dept. of Entomology, Univ. of MN

10:40 – 12:00 State/Federal/Provincial/University reports

12:00 Adjourn

Field trip stop # 1: Oak wilt pocket in Carlos Avery WMA.

Active oak wilt pocket, crown symptoms.

Dr. Jenny Juzwik and Dr. Joe O'Brien.

Excavation of an oak tree's root system.

Root grafts enable oak wilt fungus to spread between oak trees.

25th Anniversary Salute: Forest Insect and Disease Newsletter

Thanks to the Division of Forestry who, for the past 25 years, has brought the FID Newsletter to your offices, homes and, now, computers. Thanks to our writers, past and present. Your observations, analyses, recommendations, humor and dedication to forest stewardship serve people who are interested in forest and tree health.

Jerry Hecht
Ray Dolan
Bob Tiplady
Roger Hannigan
Alan Jones
Mike Albers
Olin Phillips
Meg Hanisch
Mike Carroll

Ed Hayes
Doug Rau
Jana Albers
Tom Eiber
Dwight Scarborough
Susan Burks
Mark Platta
Neville Wilson
Val Cervenka

Oak wilt suppression, Lake States comparison

Question	Minnesota	Michigan	Wisconsin
When did the state first establish their program?	Since 1992. Based on aerial photos taken in 1988, some initial treatments were done in 1989 & 1990. A federal suppression grant was awarded in 1991, with the first community grants awarded in 1992.	MI doesn't have an established program. MI DOA managed OW throughout the 1980s using their authority to treat with or without LO consent. OW was first detected in the UP in 1981. Both state agencies were involved in suppression through 1988. Federal funds were first requested in 2003.	2007, except for a one-time last-minute request for federal funding in 2004.
Cite the source of authority for the state's OW prog.	Chapters 88.82(authorizes Releaf), 89.53 (forest pests) & 89.62 (shade tree pests)	Part 5, NR & Environmental Protection Act, P.A. Act 451 1994	None. As a pilot program, we are not required to add the program to state law.
Does the state have authority to compel landowners to treat?	No	No	No
If no, how does the state ensure compliance?	Grantees are responsible for establishing LO agreements and inspecting the sites to ensure completion. The state rechecks 5% of the sites to ensure compliance.	The state acquires LO agreements before treatment and monitors the sites until trees have been removed.	The state inspects each site
When did the state first receive federal funds?	1991	2003	2005 (One-time in 2004)
How many of the last 10 yrs were grants received	1992-1997, 2002-2007	2003-4, 2006-7	2004, 2005, 2007
In 2006 how much was received	$198,000; range from $90K in 2002 to $400K in 2005	$75,000	0
In 2006, what was the state match?	Not included in the match	All in-kind	0
In 2006, what was the local match?	Over $198K in local matches	0	0
How many state FTEs are utilized in the program?	1.5 (1 admin, eradication & mapping, .5 in private contractors for outreach & compliance)	.5 (.3 field, .2 admin)	.1 permanent FTE + 1 seasonal employee
What is the primary program goal?	To reduce the damage by reducing landscape level disease incidence (STS). To build local capacity to manage OW	Project goal is to remove OW from the UP and prevent its reintroduction	In specified areas, to reduce the damage by reducing introduction & spread of OW (primarily through outreach and tech assistance?)
How is funding prioritized?	4 management zones defined by disease incidence. Eradication and containment zones are funded before the suppression zone. C/S rates vary by zone. Site level decisions are made by the grantees.	Private lands before state ownership, outlier sites before sites in more generally infested areas	Sites where there is a reasonable potential for control in a local area
Are all lands eligible for participation?	Federal lands are not eligible. State lands are, but have not received funding in the past. LUGs within 19 county core area are eligible to apply	Yes, within the 2 county UP project area	No, pilot focuses on 5 townships in 2 counties
What, if any, financial limits does	Max of 20% on admin costs; cap had been $15K per grantee, but cap was	None	None

Question	Minnesota	Michigan	Wisconsin
the state set on individual Los?	removed in 2006.		
What detection methods are used?	Past CIR & annual aerial sketch mapping, plus ground and aerial surveys carried out by grantees & LO call-ins	Aerial detection surveys, aerial photography, ground surveys in known infested areas, FH field reports & public responses	Summer employee conducts ground and aerial survey
What RGB methods are used?	Vibratory plow to a depth of 60"	Vibratory plow to a depth of 60"	Trenching. In special cases, dozing the trees.
Which model of RGB is used?	French's model	Bruhn's model to a 99% confidence	Both are eligible, but DNR staff inspect prior to ensure proper placement
What measures are used to prevent overland spread?	Pspt removal, public outreach through multiple media, no firewood permits within OW areas on state, permit process that requires treatment prior to ground breaking within some counties & communities	No firewood permits within OW areas, no cutting/timber sales between 4/15 and 7/15, outreach to discourage wounding during peak infection	PSPT removal and LO education
How is infected wood managed?	Chipped, burned, processed or tightly tarped by April, overseen by grantees.	Burned or cut into boards by April, moved to area w/ no oaks within 1 mi by April, firewood tarped until July 15th, non-pspt slash cut to 4" diameter, pspt slash chipped, tarped or moved to location w/ no oaks	Local ordinance to limit the movement of firewood
Who carries out post-treatment inspections?	Grantees are responsible for doing all post-trtmt inspections, DNR staff rechecks a minimum of 5% of sites annually	MI DNR foresters monitor operations, Project Mgr inspects all treatments, public & private.	DNR staff
What practices are available for cost sharing?	Prog admin, outreach, detection surveys, VP, PSPT and CTL, inspections and mapping. Fungicide injections, herbicides, stump grinding and reforestation are not covered	We don't cost-share	All treatment practices except cutting a buffer zone, using herbicides as a RGB technique, removal of pspt without a RGB, removal of non-pspt trees, stump grinding or reforestation.
How is QA/QC ensured?	DNR subcontractors field check a subset of the sites treated 3 yrs ago	Proj & Prog Mgrs review treatments annually, monitor sites for 3 yrs, lead the plow to ensure proper depth, confirm/culture OW before treat	Frequent communication with LO, hiring qualified staff, site inspections by DNR
How is treatment success measured?	No OW outside RGB after 3 yrs (new USFS definition)	No OW outside RGB for 3 yrs, no new infection centers, educated public measured via survey?	Use modified USFS form
What factors limit trtmt success?	Site factors that limit RBG; participation among LO, communities & public partners, pool of trained professionals, lack of funds, cost, ease & ability to detect & monitor epicenters	Uncooperative LOs, movement of infected wood, wounding during peak infection, lack of funds, ability to detect small OW epicenters	Site factors that limit RBB, availability of equipment & trained professionals, LO willingness to accommodate schedule & follow control measures
How is program success measured?	Reduction in disease incidence measured by infected acres/sq mile,	Treatment success + reduction of new and existing epicenters, annual reports	In process of determining

Question	Minnesota	Michigan	Wisconsin
	reduced spread rates, public awareness & participation, increased local capacity to manage OW		reasonable measures
What factors limit prog. success?	Stable funding, understanding of spread/disease pressure, political will to enforce existing ordinances	Stable source of funding	LO interest & willingness to participate, public awareness, stable funding,
What rsch is needed?	Factors in overland spread, disease pressure thresholds/models, detection & monitoring technologies, impact studies (econ & environmental), silvicultural guidelines, outreach tools for decision makers (local, state and federal)	Overland spread/vectoring, models for RGB, effectiveness of stump pulling, OW detection, education & outreach tools	Treatment options – alternative to trenching, models for RGB

Spruce problem diagnosis for yard trees

By Jana Albers and Mike Albers, DNR-Forestry

KEY

Effect on tree

- Kills tree
- Other damage
- No damage

Size of tree

- Seedling
- Sapling to pole
- Pole and larger

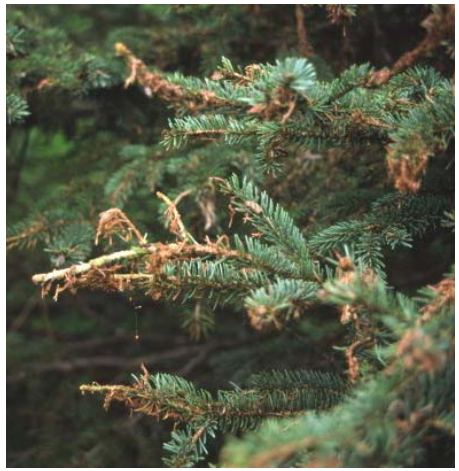
Current and/ or older needles are eaten:

Yellow-headed spruce sawfly

- Defoliation of leader and upper crown of trees < 15 ft. tall.
- No webbing, no insect remnants.
- Larvae present in late May through June.
- Usually on trees exposed to sunlight.
- Severe defoliation can lead to top-kill and even death of small trees.
- Usually occurs in clusters of young trees.
- Management: Apply chemical insecticide directly on larvae in early June. (Bt won’t work.)

Current and/ or older needles are eaten:

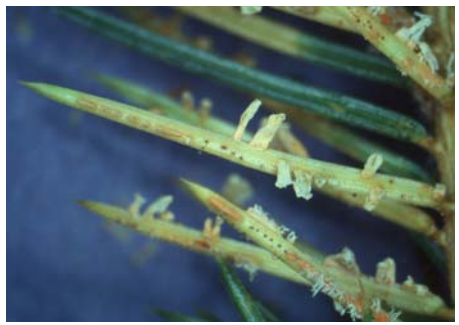
Spruce budworm



- Defoliation of leader and upper crown in trees of all sizes.
- Messy feeder, so leaves lots of debris, clipped needles, insect remnants.
- Empty pupal cases often present year round.
- Larvae present in late May through June.
- Usually on trees exposed to sunlight and seedlings below infested mature trees.
- Kills trees after several years of heavy defoliation.
- Yard trees: Spray foliage with Bt twice at 7 day intervals on small larvae.

Current and/or older needles are discolored:

Spruce needle rust



- Buds are green and alive.
- Current year needles are discolored.
- Disease causes needles to drop during the next year.
- If infection is heavy, the entire tree can look tan to pink in July and August.
- Fruiting bodies on infected needles.
- Management: Disease is unpredictable, because presence and severity depend on cool, moist spring weather for needle infection.
- Labrador tea is alternate host.

Current and/or older needles are discolored:

Spruce spider mite

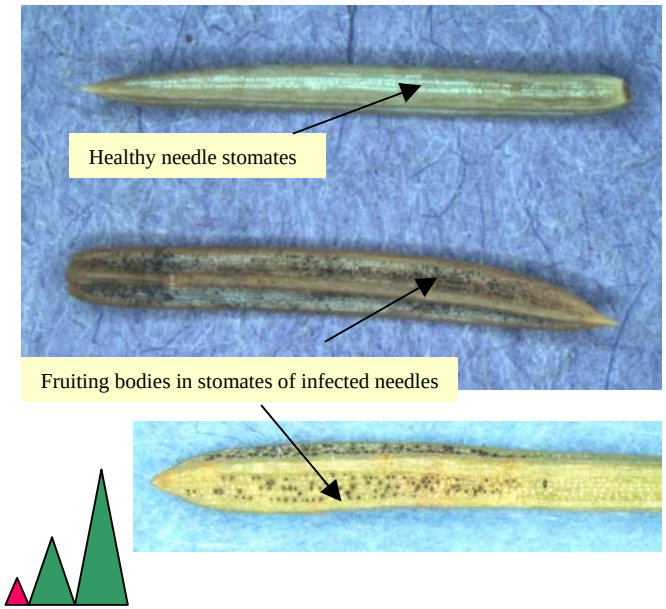
Adult

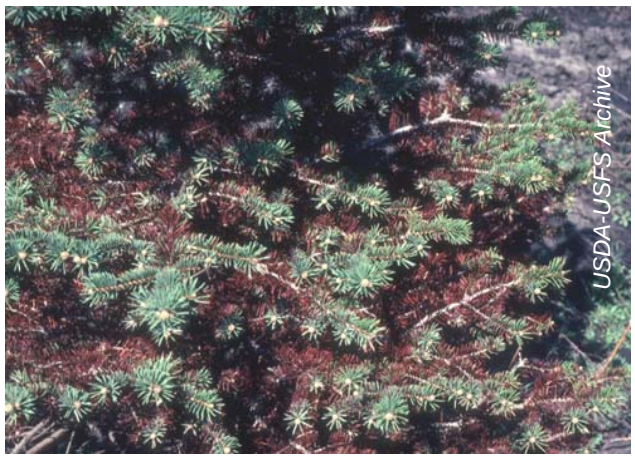
Hatched eggs

- Associated with droughty weather and looks like the needles and twigs dried up.
- With hand lens, can see egg cases and mites.
- Frequently see very fine webbing along the twig; debris gets trapped in webbing and the twig looks dirty.
- If infestation is current, you can hold a piece of paper underneath a twig, and tap it in order to get mites on the paper. Mites are the tiny specks that move.
- Management: Apply miticide in early June or twice in July or use a dormant oil in late fall.

Only older needles affected:

Rhizosphaera needle cast





- Buds are green and alive.
- Current year's needles are green.
- Some or most of the older, infected needles turn brown to purple. Later, they fall off.
- Black fruiting bodies found in stomates which are normally white. Use a hand lens.
- Tree may have a sparse-looking interior.
- Management: Apply fungicide when needles are half elongated and then when fully elongated. Two or more years of treatment will be necessary.
- Increase air circulation tree by pruning off lower branches and mowing under the tree.

Only older needles affected:

Lirula needle cast

Fruiting bodies on two-year old needles

- Buds are green and alive.
- Current year's needles are green.
- Some of older, infected needles turn tan and fall off prematurely.
- Black, linear fruiting bodies are found on underside of needle on two-year old needles.
- Tree may have a sparse-looking interior.
- Management: Single application of fungicide by July 1st.

No needles; twigs and branches are dead:

Cytospora canker

- Buds dead, no needles on infected twigs.
- Infected twigs and branches can occur anywhere on the tree.
- Lots of pitchy sap can be found at branch unions or cankers.
- Sometimes can find golden spore tendrils coming out of dead twig or cankers.
- Especially a problem on Colorado blue spruces.

Orange spore tendrils

- Management: Minimize stress by watering, mulching and fertilizing. Avoid crowding. Avoid wounding branches and trunk.
- Prune out infected branches only during DRY weather in late fall. Sterilize cutting tool between each cut; otherwise, you spread the disease among spruce trees.

Weather related damage to shoots or needles:

Late spring frost

- Associated with hard frost or low terrain.
- Several shoots droop over/ wilt and may die.
- Management: None needed.
- Chose hardier planting stock or those with delayed bud break.

Winter injury

- Due to loss of moisture during winter.
- Needles brown from tip towards base.
- Branches and twigs below snow are unaffected.
- Management: Avoid planting sites exposed to winter winds and late winter heating. Mulch plantings and water well during growing season.
- Heat can be reflected off buildings, so either wrap exposed spruces in burlap or provide a screen between the tree and the building to protect them during the winter.

Leader wilted or dead; may include more than 1 whorl of branches

White pine weevil (on spruce)

Feeding tunnels

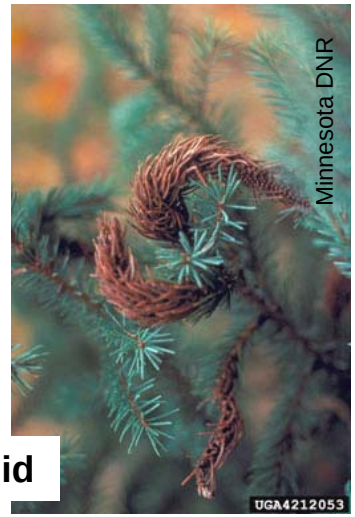
Chip cocoon

Exit hole

- Terminals with up to 3 whorls of branches drooped over/wilted and dead.
- All other branches not affected.
- Spruces of any age can be affected, but not serious once the trees are > 20 feet tall.
- Larvae are found under the bark at junction of live and dead tissues in stem during May, June and into July. Chip cocoons are evidence of infestation. May be 2 or 3 whorls down from the terminal.
- Insect prefers open grown trees; lots of sunshine on the leader. So, where possible, plant spruce under a light overstory.
- Clip and destroy attacked leaders prior to July 15th ; before the adults emerge from under the bark of the attacked shoot. Be sure to get larvae. They move downward as they develop, so they are at the junction of live and dead tissues in the stem.
- Insecticides are labeled to control adults in very early spring. Usually not a good option.

Shoots and twigs swollen; needles green or dead:

Spruce gall adelgids and midges



Eastern spruce gall adelgid

Spruce gall midge

- Several types of galls/ insects found on spruce twigs. Usually just an aesthetic problem; usually just a few galls per tree.
- Current or older twigs are curled and misshapen.
- Current needles may still be green but, on older galled shoots, needles are dead and red.
- Adelgids cause swollen galls that include the needle bases.
- Midges cause galls on the twig that do not include the needle bases.
- Management: Apply imidacloprid as a systemic in the fall; or, apply dormant oil in late fall; or, spray foliage with labeled insecticide.
- Remove young (green) galls by pruning. Bag up or destroy galls because insects will mature and emerge from clipped shoots.

Pitch tubes on trunk; tree dead or dying:

Spruce beetle

- Attacks tree > 10 inches DBH.
- Trees may die quickly or can take up to 3 years.
- Trunks are pitchy; streaks or strings of pitch on stem and branches.
- Infestation usually starts with blowdown or other local spruce tree mortality. **Mostly near North Shore, but can be found through central and northern MN.**
- Insects feed in galleries in inner bark.
- Creates pitch tubes on bark surface anywhere on the tree. Tubes < ½ inch in diameter. Older pitch tubes turn grey and blend in with the bark.
- Exit holes = 3/32 inches or 2 mm in diameter.
- Management: Complicated, so call for more information.

Pitch masses on trunk, little effect on tree health:

Pitch mass borer

- Pitch masses are up to 4 inches across; usually solid.
- Does not kill trees, but pitch-filled tunnels in sapwood causes lumber degrade.
- Prefers pole-sized trees.
- Larvae is grub-like; beige colored with brown head; up to 1 inch long.
- Adult is a clear winged moth that resembles a yellow-jacket wasp.
- Insect has a 2-3 year life cycle.
- Not managed in the forest.
- In urban settings, open pitch mass and kill larvae/ pupae with knife.

Miscellaneous

Snowshoe hare damage.

Last year’s apical bud destroyed due to grossbeak feeding.

Chip cocoons and pupae of small spruce weevil on stem.

Yellow-bellied sapsucker damage.

Armillaria root disease – mycelial fan.