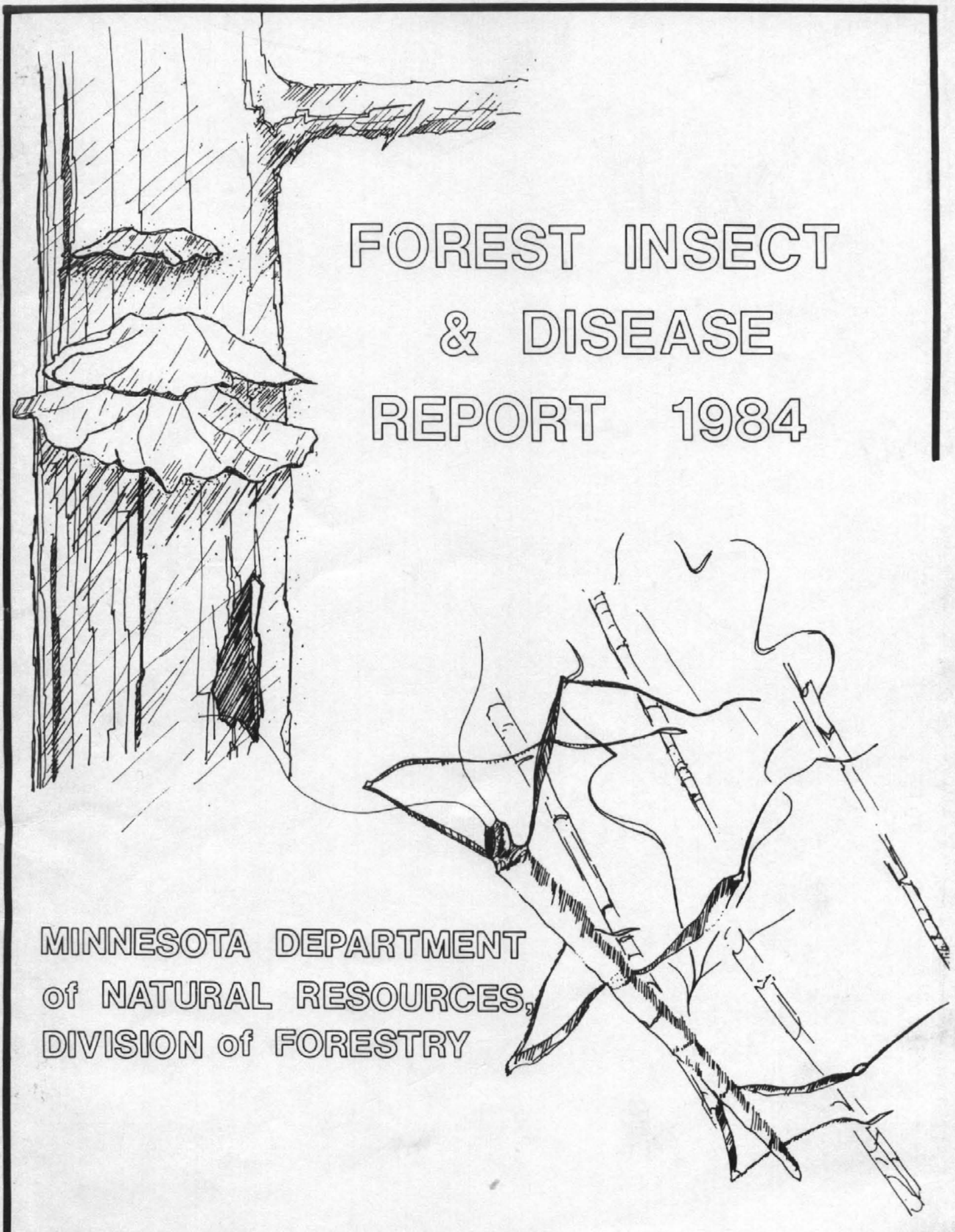

FOREST INSECT & DISEASE REPORT 1984

MINNESOTA DEPARTMENT of NATURAL RESOURCES, DIVISION of FORESTRY

1984 FOREST PEST REPORT

BY

The Forest Insect and Disease Unit

Minnesota Department of Natural Resources

Division of Forestry

May, 1985

St. Paul, Minnesota

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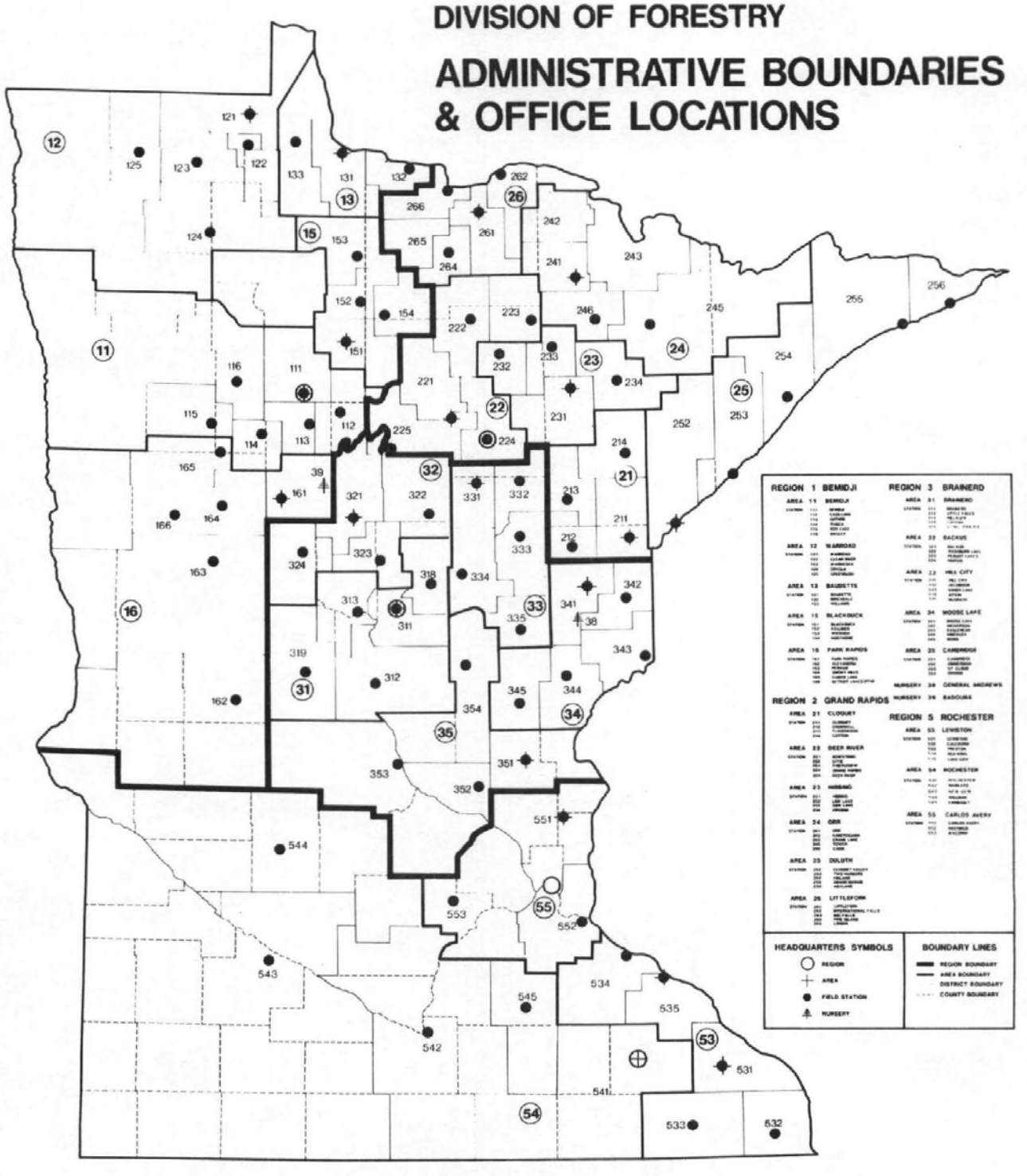

INTRODUCTION

There are approximately 16.5 million acres of forest land within the State of Minnesota. Over one-half of the commercial forest land within the state is publicly owned. These forests support a 2 billion dollar forest industry, which is the third largest industry within the sate. The Minnesota Department of Natural Resources (MN-DNR) has been charged by the legislature with management efforts and/or support on Minnesota's state, county, and private forest lands.

Minnesota's Forest Insect and Disease Management Unit is contained within the Forest Management Section of MN-DNR Forestry Division. Field activities within this division have been regionalized into six regional administrative units (see Figure 1). The insect and disease unit consist of a Forest Insect and Disease Supervisor, one statewide Pesticide Use coordinator, four Regional Forest Insect and Disease Specialists and five seasonal Plant Health Specialists. The four Specialists and the five seasonal Plant Health Specialists have regional responsibilities.

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1984 Forest Insect and Disease Highlights

In 1984 the Jack Pine Budworm infested over 210,000 acres in St. Louis, Lake, Cook, Hubbard, Crow Wing, and Wadena Counties. The feeding was light and is expected to continue at this level in 1985.

In Region II, Spruce Budworm defoliation increased to 361,000 acres, 2.6 times the acreage defoliated in 1983 and reaching a level recorded in only two other years since 1955. A new upswing in budworm activity is predicted in identified areas in 1985.

In Region V aerial spraying for gypsy moth eradication by the Minnesota Deprtment of Agriculture continued in 1984 with three new infestations eradicated. The sites treated were found in Sauk Rapids, St. Anthony, and Stillwater. In 1984, B.T., Bacillus Thuringiensis in combination with mass trapping was successfully used for the first time in Minnesota. Four additional sites will be treated in 1985.

In Region I, grasshoppers severly damaged newly planted containerized Jack pine seedlings in the Park Rapids and Warroad areas.

In Region III, cooperative nursary projects were conducted with U. S. Forest Service's State and Private Forestry Unit for gall rust control, and for loss assessment and control of Diplodia Tip Blight in red pine nurserybeds.

For the first time American Chestnut Blight was found in Minnesota. It was confirmed in a 100 year old grove of chestnut in southeastern Minnesota, ten miles east of Rochester in Olmsted County. Survey efforts are increasing in the tri-state area of Minnesota, Wisconsin, and Iowa.

In 1984 the Division cooperated with the Chippewa and Superior National Forests, U.S.F.S. State and Private Forestry Forest Pest Management Group, and the University of Minnesota in a survey to determine which species of gall rust are present in Jack Pine stands in northern Minnesota.

In this report are locations and survival of pine plantations including one plantation of resistant white pine seedlings.

Spectacular and widespread winter injury was reported in 1984 following the severe winter of 1983-84.

Special projects and studies reported include summaries on Oak Wilt Control, Cone pest studies in a white spruce seed orchard, Permanent plots for a Jack Pine Budworm study, and a Nursery Survey.

In 1984 the Insect and Disease accomplishments again included the administration of the Division of Forestry's Herbicide program.

In early 1985 a state wide pesticide coordinator was added to the Insect and Disease Mananagement staff.

INSECTS

PINE, JACK and RED

Jack Pine Budworm *Choristoneura pinus* Freeman

In 1984 Jack Pine, Budworm activity increased greatly over 1983 levels. Aerial surveys flown in early July detected budworms infesting jack pine on over 210,000 acres in St. Louis, Lake and Cook, Hubbard, Crow Wing, and Wadena Counties (see map 1). The infested jack pine stands were surveyed during the perfect time to observe feeding damage. Budworm larvae clip needles and web them to the twigs and, after they dry out, the needles turn a bright red color. This color change is mapped during the aerial surveys. Although the intensity of the defoliation looked severe from the air, ground checks showed that the actual defoliation was very light. In some cases, noticeable defoliation couldn't be found in areas mapped during the aerial survey.

Three separate areas of defoliation are mapped in Region 2. The majority of the acreage was along the Canadian border and lies inside the Boundary Waters Canoe Area Wilderness. However, budworm larvae, pupal cases and adults were found in many locations as far away as 50 miles from these borders. The two remaining areas of infestation are near Britt and near Esquagama Lake.

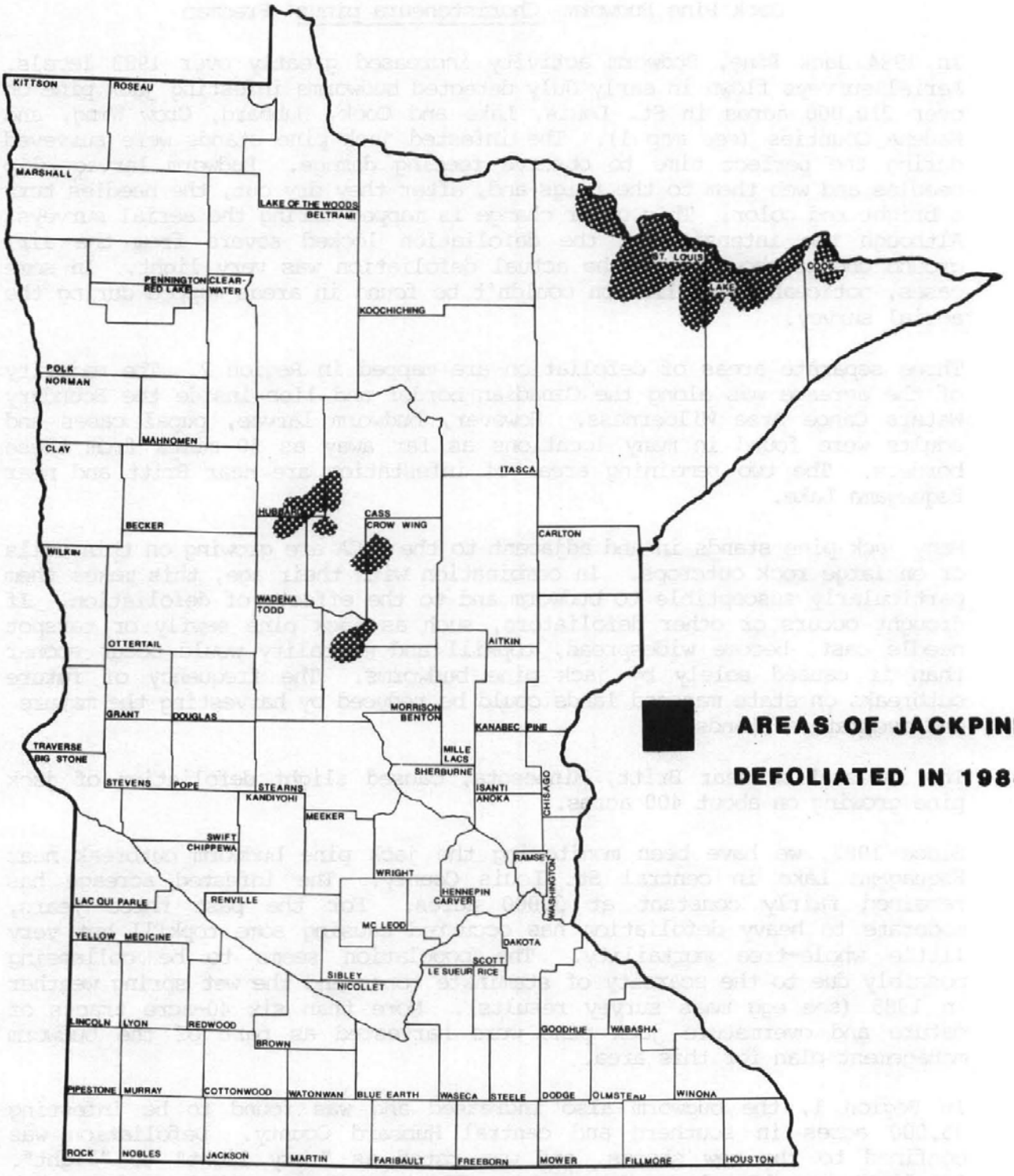
Many jack pine stands in and adjacent to the BWCA are growing on thin soils or on large rock outcrops. In combination with their age, this makes them particularly susceptible to budworm and to the effects of defoliation. If drought occurs or other defoliators, such as jack pine sawfly or tarspot needle cast, become widespread, topkill and mortality would occur sooner than if caused solely by jack pine budworms. The frequency of future outbreaks on state managed lands could be reduced by harvesting the mature and overmature stands.

The infestation near Britt, Minnesota, caused slight defoliation of jack pine growing on about 400 acres.

Since 1982, we have been monitoring the jack pine budworm outbreak near Esquagama Lake in central St. Louis County. The infested acreage has remained fairly constant at 3,000 acres. For the past three years, moderate to heavy defoliation has occurred causing some topkill but very little whole-tree mortaility. The population seems to be collapsing possibly due to the scarcity of staminate cones and the wet spring weather in 1985 (see egg mass survey results). More than six 40-acre tracts of mature and overmature jack pine were harvested as part of the budworm management plan for this area.

In Region 1, the budworm also increased and was found to be infesting 35,000 acres in southern and central Hubbard County. Defoliation was confined to the new shoots, and was rated as "very light" to "light". Defoliation could only be detected by clipping branches and inspecting them closely. In a survey conducted, fifty-one larval survey plots were established throughout the Region during the latter half of May and the first half of June. The plots consisted of inspecting a total of 30 elongating shoots from the mid-crown of 5 trees on each plot. Where

JACK PINE DEFOLIATION 1984



AREAS OF JACKPINE DEFOLIATED IN 1984

MAP NO. 1

possible, shoots bearing staminate cones and shoots bearing only new needles were looked at in equal numbers on each plot.

On 9 plots, budworm larvae were found feeding on the new shoots, as follows:

Description	# Shoots Infested
15-139-32	2
34-140-32	4
27-140-32	3
10-140-32	1
26-104-32	2
26-140-32	3
34-140-32	2
6-139-32	6
31-140-32	7

In early July another larval survey was conducted in townships 140-32 and 140-33. Ten out of 11 plots were positive for budworm larval feeding. Numbers ranged from 1 shoot infested to 5 shoots infested in 17-140-32 and 27-140-33.

Aerial reconnaissance on June 25 revealed no signs of budworm feeding. A flight made on July 11 did detect the typical reddened foliage resulting from budworm feeding. Ground checks made on July 12 could not detect the red color of the jack pine. Clipped branches did show needle chewing and loss, but damage was confined to the new shoots. The heaviest feeding damage that was detected from the ground occurred in 26 and 35-139-33.

Egg mass surveys were conducted during August, and consisted of clipping 2, 18-inch branches from the mid-crown of 4 trees at each plot location. The objective was to try to sample trees representing the 4 crown classes. Forty-nine plots were sampled, and egg masses were found on 10 plots, as follows:

Description	# Egg Masses	Ave./Tree
4-143-34	1	0.25
36-140-32	3	1.00
34-140-32	3	1.00
4-139-32	3	1.00
6-139-32	1	0.25
22-140-32	1	0.25
27-140-32	2	0.50
13-139-33	1	0.33
9-139-32	3	1.00
19-139-32	1	0.33

An average of 1 egg mass per tree would indicate that budworm numbers are great enough to cause noticeable defoliation during the next growing season provided spring weather conditions are conducive for larval survival, i.e. warm and dry.

It was interesting that the egg mass survey expanded the area of infestation identified during the larval surveys. Larval surveys indicated that the infestation was confined to the townships in the southeastern corner of Hubbard County, 139 and 140, ranges 32 and 33. The egg mass survey also detected budworm 3 townships to the north. Except for the break in the jack pine type in the southern Paul Bunyan State Forest, this type is somewhat continuous from the Hubbard County line northward to the Bemidji area. It would be logical, then, to expect to find budworm activity all throughout this large, continuous type.

In Region 3, budworm larval surveys (see Table 3) indicated populations are building but remain far below outbreak levels. Aerial survey on July 10, 11 and 12 detected red needle firing on about 40,000 jack pine acres throughout the central lakes area (see map 1). This discoloration was not visible during aerial survey in late July and early August. Light defoliation was confirmed during ground checks in Wadena, Pine and Crow Wing Counties. Egg mass surveys (see Table 4) confirmed low level populations.

Outlook for 1985

In Region 1, the last major infestation occurred from Bemidji southward during the period of1977-1980. After 1980, budworm could not be found. Because of this new upswing in budworm activity and an average of one egg mass per tree on some of the plots, a renewed cycle of budworm appears to be beginning. The year of 1985 should see noticeable jack pine defoliation occurring in southern Hubbard County, and the presence of budworm found throughout a larger area in Hubbard County.

In Region 2, based on the egg mass survey and observations of pupal cases and adults in outlying areas the infestation will continue at low population levels but over a more extensive area. Although 30 locations were surveyed, only a few had egg masses: near Winton, near Snowbank Lake, on the Echo Trail, near Moose River, in Tower District, and at Esquagama Lake. None of the plots had enough egg masses to predict damaging defoliation in 1985.

In Region 3, populations may continue to build in Wadena, Crow Wing and Pine Counties. Larval and aerial surveys will be used to monitor potential hot spots and high value recreation area.

PHENOLOGICAL NOTES: REGION 2

5-31-84	Largely 2nd instars with few 3rd feeding in staminate cones. Few noted in survey of vegetative tips. Biwabik/Eshquagama L., Virginia district.
6-06-84	3rd instar mainly with some 2nd and 4th. Virg. Dist.
6-12-84	3rd instar mainly with 4th present. Virg. Dist.
6-26-84	Larvae found in Littlefork Dist.
6-28-84	4th instar with a few 5th. No "firing"/grey aspect. Virg. Dist.
7-10-84	50% pupae. Virg. Dist.
7-13-84	Adults appearing in collections. St. Louis Co.

PHENOLOGICAL NOTES: REGION 2 (continued)

7-18-84 Found 1 larvae. Most pupa light in color. Along NE edge of outbreak 25% of adults have emerged. Virg. Dist.
7-19-84 Observed 7 adults on 1 jack pine. No evidence of feeding or pupal cases. Big Falls Dist.
7-20-84 Adults in collection Sea Gull Lake, Cook Co.
7-22-84 Adults still present in Biwabik and Gr. Marais Collection.

TABLE I. JACK PINE BUDWORM EARLY LARVAL SURVEY, REGION 3.

Method: One branch was cut from the top third, the middle third, and the lowe third of the crown from each of five trees (jack pine) at each plot. One staminate cone cluster and one vegetative shoot, on each branch, was checked for budworm. If the branch did not have staminate cone clusters, another branch was cut and checked, as indicated.

Data: Tabled below.

DATE	PLOT LOCATION	TREE 1	TREE 2	TREE 3	TREE 4	TREE 5	REMARKS ABOUT EACH PLOT
			Cone Cluster Budworms				
	Crow Wing	0 1 0	0 1 0	1 1 0	0 1 0	1 0 0	98% third instar; 2%
8	SESE 32-135-27		Vegetative Shoot Budworms				other (2nd and 4th) only
		0 0 0	0 0 0	0 0 0	0 0 0	0 1 0	1 budworm/cone cluster.
	Crow Wing	0 1 0	1 1 0	0 1 1	1 1 0	1 1 1	
11	NESW 8-136-27	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	
	NWSW 9-136-27						
	Crow Wing	1 0 0	1 1 1	0 1 1	1 1 0	0 1 0	40 - 50 ft. pines.
11	NWSW 10-136-27	0 1 0	0 0 0	0 0 0	0 0 0	0 0 0	
	Crow Wing	0 1 0	1 0 0	1 1 0	0 1 1	0 1 0	Some spittle bug and
11	NENE 23-136-27	0 0 0	0 0 0	0 0 0	0 1 0	0 0 0	needle cast.
	Morrisson	0 0 0	1 1 1	0 1 1	1 1 0	0 0 1	80% third instar; 10%
11	NESE 5-132-30	0 0 0	1 0 0	0 0 0	1 0 0	0 0 0	2nd.
	Wadena	0 0 1	1 1 0	0 1 0	1 1 1	0 0 1	2 budworm dead end
12	NENW 10-135-33	0 0 0	1 0 0	0 0 0	0 0 0	0 0 0	mushy. Many spittle bugs.
	Wadena	0 1 0	0 1 1	0 0 0	1 1 1	1 1 1	Average of 4 spittle bugs
12	NENE 6-135-23	0 0 0	0 1 0	0 0 0	0 0 0	0 0 0	bugs/15 inch branch (heavy) needle rust.
	Wadena	0 0 0	1 1 0	1 0 0	0 1 0	0 0 0	Several 50 ft. pines.
12	SENE 16-136-33	0 0 0	1 0 0	1 0 0	0 0 0	0 0 0	
	Wadena	0 0 0	0 0 0	0 0 0	0 0 0	1 0 0	
12	NWNW 27-138-33	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	
	Cass	0 0 1	1 1 0	0 0 1	0 1 0	0 1 0	90% third instar.
14	NENW 36-138-32	0 0 0	0 0 0	1 0 0	0 0 0	0 0 0	40-50 ft. pines.
	Wadena	0 0 1	0 0 0	0 1 0	0 1 0	1 1 0	One darkened 4th or
14	NESW 7-138-33	0 0 0	0 1 0	1 0 1	0 0 0	0 1 0	5th instar, rest 3rd.
	Wadena	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	
14	NWSW 26-138-34	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	
	Crow Wing	0 1 0	0 0 0	0 1 0	0 0 0	0 0 0	50 ft. pines. Heavy
15	NWNW 15-44-31	0 0 0	0 1 0	0 0 0	0 0 0	0 0 0	spittle bug.

TABLE II. JACK PINE BUDWORM EGG MASS SURVEY, REGION 3.

LOCATION and DATE	# OF EGG MASSES*
Crow Wing - July 30, 1984 SW of NW¼ of 20-43-31	1
Cass - July 30, 1984 SW of SW¼ of 34-134-30	1
Wadena - July 31, 1984 NE of NE¼ of 3-138-33	2
Wadena - August 1, 1984 NE of NE of 23-137-33	1

* number of egg masses on six, 15-inch needle-bearing branches, on each of six, 2½- to 5-foot branches cut from 6 jack pine, mid crown (2 branches from 3 trees at each location)

TABLE III. JACK PINE BUDWORM EGG MASS SURVEY, REGION 2.

LOCATION	AVERAGE NUMBER OF EGG MASSES PER BRANCH ON PLOTS WITH EGG MASSES*
20-60-15	0.17
12-57-16	0.17
9-57-16	0.17
4-57-16	0.34
4-57-16	0.34
9-57-16	0.17
10-57-16	0.17
9-63-9	0.34
36-61-13	0.17
x-65-14	0.34
x-65-14	0.34
x-63-11	0.17
x-65-14	0.34

* Two 15-inch branch samples from each of three trees were sampled on each plot. The predicted defoliation of jack pine in 1985 will be moderate to heavy if the average number of egg masses is greater than 0.50/branch.

Pine Tussock Moth Dasychira pinicola (Dyar)

Larval surveys conducted from mid to late June in Mission township of Crow Wing County and Sturgeon Lake, Windemere, Kettle River and Norman Townships in Pine County indicated continuing low level populations in these historic outbreak areas. No noticeable needle firing or defoliation was detected during aerial surveys conducted in July. Pheremone trapping was conducted for the fifth straight year. The pine tussock lure supplied by the Canadian Forest Service was used to monitor stands in Cass, Crow Wing, Pine, Hubbard and Wadena counties (see Table IV). A drastic increase in trap catches occurred. Annual trap catches had been running from 0-13 males per trap. Egg mass surveys (see Table V) conducted in late July and early August however, collected only one egg mass.

Outlook for 1985

Pheremone trapping indicated a potential increase in tussock moth populations. Egg mass surveys did not confirm this observation. Early larval surveys will be need in June, 1985, to determine if the population is building.

TABLE IV. PINE TUSSOCK MOTH PHEREMONE TRAP COLLECTIONS 1984: REGION 3.

TRAP#	LOCATION	Date Male Moths Collected 7-25	7-26	7-31	8-3	8-6	8-10	8-20	8-31	9-30	SUM
1	9-136-27		14			31		8			53
2	9-136-27		16			28		18			62
3	10-136-27		15			26		17			58
4	10-136-27		9			20		34			63
5	11-136-27		11			23		25			59
6	11-136-27		27			23		35			85
7	15-136-27		9			16		7			32
8	23-136-27		2			15		16			33
9	27-136-27		20			7		9			36
10	27-136-27		16			8		4			28
11	12-45-20		7		3		0			0	10
12	13-45-20		4		10		5			2	21
13	26-45-20		0		3		5			2	10
14	26-45-20		8		10		8			0	26
15	25-45-20		4		19		5			4	32
16	26-45-20		0		10		6			2	18
17	No trap										
18	26-45-20		11		3		6			1	21
19	26-45-20		7		2		6			2	17
20	25-45-20		7		3		3			0	13
21	25-45-20		5		4		1			0	10
22	31-45-20		1		7		5			0	13
23	31-45-20		11		10		8			2	24
24	31-45-20		9		15		8			2	34
25	29-45-19		13		7		9			1	30
26	31-45-19		11		9		4			0	24
27	31-45-19		7		25		3			3	38
28	2-44-2		7		12		2			0	21
29	1-44-20		2		2		3			0	7
30	6-44-19		0		5		4			2	11
31	6-44-19		8		15		6			1	30
32	5-44-19		9		14		6			1	30
33	36-45-20		7		3		9			3	22
34	36-45-20		1		0		1			0	2
35	35-45-20		4		1		1			0	6
36	35-45-20		4		0		1			0	5
37	18-45-19		5		2		4			2	13
38	18-45-19		5		12		4			1	23
39	13-45-20		7		6		5			0	18
40	13-45-20		4		4		2			1	11
41	1-139-32	23							31		54
42	25-138-32	21		17					22		60
43	34-137-32			31	4				15		50
44	13-134-29	13		10					7		30
45	22-135-33				30				26		56
46	28-136-33								13		13
47	16-138-33			33					16		49
48	3-138-33			24					21		45
49	22-134-29					12			13		25
50	22-134-29					24			4		28

1. Traps placed from July 6 to July 18.

TABLE V. PINE TUSSOCK MOTH EGG MASS SURVEY 1984, REGION 3.

LOCATION	PHEREMONE TRAP#	DATE	# EGG MASSES*
13-134-29	None	July 27	0
6-136-27	None	July 27	0
14-135-29	None	July 27	0
10-144-31	None	July 30	0
20- 43-41	None	July 30	1
33-138-19	None	July 31	0
16-138-33	47	July 31	0
25-138-32	42	July 31	0
22-135-33	None	Aug. 1	0
28-136-33	None	Aug. 1	0
23-137-33	None	Aug. 1	0
34-137-32	None	Aug. 1	0
1- 44-20	29	Aug. 3	0
13- 45-20	12	Aug. 10	0
26- 45-20	13	Aug. 10	0
26- 45-20	14	Aug. 10	0
26- 45-20	15	Aug. 10	0
26- 45-20	16	Aug. 10	0
26- 45-20	19	Aug. 10	0
25- 45-20	20	Aug. 10	0
31- 45-20	22	Aug. 10	0
31- 45-20	24	Aug. 10	0
29- 45-19	25	Aug. 10	0
31- 45-19	26	Aug. 10	0
1- 44-20	29	Aug. 10	0
36- 45-20	34	Aug. 10	0
13- 45-20	39	Aug. 10	0

* number per 5 trees with one arm sweep per tree

Bark beetles Ips pini (Say)

Three localized populations were noted in Region 2. Bark beetles infested 20' Norway pine plantation north of Duluth, St. Louis County. In 1983, some trees were cut and burned but slash was left and this possibly provided a brood site. In 1984, about 20 trees are showing frass on the boles and symptoms of foliar discoloration. Continued sanitation and burning is recommended. Bark beetles were also noted in an area of previous infestation south of Eveleth, St. Louis County. Overmature jack pine are infested with bark beetles and Armillaria root rot on a private site near Sturgeon Lake, St. Louis County. It was recommended that the landowner follow the Bark Beetle Guidelines to manage the stand.

In Region 3, salvage operations continued in the Sand Dunes State Forest of Sherburne County. Overstocked jack pine stands (basal area 160) continued to be attacked while managed white, red and scotch pine stands show little damage. Selective marking of mature pine stands in high use areas of St. Croix Park was used to remove high hazard trees and establish additional trap trees for removal in May, 1985. Private forest management efforts stressed cut product removal during June to September and utilization to a 3" top.

PHENOLOGICAL NOTES

8-18-84 Larvae present; a few adults; pre-pupal stage common (wing pads present).

Grasshoppers Melanoplus spp.

Grasshoppers severely damaged newly planted containerized jack pine in both the Park Rapids and Warroad Areas. Two of the 4 plantations established in 1984 in the Park Rapids Area with containerized jack pine were damaged, and one plantation in Becker County, 2-139-37, had tree loss of 80-90%. The other plantation located in Hubbard County, 9-139-32, sustained 30-40% loss due to grasshopper feeding. The Becker County plnatation will be replanted in 1985.

There were at least 8 plantations in the Warroad Area, Roseau County, involving approximately 100 acres which were damaged by grasshoppers. One 61-acre plantation, 33-161-36, sustained nearly 70% loss within 7 days of the start of planting. This plantation is scheduled to be replanted with bare root stock during 1985. The other plantations were less severely damaged, and replanting due to grasshopper damage alone will not be necessary.

In the 61-acre plantation, planting began on July 7th, and the area was completed on July 9th when grasshoppers were found to be feeding on the outplanted stock as well as the stock in styroblocks waiting to be planted. A survey of 394 trees and 562 leno scalps on July 13th revealed that only 45% of the containerized trees had been untouched in less than a week. If the empty leno scalps were assumed to be planted, undamaged trees would be reduced to 32% of the original planting.

Grasshoppers seemed to favor stem tissue over needles. The most common damage observed (30% of the trees) was the stem eaten down to the groundline. Often only a pile of brown, dried needles remained in the scalp, with a debarked stub or no stub sticking above the groundline. The root mass of the containerized seedling could be pulled out of the ground to confirm the presence of the planted seedling. The next most common damage (15%) was complete stripping of the bark from where the needles stopped downward to the groundline. Usually the needles were undamaged. The third type of damage occurring on 10% of the trees was an obvious chew mark on the stem in one or more places. The chewing did not completely girdle the stem, and the seedling may recover.

The site had been cutover 3 or 4 years previously, planted with bare root stock in 1982, deemed a failure in 1983, leno scarified in the fall of 1983, and then planted with the containerized stock. The period of years between logging and planting allowed vegetation and grasshoppers to buildup. After damage was discovered, containerized planting was switched to sites which had been cut over within 1 year. Grasshopper damage has also been observed on these sites, but populations should not be great enough to cause heavy losses.

The 61-acre area will be planted to bare root stock during the spring of 1985. The larger, more woody bare root stock should not offer such

succulent morsels for the grasshoppers' gourmet appetites. A policy has also been established that will designate containers for recent cutovers or areas with good vegetation control and bare root stock for older cutovers.

Introduced Pine Sawfly *Diprion similis* (Hartig)

Dropcloth collections on June 14 in Belle Prairie Morrison County Park (14-41N-32W) indicated moderate to high larval populations. Direct control plans were established to be implemented if defoliation became heavy and second generation early larval counts remained high. Direct control was not needed. Field checks in July and August in the Grandy Pines (Isanti County) and Sunrise (Chisago County) historic outbreak areas detected low level populations and no visible defoliation. Light to moderate defoliation was reported by resort owners in the central lakes region.

Phenological Notes

June 14 - Morrison County - new larvae and male and female adults active.
July 17 - Morrison County - first generation spinning up. No noticeable defoliation.
July 24 - Morrison County - few larvae, some viable cocoons, 3 adults. No observable defoliation or frass accumulation.
Chisago County - no larvae or cocoons, 2 adults. No feeding damage.

Outlook For 1985

Mature white pine stands in Crow Wing, Morrison, Todd, Chisago, and Isanti counties will be monitored to detect population buildup.

Red-headed pine sawfly *Neodiprion lecontei* (Fitch)

In Region 5, in Hennepin County, Sec. 28, Twp. 118, Rge. 23W, ten acres of mixed conifers were treated on private land in mid-June with Malathion. This was the beginning of the second year of defoliation on white spruce.

In Region 1, one private and three highway roadside jack pine plantings were lightly defoliated in Carlton County.

Phenological Notes

8-05-84 Mainly 5th instars, Carlton County.

Jack pine sawflies *Neodiprion pratti banksianae* (Rohwer)

The increased number of collections in 1983 and 1984 and the loss of old needles due to larval feeding in jack pine in St. Louis and Cook Counties, indicates a survey is needed in areas of jack pine budworm infestation sites in 1985.

Phenological Notes

5-10-84	Eggs present Kawishiwi River, Lake County.
5-19-84	Eggs present Crane Lake, St. Louis County.
6-14-84	2nd instar larvae Biwabik, St. Louis County.
7-13-84	5th instar present Grand Marais, Gunflint Trail, Cook County.
7-20-84	"Cocoons" present in collections from St. Louis County.
7-25-84	Mostly completed feeding. A few 5th instars present Esther Lake, Cook County.

Jack pine sawfly Neodiprion Virginicus

Present in open-growing sapling jack pine in St. Louis and Cook Counties. The 1984 collections from two sites in Cook County, were the first from that county.

Phenological Notes

7-23-84	4th instars Canyon, St. Louis County.
7-25-84	2-3 instars Cook County, Tower F.T.R.
8-04-84	5th instars Cook County, Tom & Chester Littlefork.

Northern pine weevil Pissodes approximatus

In Region 1, Northern pine weevils were recovered from heavy infestations on red pine just below ground level and girdling the trunks. These infestations were common in the stands with bark beetles reported above.

White pine weevil Pissodes strobi (Peck)

In Region 2 a high infestation in jack pine and an occasional white spruce continued in Orr district, 30-45N-17W. Norway pine was not infested. White pine weevil was commonly noted in white and jack pine regeneration Carlton and St. Louis Counties. It was also noted for the first time in natural regeneration jack pine in Cook County.

Phenological notes

6-20-84	Adults present Thistledew Dist., Itasca County.
8-05-84	Adults emerged from collections.

Red pine shoot moth Rhyacionia adana Heinrick

Field checks were conducted in red pine plantations in 5-132-20 of Morrison County, 1, 21 & 22-134-30 of Cass County, 11-138-34 of Wadena County and 36-45-20 of Pine County to determine if shoot moths were present and observe damage. Site conditions stock used and planting techniques were different on all sites and quantative comparisons were not made. All plantations contained the pest. Larvae were also found in jack pine

seedlings in and around each plantation. Eight to twenty-six percent of the trees observed (60 to 120 per site) were damaged. Mortality seemed to be occurring only where brush competition and/or browsedamage were heavy. Severe stunting and multiple stems also occurred in these situations. Open grown seedlings appeared to support less damage or were outgrowing the damage. Fewer shoots were affected on open grown seedlings or the damage was occurring on lower lateral branches. Direct chemical control was not feasible. Good site preparation, removal of pine residuals, planting larger stock and maintaining free to grow status in their early years should limit shoot moth impact. More studies are needed on site and microenvironmental factors that promote shoot moth buildup.

White-spotted sawyer Monochamus scultellatus (Say)

Heavy infestation in Norway pine in a private planting were noted in St. Louis County. The sawyer was associated with northern pine weevil and Ips pini and likely secondary, following pine decadence.

Phenological Notes

7-07-84 Adults noted Carlton County.

Pine spittlebug Aphrophora parallela (Say)

In Region 1, during the early larval survey for jack pine budworm, pine spittlebug presence was also observed. On 90% of the 51 plots, pine spittlebugs were found. Each plot consisted of 30 branches, and numbers of branches with at least one nymph ranged between 1 and 20 branches. An average of 9 nymphs per plot were found. This observation was a substantial change from the last two years. Few spittlebug nymphs were observed since 1981.

White grubs Phyllophaga spp.

Damage was observed in two private plantations established with 3-0 red pine seedlings during 1984. The plantations were located in Beltrami and Clearwater Counties. The plantation in Clearwater County experienced heavy enough damage that some replanting may be necessary.

Both plantations were established in grass fields. The foliage on the trees were red and at first blamed on drought, poor stock or poor planting techniques. When the trees were dug up, however, root damage was evident. Damage ranged from the small, lateral roots missing to the entire root system missing except for a central, bare "stem" much like a taproot. In some cases, stripped bark or chew areas were observed on the larger roots.

Because the plantations were looked at during freeze up, no grub population sampling was carried out. Sampling should be carried out in early spring after the ground has thawed and be done by inspecting a cubic foot of soil. A number of cubic-foot samples should be done throughout the plantation. An average of ½ grub per cubic foot of soil means a population great enough to cause tree damage.

There is no immediate, easy control method. No insecticides are registered for grub control in forest situations. Insecticides that will control grubs do not always have a long enough residual to protect the trees until grub numbers are reduced. Since grub feed on roots and other organic matter in the soil, feed on roots and other organic matter in the soil, complete vegetation elimination for one year is the only chance of bringing about a reduction in grub numbers. Replanting back into a grassy area probably will result in additional losses. Spot treating or strip treating the vegetation around the trees does not eliminate enough food sources to reduce grub numbers.

SPRUCE, WHITE

Yellow-headed spruce sawfly Pikonema alaskensis (Rohwer)

In Region 2, low populations continued in plantations but there was an apparent population increase in roadside and ornamental plantings in Carlton, Cook and Lake Counties especially. Big Swampy plantation in Cook County showed a very light incidence on the SE aspect. In Cotton seed orchard there was an increase in incidence and distribution. Where 1983 infestation occurred largely in south and southwest part of plantation, 1984 check shows some light current feeding and larvae throughout plantation. A check of row #1 on the east side of the plantation showed 17 of 55 standing spruce, or 31%, with 4-5th instar larvae present with light defoliation. No other plantations were noted with infestations in area of survey.

Populations remained low in Region III. Direct control was limited to yard trees and individual trees in the seed orchard in section 16 of Birch Creek Township in Pine County. Field checks in Aitkin County revealed low level populations in stands treated in '83. No direct control was undertaken in these plantations in '84.

Phenological Notes

5-31-84	Adult females noted ovipositing in Cotton seed orchard, St. Louis County.
6-06-84	1st instar larvae present, St. Louis County.
6-20-84	2nd instar mainly with some 3rd instars, St. Louis County.
6-25-84	3rd instars mainly, Cook County.
7-02-84	Mainly 5th instars with some 4th instars, St. Louis County. Many Ichneumonid wasps noted in Cotton seed orchard; 1 Pentastomid noted feeding on larvae.
7-18-84	"Cocoons" in collected material.

Outlook for 1985

Populations should remain low in 1985 with continuing isolated ornamental problems.

FIR, BALSAM

Spruce budworm Choristoneura fumiferana (Clemens)

Spruce budworm populations defoliated balsam fir and white and black spruces on 361,000 acres in St. Louis, Lake and Cook Counties (see map 2). This is 2.6 times greater than the acreage defoliated in 1983. The last time defoliation occurred on this many acres was in 1970 and the only times in the past 30 years that annual defoliation exceeded 360,000 acres were years 1956 and 1963. There are two primary areas of budworm outbreak. The main body of one outbreak is centered north of Duluth and budworm populations have been active there for the past 10 years. The other spruce budworm outbreak is in Cook County and populations have been active on much smaller acreages for only two or three years.

Both the acreage and severity of the outbreak centered on the Cloquet Valley and Finland State Forests have roughly doubled this year. Aerial survey results are:

Light defoliation	25,600
Moderate defoliation	28,050
Heavy defoliation	158,650
	212,300 acres

In 1984, the population expanded along the North Shore and into southern Lake County and also expanded to the northwest to Sherman Corner. Both topkill and mortality of balsam fir occur over extensive areas. In the Fond du Lac State Forest, larvae and moths have been collected for the past 3 years. Defoliation has not been evident because the populations were low.

There was a spruce budworm population explosion in Cook County in 1984. The defoliated acreage increased 9.7 times compared to 1983's acreage. Results of the aerial survey are:

Low defoliation	14,000
Moderate defoliation	32,150
Heavy defoliation	103,150
	149,300 acres

The area from Gunflint Lake south to Poplar Lake along the Gunflint Trail and eastward from McFarland Lake south to Portage Creek has experienced 2 years of heavy defoliation and populations have been observed there for 3 years. Complete defoliation was observed in many balsam fir crowns and understory balsam firs were heavily defoliated in this area.

Balsam fir growing in the area near Ester and Chester Lakes experienced complete defoliation of current year's growth, mining and blasting of buds and some back-feeding onto old needles. Black and white spruces were also defoliated but the impact was much less due to the amount of foliage on the spruces.

Late instar larvae and pupae from 4 locations were assessed for the incidence of parasites and/or diseases. A variable number of larvae and pupae were collected at each location.

Location	Diseased	Parasitized*	Adults Emerged	Total % parasitized or diseased larvae and pupae
Hibbing	4%	8%	88%	12%
Finland	--	20	80	20
Cotton S.O.	48	16	34	64
Esther L.	9	15	76	24

* = Itoplectus wasps most common parasite recovered.

While parasite/disease levels are fairly high at the Cotton seed orchard, they are not likely to be a controlling factor for the budworm population there.

Outlook for 1985

The great numbers of moths observed in St. Louis, Lake and Cook Counties during the peak flight period plus the high egg mass counts, (see Table VI), indicate that heavy defoliation will continue in the areas of 1984 defoliation.

Continued topkill and mortality should be expected in St. Louis and southern Lake Counties in 1985. In the Finland campground and Manitou State Park, egg mass counts indicate the likelihood of continued and increased feeding in 1985. Since the budworms have fed there for only one year, topkill and mortality are not expected. No egg masses were found in the Fond du Lac State Forest although other life stages were found there. This state forest will be monitored in 1985 for a budworm population buildup, especially with high population levels to the north.

In Cook County, very high egg mass counts at Tom and Otter Lakes, where only current year feeding was observed, indicate an expansion of the infestation to the east and south. The egg mass counts at Balley Creek, Mistletoe Creek and Sawbill Trail indicate an expansion to the west.

The extremely high egg mass count in areas where heavy defoliation has occurred for the past two years indicates the likelihood of topkill following feeding in 1985. Topkill and mortality may begin to occur on the drier sites from Gunflint Lake and south to Poplar Lake along the Gunflint Trail and eastward from McFarland Lake south to Portage Creek.

Parasite/disease levels are not likely to be a significant factor in controlling the spruce budworm population in Cook County in 1985. Only 7 of 278 egg masses showed Chalcid wasp or diseases affecting the hatching of first instar larvae.

Phenological Notes

5-19-84	Spruce pollinating. Kawishiwi River, Lake County
5-22-84	Spruce shedding scales. Cotton seed orchard, St. Louis County.
5-24-84	Female cone scales open one-third, closed 2/3; male cones pollinating; 2nd and 3rd instars Cotton seed orchard.

5-31-84	3rd instar feeding in new shoots with some webbing at base; larvae feeding on cones. Cotton seed orchard.
6-06-84	4th instar.
6-15-84	5th instar largely; 1 pupa St. Louis County.
6-22-84	90% pupae Cotton seed orchard in spruce; 30% pupae in balsam fir.
6-26-84	Mainly 6th instar Cook County; no pupae.
6-27-84	2 adults from collection. Cotton, St. Louis County.
7-02-84	Adults common in spruce/fir. Cotton, St. Louis County.
7-03-84	Pupation. Cook County collection.
7-15-84	Adults common in trees. Cook County 3/4th emerged.
7-25-84	Few adults present. Cook County. Largely spent.
8-07-84	Most egg masses hatched; 3 green stage present. Hovland, Cook County.

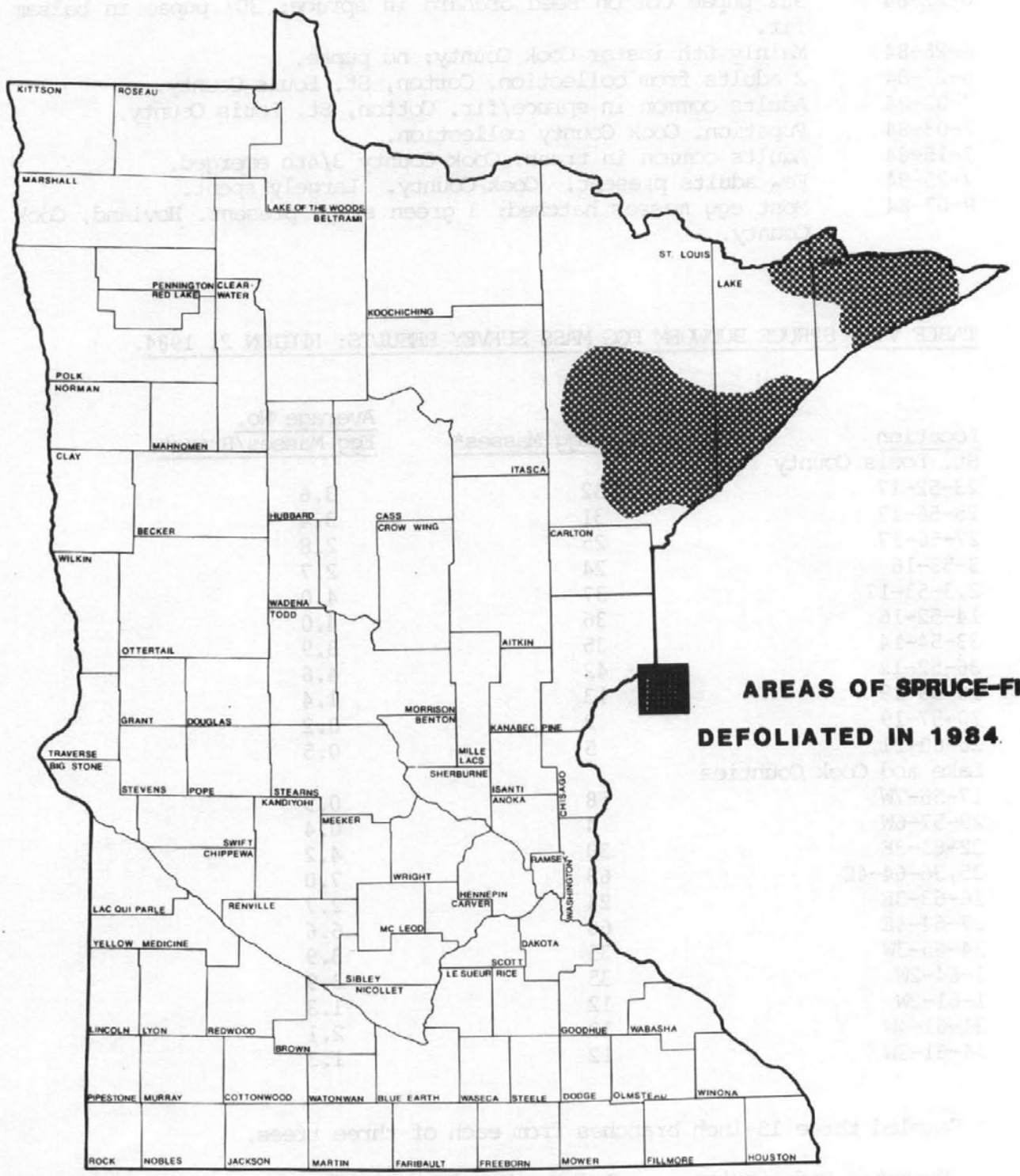
TABLE VI. SPRUCE BUDWORM EGG MASS SURVEY RESULTS: REGION 2, 1984.

Location	Total No. Egg Masses*	Average No. Egg Masses/Branch
St. Louis County		
23-52-17	32	3.6
25-56-17	31	3.4
27-56-17	25	2.8
3-53-16	24	2.7
2,3-53-17	37	4.0
14-52-16	36	4.0
33-54-14	35	3.9
36-52-12	42	4.6
16-59-19	13	1.4
30-57-19	2	0.2
25-60-21	5	0.5
Lake and Cook Counties		
17-56-7W	8	0.9
29-57-6W	4	0.4
32-61-3E	38	4.2
35,36-64-4E	63	7.0
16-63-3E	24	2.7
27-64-4E	60	6.6
34-65-3W	35	3.9
1-64-2W	35	3.9
1-61-2W	12	1.3
31-61-4W	19	2.1
34-61-3W	12	1.3

* Sampled three 15-inch branches from each of three trees.

Expected Defoliation	Average No. Eggmassed/Branch
None to light	0 - 0.1
Moderate	0.1 - 1.7
Heavy	1.8 +

SPRUCE BUDWORM DEFOLIATION 1984



AREAS OF SPRUCE-FIR DEFOLIATED IN 1984

MAP NO. 2

Balsam fir sawfly Neodriprion abietis (Harris)

Continued high populations occured in southern St. Louis County with an increase over 1983 in Carlton County. The "firing" due to larval feeding was apparent on many balsam fir branches during the first two weeks of July in St. Louis and Carlton Counties.

Phenological Notes

7-2-84 Mainly 4th instars, Independence, St. Louis County
7-12-84 Mostly 5th instars, Carlton County. Many colonies completed feeding.
7-22-84 "Cocoons" from larvae in collection containers.

TAMARACK

Larch sawfly Pristophora erichsonii (Hartig)

Three localized populations were noted in Region 2; along #97 near Sparta, St. Louis County, at Gunn Park, Itasca County and near Lion Springs, St. Louis County. Occasional roadside larch showed defoliation.

Populations remained at low levels in Region III. Light defoliation was noted in stands in Cass, Aitkin, Pine and Mille Lacs counties.

Phenological Notes

6-28-84 1st instar larvae/eggs not hatched, Lion Springs, St. Louis County.

Eastern larch beetle Dendroctonus simplex LeConte

Infested and dead tamarack were observed associated with a tamarack timber sale in Region 1. The cause of the dead tamarack was the eastern larch beetle. The infestation was directly linked to cut products stored on the sale area during the growing season. Because of this damage and to avoid future damage, the Warroad Area instituted the policy that tamarack sales will include the following regulation: "no cut products to be left on sale during summer months".

In Region 3, isolated pockets of eastern larch beetle were confirmed in Cass and Crow Wing counties. Infested stands supported heavy woodpecker activity. Strip cutting after careful inspection to delineate attacked trees was recommended to remove infested material.

ASPEN

Forest Tent Caterpillar Malacosoma disstria Hubner

In Region 2, both the incidence and distribution of aspen defoliation decreased compared to 1983 (see map 3). A total of 33,360 acres of aspen were defoliated by forest tent caterpillars in 1984. This represents 20%

of the acreage defoliated in 1983. Only 2,560 acres of aspen were heavily defoliated in 1984 which represents 3% of the acreage with heavy defoliation in 1983.

Five hundred pupae were collected and the presence of diseases, parasites and predators was assessed. Of these, 52% were diseased, 27% were parasitized, 5% were eaten by other insects and moths emerged from the remaining 16%.

An aspen stand in St. Louis County has been defoliated by forest tent caterpillars for the past 7 years. A 1/10th acre plot was established to observe the impact of defoliation in 1981. Of the 16 trees that were alive in 1981, only 6 are still alive but they all have dead tops or dead leaders. Hypoxylon canker seems to be the cause of tree mortality. Aspen regeneration is limited and only 2 saplings less than 3" DBH are still alive.

Field checks in Region 3 indicated low level populations region wide, with scattered pockets of light defoliation in Pine and Carlton counties. This damage was masked from the air by Aspen tortrix Choristoneura conflictana (Walker) feeding damage. The only noticeable defoliation detected during aerial survey occurred around Lake Koronis in Stearns and Kandiyohi counties. Damage was concentrated in hardwood stands with high basswood components. FTC remains a recreation area and resort problem around the lake. Local lake associations are planning spray programs in 1985.

A 100-acre area of hardwoods dominated by basswood in southern Pope County around Gilchrist Lake was defoliated by the forest tent caterpillar. Residents claimed that 1984 was the 4th year of defoliation. An aerial flight check conducted on July 5 found that the trees had been defoliated, and basswood leaves were 2/3rd normal size. Cast larval skins could also be detected. However, without prior knowledge of defoliation, it would have been difficult to determine that defoliation had ever occurred. Aerial spraying had been contracted by the lakeshore owners' association and carried out earlier in June. Spraying did not completely eliminate defoliation, but it may have allowed the trees to refoliate quicker.

Likewise in the northwest area of Region 5 (Kandiyohi County), the forest tent caterpillar remains active and continues to defoliate stands of basswood and red oak around Norway, Mud, and Green Lakes. Stands on the western edge of Lake Kronis in Stearns County were also again defoliated. Defoliation in these areas has continued in varying degrees for at least the past five years and are expected to continue. A parasite study will be attempted in 1985 to better predict what to expect.

Outlook for 1985

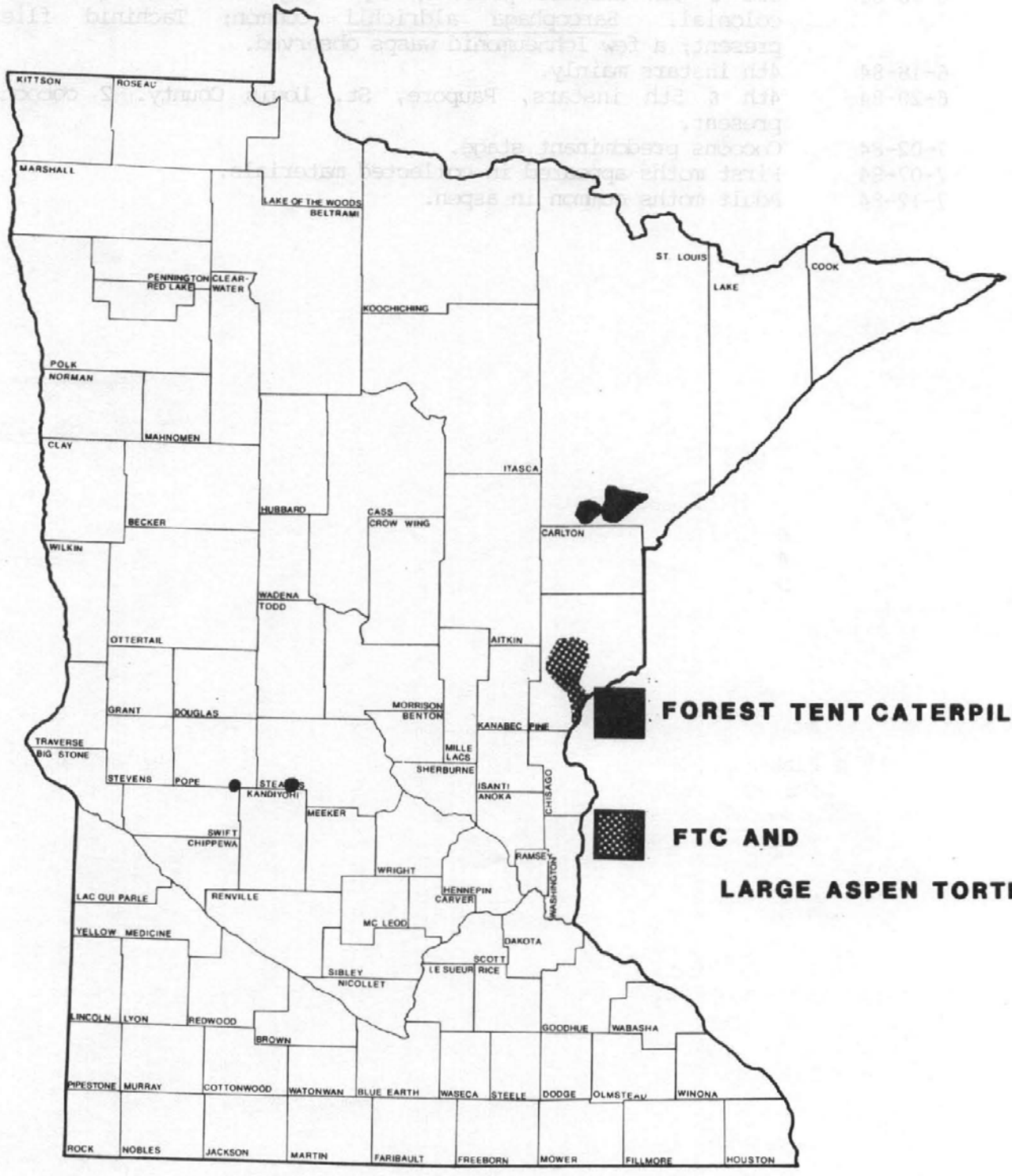
In Region II a population collapse is imminent due to the 80% and 84% loss of pupae to disease, parasites and predators over the past 2 years.

Phenological Notes

5-13-84	Aspen leafed out, Carlton County
5-17-84	1st instar larvae noted, Carlton County
5-24-84	2nd instar larvae noted, S. St. Louis County

5-31-84	3rd instar larvae collected, SW St. Louis County. No noticeable defoliation Carlton and SW St. Louis County in area of previous heavy defoliation.
6-06-84	3rd & 4th instars present; 1½" long with some ½" larvae colonial. Sarcophaga aldrichii common; Tachinid flies present; a few Ichneumonid wasps observed.
6-18-84	4th instars mainly.
6-20-84	4th & 5th instars, Paupore, St. Louis County. 2 cocoons present.
7-02-84	Cocoons predominant stage.
7-07-84	First moths appeared in collected materials.
7-12-84	Adult moths common in aspen.

ASPEN DEFOLIATORS 1984



MAP NO. 3

Large aspen tortrix *Choristoneura conflictana* (Walker)

Leaf damage and defoliation of aspen in Itasca, St. Louis, Lake and Cook Counties was caused by large aspen tortrix caterpillars in June. The population appeared to be widespread but diffuse, so only small pockets of trees showed light defoliation or leaf rolling in their upper crowns. The late flush growth of full-sized leaves above the defoliated upper branches gave the defoliated aspen a characteristic appearance in July. Pockets of heavy defoliation were noted near Sparta, St. Louis County, NE of Silver Bay, E. of Finland and NE of Hovland.

In collections made near Hovland in Cook County, 35% of the pupae were lost due to parasites or diseases.

Populations were up in Region 3. Light to moderate defoliation occurred on 60,000 acres in Pine County (see map 3). Fluctuating spring temperatures and late frosts combined with early larval feeding produced "ratty" aspen crowns regionwide. Numerous aspen leaftiers, including *Enargia* sp. and *Epinota* spp., and tortricid aspen leafrollers were also collected during tortrix field checks.

Phenological Notes

6-06-84	3rd instars noted, Sparta, St. Louis County. Defoliation noticeable on aspen.
6-12-84	4th with 5th instars, Cotton seed orchard, St. Louis County. Defoliation noted.
6-25-84	Pupae predominant, Hovland, Cook County.
7-13-84	Adults all emerged, Hovland, Cook County.

Aspen blotch miner *Lithocolletis tremuloidella* (Brawn)

The Aspen blotch miner was observed on all ages of aspen in St. Louis, Carlton, Lake and Cook Counties especially on saplings and regeneration areas following cutting. Their appearance later in the growing season is not likely to seriously affect increment growth or storage photosynthate. In Region 3, low levels were detected in aspen stands in Crow Wing, Cass, Aitkin, Pine and Carlton Counties.

Aspen leaf tierer *Enargia decolor* (Walker)

There was a decreased incidence in 1984 from that of 1983 in Region 2. Only occasional collections were made during checks of Forest Tent Caterpillar and Aspen Tortrix in the northeast.

Phenological Notes

6-18-84	3rd instars noted, Carlton County.
7-02-84	5th instars, St. Louis County (#33/2 junction)

BASSWOOD

Basswood thrips Seriocothrips tilae (Hood)

In Region 2, five sites with defoliated basswoods were noted in 1984. Light infestations were noted in basswood stands at Jnct. #7 & #33 in Carlton County, at Spirit Mountain in St. Louis County and at Midway north of Eveleth in St. Louis County. The most severely defoliated sites are north of Big Lake and on #23 near Wrenshaw in Carlton County. Both may experience some mortality in 1985.

In Region 5, basswood stands in parts of Wabasha, Goodhue, Olmsted, and Dodge counties were 50 to 90% defoliated by the end of the first week in June. By late June, most trees had refoliated and adult thrips were undetectible.

Phenological Notes

6-13-84	Nymphs common in Carlton County. Leaves defoliated and curled, blackened edges.
6-29-84	Adults present, nymphs mostly absent. St. Louis County.

Outlook for 1985

Basswood defoliation is expected to continue with scattered understory mortality expected in all aged stands.

BIRCH

Birch leaf miner Fenusa pusilla (Lepeletier)

Continued high pupulations were found in St. Louis, Carlton, and Lake Counties. During the aerial survey in early July, pockets of birch browning were noted in St. Louis County and Lake County. An 8-7-84 ground survey noted birch from Finland to Cramer in Lake County having lost current foliage due to birch leaf miner. Contributing factors to birch decadence are the birch leaf miners, drought on thin soils in this area and the bronze birch borer.

Many homeowner requests for information and control were received.

Phenological Notes

5-12-84	Birch leafing out, Carlton County.
5-23-84	Adults noted ovipositing.
6-14-84	Browning of leaves obvious, Carlton County.
6-18-84	Larvae present in mines; no pupae.
6-25-84	Pupae present. Leaves falling. Carlton County.
7-13-84	2nd generation adults present, St. Louis County.

MOUNTAIN ASH

Mountain ash sawfly Pristiphora geniculata (Hartig)

Populations again were high in 1984 with much defoliation noted in St. Louis, Carlton, Lake and Cook Counties. Occasional inquiries from private homeowners were received.

Phenological Notes

5-12-84	Mountain ash leafed out, Carlton County.
6-11-84	Eggs common. 1st instar larvae common, Carlton County.
6-17-84	Mostly 1st instars with a few 2nd instars; a few eggs present.
6-23-84	Mostly 2nd instars; defoliation to veinlets noted.
6-27-84	Mostly 3rd instars, Carlton County.
7-13-84	2nd instars present, Cook County.
7-25-84	Many understory mountain ash noted completely defoliated, Cook and Lake Counties.

GENERAL HARDWOODS

Fall defoliator complex

Variable oakleaf caterpillar Hetercampa manteo (Dbldy.)
Walking sticks Diapheromera femorata (Say)
Redhumped oak worm Symmerista conicosta Franclemont, and related insects.

In Region 1, defoliation occurred once again in southern Beltrami, northern Hubbard and northeastern Cass Counties. This is the third year for defoliation, but defoliation severity and extent of area defoliated was significantly reduced from 1983. Larval feeding was about 10-14 days behind that in 1983 with activity beginning during the week of August 6 and noticeable defoliation not occurring until August 20th. This year oaks seemed to have been favored. Basswood and birch, the favored foods in 1983, were fed on only after the red oaks were stripped. The area defoliated was approximately 40,000 acres in size, down from the 250,000 acres defoliated during 1983.

Region 2 saw a dramatic decrease in damage due to the fall defoliator complex indicating that the cycle is starting to decline. Heavy defoliation occurred on 5,650 acres in northeast Itasca County primarily on birches growing on ridges or adjacent to lakes. Light defoliation occurred in widely scattered pockets of hardwoods in Itasca County (map 4).

Populations declined to endemic levels in most of Region III, verifying the collapse that began in 1983. Aerial survey detected no noticeable defoliation in oak or northern hardwood stands in the region. Few larvae were collected during ground checks in Morrison and Crow Wing County. Larvae on ornamental and windbreak hardwoods were collected in Wadena and northern Cass counties. Some branch mortality on oaks has appeared in stands stripped by the complex in 1980, 81 and 82.

Outlook

After 2-3 years in any one location, the population is brought under control by parasites and predators. This year was the third year of the outbreak in most areas in Region 2. We expect even less defoliation in 1985.

FALL DEFOLIATOR COMPLEX DEFOLIATION 1984

AREAS OF DEFOLIATION 1984

MAP NO. 4

Gypsy Moth *Lymantria dispar* (Linnaeus)

Eradication efforts by the Minnesota Department of Agriculture continued in 1984 with the eradication of three additional sites. In 1984, B.t. (*Bacillus thuringiensis*) in combination with mass trapping was first used (see summary).

The detection of male moths increased in 1984 to 509 moths trapped on 92 sites (see map 5). The division participated in the outstate trapping program by placing and monitoring 1000 traps. No moths were caught.

In 1985, three additional sites within the Twin Cities will be treated with B.t.

MINNESOTA GYPSY MOTH SITUATION IN 1985

Gypsy moth control programs have been successful during the past two years.

Minnesota Gypsy Moth Control Program

Year	County	Acres	Insectide	No. of Treatments	Status	Remarks
1983	Ramsey (St. Paul)	300	Carbaryl	2	Eradicated	No moths trapped in treatment area in 1983.
	Washington (Woodbury)	130	Carbaryl	2	Eradicated	No moths trapped in treatment area in 1983.
1984	Benton (Sauk Rapids)	20	B.t & mass trapping	2	Eradicated	No moths trapped in treatment area in 1984.
	Hennepin (St. Anthony)	30	B.t. & mass trapping	2	Eradicated	No moths trapped in treatment area in 1984.
	Washington (Stillwater)	32	B.t. & mass trapping	2	Eradicated	No moths trapped in treatment area in 1984.

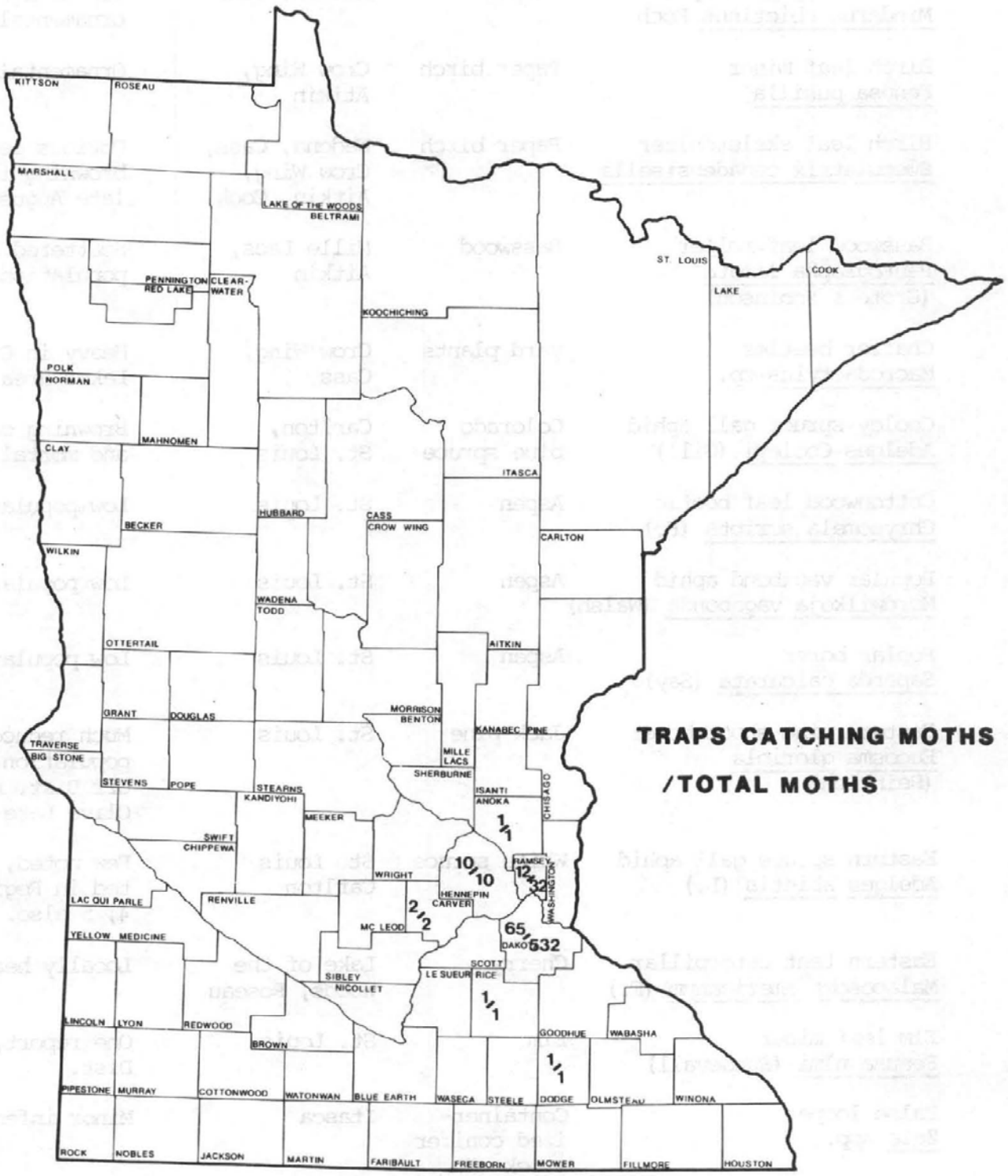
Localized infestations are found by intensively trapping for male moths using traps baited with the female sex attractant. In areas where multiple male cathes are made intensive ground searches are made to find other life stages of the moth, such as egg masses and pupal cases.

In 1984 localized infestations were found in Apple Valley (two sites): Lakeville, and White Bear Lake. These areas were treated in May, 1985.

SUMMARY OF GYPSY MOTH CONTROL PROGRAM FOR 1985

Year	County	Municipality	Acres	Insecticide	No. of treatments
1985	Dakota	Apple Valley (2 sites)	102	B.t & mass trapping	2
	Dakota	Lakeville	39	B.t. & mass trapping	2
	Ramsey	White Bear Lake	39	B.t. & mass trapping	2
			180	acres	

GYPSY MOTH TRAP CATCH 1984



TRAPS CATCHING MOTHS

/TOTAL MOTHS

MAP NO. 5

MINOR AND INCIDENTAL INSECT PESTS

Pest	Host	County	Comments
Balsam twig gall aphid *Mindarus abietinus* Koch	Balsam	Aitkin, Pine	Tip damage on ornamentals
Birch leaf miner *Fenusa pusilla*	Paper birch	Crow Wing, Atikin	Ornamentals
Birch leaf skeletonizer *Bucculatrix canadensisella*	Paper birch	Wadena, Cass, Crow Wing, Aitkin, Cook	Obvious leaf browning in late August
Basswood leaf roller *Pantographa limata* (Grote & Robinson)	Basswood	Mille Lacs, Aitkin	Scattered high population.
Chaffer beetles *Macrodactylus* sp.	yard plants	Crow Wing, Cass	Heavy in Central Lakes area
Cooley spruce gall aphid *Adelges Cooleyi* (Gill)	Colorado blue spruce	Carlton, St. Louis	Browning of twigs and mortality
Cottonwood leaf beetle *Chrysomela scripta* (F.)	Aspen	St. Louis	Low populations
Popular vagabond aphid *Mordwilkoja vagabonda* (Walsh)	Aspen	St. Louis	Low populations
Poplar borer *Saperda calcarata* (Say)	Aspen	St. Louis	Low populations
Eastern pine shoot borer *Eucosma gloriola* (Heinrich)	Jack pine	St. Louis	Much reduced population in Orr Dist. near Olive Lake
Eastern spruce gall aphid *Adelges abietis* (L.)	White spruce	St. Louis Carlton	Few noted, reported in Region 3, 4, 5 also.
Eastern tent caterpillar *Malacosoma americanum* (F.)	Cherry	Lake of the Woods, Roseau	Locally heavy
Elm leaf miner *Fenusa ulmi* (Sundevall)	Elm	St. Louis	One report, Orr Dist.
False looper *Zale* spp.	Containerized conifer stock	Itasca	Minor infestation

Pest	Host	County	Comments
Introduced pine sawfly *Diprion similis* (Hartig)	White pine	St. Louis	Light infestation. 5th instar, 8-18-84 Orr Dist.
Lace bugs *Corythuca* spp.	Oak, basswood, Cherry	Sherburne, Wright	Leaf yellowing in August and September
Larch casebearer *Coleophora laricella*	Tamarack	St. Louis	One incidence on roadside tamarack. Lion Springs.
Lecanium scale *Lecanium* spp.	Oak	Itasca	Urban, decadent oak
Mourning-cloak butterfly *Nymphalis antiopa* (L.)	Willow	Lake of the Woods	One incident, Williams District
Nesting pine sawfly *Acantholyda zappei* (Rohwer)	Jack pine	St. Louis	Noticeable populations near Elbow & Winchester Lakes
Oak sawfly *Caliroa* sp.	Bur oak	Crow Wing, Sherburne	Light on yard trees
Pine Bark aphid *Pineus strobi* (Hartig)	White pine	Sherburne, Crow Wing, Cass	Twig dieback on understory trees
Pine pitch midge *Cecidomyia* spp.	Jack pine	St. Louis Carlton	Minor flagging occasionally noted
Pine spittlebug *Aphrophora parallela* (Say)	Scots pine, tamarack, jack pine	St. Louis	Low populations
Pine tortoise scale *Toumeyella numismatica* (P. & MCD.)	Jack pine	Carlton	Noted occasionally on growing jack pines
Red headed pine sawfly *Neodiprion lecontei* (Fitch)	Jack pine Red pine	Cass, Wadena Morrison	Scattered colonies on roadside trees
Ugly-nest caterpillar *Archips cerasivoranus* (Fitch)	Cherry	Lake of the Woods, Roseau	Locally heavy
Walnut caterpillar *Datana integerrima* (G&R)	Walnut	Southeast	Increasing populations, defoliation of large single trees or groves.

Pest	Host	County	Comments
Red pine sawfly *Neodiprion nanulus namulus* (Schedl)	Red pine	Itasca made in late June.	One collection
Pitch nodule maker *Petrona albicapitana* (Busck)	Jack pine	Northeast	Occassional twig mortality along roadside noted
Spruce cone maggot *Hylemya (Lasiomma) anthracina* (Czerny)	White spruce		Seed orchard
Spruce seed midge *Mayetiola carpophaga* (Tripp)	White spruce		Seed orchard
Balsam twig aphid *Mindaries abietinus* (Koch)	Balsam fir		Few noted in NE
Aspen leaf roller *Anacampsis innocuella* (Zeller)	Aspen	Carlton St. Louis	Low populations
Bronze birch borer *Agrilus anxius* (Cory)	Birch	Carlton, Lake	Continued cause of top-kill and dieback
Fall webworm *Hyphantria cunea* (Drury)	Birch	Lake of the woods, South-east and north into metro region	Local heavy infestatious
Oak leaf rollers *Archips semiferanus* (WLK)	Bur Oak	Olmsted and Winona	Local heavy defoliation
Kermes scales *Kermes pubescens* (Bogue)	Red Oak	Olmsted	Light branch dieback
Leaf beetle *Chrysomela*	willow	St. Louis	Browning of large areas of biog. willow
Lacebug *Corythuca mollicula* O.& D.	willow	St. Louis and Cass	Browning of bog willow

Pest	Host	County	Comments
Willow sawfly Nenatus nentralis (Say)	Willow	Carlton, and St. Louis	Fourth & fifth instar noted
Fall cankerworm Alsophila pometaria (Han)	Hardwoods	St. Louis, Carlton, Itasca, and Roochiching	Light defoliation
Spiny-elm caterpillar Nymphalis antiopa (L.)	Willow and Apple	St. Louis	Light branch defoliation

DISEASES

PINE, JACK, RED and WHITE

Diplodia tip blight Sphaeropsis ellisii Sacc.

In 1984 Diplodia tip blight was widespread and abundant on red pines in Region 2. Heavy infections were noted on saplings in Itasca Co. and in young plantations in Carlton, Koochiching and Itasca Counties.

In Region 1, two areas of understory red pine in southern Hubbard County were characterized by current year shoots which were red and drooping. The shoots, upon inspection, showed the typical resin soaking wood associated with Diplodia tip blight. Cones collected from the overstory red pine were heavily infested with Sphaeropsis fruiting bodies. Damage to the understory was most pronounced the closer the trees were to the overstory pine. The younger red pine in the openings showed fewer damaged shoots. Both areas graphically illustrated the need for overstory removal when regenerating red pine. These areas are on private land. One area was thick jack pine close to lakeshore homes, restricting disease management. The overstory jack pine and the scattered, suppressed understory red pine are not being managed but exist for aesthetic purposes. But the second area is a partially cut red pine stand being managed for forestry purposes. It has a well advanced red pine understory. The overstory could and should be eliminated, but the stand is highly visible and surrounded by private land. The private landowner did originally allow logging to take place, but does not want to eliminate the stand. He will probably be continually plagued with Diplodia tip blight, and if weather conditions are conducive for infection a number of years in a row, tree mortality will occur.

Jack pine gall rust

In 1984, the Minnesota DNR cooperated with the USFS Chippewa and Superior National Forests, State and Private forestry and the University of Minnesota in a survey to determine which species of gall rust are present in the three northern Regions. Both pine-oak rust, Cronartium quercuum (Berk.) Miyabe ex Shirai f.sp. banksianae Burdsall and Snow, and pine-pine rust, Endocronartium harknessii (J.P. Moore) T. Hirat, cause gall rusts on jack pine. In nurseries, either disease can be a serious problem, with up to 60% cull of 2-0 seedlings. In plantations and natural stands, gall rust infections can reduce growth and cause degrade or mortality.

Since the gall rusts produce similar symptoms on jack pine (globose galls on branches and main stems) it is impossible to identify pine-oak or pine-pine rust based on field characteristics alone. One method used to separate the two rusts is to examine germinated aeciospores. These spores are produced on the galls for 1-2 weeks in the spring, usually between mid-May and mid-June.

Knowledge of the ranges of these rusts is important in developing control programs for these diseases since pine-pine and pine-oak rust are caused by different fungi and are subject to different management strategies.

Work is currently underway to select trees that are genetically resistant to pine-oak rust and to pine-pine rust. When resistant stock has been

identified, it will be important to know the ranges of the two rusts so that trees with resistance to a particular rust can be planted in the appropriate areas.

A total of 960 galls from 257 stands (3.7 galls/stand) were analyzed. In 46% of the stands sampled, only pine-pine rust was found, in 42% of the stands only pine-oak rust was found, and in 12% of the stands both rusts were found. The distribution of the rusts can be seen on Map 6. Each circle represents one sampled stand, with 1-5 galls tested in each stand. Pine-pine rust is the predominant rust in the northeastern half of the jack pine range and pine-oak is the predominant rust in the southwestern part of the jack pine range. There is very little overlap in the distribution of the two rusts. Based on Jakes' "The fourth Minnesota forest inventory: Area" (USFS Resource Bulletin NC-54, 1980) and the results of this survey, commercial acreage of jack pine in the state is divided equally between areas with pine-oak rust and areas with pine-pine rust. This indicates that the development of control programs for pine-oak and pine-pine rusts are of equal importance in Minnesota.

Tarspot needlecast of jack pine Davisomycella ampla (Dar.) Darker

Jack pine trees on 19 plots in the jack pine budworm outbreak area, Virginia Dist., St. Louis County, were assessed for the incidence and severity of tarspot needlecast. An average of 17% of the trees per plot had light to moderate defoliation of the 2-and 3-year old needles caused by tarspot. The extent of infection ranged from 0-50% on individual plots.

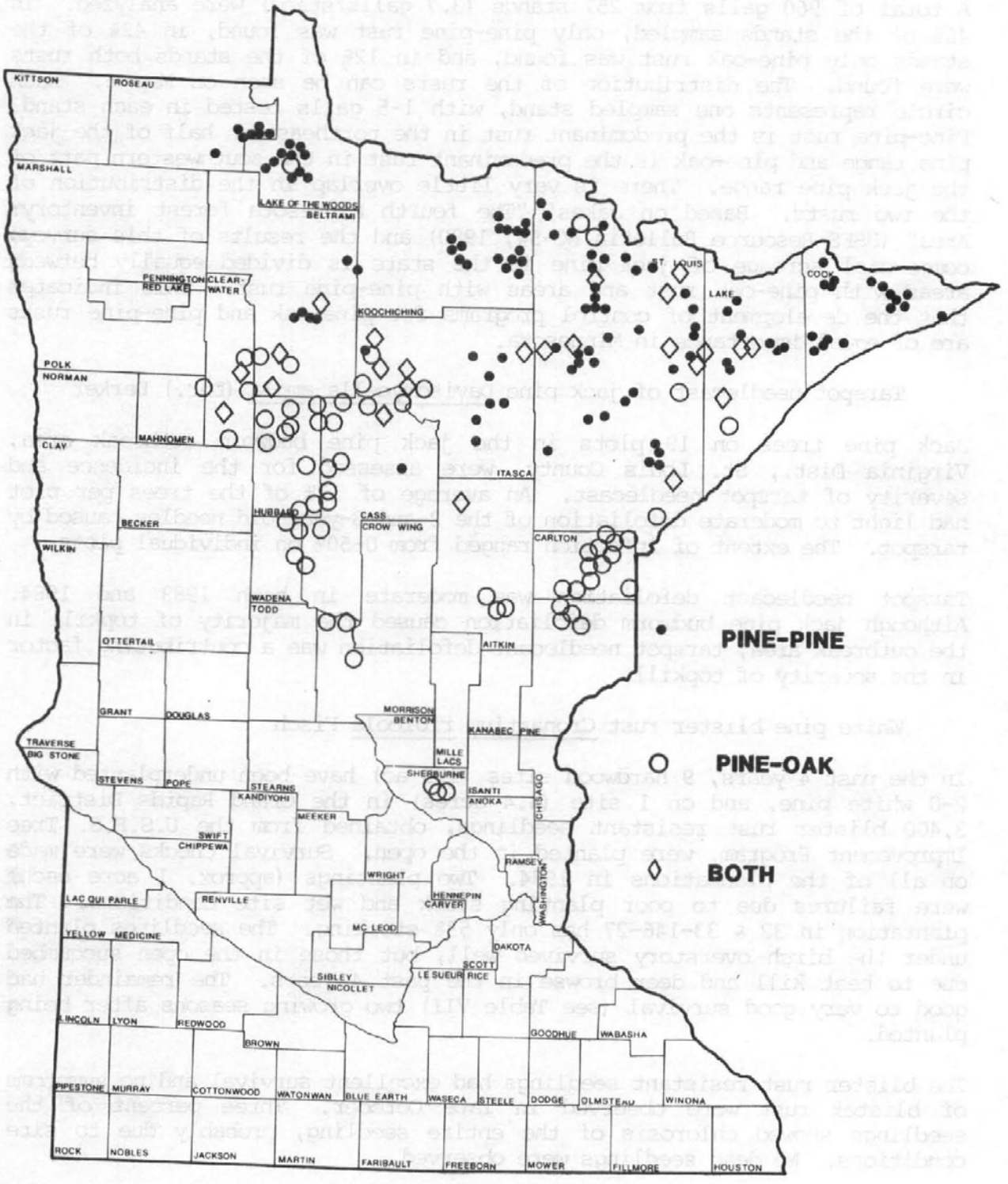
Tarspot needlecast defoliation was moderate in both 1983 and 1984. Although jack pine budworm defoliation caused the majority of topkill in the outbreak area, tarspot needlecast defoliation was a contributing factor in the severity of topkill.

White pine blister rust Cronartium ribicola Fisch

In the past 4 years, 9 hardwood sites (129 ac) have been underplanted with 2-0 white pine, and on 1 site (4.4 acres) in the Grand Rapids District, 3,400 blister rust resistant seedlings, obtained from the U.S.F.S. Tree Improvement Program, were planted in the open. Survival checks were made on all of the plantations in 1984. Two plantings (approx. 1 acre each) were failures due to poor planting stock and wet site conditions. The plantation in 32 & 33-146-27 has only 53% stocking. The seedlings planted under the birch overstory survived well, but those in the open succumbed due to heat kill and deer browse in the past 4 years. The remainder had good to very good survival (see Table VII) two growing seasons after being planted.

The blister rust resistant seedlings had excellent survival and no symptoms of blister rust were observed in late October. Three percent of the seedlings showed chlorosis of the entire seedling, probably due to site conditions. No dead seedlings were observed.

JACK PINE GALL RUST DISTRIBUTION SURVEY, 1984



MAP NO. 6

TABLE VII. LOCATIONS AND SURVIVAL OF RESISTANT WHITE PINE TEST SITES.

Location (Overstory)	# Planted/ acre (year)	# Surviving/ acre (year)	% Stocking	Acres planted	Comments
Resistant stock					
16-56-26 (none)	775 (83)	775 (84)	100%	4.4	no symptoms in 1984
Underplanted					
36-60-24 (aspen)	800 (83)	665 (84)	100%	6	
36-58-17 (asp,bi,ma)	1000 (83)	960 (84)	100%	20	looks very good
33-156-26 4-155-26 (aspen)	778 (83)	750 (84)	75%	18	
7-157-26 (aspen)	460 (82)	346 (84)	61%	26	
23,26-66-19 (birch)	1000 (83)	750* (84)	good*	33	
1-67-21 (aspen)	900 (83)	22 (84)	low	1	poor stock & site too wet
29,33-67-22 (aspen)	800 (83)	20 (84)	low	1	poor stock & site too wet
22,23-144-26 (birch)	800 (83)	----	60%	24	looks good
32,33-146-27 (birch)	775 (81)	300 (84)	53% (84)	19	poor survival in open areas

* = ocular estimate

White Pine Seedling Mortality

In 1983, 2,900 white pine seedlings from one parent showing resistance to blister rust were planted in Lake of the Woods County, 2-158-34. The site had been logged, full tree skidded and rock-raked. One the same site, next to the block of resistant white pine, 3,500 white pine from Badoura Nursery were also planted. In July of 1983, 4, 1/20th acre permanent plots were established in each of the white pine blocks. On June 14, 1984, the plots were revisited and the seedlings inspected. The results are as follows:

RESISTANT WP			BADOURA WP		
PLOT #	# HEALTHY	# DEAD	PLOT #	# HEALTHY	# DEAD
1	41	3	1	44	-
2	55	2	2	35	2
3	43	3	3	33	1
4	47	2	4	22	6

The amount of mortality was not alarming. The type of mortality, however, did cause some concern. All seedling mortality was characterized by a discolored, sunken area starting at the groundline and extending upward for 1-2 cm. The discoloration and sunken area resembled blister rust cankers. The rest of the seedlings, too, looked like a tree which had been girdled by a blister rust canker, i.e. the entire foliage above the canker was yellow-green to red in color.

Seedlings were collected and sent to our lab in Grand Rapids. No pathogen could be found associated with the discolored, sunken areas on the stems.

Seedling mortality was probably due to high temperatures at the soil surface. The intensity of the site prep and the low productivity of the site produced areas of bare ground even detectable into the second growing season.

Pine needle rust *Coleosporium* spp.

A private planting of 100 red pine averaging 2 feet in height near the edge of the City of Blackduck was reported to be heavily infected with needle rust on June 21. this was the only report received of the occurrence of this disease. This disease is usually limited to young seedlings in open, grassy areas. One control for this disease is to eliminate weed competition to eliminate the alternate hosts, goldenrod and asters, and to reduce the moisture around the trees thereby reducing the conditions which favor infection.

Physiological Needle Droop

In Region 3, during early September of 1982, drooping needles were noticed on current year shoots of young red pine plantation. The trees were

growing on sandy soils which had supported jack pine in the past. No pathogen or insect could be found, but rather the condition was diagnosed as physiological needle droop. This condition results from an abundance of moisture which promotes rapid growth followed by a period of dry and often windy weather which causes rapid tissue desiccation. This desiccation causes the needles to bend at their bases.

Twenty trees with needle droop were marked in September, 1982. These trees were inspected during May of 1984. All trees were alive and healthy, and 1983 height growth appeared comparable to adjacent trees not showing needle droop during 1982. All drooping foliage, however, had died and was in the process of being shed. Needle droop resulted in the loss of 20 to 100% of the 1982 foliage. Trees which had the needle droop were visually different than trees without the droop due to the loss of the foliage.

There should be very little adverse impact to the trees. Since the trees are missing a year of foliage, any other kind of defoliation could cause more damage to to these trees which showed needle droop during 1982.

Pinewood nematode Bursaphelenchus xylophilus (Steiner & Buhrer) Nickle

Pinewood nematodes are transported by wood borers and are secondary organisms, but they can become so numerous that they plug the xylem vessels. On a tract of private, industrial land in northern Itasca County, 20 red pines between 60 and 70 years of age have been dying for the past 2 years. The site was thinned 4 years ago. In 1984, pinewood nematodes were extracted from increment cores removed from recently killed trees.

SPRUCE, BLACK, WHITE and BLUE

Rhizosphaera Needlecast Rhizosphaera kalkhoffii Bud

Throughout Minnesota, there are widespread infections of Rhizosphaera needlecast. Blue, white, and Norway spruce have been reported infected. The disease becomes
evident in late winter and into summer although infections take place during the previous May and June. Purple-brown needles usually are more evident on the lower part of the trees. Control spraying is necessary in Christmas trees and ornamental plantings.

Lophodermium Needlecast Lophodermium pinastri (Schrad. ex Hook) Chev.

Lophodermium needlecast of red pine and can kill or damage red pine seedlings. Plantation and seedling red pine in Carlton, Itasca, Koochiching and St. Louis Counties were infected in 1984. In one private plantation in Itasca County, approximately 25% of the seedlings were infected and 15% were dead by the first week of July. Most other new red pine plantations had less than 10% incidence and 0-5% mortality.

Spruce Needlerust Chrysomyxa spp.

Spruce needlerusts were very common on white spruces and very abundant on Colorado blue spruces in areas where the alternate host, Labrador tea, was

close by in Region 2. Needlerust incidence was much increased over 1983 levels. Numerous inquiries were made by homeowners in Carlton, St. Louis and Itasca Counties. Infected needles showed yellowing and chlorosis in July.

At the white spruce seed orchard near Cotton, MN, needlerust severity was rated on 119 trees on July 30th. On 6% of the trees, no needlerust was found, on 40% rust infection was less than 5%. Moderate needlerust from, 6-49% of current needles infected, occurred on 26% of the trees. Heavy needlerust, greater than 50%, occurred on 27% of the trees. Regardless of the severity of the infection on an individual tree, most of the infected needles will be shed.

In Region 1, Lake of the Woods County received two periods of heavy rains during June. During the week of June 5, 4-5 inches of rain were received, and during the week of June 26, 1-3 inches of rain were received. These rains helped create conditions favorable for needle rust infections.

By the last week in July, many homeowner calls were received regarding "funny bumps" on the needles, and discolored trees. At that time, the pustles of apical spores were erupting through the needle epidermis turning trees a dusty color. In a localized area along the Bankton Trail, 18-158-33, white spruce close to a bog edge had 90% of the needles infected. Needle infection was heavy enough that the needles were yellowing and dropping.

White Spruce cone rusts
Chrysomyxa pirolata Wint. Pucciniastrum americanum (Farl.) Arth.

In 1984 the presence of 2 cone rusts were verified, Chrysomyxa pirolata and Pucciniastrum sp. (probably americanum). The Chrysomyxa rust occurred on 4% of the white spruce cones at the seed orchard near Cotton, MN. Chrysomyxa systemically infects an individual cone and destroys seed production. Pucciniastrum rust infected 78% of the seed orchard cones in 1984. Pucciniastrum rust infects individual cone scales and only destroys seed adjacent to the infection.

In natural stands and plantations, both rusts were observed but at a much lower incidence.

Spruce Decline

Areas of ornamental and windbreak white spruce in Roseau and Kittson Counties showed branch and tree mortality. Blue spruce mixed in with the white spruce exhibited similar symptoms, but Rhizosphaera kalkhoffii was found on the blue spruce. No Rhizosphaera could be found or isolated from the white spruce. A fungus resembling Lophodermium was detected, but fruiting never occurred, and positive identification could not be made.

In October word was received from Jim Walla of North Dakota State University that a needlecas of white spruce had been found in North Dakota, and it was caused by Lirula macrospora. A sample of spruce collected in Cloquet was sent to NDSU and Lirula was found on the needles. No samples have yet been sent in from Roseau or Kittson Counties, but samples will be collected during the spring of 1985.

Lirula needlecast in North Dakota infects second-year needles in the spring, and by October purplish-brown bands are evident. During the second growing season after infection, the needles become tan, and fruiting bodies become noticeable on the undersides of the needles. The fruiting bodies appear to be black lines or spots and are large enough to be seen without magnification.

In southern Minnesota since 1983, observations have been made of an unknown decline of blue and white spruce found in shelterbelts and windbreaks in the southwest. The symptoms include general chlorosis beginning in the two-year-old needles which is nearly always uniform over the entire tree. For most affected trees, the chlorosis continues in the following year and includes the current seasons needles from which the trees do not recover. Affected trees range in age from five to twenty years and have been found in Freeborn, Steele, Kandiyohi, and Goodhue counties.

The commonly known insect and disease problems have been ruled out as well as soil ph. A distribution survey may be conducted in cooperation with the SCS with some follow-up soil and foliage analysis.

CHESTNUT

American Chestnut Blight Endothia parasitica (Murr.) P.J.& H.S. And.

Chestnut blight was confirmed for the first time in Minnesota on a farm ten miles east of Rochester (23-107-12) in the fall of 1984. The trees were planted about 1870 by a homesteader from Europe . The seed source was from New York. The entire stand of 22 trees were disease free by a report of a 1976 survey but are now all infected with 8 dead. They range in size from 8 to 22 inches dbh. The strain of Endothia found had been studied on the east coast and is different than the 37 known strains found there. Several other stands and individual chestnut around the southeast have been checked and appear disease free.

ELM

Dutch elm disease Ceratocystis ulmi (Buism.) C. Moreau

There has been a dramatic increase in the incidence of Dutch elm disease in northwestern Minnesota. Communities and countryside experienced the tremendous waves of infections similar to that experience throughout southern Minnesota nearly 10 years ago. Sanitation and timely removals seem to be the key in buying time to establish species other than elms.

In Region 2, the incidence of Dutch elm disease was much increased over 1983 with new branch flagging and tree mortaility common in Carlton, St. Louis and Itasca Counties.

OAK

Red Oak Decline

Areas of red oak (Quercus spp.) in Beltrami, Cass, Hubbard and Becker Counties had been slow in leafing out or had not leafed out at all.

Characteristically the trees had a few clumps of leaves, often smaller sized than normal, located on the trunk or on branch portions close to the trunk. Some trees were completely devoid of leaves but still had green cambium on the trunks and branches. Other trees had 50-80% of their leaves but had bare tops and branch tips. On all trees inspected, green cambium was found, but the buds on the bare branches were dried and shrivelled.

In southern Beltrami County and in northern Cass County the oaks showing the greatest damage were associated with sandy, droughty soils. On heavier more loamy soils, the oaks definietly showed crowns of less than normal foliage, but generally had more leaves than the oaks on sandy soils. White oaks on both soil types showed little affect and generally were leafed out normally.

The area of red oak delcine corresponded to the area that had been defoliated by the variable oakleaf caterpillar, Heterocampa manteo (Dbldy.), the redhumped oak worm, Symmerista canicosta Franclemont, and walking sticks, Diapheromera femorata (Say) during 1982 and 1983. Defoliation was spotty in 1982 but widespread and heavy in 1983. Most hardwood species were defoliated, especially basswood and birch, but only the red oaks showed the stress symptoms. Reports from the Beltrami County Extension Agent in 1983 indicated that areas of oaks started to refoliate in September after being completely defoliated during August.

Normally late-season defoliation will cause little damage to hardwoods, particularly after only 2 years of defoliation. Defoliation is a stress factor and certainly had contributed to the decline. There have been other stresses on the trees. The trees are commonly what are called scrub oak; they are limby, poor form, slow growing trees, and they generally grow on poor sites, particularly droughty soils. The spring of 1984 was particularly dry adding stress to the trees growing on sandy soils. There have been at least 2 consecutive years of late spring frost which have damaged the newly emerging leaves on the red oaks. Trees had to refoliate in areas where trees were severly damaged by frost. The winter of 1983-84 was particularly severe, reaching -40°F. in December and then experiencing periods of warming followed by bitter cold during the rest of the winter. The wet fall combined with a late season refoliation may not have allowed the trees to properly harden off for the winter. Finally, some areas of oaks did refoliate in September also contributing to the hardening off problem and depleting food reserves in the roots.

The oaks do show stress symptoms. No shoestring root rot (Armillariella mellea (Vahlix Fr.) Karst) could be found in Beltrami and Cass counties. While no trees were dropped and tops inspected for two-lined chestnut borer (Agrilus bilineatus (Web.)), the sudden appearance and the large area covered by the red oak problem would indicate that two-lined chestnut borer was not responsible.

It is difficult to predict what will happen to the red oak. The present condition of many of the oaks would indicate that tree mortality will occur this growing season. Chances are good for a build up of the two-lined chestnut borer and shoestring root rot so that there may be slow, steady decline of red oak occurring throughout the affected area.

Field checks in Cass, Morrison, Crow Wing, Pine, Aitkin and Kanabec counties during 1984 verified oak decline and mortality due to a variety of agents: two lined chestnut borer Agrilus bilineatus (Web.), construction damage, drought stress, repeated defoliation, and Armillaria buildup.

Oak Wilt Ceratocystis fagacearum (Bretz.) Hunt

In Region III, active oak wilt pockets exist in residential areas and along powerlines and roadcuts in parts of Wright, Stearns, Sherburne, Isanti and Chisago counties. Suspect samples from Benton, Morrison, Aitkin and Crow Wing counties processed by the state shade tree lab were negative. One site in Todd county and one in Aitkin county remain to be sampled and tested. Direct control using clearcut strips and stump poisoning with picloram was conducted adjacent to a recreation area in the Sand Dunes State Forest in Sherburne County (15-27-123). Oak wilting and mortality was reported in St. Croix Wild River State Park in 1984. Directed cuts were initiated and inspections will be made in Spring '85.

Outlook for 1985

Active pockets on state forest land in Region III will be clearcut, stump poisoned and trenched if necessary to prevent spread. No comprehensive program exists for control of oakwilt on other ownerships and spread will continue.

Oak anthracnose Gloeosporum spp.

White and burr oaks were observed infected with anthracnose from Detroit Lakes to Warroad. Infections included brown, curled leaves localized in the lower crown and prematurely dropping in August.

Infections generally were lighter throughout the Region in 1984. In some locations, June was wet but the spring was generally dry and July was very dry. Wet, humid weather is ideal for spread and infection. Homeowners with chronic infections should be diligent in raking and burning leaves in the fall since the fungus mainly over-winters on the fallen leaves.

BLACK WALNUT

Fusarium Stem Canker Fusarium sp.

During February and March, 1984, several rows of pole size walnut growing on an excellent private land site in Wabasha county (30-110-11) were laterally pruned. During the '84 growing season, 100% of the these pruning wounds formed healthy callus tissue without evidence of canker formation. On adjacent unpruned trees, a number of fusarium cankers have formed. The infection courts for all of these new cankers are dead branch stubs.

To manage walnut intensively on an excellent site such as this example, consideration should be given to begin lateral pruning when the trees are young, in moderation, and while the lateral branches are still alive.

Shoot dieback Phyllosticta sp.

Continues to be of concern in several bottomland plantations where small pockets of mortality are occurring, Wabasha county (30-110-11), (21-109-13), and Fillmore County (2-103-10).

WILLOW

Willow blight and black scab Physalospora miyabeana Fuka and Fusicladium saliciperdum (Allesch, & Tub.)

Neither new infections nor symptoms were noted in willows having a past history of infection in Lake, Carlton, Itasca and St. Louis Counties. Much mortality has occurred in the past few years due to this disease complex. The willows that had tufts of growth in 1983 appear to have survived and added new growth in 1984.

GENERAL HARDWOODS

Winter Injury

The winter injury on Minnesota tree species following the 1983-84 winter was particularly severe and in terms of recent history (30 years) a rare event. The winter burn on conifer species especially on some Scotch varieties and red pine was spectacular and statewide. The result however was likely full recovery since little mortality was reported.

The damage however to ornamental hardwoods was unusual and widespread across southern Minnesota and the metro area. Various stages of top kill and invidivual tree mortality was common on planted Norway maple and honeylocust. These trees continued to dieback into early summer responding to tissue loss below the wilting areas. In Rice county, well established Siberian elm were heavily damaged with 70-90% of the fine branching killed. In portions of Fillmore and Houston counties, individual mature Norway spruce were killed.

This was presumably the result of a delayed dormancy, an early record snowfall, followed by severe low temperatures in December (-30 to -40° was common statewide).

MINOR AND INCIDENTAL DISEASES AND OTHER PESTS

PEST	HOSTS	COUNTY	REMARKS
Naemacyclus Needlecast *Naemacyclus minor*	Scots	Metro Region	Light infection of Christmas trees.
Cytospora canker *Cytospora kunzie* Sacc.	white spruce	Koochiching	Urban
Porcupine damage	white pine red pine	Itasca St. Louis	Terminal damage
Witches' broom *Chrysomyxa arctostaphyli*	black spruce	Koochiching	Brooms formed
Black knot *Dibotryon morbosum* (Schw.) Th. & Syd.	cherry	Cook	Meteor variety & native pine cherry heavily infected. Missabi variety apparently not infected.
Cedar blight *Didymascella thujina* (Durand) Maire	arbor vitae	Carlton	Urban
Mountain ash leafspot *Fabraea maculata* Atk.	mountain ash	Aitkin	----------
Physiological problem and ice damage	cedar	Itasca	Mortality along lakeshore due to changing water levels.
Container stock: low soil pH, *Fusarium* spp. sunscald	conifers	Itasca	Greenhouse, slight incidence
Root problems *Cylindrocarpon* sp., *Pythium* sp., *Fusarium* sp.	red pine white spruce	St. Louis Itasca	Nursery, slight incidence
Armillaria root rot *Armillariella mellea* Vahl, ex Fr.	jack pine	St. Louis	Overmature trees
Drought	sugar maple	Carlton	Scorching of leaves
Drought	jack pine	St. Louis	Flagging
Drought	balsam poplar	----------	Leaf yellowing and leaf drop
Drought	birch	Lake	Leaf loss

PEST	HOSTS	COUNTY	REMARKS
Needlerust *Chrysomyxa* sp.	white spruce blue spruce	Pine, Carlton Kanabec	Heavy on ornamental and shelterbelt trees
Needlecast *Lophodermium* sp.	red pine	Cass, Crow Wing, Aitkin	Moderate to heavy on Christmas trees and private plantations
Anthracnose *Gloesporium*	ash soft maple	Crow Wing Morrison	Moderate to heavy on yard trees
Armillaria	red pine jack pine	Wadena, Cass Crow Wing, Aitkin	Plantations on droughty soils
Hail damage	All vegetation	Todd, Stearns	Heavy damage in recreational areas
Hail damage	White & Scotch pine	Wabasha	Branch dieback and mortality from 1983 storm
Shoot blight *Venturia macularis* (Fr.) Mull. & Anx.	Aspen	St. Louis	Terminal dieback in cut-over

SPECIAL PROJECTS AND STUDIES

NURSERY SURVEY

Nursery pest management activities in 1984 in Minnesota included two cooperative projects with the Forest Pest Management Staff of the U. S. Forest Service's State and Private Forestry Branch. The gall rust control program to evaluate foliar applications of triademefon (Bayleton®) and the loss assessment and control projects for diplidia tip blight in red pine nurserybeds. Updates are published by State and Private forestry St. Paul. Three additional special projects were conducted by division personnel.

Preventative spray programs were conducted in both state nurseries to preempt lophodermium outbreaks experienced in other nurseries in the state. Chlorothalonil (Bravo®) was applied in the late summer and fall using repeat applications over all hard pine stock. Volume and pressure trials were conducted to improve spray penetration. Evaluations will be made during lifting operations in the Spring of 85'.

A general site inspection and pest survey was conducted in all Region III seed orchards. This new survey will be conducted and reported annually (See Table A). Inspections of fall lifted freezer stock were also conducted in both nurseries during the winter.

SEED ORCHARD SURVEY

LOCATION	SPECIES	PEST	SITUATION
Cushing 16-131-31	Red pine	Needlerust *Coleosporium solidaginis*	Light
		winterburn	Light tip burn
		flooding	90% mortality in low area
Browerville 14-131-33	Jack pine	drought/planting stress	10% mortality
Sturgeon Lake 16-45-21	Grafted White and Black Spruce	Cooley spruce gall aphid *Adelges cooleyi* (Gill.)	Light
		Frost	
		yellowheaded spruce sawfly	Light
		Needlerust *Chrysomyxa* sp.	Light
Eaglehead 22-42-17	Black Spruce	Cooley Spruce gall aphid	Light
		Frost	Tip burn
		yellow headed spruce sawfly	Light
Eaglehead 16-42-18	Red Pine	Needlerust *C. solidaginis*	Moderate on 50% of trees
		Tip Moth *R. adena*	Light on 30% of trees
General Andrews 20-45-20	White pine Improved blister rust resistant stock	Blister rust *Cronartium ribicola*	1 infected tree

Freezer stock samples were screened for potential root rot and needlecast problems. No widespread problems were detected and additional samples will be taken during repackaging in the spring. Selected boxes of spruce, red pine and walnut stock will be monitored during the defrosting, repackaging, shipment, distribution, on-site storage and planting operations.

Pest problems reported from the General Andrews (26-45-20) and Badoura (16-139-32) State Forest nurseries in 1984 included:

HOST	LOCATION	AGENT	SYMPTOMS/SEVERITY	CONTROL
Northern Red oak	Gen. And.	oak leaf shredder *Croesia semipurpurana* (Kearfoot)	foliage loss/light	None
		pine oak gall rust *Cronartium quercum*	telial horns moderate	None
		anthracnose *Gnomonia quercina*	leaf blotch/light	None
Honeysuckle	Gen. And. Badoura	Herpobasidium leaf blight	leaf curl/moderate	Mancozeb trials
Caragana	Badoura	leaf hoppers	foliage browning/ light	Malathion
2-0 Red Pine	Badoura	flooding	mortality/low areas	Irrigation shifts
Jackpine	Badoura	White pine weevil	shoot mortality	Pruning
Seed Orchard		Pine oak gall rust	stem galls	None
White Pine	Gen. And.	Fertilizer burn	tip and branch yellowing	Avoid periods of dew
White spruce	Gen. And.	winter burn	tip discoloration	None

RESULTS & DISCUSSION OF CONE PEST STUDIES
at the white spruce seed orchard near Cotton, MN.

Although there was a bumper crop of cones this year, only 7% of the cones collected at the white spruce seed orchard were totally sound. This, of course, was reflected in poor seed yield. Only 3.6 ounces of seed per bushel were extracted from all the cones (whether classed as good and no good) in the seed orchard while the statewide average yield was 18 ounces of seed per bushel.

As the grafted trees began bearing cones over the last four years, the incidence of cone pests in the orchard has been monitored in 1981. Insects infested 19% of the cones, yet less than 2% of the cones were disease infected. Since then, the incidence of insect infestation has remained at 42% each year. However, the incidence of cone disease has leaped from 1.5% in 1981 and 2.0% in 1982 to 56% in 1983, and to 82% in 1984.

Three hundred cones were selected and dissected on July 30 to determine the incidences of cone pests. Results are:

	Pest incidence* on sampled cones
Totally health	6.6%
Spruce budworm damaged	26.0
Dioryctria and/or Holcocera damaged	17.6
Chrysomyxa rusted	3.7
Pucciniastrum rusted	78.3

* = A single cone could have one or more pests.

These cones were also ranked as "good" or "no good" for seed production. A label of "no good" meant that at least 50% of the cone was destroyed or they were deformed by spruce budworm feeding. Sixty percent of all the dissected cones were deemed "no good" for seed production.

Prior to this growing season, we thought that we were dealing with only one disease, Chrysomyxa rust. In 1984, we verified the presence of two cone rust species present at least in 1983 and in 1984. Chrysomyxa pirolata systematically infects an entire cone and destroys all seed production. The incidence of Chrysomyxa rust has remained below 4% during the past four years. Pucciniastrum spp. infects individual cone scales, only destroying seed adjacent to the infection. However, multiple infections (more than four bracts per cone) can destroy the entire cone's seed production. However, the incidence of Pucciniastrum rust has dramatically increased in the past two years. In 1983, Pucciniastrum infected 47% of the cones and in 1984, this rust infected 78%.

Rust fungi require two plants to complete their life cycle, the crop host and the alternate host. Raspberry is the alternate host for Puccinastrum rust, Pucciniastrum rust spores produced on raspberry leaves infect spruce cones furing the two weeks before and after pollination. Clumps of infected raspberry are growing extensively over the seed orchard, in the windrows along the edges and in adjacent stands to the

north, east and west. This may account for the increase of Pucciniastrum cone rust over the past two years. Two species from the wintergreen family are the alternate hosts for Chyrsomyxa rust. These wintergreen plants are commonly found growing in spruce-fir stands. Chyrsomyxa spores produced on Pyrola or Moneses spp. can infect spruce cones in late spring. So far, only one clump of infected Pyrola has been found growing in a stand adjacent to the seed orchard.

Since 1984 was an excellent year for white spruce cone production and also for cone rust infection, we assessed each tree for the presence or absence of cone rust. There are 1,480 trees growing in the orchard representing 105 different clones. A single clone, #7237, is apparently resistant to both species of cone rust.

Cone rust incidence at the Cotton seed orchard was extremely high compared to natural stands where both rust occurred, but at a much lower incidence. A private white spruce seed orchard was established with the same scion material as the DNR orchard. Both rusts were found in the private orchard in 1984 but at a low incidence, primarily because alternate hosts are not growing on or adjacent to the orchard site.

The three major insect pests found included two species of coneworms and the spruce budworm. Coneworms, Dioryctria abietivorella and Holcocera lepidophaga mine the cones interior, leaving no extractable seed. Dioryctria coneworms feed from early June to late August. Little is known about the life cycle of Holcocera coneworms in Minnesota. It is interesting to note that this is the first report of Holcocera lepidophaga in the Midwest. Ray Dolan, Region II Seasonal Entomologist, collected and identified this species. Spruce budworms, Choristoneura fumiferana, feed on foliage buds, floral buds and developing cones. The damage inflicted to cones ranges from a slight scarification of the outer cone scales to a complete mining of the cone interior. Often, spruce budworm feeding damage causes cones to curl along the cone axis and causes formation of excess resin. As a rule, seed cannot be extracted from these curled cones.

There are other minor insect pests present such as seed midges and maggots. To this date, they have not caused a significant problem.

In 1984, a study was set up to determine if female cone abortion losses to pest are signifant and, if so, what caused the abortion. Of the 218 cones monitored, an insignificant number of cones (6%) were aborted due to insect and diseases and eleven percent of the cones were lost to undetermined causes, in 1984. This agrees with our finding in 1983.

One of the big problems in controlling pests in seed orchards is that there are only a few chemicals labelled for use there and it is unlikely that additional labeling for this use will be obtained.

Trials in 1982 at the seed orchard suggested that Orthene had insecticidal action on coneworms. No trials were made in 1983 because the cone crop was too small. In 1984, cones on 15 trees were treated with Orthene to see if they could be protected from coneworm infestation. Four hundred cones from 20 trees were dissected July 30 to determine the presence of coneworms.

	Average number of cones infested per tree	Percent of cones infested per tree
Treated	2.2/20	11%
Untreated	4.2/20	21%

51

There was a signficant difference (at 5% level) between the number of infested cones on treated trees and on untreated trees in the same clone, but the Orthene treatment did not prevent insect damage. On 4 Orthene treated trees, the presence of brown, shriveled cones were found and presumed as evidence of phytotoxicty.

Three fungicides, Ferbam, Bravo 500 and Bayleton were tested for fungicidal activity on 26 trees in 1984. Based on the dissection of 320 cones, the applications were ineffective because the timing of the fungicide treatments were too late. In the spring of 1984 we thought we were only dealing with Chrysomyxa rust and delayed spraying until the Pyrola & Moneses plants were up. We now know that we are also dealing with Pucciniastrum rust and should have monitored spore production on raspberry also & timed the applications earlier.

It may be possible to control rust infection by controlling the abundance of the alternate host. Controlling raspberries, either by mowing or the use of herbicides, will be attempted in 1985 to reduce Pucciniastrum rust infection.

PERMANENT PLOTS FOR JACK PINE BUDWORM STUDY

In October, 1983, 19 permanent plots were established inside the jack pine budworm outbreak area in the Virginia District, St. Louis Co. Phenology and impact data were gathered in 1984 (see Table B) and information from 1982 came from preliminary work done in the outbreak area.

Although the incidence of tarspot needlecast increased, the overall level of defoliation decreased due to a decrease in budworm defoliation. Nonetheless, 3 trees on 3 plots died; 1 wolf, 1 intermediate and 1 codominant crown class trees. All three had moderate to heavy defoliation in 1983 and the codominant tree also had a bark beetle infestation in 1983. New topkill (= 15% of live crown) appeared on 5 trees on 3 plots; 2 were damaged by porcupines, 1 by mechanical injury and only 2 were severly defoliated in 1983.

There was an apparent jack pine budworm population decrease in 1984. The 1983 egg mass survey predicted that 66% of the plots would have damaging populations and 33% would have populations causing light defoliation. Only 13% of the plots actualy had damaging defoliation, the remainder had zero to light defoliation. The population decrease can probably be tied to the low percent of staminate buds present in 1984 and perhaps to weather conditions in 1984 and to parasitism in 1983. Where defoliation had been heavy in 1982 and 1983, there were scarcely any staminate cones. Jack pines in nearby areas had abundant drops of staminate cones.

A further reduction in the budworm population is expected in 1985, based on the egg mass survey, levels of parasitism, and the rare occurrance of staminate buds.

Twelve 40-acre tracts of jack pine have geen harvested in the outbreak area, six of these harvests were directly due to DNR recommendations. Three of our permanent plots on private land were harvested.

TABLE B. PHENOLOGY & IMPACT DATA TAKEN ON PERMANENT PLOT LOCATIONS.

Category	Unit of measure	1982	1983	1984
Overall defoliation	Number of plots with defoliation rating:			
	O = none	O = 3	O = 2	O = 1
	L = light	L = 11	L = 12	L = 12
	M = moderate	M = 3	M = 5	M = 1
	H = heavy	H = 1	H = 0	H = 1
Dead trees	Total number on all plots	--	10	13
Top killed trees	Total number of all plots; Average percent top kill on affected trees.	--	7;20%	8;9%
Presence of staminate buds	Average percent on 10 trees/plot		9.2%	0.3%
Early larvae survey	Percent of plots with early larvae present	--	91%	94%
Pupae survey	Percent of all pupae lost to parasites and/or predators	--	35%	40%
Egg mass survey	Average number/branch plot; Average percent parasitism	0.33;-	0.74;22%	0.12;25%
Tarspot needlecast	Average percent infection on 10 trees/plot.	--	12%	17%
Predicted defoliation	Number of plots with rating:			
	O = none	O = 1	O = 0	O = 6
	L = Light	L = 1	L = 3	L = 6
	D = damaging	D = 3	D = 6	D = 0

OAK WILT CONTROL: A CASE HISTORY AT THE TWIN CITIES ARMY AMMUNITION PLANT. New Brighton, Minnesota Initial Stages; by Larry Westerberg, District Forester, Hastings, Minnesota.

In June, 1969, a comprehensive land management plan was prepared by the managing corporation of the Twin Cities Army Ammunition Plant. Forest management was an integral part of the plan which made note of the presence of oak wilt disease.

In August, 1975, the forest management section of the plan was updated with the control of oak wilt disease recommended. Two treatment methods were proposed. The first consisted of the felling of infected trees and placement of a chemical barrier with the use of the soil sterilant, Vapam, between the infected and the next healthy tree. The second consisted of clearcutting a 50-foot buffer strip around the infection center and the treatment of all live stumps within the buffer strip with the herbicide, Amate.

In June, 1978, the plant began an active oak wilt control project utilizing the second method.

Vibratory Plow Control, 1982

In 1982, the Minnesota Department of Natural Resources, Division of Forestry was again contacted and asked to review the oak wilt control program. At the time, the plant questioned the effectiveness of the current control practice and the cost of having the felled trees removed. A survey was made to determine the extent of the oak wilt disease. Following this survey, the Division recommended the use of a vibratory plow for control of oak wilt disease and a timber sale for removal of marketable material.

In November of 1982, a 52" deep vibratory plow line was individually established around each of 38 identified infection centers. A total of 14,935 feet of barrier line was installed isolating 1,311 marked trees. The line was place between the first and second healthy tree adjacent to the infected trees and was considered the primary root graft barrier.

Results

Examined again during August and September 1984, 18 of the original 38 infection centers continued to have oak wilt infections spreading beyond the 1982 vibratory plow barrier. There was only one new infection center that was unrelated to the orginal 38 center identified in 1982. Around these original 18 infection centers there were 33 instances of new infections beyond the 82 vibratory plow barrier. Twenty-three (23) of these were so close to the 82 line that it is presumed that the disease had moved through the root systems before the barrier was established. The remaining ten (10) are close to the 82 line but it cannot be determined if they resulted from overland spread or root graft transmission.

Vibratory Plow Control, 1984

Following the survey of the 1982 results, the still active 18 infection centers were remarked for a fall 84 control project. A total of 5,475 feet was marked and again treated to a depth of 52". The line was widened beyond the limits used in 82 and placed between the second and third healthy trees adjacent to the actively wilting area. The line was well marked to ensure accurate evaluation in 1986 and beyond.

Discussion

Due to the large scale nature of the project, it was considered uneconomical in 1982 to have installed both a primary and secondary root graft barrier with only the minor losses that were expected. The cost of the 14,935 feet of plow line in 1982 was $5,152.00. This cost was off-set by the sale of the 1,311 marked trees for $1,780.00. The possible spread of oak wilt disease to an area outside the plant as a result of harvesting the infected trees was not considered significant enough to prevent marketing of the material.

Had a second barrier been installed in 1982, the total amount of line would have increased to just over 30,000 feet.

In 1984, the cost of 5,475 feet of barrier line was $4,927.00. The number of trees to be harvested from the infection centers decreased to 446, 33% of which were infected. The sale of these trees returned $549.78 to the plant. Harvesting is specified to take place only between August 1 and April 1 to reduce the probability of local spread on or off the plant facility.

CHEMICAL CONTROL OF OAK WILT DISEASE AT THE CARLOS AVERY WILDLIFE REFUGE: UPDATE OF COOPERATIVE PROJECT

Beginning in September 1981 the University of Minnesota Department of Plant Pathology and the Minnesota Department of Natural Resources Division of Forestry started a cooperative project to study oak wilt disease control on the Carlos Avery Wildlife Management Area between Wyoming and Stacy, Minnesota. The objective of the project was to test the effectiveness of two chemical silvicides, Tordon RTU, and Dozer (Fenuron TCA) for their use in preventing root graft transmission of Ceratocystis fagacearum from trees in established oak wilt infection centers to adjacent healthy trees.

The number of trees treated on each site, the silvicide used, the rate of application, and the dates of treatment are reported in the 1982 Forest Insect and Disease Report.

In May, 1984 the plots were ground checked with the results reported below. Complete top mortality of the oaks was achieved regardless of the silvicide used. However, achievement of effective root mortality is questionable given the large amount of live basal sprouts on treated trees regardless of the silvicide used.

In both years 1983 and 1984 mid-season aerial surveys have not detected oak wilt disease spreading outward from these study areas.

Table 1. SURVIVAL RESULTS OF NORTHERN PINE OAKS TREATED WITH TWO CHEMICAL SILVICIDES IN THREE AREAS IN THE CARLOS AVERY WILDLIFE MANAGEMENT AREA, EVALUATED IN MAY 1984.

Site	Silvicide	Apparent Complete Mortality in (% of treated trees)	Complete Top Kill with Live Basal Sprouts in (% of treated trees)
1 MAIN	Tordon	49	51
	Dozer	79	21
2 MAIN	Tordon	62	38
	Dozer	75	25
SOUTH OF MAIN	Tordon	15	85
3 MAIN	Tordon	33	67
	Dozer	52	48
WEST OF MAIN	Dozer	92	8
NORTHWEST OF MAIN	Tordon	37	63