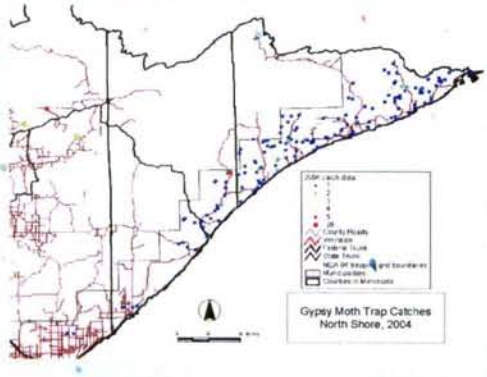
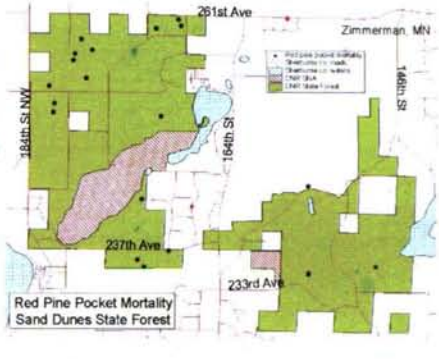
Jana's

Minnesota Forest Health Annual Report

2004

DNR-Forestry
Forest Health Unit





The forest resources of Minnesota

In Minnesota there are approximately 16.3 million acres of forest land, of which 14.9 million acres are classified as "timberland" or lands capable of producing timber. Forest type acreage can be found in the table below. (Source of data is the Minnesota 2001Eastwide Database provided by the USFS-NCFES.) A geographical depiction of forest land location can be seen on the map. 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.

Two major industries depend on Minnesota's forest 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.

Forest health staff

Tom Baumann
Section Manager
500 Lafayette Rd.
St. Paul, MN 55155
(651) 296-4499

Alan Jones
Management Supervisor
500 Lafayette Rd.
St. Paul, MN 55155
(651) 296-4482

Jana Albers
Reg 1 - Forest Health Specialist
1201 E. Hwy. # 2
Grand Rapids, MN 55744
(218) 327-4234

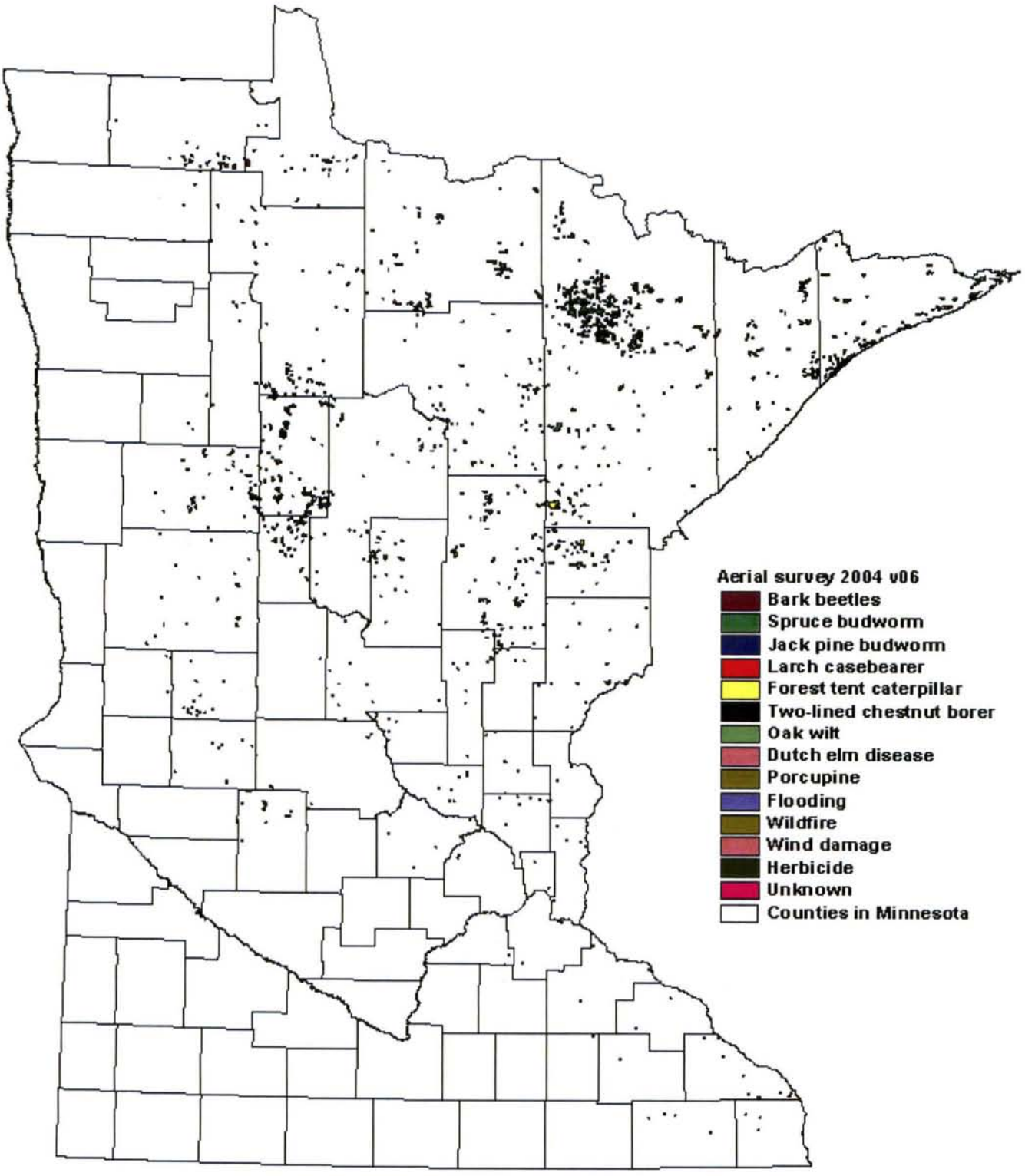
Mike Albers
Reg 2 - Forest Health Specialist
1201 E. Hwy. # 2
Grand Rapids, MN 55744
(218) 327-4115

Susan Burks
Reg 3 - Forest Health Specialist
1200 Warner Rd.
St. Paul, MN 55106
(651) 772-7927

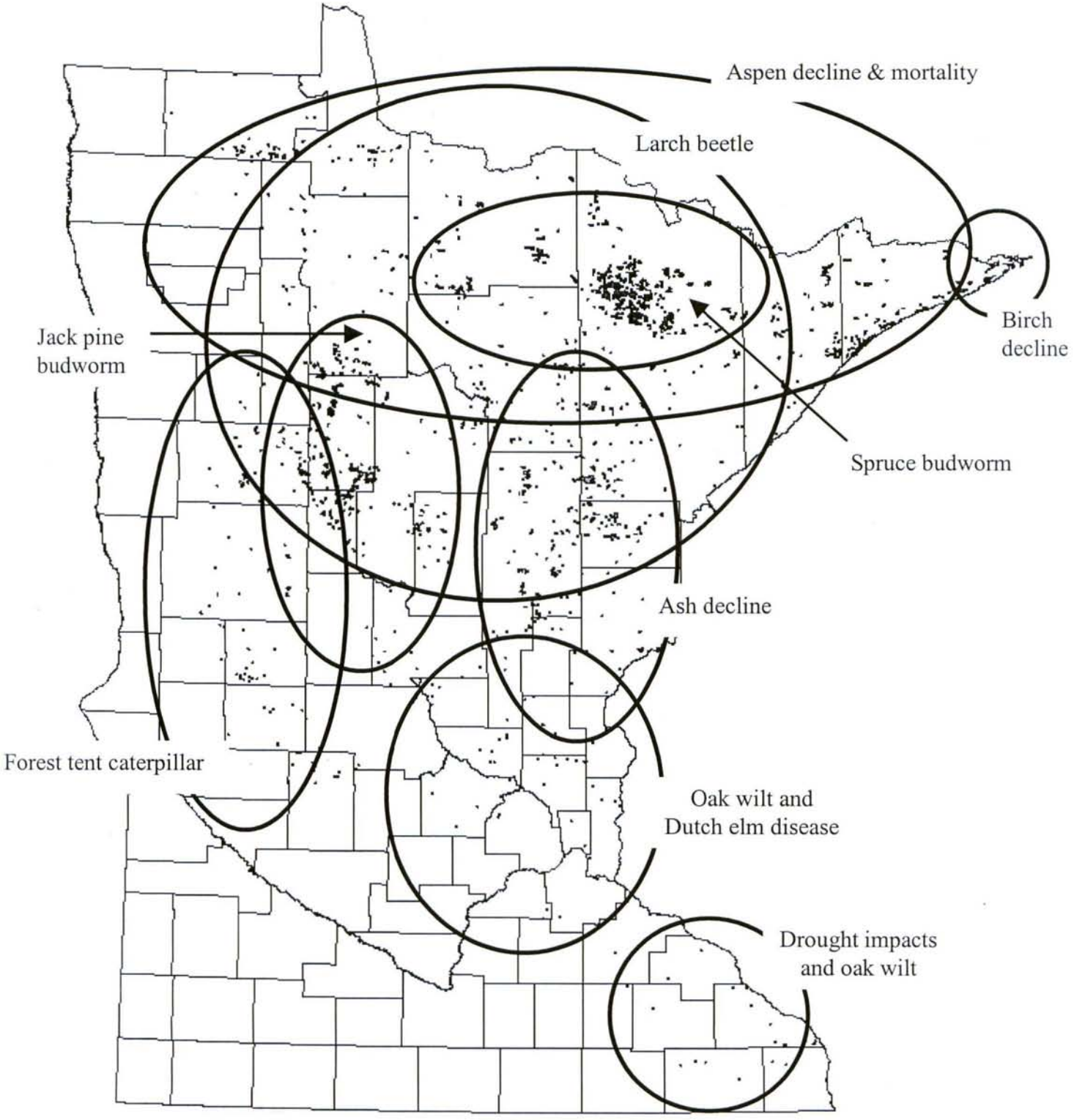
Ed Hayes
Reg 4 - Forest Health Specialist
2300 Silver Creek Rd. NE
Rochester, MN 55901
(507) 285-7431

Table of contents

Aerial Sketch Map – Pest Detection 2004



Aerial Sketch Map – Pest Detection 2004



Pest Detection Survey Results – FFY04	
Causal Agent	**Acres**
Spruce budworm	83,200
Jack pine budworm	47,700
Aspen mortality (due to FTC)	27,500
Ash decline	27,000
Aspen decline (due to FTC)	22,900
Forest tent caterpillar	10,500
Larch beetle	10,000
Larch casebearer	6,700
Flooding damage	4,000
Birch mortality (due to FTC)	3,200
Oak wilt	3,000
Red pine mortality	600
Wind damage	500
Two-lined chestnut borer	250
Birch decline (due to FTC)	200
Wildfire damage	200
Dutch elm disease (not in Twin Cities)	160
Herbicide damage	60

INSECTS

Banded elm bark beetle

Scolytus schevyrewi

Banded elm bark beetle (BEBB) was first identified in Colorado last year. This year, Minnesota was among five additional states to find this exotic pest in residence. Pheromone traps were set out by MDA and APHIS in the Metro area and in several counties along the Iowa border. DNR set 2 traps for BEBB in Itasca county, one in Grand Rapids in a gravel pit where the city disposes of trees and brush and the other at the county landfill north of Cohasset in an area used for tree and brush disposal. In June, three banded elm bark beetles were caught in Fridley, a northern suburb of Minneapolis. Interestingly, the three beetles were caught in three separate traps, each baited with different pheromones. No BEBB were caught in the DNR traps.

The map shows locations where BEEB has been found and where it hasn't been found when people have specifically looked for it. The broad distribution probably reflects multiple introductions over a long period of time. It is suspected that banded elm bark beetles have made their way into the US in pallets made of elm wood with the bark still attached.

Exotic insects and diseases all have the potential to alter our natural forest ecosystems and/ or damage ornamental vegetation. We'll have to wait to see what the effects of banded elm bark beetles are and where they become established.

Douglas-fir beetle

Dendroctonus pseudotsugae

MN Dept of Agriculture set 125 Lindgren funnel traps in Itasca County near Cohasset baited with commercially available bait for Douglas-fir beetle. No Douglas-fir beetles were caught in the traps. The DNR did not trap for Douglas-fir beetle in 2004.

Eastern larch beetle

Dendroctonus simplex

Hosts:	Tamarack
Damage:	Mortality
Area:	9200 acres mapped on aerial survey
Severity;	Variable
Trend:	Unknown

Eastern larch beetle continues to kill tamarack. Last year 6,000 acres of tamarack mortality were reported and this year, about 10,000 acres were reported. While the aerial survey indicates an increase, ground surveys at least in stands where the beetles have been active for a number of years indicate populations are declining. Declines in these stands may be due to a buildup of predators. In addition, much of the larger tamarack (4 inches and greater DBH) have already been killed in many of these stands. Also temperatures during the winter of 2003-2004 were colder than the past 4 or 5 years reaching a low of –34 F in Grand Rapids. Cold winter temperatures are believed to kill overwintering larvae and pupae reducing larch beetle populations.

Eastern Larch Beetle Mortality 2004

Defoliation Levels	Acres
Trace	300
Light	6062
Moderate	2384
Heavy	456
Total	9202

In the spring of 2003, aerial reconnaissance was flown by the Aitkin Area staff to estimate the amount of pest mortality on timber sales. Nineteen active timber sales were flown and mortality was found on nine of the sales. The 9 sales and results are listed below.

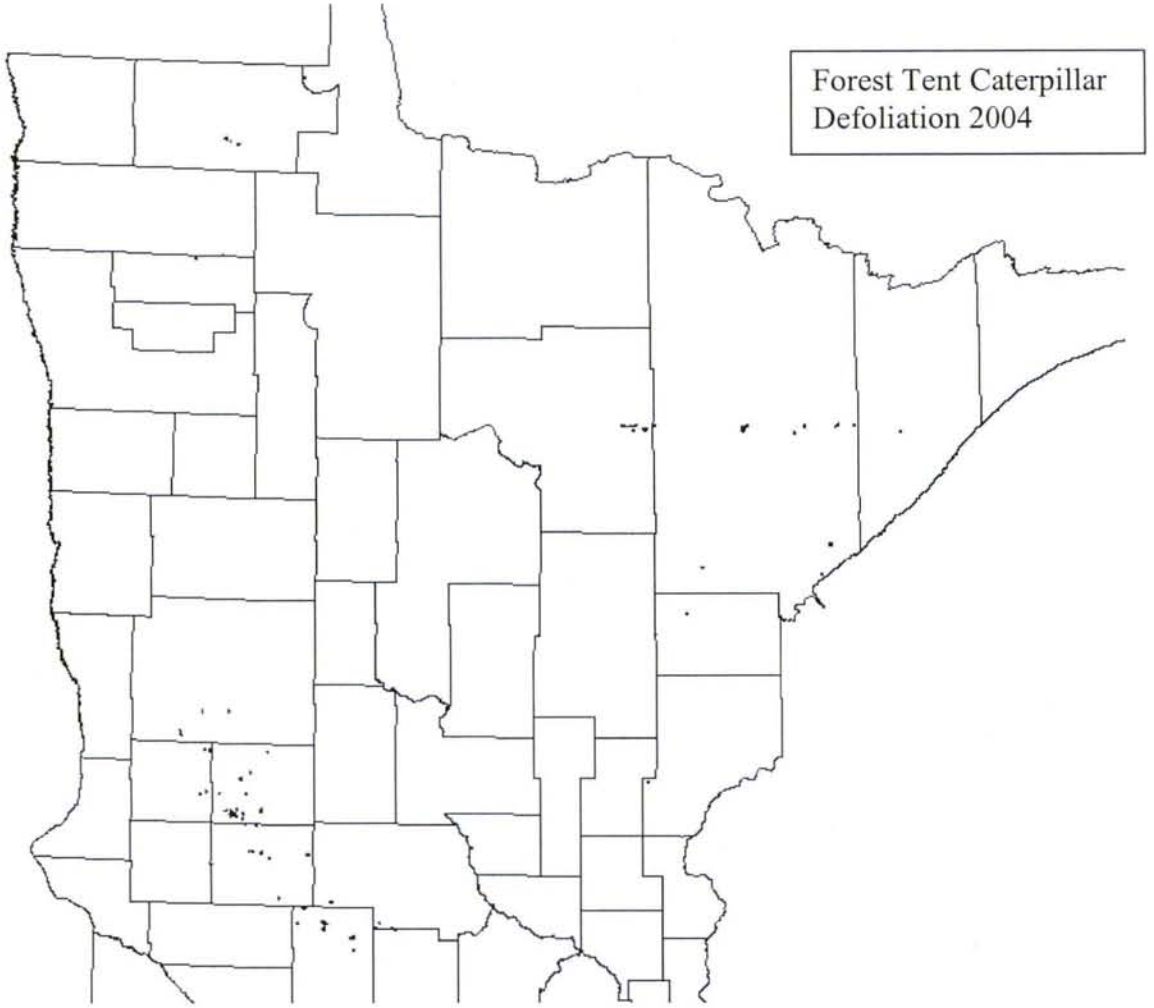
X2214- S26-T51N-R25W - Less than 5% mortality around blow down
X1642- S2-T50N-R25W - Less than 5% mortality
X2210- S6-T50N-R25W - Less than 5% mortality
B1129- S20-T50N-R25 – Ten percent mortality in several small pockets. Sale = 1600 cords of tamarack on 60 acres.
X1660- S13-T48N-R27 - Greater than 70% mortality. Sale = 300 cords of tamarack on 21 acres.
B0673- S14&15-T48N-R27W - East block had 95% mortality and west block had 90% mortality. Sale = 620 cords of tamarack on 23 acres.
B0672- S11&12-T48N-R27W - Greater than 50% mortality. Sale= 2160 cords of tamarack on 130 acres.
X2206 S5-T50-R23W - Less than 10% mortality in a few pockets
X2205- S35-T48N-R23W - Less than 5% mortality in two small pockets.

Forest tent caterpillar

Malacosoma disstria

Hosts: Aspen, oak, basswood and other hardwoods
Damage: Defoliation
Area: 10,500 Acres
Severity: Mostly trace or light
Trend: Decreasing/ collapsing outbreak

The forest tent caterpillar collapsed in 2004 over much of the state. Only 10,500 acres were tallied during the aerial survey. See map. At its peak in 2002, this outbreak saw the highest number of acres ever recorded (7,374,000 ac) for an FTC outbreak in Minnesota.



In its wake, this outbreak left thousands of acres with trace levels of mortality in both aspen and birch stands all across northeastern counties. Many of the dead aspens had Hypoxylon cankers on the main stem. See map. Host trees in these areas experienced heavy defoliation for two or more years as well as severe drought before, during and after the defoliation episodes.

Egg mass surveys for forest tent caterpillar indicated that heavy defoliation in 2004 could be expected in some locations especially across the Iron Range in St. Louis County from Nashwauk to Virginia. Up to 21 egg masses were found on individual small aspen trees in some locations. This is three times more that would be needed for complete defoliation. Yet, in most of these locations larvae are absent or scarce. What happened? In some egg masses a high percentage of eggs did not hatch, likely due to a build up in the number of egg parasites. However, even when eggs hatched larvae are scarce. This is likely due to the cool spring. FTC egg masses were hatching from Grand Rapids to Ely on May 6th just as aspen leaves were beginning to emerge. However, May was a cold month with frosts occurring every week. Aspen leaves across the Iron Range have some evidence of frost damage. Average weekly temperatures in Hibbing were from 6.3 to 9.1 degrees below normal. It may have been too cold for newly hatched larvae to feed and they may have starved to death. Those that did make it to the pupal stage were likely attacked and killed by the abundant parasite, *Sarcophaga aldrichii*.

Location	Average DBH	Ave. # of egg masses	Predicted Defoliation	Actual Defoliation
S22-T63-R22 East of Winton	2.6 "	0.5	Light	None
S25-T62-R15 West of Ely	2.3"	3.0	Moderate	None
S8-T61-R16 West of Peyla	2.7"	1.0	Light	None
S17-T55-R26	2.8"	1.6	Light	None

West of Grand Rapids				
S16-T141-R25 East of Remer	2.6"	Moderate	Light	None
S18-T57-R23 NW of Nashwauk	2.4"	5.3	Moderate	None
S16-T57-R22 NE of Nashwauk	2.1"	6.3	Heavy	Trace
S16-T57-R21 West of Hibbing	2.2"	6	Heavy	None
S19-T58-R20 North of Hibbing	2.1"	12.6	Heavy	None
S4-T59-R20 North of Chisholm	2.6"	1.6	Light	None

5/2 Leatherwood in bloom this week. Grand Rapids, Itasca Co

5/6 FTC hatching near Ely, Tower and Grand Rapids. Aspen leaves just starting to emerge

5/16 Juneberry starting to bloom. Grand Rapids, Itasca Co

6/18 Found 1 FTC larva, 5/16 inch long. North of Hibbing, St Louis Co

6/15 Larvae 5/8 to ¾ inches long. Grand Rapids, Itasca Co

6/21 Larvae 1 and ½ inches long. Grand Rapids, Itasca Co

7/2 FTC pupating. Grand Rapids, Itasca Co

Gypsy Moth Statewide Program Summary

Lymantria dispar

Prepared by Kimberly Thielen Cremers, Gypsy Moth Program Coordinator,
with edits and comments by Susan Burks, DNR Forest Health Specialist

General survey program

The Minnesota Department of Agriculture (MDA) was the lead agency during the 2004 gypsy moth detection survey program. Other cooperators included USDA, APHIS, PPQ; USDA, FS, MNDNR; and the Three Rivers Park District in the Twin Cities metro area. Staff in the cooperative program set 18,646 delta traps across the state, and 396 male moths were recovered. This was a 26 percent decrease from 2003, when 535 male moths were recovered.

In the fall of 2003, the STS action boundary moved into southeast Minnesota. This change did not have much impact on the management of gypsy moth in the state of Minnesota. What it does mean is that the gypsy moth front is nearing the Minnesota border and that the introduction pressure is likely to increase accordingly.

Overall, moth numbers were down substantially in the central and southeastern part of the state, making up only 107 of the total moths captured. The big surprise for the 2004 season was the record number of finds in Cook, Lake, and St. Louis County in northeast Minnesota (see map). These three counties had a total of 286 moths combined, with Cook County alone at 198 moths. With the record low temperatures throughout the months of June, July, and August (frost in parts of northeastern MN in August), it was expected that traps in northern Minnesota would also show a substantial decrease in moth numbers. That did not end up being the case. It is expected that in 2005, the STS action boundary will be expanded to include Cook and Lake Counties in northeastern Minnesota. However, for the first time since the area was trapped on an annual 1 mile base grid beginning back in 2000, there was some correlation between positive finds and delimit sites (sites with past finds), which suggests isolated introductions (which are easier to control) rather than the possibility of low density resident populations suggested by widely scattered single moth catches.

Several grid densities were utilized across the state to be consistent with past trapping protocols yet allow for a smooth transition into STS protocols and data collection. The STS action area was trapped on a 2-kilometer grid with several areas of concern receiving a higher density of traps. Areas outside the STS action area that were considered high-risk for the introduction and establishment of gypsy moth received traps on a 1500 meter grid similar density to the one trap per square mile (1/1) density that had been used in the past. Areas are considered high risk for the introduction and establishment of gypsy moth due to human activity levels, preferred habitat for gypsy moth, and the advancing gypsy moth front from Wisconsin. Areas designated high-risk included the seven-county Twin Cities metro area extending north through the city of St. Cloud, counties bordering Wisconsin in southeastern Minnesota including Fillmore and Olmsted county, and two quads inland from the shoreline of Lake Superior including the entire city of Duluth.

The remainder of the state received traps at one trap per four square miles (1/4) or 3-kilometer grid on a four-year rotation, with approximately one-third of the state receiving traps annually. The entire central half of Minnesota was trapped in 2004 including the counties of Benton, southern portion of Cass, Chisago, Crow Wing, Dodge, Douglas, Isanti, Kandiyohi, Meeker, southern portion of Mille Lacs, Morrison, Mower, Otter Tail, Pine, Rice, Stearns, Steele, Todd, and Wadena. All Municipalities within these areas received a higher trapping density of 1500 meters. In addition to the standard trapping densities, areas which had positive moths in the past received intensive trapping or delimit trapping at densities of 250 meter, 16 traps per square mile, 500 meter, or 1 kilometer to determine if a potential population exits.

Additional traps were set at state parks, mills, and nurseries within the standard trapping grid. Thirty-nine of Minnesota's 69 state parks were within the standard trapping grid and received 1-2 additional traps. Twenty-eight moths were caught in the state parks.

Mill and nursery trapping

Mills and nurseries were trapped according to risk of gypsy moth introduction. Nurseries either reporting stock sources from gypsy moth-quarantined areas, who are wholesale dealers, or who have a history of pest problems are considered high/moderate-risk, and received between two and twelve traps this year. One hundred seventy nurseries are considered high/moderate-risk. Outside the standard grid, MDA nursery inspection staff trapped five high-risk nurseries and no moths were caught.

High-risk mills throughout the standard trapping grid received two random traps. Mills are considered high-risk if it is known or likely that they have out-of-state sources or if they are within 60 miles of Wisconsin counties trapping fifty or more moths. There are 63 high-risk mills throughout Minnesota.

Mills that are high-volume pulp or veneer or have greater than 500 MBF annually are considered to be at moderate risk. Moderate-risk mills received two traps if they were in the 1/4 trapping grid. There are 80 moderate-risk mills throughout Minnesota.

Three mills are under federal Compliance Agreements for gypsy moth. A Compliance Agreement is designed to decrease the risk of gypsy moth establishment and allows mills to transport logs from gypsy moth-quarantined areas for milling or pulpwood. Mills under compliance are trapped on a 250-meter grid. One hundred seventy five traps were set at compliance mills. No gypsy moths were captured at these sites.

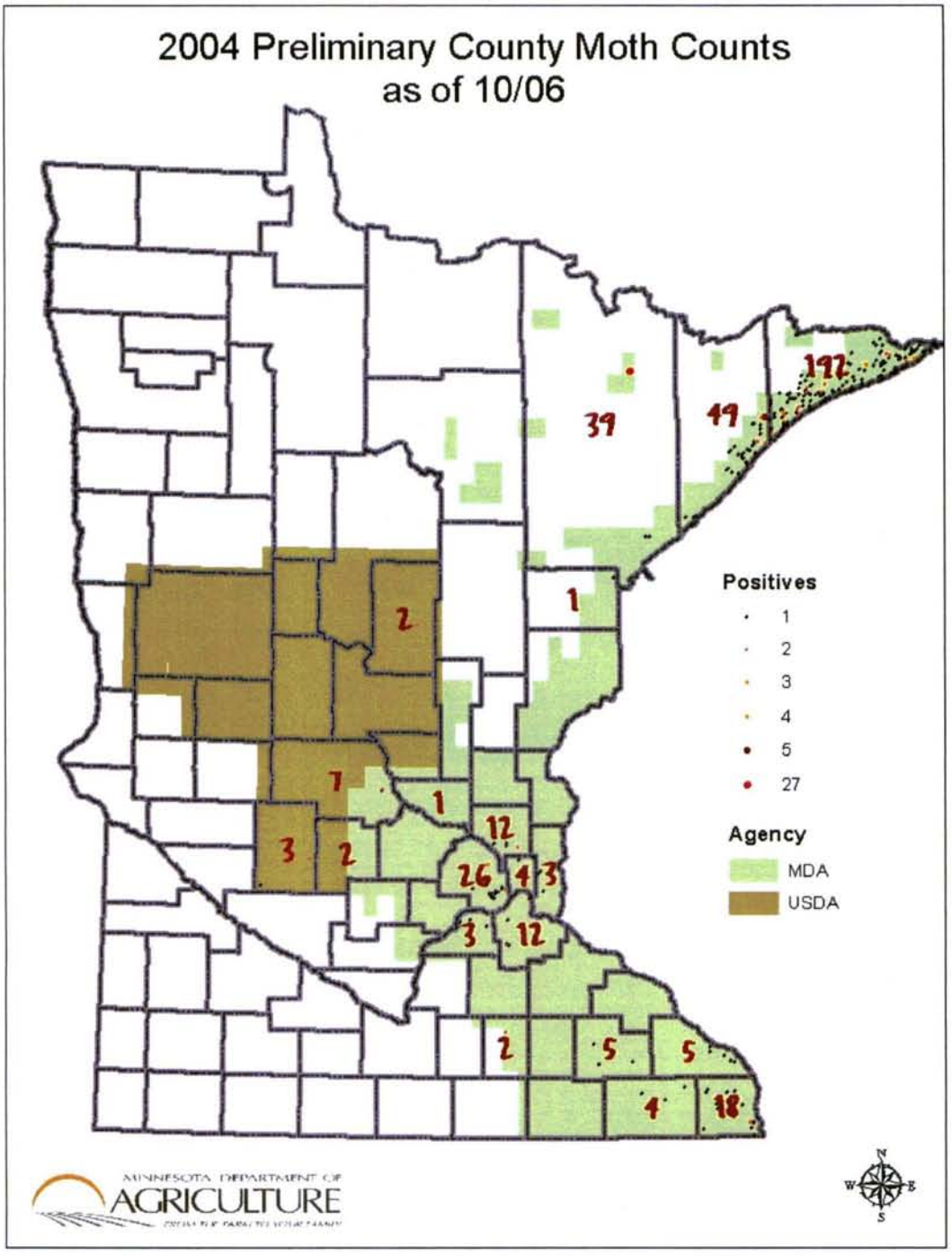
Trapping for Asian gypsy moth was conducted at the northern Minnesota seaports of Duluth (MDA). Any moths collected at the seaport or in St. Louis, Lake, and Cook Counties are sent to OTIS Laboratories for Asian gypsy moth DNA analysis. No Asian gypsy moths have been identified at this time.

USDA, FS trapping

The USDA, FS provided funding to MDA to trap all other National Forest land and Bureau of Indian Affairs land within MDA's standard trapping grid. Since 2002, a seasonal trapper conducted "hike-in" trapping along a predetermined 1/1 grid, 1500 meter in 2004 (as opposed to using available roads) for all of the Grand Portage Reservation in Cook County. One hundred seventeen traps were set on the Grand Portage Reservation, and 22 moths were caught in 19 traps. Ten traps were set on the Fond du Lac Reservation, and no moths were trapped. Nine hundred seventy nine traps were set in Superior National Forest, and 219 moths were caught in 153 traps.

Egg mass surveys

Only one site, north of Tower and one mile south of the Boundary Waters Canoe Area (BWCA) Wilderness boundary in northern St. Louis County, warranted an egg mass survey. The survey was conducted on October 26, 2004 and two egg masses were found at the site. There is a combination of forested landownership between Superior National Forest, St. Louis County, and the City of Tower. This site is being proposed for treatment with Btk in 2005.



General treatment program

In 2004, Minnesota conducted gypsy moth eradications at six separate locations across the state. Four of the six locations were regulatory sites (nursery operations) that had received quarantine breach material during the 2003 season. All four nursery operations were under state/federal compliance agreements, which required spring treatments in 2004. The other two sites were funded by state and federal cost share dollars.

Dimilin Treatments:

All four nursery operations conducted two applications of Dimilin, spaced 7-14 days apart. The first application was conducted on April 16, 2004 and the final application was conducted on May 8, 2004. The individual nurseries paid treatment expenses. After successful treatments were conducted the compliance agreements were removed. All four sites received intensive trapping during the 2004 trapping season and three of the four nurseries had positive gypsy moth finds.

Site inspections were conducted and no alternate life stages were found. No further regulatory action has been taken at this time.

Btk Treatments:
One site in the Edina area within the Twin Cities metropolitan area received two applications of Btk, spaced 7-10 days apart. This was a rather small site of less than 5 acres in size. Both applications were conducted by ground utilizing a hydraulic mist blower. This site was part of the 2002 Lake Harriet treatment delimit site and had been delimit trapped for three years, with an increase in trap density from 16 traps per square mile in 2002 to 36 traps per square mile in 2003. Twenty-two moths were caught in seven traps at this site, the largest number of finds at a single site for the 2003 season. During the egg mass survey, more than a dozen egg masses were found on two large, isolated oak trees. A USDA-FS trained tree climber assisted in removing between 30-40 egg masses from these two oak trees.

After the treatments, the site received mass trapping at 3 traps per acre and two male moths were caught at the far northeastern corner. This site will again receive intensive trapping in 2005 to determine treatment success.

Pheromone Flake Treatment:
One site in southeast Minnesota totaling 225 acres was proposed for pheromone flakes. This site has had a history of low gypsy moth finds since 2002. Moth catches increased from eight moths in one standard detection trap (1 per sq mile) in 2002 to 14 moths in five delimit traps (36 traps/sq mile) in 2003, indicating the likelihood of a reproducing population. No egg masses were located during follow-up egg mass surveys (Fall of 2002 & 2003), although this is not unusual in forested areas with low gypsy moth populations. Pheromone flakes were the preferred treatment option at this site due to location, the history of finds at the site, and the forested component.

The pheromone flake treatment was conducted on June 28 and was completed without incident. The aircraft flew into Minnesota from an airport in Boscobel, Wisconsin. The site received 15.2 grams active ingredient (disparlure) per acre. A total of 85 grams of flakes were applied.

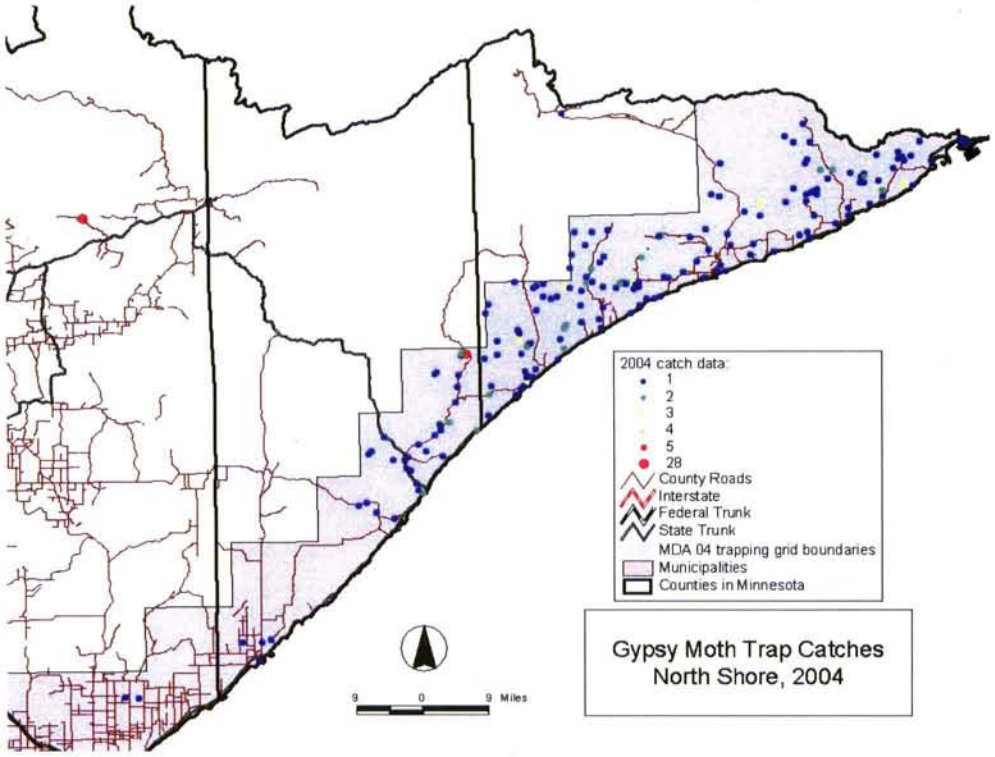
The site received follow-up traps in 2004 to ascertain that no male moths were caught in the pheromone traps (i.e., males are sufficiently confused by the amount of pheromone used that they are unable to locate the traps). No male moths were caught in these traps. Intensive trapping will be conducted in the summer of 2005 and 2006 at a density of 250 meters. This monitoring will determine whether the project was successful and whether there is a need for further action.

Future Outlook
Although, moth catches along the North shore were correlated to some extent with existing delimit sites, the large number of catches across a wide-area is a concern. Typically, isolated introductions that later become established produce a pattern of moth catches that increase in number over time around a focal point. The intensity of the focal point among a background of relatively few, if any moth catches, makes locating isolated populations much easier. A more or less uniform distribution of moth catches over a wide-area provides few clue as to the origin of the population. That kind of pattern suggests either a low-density resident population across the landscape or a 'moth blow'. A moth blow occurs when weather patterns pick up a large number of moths and either move them or drop them into another area. While the occurrence of moth blows has been debated, there is considerable evidence to defend the theory. For instance, early in the history of the Wisconsin infestation, trap data demonstrated two peaks in the timing of moth catches. These two peaks neatly corresponded to the timing of moth emergence in the few isolated populations within WI and to emergence in the larger MI infestation. Apparently, at least some of the WI moth catches were being blown in as adults from MI.

Along the North Shore, moth catches in 3 of the last 5 years were widely scattered across the landscape. The interim years saw few moth catches, so no clear pattern was evident (except around 1-2 delimit sites that were being closely monitored). The same pattern was seen in the early years of moth catches in Dorr County, WI. The question is whether the North Shore catches due to moth blow or a resident population. In Dorr County, even though moth blow was evident, there was also a resident population that dramatically increased in number in the mid 1990s. In that case, moth blow obscured the data, so the resident population wasn't evident until it had grown substantially. Could that be happening in the North Shore?

We don't know. The current data suggests moth blow is producing the pattern of moth catches seen along the North Shore. One piece of evidence to support that theory is the moth catch pattern in the Apostle Islands. This year, moth catches along Apostle Island shorelines were extremely high, while moth catches in the interior of the islands were quite low. If the moth catches were due to a resident population, you would expect to see uniform moth catches across the entire island and not just along the shore. Moths associated with the shoreline tend to suggest the moths were moving across the water and were

trapped by the first trap they came to. Given the high numbers of moths building on the mainland, moth blow makes sense to explain the patterns seen. But the STS scientists are carefully studying the data. That attention is the best part of being included in the STS action zone, because few in Minnesota have the experimental expertise to decipher these complex patterns (a plug to encourage the UMN to fill their vacant staff position in forest entomology).



The end result is that as the Wisconsin infestation moves closer, we don't know which will become infested first (if they aren't already), SE Minnesota or the North shore. Both are predicted to become infested sometime around 2007 or 2008. However, even after permanent infestations move into the state, we are likely to see many years before gypsy moth defoliation becomes an issue. So instead of panicking just yet, we ought to take the time to review the management status of those lands under our care and prioritize those at need of attention prior to gypsy moth arrival.

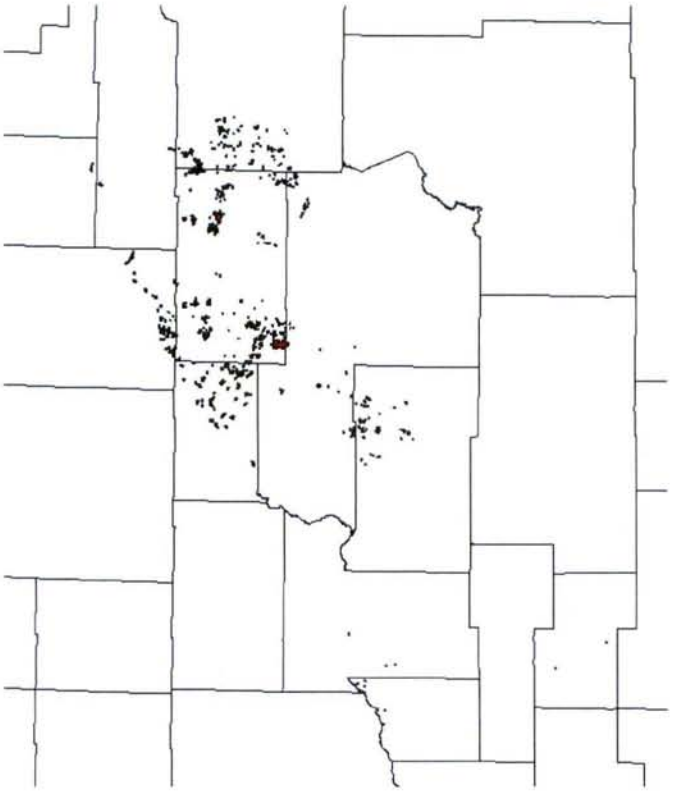
Jack pine budworm

Choristoneura pinus

Host:	Jack pine
Damage:	Defoliation, topkill, mortality
Area:	47,700 acres
Severity:	Trace to heavy
Trend:	Decrease

In July, more than 47,000 acres of jack pine defoliation were mapped in the west central counties. See map. The jack pines looked like they had been dipped in red paint as the effects of budworm feeding became apparent. Winds and rains eventually knocked off the red, clipped needles and by September, a calm and cool evaluation of JPBW defoliation could be done. By then it was easy to see how much green foliage was left to support the trees through next year's defoliation.

Many jack pine stands in Hubbard, Wadena, Becker and Cass and northern Crow Wing Counties suffered their first year of defoliation prompting foresters to wonder what next year will bring. The majority of this defoliation was rated as light in the aerial survey but looked quite heavy from the ground. Fall egg mass studies allow us to predict next year's defoliation potential, leaving ample time to identify pre-salvage operations.



Jack Pine budworm
Defoliation 2004

Defoliation levels	Acres
Trace	1000
Light	30,800
Moderate	7500
Heavy	8400
Total	47,000

In Beltrami and some parts of northern Hubbard County, this was the second year of defoliation for most of the affected stands. The vast majority of these stands (15,000 acres) will not be defoliated in 2005, because male flowers, necessary food for young caterpillars, won't be produced. State and county foresters have been salvaging dead and dying jack pine stands since this time fall of 2003.

Typically, outbreaks only last two to three years in any stand or location. A collective sign of relief could almost be heard in Bemidji Area, but other nearby areas were gearing up for stand evaluation and timber sale preparation through the winter. In these locations, both young and old stands suffered heavy to severe defoliation, leading to top kill. Fortunately, cool weather prevailed this summer preventing a bark beetle outbreak from developing in the defoliation-stressed trees.

Phenology:

6/10 Larvae 1/8 to 5/16 inch long, still in pollen cones. Pollen has already been shed. Brainerd, Crow Wing Co

7/13 Budworm all pupated but no moths have emerged yet. Brainerd, Crow Wing Co

7/28 Jack pine budworm moths covered side of building at Grand Portage monument in Grand Marais. There are no known jack pine budworm outbreaks in northeastern Minnesota prompting the question, where did these moths come from. Grand Marais, Cook Co

Jack pine budworm egg mass survey: Fall of 2004 Survey by Roger Hannigan					
County	**Location**	**Defoliation in 2004**	**Average number of egg masses per branch**	**Average DBH of trees sampled**	**Defoliation prediction for 2005**
Beltrami	SESE 36-148-35	2nd year, L	0.125	5	Light
	NENE 32-148-35	2nd year, M - S	0.375	7	Light
	NWSE 29-148-35	2nd year, L - M	0.675	9	Heavy
	SENW 29-148-35	2nd year, M- S	0.500	11	Light to Mod.
	NWNW 19-148-35	2nd year, very L	0.750	4	Heavy
	SESE 19-148-35	2nd year, very L	0.500	8	Light to Mod.
	SWNW 19-148-35	2nd year, very L	0.375	10	Light
	NWNE 31-148-35	2nd year, M - S	1.000	12	Severe
	NENE 3-147-35	2nd year, M - S	0.250	6	Light
	NWNE 3-147-35	2nd year, M - S	0.500	7	Light to Mod.
	SENE 3-147-35	2nd year, M – S	0.675	6	Heavy
	NENE 4-147-35	2nd year, L	0.125	6	Light
	SWSE 11-147-35	2nd year, M – S	0.675	9	Heavy
Hubbard	NWNW 15-140-32	2nd year, L	0.500	4	Light to Mod.
	SWSW 14-140-32	2nd year, M – S	0.375	9	Light
	NENE 23-140-32	2nd year, very L	0.125	6	Light
	NWNW 36-140-32	2nd year, M – S	0.125	10	Light
	SESE 34-140-32	2nd year, S	0.125	10	Light
	NWSW 34-140-32	2nd year, S *	0.125	9	Light
	NENE 28-140-32	2nd year, M – S	0.250	6	Light
	NENE 10-139-32	2nd year, M – S	0.675	6	Heavy
	SESE 11-139-32	2nd year, M – S	0.000	7	Very light
	SWSW 12-139-32	2nd year, M – S	0.125	7	Light
	SWSW 10-139-32	2nd year, S *	0.000	7	Very light
	SWNW 15-139-32	2nd year, S *	0.000	7	Very light
	SESE 9-139-32	2nd year, very L	0.375	4	Light
	SWNW 10-139-32	2nd year, S	0.375	7	Light
Becker	SWSW 9-142-37	2nd year, S	0.150	12	Light
	SWNE & NENW 9-142-37	2nd year, S	0.000	12	Very light

* = Topkill noted in trees on plots.

Jack pine budworm in red pine

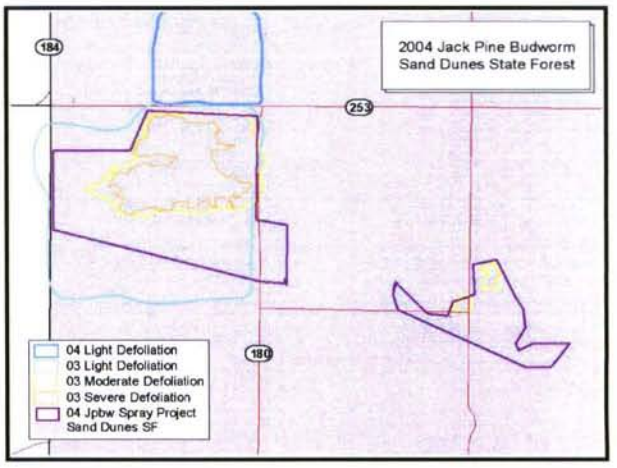
Due to an outbreak of jack pine budworm among red pine plantings in the Sand Dunes State Forest, 128 acres were treated this year with two applications of *Bacillus thuringiensis* kurstaki (Btk). While follow-up eggmass surveys have not yet been completed this fall, it is looking unlikely that additional treatments will be needed in 2005.

The outbreak was first discovered in July 2003. At that time, the damage had already been done and the adult moths were flying. In a 30Ac portion of the stand, the defoliation was severe enough to cause top kill of the trees. Because of the potential for a bark beetle infestation in the area, the area most severely damaged was cut the winter of '03-04. The rest of the stand was sprayed with Btk in June of 2004.

Spray boundaries were established based on an egg mass survey conducted in November, 2003 with the help of local forestry staff. Defoliation predictions are based on the average number of egg masses found on 15" branch samples (four

branches per tree and four trees per plot). Of the 21 plots sampled, egg mass counts indicated 8 plots were at risk of minor defoliation, 7 were at risk of moderate defoliation, and 6 plots were at risk of severe defoliation. Because these sites had already been defoliated once, the concern was that a second defoliation would greatly increase top kill among the residual trees.

Larval surveys were conducted in May 2004 to determine winter survival rates and to monitor the potential spray schedule. Six shoots on each of five trees were surveyed on fifteen plots to determine the presence and location of actively feeding larvae. Based on the literature, selected shoots were evenly divided among those with pollen cones and those without. The number of shoots with actively feeding larvae determines the estimated population size, where a sample of 20 infested shoots out of 30 shoots sampled suggests severe defoliation is likely. Survey results this spring indicated 4 plots were likely to experience severe defoliation, while another 4 were likely to see light to moderate defoliation. Because the cone crop was large this year and almost no larvae were found on shoots without pollen cones, there was some later concern that selecting shoots without cones may have significantly under sampled the population.



Informal larval surveys were also conducted through out the summer at a number of sites at up to 3 miles outside the proposed spray area. In all but one site, larvae were found, but in very small numbers.

Based on larval development, the first application would have ideally taken place the wk of June 7th. Because of heavy rains the first application was actually made on June 15 and the second application was made on June 2nd. Because of the delayed applications, light defoliation was noted across much of the spray area by the time the larvae stopped feeding. However, the treatment was deemed a success based on informal larval surveys completely on June 29th following the final application.

However, due to larval dispersal prior to the Btk applications, the stand immediately to the north of the 2004 spray project (see map) saw light to moderate defoliation. Unlike the stand that was treated this year, there had been no shoot moth in the northern stand and it seemed to be less stressed by the previous drought. The stand also seemed to be handling the defoliation this year fairly well. By early fall, secondary growth had largely covered the previous damage so that it could not be seen from the air.

Prior to the 2003 outbreak, the entire area had been under severe drought stress. That plus additional damage by pine shoot moths contributed to the level of top kill seen in 2003 and the increased risk of pine bark beetle attack. With the heavier than normal rains in 2004, much of that stress was relieved. The rains combined with the increased vigor of the younger stands currently infested means that treatments are not likely to be necessary in 2005. A smaller scale egg mass survey is planned for later this fall to confirm that assumption.

Larch casebearer

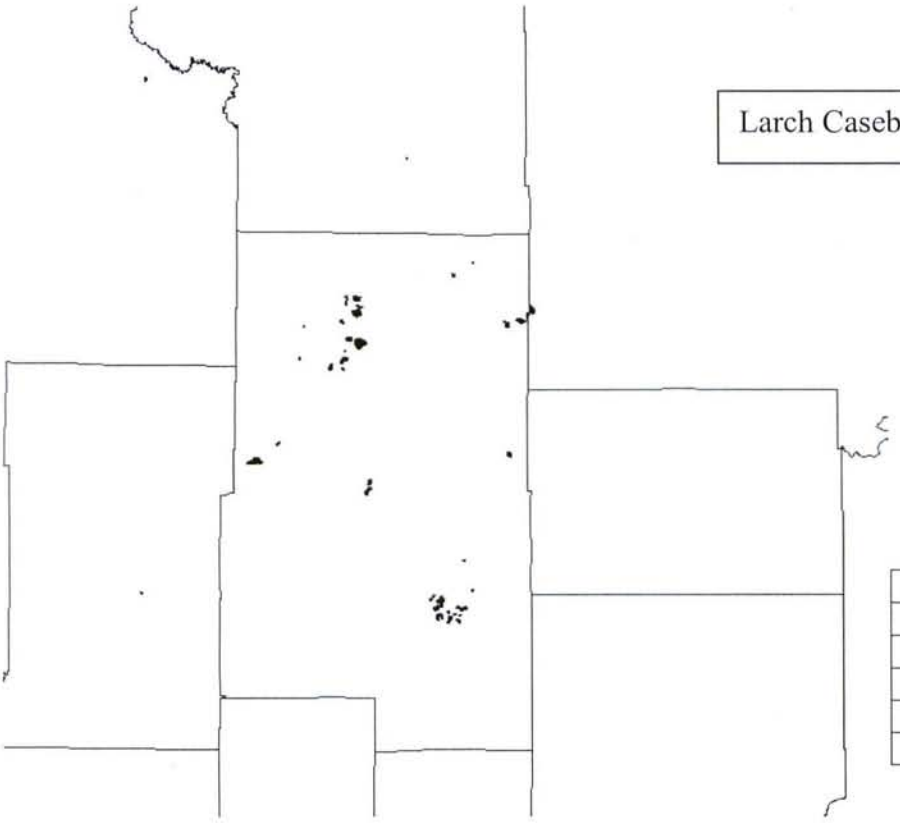
Coleophora laricella

Hosts:	Tamarack
Damage:	Discoloration, defoliation
Area:	6,700 acres
Severity:	Light and Moderate
Trend:	Unknown

Larch casebearer continued to cause noticeable defoliation on tamarack. The majority of acreage mapped on the aerial survey occurred in Aitkin County. Much of the tamarack being

defoliated is small diameter or stagnant and so far does not appear to be causing mortality. However continued repeat defoliations may cause enough stress to make stands susceptible to the eastern larch beetle. Significant casebearer damage started to show up in scattered pockets in Region 2 in 1999 followed by a large increase statewide in 2000 and has continued every year since then. In the 20 years or so prior to that it was only reported occasionally on a few scattered trees. Larch casebearer is an exotic pest that has been in North America since the 1880's. It is considered a serious defoliator of larch species both exotic and native.

A number of species of parasites have been imported from Europe, two of which are now widely established. They are believed to be effective in reducing the severity of outbreaks. In a collection of tamarack from the Aitkin area in 2001, 90% of the parasites recovered were *Agathis* while in a collection from Beltrami the other imported parasite, *Chrysocharis* was most abundant. Imported as well as the native parasites and predators are expected to buildup to high enough levels to eventually bring the outbreak to an end eventually.



Defoliation level	*Acres*
Trace	7
Light	2572
Moderate	3458
Heavy	698
Total	6735

Multi-colored Asian lady beetles

Harmonia axyridis

Few complaints about these exotic lady beetles were received this year following many complaints in 2003. The summer of 2004 was much colder than normal.

Spruce beetle

Dendroctonus rufipennis

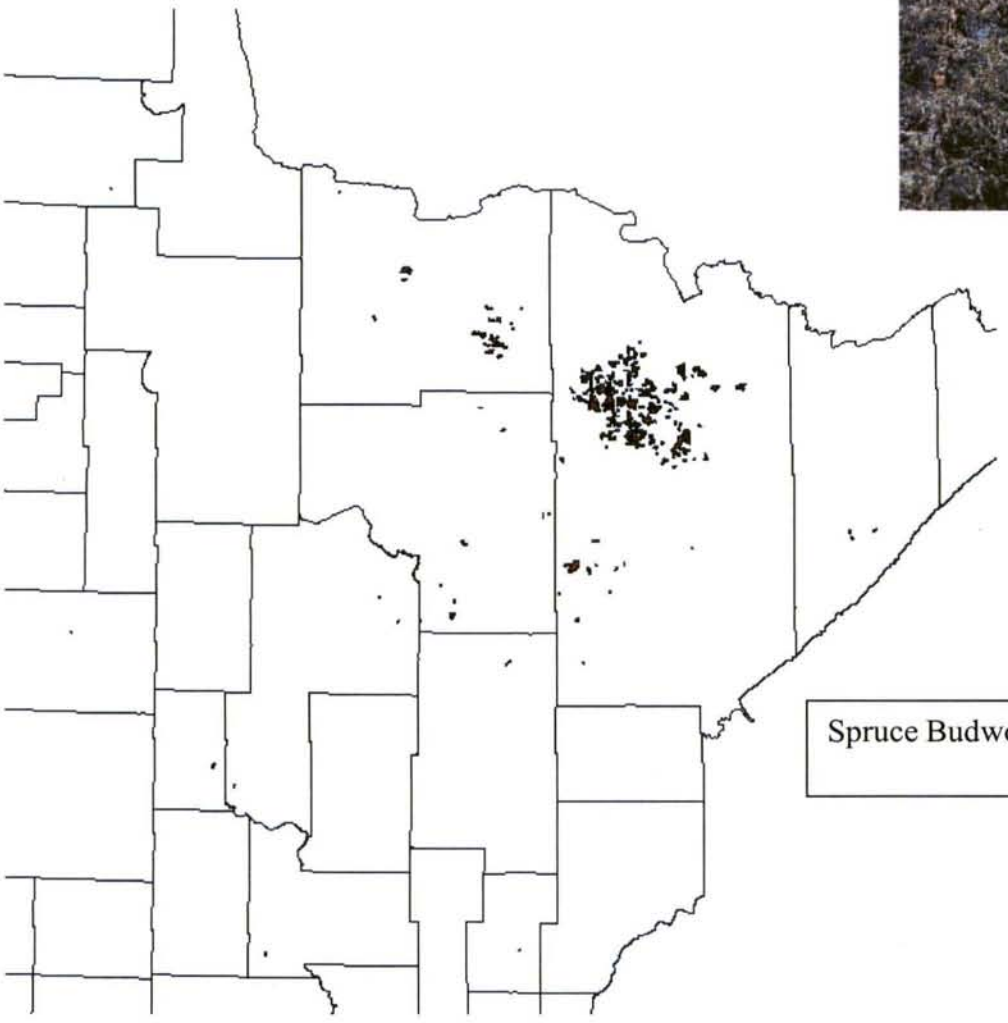
No surveys specific for spruce beetle were conducted this year. No reports of new locations were received.

Spruce budworm

Choristoneura fumiferana

Host:	Balsam fir and white spruce
Damage:	Defoliation, topkill and mortality
Area:	83,200 acres
Severity:	Trace to heavy
Trend:	Increase

For the last fifty years, spruce budworm has been active somewhere in Minnesota. Currently, the main population center is in northern St. Louis County. Between 2003 and 2004, the number of defoliated acres has risen four-fold to 83,200 acres leading to the speculation that the population is on the rise again.



Spruce Budworm Defoliation 2004

White spruce plantations in the white spruce thinning study were ground surveyed in the fall of 2004 for defoliation levels. Results are presented below:

Plantation name	Location	Defoliation
White spruce alley	S21-T64-R21, ST Louis	0 defoliation on all plots
Warba	S23-T54-R23 Itasca	0 defoliation on all plots
Power line	S36-T155-R25, Koochiching	0 defoliation on all plots
Johnson Landing	S28-T65-R26, Koochiching	0 defoliation on all plots
Plantation Road	S24-T149-R27, Itasca	0 defoliation on all plots
Larson Lake Salvage	S16-T61-R24, Itasca	40% defoliation on plots R1 and R2 20% defoliation on plots R2, R3, T1, T2, T3, T4
Sam Welches Corner	S12-T147-R30, Beltrami	0 defoliation on all plots
White Township	S36-T57-R15, St Louis	0 defoliation on all plots
Smith Creek	S12-T53-R26, Itasca	80% defoliation on plots T1, T2, and T3 70% defoliation on plot R1 60% defoliation on plots R2 and R3
Aitkin County	S8-T52-R25, Aitkin	0 defoliation on plotsR1, R2, R3 T1, and T3 5% defoliation on plot T2
Taconite Trail	S36-T60-R23, Itasca	0 defoliation on all plots

Phenology:

6/8 Larvae ¼ inch long on balsam fir and white spruce in S22-T60N-R20W app 13 miles north of Chisholm on Hwy 73, ST Louis Co

6/18 Larvae 5/8 to ¾ inches long, S6&7-T51N-R23W Ball Bluff, Aitkin Co

6/21 Larvae ½ to 5/8 inches long, S12-T53N-R26W Smith Creek Rd., Itasca Co

6/22 Larvae 5/8 to 7/8 inches long, S35-T63N-R20W, 2 miles west of Jct 53&73, St Louis Co

6/24 Budworm pupating, S12-T53N-R26W, Smith Creek Rd, Itasca Co

Two-lined chestnut borer

Agrilis bilineatus

Oak mortality caused by drought stress and two-lined chestnut borer activity continued this year but at a much lower level than in the past two years. Weather seemed to be the driving force. Precipitation was higher than during the past two years but was still below normal in some locations. For example, for the period of April 1st to August 31st, Grand Rapids received only 60 to 70 % of normal precipitation. Grand Rapids normally receives around 4 inches of rain in June but was over 3.2 inches short this year. Temperatures were also below normal, which reduced evaportranspiration, ultimately reducing the trees' moisture stress. The cool weather also slowed the development of the TLCB larvae.

During a hot and dry summer, sudden wilting of branches and entire trees starts during the last week of July. Wilting occurs at that time because the larvae have grown large enough so that the diameter of their galleries cuts

through the entire width of the current year's growth ring. This cuts off almost all of the water supply above the gallery so the leaves wilt and die. By the end of July this year, most of the larvae were still too small to cut through the entire growth ring and cut off the trees' water supply.

In order to study the flight period of the adult two-lined chestnut borer, adults were trapped in an oak stand near Grand Rapids. Half-gallon paper milk cartons were cut open and nailed to red oak trees. The surfaces of the milk cartons were coated with tanglefoot. Six traps were set out on June 7th. Adults were counted and collected on a weekly basis. Traps were removed on August 17th because the stand was being salvage logged. Results are listed below.

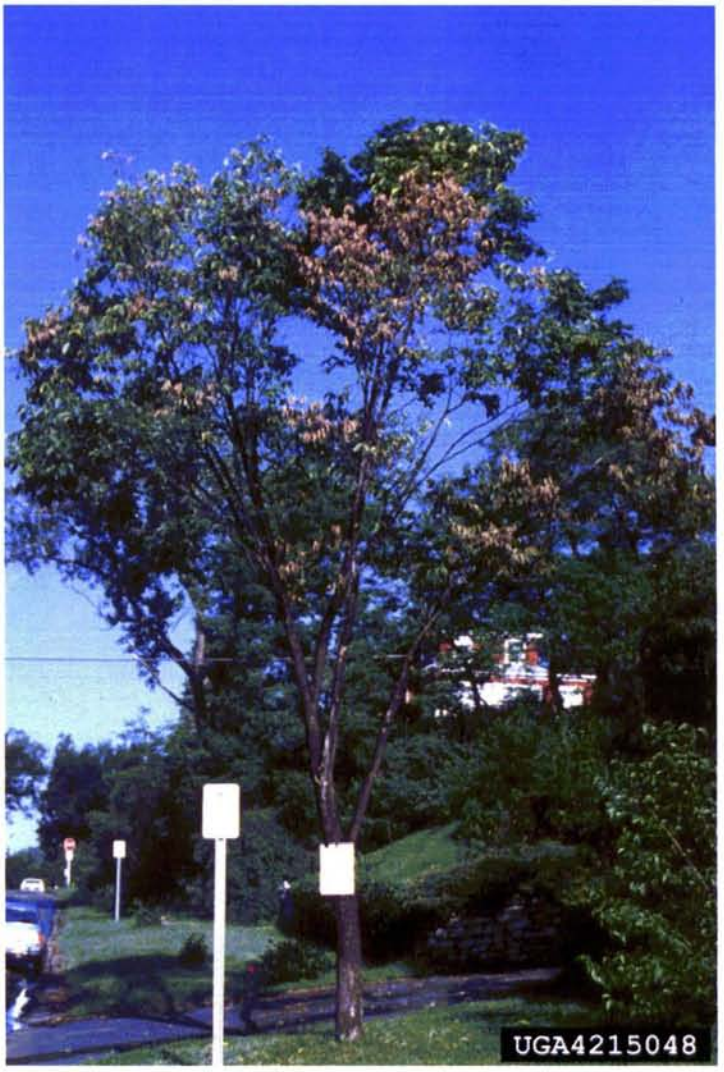
June 14th – 1 adult trapped
June 21 – 4
June 28 – 28
July 5 – no collection made
July 12 – 105 (two week period)
July 19 – 147
July 23 – 54
August 2 – 19
August 10 – 13
August 17 – 2

It's likely that a few adults were active before the traps were set on June 7th and also after the traps were removed on August 17th. The trapping appears to have covered most of the adult flight period including the peak. The flight period likely occurred later than normal this year due to the cooler than normal spring and summer. It appears that the safest approach in a normal year would be to cover firewood piles from mid to late May to the end of July or early August. This year, it was likely that the piles would have needed to be covered for the whole month of August.

Hopefully normal levels of rainfall and snow cover will continue, drought stress will diminish and this outbreak will finally be over.

Diseases

Dutch elm disease



According to Minneapolis records, 2004 was the third worst year in history in the number of trees lost (over 8000 trees marked by mid August with the season yet incomplete). Only 1977 and 1978 saw more elm trees cut down - a total of 20,823 and 13,668 lost to Dutch elm disease (DED) during each of those years. So is Minneapolis an exception, or is DED truly on the rise? To help describe disease occurrence and community responses, a brief survey was conducted in central Minnesota. The survey points out that after several years of steadily increasing numbers of infected trees, 2004 saw a decided jump in the occurrence of DED.

The survey was sent to 194 communities in central Minnesota, including all incorporated cities and many townships. Of the 71 who responded (36.5%), 42 said they actively try to manage DED and reported the number of trees lost over the last 4 years. Excluding Minneapolis and St Paul, the respondents reported 18,013 trees cut down or marked for removal as of mid August. Several communities reported they were still marking an average of 20-30 trees per day, adding an estimated 1000 trees infected by the end of the 2004 season. This compares to a total of 9560 trees cut in 2003, an increase of almost 100% by the end of the 2004 season. In 2002 and 2001, 5674 and 4204 trees were cut down respectively, increases of 68% and 35% during those years. Clearly DED is on the rise!!!

Contributing Factors

Without the time and means for scientific study, community staff rely on observation and professional judgment to describe factors influencing the disease incidence in their area. While the responses varied, weather patterns and sanitation practices were most commonly cited as key factors in the current outbreak. One specifically said weather patterns were not involved and two specifically said the level of sanitation was not involved in the current outbreak. Other factors contributing to the outbreak that were commonly mentioned include insufficient staff and/or funds to manage local programs, lack of public awareness and/or interest in disease management, and an increase in the number of volunteer elms (mostly Siberian) in unmanaged areas. Two communities with active programs reported no increase in disease incidence.

Sanitation

The costs associated with disease management in native parks and woodlands make it impractical, so few communities address the large reservoir of beetle-infested wood these areas often contain. Sanitation of infected ornamental trees (i.e. street, park and privately owned yard trees) may also be inadequate even in communities with active programs. Once city staff mark diseased trees, private landowners may not remove them. City ordinances may not contain the language necessary to enforce compliance. Or the program may not have the staffing necessary to follow through on compliance. For instance, seasonal staff may be laid off before private landowners have carried out ordered tree removals, so the trees are left standing until the following season. Another problem is the number of townships and/or communities without either an ordinance or the staff to carry out a disease management program. These areas can maintain large reservoirs of infested trees that can contribute to high rates of disease in the surrounding area. This can make it difficult for conscientious communities to stay on top on local enforcement.

Another factor contributing to the current incidence of disease is confusion about the need to manage Siberian elms. Siberian elms are more "resistant" to DED infection than American elms; so many communities tend to ignore them.

Others confuse Siberian elms with Chinese elms, which rarely get DED, so attribute disease symptoms to some other problem. The end result is DED infected Siberian elms that are left standing to further contribute to the reservoir of beetle-infested wood. Because Siberian elms readily reseed themselves creating a large pool of volunteer trees, they can greatly increase the number of trees susceptible to infection, even though they are less susceptible than the remaining American elms.

Weather patterns

Three of the last four years have seen late season droughts that have stressed trees going into the winter. Three of the last four years have seen mild winter temperatures that may have increased the survival rate of over-wintering beetle populations. And two of the last four years have seen little if any snow cover. The winter of '02-03 in particular had a huge impact on tree health. Drought the previous summer left soils extremely dry and water levels dangerously low going into the winter. Prolonged cold spells and no snow cover drove frost lines far below normal. Many tree species; ash, hackberry, catalpa, honey locust and elm among them, showed signs of severe stress the following spring. The symptoms among elm included late leaf-out, small undersized leaves, sparse crowns, poor color, reduced growth and heavy seed crops. The results of a case study reported in 2003, showed 60% of the trees surveyed showed some signs of winter injury, while 9% showed signs of DED. At the time, the obvious question was how the current levels of stress were going to impact the future incidence of DED. This year, we found out. The incidence of DED in the area surveyed for winter injury in 2003 more than doubled in 2004.

Over-wintering beetle populations may be paying a large role in the current outbreak. Increasingly lax sanitation in many areas has increased the number of dead standing elm trees available as brood wood for the beetles. The mild winters have likely increased the survival rate. The combination has likely increased the population as a whole looking for suitable material for maturation feeding and reproduction. The large population of stressed elms seems to have met that need. The combination may well have led to the current outbreak.

Wood disposal

A third factor mentioned by only a few survey respondents, but frequently observed by DNR staff, is the question of proper wood disposal. A lack of staff and/or funding to enforce compliance, a lack of suitable disposal sites and a general lack of understanding among landowners and firewood dealers are contributing to the storage and/or distribution of diseased wood. Particularly this year, when there is such an abundance of infected wood and limited means to dispose of it, landowners are struggling to find appropriate solutions. City staff are barely keeping up with large increase in tree removals so are giving scant attention to the accumulating piles of infected wood. The likely result will be the continuation of high levels of disease over the next few years.

Local Program Needs

Back to the community survey - how well are communities addressing the current outbreak? Of the 71 survey respondents, 24 communities employ full-time staff to manage their treed resources and 28 employ part-time or seasonal staff. A few communities employ both full and part-time staff. An additional 5 communities contract community tree care and technical assistance for area residents out to local professionals.

Forty-nine communities have tree ordinances on the books governing disease management, 41 of which specifically mention infected wood disposal. Forty-five provide technical assistance to area residents, 16 provide wood disposal and/or composting facilities for use by area residents and seven provide financial assistance to help manage diseased trees on private property.

Eighteen communities said staff and funding levels were sufficient to carry out needed disease management prior to the current outbreak. That number went down to 12 with the disease incidence seen this year. Staff and funding for normal maintenance and other public works projects were being diverted to cover tree removal needs in those communities with insufficient funds. Other program needs are described below.

Community needs to meet the demands of disease management:

	Not needed	Some need	Strong need	Critical need	Left blank
Enhanced grant writing skills	25	27	7	3	9
Sample forms, handouts or help creating local publications	19	31	9	4	8

	Not needed	Some need	Strong need	Critical need	Left blank
Sample tree ordinances or help drafting local legislation	33	19	6	3	10
Larger pool of licensed contractors	35	17	7	4	8
Larger pool of trained seasonal employees ready for hire	31	15	8	8	9
Staff and/or city council training	19	29	13	2	8
Tree or natural resource inventory/assessment	15	20	24	4	8
Natural resource planning	22	19	18	3	9
Other, please list: one mentioned research on and the implications of population and disease dynamics among Siberian elms					

Outside resources available for community use:

	Used regularly	Used occasionally	Aware of, but not used	Not aware of	Left blank
District Energy wood chip acquisition/utilization	3	4	17	37	10
MN Releaf grants opportunities*	16	9	16	21	9
County solid waste disposal facilities	8	15	16	22	10
County financial aid programs for local residents**	3	4	9	45	10
UMN on-line technical assistance	4	23	17	17	10
MNSTAC on-line technical assistance	2	11	21	23	14
On-line list of certified arborists	5	13	25	19	9
Regional DNR Forest Health Specialists	2	32	20	10	7
MDA and UMN diagnostic services	10	22	15	14	10

* Only 2 communities used MN Releaf funds for DED management. The remainder of those utilizing MN Releaf funds use them for oak wilt management and not DED.

** In the area surveyed, only Hennepin county is currently known to offer financial assistance to private landowners facing an undue burden due to forced tree removals.

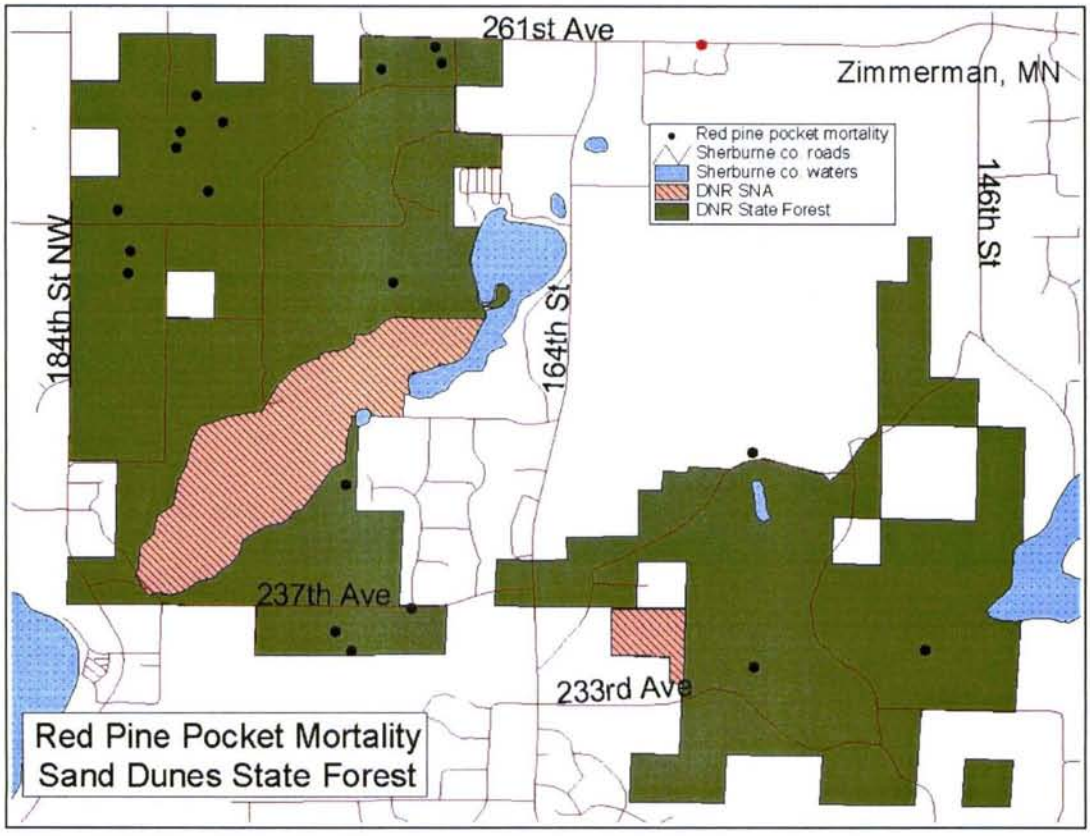
Clearly local communities need help in educating their residents and their council members. They need innovative ways to address disease management during times of tight budgets. Area residents need technical and financial assistance to deal with the burden of forced tree removals and wood disposal.

The needs of the last serious outbreak during the 1970's fostered renewed interest in our urban forests, which resulted in the birth of many local programs. It may be time to revisit those efforts, take what we can from those lessons and rekindle the cry for enhanced protection of our urban and community treed resources.

Red pine pocket mortality

Leptographium and vectoring insects

With the help of the UMN Plant Disease Clinic, *Leptographium* spp. (most likely *L. procerum* based on morphological characteristics in culture) was confirmed to be present on two of several sites being monitored in Sherburne County. A total of nineteen sites on the Sand Dunes State Forest ranging in size from one to five acres, plus four sites on nearby private land have been identified with symptoms of a syndrome called "red pine pocket mortality". The syndrome, fairly common in Wisconsin, has been reported in MN before, but has been limited to isolated cases. The abundance of these pockets within relatively close proximity to each other is new to the state.



The progressive symptoms of tree decline include reduced growth, poor color, dieback or red tops and wood staining. Signs of insect attack can also be seen, including pitch tubes, frass, exit holes and galleries. A typical pocket has a few dead trees at its center, surrounded by a rough circle of live trees in varying stages of decline. Pocket boundaries expand over time as more trees become affected and the symptoms spread outward. Only red pines seem to be affected even when white pines are grown in close proximity, as when rows of red and white pine are planted in alternate rows across the plantation. The following images were taken in Wisconsin

The affected stands range in age from 22 to 59 years of age, with all but three stands over 40 yrs old. All but one stand saw some sort of disturbance (all but three in the last ten years), due to one to multiple thinnings, or damage due to flooding, storm damage, off-highway-vehicle (OHV) traffic, or pine bark beetles. The entire area also suffered severe drought during three of the last five years and widespread storm damage in '97 and '98. While red turpentine and *Ips* pine bark beetles can be found on these sites, not all trees show signs of insect damage. However, most of the affected trees demonstrate some form of wood discoloration; black streaks, butterscotch colored areas and areas soaked with resin.

As described in Wisconsin, *Leptographium* are a group of opportunistic fungi spread by insects attracted to stressed trees. Red turpentine beetles, Ips pine

bark beetles, pitch eating, root collar and root tip weevils are all known vectors of *Leptographium* spp. Wood staining can often be found extending downward just below the point of insect attack. While not known to kill trees on their own, *Leptographium* spp. can move into the roots and then from tree to tree through root grafts contributing to disease spread..

Leptographium spp. are not fully understood, nor is the exact relationship between the various species of fungi and their insect vectors. One possible relationship was described in Wisconsin by Klepzig et al., in 1991: 1) *Leptographium* spp. are introduced into a new site by root or lower-stem feeding insects, 2) fungal root invasion and subsequent death of increasing numbers of roots leads to reduced tree growth and stress, 3) increasing levels of stress (increased by weather patterns and other disturbances) attract a community of opportunistic insects, many of whom serve as vectors for the fungi, 4) dead trees and stumps provide suitable habitat for reproduction and insect populations increase, 5) the combination of continued fungal root invasion and insect feeding expand the pocket of mortality over time.

Storm damage, thinning operations, drought stress and certain site conditions are correlated with tree mortality and pocket expansion, but the relationships are not well understood. Because of that and the community of interacting species involved, there are no concrete management recommendations at this time. Treatment methods being tested include 1) vibratory plowing, removing all trees within the plow lines and 2) clear-cutting affected pockets with varying buffer widths, often a full tree length. Whether or not it is possible to stop pocket expansion is not known. But even if stopping disease spread is not possible, it seems feasible to cut the pocket along with a buffer wide enough to match the distance of likely spread between now and the next thinning. Doing so limits additional entries while utilizing the affected trees before they deteriorate.

Because Minnesota has seen so few areas affected by red pine pocket mortality, none of the treatment methods have been tried here. The number of pockets on the Sand Dunes S.F. provides an opportunity to try and compare several methods of control. The details have not yet been worked out, nor the funding obtained, but the current plan is to explore and implement a trial comparing the two experimental treatment methods with no treatment across a range of sites.

Sphaeropsis collar rot in nursery seedlings

Until the late 1990's, the prevailing pathological dogma was that if there were no shoot blight infections in the nursery seedbeds, then there were no *Sphaeropsis* infections of the seedlings. That belief was turned upside down by the work of Glen Stanosz's lab at the University of Wisconsin. Stanosz and co-workers found that there could be Sphaeropsis infections without and symptoms. *Sphaeropsis sapinea* is a "latent pathogen". A latent pathogen has three attributes:

- The pathogen can persist in the host plant in the absence of symptoms.
  Sphaeropsis creates structures called "hyphal bundles" in needle stomates or in the bark surface without any disease reaction or symptoms being expressed.
- It has a prolonged, host-induced quiescence.
  As long as the seedling is vigorous, latent *Sphaeropsis* infections do not occur. Even after outplanting, latent infections in red pine seedlings can persist for as long as seven years.
- The pathogen can be released to cause disease symptoms as a result of a physiological change in the host.
  Sphaeropsis infections are released by internal water deficits in the red pine seedlings. In fact, the incidence and severity of symptoms are directly related to soil moisture deficits.

As it fate would have it, in the spring of 2002, Dr. Stanosz decided to sample all the Mid-western nurseries to document the incidence of latent *Sphaeropsis* infections in red pine seedlings. We were certain that Minnesota's nurseries would be fairly clean. See dogma above.

Here's where the karma comes in:

- Northern Minnesota experienced a significant drought in 2002, especially during the planting season.
- By mid-July, losses in newly established plantations averaged an unprecedented 55%.
  Lab examinations showed that these losses were due to *Sphaeropsis* collar rot infections.
- In late August, we learned that Badoura Nursery had 18 and 88% latent infections at the two sample locations.

Not only did we have *Sphaeropsis* in our Nursery, but we were also in the midst of an epidemic. Bad karma.

Our best course of action was to eliminate the sources of the primary infections in the Nursery by removing the overstory red pines. In the winter of '02-03, Badoura Nursery removed 1250 cords of red pine windbreaks. These removals would have an impact, but not immediately. Seedlings that were alive in 2002, prior to the removal of windbreaks, had already been exposed to *Sphaeropsis* and were likely infected. Nursery managers also reinstituted fungicide spray regimes and rogued seedbeds regularly among other actions.

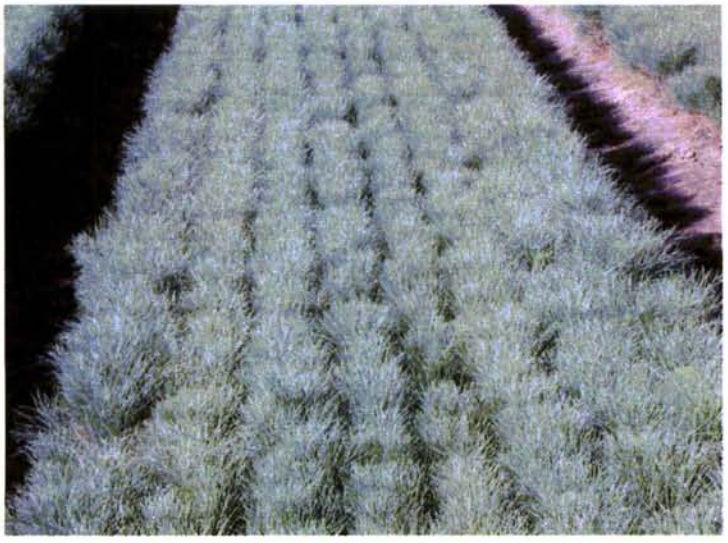
In 2003, a systematic survey of the entire 3-0 red pine crop was done. Dr. Stanosz's lab found averages of 40 to 71% latent infections in the red pine fields. So, the entire crop of two million seedlings was rejected and destroyed.

In 2004, we anticipated a drop in disease levels because these seedlings had emerged after the windbreaks were removed. This summer, another systematic survey of the 3-0 red pine crop was done and latency levels were determined by Dr. Stanosz's lab. We were delighted to hear that less than 3% latent infections in the nursery beds were found at Badoura Nursery.

Two surveys were completed at Badoura Nursery and a single survey was conducted at Gen. Andrews Nursery in 2004. All seedlings were sampled in a systematic design and were assayed for the presence of *Sphaeropsis sapinea* by Dr. Stanosz's lab at the University of Wisconsin.

Results of *Sphaeropsis* studies at State Nurseries in 2004

Location	Sample / results dates	Seed-bed	Seedling age	Number of seedlings sampled	Percent latent infections	Notes
Badoura	May 17 / Sept. 1	F-5, F-8, F-9, F-14	2-0	233	2.58	Emerged after windbreak removal.
Badoura	Aug. 4 / Nov. 16	C-10	3-0	80	10.0	Not rogued.
		C-2	2.5-0	80	36.2	Emerged before windbreak was removed.
		F-2	2-0	20	0.0	Rogued once. Sprayed.
General Andrews	Aug. 3 / Nov. 16	G-1	3-0	81	40.7	Emerged before windbreak removal. Sprayed and rogued.
		B-9	2-0	90	7.7	
		B-11	2-0	9	11.1	



Abiotic agents and declines

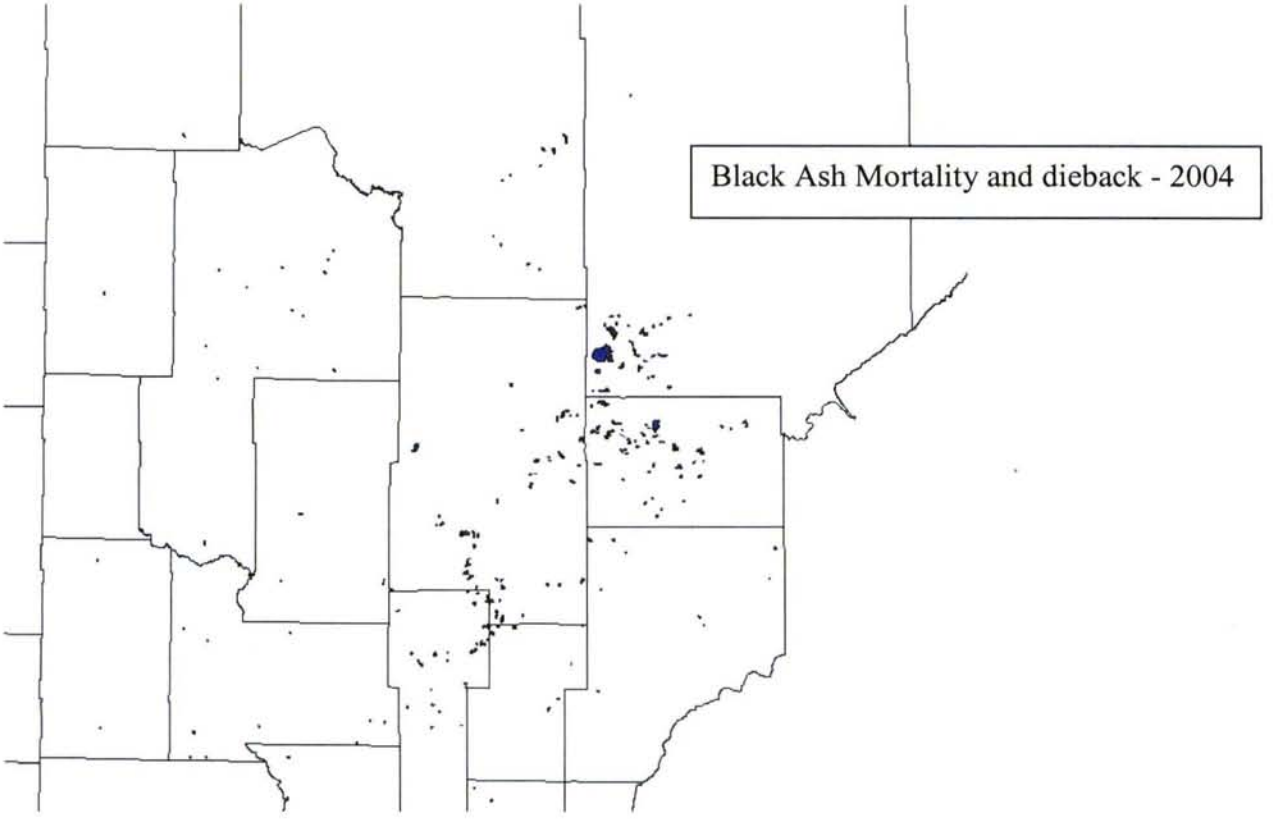
Black ash decline

Causes unknown

Hosts:	Black ash
Damage:	Mortality and dieback
Area:	27,000 acres
Severity:	Variable
Trend:	Increase

Black ash, along the roads commonly looks bad, but in 2004 a lot more were showing serious dieback and mortality. The worst of it appeared to be in a swath running through Mille Lacs County up through Aitkin, western Carlton and into southwestern St Louis County, but scattered amounts occurred outside these areas. And while many stands looked poor, there were often many stands of healthy and vigorous looking ash nearby. The first question that came up was "Is it emerald ash borer"? The simple answer was no, it is not emerald ash borer. There is no evidence that emerald ash borer was involved. Emerald ash borer has not yet been found in Minnesota or anyplace west of Lake Michigan. Of course that could change at any time, so it is important to remain on the alert for it.

Right now the problem appears to be physiological and weather related. Recently we have had a winter with no snow cover resulting in deep frost and much colder than normal soil temperatures possibly causing some root damage along with drought, a late cold spring, and a cool summer.



In an effort to determine the cause of dieback, DNR Forest Health staff examined a number of stands and cut down and examined trees in 5 or 6 of them. See list below. Northern ash bark beetle was found on one tree and Armillaria on another, but so far, no insects or fungi have been found to be consistently associated with the declining trees. The trees produced a healthy set of buds in the fall of 2003 and looked as if they just didn't break bud in the spring of 2004. By mid-summer the cambium was brown and fermented in the branches and upper stem of the trees, usually without evidence of any boring insects. Some trees were entirely dead. The entire crowns of many other trees appeared dead, but most were producing epicormic branches on the lower trunk.

A similar episode of ash dieback and mortality occurred in the early 1990's. At that time forest health staff examined 37 stands of ash along a transect in eastern Aitkin County. Results were reported in the 1995 Forest Health Annual Report and also in the Winter 1996 Forest Insect and Disease Newsletter. Here's a brief summary: No insect or diseases were consistently associated with the problem. Ash growing in areas with a flow of water through the stands were generally healthy. The worst damage occurred in ash growing in closed depressions. During wet years, water collects in these closed depressions and can't flow out. The ash roots grow very shallow in these waterlogged soils. It was thought that when drought hits, these ash trees are unable to draw water from lower in the soil profile because of the shallow root systems, become stressed and dieback.

Further investigations need to be done to better explain and understand the current problem and also to help answer questions about how to manage these stands and how to avoid or reduce these problems in the future. In the mean time, it is too early to give up on your black ash.

Black Ash stands examined in July and August 2004

West of Tower along Hwy 169 – Only a few very small twigs with foliage rest of crown dead, buds look normal but dead, cambium on trunk moist and milky white around the entire circumference of the tree.

Sec 32-T52N-R26W Aitkin Co Some trees show dieback others appear healthy.

NENE Sec 21-T52N-R26W Aitkin Co Healthy stand has pockets of sphagnum moss.

Sec 28-T49N-R22W Aitkin Co north of Tamarack -Northern Ash bark beetle in branches. Epicormics on stem, buds look normal but are dead.

NENE Sec 4-T48N- R21W Carlton Co north of Wright - Unidentified phloem borer in branches. Some trees have dead crowns with epicormics on trunk others have a few live twigs in crowns. Buds look normal but dead. Cambium turning brown and fermenting.

SWNW Sec 5- T 48N-R19W east of Cromwell - Armillaria in root collar, epicormics on trunk, crown dead, buds look normal but dead

NWNW Sec 5-T48N-R19W East of Cromwell – Epicormics on trunk and a few live branches in crown, some evidence of bark beetles.

Sec 22-T51N-R21W SW of Floodwood - Crown dead only a few epicormics low on stem, no evidence of insects or diseases. Cambium turning brown and fermenting.

Aspen Mortality and Dieback

Host:	Quaking aspen
Damage:	Mortality and decline
Area:	27,500 acres mortality
	22,900 acres decline
Severity:	Trace to Light
Trend:	Increase

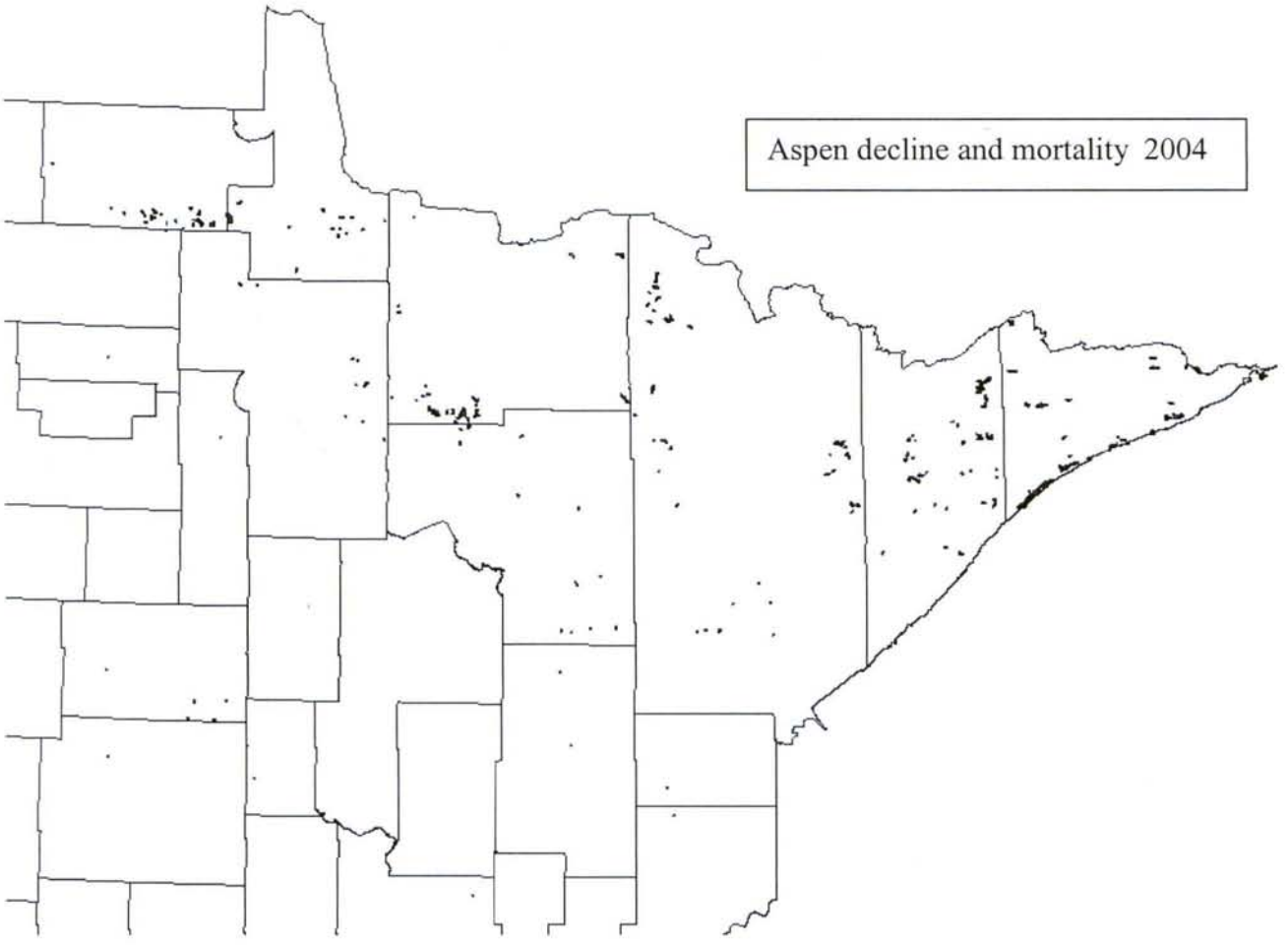
Aspen mortality were mapped by the aerial survey on 27,500 acres and dieback were reported on an additional 22,900 acres. Most of the damage levels were listed as trace or light. The mortality is likely related to forest tent caterpillar defoliation and possibly also to drought stress. In stands examined on the ground, many of the dead aspens had Hypoxylon cankers on the main stem. Hypoxylon cankers have been reported to increase during tent caterpillar outbreaks. These reported increases are likely due to an increase in populations and activity of insects producing wounds on the aspens that serve as infection courts for Hypoxylon canker. Some of the perceived increase may be a result of defoliation stress

allowing Hypoxylon cankers to kill trees quicker resulting in more trees dying during the years immediately following a forest tent caterpillar outbreak. Armillaria root disease was also likely involved. Stress from drought and defoliation is known to increase Armillaria root disease in stands leading to decline and tree mortality. While the acreage involved is quite large the number of trees was generally small often involving only a few trees per acre in the ground truthed stands. As long as the defoliation and drought abate it will hopefully be unimportant in the long run. See map.

Aspen mortality levels *	Acres
High	158
Moderate	132
Light	10,946
Trace	16,315
Total	**27,551**

Aspen Dieback levels *	Acres
Moderate	335
Light	7114
Trace	15,472
Total	**22,921**

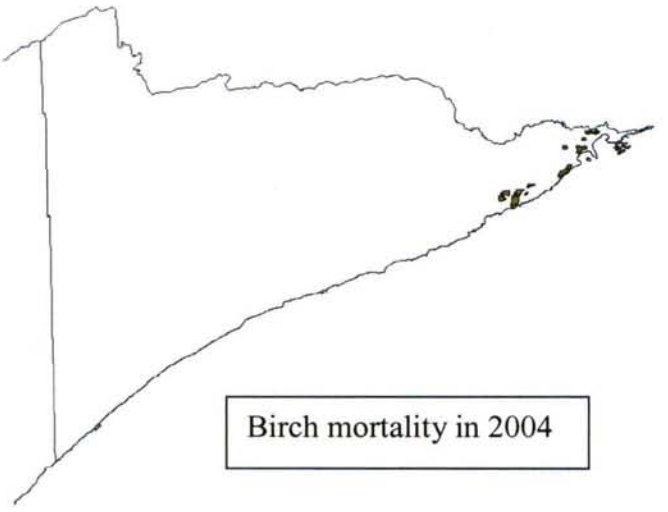
* Trace = 5 to 25% of trees on the site affected, light = 26 to 50%, moderate = 51 to 75%, heavy = greater than 75%.



Birch mortality

Host: Paper birch
Damage: Mortality
Area: 3200 acres
Severity: Light
Trend: Unknown

Aerial survey results show birch mortality in the extreme eastern tip of Cook County. Stands in this area were defoliated by forest tent caterpillar in 2000,2001 and 2002 with reduced amounts of defoliation continuing in 2003. Stands in this area have also suffered from drought and site disturbances such as road reconstruction, new road construction, powerline clearing, etc. Stresses make birch trees susceptible to secondary organisms such as bronze birch borer and Armillaria root disease, which ultimately cause dieback and topkill and often lead to whole tree mortality.



Impact of drought in the southeastern counties

The southeast experienced a severe drought during the later half of the 2003-growing season. It was unusual as it began in early July. Little precipitation was seen in the region until late in the year. The following winter months produced some typical cold and fluctuating temperatures, which usually result in various amounts of winter injury in the spring. As a result winter injury was evident in the spring of 2004. There was scattered mortality in arborvitae, which was very unusual, and young spruce in windbreaks and ornamental plantings. It is difficult to separate which contributed more to the winter injury, the late season 2003 drought and or the 2004 winter conditions. Additionally winter injury was evident in a number of conifer species. A significant amount of bark beetle activity took place in August of 2003 that was not evident until the early summer of 2004. All of this activity took place at the end of the 2003 season. All bark beetle activity had diminished by the early 2004-growing season.

As the 2004 growing season began to get underway there was a real threat that the late season 2003 drought would carry into 2004. However, during the third week in April the weather patterns again made an abrupt change and the rains began. It rained almost continuously until early July. The early growing season rains of 2004 contributed too much of the chlorosis that was evident by mid-season in 2004 particularly across southwest Minnesota.

Bark Beetles
A number of bark beetles and woodborers were active late in the season in 2003 and not detected until early in the season in 2004.

Phloeosinus canadensis, the red cedar bark beetle, also sometimes called the northern cedar bark beetle was confirmed killing 20-year-old open grown eastern red cedar in Goodhue County. Field checks in May found the activity had stopped.

In the greater region, the hickory bark beetle, *Scolytus quadrispinosus* was active on stressed sites.

In red pine there were a number of pockets killed late in the 2003 season by what was assumed to be *Ips pini*.

Scattered red oak mortality was evident in late 2003 and early 2004, from the twolined chestnut borer, *Agrilus bilineatus*.

Chlorosis
Iron chlorosis was highly visible over much of southwest Minnesota during much of the 2004 growing season. Why can we see the high visibility of iron chlorosis across southern Minnesota in 2004?

Iron, in alkaline soils (soils with high pH), is often in a form too tightly bound to other molecules to be available for trees. This problem occurs most frequently in high calcium carbonate soils and is sometimes called lime-induced iron chlorosis. Iron chlorosis is seen in most years on the side slopes, bluffs, hardwood forests, and urban areas across southern Minnesota. Where we see these chlorotic trees, the pH is higher there, than in the surrounding soils. In soils of a high pH, soluble iron can become unavailable for trees. Wet seasons are worst than dry years.

The reasons are complicated and not completely understood. However, what we know is this. In calcium carbonate containing soils, excess water will actually increase the bicarbonate content, which will act to tie up the iron and or, reduce iron availability. Bicarbonate is HCO3. Bicarbonate acts as a buffer for hydrogen ions. It in effect captures or binds the hydrogen ions. It is these hydrogen ions that play a role in providing the soluble iron. In fact, one mechanism that plant roots of some species have developed to acquire iron is to excrete hydrogen ions. The hydrogen ions act to solubilize or free up iron. But if the bicarbonate content is high the hydrogen will react to form water and carbon dioxide before it has a chance to un-tie or free up the iron. So the extra rainfall complicates the otherwise peaceful co-existence for some of these tree species and their alkaline soils. In addition, a lot of water in poorly aerated soils can destroy the smaller roots and reduce the uptake of all minerals. The roots of some grass species have apparently developed a different mechanism to deal with this problem of high bicarbonate. As the season progressed and the rains diminished there was a decrease in the amount of chlorosis.

The symptoms of iron chlorosis are a general yellowing of most of the leaves is the first visible symptom of iron chlorosis. A closer look will reveal the yellowing to be intervainal, meaning the chlorosis is between the veins, while the veins remain green. In severe cases, intervainal necrosis (dead tissue) can result.

Special Projects

Doug-fir beetle risk assessment

A grant from the USDA Forest Service, Forest Health Protection Suppression Program was used to fill a post doctorate position at the University of Minnesota, Department of Forest Resources to complete further studies on Douglas-fir beetle in Itasca County, MN. This position was filled by Dr. Kevin Dodds. In cooperation with Daniel Gilmore and Steven Seybold, he set up a field sturdy, placing Douglas-fir and tamarack logs baited with Douglas-fir beetle pheromones at four sites surrounding Grand Rapids. The locations were: Arbo township, Hwy 17 south of Cohassett, Larex in Cohassett and NCROC east of Grand Rapids. Logs were left in the field from April 29 to June 22, 2004. After retrieval the logs were cut in half. Bark was removed from one half of the log and any insects or galleries were identified. The second halves of the logs were put into screen bags for insect rearing. Beetles emerging in the spring/summer of 2005 will be identified to determine the presence of Douglas-fir beetles in the logs.

The grant was also used to prepare and publish a risk assessment as follows. Ecological Risk Assessments for Insect Species Emerged from Western Larch Imported to Northern Minnesota, by Kevin J. Dodds, Daniel W. Gilmore, Steven J. Seybold. July 2004. Staff Paper Series No. 174, Department of Forest Resources, College of Natural Resources and Minnesota Agricultural Experiment Station, University of Minnesota, St Paul, MN.

Plans for 2005 include continued monitoring near the Larex site. Trapping will be limited to 5 traps to be maintained cooperatively by the MDA and DNR. Collections will also be made from imported western larch logs to continue monitoring for insects being brought into Minnesota.

Chemical ecology of the eastern larch beetle

A study on the chemical ecology of eastern larch beetles was continued in cooperation with Steven Seybold. Lindgren funnel traps were placed at 3 locations: Arbo township; Larex in Cohasset; and at NCROC in Grand Rapids, on June 28th. Five traps were placed at each location baited as follows: A) blank trap; B) (-)-seudenol; C) (+)-seudenol; D) racemic seudenol (1 bubble cap); and E) racemic seudenol (2 bubble caps). Contents of traps were emptied into plastic bags and placed in a freezer on a weekly basis. Traps were also re-randomized on a weekly basis. Trap catches have not yet been sorted and counted.

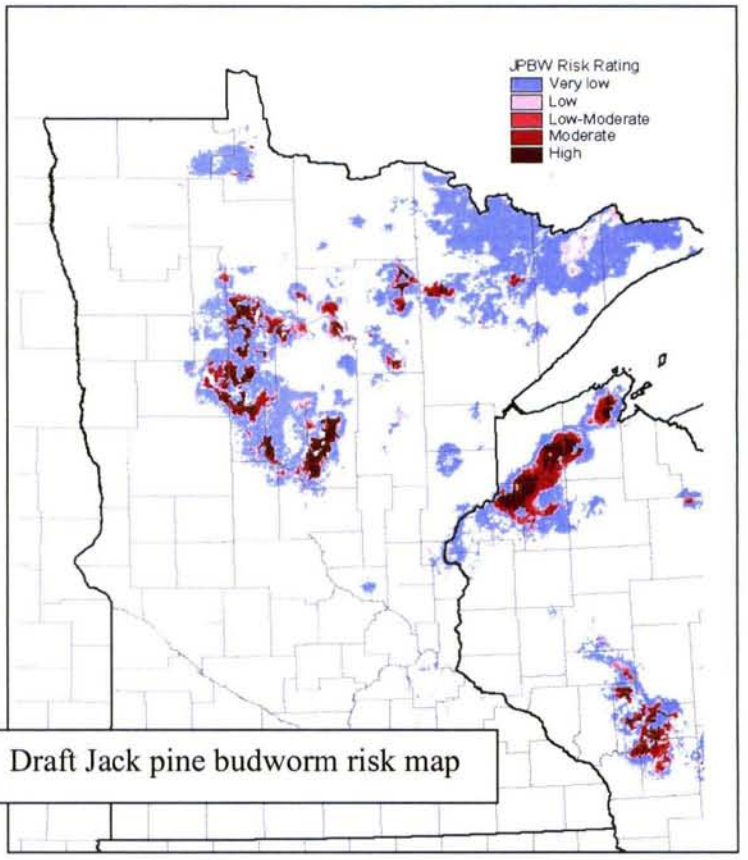
Risk mapping North Central (Formerly Lake States) style

To provide an alternative to the national risk map developed by the Forest Service, during a 2000 meeting of three of the Lakes States (Michigan, Minnesota, and Wisconsin) Forest Health Specialists, it was agreed that a multi-criteria modeling approach would be utilized to identify regions of "high risk" for tree mortality due to various risk agents or forest pests. A multi-criteria approach provides a means for combining information about criteria (factors and constraints) to generate a single index of evaluation (Eastman 1995, 1999). Multi-criteria modeling also provides a transparent, repeatable process in which models can be easily adjusted or tweaked as our knowledge base about the behavior of insects and diseases expands and or new datasets become available.

Although determining risk for tree mortality within a particular cover type is the ultimate goal of this risk mapping effort, a pest based modeling approach (risk agent approach) also has the advantage of producing intermediate maps which are useful planning tools. For example, during the development of the oak mortality risk map, an oak wilt and oak

defoliation/TLCB risk agent maps were produced. These maps demonstrated their usefulness as planning and decision making tools.

An approach focused on risk agents does have disadvantages, however. The accuracy of final mortality risk map is dependant on our knowledge about risk agents. Since little is known about predicting the occurrence of many risk agents, there may be inaccuracies or weaknesses in some of our mortality maps. This does not diminish their usefulness, however, and the process of developing risk agent maps and tweaking them has helped us better understand the behavior and factors limiting the distribution of forest pests in the Lake States. It has also helped identify research and data needs.



Draft Jack pine budworm risk map

In response to a request to update the Forest Service's national risk map we decided in 2004 to undertake a second effort. In this second effort, which was first expanded to seven states or the North Central Risk Mapping Team (Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, and Wisconsin) and now has been expanded to also include the Northeastern region (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Ohio, Rhode Island, and West Virginia), we refined, enhanced, and expanded our original multi-criteria modeling approach.

The multi-criteria model developed for this project, constructed within the IDRISI Geographic Information System (GIS) software (Eastman 1999), first required Forest Health Specialists to identify the risk agents affecting the potential of mortality occurring within a set of five predefined cover type classes: oak/hickory, spruce/fir, jack pine, red/white pine, and aspen/birch. It was decided that forest pests, such as oak wilt, would comprise the agents for each cover type. These agents, then act as criteria that determine the outcome of each cover type's component risk map. Next, the criteria determining the extent of each risk agent must be identified. Finally a series of multi-criteria evaluations were used to assemble the information into a single risk map. The effect that criteria have on the outcome for each multi-criterion evaluation is based on the relative importance of every criterion.

Minnesota's participation

Minnesota FH Specialists are on all the teams, except for the one dealing with shortleaf pine. See table. Preliminary maps were created and submitted by the committees in mid-December. See the attached risk map for jack pine budworm.

Covertype	Lead	Subteam
Spruce-fir	X	
Aspen-birch	X	
Black spruce	X	
Elm-ash-cottonwood		X
Jack pine		X
Oak-hickory		X
Short leaf pine		
Tamarack	X	
White pine	X	

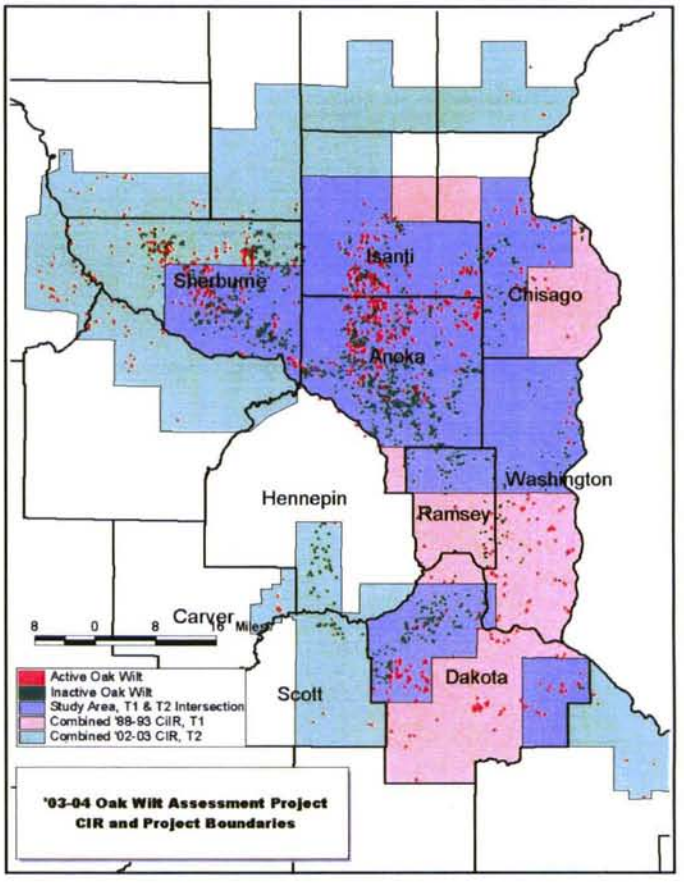
2003-2004 Oak wilt assessment project

Although a large number of communities have been aggressive in their management of oak wilt, the number of new infection pockets being discovered each year exceeds the number of infection pockets being treated each year. The result has been a gradual increase in the incidence of oak wilt across most of the original control zone and a dramatic increase in the incidence of oak wilt in Sherburne County - in spite of a model control program.

These increases led to several questions about statewide management strategies and the associated funding. The Forest Health Protection Branch of the USFS, State and Private Forestry provides the current oak wilt suppression funding. Their program targets areas at high risk of forest damage and as such are usually directed at areas with the highest pest incidence. But as seen with the gypsy moth program, not all areas are necessarily given equal consideration because of the likelihood of spread and the adjacent forest acreage at risk of damage. So for instance, the gypsy moth Slow-The-Spread program treats many more acres of forest than does the gypsy moth suppression program, even though the pest incidence is much lower. That is because, in the case of the gypsy moth, control measures have proven to be more cost effective when aimed at the leading edge of gypsy moth expansion or at high value forests under immediate threat of defoliation.

So what are the implications in oak wilt management? Should we target areas along the leading edge of expansion and abandon areas too heavily infested to manage? That might doom adjacent communities who are currently doing their best to limit disease incidence. Or should we continue to target areas with high pest incidence independent of where they occur? That tends to punish those communities that aggressively manage the disease and in the process lower its incidence. Or should we favor those demonstrating a long-term commitment to integrated urban forest management or those struggling to initiate a new program? Any approach we choose favors some communities over others.

Independent of the approach we choose, future federal funding is limited and dependent on demonstrable results. So it is imperative that the state defines where its priorities lie and define management goals accordingly. As such an assessment project was initiated in 2003 and is scheduled for completion this winter.



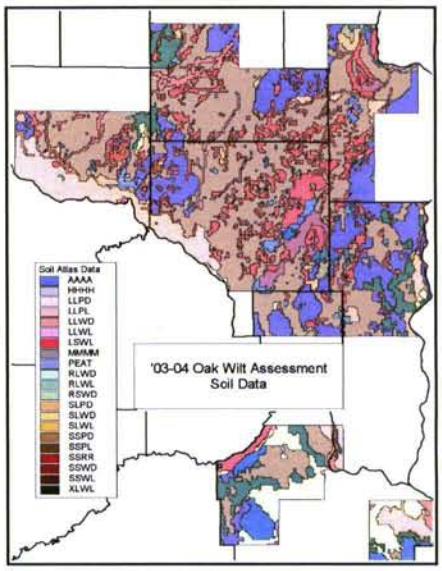
The hopes are that the assessment project will shed some light on where the incidence of oak wilt is changing and why. The results may help demonstrate which components of a community management program are most effective. The results may also highlight under what conditions disease management is most difficult. How these areas are distributed across the state's oak resource may help determine where we need to focus our efforts or perhaps where we need to redirect federal funds administered under the MN Releaf program.

Methods and materials

CIR

Color infrared photography (CIR) was taken of various parts of the study area in 1988, 1989, 1993, 1997, 1999, 2002 & 2003. Photographs taken in 1988, 1989 and 1993 were combined to cover all of Anoka and Ramsey counties, and roughly half of Washington, Chisago, Isanti and Sherburne

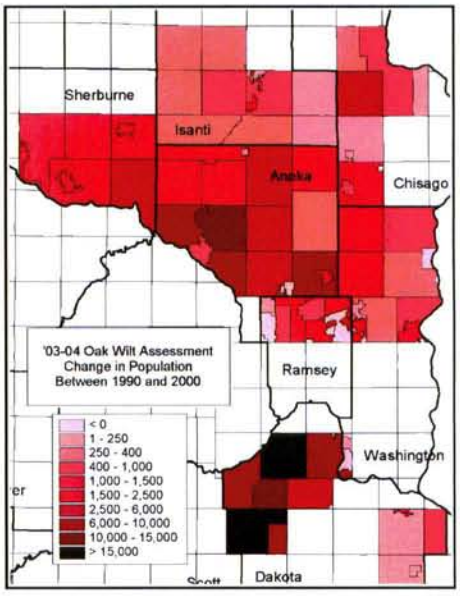
counties. This set of photos was used to represent time one (T1) in the assessment project. Photographs taken in 2002 and 2003 were combined to cover all of Anoka, Ramsey and Sherburne counties, as well as parts of Chisago, Isanti, Dakota, Hennepin, Scott and Washington. This set of photos was used to represent time two (T2). The intersection of these two photo periods defined the project boundaries (see the CIR map). Photos taken in 1997 and 1999 were not used as part of this study.



Plot Selection and Design

The study area was divided into quarter sections, based roughly on the public land survey. The percent forest cover for each quarter section was determined based on the 1995 GAP data (1). A total of 600 plots were randomly selected from those quarter sections with greater than or equal to 15% forest cover. After exploring different thresholds of forest cover, 15% seemed to represent the best compromise between the labor needed to sample a large number of plots falling into agricultural areas if the threshold of forest cover was set too low, and potentially under sampling highly developed areas if the threshold of forest cover was set too high.

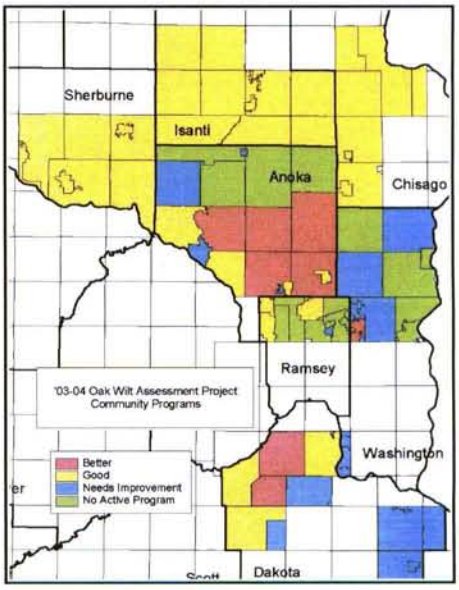
A regular grid of points was laid over the top of each quarter section plot, with an average of 64 points per plot. Each point represented roughly 1/10 acre. Both sets of photographs were rectified to the 2002 FSA photography. The office of DNR Forest Resource Assessment interpreted the photos covering each plot for both time periods. Land usage was defined as outlined below. Polygons representing each land use were visually determined. All points falling within a particular polygon were assigned to that land use category. For each point within a land use, the presence/absence of tree canopies and the presence/absence of oak wilt were recorded.



Field Checks

Five percent of the plots in each county were randomly selected to be field checked. Paper maps were created using the 2002 FSA photography as the base layer. County parcel data was laid over each plot and the landowner determined, where that data was available. Identified landowners were contacted for permission to access their land. Where landowners could not be identified, letters were sent to the current resident. All but one landowner contacted provided access to their property.

Field staff attempted to visit all points that appeared to have trees in the immediate vicinity. Points that were inaccessible were viewed with binoculars from the nearest possible location. Out of a total of (x) possibly treed points, (y) were visited and (z) were viewed from a distance. At each point tree cover was determined to be hardwood, conifer, mixed or none. Disease incidence was recorded as present, absent or unconfirmed, which meant dead oaks were present, but the cause of death could not be determined.



Independent Variables

Over the plot data, several GIS layers were overlaid. Soil type was based on the soil atlas (reference) where the four letter codes represent subsoil, topsoil, drainage and color in that order, where r = rock, s = sand, c = clay, l = loam, w = well drained, p = poorly drained, d = dark or unleached, l = light or leached. Change in human population, based on the difference between the 1990 and 2000 census was another data layer used along with the type of community oak wilt management program (see maps for all three data sets). The type of oak wilt management program was determined by a phone survey of all local units of government within the study area (xx total). The phone survey identified the field survey method(s) used, outreach and education activities, resident participation, management techniques, mapping and data collection, planning

and long-term monitoring. Points were given or taken away from their total score based on components found in an "ideal program" as outlined by DNR and MN Releaf staff. Each local unit of government was then placed in one of four categories based on the sophistication of
their program. Spring storm events were not used as an independent variable because of a lack of data. Forest cover was not included because of the threshold used to define forest types in the statewide GAP data. The other reliable data set, MLCCS, does not yet cover the entire study area. Having that data layer would have made this analysis more robust because it combines land use with vegetative cover and describes percent imperviousness as well as the minor species commonly found in that cover type.

Analysis
The change in incidence of oak wilt will be calculated for each civil division on an area basis. Regression analysis will be performed by the USFS, NC Forest Exp. Sta. to determine the correlation, if any, between the change in disease incidence and the independent variables. At this point in time, all interpretation and fieldwork is complete. The final analysis will be completed and the final results presented in 2005.

Minnesota participates in a national Sudden Oak Death survey And a *Phytophthora ramorum* survey

Since the mid-1990's, mortality of several oak species has been detected in northern California. A new disease, sudden oak death (SOD), caused by a fungus-like organism, Phyophthora ramorum, has been identified and is now known to occur in coastal areas of California and Oregon. Phytophthora ramorum is a quarantined pathogen that may have been inadvertently introduced to other states outside of large regulated areas on infected nursery stock in 2003 or 2004. Given this unfortunate probability, a national SOD detection survey was designed and implemented this year.

SOD survey
DNR Forestry participated in the SOD survey by gathering vegetation samples and information on the possible presence and distribution of the pathogen within the state. Forestry crews, working out of the Resource Assessment office, were trained in data collection and were dispatched to 30 pre-selected sites in 18 counties. See map. The majority of these sites were forested areas adjacent to major nurseries that have the potential to import nursery stock from California nurseries. At each plot location, transects were run in four cardinal directions. Along those transects hundreds of suspect leaf disease samples were collected and later examined. Ultimately, 89 specimens made it to laboratory testing. They were sent to labs in Minnesota (MN. Dept. of Ag.) and Louisiana (Univ. of LA at Baton Rouge). Samples were sent to the lab in Louisiana as a quality control check. All samples were negative for the pathogen *Phytophthora ramorum*.

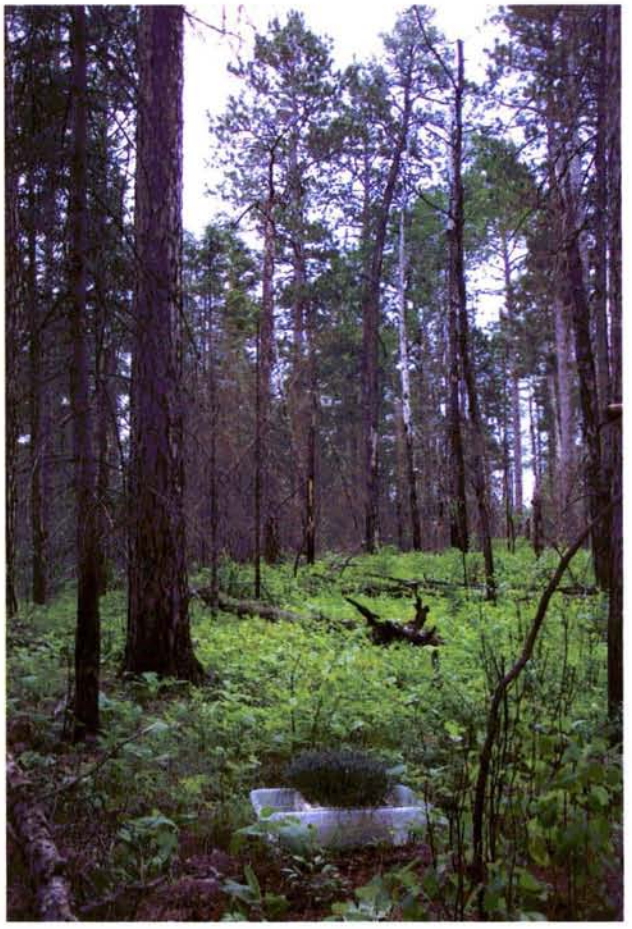
***Phytophthora ramorum* survey**
Soil sampling sites were located in major oak forest types and with a statewide distribution from northern to southern Minnesota. Eight oak stands were pre-selected with one half in declining oaks and the other half in non-declining oaks. The paired oak stands of were located in and around Grand Rapids, Onamia, Zimmerman, and Preston. Eight sites were sampled two in each of the four locations. At each site, four mineral soil samples were collected from the base of five oak trees in each stand. The soil samples were collected from the forty oaks in both the spring and again in the fall. In the fall, different oaks were selected and sampled in each of the same stands.

Soil samples were screened for *Phytophthora* species. Soil samples were processed in St. Paul at the USDA-Forest Service laboratory. An oak leaf baiting procedure was used whereby soils from each tree are placed in a container and flooded with distilled water. New oak leaves are floated on the water surface to bait for *Phytophthora* infections on the foliage. The lesions that develop are then cultured for organisms.

In Minnesota, the Zimmerman and Preston sites were positive for *P. citricola* associated with northern pin and northern red oaks for the spring survey. The results from the fall survey are yet to be determined.

Several states participated in the survey including Illinois, Indiana, Maryland, Minnesota, Ohio, Pennsylvania, Wisconsin, and West Virginia. Over the entire sampling area of all eight states nearly 500 oaks were sampled on 96 sites. *Phytophthora* species were isolated from about 50%of the sites and about 20% of all the soils samples. Generally fewer positive cultures for *Phytophthora* were found in IL, MN, MI, and WI. Data analysts assume that the generally sander soils yield lower incidence and fewer species of *Phytophthora*.

Sphaeropsis study at Itasca State Park



Itasca State Park is having difficulty regenerating red pine in spite of excellent site preparation using prescribed fire on suitable sites with excellent seed sources. Questions remain regarding the influence of animal browse or shrub competition and environmental parameters such as duff depth and amount of light reaching the forest floor. Until this year, no one had looked into the possibility that diseases could be having a deleterious influence on red pine regeneration. From recent studies and surveys elsewhere in Minnesota, we know that *Sphaeropsis sapinea* can have a huge effect on nursery seedlings and the success of outplanted seedlings due to its ability to cause latent infections. Internal water deficits, such as those caused by droughty weather, release latent infections to cause disease symptoms and seedling death.

Purpose:
To determine if live, containerized red pine seedlings could be used to "trap" *Sphaeropsis* spores and produce disease symptoms by placing the seedlings under overstory red pine trees. This might indicate the presence and, perhaps, level of *Sphaeropsis* inoculum in the stand. Fallen cones were also collected to provide another determination of the amount of inoculum in the stands.

Methods and materials:
On May 28th, containerized seedlings were placed in 8 red pine stands and 1 hardwood stand in Itasca State Park. There are no red pine seedlings or saplings in any of the stands. All of the red pine stands are classified as FDc34 in Minnesota's ecological classification scheme.

Blocks of containerized seedlings were produced in a greenhouse and had never been exposed to overstory pines, the predominant source of *Sphaeropsis* inoculum. Two locations in each stand received a half- block containing approximately 90 seedlings. Seedlings were watered and monitored weekly then collected on July 21st. Overall, seedlings broke bud and grew 2 to 3 inches in height during that time and set new buds. Only one half-block was destroyed by bear depredation.

On July 21st, the blocks of seedlings were stored in a sunny garage and watered for one more month. After that they were allowed to dry out, giving the latent infections an impetus to cause disease and produce fruiting structures.

Once the root mass had completely dried out, 50 seedlings were collected from each half block. Each seedling was examined using binocular scopes for the presence of classic shoot blight symptoms, internal stem and root collar symptoms, presence of *Sphaeropsis* pycnidia and other damaging agents. For this report, seedlings that showed internal symptoms of *Sphaeropsis* infection after being drought-stressed will be termed "latently" infected seedlings.

100 fallen red pine cones were collected in mid-November under the overstory red pines where the seedlings were set out earlier in the year. Efforts were made to collect the youngest, freshest cones. In the lab, each cone was visually inspected for the presence of *Sphaeropsis* infections. Each cone was tallied as either infected or uninfected. Infections were verified by microscopic examination of the pycnidia and spores. Stand density group and distance to nearest tree were estimated by

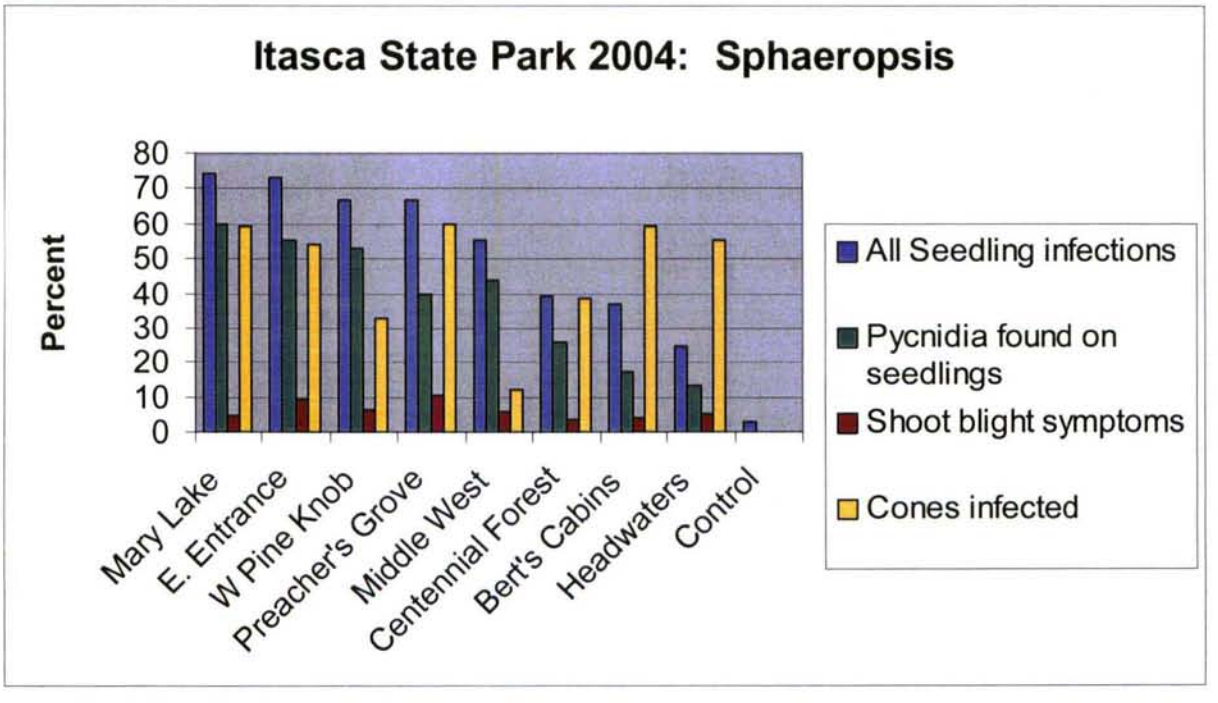
using FSA photos and GPS locations of the half-blocks. Two stand ages were supplied by Itasca State Park, Frissell's age and FIM age.

Results and discussion:
Containerized seedlings exposed to overstory red pine trees for eight weeks in the spring exhibited classic shoot blight symptoms of *Sphaeropsis* infection. Diagnosis was based on external and internal symptoms and by the presence of *Sphaeropsis* pycnidia, when present. The number of blighted seedlings was small, ranging from 3.3 to 10.2%. See Table 1. Using in containerized seedlings, the presence of classic shoot blight symptoms can indicate that *Sphaeropsis* is present in the red pine overstory.

Table 1. Symptoms found in sampled seedlings

Location	# seedlings	Stem infection	Pycnidia found	Classic shoot blight	SB +latent infections	Cone infection
	#	%	%	%	%	%
Mary Lake	100	74	60	4.4	78	59
E. Entrance	100	73	55	9.4	82	54
W Pine Knob	100	67	53	6.6	73	33
Preacher's Grove	100	67	40	10.2	77	60
Middle West	96	55	44	5.5	60	12
Centennial Forest	49	39	26	3.3	42	39
Bert's Cabins	100	37	17	4.3	41	59
Headwaters	100	25	13	5.1	30	55
Control	174	3	0	0	3	0
corel coef	stem / #	stem/pyc	stem/SB	SB/ cone	cone/tot inf	cone/stem
	-0.46798	0.968975	0.773713	0.571242	0.512465	0.489613

Since all the seedlings were drought stressed to induce disease symptoms and sporulation, using internal symptoms was much more descriptive of the true level of infection than was using external symptoms alone. Latent stem infections occurred on an average of 55% of the exposed seedlings (range 25-74%). Most of the latent infections were stimulated to produce internal disease symptoms and, very often, pycnidia. In fact, the production of pycnidia was highly correlated with the presence of internal symptoms on latently infected seedlings (R = 0.96897). See Figure 1. The levels of classic shoot blight and the levels of latent stem infections from each stand were moderately correlated (R = 0.7737).



Three percent latent stem infections were found on the control seedlings. This could be explained by either the use of infected seeds in the greenhouse or by the proximity of several mature red pine trees to the control site (closest tree was approx. 220 feet). This study couldn't distinguish between these possibilities.

Overall, 48% of the cones were infected by *Sphaeropsis* (range 12-60%). Cone infection levels were only moderately correlated with the shoot blight levels, latent infection levels and the total amount of disease (shoot blight plus internal stem infections). Based on this study, cone infections are not descriptive of the amount of disease in a stand but only show a general trend. However, lower cone infection levels might be used to predict where regeneration may be successful. Further work needs to be done developing the relationship between cones and regeneration success, as there were no stands with less than 12% cone infection in this study.

As expected, there was an inverse correlation between stem infections and the distance from the inoculum source. See Table 2. Stand age was moderately correlated with percent stem infections.

Table 2. Stand characteristics

Location	Dist to Nearest tree feet	St density group	Friss age years	FIM age years
Mary Lake	0	10	201	176
E. Entrance	35	5	201	150
W Pine Knob	39	5	184	161
Preacher's Grove	0	10	201	251
Middle West	0	10	184	168
Centennial Forest	7	8	201	150
Bert's Cabins	0	10	120	120
Headwaters	23	10	109	111
Control	220	0	NA	NA
corel coef	stem/dist	stem/dens	stem/Frage	stem/ Fage
	-0.65943	0.384918	0.785329	0.639231

Conclusions:

1. Containerized seedlings can be used to "bait" *Sphaeropsis* spores in the spring to cause classic shoot blight and latent infections.
2. Latent stem infections in containerized seedlings will produce pycnidia when suitably drought-stressed.
3. At Itasca State Park, shoot blight infections indicate that *Sphaeropsis* inoculum is present in the overstory but shoot blight levels are not a descriptive indicator of disease potential of the overstory stand. Examining the drought-stressed seedlings for internal symptoms of latent infections is a better indicator. This is exactly what we found during surveys of nursery seedbeds in 2003 and 2004. This study shows that in natural systems latent infections are a more reliable indicator of the disease potential of the overstory stands than shoot blight.
4. *Sphaeropsis* is an important disease of red pine and red pine seedlings in Itasca State Park. Growing red pine seedlings in the understory of mature red pine trees should be considered as having a very, very small chance of success.
5. Further work needs to be done developing the relationship between cone infection and shoot infection, as there were no stands with less than 12% cone infection in this study.

Special thanks to Becky Marty, NR Specialist at Itasca State Park.

Evaluating *Sphaeropsis sapinea*: Disease potential in overstory red and jack pine trees

Abstract:
This project will address critical gaps in understanding and managing the lethal, invasive pathogen, *Sphaeropsis sapinea,* on red and jack pine seedlings in plantations and in natural regeneration of multi-storied pine stands.

Current, unprecedented losses of pine seedlings in nurseries, young plantations and natural regeneration are attributed to this pathogen. We propose to develop a method that foresters can use to evaluate *Sphaeropsis* disease potential in overstory trees. Site specific information on the incidence and disease potential of 120 mature pine stands in 10 ecological subsections would be analyzed so that (1) a technique to evaluate disease potential is developed, (2) guidelines for natural and artificial regeneration of pines next to overstory pines are developed, and (3) a thematic map is created that shows the *Sphaeropsis* distribution, severity and fungal strain type across northern Minnesota.

Background:
Coniferous trees are critical components of eastern woodlands, which provide economic value, aesthetic beauty, recreational opportunities, wildlife habitat, water protection, and biodiversity. Approximately 12 million acres of forests in the eastern US are categorized as the red/white/jack pine cover type (USFS 2001). Among diseases affecting red and jack pines is Sphaeropsis shoot blight and canker, caused by *Sphaeropsis sapinea*. The disease occurs worldwide and causes economic damage in exotic pine plantations in New Zealand, Australia, and South Africa. Although long recognized, the disease was not noted as cause of severe damage in the north central United States until the mid-1970's. Unprecedented epidemics were then reported affecting red and jack pines in plantations.

Coincident with severe damage in Lake States has been recognition of variation within the pathogen, and confirmation of the biological significance of these differences. Palmer et al. (1987) recognized two morphological groups among isolates identified as *S. sapinea* from MI, MN, and WI. Two distinct groups, referred to as A and B, now have been confirmed on the basis of independent molecular genetic markers including isozymes, RAPDs, ITS sequences, and microsatellite fingerprints (Stanosz et al. 1999, Zhou and Stanosz 2001, Zhou et al. 2001). A group isolates appear to be highly genetically similar and isolates from the Lake States are not differentiable from those from other parts of the world. Inoculation of shoot tips in greenhouse trials reveal that these A group isolates are highly aggressive on red and jack pine (Blodgett and Stanosz 1997) and several other conifers (Blodgett and Stanosz 1999). B group isolates, while not aggressive on red pine shoots, were able to cause disease of jack pines.

In recent years, a new type of disease referred to as "collar rot" has been widespread on red pines in the region. Collar rot is characterized by rapid colonization of lower stem and root collar regions, resulting in sudden death (estimated as high as 95%) of newly planted seedlings and young saplings (Stanosz and Cummings Carlson 1996). Such outbreaks continue to occur, including areas where severe damage and widespread mortality has not been previously observed, such as portions of Minnesota, Wisconsin, and Michigan. Recently, it has become apparent that mortality associated with collar rot is not limited to red pines, but also affects large numbers of jack pine seedlings and saplings.

A connection has been proven between association of *Sphaeropsis sapinea* with red pine nursery seedlings and their death from collar rot. The pathogen is able to persist on asymptomatic (healthy appearing) red pine nursery seedlings (Stanosz et al. 1997, Stanosz et al. 2001). The fungus persists even on fungicide treated seedlings. Later under conditions that induce host stress, including transplanting and water stress, the fungus rapidly proliferates in the lower stem or root collar to rapidly kill seedlings. Recent widespread losses prompted a recent USFS Pest Alert by Joseph O'Brien and Linda Haugen,

USFS, Jana Albers, MN DNR, and Glen Stanosz, University of Wisconsin-Madison. Although the etiology of this disease is now accepted for red pine, information regarding jack pine is lacking.

Trends toward uneven-aged management of red pine (Ostry et al, 1998) and the paucity of natural jack pine regeneration (FH Report, 1999) have renewed concerns over the impact of *Sphaeropsis* on pine seedling vigor and survival. The presence of infected overstory red pines limits the success of both artificial and natural regeneration (Palmer, 1991). Since the early 1980's, infected red pine seedlings and saplings have died or remained stagnant, the inoculum being derived from cone and shoot infections in nearby or overstory red pines. Under optimal conditions, such as in conifer nurseries, spores can be rain-splashed more than 1000 feet from the inoculum source (Palmer et al, 1988). Empirical evidence has shown that the impact of this disease is variable across northern Minnesota (FH Reports, 1976 to 2003), reflecting both differences in overstory infection and in epidemiological conditions on those sites. At present, we have no field method to evaluate the presence of *Sphaeropsis* in mature red pine stands, much less to evaluate their disease potential. By developing a method to evaluate *Sphaeropsis* at the stand level, foresters could evaluate sites prior to planting and avoid losses by preventing the acquisition of lethal infections. More importantly, sites where inoculum levels are low would be well suited to natural regeneration and the development of multi-storied red pine stands.

Objective:
Since the early 1980's, red pine seedlings, saplings and pole-sized trees have exhibited shoot blight symptoms, the inoculum being derived from cone and shoot infections in nearby, overstory red pines. Natural regeneration of red pine in northeastern counties is scarce in large areas where it occurred historically due to mortality caused by *Sphaeropsis*. In northwestern counties, natural jack pine regeneration is poor or lacking, with *Sphaeropsis* likely as a contributing factor.

In the forest, the presence of infected overstory trees limits the success of both artificial and natural regeneration because seedlings and saplings can acquire the fungus from the overstory trees. At present we have no field method to evaluate the presence and severity of *Sphaeropsis* in overstory trees. We could reduce the risk of disease losses if the levels of infection could be predicted. Losses in red pine plantations could be reduced if foresters knew where to plant seedlings to avoid acquiring the disease. More importantly, natural regeneration would be more reliably predicted if we knew where disease potential in the overstory is very low or rare.

To reduce current losses in artificial regeneration and make predictions of natural regeneration more reliable, we propose the following:

1) to evaluate the ability of *Sphaeropsis* infections in overstory red pine trees to cause disease in understory seedlings and in nearby plantations by studying cone and seedling infections in stands with different ecological characteristics.
2) to evaluate the potential ability of *Sphaeropsis* infections in overstory jack pine trees to cause disease by studying cone infections in stands with different ecological characteristics.

Methods:
Red pine: One hundred red pine survey sites will be selected as follows. Ten red pine sites will be selected in each of the ten ecological subsections across the northern half of Minnesota. Each site will be composed of a mature red pine stand and an adjacent red pine plantation, established from 1997 to 2001. If ten sites per subsection cannot be found, then a site would consist solely of the mature red pine stand. Since all sites will occur on state-owned lands, inventory data will be available for each site. Additional mature stand information will be collected, such as, ecological classification (Aaseng et al, 2003) and the presence of a subcanopy and its composition. A single GPS location will be established in each mature stand so that a GIS layer documenting these sites can be created. The incidence of *Sphaeropsis* will be evaluated on four $1/20^{th}$ acre plots of understory red pines. From understory seedlings (less than 10 feet tall), ten symptomatic and ten asymptomatic samples will be collected for determination of fungal species and fungal strain in the lab. 100 cones found on the ground in the four plots will be collected for determination of the incidence of *Sphaeropsis* infection.

In the adjacent plantation, seedlings will be inspected for the presence of shoot blight by walking transects away from the mature pines, the inoculum source. The distance to the furthest infected seedling will be determined and used to infer maximum distance of spore spread under the site's environmental conditions for the past several years.

All cone samples will be examined for the presence or absence of *Sphaeropsis* fruiting bodies. The percentage of infected cones will be documented for each survey site. Where *Sphaeropsis* infected cones are found, ten infected cones and ten uninfected cones will be subsampled and sent to the University lab where they will be verified, cultured and classified as Strain A or Strain B. Distance data and cone and shoot infection data from each site will be analyzed to determine

statistical significance of the findings. Correlations between study findings and location, ecological classification, or other geographical variables will be determined by geostatistical tests.

It is expected that there will be both geographical and ecological differences in shoot blight infection and impact between sites. Empirical data has shown that there are differences, but the extent and the cause of those differences are currently unknown. We anticipate that this study will (1) verify a field technique for determining a mature stand's *Sphaeropsis* disease potential, and, (2) identify localities and ecological classifications where disease potential and impacts are high, low or none. In localities where the expression of shoot blight disease is high, natural regeneration will likely be precluded and artificial regeneration will be reliable only beyond a set distance from overstory red pines. Guidelines for buffer distances along the edge of new red pine plantations will be created based on the results of this study. In localities where there is no expression of shoot blight disease, natural regeneration will likely succeed. Creation of two-storied red pine stands by shelterwood cuts of existing plantations (Palik and Zasada, 2003) would also have a high likelihood of success. Artificial regeneration will succeed without the creation of buffer along the edge of a new plantation. In localities where there is a low incidence of shoot blight, natural regeneration will likely succeed only when there a large gaps in the red pine canopy. This study may identify the size of canopy gaps needed to avoid heavy shoot blight impacts. The use of shelterwood cuts in existing red pine plantations are less likely to be successful in this scenario.

Jack pine: Twenty jack pine survey sites will be selected as follows. Ten sites will be selected in two subsections. Each site will be composed of a mature jack pine stand. Since all sites will occur on government-owned lands, inventory data will be available for each site. Additional mature stand information will be collected, such as, ecological classification (Aaseng et al, 2003). A single GPS location will be established in each stand so that a GIS layer documenting these sites can be created. 100 cones clipped from 10 trees will be collected for determination of the incidence of *Sphaeropsis* infection.

All cone samples will be examined for the presence of *Sphaeropsis* fruiting bodies. The percentage of infected cones will be documented for each survey site. Where *Sphaeropsis* infected cones are found, 10 infected cones and 10 uninfected cones will be subsampled and sent to the University lab where a subset will be cultured and classified as Strain A or Strain B. Cone infection data from each site will be analyzed to determine statistical significance of the findings. Correlations between study findings and location, ecological classification, or other geographical variables will be determined by geostatistical tests.

Similar to the red pine study, we expect that there will be both geographical and ecological differences in cone infection between sites. Empirical data has shown that there are differences, but the range and extent of those differences are currently unknown.

Site selection will be the responsibility of the DNR-Resource Assessment and Forest Health Units. Training for field and lab crews for Objective B will be a collaborative effort between USFS-FHP-St. Paul, DNR-Resource Assessment and Forest Health Units and Dr. Stanosz, Univ. of Wisconsin. Similarly, data compilation and analysis will be accomplished by Dr. Glen Stanosz., DNR-RA and FH Units, in conjunction with USFS-NCFES-St. Paul.

Time Lines:
12 months from the starting date beginning approximately 6/1/04.

Deliverables:
A report that includes: 1) guidelines for natural and artificial regeneration of pines next to overstory pines, 2) a thematic map that show the *Sphaeropsis* distribution, severity and fungal strain type across northern Minnesota, and 3) a method that foresters can use to evaluate *Sphaeropsis* disease potential in overstory trees.

Progress Report as of December 30, 2004:
All field data and field collections are completed. There are 28 jack pine sites and 109 red pine sites. All samples have been processed except for the final step for the cones. A subsample of cones from 120 sites will be assayed for *Sphaeropsis* strain in Dr. Stanosz's lab. Ecological classifications have been made on a number of sites and we anticipate that more sites will be done in the late spring of 2005. Statistical and spatial analyses are just beginning.

Press Releases

DUTCH ELM DISEASE – WHAT DO WE DO NOW?

There seems to be a large increase in the number of diseased elms showing up this season. Minneapolis, St. Paul and many of the surrounding suburbs are reporting numbers of diseased trees that sound more like those of yesteryears than like recent history. It has many communities struggling to find the time and the funds to maintain their disease management programs.

What can landowners do to help limit what they lose? While there are a number of theories out there about why the disease incidence has jumped so, there are a number of steps that homeowners can take to limit the amount of future disease in their area.

FIRST quickly remove diseased elm before the disease can spread to additional trees. The fungus can spread through root grafts and removing newly infected trees before the fungus has a chance to move into the roots can often save adjacent elms. If new infections are caught early, very early that is, the trees can sometimes be saved. To do that, the infected portion has to be pruned out (before the fungus moves into the trunk) and the rest of the tree has to be injected with a fungicide to prevent any additional infection. Contact a certified arborist at the very first signs of wilt.

The **SECOND** thing folks can do, is remove all of the volunteer elm in alleys, fencerows and windbreaks. These are often Siberian elms that are prolific reseeders. Their seeds scatter and seem to sprout just about everywhere. Although Siberian elms are more resistant to disease than the American elm, they still readily become infected and thus maintain high populations of fungal spores and elm bark beetles ready to infect more desirable trees. By removing them you can reduce the disease pressure in your neighborhood. As a weed tree, Siberian elms certainly aren't providing any landscape value and they can put American elms at risk.

Many folks confuse Siberian elms with Chinese elms, which are known to be resistant to disease. So they leave them standing. But they are not the same tree species. Siberian elms are much more course in texture than Chinese elms with slender leggy irregular branches and small .5-2" leaves. The bark is a fairly uniform grey-brown, often streaked with white due to bacterial wetwood. The bark on Chinese elms is a pretty mottled mosaic with grey, brown, green, and orange patches that provide useful winter interest. They don't as readily reseed themselves like Siberian elms, so don't usually become a nuisance. Mature Chinese elms tend to be slightly more broad and shorter than mature American elms. Many of the new hybrid elms are crosses between Chinese and American. Learning the difference between Chinese and Siberian elms can help avoid leaving disease prone trees in your yard that could threaten the remaining American elms planted long ago.

THIRD is to keep their American elms healthy. Trees that are stressed due to wounding, over pruning, root disturbance or severe weather, are much more likely to become infected because the bark beetles find them more attractive. The combination of the droughty summers of '02 and '03 and the dry open winter of '02-'03 which produced a frost line much deeper than usual is one reason we are seeing so much disease this year. Additional water might have helped some of those stressed trees fend off beetle attack. Pruning during the height of beetle activity can also increase the risk of beetle attack, because the trees are temporarily stressed after being pruned. Although trees quickly recover, pruning may be more advised during the dormant season, or least after the trees begin to shut down for the winter – usually sometime in September. Root disturbance around desirable elm is always ill advised. So avoid construction work and flowerbeds in the immediate vicinity. Where construction is unavoidable, removing the tree before hand may be a better option than leaving it to become infected later on, just to avoid inviting DED into the area.

FOURTH, is to plant a diverse array of tree species including the disease resistant elms. Elms are an important component of our urban and community forests, so we shouldn't give up on them. While not immune to disease, the resistant varieties do quite well under normal circumstances. So use them. They remain a valuable tree resource that add multiple benefits for urban and community dwellers.

DUTCH ELM DISEASE – WOOD, WOOD EVERYWHERE

With the large increase in diseased elms being reported around the central region, there is an additional problem cropping up, i.e. what to do with all the wood. Many communities regulate elm wood as well as diseased trees. This is because the bark beetles that spread the disease can continue to thrive and reproduce in cut wood as long as there is still adequate moisture in the wood. So landowners may get a notice to dispose of their woodpile following tree removal. That can pose a major problem for the landowners, since many landfills won't take yard waste. It also creates problems for the community because some fire wood dealers are buying up excess wood and redistributing it without adequate precautions. The result is more disease, more tree removals and more wood to dispose of.

There are several options to dispose of infested and/or diseased wood to prevent further infestation. Plan ahead, so you know where the wood is going before you cut the tree down. Where possible work with your community. Here's an outline of your choices.

Chipping
Diseased elm wood can be chipped and reused as mulch. While the fungus can remain viable in the chips for a short period of time before the chips dry and the beetles can occasionally survive the chipper, the chances are so small as to be insignificant. Practices that speed drying, such as spreading the mulch out to dry before using it in the landscape, will help ensure that the risk of disease spread remains miniscule.

While renting a chipper may be costly for a single landowner, renting one for the block, the neighborhood or the entire community may be more reasonable. Many communities are willing to work with neighborhoods in order to help facilitate such a cooperative effort. So give them a call and ask.

Another option is to involve District Energy. They use chips to fuel their power plant and need a constant supply. While they can't effectively take wood from individual landowners, they are more than willing to work with trimming contractors, logging operators and/or local communities. Working with them helps ensure limited disease spread and efficient use of the wood resource.

Burning
Diseased elm wood can be burned and this approach is probably the surest way to prevent further disease spread. However, it wastes wood that could otherwise be used and the practice may not be allowed in your particular community. If the community has burning restrictions within city limits you may have to find another option.

Debarking
Since the beetles have to have wood with intact bark on it to survive and reproduce, diseased elm wood can be debarked to prevent further disease spread. However, this can be difficult for a small homeowner. Some communities are setting up collection sites where grinders are brought in on a regular basis to take the bark off diseased wood. The wood can then be sold and/or used for various wood products that can offset the cost of the grinder. It is important though to remove the bark as soon after tree removal as possible. If the wood is left piled up for an extended period of time before it is debarked, then the risk of further disease spread remains high. In fact it may be higher now in the vicinity of the collection site, because you have concentrated both the source of fungal spores and the beetles in one area.

Covering
Individual landowners can keep their diseased elm firewood if they tightly seal it for a minimum of one growing season. Cut and stack the wood and cover it with heavy plastic or tarp. Bury the edges with soil and weight the edges down with rocks or logs of some species other than elm. Leave the pile covered until the next year. This keeps beetles from flying into or out of the cut wood. Once the wood has been aged, it dries and the bark becomes loose. Not only does the aged wood burn better, but the beetles can no longer use it, so it becomes safe to uncover.

As discouraging as it is to see the large number of mature trees being lost, Dutch elm disease can be contained with active management. But sanitation is the key and that means getting the diseased trees down quickly followed by proper wood disposal. Contact your community leaders to see what options may work best for your area. Encourage them to work with District Energy to utilize the available wood chips. Encourage them to monitor firewood vendors to make sure they are not spreading the disease to other neighborhoods. Take heart and plant resistant elm species. It is possible with diligence to maintain elm in our urban and community forests.

Wildfire: A potential legacy of the Jack pine budworm outbreak

In 2003 and again in 2004, area Jack pine trees have been defoliated by an outbreak of the Jack pine budworm, causing top-kill and whole tree death in many woodlots and backyards. Little, if any, budworm defoliation is expected next year in Beltrami County. Cass and Hubbard Counties will see some further defoliation in 2004.

In the wake of the Jack pine budworm outbreak, many rural and suburban landowners are concerned about the outbreak's legacy...dead trees, dying trees and woody debris; lots of it. They are not the only ones taking an active interest. State and local wildfire officials have been looking at the potential for wildfires caused by the sudden buildup of woody fuels. Wildfire officials, such as William Glesener, Regional Firewise Communities Specialist, would like to make landowners aware of potential wildfire hazards created by the budworm outbreak and show all landowners the steps they can take to prevent property damage from wildfires.

Why should homeowners be concerned when they see the effects of jack pine budworm outbreak? If a wildfire would spread into budworm affected jack pines, the resulting fire has the potential to be very severe, even initiating the fire spread through crowns of the trees. This is known as a "crown" fire. The amount of dead needles and branches that are available in affected jack pine can enable a crown fire to develop more easily. Once initiated, it can advance through wooded areas that aren't affected by insects or disease. Ember showers that result may ignite houses and other buildings in the vicinity; in addition to starting spot fires that make control more difficult.

Firewise Communities, a national program, was developed to tackle the problem of the wildland urban interface. Areas where houses and buildings are in and amongst natural vegetation like tall grass, brush and trees are known as the wildland urban interface.

Firewise can help landowners make their homes less susceptible to losses caused by wildfire. On the ground assessments of the areas around homes and outbuildings by foresters, fire department personnel or other trained volunteers can show homeowners what they can do to make their home "fire wise".

The Firewise assessment identifies issues in the defensible space zones around a home. The *intensive zone* includes the area within 30 feet of the home and any structure that falls inside. The *extensive zone* is the next 70 to 100 feet around the structures. The general management zone extends to the edge of your property. Many issues identified can be addressed by simple yard cleanup and maintenance.

For no cost and just a little time you can:

- Move your firewood pile at least 25 feet from any structure and mow down all flammable vegetation within 10 feet of the woodpile.
- Clean your roof and gutters of leaves and pine needles.
- Ensure a clear view of your house number so that it may be seen from the street and make sure that your address is adequately marked at the end of your driveway.
- Have a hose at least 100 ft. long attached to an outside faucet and ready to use.
- Trim all tree branches that overhang your house and within 20 feet of all chimneys.
- Remove all trees and branches along the driveway to make it 12 feet wide to allow fire trucks to access your home. Prune any remaining trees adjacent the driveway to 14 feet for overhead clearance.
- Maintain a green, well-watered lawn for 30 feet around your home.
- Prune any yard trees so there is 6 feet to the lowest branches, but don't take more than 1/3 the crown height. If the tree is only 10 feet tall, remove only the branches on the lower 3 feet.
- Clear dead wood and dense flammable vegetation from your homes defensible space. Remove conifer shrubs especially if your home is rated a high risk.
- Compost leaves in the fall; don't burn them. Always follow local burning regulations. Never burn if the smoke and flames are blowing toward any structure.
- Plan and discuss an escape plan with your family. Have a practice drill. Include your pets.
- Check all your fire extinguishers. Are they charged? When was the last time they were inspected? Are they easy to get to? Does everyone in your family know how to use them?
- If you own a larger tract of land with affected jack pine on it, contact your local forestry office to get the name of a consultant forester who will be able to determine if a timber sale might be feasible. The best time to harvest pine is between Sept. 1 and March 1. However, the trees may be no longer merchantable within 9 months after death.

- Get involved with your communities disaster mitigation plans. Contact your local officials and encourage them to apply for a Firewise—Hazard Mitigation Grant.

The Minnesota DNR has obtained federal grants through the National Fire Plan to pass Firewise funds down to local units of government like counties, cities, organized townships, as well as fire department districts. For your community to obtain a Firewise Grant an action plan needs to be in place to: avoid potential wildfire emergencies by addressing and correcting wildland fire hazards; prepare themselves in the event a wildfire threatens; and educate the community on fire prevention. In many cases the County Emergency Operations plan will suffice.

If you would like more information on Firewise visit http://www.dnr.state.mn.us/firewise; visit your local forestry office or fire department; or call 1-800-MINN-DNR. Remember, don't be a fuel, be Firewise.

Incidental Pests

Diseases	Host	County	Comment
Venturia inaequalis Apple scab	Crab apple	Itasca Co	Common on ornamental crabs in Grand Rapids causing defoliation
Marsonina spp. Marssonina leaf spot	Quaking aspen	Aitkin and Itasca Co	Scattered throughout the counties
Septoria musiva Septoria leaf spot	Balsam poplar	Aitkin Co	Scattered locations
Taphrina coerulescens Oak leaf blister	Oak	Itasca Co	Scattered locations

Insects	Host	County	Comments
Xylotrechus undulates Longhorn borer	White pine or white spruce?	Lake Co	Emerged from 2 or 3 year old table
Alsophila pometaria Fall cankerworm	Basswood, oak and ash	Itasca Co S27-T55-R27	Complete defoliation, small pocket of trees
Pikonema alaskensis Yellowheaded spruce sawwfly	White spruce	Aitkin Co SESW S30-T49-R23	Roadside trees north of McGrath
Ips perturbatus Northern spruce engraver	White spruce	St Louis Co S16-T67-R21	Dead and dying spruce in plantation thinned 1998
Polygraphus rufipennis Four eyed spruce beetle	White spruce	St Louis Co S16-T67-R21	Dead and dying spruce in plantation
Ips perturbatus Northern spruce engraver	White spruce	Cook Co Near Sugar Loaf Cove	On cut logs on timber sale –laying eggs
Callirhytis seminator Wool sower gall insect	White oak	Itasca Co	
Hylesinus criddlei Northern ash bark beetle	Black ash	Aitkin Co S28-T49-R22	Roadside tree with topkill
Neoclytus accuminatus Redheaded ash borer	Black locust?	Crow Wing Co	In wood purchased in Iowa by furniture company.
Sirex cyaneus Blue horntail	White spruce	Itasca Co	Emerged in home from fireplace mantle