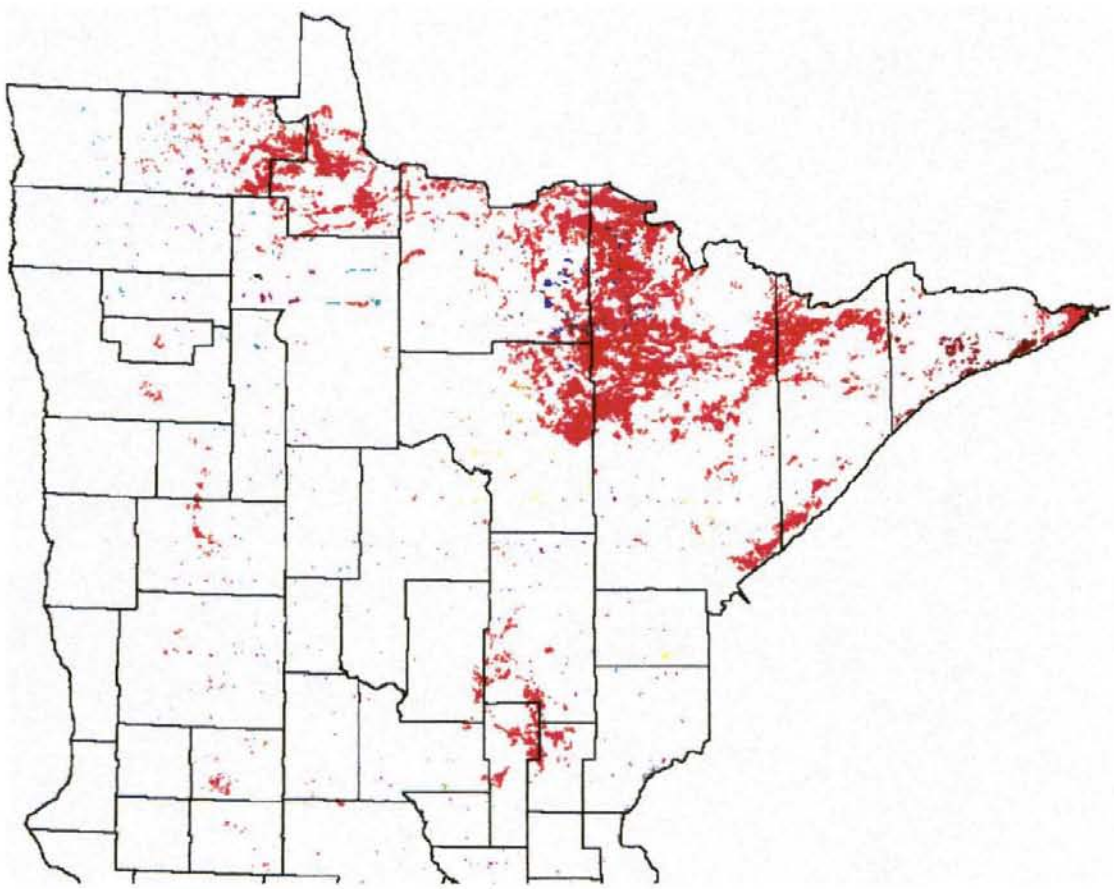
Minnesota Forest Health Annual Report 2000



Dept. Natural Resources, Division of Forestry, Forest Health Unit

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Bark beetles did not develop into a serious problem in the blowdown of July 4, 1999. Much of the pine blown down never was colonized in either 1999 or 2000. There seems to have been much more downed pines than the bark beetles could utilize. Also rainfall levels were adequate through most of the blowdown area so that standing live trees were generally not successfully attacked by bark beetles. The summer temperatures and length of the growing season appear also to have allowed only two generations of bark beetles to develop in 2000.

On the east end of the blowdown very little bark beetle activity was observed in the down pine in either 1999 or 2000. By mid-summer 2000 much of the pine in sunny locations was no longer suitable for bark beetles since the inner bark was turning color and had a fermented odor. However some of the more shaded material as well as downed trees with roots still attached was still suitable brood material. Bark beetles (*Ips pini, Ips perroti, Ips grandicollis*) did move into some pine debris, but most of this material remained uninfested. However, populations did not build up enough for beetles to be able to move into standing live trees.

On the west end of the blowdown, around Lake Vermillion, bark beetles were much more obvious in the downed pines in the fall of 1999 and most of the downed pines were infested with bark beetles by the spring of 2000. The higher populations of bark beetles on the west end was likely the result of a drought in this area in 1997 and spring of 1998. This drought resulted in pockets of pine trees dying as a result of drought and bark beetle attack on rocky shallow soil sites. These pockets of bark beetles may have resulted in higher residual populations that were able to attack the blown down pine trees on the west end in 1999. Here also the bark beetles did not develop into a problem in standing live trees in 2000.

By May 4th some of the pine material exposed to direct sunlight had phloem that was beginning to ferment, making it unsuitable for *Ips* colonization. Phloem on the undersides of logs, in the butt sections of larger pines, bent standing trees and standing stems of trees that had lost their tops was still suitable for bark beetles.

Ips pini were found in both red pine and jack pine on the west end of Lake Vermillion in the spring of 2000. *Pityogenes* (probably *hopkins*) was found in the tops and small branches of jack pine. *Pityophthorus spp.* was found in white pine branches also on the west side of Lake Vermillion.

Bark beetles, turpentine beetles and fire damage

Ips pini (Say)
Dendroctonus valens LeConte

In Region 2, red pine, both dead and living, but damaged by a fire in a private plantation near Hibbing in April were heavily infested by *Ips pini* bark beetles. In some galleries in these trees, the larvae were pupating on June 8th. Recommendations to remove and destroy the infested trees as soon as possible were given to the land owner to prevent damage to unburned pine trees on the same property as well as the neighbor's red pines which were nearby.

In contrast, red pine damaged or killed in the Elbow Lake fire on May 3rd, north of Cook contained very few *Ips pini* bark beetles when examined on May 31st.. The fire in April near Hibbing, apparently damaged the trees when emerging overwintering bark beetles were looking for brood material to infest and the damaged trees were very attractive to the beetles. The fire in May appears to have occurred after most of the emergence and mating was already complete and therefore the damaged trees suffered little or no attack early in the summer. However, by late summer, trees killed by the fire were infested with bark beetles as well as wood borers. The bark beetles did not move into any standing burned pine trees that still had at least one live green branch.

Red turpentine beetles, *Dendroctonus valens,* were common at the base of burned trees at both sites.

In Region 3, the Zimmerman 101 fire occurred on May 3rd and burnt a total of 80 acres in a suburban community, including four homes. As the burnt and partially burnt stands were being evaluated for harvest or demolition, the threat of a bark beetle outbreak was recognized.

After inspecting the burned and scorched stands, we recommended the following:
1. Log and slash disposal by June 15th or within 3 weeks of being cut through Sept. 1st.
2. Current foliage browning on charred or heat-scorched pines shows the trees that should be removed. Take all trees that show even 10-25% discoloration. More trees may need to be removed later as foliage flags/ browns or as bark beetles attack weakened trees.
3. Pitching-out response will be low for the next 30 days, according to Ayres et al, so this time period is critical for monitoring stands and rapidly removing/ destroying trees that are infested.
4. Use trap logs as a tool to draw out and dispose of bark beetles in affected pine stands. After 3 weeks, dispose or destroy the cambium of the trap trees.

Ultimately, 30 acres of pine were harvested to clean up after the fire and to prevent pine bark beetle buildup in the fire-stressed trees.

Fall defoliator complex

Drypcampa rubicunda rubicunda (F.) = green striped mapleworms
Anisota senatoria (JE Smith) = orange-striped oakworm
Anisota virginiensis (Drury) = pink-striped oakworm

Hosts:	Maples and oaks, predominantly
Damage:	Defoliation
Area:	< 40 acres
Severity:	Locally light to moderate
Trend:	Collapsing after a peak defoliation of 2400 acres last year

Only two of the fall defoliators, green-striped mapleworms and orange-striped oakworms, remained active this year after a peak defoliation of nearly 2400 acres last year. A few pink-striped oakworms were found in mid-July but they were few in number and small sized (½ inch long). The locations were 4,10,15-42-32 in Morrison County and they could not be found during the September survey.

Rosy maple moths (green-striped mapleworms as caterpillars) showed up the week of June 6th in the central counties, especially Crow Wing County. The greenstriped mapleworm defoliated isolated pockets of red maples in Crow Wing County: on the west side of the Mississippi River on the northern edge of Brainerd, along the southwest side of Mollie Lake north of Merrifield, and along the Legionville road bordering the southeast side of North Long Lake. By July l9th, 90% of these mapleworms had grown to l ½ inches and would be ready to pupate within a week or two. This pest was first seen in l997 along the Legionville road, and during the next 2 years it spread to several red maple areas in Crow Wing, Cass, Morrison and other central Minnesota counties, causing heavy defoliation in many of these areas. Their numbers have dramatically fallen in Crow Wing County and their defoliation of red maples is not very noticeable. Birds and other predators and parasites reduce their numbers, and mice also feed on their dormant pupae overwintering in the ground litter.

This year, the orangestriped oakworm is the only species of this complex that was found during our August surveys. It is present in small numbers on oaks (NE 20-39-32) about six miles south of Little Falls near the Mississippi River in Morrison County. Unlike many other defoliating moths, these insects overwinter as pupae in the soil and ground litter until late June or early July when they emerge, mate and lay eggs in clusters on leaves. As of September 7th, they had not started dropping to the ground where they will change into pupae and overwinter.

A general population collapse for both of these insects is predicted for next year.

Forest tent caterpillar

Malacosoma disstria (Hubner)

Host:	Basswood, oak, birch, ash and aspen
Damage:	Defoliation
Area:	2,095,091 acres statewide (includes 55,172 acres mapped as of FTC plus large aspen tortrix)
Severity:	Trace to heavy
Trend:	Increasing

Forest Tent Caterpillar defoliation was observed and reported in the central counties of Region I and continues to build up from 1999. Scattered aspen stands in the northern and NW counties had moderate to heavy defoliations, while defoliation across Beltrami, Clearwater, and Hubbard Counties was very light to light, if any, even though caterpillars and adults were frequently observed in towns and farms. EM observations this fall, indicate the population will increase its range and activity throughout most of the Northern half of Region I in 2001. Aspen blotch miners were observed quite widespread throughout most of the Northern part of Region I during 2000.

In 1999, defoliation was very widely scattered, in Region 2, with the largest blocks of defoliation being several sections in size. In 2000, total acreage of defoliation increased dramatically. Defoliation was common in all counties in Region 2 except for Carlton. A total of 55,173 acres were reported as a combination of forest tent caterpillar and large aspen tortrix in Cook and Lake Counties. Forest tent caterpillar alone was responsible for 1,575,969 acres of defoliation.

As is usual with a FTC outbreak there was a lot of interest by the news media wanting information and interviews for reports. A lot of information was provided through TV and radio interviews and newspaper articles. The media did a good job this year of avoiding a tone of hysteria. People were provided with a lot of useful information to help them deal with the nuisance in their backyards. There were fewer calls then expected from homeowners and vacationers upset about the outbreak. Of course defoliation in many of the larger towns such as Duluth was not as widespread or as heavy as it is likely to be next year. Also, people sensitized to FTC in 2000 may be less tolerant of it next year.

Of particular concern is the stress on aspen due to defoliation by forest tent caterpillar followed by aspen blotch miner damage. By late August aspen crowns turned brown in an area from Chisholm to Ray. Many of the aspen in this area suffered complete defoliation from FTC, refoliated and then were attacked by aspen blotch miner. The Orr Area was somewhat below normal for rainfall during the growing season this year also, possibly adding to the stress. Trees in this area will be monitored for dieback and decline.

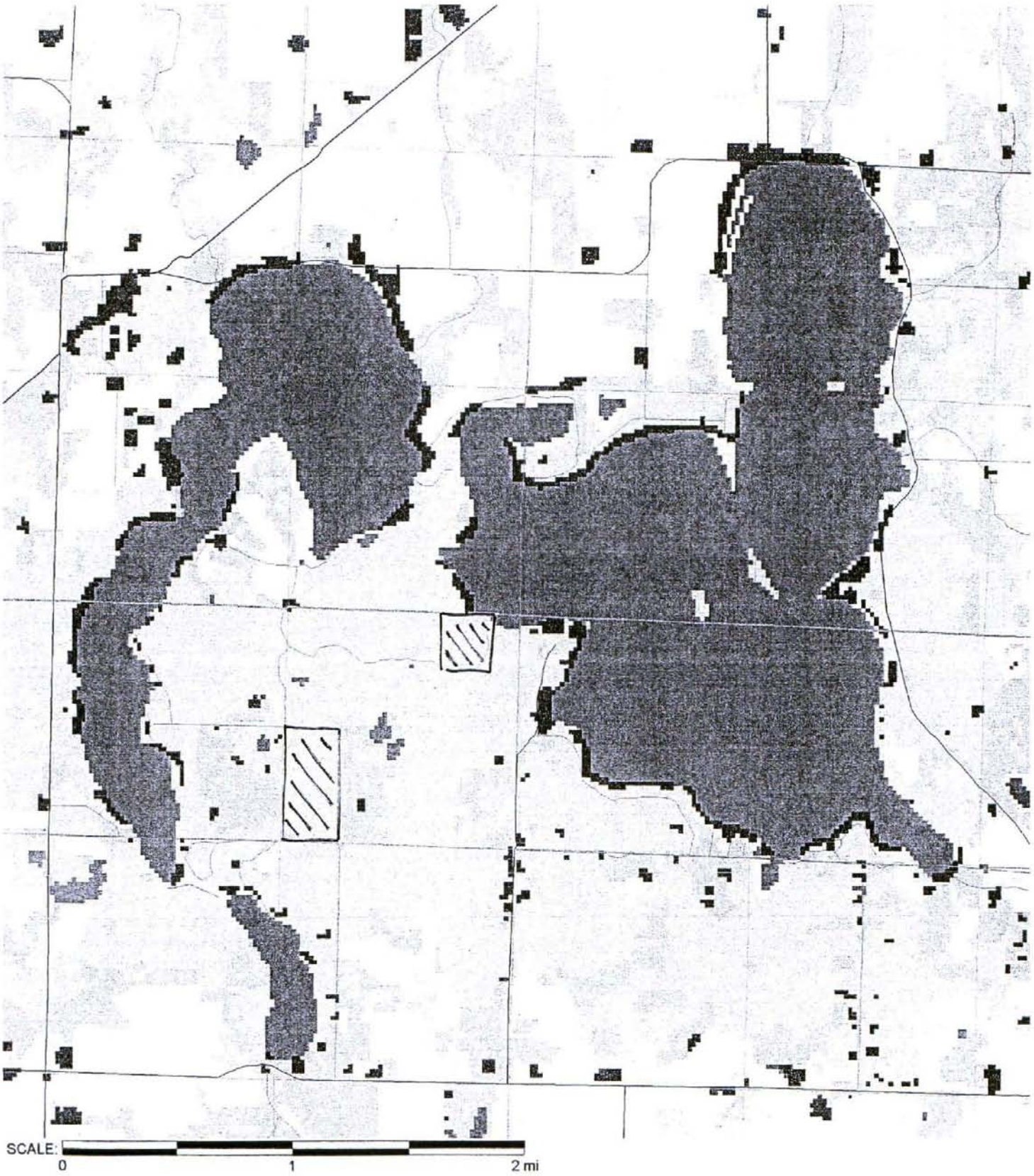
Residents of many northern Minnesota towns found their homes and businesses covered with forest tent caterpillar moths the morning of July 10th , especially if they had outside lights that stayed on all night. The moths are definitely attracted to lights, and they can fly long distances in large masses. Some communities having little or no defoliation were suddenly swarming with moths. For example, there were no large areas of defoliation within fifteen miles of Grand Rapids, yet the morning of July 10th, buildings and sidewalks were covered with thousands of moths. Business owners were scooping them up with shovels trying to keep customers from tracking squashed moths into their stores.

An egg mass was conducted in the late winter and spring of 2000 to predict the location and severity of defoliation to expect in the summer of 2000. Results of that survey can be found in the survey section of this report.

The most seriously defoliated areas in Region 3 center around lakes and rivers, notably, Mille Lacs Lake, Big Birch Lake in Stearns County, Ann and Knife Lakes in Kanabec County and the Rum River Watershed in Mille Lacs County. See map. In these areas, defoliation intensified in 2000. There was not a region-wide outbreak this year.

Two groups of lake shores owners had their property helicopter-sprayed with Bt insecticide. For the past two years, caterpillar populations increased greatly, prompting the control treatments. 116 acres between North Long and

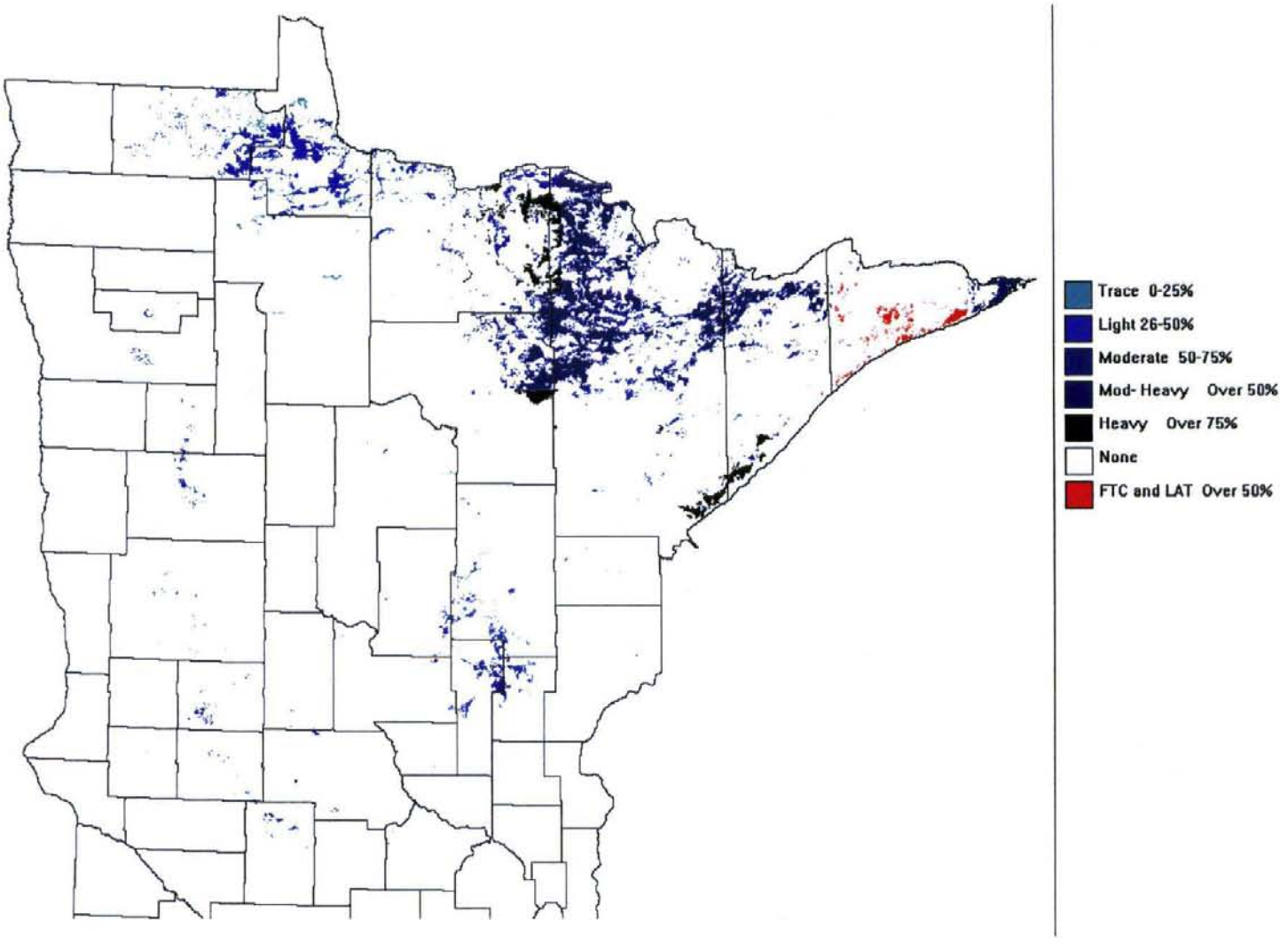
Big Birch Lake SFC - Spray Area



Township road
All county roads
State highway
Rivers, streams and ditches
County border
Township border
Section border

= Spray block

Forest tent caterpillar and Large aspen tortrix 2000



Round Lakes and 70 acres on Anchor Pt. of Cross Lake were treated in late May. The cost was approximately $60 per acre for a double application and was done by Scotts Helicopter Service, Le Sueur.

120 acres of Big Lake State Forest Campground was sprayed with Bt to protect foliage and prevent defoliation-induced mortality to basswoods, aspen, ash and oaks. See map. This is an unusual area; two defoliators are active there. For the last decade, walkingsticks have been actively defoliating in the area bounded by Big Birch Lake, Little Birch Lake and Sylvia Lake. FTC populations have now built up in these stands and caused heavy defoliation for the past two years. Prior to this, the drought of the late 1980's caused extensive mortality of oak. The remaining basswood, oak, ash and aspen are currently threatened by repeated defoliation.

Unfortunately, two defoliation events in one growing season more than doubles the impact on the trees, since trees are denuded by FTC, refoliate and then are defoliated again by walkingsticks. This loss of energy is very hard on the trees and over a few cycles of defoliation (in only a few years), can cause extensive tree mortality.

Walkingsticks have a two year life cycle, causing defoliation only in odd number years in this area. No defoliation was expected in 2000 and none was observed. Walkingsticks would not be chosen for insecticide treatment because they are very rare, ecologically speaking, and are difficult to target because of their feeding behavior. However, FTC defoliation is relatively easy to control and bio-rational insecticides can be used.

FTC eggmass counts, early instar counts and initial defoliation levels were very high. Spring this year was warm and very early, similar to the two previous years. So, we anticipated that caterpillar development would be about the same rate, allowing us to predict when the spray window would be for the intended Bt application.

Year	Date of hatch, approximate.	Hatch to ½ inch long caterpillar	Spray window for ½ inch long FTC
1998	April 20	19 days	May 15 - May 22
1999	April 29	25 days	May 17 - May 24
2000	April 25	est. 20 days	May 15- May 22

On May 15th, a fixed wing aircraft (Benson Air Ag, Benson) sprayed 120 acres in the State Forest Campground with Foray 48B (plus Bond, a sticker-spreader) at 16 BIU's per acre. A second application was repeated on May 17th . The cost was $55 per acre. Most of the adjacent private forest lands were also sprayed by the same vendor under private contracts.

Gypsy Moth

Lymantria dispar

Together, representatives from each organization assess the status of gypsy moths within the state, outline survey and treatment needs and carry out various activities to meet those needs. Cooperating partners include MDA, MNDNR, USDA APHIS, FS & F&WS, BIA and several county agencies. Overall, more than 16,700 traps were set up across the state. MDA trapped the eastern half of the state at varying grid densities based on the risk of introduction, presence of favorable habitat and history of past catches. The western portion of the state was not trapped on a grid system. Instead, high risk sites, such as parks, campgrounds and truck stops were trapped by local DNR personnel. In general, the south eastern portion of the state was trapped at one trap/sq. mile, while the north eastern portion of the state was trapped at one trap/four sq. miles. Other agencies contributed by trapping lands under their own management.

We try never to let the term "Minnesota Nice" apply to gypsy moths attempting to introduce themselves to our state and it's resources. For the second year in a row, moth catches dropped dramatically from the previous season. At

the same time trapping intensity remained constant or was substantially increased in areas of high concern. Nearly 16,500 traps were set from Canada Iowa. From a high of 953 moths in 1998, only 286 moths were caught in 1999. This year the total number of moths caught slipped even further to 182.

Regionally numbers fell significantly or remained steady in all counties surveyed except Hennepin. Of 54 moths caught in Hennepin, three sites account for more than 60% of catches. The same pattern holds true in three other counties with relatively high moth counts. Areas of concern in Hennepin Co. include a site in Plymouth, west Minneapolis and Golden Valley. The Minneapolis site is primarily residential with few trees to support moth establishment. The Plymouth site is also residential, but it is adjacent to native areas that increase the likelihood of moth establishment and make eggmass surveys more difficult. While repeated catches at these sites are of concern, no alternate life stages (eggmasses or pupae) have been found. Delimit trapping at 36 traps/sq. miles, is expected to determine the need for further action.

In Houston Co., a site in Brownsville Twp. produced nine of 23 moths caught and Money Creek Twp. accounted for another seven moths. The Money Creek site is associated with 21 moths caught just across the border in Winona Co. The site, an area situated on steep, heavily wooded hills surrounding a farm in Wiscoy Twp. had a three-year history of low moths catches that grew to 28 moths this last summer.

In October, an egg mass survey was conducted in Winona Co. Twenty eight-staff members from multiple county, state and federal agencies were present. Searchers combed the area for three hours before the sharp eyes of an MCC crew member spotted an egg mass on an oak branch situated nearly ten feet overhead. An intensified search around this initial egg mass produced two more egg masses and several spent female pupal cases. Planning for possible treatments in May 2001 have already begun. Several options being considered include foliar applications of Dipel® DF(a Bt product) or mating disruption via pheromone flakes.

The North shore situation also looks greatly improved this year. Last year, the northeast created quite a stir when moth catches rocketed to an unprecedented 96 moths over three counties. In response, all three NE counties were trapped at one trap/4 sq. miles in the interior and one trap/sq. mile along the tourist route from Duluth to Grand Portage. All 1999 catch sites were delimited at 16 traps/sq. mile. In addition, from Duluth north, the trapping schedule was extended from four to six weeks longer to take into account the colder seasonal temperatures.

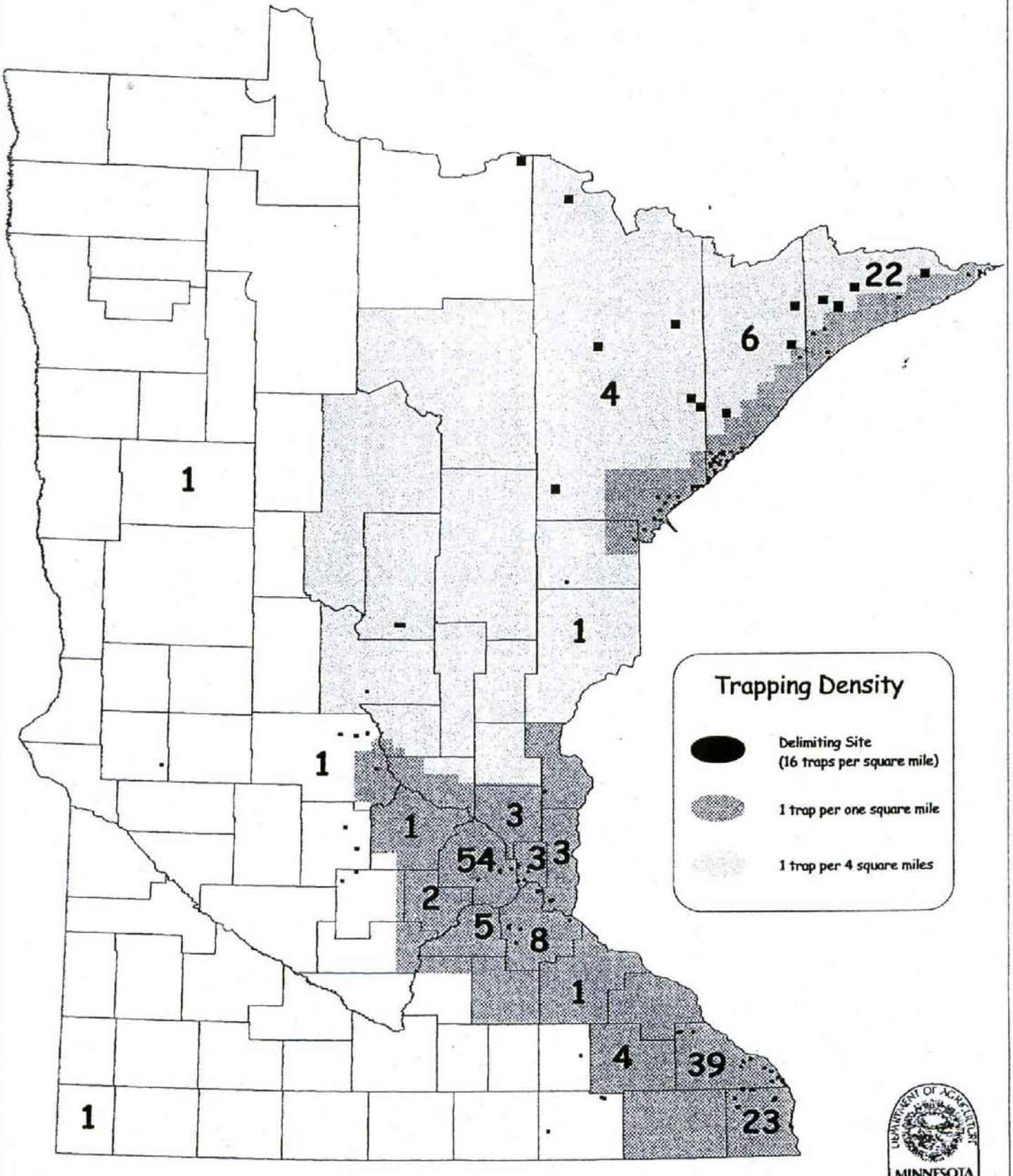
In St. Louis county, moth catches dropped from 26 a year ago to four, just one of which was caught in a delimiting site. Moving up the shore into Lake Co., the overall number declined from 37 to six. Last year, 32 moths were caught in the city of Two Harbors. This year, in spite of heavy delimiting throughout the township, only five moths were caught. While the results do not eliminate the need for extensive follow-up trapping next year, the picture looks much less grim than previously thought.

Cook, the northeastern most county faired the worst. Catches remained regionally high at 22, down only eleven from last year's 33. However, a single trap catch of nine moths accounted for nearly half the moths caught. This was a standard detection trap not associated with any of last year's finds. Using the GMHPEN model for gypsy moth phenology based on seasonal high and low temperatures, adult moth emergence in Cook progressed slowly into October. Strategic delimiting traps were left out through October 15th. The timing of moth development suggests the catch was a recent introduction rather than from a resident population. Follow-up trapping in the region next year should give us a clearer picture of how the gypsy moth behaves in such northern regions.

There was also good news in the nursery monitoring portion of the survey. Overall numbers declined from 44 moths at six sites last year to eight moths at three sites. One of this year's sites was placed under a compliance Agreement (CA), however, there is no indication of any major quarantine breach having taken place. In addition, the three sites under CA in 1999 were successfully treated this spring and all regulatory actions have been lifted.

While the relationship between regulatory personnel and the nursery industry is well established, there has been relatively little contact in past years with the logging mills. This year, efforts were initiated to develop ties between regulatory officials and the logging industry. Trapping efforts were used as an opportunity to contact mill owners, map mill sites and build a network for future communication. Those contacted were made aware of the risks associated with imported wood products and precautions that help prevent accidental introductions. Educational

Minnesota 2000 Gypsy Moth Catches By County



November 2000

efforts planned for the future will build on the contacts made this year.

Conclusions: The results of this year's survey are good news for the people and resources of Minnesota. It is another year of reprieve against the oncoming threat of gypsy moth invasion. As with last year, it appears that cool wet weather in May and June probably had a significant impact on any small moth populations present. This is also the conclusion of Wisconsin's GM program for their western counties.

Any conclusions for the north shore of Lake Superior would be premature. Tourism is still likely a major factor in moths showing up where they do, although imported logs are being assessed as another pathway for the introduction of gypsy moth life stages. Future trapping should give us a better understanding of the region.

Overall the entry pressure into Minnesota appears to be steady. However, moth populations in eastern Wisconsin remain steady or continue to increase. This means that when a warm dry spring does come along (and it will), we can expect a sudden and dramatic increase in trap catches through the eastern half of Minnesota. The multi-agency program plans to be ready when the next wave arrives.

Jack pine budworm

Choristoneura pinus Freeman

Host:	Jack pine
Damage:	Defoliation
Area:	None
Severity:	NA
Trend:	This was the fifth consecutive year of zero jack pine budworm activity in Region 3 and the outlook is for more of the same.

Jack pine budworm populations have been extremely low the past two seasons with no defoliation witnessed in Region 1. Nevertheless , thirty four larvae and egg mass plots were taken at scattered JP sites throughout stands in southwest Beltrami, Hubbard, and eastern Becker counties. Only one egg mass was found. No larvae were found.

In Region 3, three egg mass plots were put in St. Croix State Park on July 6th. No egg masses were found at the following locations: SENW 20-40-18, NWSE 15-40-18, NENW 9-40-18.

Jack pine gall rust

Cronartium quercuum (Berk.) Miy.ex Shirai

Host:	Jack pine
Damage:	Reduced growth and mortality of seedlings
Area:	Approx. 400 acres
Severity:	Locally severe in Wadena County
Trend:	Severe losses in some years, usually due to a combination of mortality factors.

To begin with, jack pines are one of the few trees that can withstand the droughty, nutrient-poor sandy soils found in many areas of Minnesota, notably Wadena County. Sometimes, seedlings are planted and then must go ten days without rain. After surviving that, there are hungry deer and insects and diseases to contend with. This just doesn't sound like a recipe for success.

Backus Area Foresters are concerned about jack pine seedling survival, noting mortality levels in plantations in northern Wadena County that occasionally exceed their expectations. In most cases, however, the plantations are still considered well-stocked. In May and June of this year, twenty plantations less than eight years old were

surveyed for establishment losses and incidence of gall rust. Collections were made to determine which gall rust species were infecting the seedlings and saplings. Most plantations have been annually bud capped to prevent deer browse.

Establishment losses are losses during the first one or two years that seedlings are in a plantation. Seedlings die if they are planted improperly, if the roots are trimmed off, if the roots dry out during planting, if the microsite is unfavorable, if rains aren't timely, if the soil is cold and the air is hot, and so on. For the last eight years, establishment mortality in these plantations has averaged 22%. Deer mortality is less than five percent due to a program of bud capping otherwise it would be much, much higher.

Gall rust is not a problem for tall saplings or pole sized trees but can cause mortality in seedlings. A gall on the mainstem of seedling can girdle it or can be a point of fracture, in both cases, killing the seedling. A rule of thumb for seedling mortality is that about 25% of the mainstem galls kill the infected seedlings. The other 75% of the galls do not kill the seedling because the galled tissues did not completely encircle the stem and, ultimately, the tree will be able to grow over the gall.

In 1984, a University of Minnesota/ DNR-Forestry survey found that 100% of the galls (n=30) found in Wadena County were caused by *Cronartium quercuum*, commonly called pine-oak gall rust. In May and June of 2000, all the sampled galls (n=100) were still pine-oak gall rust. The alternate host for this rust is oak and there are plenty of oaks on and near these sandy, plantation sites. And, in fact, gall rust is very widespread in the county since jack pine and jack pine/oak are the main covertypes there. The recent survey also found that the bulk of the infections occurred during the "wave years" of 1996 and 1998. Up to fifteen galls could form on the elongating mainstem during a wave year; the average being three galls. Woody galls developed but do not fruit (bear spores) for at least three years so the galls from 1998 and 1999 were not collected. Gall rust was also found on the lowest portion of the mainstem and in one year old plantations, indicating that a small proportion of the trees are infected with gall rust while still in the nursery.

Plantation surveys showed that 50% of the jack pine seedlings had galls on their mainstems. Gall rust losses were estimated to be 13%. This gall rust estimation is based on the average incidence in Wadena County of 50% mainstem galls and the observation that about 25% of infected trees die.

On average, establishment mortality accounts for 22%, deer browse less than 5% mortality and gall rust is estimated to cause 13% mortality. So, the total average mortality of seedlings is about 40%. Seedlings are planted at 800 trees/ acre, and, doing the math, about 480 trees/ acre survive. Foresters would like have 400 to 500 trees/acre to consider the plantation well-stocked.

Plantations become poorly stocked if establishment, deer browse or gall rust mortality exceeds the average. Gall rust incidence, as you might expect was quite variable, ranging from 33% to 84%. And this is where the problem lies, especially if establishment or deer browse mortality are also high.

What can be done? Here are some suggestions to boost the chances of plantation success:

1. Plant jack pine at higher densities to allow losses yet still have acceptable stocking levels.
2. Where feasible, plant red pine instead.
3. Accept lower stocking and encourage oaks after about 10 years.
4. Wave years are unavoidable, work around them with replantings or interplantings.
5. Investigate mortality factors of natural jack pine stands, seeded stands, containerized stock, etc. to see if 2-0 stock is more prone to mortality than other types of seedlings.

Another suggestion, "Add red pine seedlings to the plantations, either at establishment or as interplanted seedlings in "failed" or browsed areas." was nixed by the Area. Jack pine grows about 50% faster than the red pine and the interplanted seedlings would be lost. Also, the silviculture is not compatible for pre-commercial or commercial thinning.

Larch Casebearer

Coleophora tiliaefoliella Clemens

Host:	Tamarack
Damage:	Defoliation
Area:	6363 acres (aerial survey)
Severity:	mostly trace (<25%)
Trend:	large increase over past years

Larch casebearer was common and widespread, in Region 2 this summer, and could be found in most counties. Throughout most of the summer starting in May, tamarack in many locations had a faint yellow or tan coloration to the foliage. It was often difficult to see this color change unless you were right next to the tree. Because of this only 5710 acres were observed with the aerial survey. This is an under estimation of the amount of larch casebearer. It was widespread and common. In most years, casebearer is not common and usually only a few trees with casebearer are found in Region 2.

Larch casebearer is an exotic insect in North America and occurs throughout most of the range of tamarack *It is* considered one of the most serious defoliators of tamarack. Casebearer eggs are layed on needles in early summer. The larva bores into a needle and mines in it until late summer. Then the larva lines a hollow section of needle with silk, chews the section free at both ends. It spends the remainder of the larval stage in this case. In the fall the larva fastens its case to the base of a bud on an outer twig or branch and overwinters. Next spring they continue to feed. Most damage is done by large larvae feeding in the spring. Adults emerge in late May or early June.

Two introduced parasites are now widespread and believed to be quite effective in controlling the insect.

This one was a surprise for us this year in Region 3, although we knew it was active in the state because pockets of this insect were found in Region 2 last year. Here, it really was widespread, anywhere we looked on the ground, (maybe a much as 130,000 acres) but it only caused "trace" levels of defoliation. Larch casebearer was not detectable from the air given the fact that tamarack is normally multicolored and defoliation was a slight variation on orange/ green by the time of the survey. In spite of this, aerial surveyors detected 536 acres in Cass County, but that's just the tip of the iceberg. Light defoliation occurred in several stands in Aitkin County and these will be ground surveyed for larval cases during the winter when access improves.

Large aspen tortrix

Christoneura conflictana (Walker)

Host:	Aspen
Damage:	Defoliation
Area:	63,942 acres statewide
Severity:	Trace to Heavy
Trend:	Steady to declining

In Region 1, large aspen tortrix defoliation was detected in aspen forest areas just north of Red Lake in stands that escaped defoliation by FTC. These areas were detected when ground checking aerial survey flight maps.

Large aspen tortrix was less abundant in Region 2 than last year at least around Duluth. The aerial detection survey in 1999 did not map tortrix mainly because it was too late to see it. Large aspen tortrix was mapped in 2000 and an acreage determined. However, with the forest tent caterpillar population defoliation increasing it becomes difficult to accurately separate defoliation caused by tortrix from that caused by tent caterpillar.

Acreage by severity and county of defoliation caused by large aspen tortrix in Region 2:

County	Acres of defoliation
Carlton	2,167.0
Cook	54,759.8
Itasca	2718.0
Lake	508.9
St Louis	1539.4
Total	61,693.1

The table includes acres of large aspen tortrix defoliation as well as acres reported as a combination of large aspen tortrix and forest tent caterpillar. The combination of forest tent caterpillar and large aspen tortrix was a result of the aerial survey mapper seeing defoliation where both insects appeared to be involved. Large aspen tortrix defoliation alone was reported on 6520.7 acres in Carlton, Itasca, Lake and St Louis counties. The combination of forest tent caterpillar and large aspen tortrix was reported on 55,172.4 acres in Cook and Lake counties.

5/18 Large aspen tortrix feeding on aspen near Duluth at junction of Martin Road and Jean Duluth Road. Larvae approximately 1/4 inches long. Duluth, St Louis Co

6/15 Large aspen tortrix have pupated along the Jean Duluth Road. Duluth, St Louis Co

Oak twig dieback

Undetermined

Host: Red and white oaks
Damage: Twig dieback and leaf wilting
Area: Not determined
Severity: Heavy and continuous in southern part of region, but scattered and light in the northern parts.
Trend: Unknown

The most obvious symptoms observed among trees were flagging and tip dieback of oak. All species of oak have been affected. Three to twelve inch shoots have wilted and browned on scattered branches of scattered oaks across Region 3. The leaves have hung on, leaving trees dotted with brown patches throughout their crown. Froma distance, it looked like the classical cicada egg-laying damage on twigs or even twig-girdlers. Once twigs were closely examined, something else was going on. Only two types of causal agents were present, tiny (and unidentified) twig borers and a fungus, *Botyrosphaeria quercuum*.

Borer larvae, 1-2 mm in size, and their tunnels have been found just under the bark near the base of damaged shoots in nearly half of the samples collected. Their presence near the base of the injury, rather than further out along the damaged shoot, suggests they may be causing the damage. Their tunneling destroys the tissue beneath the bark which can girdle and kill the twigs they inhabit, producing the dieback symptoms. However, their absence in so many shoots indicates they aren't the only agents causing the damage we're seeing.

B. quercuum and related fungi enter twigs through wounds and/or lenticels causing small lesions in the bark. As the infection expands, the fungus kills the cambium, girdling the twigs and causing dieback in much the same fashion as the twig borers. Since both the borers and the fungi are usually associated with stressed trees and/or damaged tissue, what predisposed the shoots to invasion is of concern.

Weather is commonly associated with both the predisposition of host trees and the success of insect and disease organisms. It is likely involved in this case as well. This has been an unusual summer. The season began early with high April temperatures. A sudden drop in temperatures late in the month caused visible cold injury among some

species. May turned hot and dry, scorching new shoots in some areas. A mid-month freeeze occurred on the 19th. June was very cool and wet, conditions ideal for most fungi. After that, the weather was on the warm and dry side producing drought stress symptoms among maple, ash, birch and poplars.

Oak wilt

Ceratocystis fagacearum (TW Bretz) J. Hunt

Host Oaks
Damage Mortality
Area 6074 acres in Region 3
Severity Varies, see table below
Trend Increasing in Region 3. Storms in last four years have more than doubled the number of infection centers in Sherburne Co. Currently, we have treated and controlled 27 % of the existing oak wilt infection centers in Region 3.

Oak wilt in Region 3: Summary data for active and controlled sites
Data from summer and fall of 1999

County	Total area of active and controlled sites (ac)	Total number of active and controlled sites	Number of active sites remaining	Percent of sites controlled	Average acreage of active oak wilt per sq. mile	Average number of active sites per sq. mile
Chisago	621	446	302	32.3	1.37	1.73
Isanti	932	566	366	35.3	1.12	0.97
Mille Lacs	7	7	7	0	0.01	0.10
Pine	2	1	1	0	-	-
Sherburne*	4456	2548	1931	24.2	3.58	3.88
Stearns	45	13	8	38.5	0.81	0.15
Wright	11	5	5	0	0.14	0.05
Regionwide	**6074**	**3586**	**2615**	**27.0**	**1.81**	**1.89**

* = Excludes state land in the Sand Dunes State Forest.

In 1997 and 1998, the forests in Sherburne and Wright Counties have suffered very destructive wind storms, especially during June and early July. This was perfect timing for the spread of oak wilt by beetle vectors into storm-damaged oaks. Since then, oak wilt has spread out from the initially infected trees and formed discernable, but small, pockets of infection. Aerial photography done in the summer of 1999 was interpreted and digitized over the winter of 1999-2000 and the results are impressive. For the past three years, the number of active oak wilt pockets in Sherburne County was holding steady around 650. After the intensive survey, the number jumped to more than 1900 pockets. Tim Edgeton, Sherburne County Forester, confirms the magnitude of this increase with his ground surveys and observations. Five infection centers encompassing eleven acres were documented in Wright County. In 1990, Wright County had no oak wilt. See Survey Results section for data by township. See Map.

The oak wilt transmission season started early this year. On March 30th, Dr. Jenny Juzwik posted the following advisory for Minnesota: "**Stop pruning oaks immediately!**" The basis for this recommendation is (1) the Nitidulid beetle species involved in overland transmission of oak wilt were commonly found in pheromone-wheat dough traps at study sites in Blaine and Burnsville last week, and, (2) fresh, open spore mats were observed last week on oak trees that were killed last summer in both Blaine and Burnsville. It seems that the oak wilt season is lengthening at

both ends. Last summer, the season extended to July 15th and this spring, it got off to an early start during late March.

Bill Foss, Forestry Technician in Hinckley Area, found a potential oak wilt pocket in Pine County in August which was confirmed by lab analysis (Disease Clinic and Shade Tree Lab) in September. The new site is more than 20 miles north of any other known pocket and is a half mile from any public road. The pocket (SW of NE 19-39-20) has been active for about five years according to the owner. It is less than two acres in size and occurs in veneer quality red oak. The owner has simply cut the trees as they died, believing they died from something else. He has a small sawmill operation north of the pocket, which may prove to be the source of the introduction. This find opens up yet another county to the threat of oak wilt and our efforts to control it.

On State-owned lands in the Sand Dunes State Forest in Sherburne County , three projects were accomplished as follows:

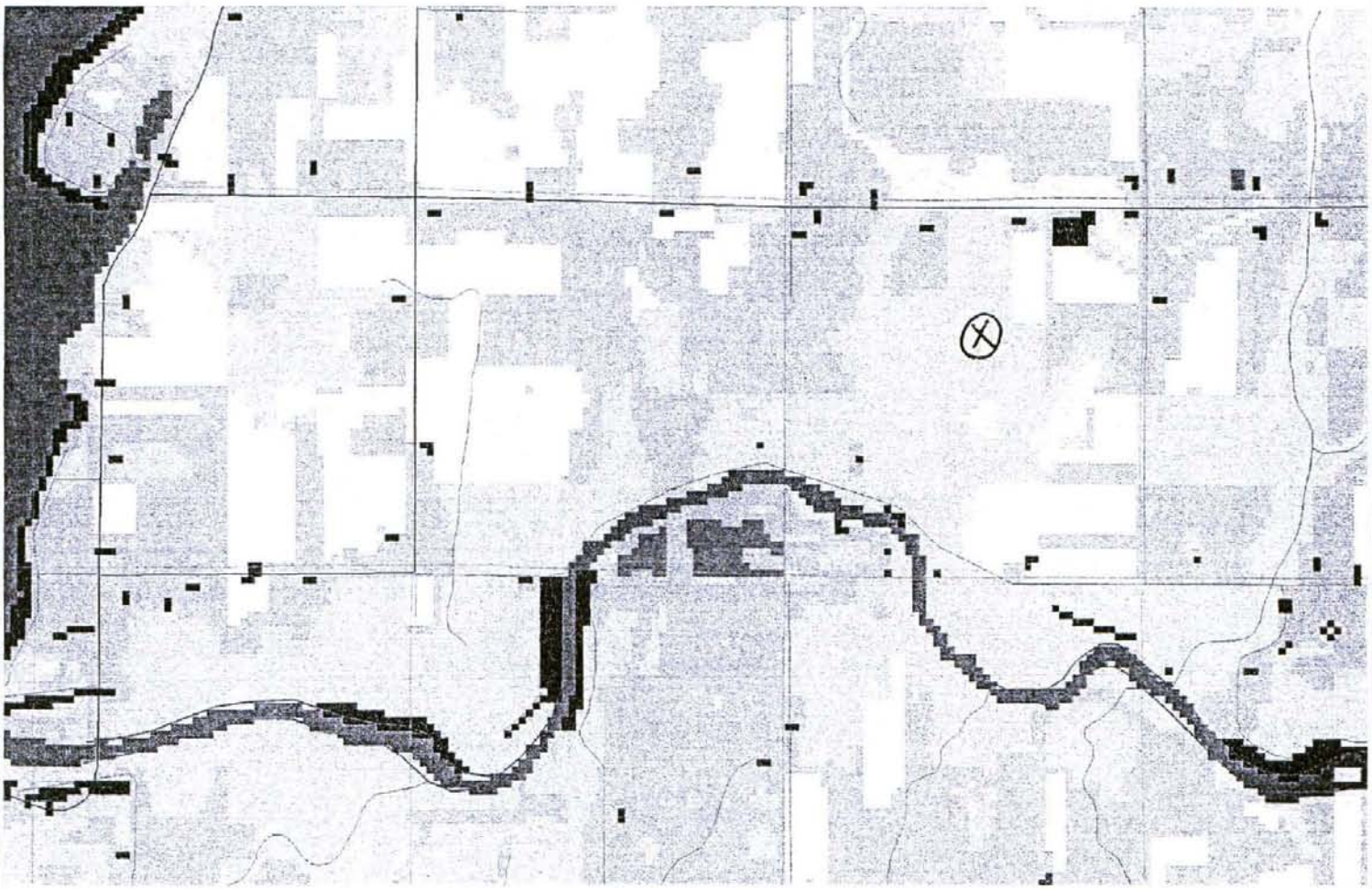
Oak wilt control in Sand Dunes State Forest - 2000			
Location	**Size in acres**	**Control method(s)**	**Previous activities on site**
Stand 14 in 25-34-27 and stand 22 in 26-34-27	<1	Vibratory plow, cut to the line, spore tree disposal	1994 = plow and CTL, 1998 = plow and CTL
Stand 1 in 16-34-28	<1	Vibratory plow	Fall 2000 = harvest clear cut with reserves
Stand 2 in 22-34-27	<1	Vibratory plow	None

There were eleven forest health - oak wilt related projects for the Mn ReLeaf biennium, 1999-2000. Reports and financial statements are not due until June of 2001. Here is the breakdown of projects by local unit of government:

Mn ReLeaf - Forest Health Grants for 1999-2000				
Local unit of government	**Type of grant and grant number**	**Forestry Area**	**Number of sites treated or other**	**Grant amount***
Chisago County	Oak wilt suppression A07992	Cambridge	26	$ 15,000
Chisago & Isanti Counties	Technical assistance A04773	Cambridge	140 hours	5,000
Isanti County	Oak wilt suppression A07991	Cambridge	26	15,000
Mille Lacs East Central Woodland Owners Council	Oak wilt suppression A08350	St. Cloud	12	10,000
Sherburne County -1	Oak wilt suppression A03275	Cambridge	50	20,000
Sherburne County -2	Oak wilt suppression A07845	Cambridge	25	15,000
Sherburne County -3	Oak wilt suppression A 06918	Cambridge	18	6,000

New Oak Wilt Pocket in Pine County - 2000

SW of NE of 19-39-20



SCALE: 0 0.5 1 mi

- Township road
- All county roads
- Major rivers
- Rivers, streams and ditches
- Township border
- Section border

Sherburne County -4	Oak wilt suppression Pending	Cambridge	6	2,500
Sherburne County	Technical assistance A13809	Cambridge	200 hours	2,100
Sherburne County	Educational A06918	Cambridge	Newsletter and education program	5,000
Stearns County	Oak wilt suppression A06924	St. Cloud	10	10,000
Total			**Sites = 173**	**105600**

* = Grant amount is less than 50% of total project monies.

Pine tussock moth

Dasychira pinicola (Dyar)

Host: Jack pine
Damage: None
Area: None
Severity: NA
Trend: Increasing again in Wadena County. See Table.

Pheromone trapping of male pine tussock moths in northeastern Wadena and southeastern Hubbard Counties in late June, July, August and early September indicated that the population of this pest of jack pine is increasing. Pheromone traps were checked every two weeks starting June 27th and ending August 6th. See Table. At five locations, it has increased sharply. Larval and defoliation surveys in May and June of 2001 will be done to determine if an insecticide application or harvesting of affected jack pine trees is warranted.

COUNTY	LOCATION	DATE TRAP PLACED	TRAP NO. OR NAME	MALE P.T. MOTHS IN TRAP	COMMENTS
Crow Wing	SWNE 11-44-28	6-20	10	22	
Crow Wing	NENE 10-44-28	6-20	11	3	
Crow Wing	NENE 16-44-28	6-20	12	27	
Hubbard	SESE 9-139-32	6-13	1	101	
Hubbard	SESE10-139-32	6-13	2	166	
Hubbard	NWNW 33-139-32	6-13	3	80	
Hubbard	SWSW 29-139-32	6-13	4	109	
Hubbard	NESE 26-139-32	6-13	5	114	
Hubbard	SESE 35-139-33	6-13	6	155	
Wadena	SWSW 10-138-33	6-13	7	112	

COUNTY	LOCATION	DATE TRAP PLACED	TRAP NO. OR NAME	MALE P.T. MOTHS IN TRAP	COMMENTS
Wadena	SWSW 19-136-33	6-13	8	82	Bird Predation (Count low)
Wadena	NWNW 5-135-33	6-13	9	104	

Spruce beetle

Dendroctonus rufipennis (Kirby)

Spruce beetles, *Dendroctonus rufipennis*, were founding killing white spruce in Judge Magney State Park north east of Grand Marais. According to the park manager, trees have been dying since 1998 and die over a period of one to two summers. They are killing mature white spruce that appear quite healthy although there probably is some soil compaction in the campground. Many of the trees also have root rot as evidenced by fruiting bodies at the root collar. Infested trees were also found in Cascade River State Park and in the Grand Portage Reservation. As far as we know these beetles are not very common in Minnesota and have only been reported a few times in the past.

The spruce beetle is a bark beetle that occurs across North America. It is a serious problem in the western US with Alaska reporting an estimated 30 million trees per year killed by spruce beetle at the peak of the outbreak, in the 1990's. It infests all species of spruce in its range.

The first sign of attack on standing trees is reddish-brown boring dust on the ground around the trunk or in bark crevices. Pitch tubes made of a mixture of pitch and reddish-brown bark may also be obvious. The pitch tubes are about 3/8 inch in diameter and up to about 3/8 inch long with a hole through the center. The beetles may complete their life cycle in one year on warm sites or take up to three years on cooler sites. We don't know how long their life cycle is in Minnesota, yet. They may overwinter as adults, as larvae , or both stages in infested trees. Most of the adults are thought to move to the base of the tree where they bore into the bark near the litter line to overwinter. Here they will be under the snow, protected from cold temperatures as well as from woodpeckers.

Spruce beetles prefer mature white spruce twelve inches in diameter and larger, however, some were found in trees as small as eight inches in diameter at Judge Magney State Park. Trees under stress from over crowding, soil compaction, root rot and/ or spruce budworm are probably more likely to be attacked. The beetles also can buildup in recent spruce blowdown.

6/29 Adult spruce beetles *Dendroctonus ruffipennis* present in a white spruce stump. The tree was removed about 9 months to 1 year ago. Judge Magney State Park, Cook Co

8/10 Spruce beetle adults present in some white spruce and immatures in others. Lots of fresh pitch tubes on trees that had no pitch tubes on 6/29. Trees with fresh pitch tubes look green and healthy. Pitch tubes found on trees from 8 inches DBH and greater. Affected trees are in a state park campground and likely have compaction and other root damage. Many of the infested trees also have root rots as evidence by mycelial fans of Armillaria or by the presence of conks of other fungi at the root collar. Old pitch tubes found 6.2 miles north of hwy 61 on #70 on north east edge of park in Sec 3-T62N-R3E. This tree was an old dead white spruce. Judge Magney SP, Cook Co

8/10 Old pitch tubes found on white spruce stump in campground in Cascade River State Park. The tree had died and was cut down a year ago. Cascade River SP, Cook Co

10/3 Spruce beetles found in 2 large white spruce. Lots of fresh pitch tubes. The tree crowns look green and healthy. Cascade River SP, Cook Co

10/4 Spruce beetles found in a live white spruce along Gunflint Trail near (Gunflint Lake overlook) trail, Cook Co — Gunflint

10/4 Spruce beetle found in several white spruce on Grand Portage Reservation. Cook Co

Spruce budworm

Choristoneura fumiferana (Clemens)

Host: Balsam fir, white spruce
Damage: Defoliation, topkill and mortality
Area: 28,481 acres statewide
Severity: Trace to heavy (See table)
Trend: Declining

Only 370 acres were defoliated in Region 3

Spruce budworm defoliation - 2000 - aerial survey				
County	Trace	Light	Moderate	Heavy
Aitkin		210	108	
Pine		52		
Totals		262	108	

Defoliation and egg mass surveys completed in July and August found very little evidence of current budworm activity in Region 3. Most plantations are deemed vigorous and one is still recovering from heavy defoliation in 1997-98. The exception is a white spruce plantation in northeastern Aitkin County where light defoliation occurred but heavy defoliation is predicted for 2001 based on egg mass counts. See Table in Spruce Budworm Survey Results.

Spruce budworm populations continue to decline in Region 2. There were 27,783 acres in Region 2 in 2000, compared to 68,024 acres in 1999. See map and table below showing acres of defoliation by severity and county in Region 2 in 2000.

County	Trace (0-25%)	Light 26%-50%	Moderate 51-75%	Heavy >75%	Moderate-Heavy* > 50%	Total
Itasca					874.7	874.7
Koochiching		333.5	7,123.8	6,192.3	4,736.9	18,386.5
St Louis	407.7	234.7	390.4		7,489.6	8,522.4
Totals	407.7	568.2	7,514.2	6,192.3	13,101.2	27,783.6

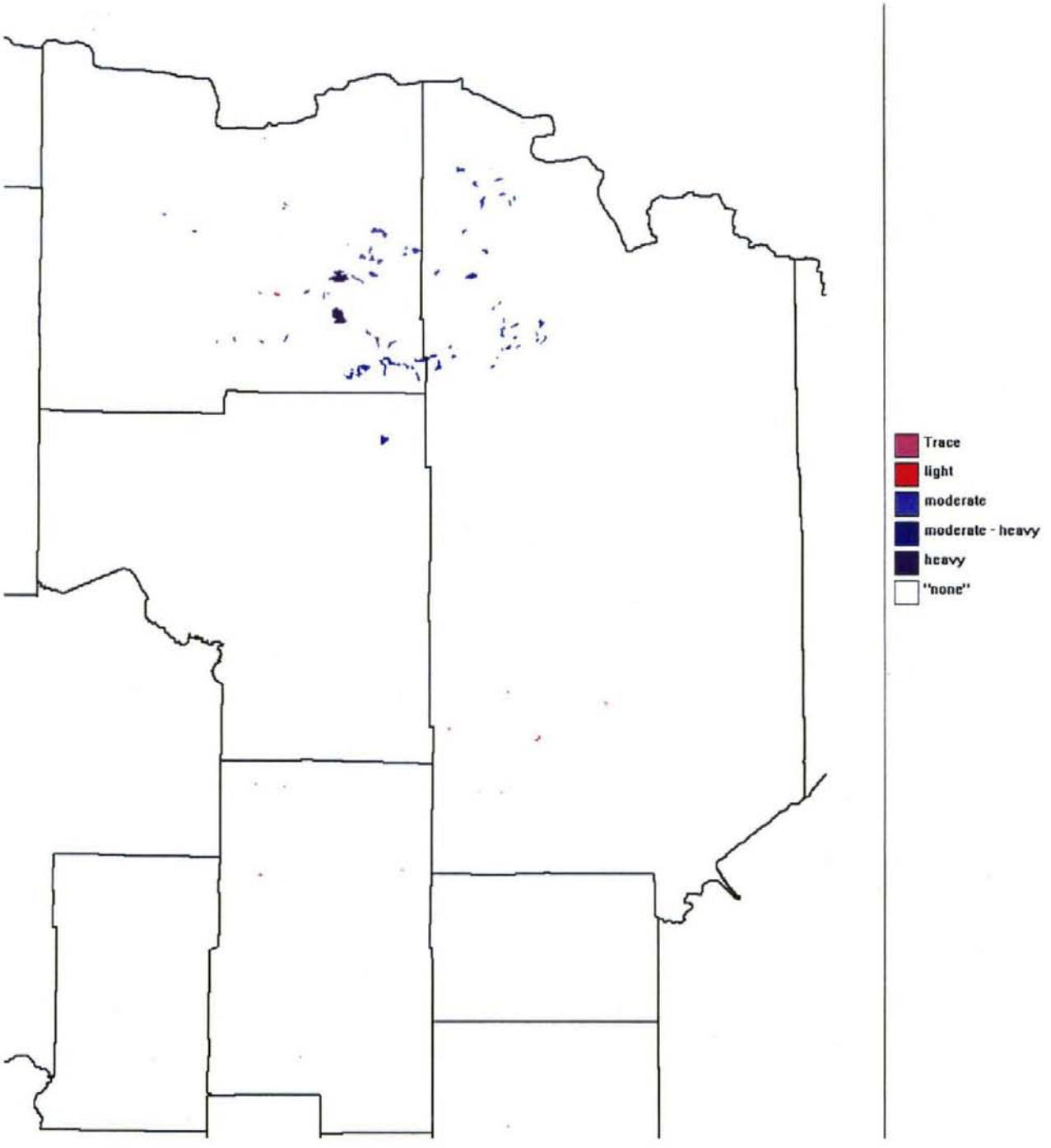
* The USFS combines the moderate and heavy categories into one called moderate to heavy(greater than 50%) and does not report moderate and heavy separately.

Defoliation and egg mass surveys were completed on 23 plots in Region 2 this past year. A comparison of results for 1999, 2000 and 2001 are summarized below. The level of defoliation declined in 2000 relative to1999. The egg mass survey predicts that defoliation will continue to decline in 2001 as well.

	Level of Defoliation			
	0	Light	Moderate	Heavy
Plots defoliated in:				
1999	4%	65%	17%	13%
2000	26%	52%	17%	4%
Predicted defoliation in:				
2001	61%	17%	17%	4%

Larval and egg mass survey data by plot can be found in the survey results section of this report.

Spruce budworm 2000



Miscellaneous Issues

Anthracnose

Apiognomonia spp.

Concurrent with the cool weather this spring was rainy weather that ultimately lead to leaf diseases. Oaks, ash and several other trees developed browned or blackened leaves due to infection by several different fungi. Damage was localized along larger rivers in Morrison, Pine and Benton Counties causing discoloration and defoliation amounting to 700 acres.

Anobiid deathwatch beetles attacking log cabins

*P*tilinus *lobatus* Casey

One case occurred in Carlton Co. (near Lawler), while the other occurred in St. Louis Co. (near Lake Vermillion). While typically lumped in with true powderpost beetles (family Lyctidae), deathwatch beetles are actually quite different in host range and biology. Lyctid powderpost beetles are confined to attacking the sapwood of large-pored hardwoods (oak, hickory, etc.) and bamboo, while the deathwatch beetles can attack sapwood or heartwood of practically any type of wood. Deathwatch beetles also have an elaborate courtship behavior that can involve eerie tapping sounds (hence the name deathwatch).

Infested logs were collected from both Minnesota localities by Dr Steve Seybold (Uof MN). New adult beetles emerged in rearing containers in the forest entomology laboratory at the UMN about two months after the logs were brought to room temperature. Pinned specimens were sent to Dr. Richard White (US National Museum, retired), who identified them as *Ptilinus lobatus* Casey. Little is known of the biology of these wood destroyers, but like all anobiids, eggs are laid from the outside in cracks, crevices, or old emergence holes on the surface of wood and larvae can take from one to six years to develop to the next generation of adults. Adults are likely emerging in Minnesota in June and July. Management techniques for these types of insects were covered in the May 12, 2000 issue of the MN DNR Div of Forestry "Forest Insect and Disease Newsletter" (see Wood Products Insects in Minnesota by Bob Tiplady). Borate insecticides are available to apply to wood surfaces to prevent newly hatched larvae from boring more deeply into the wood. They should be applied just prior to adult emergence.

Aspen blotch miners

Phyllonorycter tremuloidiella (Braun)

Aspen blotch miner defoliation was common in Region 2 during August and early September.

Aspen in parts of northeastern Minnesota including a large area from Chisholm to Ray in St Louis County turned brown by late August due to aspen leaf blotch miner activity. Many of these trees were defoliated by the forest tent caterpillar in June, refoliated in July only to be attacked by the blotch miner. This area was somewhat below normal for rainfall through the summer. These trees will likely be defoliated by forest tent caterpillar again next year. FTC egg masses are very abundant on many of the trees examined. These aspens definitely have been stressed and should be monitored for dieback and mortality.

When there is an outbreak of blotch miners, homeowners often call concerned about piles of bark scales around the base of pine trees. Birds flick the bark scales off trees to get at the thousands of overwintering, aspen blotchminer moths, and at times can remove almost all the bark scales from individual jack pines. This doesn't hurt the trees since it does not damage the phloem or cambium and is just removing the outer dead bark.

Frost

On Saturday evening, May 13, many of the wise were covering new bedding plants to prevent possible frost injury as predicated by local weather forecasters all across the southeast. As predicted, a frost occurred on Sunday morning May the 14th. The minimum temperature at the Rochester weather station reached 35F. In the surrounding country

side it can be as much as 5 to 15 degrees lower across much of the southeast depending on elevation. It resulted in wide spread frost injury all across southeastern Minnesota. About 20% of everything that was green and growing received some frost injury, most on the lighter side. Reports were widespread of injury on walnut, bur oak, hackberry, and many, many other species of trees and scrubs. During the early season, nearly all affected trees and shrubs quickly recover from light frost injury.

Meanwhile in northern Minnesota during the first week in May, many trees started extending their new leaves as temperatures soared and night-time temperatures remained higher than 50 degrees. On the 19th, freezing temperatures of 25 degrees were recorded at several weather stations across the northern two thirds of the state and many people in this area reported temperatures of 17 degrees or lower. Oaks, ash, basswood, hawthorn, sumac and many other trees' leaf tips curled and turned brown or black. Young trees and trees growing in low-lying areas were most affected. On the whole, oaks were most severely damaged.

Frost damage was visible from the air and 7439 acres were sketch-mapped along the St.Croix River in Pine and Chisago Counties. Another 66 acres were visible in Todd County.

Hail damage

A severe hail storm hit Cloquet and the Potlatch Tree Nursery in early August. Hail was reported to be as large as tennis balls. The hail severely damaged all of the bare root seedlings growing in the beds as well as the container seedlings sitting outside. Four to 5 million bare root and over one million container seedlings were damaged. Most seedlings lost the majority of their needles, had multiple stem cankers, broken or missing leaders and branches.

We recommended spraying with benomyl, as soon as possible, any beds the nursery staff were considering trying to salvage.

The nursery kept some of the container seedlings but very few of the bare root seedlings, deciding that most of them were not worth trying to save.

Imported leaf beetle

Plagiodera versicolora

The imported willow leaf beetle, was observed on willow in scattered locations in central and northern Minnesota during August causing severe leaf skeletonizing and browning. Our mild winters over the past three years may have contributed to the buildup of this beetle because only extremely cold winters kill the adults which hibernate under loose bark or in debris under trees. Both adults and larvae skeletonize and brown leaves, but the larvae do most of the damage. This introduced pest was first found in Staten Island, N. Y. in 1915, and it is now widely distributed in the eastern United States, southern Canada and Alaska. It also feed on poplars. An imported pupal parasite, *Schizonotus latus*, can increase in numbers and exert considerable natural control on beetle populations.

Jumping oak gall

Neuroterus saltatorius Hy. Edwards

Jumping oak galls were reported on a burr oak in Floodwood and on an oak tree near the golf course in Grand Rapids. The homeowner in Floodwood noticed the thousands of poppy seed sized galls bouncing on the picnic table and sidewalk near their home. The galls are caused by the activity of tiny wasp larvae inside the galls, just like miniature Mexican jumping beans. This insect is known as the jumping oak gall wasp, *Neuroterus saltatorius*. Larvae have chemicals in their saliva that stimulate the oak leaf tissue to form the yellow blister-shaped galls. As the galls mature, they are released from the leaf and rain down onto the soil. The galls bounce around until they become lodged in the soil and they overwinter there. The galls bounce one inch or more.

The galls on the oak in Floodwood were causing the leaves to curl and turn brown. Individual leaves had hundreds or thousands of galls. They are not considered to affect the health or vigor of infested trees and the infestation

usually occurs only for a year or two in any location. The tree in Floodwood also had anthracnose and spittlebug on the leaves.

Multi-colored Asian lady beetles

Harmonia axyridis (Pallas)

Residents and foresters in Regions 2 and 3 reported the appearance of a large number of ladybugs in and near their homes, offices and in the forests. The species that is being seen is the Asian lady beetle. This is the first year it was found in northeastern Minnesota and it was found from Grand Rapids to International Falls. This species is similar to our native species but is a little larger in size. The appearance of this lady beetle is highly variable. The 19 spots on its wing covers can distinguish it, though some beetles may have 2, 4, 6, 10 or no spots. The color of this lady beetle ranges from yellow-orange to dark red.

Last fall was the first year that a number of reports about the multicolored Asian lady beetle occurred in Minnesota. Large numbers of this beetle were reported in homes in other states beginning in the early nineties. Though this insect was introduced from China, the lady beetle is a beneficial insect that feeds on a variety of insects that include aphids, scale insects and psyllids found on a variety of trees and shrubs, roses, flowers and crops such as wheat. Despite the beneficial nature of these beetles, they are sometimes pests because they aggregate in large numbers on the sides of houses in the fall. Because of their large numbers at this time of year and their bright orange color it is also known as the "Halloween Lady Beetle".

The lady beetles, in late summer and autumn, may move to over-wintering sites in houses, sheds and other buildings. During warm winter days and the spring they move out from their over-wintering sites and are attracted to sources of light. These beetles are very beneficial and are in no way harmful to people though their large numbers can create quite a nuisance in homes.

Oak Tatters

Hosts:	Bur oaks
Damage:	Deformed leaves
Area:	20,000 acres
Trend:	Decline from 1999

In addition to frost injury, oak tatters were again reported on bur oak in limited areas across a the southeast. Approximately 20,000 acres of oaks were affected by tatters in early June. The size of the affected area has greatly decreased from 1999. Oak tatters is a relatively newly described condition that affects emerging oak leaves, causing them to appear lacy or tattered. We do not actually know what causes oak tatters. We have suspected in the past, early season oak anthracnose, frost injury, and possible early season thrips. The first two of which can be common in most years. None of the above may be involved. It may be something more complicated such as a virus or a bacterium. Clearly there is genetic variability from tree to tree. Samples have been collected this year for analysis through Forest Service channels. As in past seasons the affected trees refoliated with what appears to be little long term impact. Multiple year early season defoliation can eventually have a long term impact. We may start seeing some dieback in these affected bur oak, which would be significant and unfortunate loss. If and when that begins to occur it will be verified by 2-lined chestnut borer causing branch dieback.

Pale Green Weevil

Polydrusus impressifrons (Gyllenhal)

This exotic weevil was abundant in locations throughout Region 2 again this year. Population numbers did not appear to be quite as high this year around Grand Rapids as in the last several years but they were still common. The weevils were common in Judge Magney State Park northeast of Grand Marais this year.

Root Rot Problem in Nursery

Routine checks at Gen. Andrews Nursery found what appeared to be a root rot problem in the 2-0 red oaks in mid-June. Two inches of the distal ends of the roots were black. Also noted was heavy white grub populations that probably caused wounds serving as the entry points for the fungal infections. Dr. Juzwik, NCFES, and Sandy Gould, U of M Disease Clinic, found *Fusarium* and *Pythium* spp. to be the causal agents.

Jan Thompson, U of Iowa-Ames, was also consulted and she though that the root rot would not be a survival problem if the seedlings were given 6-8 weeks of growth prior to root pruning in mid-August. Root pruning would not spread the problem.

High water

In the Northern and Northwestern parts of Region 1, wet conditions during the growing season have produced high water tables resulting in red and jack pine mortality, especially in areas of human development and plantation trees. White Pines and spruce species seem to have faired better than the red and jack pine components in those stands. High water tables around lakes, ponds, etc., also accounted for mortality of fir, cedar, tamarack, and mixed hardwoods.

White pine needle blight

Canavirgella banfieldii Merrill, Wenner & Driesbach.

White pine needles infected by the needle blight fungus, *Canavirgella banfieldii*, fade out to a grayish tan color by June. Scattered infected trees were observed in Itasca and St. Louis Counties this year. Heaviest needle infection usually seems to be confined to the lower ¼ to ½ of the tree crown. Mature fruiting bodies, present by June, are thin, dark gray and run along the length of the needle. Some of these fruiting bodies are over an inch long.

Yellow witches broom on spruce (also called spruce broom rust)

Chrysomyxa arctostaphyli Dietel

What appears to be yellow witches broom of spruce, caused by *Chrysomyxa arctostaphyli*, was found on a white spruce in Judge Magney State Park northeast of Grand Marais this summer. This rust disease occurs mainly on black, Norway and white spruce. Bearberry, also called kinnikinnick, is the alternate host. This disease is reported to occur throughout the range of its hosts in eastern Canada but is not reported very often in Minnesota.

The most obvious symptom of the disease is a witches' broom with stunted needles. In summer the broom turns a very conspicuous yellow. The needles are shed in the fall and the broom appears dead over the winter but produces new needles the next spring.

The broom in Judge Magney State Park occurs on a white spruce infested with spruce beetle and will be removed this winter to control the beetle in the campground.

Weather related injuries to sugar maples in southern Minnesota

The mid-summer heat has visibly taken a sizeable toll on sugar maple's in urban areas across southern Minnesota. Despite the extra rainfall earlier this summer, (which resulted in huge amount of iron chlorosis) the weather turned dryer and hotter by mid-July. Acute leaf scorch first became most evident, especially on trees with associated local heat stress. By early August widespread early fall color and defoliation was common on sugar maple. There is more widespread visibility this year than has been observed in several recent years. These observations are likely going to translate into serious losses of sugar maple in many cities and towns over the next few years.

All of this increased visibility is likely related to recent climatic conditions. The fall of 1999 was very dry. In fact, in southern Minnesota, a news release was issued to address the predicted moisture shortfall going into the fall. The

winter was very mild, in fact, a 20 year high temperature of 75 was recorded in March at Rochester. In some areas a frost followed later in the spring. This resulted in the several instances of winter drying in newly transplanted conifers in the region, (several scattered locations) and may be related to the scattered dieback in hardwoods across the region and in particular to the serious ash dieback in the city of LeSueur.

The sugar maple losses will mount and continue to be an increasing problem. Although weather related several stress inducing issues are at work on individual trees and include, site, cultural, disturbance, girdling roots, Armillaria, verticillium, and likely unknown influences. Planting too deeply is a common occurrence, and it can take years for the inevitable end.

In addition however, there is a serious lack of any follow-up in the field of maple clones, seed sources, or tracking of a genetic nature, in the urban landscape. There is dramatic, genetic variability out there, that remains unexplored!

Wind, salt spray and freeze-thaw cycles

In Isanti County, there are two major highways that move traffic, lots of traffic, to and from Cambridge. Red pines planted thirty to fifty years ago bear witness to this in the form of red needles and declining and dying lower twigs on branches facing the roads. On some trees, 100% of last year's needles are 50 to 75% dead. Yet, needles produced this spring are green and the new shoots are vigorous. These trees were planted in two to five rows paralleling the roadways and are within twenty to fifty feet of the pavement. They are overcrowded now, as are many trees of this vintage. The extent and severity of needle reddening is worse on pines near road curves and trees along stretches of road where pines line both sides of the road.

Red pines have a very low tolerance to salt spray that is revealed by needle tip dieback and reddening in late winter. Salt spray is made up of chlorine and sodium ions in liquid water. It's the chlorine that causes the problem. Chlorine ions accumulate to lethal concentrations in needle tips. Wind enters the picture as micro-wounds due to needle abrasion allow entry of the toxic chlorine ions and loss of water vapor. And that's not all that the salt spray does. Salt injury can impair cold hardiness and recurrent salt damage causes twig, branch and even tree death.

Along these highways there's always some winter/ salt injury. What was so different about last year? To begin with, more road salt was applied. These highways were pre-treated with a liquid salt solution before the snow storms and then treated afterwards with granular salt. Salt sprays are created as vehicles travel over the roads. Pine needles are very efficient collectors of salt spray droplets. So when eddies of salt sprays are swirling around they are quickly gleaned by needles close to the ground and close to the road.

Secondly, the winter was mild with many episodes of freezing-thawing. Needle tip dieback results from the deprivation of internal water when the needles are temporarily thawed and water vapor leaves the needles. In the presence of salt spray, more needle tissues are killed. This winter, 100% of the exposed needles had tip dieback on upwards of 50% of the pines growing along these highways.

Incidental Pests

Insects

INSECTS	HOST	COUNTY	COMMENTS
Mountain ash sawflies *Pristiphora geniculata*	Mountain Ash	Itasca	1/8 inch long in first week of June
Spiny ash sawfly *Eupareophora parca*	black ash	St Louis Co	Week of June 5th in Ash River Campground
Pale green weevil *Polydrusus impressifrons*	hardwood trees and shrubs, herbaceous veg.	Itasca	First adult of year on June 7th
Small spruce weevil *Pissodes rotundatus*	white spruce	Itasca	Adults reared from dead trees in Federal plantation near Marcell
Bronze birch borer *Agrilus anxius*	paper birch	Itasca	Adult on 6/12
Yellowheaded spruce sawfly *Pikonema alaskensis*	white spruce	Itasca	1 inch long larvae on 6/27
White pine weevil *Pissodes strobi*	blue spruce	Itasca	On 3-5 foot Christmas trees
Hedgehog gall *Acraspis erinacei*	white oak	Itasca	Common
Birch leaf miner *Fenusa pusilla*	paper birch	St Louis	
Maple petiole borer *Caulocampus acericaulis*	sugar maple	Itasca	
Spittlebug Unidentified	white oak	St Louis	Floodwood
Pine root collar weevil *Hylobius radicis*	Scotch pine	Itasca	
Maple Petiole Borer *Caulocampus acericaulis*	Sugar Maple	Becker	Early June. Not widespread
Cottony Maple Scale	Silver Maple	Beltrami	Less common in 2000
Birch Leaf Aphids	White Birch	Cass, Beltrami	June-July. Less common in 2000.
Striped Alder Sawfly	White Birch	Beltrami, Cass	Yard trees

Aspen Blotch Miner	Quaking Aspen	Central and Northern	Low populations in 1998-1999
Large Aspen Tortrix	Quaking Aspen	Beltrami, L.O.W.	Scattered, isolated, populations
Imported Willow Leaf Beetle	Willow sp.	Hubbard, Beltrami, Roseau, L.O.W., Pennington	Widespread in Region June-August.
Elm Sawfly	American Elm Willows	L.O.W.	Large Saw-coils when not feeding. July
Box-Elder Bugs	Box Elder	All counties	This is their year!
Introduced Pine Sawfly	White Pine, Scots Pine, Red Pine	Beltrami, Cass, Hubbard, Clearwater	Throughout Region and June-September
Spruce Budworm	White Spruce, Balsam Fir	Hubbard, Beltrami, Cass	Population collapsed since 1998 high.
Yellowheaded Spruce Sawfly	White Spruce reproduction	Beltrami, Hubbard	Few reports - down in activity from 98 year.
Jack Pine Budworm	Jack Pine	Hubbard, Beltrami, Becker	Nearly absent from 1998 low levels of defoliation.
Pine Bark Adelgids	White Pine	Clearwater	Shaded yard trees.
Pine Bark Aphids	White Pine	Clearwater	Associated with Black sooty mold.
Gypsy moth	Hardwoods	Becker	One adult male trapped in Detroit Lakes
Mountain Ash Sawfly	Mountain Ash	Beltrami, Hubbard, Clearwater	Generally some each summer in yards. Two generations.
Aphids Galls	Oaks (Bur)	Hubbard, Beltrami, Clearwater, Cass	Less reported and observed in 2000.
Abbot's sphinx moth caterpillar *Sphecodina abbottii*	Woodbine	Crow Wing	
Acorn nut weevil *Curculio* spp.	Oak	Crow Wing	
Alder tubemaker *Acrobasis rubrifasciella*	Alder	Aitkin	
Aphids *Cinara* spp.	Jack pine	Central MN	
Aspen leafblotch miner *Phyllonorycter ontario*	Aspen	Central MN	Widespread

Bark beetles *Ips pini*	Pines	Central MN	Stressed trees
Basswood leaf roller *Pantographa limata*	Basswood	Crow Wing 7-137-27	20-26 mm long.
Birch leaf miner *Fenusa pusilla*	Paper birch	Central MN	Fairly low populations.
Boxelder bug *Leptocoris trivittauts*	Boxelder	Crow Wing	
Bronze birch borer *Agrilus anxius*	Paper birch	Crow Wing	Stressed trees
Carpenter ants *Camponotus pennsylvannicus*	Pines	Central MN	Excavate nests in heartwood
Cottony maple scale *Pulvinaria innumerabilia*	Basswood	Ottertail	
Dusky birch sawfly *Croesus latitarsus*	White birch	Cass	
Eastern spruce gall adelgid *Adelges abietis*	White spruce	Central MN	
Eastern tent caterpillar *Malacosoma americanum*	Cherries	Crow Wing, Wadena	
Eastern larch beetle *Dendroctonus simplex*	Larch	Pine	
Flat leaftier *Psilocorsis reflexella*	Burr oak	Crow Wing, Morrison, Todd, Isanti	
Gall wasp *Neuroterus* spp.	Burr oak	Stearns	
Imported willow leaf beetle *Plagiodera versicolora*	Willow	Hubbard	
Introduced pine sawfly *Neodiprion sertifer*	Pines	Central MN	
Jack pine sawfly *Neodiprion pratti banksianae*	Jack pine	Wadena	
Leaf rollers Unknown species	Basswood	Crow Wing	
Longhorned beetle *Sarososthes fulminans*	Oak	Pine	
Maple petiole borer *Caulocampus acericaulis*	Maple	Todd	

Maple bladdergall mite *Vasates quadripedes*	Maple	Crow Wing	
Mites *Phytoptus emarginatae*	Plum	Pine	Yard trees
Mountain ash sawfly *Pristiphora geniculata*	Mountain ash	Central MN	Widespread, esp. on ornamentals.
Northern pine weevil *Pissoides approximatus*	Jack pine	Wadena	Stressed trees
Oak lace bugs *Corythucha arcuata*	Burr oak	Morrison	
Oak apple gall *Amphibolips* sp.	Oaks	Morrison	
Oak leaf blister mite *Aceria mackei*	Burr oak	Crow Wing	
Oak webworm *Archips fervidanus*	Oaks	Crow Wing	
Oak twig pruner *Elaphidionoides villosus*	Oak	Pine	
Pine spittlebug *Aphrophora parallela*	Pine	Benton, Stearns	
Pine root collar weevil *Hylobius radicia*	Pines	Central Mn	
Pine tortoise scale *Toumeyella parvicornis*	Jack pine	Crow Wing	
Pine flower sawfly *Xyela minor*	Norway pine	Crow Wing	
Pitch mass borer *Synanthedon pini*	White spruce	Pine, Morrison	
Poplar petiole gall aphid *Pemphigus populitransversus*	Cottonwood	Crow Wing	
Poplar borer *Saperda calcarata*	Poplar	Hubbard	
Poplar and willow borer *Cryptorhynchus lapathi*	Willow	Morrison	
Ragged spruce gall adelgid *Pineus similis*	White spruce	Sherburne	
Red pine sawfly *Neodiprion nanulus*	Jack pine	Crow Wing	

Red turpentine beetle *Dendroctonus valens*	Pines	Crow Wing, Cass, Sherburne	
Roly-poly gall Species unknown	Oak	Crow Wing	
Rose chafer beetle *Macrodactylus subspinosus*	Broadleafed trees	Crow Wing	
Rough bullet gall *Disholcaspis mamma*	Burr oak	Crow Wing	
Slug oak sawfly *Caliroa quercuscoccineae*	Burr oak	Crow Wing	
Soldier beetle *Podabrus* spp.	White spruce	Stearns	
Spider mite *Oligonychus* spp.	Spruce	Crow Wing	
Spruce gall midge *Mayetiola piceae*	White spruce	Crow Wing	
Succulent oak gall *Andricus palustris*	Red oak	Morrison	
Twig gall *Andricus formosus*	Burr oak	Stearns	
Two-lined chestnut borer *Agrilus bilineatus*	Oak	Crow Wing	Stressed yard trees. Low populations.
White spotted sawyer beetle *Monochamus scutellatus*	Pine	Pine	
White pine bark adelgid *Pineus strobi*	White pine	Crow Wing	Especially on bud capped seedlings.
White pine weevil *Pissodes strobi*	White pine	Crow Wing, Cass	
Willow sawfly *Nematus salicisodoratus*	Bigtoothed aspen	Crow Wing	
Wood borers Cerambicids and Buprestids	Various trees	Central MN	Stressed trees or logs
Wool-bearing gall wasp *Andricus lanigerus*	Burr oak	Central MN	
Woolly alder aphid *Prociphilus tellelltus*	Silver maple	Crow Wing	
Woolly elm aphid *Eriosoma americanum*	Elm	Crow Wing	

Yellowheaded spruce sawfly *Pikonema alaskensis*	White spruce	Central Mn	Small trees in plantations.
Zimmerman pine moth *Dioryctria zimmermani*	Spruce	Central MN	

DISEASES

DISEASE	HOST	COUNTY	COMMENTS
Spruce needle rust *Chrysomyxa ledi*	Blue spruce	Carlton, St Louis	Near Cloquet and Pike Lake
Anthracnose *Apiognomonia errabunda*	white oak	St Louis	Floodwood
Tar spot *Rhytisma salicinum*	willow spp.	St Louis	North of Cook
Black knot *Apiosporina morbosa*	Prunus sp	Cook	Judge Magney State Park
Rhizophaera Needlecast	Blue Spruce, White Spruce	Beltrami	Near shorelines. Mature trees.
Armillaria	White Cedar	Hubbard	Northern White Cedar Hedge, stressed soils.
Armillaria	Balsam Fir, White Spruce	Beltrami	Stressed yard trees.
Pine Needle Rust	Jack Pine	Hubbard, Beltrami, Roseau, L.O.W.	Seedlings and small sapling plantation trees. Thick vegetation.
White Pine Needle Blight	White Pine	Clearwater, Hubbard, Becker, Beltrami	Wherever White Pine are found.
Ash anthracnose *Discula umbrinella*	Ash	Crow Wing	
Balsam fir needlecast *Rhizosphaera pini*	Balsam fir	Crow Wing	
Black knot *Apiosporina morbosa*	Pin cherry, plum	Crow Wing, Stearns	
Butternut canker *Sirococcus clavigignenti-juglandacearum*	Butternut	Cass	

Cytospora canker *Leucostoma kunzei*	Spruce	Crow Wing, Morrison	
Diplodia shoot blight *Sphaeropsis sapinea*	Norway pine	Central MN	
Dutch elm disease *Ceratocystis ulmi*	American elm	Central MN	
Eastern gall rust *Cronartium quercuum*	Jack pine	Crow Wing, Wadena	
Elm wetwood *Erwinia nimipressuralis*	American elm	Isanti	
Leaf rust *Melampsora* spp.	Poplars	Pine	
Leaf and shoot blight *Venturia macularis*	Trembling aspen, balsam poplar	Central MN	
Maple leafspot Undetermined	Maple	Crow Wing	
Oak anthracnose *Apiognomonia quercina*	Burr oak	Central MN	
Plum pocket *Taphrina communis*	Plum	Crow Wing	
Root rot *Armillaria* sp.	Balsam fir	Cass	
Septoria leafspot *Septoria musiva*	Trembling aspen, balsam poplar	Central MN	
Sirococcus shoot blight *Sirococcus conigenus*	Norway pine	Central MN	
Spruce needlecast *Rhizosphaera kalkhoffii*	Spruce	Central MN	
White pine blister rust *Cronartium ribicola*	White pine	Central MN	
Witches' broom Unknown species	Balsam fir	Crow Wing	

Animal and abiotic	**Host**	**County**	**Comments**
Animal			
Gopher	Scotch pine	Crow Wing	Plantation
Sapsucker	Ash, birch, spruce, scotch pine	Central MN	

Chlorosis	Spruce	Pine	Seasonal high water runoff of ice control chemicals, and septic tank effluent
Drought	Pines and spruce	Crow Wing	
Drought and wind	Norway pine	Isanti	Roadside trees
Fire scarring	Norway pine	Crow Wing	
Frost	All trees	Central MN	Leaf and bud mortality
Herbicide damage	Pines	Morrison	Plantation
Mouse girdling	White cedar	Crow Wing	
Road compaction	White pine	Morrison	Gravel and oil on road near trees
Root confinement	White spruce	Crow Wing	Burlap root covering not removed or cut after transplanting
Root damage	Norway pine	Isanti	Excavations
Salt damage	White pine	Pine	Salt deicer runoff from concrete driveway
Septic tank effluent	Norway pine	Pine	
Sunscald trunk crack	Sugar maple	Cass	
Transplanting mortality	Norway pine	Wadena	Planted 6 inches above root flare and j rooted
Sapsuckers	Mountain ash, blue spruce, balsam fir, jack pine	Beltrami, Hubbard, Cass	Stressed yard trees
Fluctuating water table	Red pine, jack pine, aspen, white spruce	Beltrami, Clearwater, Polk, Mahnomen, Roseau. L.O.W., Kittson, Marshall, Pennington	Wet condition 1999-2000 growing seasons
Grade change- dirt fill	Burr oak, black ash	Hubbard	10 inch fill on root systems. Dieback of crown.
Mechanical tree spade	Red pine, white spruce	Beltrami, Hubbard	Planting shock. Summer transplanting

Phenology for 2000

Date	*Event*	*Location*
3-21	Wildfire season was off to a brisk start with 170 fires occurring during the first snow free week in March.	State-wide
3-31	Trembling aspen catkins out.	Itasca
4-07	Aspen male catkins ½ to 1 ½ inch. Elms blooming.	Crow Wing
4-1	Silver maples blooming	Crow Wing
4-11	Maple buds swollen. Some aspen with catkins (< 1%).	Aitkin
4-13	Red turpentine beetles emerging	East Central MN
4-14	Buds not swollen on oak or aspen leaves	Todd
4-14	Lilac leaves to 1 ½ inches.	Crow Wing
4-19	Poplars blooming.	Morrison
4-19	Aeciospores of white pine blister rust visible on cankers. Gooseberry leaves 3/4 inch long. Dandelions blooming.	Crow Wing
4-21	Aeciospores of white pine blister rust visible on cankers.	Morrison
4-24	Crabapple leaves showing	Crow Wing
4-25	Larch needles just visible	Crow Wing, Aitkin
4-25	Dandelions blooming	Crow Wing
4-28	Larch needles present.	Todd, Morrison, Aitkin
4-28	Basswood leaves green tip to ½ inch long. Small leaves on understory shrubs. Boxelder in flower and leafing out. Wood anemone in bloom.	Todd
4-28	Willows leafing out.	Carlton, Aitkin
5-01	Few aspen clones (<1%) beginning to show green. Sugar maple flowers unopened but pendant. Common elder buds ready to open. Blooming: bloodroot, Hepatica.	Itasca
5-01	Aspen leaves about 1 inch long. Amelanchier blooming. Honeysuckle leaves out.	Isanti
5-01	FTC hatched within last day. Oak buds ½ to ¾ inch long. Some basswood and oaks with crowns appearing green. Blooming: marsh marigolds. E. shore ML.	Mille Lacs
5-01	Paper birch catkins well developed and small leaves showing. Choke cherries in bloom	Crow Wing
5-02	FTC 4 mm and secreting silk threads. FTC drop when disturbed. Many flies eating FTC. Basswood buds to 1 inch	Todd

5-02	Crab apple leaves present. Most aspen twigs look green, some with leaves about 1 inch long. Weeping willow catkins yellow with pollen and small green leaves just visible.	Pine
5-02	About 1% of aspen clones look green. Very few clones with small leaves. Red maples blooming. Marsh marigolds blooming.	Aitkin
5-02	Sugar maples blooming.	Itasca
5-02	FTC just hatched. Oak leaves showing. Tamarack needles about ½ inch long. Jack pine candles to 2 inches with plump staminate cones, red pine similar. Plums blooming	Crow Wing
5-04	FTC second instar	Todd
5-04	FTC 1/8 inch long.	Crow Wing
5-05	About 95% of deciduous tree leafed out	Crow Wing, Morrison
5-05	White spruce buds to l inch, and bud caps 2% off. No SBW observed.	Morrison
5-05	FTC in first instar. Wild strawberries blooming. Father Hennepin State Park.	Aitkin
5-05	White spruce buds to 1 inch and 1% of bud caps off. Lilacs and flowering crab apples blooming	Sherburne
5-05	White trillium blooming	Kanabec
5-05	Rosy maple moths sighted.	Crow Wing
5-07	Many red turpentine beetles in traps	Crow Wing
5-08	FTC second instars	Crow Wing, Mille Lacs
5-08	Lilacs, crabapples and pears blooming	Crow Wing
5-09	FTC 1/4 inch long. Jack pine pollen being shed. Ash leaves showing. Oak leaves about 3 inches long. End of pin cherry bloom. Choke cherries in white bud stage.	Crow Wing
5-09	Jack pine candles 1-2 inches long; male cone clusters visible. Sugar maple leaves 2-3 inches. Aspen fluff is flying. Bigtooth leaves about 1 inch long. Amelanchier is done blooming. Peak pin cherry and crab apple bloom. Lilac inflorescenses fully extended and a few blossoms open. Marsh marigolds blooming. A jillion dandelions blooming.	Cass, Itasca
5-10	FTC to l and ½ inch, but most ½ inch, on basswood. Basswood leaves 3/4 full size. Bigtooth aspen leaves to 2 inches long. Ash leafing out. Blooming: Chokecherries, meadow-rue, pin cherries, lilacs (in farmsteads, just starting), crab apples at peak. Dandelions done but yellow still visible.	Todd
5-10	Mountain ash blooming	Crow Wing
5-15	Rust galls on jack pine sporulating. Found 2 pine tussock moth caterpillars in drop cloth sampling. Mocassin flower blooming. Wild strawberries and blueberries blooming. Pin cherries blooming and pink lady slippers in bud	Hubbard

5-15	Hoary puccoon, water cress, lilacs, Trillium, wood anemone and juneberries blooming	Cass
5-16	Spruce budworm 1/8-3/16th inch long on balsam fir.	Togo, Itasca Co
5-16	Ash not leafed out. JP gall rust, no aeciospores. Blooming: Hoary puccoon, yellow corydalis, wood anemone, fumitory, little blue-eyed grass, wood betony, low bush blueberry, crab apples, lilacs, dandelions and birds-foot violet. Wild plum just past blooming.	Wadena
5-16	Bark beetles on Jack pine- some eggs have hatched and grubs are feeding and tunneling.	Wolf Lake, Itasca Co
5-17	Blooming: Trillium, lilac (pre-peak), yellow rocket.	Pine
5-17	Rough bullet galls on oak leaves. Bur oak, long-plumed purple avens blooming.	Crow Wing
5-18	Pine bark beetles laying eggs in fire damaged trees. Red turpentine beetles same.	Sherburne
5-18	Large aspen tortrix feeding on aspen near Duluth at junction of Martin Road and Jean Duluth Road. Larvae approximately 1/4 inches long.	Duluth, St Louis Co
5-18	FTC larvae about 1/4 inches long at junction of Martin and Jean Duluth roads.	Duluth, St Louis Co
5-18	Ash terminal buds just breaking on a few trees. Blooming: lots of Trillium, crab apple, choke cherry full bloom.	Itasca
5-20	FTC 3/4 inch and starting to disperse	Todd
5-22	Larch casebearer common on tamarack along Hwy 46 from Deer River to Winnie.	Itasca Co
5-22	Jack pine gall rust just beginning to sporulate. Jack pine needle rust sporulating. Bur oak catkins emerging, all new oak leaves killed by frost on the 19th. Bigtooth leaves nearly 2 inches long. Blooming: Pale corydalis, yellow corydalis, wood betony (just starting) and winged Polygala. Cotton grass and choke cherries blooming.	Wadena
5-23	Spruce budworm 1/4 to 1 inch long; found 1 pupa. Spruce bud scale females with many eggs in body. Wild geranium and Indian paintbrush blooming .	Morrison
5-24	Maple bladdermite galls on silver maple.	Crow Wing.
5-25	Downy phlox and meadow parsnip blooming	Cass
5-26	Rosy maple moths emerging	Crow Wing
5-26	FTC larvae are ½-1½ inches long with most about 1 inch long. They have completely defoliated some fairly large patches of large aspen trees and some are migrating across a gravel road.	Nashwauk, Itasca Co
5-26	Larch casebearer on tamarack north of Nashwauk.	Nashwauk, Itasca Co
5-26	FTC to 1 and ½ inch	Wright
5-27	Many rosy maple moths	Crow Wing

5-31	Red turpentine beetles were common in the base of red pines in areas where crown fire went through a red pine plantation on the Elbow lake fire.	North of Cook, St Louis Co
5-31	Pink mocassin flower blooming	Hubbard
5-31	Goatsbeard and lupine blooming	Crow Wing
5-31	Larch casebearer along Hwy 73 north of Chisholm, also around Cook and north of Cook on Hwy #24.	Cook, St Louis Co
5-31	FTC larvae 1¼ -1½ inches long and have defoliated trees on the hills to the east of Virginia. Pockets of complete defoliation from near Ironworld and north on Hwy 73 to Sturgeon River. Also pocket of complete defoliation around and north of Cook.	Cook, St Louis Co
5-31	Only a few *Ips pini* found in burned red pines in a plantation on the Elbow Lake fire. Egg niches were present in the tunnels but no larvae yet	North of Cook, St Louis Co
6-02	Rose chafer beetles shredding leaves and flowers	Crow Wing
6-07	First *Polydrusus* weevil of the year observed in Grand Rapids.	Itasca Co
6-07	FTC 80% 2 inches long, but no cocoons	Crow Wing
6-07	Labrador tea in bloom	Aitkin
6-08	Spruce budworm larvae are about 5/8th inches long with a few up to 3/4 inches. Defoliation is very light with no obvious color change to the foliage even though the larvae are quite abundant on white spruce and balsam fir trees just southwest of the junction of Hwy 73 and 53. No pupation has occurred yet.	Northwest of Cook, St Louis Co
6-08	Larch casebearer present in Koochiching Co along Hwy 6.	Koochiching Co
6-08	Pockets of FTC defoliation between Littlefork and Ray. No defoliation observed between Littlefork and Big Falls. Defoliation evident south of Big Falls along Hwy 6 in a few pockets	Koochiching Co
6-08	Lots of FTC near Kabatogama DNR Station.	Kabatogama, St Louis Co
6-08	Very few spruce budworm in white spruce plantation north of Ash River trail.	Kabatogama, St Louis Co
6-08	No spruce budworm found in Paul Vohler memorial plantation planted in 1978 along the Johnson Farm Road. SBW larvae were easy to find in white spruce plantation past the hunting shack south of the Johnson Farm Road. Defoliation was light and probably undetectable by aerial survey.	North of Orr, St Louis Co
6-08	Mt Ash Sawfly larvae are 1/8 inches long	Grand Rapids, Itasca Co
6-08	FTC 1½ -1¾ inches long. No cocoons yet. Heavy defoliation of aspen in patches. Quite a few of the grey flies present in some locations	North of Chisholm, St Louis Co

6-08	Spruce budworm 5/8-3/4 inches long west of Pelican Lake. No pupation has occurred yet. Very little defoliation. No shoots were completely defoliated and there is no color change due to the defoliation	Orr, St Louis Co
6-09	Spruce budworm starting to pupate near Myrtle Lake and Pelican Lake. Most budworm are in the 5th and 6th instars but there are still a few earlier instar larvae also present	Orr, St Louis Co
6-09	FTC cocooning. Noted defoliation of red maples and larches. Rosey twisted stalk blooming	Crow Wing
6-12	Adult bronze birch borer on paper birch tree.	Grand Rapids, MN
6-13	Blackberries blooming	Pine
6-13	Jack pine gall rust done sporulating	Wadena
6-13	Oxeye daisy, common fleabane, yellow goat's beard and roundleaf ragwort blooming	Cass
6-14	Only found 2 FTC cocoons, rest were 1 ½ - 2 inches long. Observed 1 "sacked-out" caterpillar. Several friendly flies. Mille Lacs. Blooming: blackberries, oxeye daisies, birdsfoot trefoil, lilacs and black locust.	Mille Lacs
6-14	Callow bark beetle adults in red pine log pile. (near Savana Portage State Park)	Aitkin
6-15	FTC up to 2-2¼ inches long but none are pupating yet along Tescher Road and Jean Duluth Roads.	Duluth, St Louis Co
6-15	FTC starting to pupate.	Larson Lake, Itasca Co
6-15	Spruce budworm pupae and 6th instar larvae present	Larson Lake, Itasca So
6-15	Large aspen tortrix have pupated along the Jean Duluth Road.	Duluth, St Louis Co
6-16	Spruce budworm have all pupated along the Smith Creek Road.	Grand Rapids, Itasca Co
6-19	Blooming: Beard's tongue, white water lily, wild geranium, blue flag iris.	Cass, Wadena
6-19	Red pine sawfly 5/8 inch long feeding on jack pine.	Crow Wing
6-21	Spruce budworm moths emerging from pupal cases along Smith Creed Road.	Grand Rapids, Itasca Co
6-22	Larch case bearer caused moderate defoliation to tamarack.	South of Tower, St Louis Co
6-22	FTC pretty continuous from Ely to Babbit but pretty spotty from Virginia to Ely and Virginia to Babbit.	St Louis Co
6-22	A few FTC spinning cocoons but most are caterpillars still feeding.	Lake One, Lake Co

6-22	FTC spinning cocoons	Tower, St Louis Co
6-26	Greenstriped mapleworm 1/8 inch	Crow Wing
6-27	Yellowheaded spruce sawfly feeding on 2 fifteen foot tall white spruce trees along River Road. One tree has been heavily defoliated. Larvae are 1 inch long.	Grand Rapids, Itasca Co
6-27	Jack pine sawfly larvae feeding in colonies. Various and mixed sizes in each colony. Blooming: Wood lily, Canadian lily, harebells,downy phlox, yellow hawkweed, Indian paintbrush, ground cherry, daisy fleabane and goat's beard. Wintergreen and Pyrolas just starting to bloom. Wild strawberries ripe.	Wadena
6-29	Adult spruce beetles *Dendroctinus ruffipennis* present in a white spruce stump. The tree was removed about 9 months to 1 year ago	Judge Magney State Park, Cook Co
6-30	FTC 97% pupated north of Duluth	Duluth, St Louis Co
7-03	Larch casebearer moths emerging	Aitkin
7-06	Wild carrot, Joe-pye weed, common milkweed and woodland sunflower blooming	Benton
7-06	Milk vetch, black-eyed susan, mullein, fireweed, butterfly weed, blue vervain, and turk's cap lily and swamp milkweed blooming	Pine
7-06	Introduced pine sawfly larvae ½ inch	Wadena
7-07	Poke milkweed, common treefoil, and creeping bellflower blooming	Stearns
7-10	Grand Rapids was covered with a moth flight of FTC overnight. Sidewalks and sides of buildings especially near all night lights were covered with FTC moths. There were no areas of heavy defoliation within 15 miles of town.	Grand Rapids, Itasca Co
7-10	FTC moths	Crow Wing
7-11	Pine spittlebug adults mating	Stearns
7-11	Bull thistle, soapwort, and evening primrose blooming	Todd
7-12	FTC moth flight in Two Harbors and Split Rock Lighthouse State Park observed today.	Two Harbors, Lake Co
7-13	Jumping oak galls jump.	Hubbard
7-13	Aspen defoliated by FTC north of Chisholm have now refoliated pretty	Chisholm, St Louis
7-13	well.Spruce budworm caused moderate to heavy defoliaton of balsam fir just 2.3 miles south west of junction of Hwy 53 and 73. Even with this level of defoliation there is no color change of the foliage or tree and this defoliation would not be observable during aerial survey.	Cook, St Louis Co
7-14	Jumping oak galls on oak in Floodwood. Also reported on oak near golf course in Grand Rapids.	St Louis and Itasca Co
7-15	Anthracnose on oak in Floodwood.	St Louis Co
7-17	Tansy and Blackeyed Susan blooming	Morrison

7-18	Jerusalem artichoke, spotted touch-me-not, cow parsnip, dog bane, fireweed, angelica, and common day lily blooming	Pine
7-19	Mortality of red pine, jack pine, some paper birch and blue berries die to flooding on July 4 & 5, 1999, along Stepetz Road.	Esquagama Lake, St Louis Co
7-19	Green-striped mapleworms 1 ¾ inch long. Will pupate within a week. Legionville, Molly Lake. Butter-and-eggs, wild bergamot, culiver's root, and purple loosestrife blooming	Crow Wing
7-19	*Canavirgella banfieldii* on white pine .	Big Fork, Itasca Co
7-20	Mortality of balsam fir due to flooding in 1999 south of Wolf Lake on Brimson Road.	Brimson. St Louis Co
7-20	*Canavirgella banfielii* on white	Duluth, St Louis Co
7-24	Aspen leaf blotch miner larvae only; no pupae present, yet.	Wadena, Hubbard
7-26	Greenstriped mapleworm 90% l to 1 ½ inches and pupating	Crow Wing
8-08	Dogbane leaves turning yellow as first indicator of autumn. Tall sunflower, tansy and goldenrod in bloom	Crow Wing
8-10	Old pitch tubes found on white pine stump in campground in Cascade River State Park. The tree had died and was cut down a year ago.	Cascade River SP, Cook Co
8-10	Spruce beetle adults present in some white spruce and immatures in others. Lots of fresh pitch tubes on trees that had no pitch tubes on 6/29. Trees with fresh pitch tubes look green and healthy. Pitch tubes found on trees from 8 inches DBH and greater. Affected trees are in a state park campground and likely have compaction and other root damage. Many of the infested trees also have root rots as evidence by mycelial fans of Armillaria or by the presence of conks of other fungi at the root collar. Old pitch tubes found 6.2 miles north of hwy 61 on #70 on northeast edge of park in Sec 3-T62N-R3E. This tree was an old dead white spruce.	Judge Magney SP, Cook Co
8-2	pine.Nest of web-spinning sawfly or false webworm on jack pine in Sec 19-T61N-R22W. Larvae were gone, but it was probably web-spinning sawfly.	Togo, St Louis Co
8-24	Aspen blotch miner heavy on trees north from Chisholm to Cook along Hwy 73. These trees were defoliated by FTC and refoliated, before being attacked by aspen blotch miner. The crowns on many of these trees have turned brown. Lots of FTC egg masses present.	St Louis Co
8-24	Moderate to heavy defoliation evident from spruce budworm in Sec34-T64N-R18W	Cook, St Louis Co
8-24	Tar spot on willow north of Cook on #24 in Sec4-T63N-R18W	Cook, St Louis Co
8-31	Orangestriped oakworm l to 2 inches	Morrison
8-31	Introduced pine sawflies still defoliating pines.	Crow Wing
9-05	Introduced pine sawfly 2nd generation larvae cocooning	Wadena
9-06	Orangestriped oakworms still feeding	Morrison

9-06	Found basswood leafroller (*Pantographa* spp.) and flat oak leaftier (*Psilocorsis* spp).	Crow Wing, Morrison
9-11	Orangestriped oakworms pupating	Morrison
9-20	Boxelder bugs starting to invade.	Crow Wing
10-02	Multicolored Asian lady beetles congregating on houses.	Regionwide
10-03	Spruce beetles found in 2 large white spruce. Lots of fresh pitch tubes. The tree crowns crowns look green and healthy.	Cascade River SP, Cook Co
10-04	Spruce beetle found in several white spruce on Grand Portage Reservation.	Cook Co
10-04	Spruce beetles found in a live white spruce along trail (Birch Lake overlook?).	Gunflint Trail, Cook Co
10-06	Killing frost (20°). Frozen introduced pine sawfly larvae found at Belle Prairie Park.	Morrison

Special Projects

Gypsy moth strategic planning -Minnesota Cooperative Gypsy Moth Program

(taken in part from the MDA Annual Report 2000, written by Peter Dzuik)

The gypsy moth, Lymantria dispar, is one of the nation's most serious tree pests. The pest currently infests nearly all of the eastern United States, from Maine south to North Carolina and west to Wisconsin. Although establishment of the gypsy moth in Minnesota is inevitable, tactics that delay its establishment allow more time to implement activities that may help reduce the impact on the state's residents, industries and nature resources, as well as provide public officials and land managers more time to make and implement informed policy and management decisions. In response to expanding populations within Wisconsin, the Cooperative Minnesota Gypsy Moth Program was initiated and development of a strategic plan was begun. Participating agencies include the MN Dept. of Agriculture (MDA), Dept. of Natural Resources (MNDNR), USDA Forest Service, USDA Animal and Plant Health Inspection Service and the University of Minnesota. The Strategic Plan, to be finalized early in 2001, represents a comprehensive guideline for the management of the gypsy moth within the state.

Once endorsed by the Minnesota Departments of Agriculture (MDA) and Natural Resources (MNDNR) and the United States Department of Agriculture (USDA), the proposed plan would formalize the relationship between the participating agencies, lay the foundation for cooperative decision making and establish a model for the management of other exotic invasive tree pests, such as the Asian Longhorned Beetle. The model revolves around the structure of the program which places the MDA and MNDNR commissioners in an equal partnership over the program. The Gypsy Moth Program Advisory Committee (GMPAC) manages the program under the supervision of the State Executive Committee (GMSEC), which is in turn responsible to the commissioners. Management decisions and policy recommendations are formulated cooperatively within GMPAC along procedural guidelines set forth in the GMPAC bylaws. Public input and outreach would be achieved through the Gypsy Moth Program Statewide Network (GMSAN), an interactive network of interest groups and individuals.

The gypsy moth program as outlined in the plan, involves three levels or phases of gypsy moth infestation: pre-infestation (no established populations are known to exist in the state), transition (high male moth catches indicate low-level populations are likely to exist in some portions of the state, while other portions remain uninfested) and general infestation (permanent populations of gypsy moths exist in all or portions of the state). MDA, recognized as the lead regulatory agency, will be the lead agency during the pre-infestation and transition phases of gypsy moth management. MNDNR will be the lead agency over gypsy moth population management activities under generally infested conditions. Once the plan is finalized, copies will be made available at DNR and MDA field offices.

Observations From Use Of Herbicides In Active Oak Wilt Centers:

2000 is the second year of observations following applications of herbicides to stop oak wilt disease using herbicides on sites where plowing was not an option. Results are reported for the 123 treated trees, on 5 sites, from fall 98 to winter 99. All on cooperating private land ownerships. In the fall of 2000, 5 new sites were added, all on state land in Wabasha county.

Herbicide option;
Initial recommendations in fall 1998 were as follows.

Application method: Low Volume Basal
Herbicide: Mix: 3 Quarts of Riverside Diluent XLT
1 Qt. Garlon 4
4 Ounces Stalker

Apply with a backpack sprayer, equipped with a cone nozzle. Spray should be misted on to the lower 18 of the stem. Spray for coverage only, not to the point of runoff.
For oak trees greater than 8 inches dbh, cut axe notches around base of tree every 3 inches, just before treatment.

Fall, 2000 changes to the above.
Changes increased the rate of stalker to 4-5 ounces. All trees regardless of size were carefully and completely girdled with a chain saw at about 18 inches above ground. The herbicide mix was then applied to the cut surface of the girdle only.

TREATMENT SITES:

All treatments before 2000 were completed by a trained contractor. The additional treatments added in 2000 were treated by Ed Hayes.

Site 1, Waldorff, Treated 1/25/99.
Results: All trees leafed out in the spring. Signs of herbicide activity continued throughout the summer. At the time of the final field check, 9/24/99 all trees were completely dead, no sprouts.

Comments: Appears to be extremely effective. In follow-up observations next year and in later years, this site will offer observations on:
1. Flash-back, (movement of the herbicide through treated tree root system into adjacent root grafted untreated tree root system, some early fall color noted on one side of an untreated oak right next to a small treated oak),
2. Effects on untreated bur oaks adjacent to treated red oaks.
3. The eventual opportunity to see if the oak wilt spreads out of either treatment area.

There were 2 separate treatment sites, on this property.

#1 A barrier between an active infection center and area of red oaks to be saved.

15, trees all pin oak, recorded in dbh. All dead after one year, no sprouts.

9.1	10.2	10.2	11.3	8.2	13.7	6.9	6.7
6.4	6.5	5.9	8.7	10.1	6.9	9.0	

#2 active infection center on west side of property.
10, trees all pin oak, in dbh. All dead after one year, no sprouts.

13.9	4.3	2.5	1.9	4.5	9.2	8.5	9.5	10.1	12.5

In 2000, all the above trees remained dead and did not sprout. A small red oak observed in the fall of 1999 with possible signs of flash back, did slightly die back without additional symptoms. A small bur oak next to a treated red oak remained free of any herbicide symptoms. No new wilt appeared outside the barrier of treated red oaks, year 1.

Site 2, Elwood, Treated 11/30/98.
Results: Some trees did not leaf out in the spring. By early August all oaks were completely dead, no sprouts.

This was a classic new, from the edge, infection center. Spreading rapidly thorough high density small diameter northern pin oaks. A site that would be difficult to isolate or get ahead of with a vibratory plow. There were approximately 35 trees 2 to 6"in dbh all pin oaks.

Comments: Again appears to be effective. Follow-up observations this site will offer the opportunity to see if the oak wilt spreads out of treatment area.
In addition, on August 18th, two 5 inch pin oaks trees were removed from this site to observe their root systems. One treated and one live tree donated by the landowner. The root collar on the treated tree was discolored throughout the root collar zone and well below ground line. Armarillaria was evident throughout the root collar. The only parts of

the tree that did not appear dead were 2 feet below ground, quarter inch diameter roots. Slides of these excavated root systems are available. Trees were excised from the ground by MCC crew.

In 2000, all the above trees remained dead and did not sprout. No new wilt appeared outside the area of treated red oaks, year 1.

Site 3, Smith, Treated 11/30/98.
Results: As of field check on 9/24/99, the average dieback was 50%.This treatment site was an large, old but still active infection center where basically all the remaining red oak on the site were killed to prevent future sporulation. The site is within a quarter mile of several vibratory plow sites installed in 1998.

Comments: This treatment was not as effective as some of the others and obviously not what we would like to see. The possible reasons include, under treatment (not enough herbicide applied), a less intensive frill than what may be needed, or something else.
See current recommendations below. We recommend a more intensive frill (continuous) and have increased the rate of stalker.
Follow-up observations; Re-treatment is likely not needed. There is a good chance all of these trees will not even leaf out to the spring of 2000. If they did it would be interesting to see if they could survive attack by to the 2-lined chestnut borer past July 1st. (note that borer activity is common on all dead trees that were examined in 99).
This looks like an effective treatment with 3 ounces of stalker and 1 quart of Garlon 4 within a year and one half of treatment.

15, trees 12" to 18" dbh. One bur oak, the rest pin oak. Trees by dbh and % of crown dead on 9/24/99.

15, Bur-100%	14.8-40%*(sa)*	12.9-25%*(sa)*	12- 20% (70%)	13-40% (70%)	14.6-20% *(30%)*	11.1-90% *(100%)*	7.4-100%
13.6-50% *(60%)*	16.9-40% *(50%)*	18.7-70% *(50%)*?	15.9-90% *(20%)?*	14-100% *(70%)*?	12.1-10% *(20%)*	15.9-75% *(90%)*	

At mid-season 2000 several of these trees were making limited progress as above. A few were obviously mis-read in 1999. All were retreated with the exception of the two 100's in mid-August with the year 2000 method above. Should be complete in 2001.
This is basically a host removal area. There are two red oaks left alive on this site. Both were left due to distance away from any active 1998 wilting.

Site 4, Ward, treated 9/15/98.
Results: By mid season the activity level was low. By August 1 it became evident that the site was under treated (not enough herbicide was used or the amount of frill was not enough). The only symptom on the treated trees was generally smaller leaf size. The site was retreated in August 99 with additional hatchet frill and treatment to the cut surface only.

Comments: This was a large old active multiple (2) infection centers with multiple wilting trees. Follow-up observations next year will determine any symptom development and time of mortality.

35, trees all pin oak recorded in dbh.

11.6	14.2	12.5	13.8	9.6	11.9	14.2	10.4
9.1	11.9	13.5	11.8	10.0	15.9	13.0	11.7
12.0	11.3	9.0	10.7	10.1	9.7	12.2	15.4
13	15.9	14.8	3	5	4	5	6

2	3	4					

The re-treatment made a lot of progress, however a few trees remained partially alive. One tree on the edge of the site was missed in the re-treatment and based of field symptoms wilted. The few remaining live trees were treated with the 2000 method and three trees were added in an attempt to re-establish a barrier. The three new trees were treated about the first of August. By late August they appeared completely top dead, and bore activity was active and had all ready reached the root collar. These trees went fast with the chain saw girdle method.

Site 5, Kepp, Treated 12/18/98.
Results and comments will be the same as See Smith above.

12 trees, average 19.6" dbh. Trees by dbh and % of crown dead on 9/24/99.

15.1-5% (100%)	18.9-50% (100%)	19.1-100%	19.2-40% (70%)	14.7-100%	17.3-100%	17.7-100%	30.2-100%
14.5-50% (100%)	25.6-80% (100%)	25-25% (100%)	17.9-25% (100%)				

Big surprise, this site was checked after September 1. With the exception of one tree, all of these large diameter trees appeared dead, after 2 seasons. No wilt has moved into the nearby untreated red oaks. This may serve as a observation for a barrier.

New sites in 2000

Five new sites were added on state land in Wabasha county. The year 2000 method as stated above was used. 55 trees averaging 10 inches were treated in 5 locations off 5 actively wilting trees. Should provide great observations.

By estimated computations the rate of herbicide used in these 55 trees is (2x) the rate used in research reported from Missouri, which did not include diluent. Approximately 5 quarts of herbicide mix were used to treat these 55, 10 inch trees. Depending on how this looks next year, these trees may offer an opportunity to test for root mortality if someone qualified can be obtained.

One additional site treated by contract in Wabasha county on private land in 1998 was inspected in the fall of 2000. This site was made up of small diameter red oaks on an upland site. All marked trees appeared completely dead, no new wilting was observed.

Several sites on state land in Wabasha county were additionally treated following timber sales, or where active centers had been previously surveyed and marked.

Storm Damage -Granite Falls Tornado: Risk Assessment Inspection Of Storm Damage Trees

The Risk Assessment Inspection: On Monday July 31, 2000 all of the remaining standing trees within the storm damaged blocks of the city of Granite Falls were inspected for storm damage.
The survey area covered approximately 370 residential lots, (homes), the entire private property, the grade school grounds, existing parks, and some limited commercial areas within the storm damaged blocks.
Five two person DNR crews inspected 1, 001 trees in approximately 7 hours. (That works out to be an average of 143 trees per hour).
Removals; A five point defect system was used, thirty nine (39) trees were marked for removal. They included 10 species with the majority being ash, elm, and silver maple.
Trees marked for pruning; Crews were instructed to mark only trees with broken and or had lodged branches for safety reasons. Forty seven (47) trees were for pruning. They included 13 species with majority being elm, silver maple, hackberry, and ash.

***All of these marked trees, both the trees marked for removal and marked for pruning represent a public health and safety problem and should qualify for FEMA cost share assistance.**

The table below summarizes the recommended tree removals.

Defect type	# trees marked for removal
Crown damage (45% was threshold)	21
Wind-throw	4
Failed union main stem (½ stem was threshold)	5
Decay (main stem failure with pre-existing decay)	0
Multiple (two or more of the above)	4
In addition crews marked 2 trees that had been girdled, and 2 that had been topped.	2 + 2

Granite Falls Tornado: Tree Loss Assessment Survey.

In addition to the standing tree inspection the DNR crews were instructed to survey, and tally the missing trees. These were the trees removed in the 3 days following the tornado. This was done by tally of both stump holes and records of the remaining stumps, recorded by size (diameter), and species where possible.
A total of 146 stump holes and 361 stump records were recorded in the storm damaged blocks.
Based on the average number of stumps of each species reported, and on the average size of the stumps, the a total tree loss can be accurately estimated and is summarized in the table below.

Tree Loss In The Granite Falls Tornado.

# trees	Species	Average size in d.b.h. (Diameter at 4.5feet)
140	green ash	16"
120	silver maple	16"
100	spruce Sp.	12"
25	elm	16"
122	other species, ✱	12-14"
Total Number Of Trees Lost = 507		

✱The other species included; white birch, crab-apple, hackberry, cottonwood, other conifer, black willow, box elder, linden, oaks, red cedar, mountain ash, sugar maple, black walnut, and one balsam fir.

Survey Results

Forest tent Caterpillar Egg Mass Survey

An egg mass survey was conducted during the winter of 1999-2000 and in the early spring of 2000 to predict the amount of defoliation to be expected from the forest tent caterpillar in the summer of 2000. Trees, usually aspen in a dominant or co-dominant crown position are cut down and the number of egg masses in the crown are counted. The DBH of the trees is also recorded. On each plot 3 trees are measured, cut down and egg masses counted. The average number of egg masses and DBH of the plot is determined. A graph, developed in Canada, is then used to arrive at a prediction for expected defoliation.

Eggmass survey -Region 2- to predict defoliation in 2000.

County and Legal	AVE DBH	AVE # Egg Masses	Predicted 2000 Defoliation	Remarks
Carlton, SWNW S25T48R16	2.7	0	0	
Cook SESW, S4T61R1E	2.1	0	0	Close to Grand Marais on Gunflint trail
Cook SENE, S14T62R4E	2.06	0	0	10 miles inland
Cook NENE, S12T63R3E	2.9	0	0	10 miles up Arrowhead trail
Cook NENW, S33T60R4W	3.1	0	0	Sawbill trail
Itasca S20T62R25	3.1	0	0	East of Effie
Itasca, S3T53R23	2.5	0	0	Near Dora Lake
Itasca, NENE S36T58R23	2.9	16.6	Heavy	North of Nashwauk
Itasca, S2T62R22	5	0.6	L	Near Togo
Itasca, S16T62R23	2.6	0	0	
Itasca S10T149R27	3.5	0	0	
Koochiching, S18T70R24	2.3	0	0	Near Int'l Falls
Koochiching, S35T65R26	2.4	0	0	
Koochiching, S18T69R26	3.5	0	0	
Koochiching, S36T69R23	2.4	0	0	
Lake, S22T63R11	2.8	1	L	East of Winton
Lake, S11T61R11	2.7	3.6	L	SE of Ely
Lake, SWSW S36T54R10	2.9	0	0	North of Two Harbors

FTC egg mass survey Region 3- winter 1999 and spring of 2000		
County	**Legal description**	**Predicted defoliation 2000**
Aitkin	32-49-26	None
Cass	5-140-31, 34-141-31	None to very light
Crow Wing, Cross Lake	7,8-137-27	Heavy
Crow Wing, North Long & Round Lakes	6-134-28, 1,2-134-29	Heavy
Kanabec	25-40-23	None
Mille Lacs	22-41-26	None
Stearns, Big Birch Lake	36-127-33	Severe
Todd	21-129-32	None
Todd	13-129-34	None

Lake NWSE, S29T57R7W	2.7	0	0	East of Finland
St Louis SESE, S5T66R20	2.06	5	M-H	Ash Lake
St Louis, S16T60R20	2.9	34	H	North of Chishom
St Louis, NWNE S36T51R15	2.5	0	0	
St Louis, SENW, S3T50R18	3.0	0	0	
St Louis S5T56R19	2.8	0	0	
St Louis, S16T55R16	2.6	0	0	
St Louis S12T54R17	3.2	0	0	Near Cotton
St Louis, S20T62R17	2.8	2	L	East of Cook
St Louis, SWNW S21T58R21	2.5	1	L	NW of Hibbing
St Louis, SESE S14T51R13	2.5	0.6	L	Lakewood Township
St Louis, SWNE S32T51R13	2.3	0	0	Lakewood Township, Duluth
St Louis, SWNE S5T51R13	2.1	0	0	Lakewood Township, Duluth
St Louis, S22T62R19	2.4	3.3	M	Near Cook
St Louis, S13T61R19	2.7	3.6	L	
St Louis, NESE S21T51R13	2.4	1.6	L	Lakewood Township, Duluth
St Louis, NENW S14T68R21	2.7	0.33	VL	Ash River Trail
St Louis, SWNE S30T63R19	2.3	2.3	Light	South of Orr
St Louis, NWNW S19T52R12	2.5	0	0	South of Two Harbors

The survey predicted defoliation in 2000 would occur primarily from Nashwauk to Kabetogama to Ely and back to Nashwauk. It also predicted light defoliation on the north edge of Duluth.

Spruce budworm survey - 2000

Location	Species	1997		1998			1999				2000					Notes
		Egg mass survey		Egg mass survey			Larval survey		Egg mass survey		Larval survey		Egg mass survey			
		defoliation	Ave # egg mass	Actual defoliation	Ave. # egg masses	Predicted defoliation 1999	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	Predicted defol. for 2001	
Aitkin Co.													0	0	0	Blandin, Thinned
NWSW 8-52-25Thinned Blandin	WS												0	0	0	Blandin, Unthinned
NWSW 8-52-25 Unthinned Blandin	WS															
Becker Co.																
SESE 21-141-36	WS		1.33	M-H	0.77	M			M-H	1.11			M	0.66	L-M	Thinned
Beltrami Co.																
NWSW 12-147-30 Thinned Sam Welch's Cornor	WS								L-M	0			VL	0	0	Sam Welch's Cornor Thinned
NWSW 12-147-30 Unthinned Sam Welch's cornor	WS								L	0.1			L	0	0	Sam Welch's Cornor, Unthinned
NESE 26-149-30	WS															
NENE 26-149-30	WS		1.0	H	0.88	M										
SESW 2-147-31	WS		2.1	H	0.55	M			M-H	0.55			VL	0.11	VL	
	"															
NESW 1-148-31	WS															
Cass Co.																

Spruce budworm survey - 2000

Location	Species	1997		1998			1999				2000					
		Egg mass survey		Egg mass survey			Larval survey		Egg mass survey		Larval survey		Egg mass survey			Notes
		defoliation	Ave # egg mass	Actual defoliation	Ave. # egg masses	Predicted defoliation 1999	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	Predicted defol. for 2001	
NENE 1-139-26	WS		0													
NWNE 1-139-26	WS		0.66						0	0						
NWNW 11-139-26	BF		0.44	14	0.11	VL										
NENE17-140-27	BF															
SENW 21-145-30	WS		.077	H	0.1	L			M	0.11			VL	0	0	
NWSE 9-145-30	WS		3.0	H	2.22	H			L-M	0			VL	0	0	
SWSE13-136-31	WS		0.33	24	0	VL										
SWSE 13-136-31	"			21	0.11	VL										
SWSE 22-138-31	BF															
SWNE 30-139-25	WS			58	0.1	Light										
NWNE 30-139-25	WS			52	0.1	L										
NWSE 8-145-30	WS															
Chisago Co.																
SESE 36-36-21	WS															
Cook Co.																
NWNW 33-63-4E	WS, BF															
NESW 35-64-3E	BF															
NWSE 3-61-1E	BF	L	0.0													

Spruce budworm survey - 2000

Location	Species	1997		1998			1999				2000					
		Egg mass survey		Egg mass survey			Larval survey		Egg mass survey		Larval survey		Egg mass survey			Notes
		defoliation	Ave # egg mass	Actual defoliation	Ave. # egg masses	Predicted defoliation 1999	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	Predicted defol. for 2001	
SWNE 22-63-1E	BF															
NESW 10-64-1W	BF															
SENE 4-61-1E	BF, WS	L	0.0	1	0	0										
Crow Wing Co.																
SENE 19-44-31	WS		0.33	3	0	O-VL	<10%	0.44	0	0						
Hubbard Co.																
SE 13-141-32	WS		0.33	H	0.0	L			VL	0.11			VL	0	0	
SESE 1-142-33	WS		0.44	M	0.22	L			VL	0.55			VL	0	0	
SE 1-142-33	WS															
NWSE 23-145-33	WS															
NENE 24-139-34	WS		NA	VL	0.11	L										
NWNE 21-141-36	WS															
Itasca Co.																
NWNE 16-61-24 thinned Larson L	WS												L	0.44	L	Larson L Thinned
NWNE 16-61-24 Unthinned Larson L	WS												L	0.11	L	Larson L Unthinned
NENW 12-53-26 Thinned Smith Creek	WS								L	0			VL	0	0	Smith Creek Thinned

Spruce budworm survey - 2000

Location	Species	1997		1998			1999				2000					
		Egg mass survey		Egg mass survey			Larval survey		Egg mass survey		Larval survey		Egg mass survey			Notes
		defoliation	Ave # egg mass	Actual defoliation	Ave. # egg masses	Predicted defoliation 1999	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	Predicted defol. for 2001	
12-53-26 Unthinned Smith Creek	WS								L-M	0.1			L	0.1	L	Smith Creek Unthinned
SENE 24-149-27 Thinned Dora Lake	WS								L-M	0			L	0	0	Dora Lake Thinned
SENE 24-149-27 Unthinned Dora Lake	WS								H	0.8			L	0	0	Dora Lake Unthinned
NESE 2-61-23	BF	M	0.33	88	0.66	M			L-M	0.2						
NENW 34-62-22	BF	VL	0.77	29	0.22	M										
NWSE 26-62-23	BF	L	0.55	32	0.22	M										
NWSW 3-58-24	WS	O	0.0	<1	0	O										
SWNE 3-58-24	WS	O	0.0	<1	0	O	2	0.44	0	0		0	0	0	0	
SWSW 35-58-24	WS	M	1.22													
NENW 23-59-24	BF			<1	0	O										
SWSE 36-62-24	WS															
NENE 17-53-25	WS	M	1.99													
NWSW 35-58-24	WS	M	1.2	40	0.44	M	67	23.78	H	0.1		26	M	0.8	M	
NWNE 7-60-25	WS															
NW 9-56-25	WS															
NWNE 4-60-26	WS															
SENW 12-53-26	WS		0.11	3	0.11	L										

Spruce budworm survey - 2000

Location	Species	1997		1998			1999				2000					
		Egg mass survey		Egg mass survey			Larval survey		Egg mass survey		Larval survey		Egg mass survey			Notes
		defoliation	Ave # egg mass	Actual defoliation	Ave. # egg masses	Predicted defoliation 1999	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	Predicted defol. for 2001	
SESW 11-53-26	WS	VL	0.66	17	0	O-VL	59	15.33	M	0.44		18.7				
SWSE 17-60-26	BF			1	0	O										
Koochiching County																
SESE 28-65-26 Thinned, Big Falls, Johnson Landing	WS												L	0.11	L	Thinned, Big Falls, Johnson Landing
SESE 28-65-26 Unthinned, Big Falls, Johnson Landing	WS								H	1.0			M	0.33	M	Unthinned, Big Falls,Johnson Landing
36-155-25 Thinned, Big Falls, Power line	WS												L	0	0	Thinned, Big Falls, Power Line
36-155-25 Unthinned, Big Falls, Power line	WS								L	0			L	0	0	Unthinned, Big Falls, Power Line
NWNW 4-65-22	BF	H	1.2	98	1.33	Modrate - Heavy	less than 10%	2.67	L-H	0		0.8	L	0	0	
NWNW 19-65-22	WS, BF	L	1.1	74	0.77	M										
NENE 24-65-23	BF	M	0.55													
10-67-22	WS			H	0.55	M-H										
SENE 23-67-22	BF															
NESW 31-70-26	WS		0.1	60	0.22	M			L	0						

Spruce budworm survey - 2000

Location	Species	1997		1998			1999				2000					
		Egg mass survey		Egg mass survey			Larval survey		Egg mass survey		Larval survey		Egg mass survey			Notes
		defoliation	Ave # egg mass	Actual defoliation	Ave. # egg masses	Predicted defoliation 1999	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	Predicted defol. for 2001	
SENW 4-71-22	BF WS		0.44	82	0.55	M			L	0						
SESE 35-71-24	WS															
SESE 8-69-23	BF		0.11	57	0.44	M			L	0						
SESE 16-69-23	BF															
NWNE 22-65-23	BF	M	0.55	83	0.88	M			L- M	0						
SWSW 25-69-23	WS			41	0.44	M										
NWSE 5-70-23	BF			95	0.77	M										
SWSE 36-62-24	BF WS	H	1.0	99	0.33	M										
SENE 27-70-25	WS			80	0.44	M			L	0						
NWNE 27-158-26	WS															
Lake Co.																
SWNE 11-55-8	BF	O	0.0	<1	0	0										
SWSE 5-59-8	BF WS	O	0.0	0	0	0							0			
SENE 11-61-11	WS, BF															
SENW 31-62-11	WS, BF															
Mille Lacs																
SWSE 1-35-27			1.0													

Spruce budworm survey - 2000

Location	Species	1997		1998			1999				2000					
		Egg mass survey		Egg mass survey			Larval survey		Egg mass survey		Larval survey		Egg mass survey			Notes
		defoliation	Ave # egg mass	Actual defoliation	Ave. # egg masses	Predicted defoliation 1999	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	Predicted defol. for 2001	
Morrison Co.																
NENE 1-41-29	WS		0.33	6	0	O-VL	<10%	1.44	O-VL	0						
NESW 11-42-32	WS		0.44													
Sherburne Co.																
NWNW 33-34-27	WS		0.22	31	0.1	L	<10%	2.88	L	0						
NENE 29-35-27	WS			M-H			<10%	2.44	Trace	0						
St. Louis Co.																
NESE 22-62-12	BF	L	0.33	12	0	O-VL							0	0	0	
NWNE 6-63-12	BF															
SESE 31-58-13	WS, BF	O	0.0	<1	0	O										
NWNE 4-62-13	BF															
NESE 6-63-17	BF WS	M	1.55	35	0.77	M	30	9.44	L	0		2.7	VL	0	0	
SWNW 2-64-17	BF															
NENE 8-51-18	WS															
SWSW 33-61-18	WS, BF	L	2.11	41	1.22	M	47	13.67	H	0.8		10	H	2.2	H	
NWNW 33-65-18	BF	H	3.33	86	1.22	M	8	5.33	M	0.44		8.7	M	0.55	M	
SWSW 26-61-20	WS			<1	0	O										
NWNE 25-63-20	BF			82	1.33	M			H	0.66		6	M	0.4	M	

Spruce budworm survey - 2000

Location	Species	1997		1998			1999				2000					
		Egg mass survey		Egg mass survey			Larval survey		Egg mass survey		Larval survey		Egg mass survey			Notes
		defoliation	Ave # egg mass	Actual defoliation	Ave. # egg masses	Predicted defoliation 1999	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	Predicted defol. for 2001	
NENE 12-68-20	WS, BF															
SWNW 33-60-21	WS	M	1.66	82	0.33	M										
SWSW 2-60-21	WS	M	2.77	87	2.0	Heavy	14.22	10.22	L	0.2		1.7	VL	0	0	
NWSW 12-64-21	BF		0.66													
NESW 12-64-21	BF		.066	95	1.55	M	6	2.89	L-M	0.01		1.2	L	0	0	
NWSW 15-67-21 Thinned 1998	WS thinned 1998			H	0.44	M			M	O						
NWSW 15-67-21 Planted 1978	WS			H	0	O			L	O						
16-67-21	WS			L	0.3	L			L	O						
NWNW 30-67-21	WS			L	0.44	M			L	0.3						
NWNW 30-67-21	WS			H	0.44	M			L	0.3						
SESW 12-68-21	WS	H	1.55	83	1.22	M			L	0						
SESE 13-64-21	BF	L	0.66	96	0.33	M										
5-68-19 Ash River Campground	WS						7	15.44	L	0		0.33	0	0	0	Sprayed with BT in 1999

Spruce budworm survey - 2000

Location	Species	1997		1998			1999				2000					
		Egg mass survey		Egg mass survey			Larval survey		Egg mass survey		Larval survey		Egg mass survey			Notes
		defoliation	Ave # egg mass	Actual defoliation	Ave. # egg masses	Predicted defoliation 1999	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	%of buds on twigs infested	Ave # of larvae on twig	Actual defoliation	Ave # egg masses	Predicted defol. for 2001	
10-67-22 Velpar Short trees	WS								L	0.6						
SENW 10-67-22	BF, WS											0	0	0		

MINNESOTA DEPARTMENT OF NATURAL RESOURCES
FOREST ECOSYSTEM HEALTH PROGRAM
FFY 2000 GRANT **ACCOMPLISHMENTS**

I. INTRODUCTION

Staffing. *MN FEHP staffing in FFY2000 will include:*

Staff	*Location*
(1) Program Supervisor	*St. Paul*
(1) Program Coordinator	*Grand Rapids*
(4[1]) Regional Forest Health Specialists	*Brainerd, Grand Rapids, Metro, Rochester*
(3) Seasonal Plant Health Specialists	*Brainerd (2), Bemidji*

[1] Depending on budget priorities and capabilities, a fifth Regional Forest Health specialist may be added to Bemidji. Traditionally, there has been a Forest Health Specialist in Bemidji.

Discussion

In March the **Program Coordinator** incumbent moved to Alexandria to become an Area Forest Supervisor. The Program Coordinator position is now a shared position with the Alexandria Area Forester position. This move will result in less time given to the Forest Health Program by the Program Coordinator, and potentially the MN Forest Health Program will be less able to participate in and respond to issues beyond the borders of Minnesota.

The **Bemidji Regional Forest Health Specialist** position was not filled due to budget constraints. The Forest Health Program continues to be less able to deliver services and address forest health issues in the northwestern region of the state. Currently, there is a Seasonal Plant Health Specialist located in this region during the growing season. This position does address seasonal, on-going issues but is unable to address longer term forest health issues and problems in the Region.

II. FOREST HEALTH MONITORING - OFF PLOT ACTIVITIES

Detection Surveys. *A general aerial detection survey of the major forested areas of MN will be conducted from early June through mid-July. During the aerial survey, each forested Forest Health Monitoring plot will be checked. Follow-up ground verification of selected aerial survey polygons and checking of unknown polygons detected from the aerial survey will also be carried out. Survey maps will be provided to the field staff during the growing season to provide the managers with current forest damage information, and insect and disease incidence information. Survey data will be digitized and stored as data layers for use with the EPIC GIS program. Survey results will be made available to USFS State and Private Forestry. Additional aerial and ground surveys will focus on spruce budworm, jack pine budworm, pine tussock moth, forest tent caterpillar, and large aspen tortrix. Surveys will also be conducted in response to new pest outbreaks.*

GENERAL DETECTION SURVEYS		
Item	Accomplishment	Target
General detection survey	13,000,000 acres	12,000,000 acres
Check FHM plots	320 plots	100 plots
Pest Conditions Report	Done	Submit by 12/15
Forest Health Highlights	Done	Submit by 1/15

2000 TOTAL FORESTED ACRES WITH DAMAGE OR MORTALITY	
ACRES	PERCENT of MINNESOTA FOREST LANDS WITH DAMAGE or MORTALITY
2,268,815	13.4% (39% increase in acreage)

SURVEY RESULTS - SIGNIFICANT CAUSAL AGENTS				
		ACRES		
		2000	1999	% change
Forest tent caterpillar	Defoliation	2,039,919	488,889	317%
Large aspen tortrix [1]	Defoliation & dieback	63,942	336,170	- 81%
Flooding/high water	Mortality/dieback/discolor	30,697	45,393	- 33%
Spruce budworm	Defoliation	28,481	69,620	- 59%
Oak tatters	Discoloration	20,000	-----	-----
Frost	Defoliation	7,507	-----	-----
Larch casebearer	Defoliation	6,363	-----	-----

SURVEY RESULTS - SIGNIFICANT CAUSAL AGENTS				
		ACRES		
		2000	1999	% change
Oak decline [2]	Mortality & defoliation	6,061	-----	-----
Wind	Broken/uprooted	1,740	465,882	-99.6%

[1] Forest tent caterpillar was found mixed with large aspen tortrix on the acres reported for the large aspen tortrix causal agent.

[2] Oak decline included oak wilt, twolined chestnut borer, and environmental stress.

Discussion

Other causal agents encountered included anthracnose, Dutch elm disease, brown spot needle blight, pine spittlebug, herbicides, pine engraver, fire, eastern larch beetle, drought, and soil compaction.

The most significant biotic causal agent of damage to Minnesota's forests was the **forest tent caterpillar**. Defoliated acres increased in excess of 300% over defoliation in 1999. Projections are for this trend to continue. **Large aspen tortrix** caused significant defoliation in 1999, but in 2000 there was an 81% reduction in the acreage defoliated compared to the previous year. The great increase in forest tent caterpillar populations may have been the major contributing factor to the decline in large aspen tortrix since both insects occur at the same time and feed on the same hosts.

In 1999, **wind** damage was the most significant causal agent of damage to Minnesota's forests. In 2000, there was a 99.6% decrease in the acreage effected. **Frost** damage was the most significant weather event in 2000 causing noticeable damage on 7,507 acres. **Flooding** primarily from beaver activity continued to be a significant problem on Minnesota's forest lands although there was a slight reduction in acreage in 2000.

Gypsy Moth Monitoring. *Detection monitoring for gypsy moth will include Division personnel placing traps in state forest recreation areas and state parks as well as in areas of public concentrations in rural forested counties outside of the MN Department of Agriculture's (MN DOA) trapping grid. These efforts are coordinated with the MN DOA as the lead agency for detection activities. Delimiting trapping efforts will also be undertaken as requested by the MN DOA on an "as need" basis.*

GYPSY MOTH MONITORING		
Item	Accomplishments	Targets
Pheromone traps	221	700
Delimiting trapping	1 area trapped	No target

2000 Statewide Gypsy Moth Trap Catch Summary				
	2000	1999	1998	1997
Total # of traps	16,757	18,000	25,362	12,965
Total # moths caught	182	260	953	261
Total # positive traps	119	188	679	154
Total # of counties	19	20	26	25

Discussion

In 2000, the interagency group, "Gypsy Moth Program Advisory Committee" or "GMPAC" adopted Slow the Spread protocol and coordinated trapping. Part of the protocol adopted was the establishment of a trapping grid in those areas of the state likely to find gypsy moth first and then digitizing the grid points so that they become permanent trapping locations. Department of Agriculture was responsible for trapping the established grid, and traditional DNR trapping sites that fell within the trapping grid were no longer used. The reduction in the number of DNR traps is directly related to this new trapping procedure. Only in the western part of the state where a trapping grid was not used were traditional DNR trap locations used.

Trap catches continued to be down, and the statewide pattern of trap catches returned more to the normal, expected pattern, i.e., heavier trap catches in the hardwood forests along the Wisconsin border from the Twin Cities southward. The high trap catches along the North Shore that were experienced there in 1999 were down in 2000 although still higher than in years previous to 1999.

Egg masses were found at one trap location in southeastern Minnesota in Houston County. It is too early to determine course of action at this site. Egg mass searches were also carried out in northeastern MN on 20 sites, but no egg masses were found.

Oak Wilt Survey. *Current color IR aerial photography will be interpreted to locate oak wilt pockets. These pockets will be ground checked and if active oak wilt is found, control strategies will be developed. Aerial photography will be digitized and stored on CD's for continued and follow-up activities.*

OAK WILT SURVEY		
Item	Accomplishments	Targets
Interpret photography	28 townships	25 townships
Digitize photographs	1,600 aerial photographs	700 aerial photographs

Discussion

CD's with the digitized aerial photography were produced, and CD's were distributed to Sherburne County and the DNR Cambridge Area. Photography will be used to develop oak wilt control strategies.

In 1997 and 1998, the forests in Sherburne and Wright Counties suffered destructive wind storms, during June and early July. This was perfect timing for the spread of oak wilt by beetle vectors into storm-damaged oaks. Aerial photography done in the summer of 1999 was interpreted and digitized over the winter of 1999-2000. For the past three years, the number of active oak wilt pockets in Sherburne County was holding steady around 650. After the intensive survey, the number jumped to more than 1900 pockets.

In Wright County, 5 infection centers encompassing eleven acres were documented. In 1999, Wright County had no oak wilt.

In Hennepin County aerial photography from three townships was analyzed and no oak wilt infections centers were found.

Pest and Host Evaluations. *Populations of historically important forest insects and diseases will be monitored by ground-based, life stage surveys. Evaluations of new pest outbreaks will also be conducted to determine severity and trend. Potential host impacts will be evaluated, and control measures prescribed when appropriate.*

EVALUATION SURVEYS		
Item	Accomplishments	Targets
Evaluation surveys	6,581,130 acres	500,000 acres

EVALUATION SURVEYS		
Pest	Acres Surveyed	Results
Forest tent caterpillar	4,000,000	Populations continue to increase; area of defoliation should increase in 2001
Spruce budworm	1,790,000	Populations continued to decline in the historic SBW areas; populations are still evident in white spruce plantations
Jack pine budworm	310,000	Populations continue to be undetectable.
Fall defoliators	199,000	Populations decreasing
Pine tussock moth	149,000	5 sites had building populations with enough moths to trigger control
Jack pine gall rust	84,000	Found only pine-oak galls; no pine-pine galls; found significant deer browse

EVALUATION SURVEYS		
Pest	Acres Surveyed	Results
Forest health assessments	41,400	General forest health assessments conducted within in conjunction with a Wildland Urban Interface project; construction damage was the most significant damage found.
Pine discoloration	2,000	Caused by winter drying and road salt in east central MN
Bark beetles	1,880	Beetles found in fire damaged trees; salvage implemented
Honey locust nipple gall	1,500	50% of the host type was 75% defoliated; populations predicted to remain high if mild winter conditions persist
Oak twig damage	1,500	40% of host type with 25% of twigs damage from a combination of *Botryosphaera quercuum*, unknown twig borer and cold injury
Elm leaf miner	750	50% of host type was 25-50% defoliated
Spruce beetle	100	Detected in 5 locations in Cook County; found killing trees in 2 state parks and on the Grand Portage Indian Reservation

III. PREVENTION and SUPPRESSION

White Pine. *In 1997, a white pine initiative began to increase white pine in Minnesota. The initiative included more intensive management of white pine on state lands, funding for white pine management on private lands and for grants to counties for white pine management on county lands, and white pine research. A part of the white pine initiative on all ownerships was emphasis on practices to protect white pine from insects, diseases, and deer browsing.*

Item	Accomplishment	Target
Pathological pruning	Not yet available	550
Bud capping	Not yet available	1,500

Sub-Section Forest Resources Management Planning. *Efforts will begin during FFY2000 to develop forest resource management plans based on the sub-section level of the DNR's ecological classification system (ECS). The planning process calls for an assessment of forest insects and diseases in each sub-section. Assessments will include (1) identifying the forest insects and diseases known to cause tree mortality or grade reductions in the sub-section, and (2) developing trend information including population estimates and outbreak maps.*

Item	Accomplishment	Target
Forest insect and disease assessments	4 completed + 1 in process	Prepare 4 sub-section

Community Forest Health Grants. *State money has been allocated "to undertake projects that improve the health of forest ecosystems including insect and disease suppression programs (and) community-based education programs." More than half of this funding is specifically targeted for oak wilt suppression, and a large portion of the remainder will also be spent on oak wilt suppression.*

Item	Accomplishment	Target
Number of grants	31	-----
Treat oak wilt pockets	190 pockets	150 pockets
Projects other than oak wilt control[1]	2	-----

[1] Grants for educational activities related to forest/tree health undertaken by communities.

Nursery Pest Suppression. *Routine spraying of insect pests on nursery stock including such insects as aphids, leafhoppers, and grasshoppers will be carried out as needed.*

Item	Accomplishment	Target
Area treated with pesticides	26 acres	140 acres

Vegetation Management. *Technical support and assistance will be provided for vegetation management on state, county and private lands. Vegetation management primarily involves the use of herbicides for preparing tree planting sites, releasing trees from competing vegetation, and controlling noxious weeds.*

Item	Accomplishment	Target
Area treated with herbicides (state land)	1,549 (air)	3,200 acres

Pest Suppression Projects. *Other direct control activities that are not covered in any of the categories above. This was not a target on the grant narrative.*

Pest Suppression Projects	
Activity	Results
Oak wilt control	3 sites plowed in the Sand Dunes State Forest; 1,100 feet of plow line installed; spore trees were removed; all trees cut to the plow line
Forest tent caterpillar spray	1 site in Birch Lake State Forest Campground; 120 acres treated; Bt was used; area sprayed had a history of FTC and walkingstick defoliations

IV. SPECIAL PROJECTS

Basswood Project. *Cooperate in a multi-state forest health evaluation project to study the health of basswood in the Lake States. Michigan DNR is the coordinating agency.*

✔ No activity in FFY2000.

Developing Guidelines for Managing White Spruce Plantations Threatened by Spruce Budworm. *This is a cooperative Focus Fund Project with the University of Minnesota, Department of Forest Resources. The objectives of the project are: (1) Develop management guidelines for established white spruce plantations including a density management diagram and information specific to spruce budworm concerns. (2) Determine if stand thinning conducted during an ongoing budworm outbreak can be beneficial in reducing growth loss, top-kill, or mortality. (3) Determine the impact of long-term spruce budworm feeding on the productivity and health of established white spruce plantations. (4) Investigate the hypothesis that monoculture plantations of white spruce are not ecologically sound and may be encouraging defoliations and damage by spruce budworm.*

✔ Provided stands for plot establishment.
✔ Set up and supervised thinning sales.
✔ Assisted investigators in plot measurements.
✔ Conducted technology transfer workshop

Evaluate and Monitor the Health of Black Ash. *The objective of this study is to address the question of whether or not black ash is declining in Minnesota, and if so, what the causal agents of decline may be.*

✔ No activity

Herbicide Efficacy Trials for Oak Wilt Control in SE Minnesota. *In 1998, herbicides were applied to red oaks in and adjacent to active oak wilt pockets. The objective of this study is to determine if herbicides are effective in reducing the spread of oak wilt. The first follow-up observations of the herbicide treated oak wilt pockets was made during the 1999 growing season. A second observation will be made during the 2000 growing season.*

Five new sites were added on state land in Wabasha county. 55 trees averaging 10 inches were treated in 5 locations of 5 actively wilting trees. Approximately 5 quarts of herbicide mix were used to treat these 55, 10 inch trees.

Sites treated in 1998 are continued to be monitored for mortality and for sprouting.

Hazard Tree Educational Materials. *Currently MN DNR's publication "How to Detect, Assess and Correct Hazard Trees in Recreational Areas" is out of print and needs revision. Also, a cooperative interagency project is underway to develop a hazard tree manual for urban areas. Leadership for this project is provided by the USFS, State and Private Forestry.*

- ✔ Produced first review draft of "How to Detect, Assess and Correct Hazard Trees in Recreational Areas."
- ✔ Produced a first review draft of the hazard tree assessment chapter for the urban manual

Granite Falls Tornado: Risk Assessment Inspection Of Storm Damage Trees. On July 31, 2000 all of the remaining standing trees within the storm damaged blocks of the city of Granite Falls were inspected for storm damage. The surveyed area covered approximately 370 residential lots. The area surveyed included all the private property, the grade school grounds, existing parks, and some limited commercial areas. Five two person DNR crews inspected 1, 001 trees in approximately 7 hours. A five point defect system was used to rate the trees. Crews were instructed to mark only trees with broken tops and lodged branches for safety reasons.

- ❑ 39 trees were marked for removal; 10 species; majority were ash, elm, and silver maple.
- ❑ 47 trees were for pruning; 13 species; majority were elm, silver maple, hackberry, and ash.

V. TECHNOLOGY TRANSFER

Training and Presentations. *A major emphasis for the MN FEHP personnel is technology transfer through formal training events centered on forest ecosystem health to talks and presentations at other kinds of events. Training emphases will be on A) ecological concepts and how ecological concepts impact managing insects and diseases; B) insect and disease identification and diagnosis; and C) hazard tree management, particularly in the urban environment.*

Training and Presentations		
Audience	# Opportunities	# People
Forest Resource Managers	17	581
Urban Forest Resource Managers	5	85
Recreation Resource Managers	4	59
Loggers	3	125
Schools/Colleges	4	248
General Public	13	522
TOTALS	46	1620

Written Materials. *Publications include a Forest Health Newsletter produced monthly during the growing season and an annual summary of pest conditions and program activities. In addition, news releases are prepared in response to new and on-going pest occurrences and tree damage.*

Item	Accomplishments (number)	Target (number)
Newsletters	5	4
Annual Report	0	1
Newspaper/Magazine Articles	10	5
Radio/TV	7	0

Requests for Assistance. *An important function of the program is to respond to foresters and general public who have questions or need assistance with pest identification, tree damage, or pest management issues and problems. Responses can occur via phone, letter, e-mail, walk-ins, and field visits.*

Item	Accomplishments (number)	Target (number)
Requests	1,100	750

VI. COMMITTEES, COORDINATION, and MEETINGS

Forest Ecosystem Health personnel are called on to participate in work groups, task forces, and standing committees. Their roles include providing pest management and tree health information, and providing a broader ecological perspective.

Committees, groups, meetings

NE MN Storm Recovery Research Committee - Insect and Pathogen Focus Group
NE MN Shade Tree Advisory Council
State Land Forest Development Coordinating Committee
DNR Regional MN ReLeaf Committees
Subsection Planning Committees
Oak Wilt Multi-Agency Coordination Committee
DNR Region 3 Leadership Committee
Wildland Urban Interface Project Steering Committee
Gypsy Moth Advisory Committee
DNR Metro Region CFM Team
DNR Metro U&CF Team
DNR Metro PA Team
MN Shade Tree Advisory Council
Oak Working Group
MN Risk Mapping Working Group
Lake State Risk Mapping Working Group
Community Forest Health Grant Steering Committee