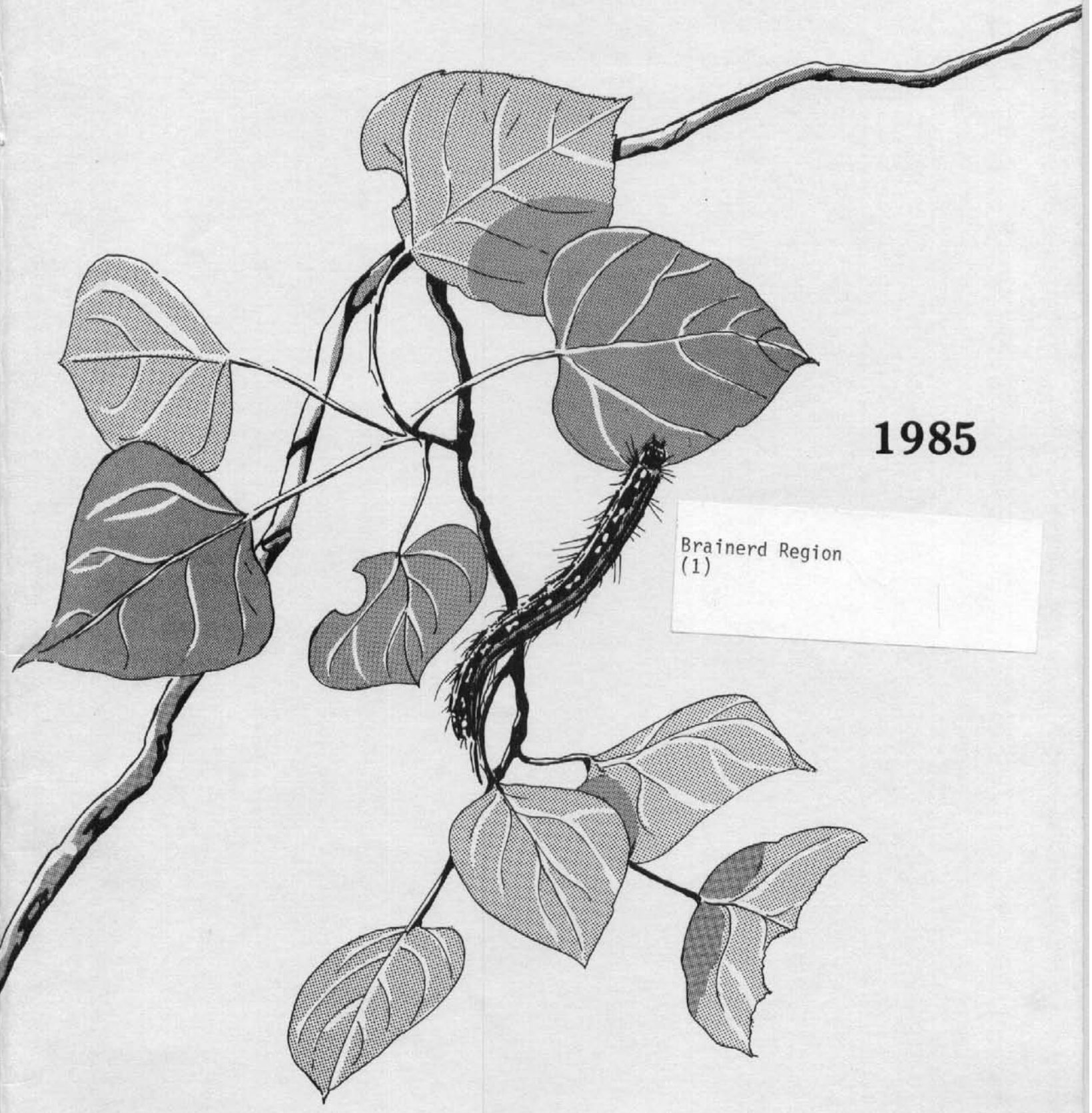
Forest Insect and Disease Report



1985

Minnesota Department of Natural Resources, Division of Forestry

1985 FOREST PEST REPORT

BY

The Forest Insect and Disease Unit

Minnesota Department of Natural Resources

Division of Forestry

March, 1987

St. Paul, Minnesota

- Acknowledgement -

The staff of the Forest Insect and Disease Unit would like to take this opportunity to thank Ray Dolan for the many years of service he provided to the Division of Forestry as a seasonal staff specialist. The professionalism and sense of history he brought to this unit and to this report were invaluable. Due to budget cuts this will be the last annual report to references Ray's direct efforts but by no means the last to demonstrate his influence on this program!

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

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 state. 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. 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.

S. Olin Phillips
Forest Insect and Disease Supervisor
Box 44, DNR Building
500 Lafayette Road
St. Paul, MN 55155-4044

Mike Phillips
Pesticide Coordinator
Box 44, DNR Building
500 Lafayette Road
St. Paul, MN 55155-4044

Region I

Alan Jones
Forest Insect & Disease Specialist
and
Roger Hannegan
Seasonal Plant Health Specialist
2115 Birchmont Beach Road N.E.
Bemidji, MN 56601

Region II

Mike Albers
Forest Insect and Disease Specialist
and
Ray Dolan & Jana Campbell
Seasonal Plant Health Specialists
Grand Rapids Regional Office
1201 East Highway 2
Grand Rapids, MN 55744

Region III

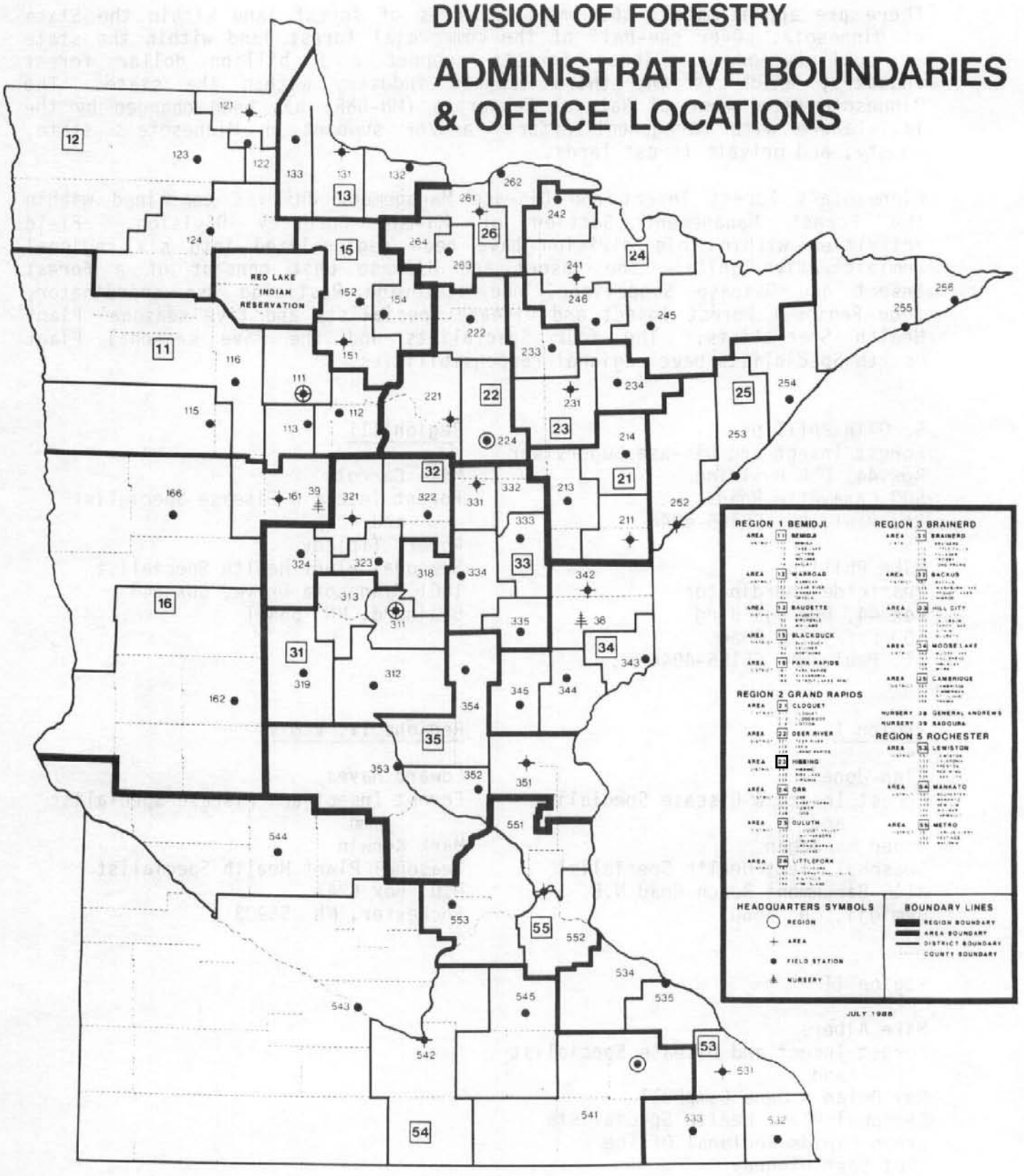
Mike Carroll
Forest Insect & Disease Specialist
and
Robert Tiplady
Seasonal Plant Health Specialist
1601 Minnesota Drive, Box 648
Brainerd, MN 56401

Regions IV, V & VI

Edward Hayes
Forest Insect and Disease Specialist
amd
Mark Korwin
Seasonal Plant Health Specialist
P.O. Box 6247
Rochester, MN 55903

DIVISION OF FORESTRY

ADMINISTRATIVE BOUNDARIES & OFFICE LOCATIONS



JACK PINE BUDWORM
Choristoneura pinus Freeman

SUMMARY: Budworm activity increased in all three Northern Regions. Both aerial and ground surveys confirmed the presence of the budworm in Pine, Crow Wing, Cass, Wadena, Hubbard, Becker, Beltrami, Roseau, Lake of the Woods, St. Louis, Lake, and Cook Counties (see Map 1). Defoliation and foliage firing, however, was only detected in Pine, Crow Wing, Cass, Wadena, Hubbard, St. Louis, Lake, and Cook Counties. Areas of concern, based on survey results of the intensity of the defoliation during 1985, include areas in St. Croix State Park in Pine County, west central Cass, northeastern Wadena, southeastern Hubbard, and areas of northern St. Louis and Lake Counties. The higher than normal precipitation experienced during 1985 may help reduce the impact of budworm feeding.

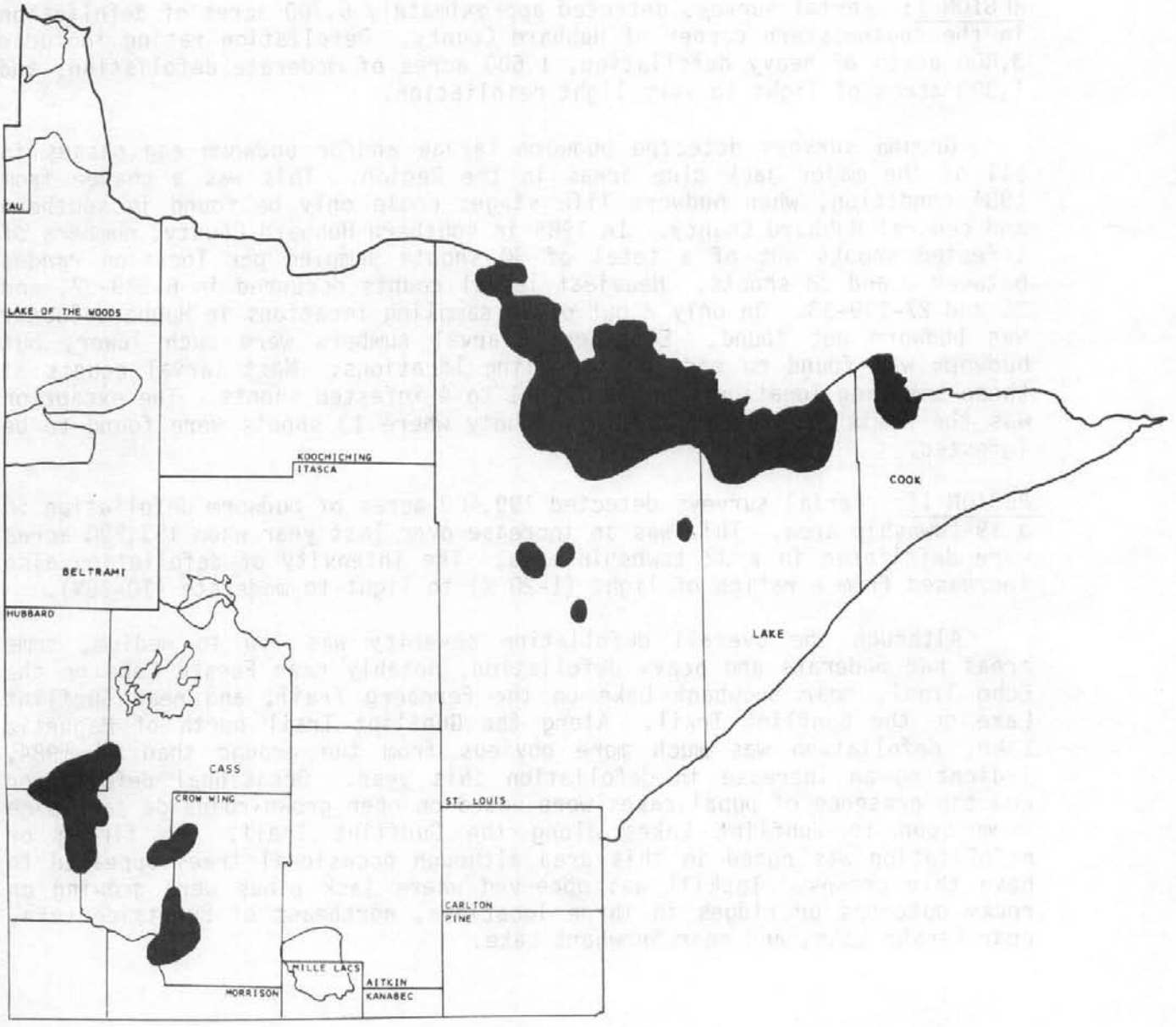
REGION I: Aerial surveys detected approximately 6,700 acres of defoliation in the southeastern corner of Hubbard County. Defoliation rating included 3,800 acres of heavy defoliation, 1,600 acres of moderate defoliation, and 1,300 acres of light to very light defoliation.

Ground surveys detected budworm larvae and/or budworm egg masses in all of the major jack pine areas in the Region. This was a change from 1984 condition, when budworm life stages could only be found in southern and central Hubbard County. In 1985 in southern Hubbard County, numbers of infested shoots out of a total of 30 shoots sampled per location ranged between 0 and 28 shoots. Heaviest larval counts occurred in 6-139-32, and 25 and 27-139-33. On only 2 out of 30 sampling locations in Hubbard County was budworm not found. Elsewhere, larval numbers were much lower, but budworm was found on most all sampling locations. Most larval counts at these sampling locations ranged from 1 to 4 infested shoots. The exception was the Bemis Hill area in Roseau County where 13 shoots were found to be infested.

REGION II: Aerial surveys detected 199,400 acres of budworm defoliation in a 39-township area. This was an increase over last year when 153,500 acres were defoliated in a 32 township area. The intensity of defoliation also increased from a rating of light (1-20 %) to light-to-moderate (10-20%).

Although the overall defoliation severity was low to medium, some areas had moderate and heavy defoliation, notably near Fenske Lake on the Echo Trail, near Snowbank Lake on the Fernberg Trail, and near Gunflint Lake on the Gunflint Trail. Along the Gunflint Trail north of Magnetic Lake, defoliation was much more obvious from the ground than in 1984, indicating an increase in defoliation this year. Occasional defoliation and the presence of pupal cases were noted on open-grown roadside jack pine from Loon to Gunflint Lakes along the Gunflint Trail. No firing or defolilation was noted in this area although occasional trees appeared to have thin crowns. Topkill was observed where jack pines were growing on rocky outcrops or ridges in three locations, northeast of Burntside Lake, near Fenske Lake, and near Snowbank Lake.

Jack Pine Budworm Defoliation 1985



REGION III: Aerial surveys confirmed the presence of outbreak proportion populations in portions of Backus, Nimrod, Pequot Lakes, and Brainerd Districts where entire sections showed foliage firing. Defoliation was only light in the Crosby and Moose Lake Districts. Due to the loss of the Regional Insect and Disease Specialist, no acreage figures of defoliation were determined. Heavy top feeding was observed in Wadena County, in 10-138-33, and in Cass County, 12-134-30 where 5% of the jack pine have been killed, and understory white pine had been infested with budworm larvae. Ground surveys detected high larval counts in jack pine stands surrounding Brainerd, Pillager, Pequot Lakes, Willow River, Sturgeon Lake, Pine River, and the Huntersville-Badoura area. Major concern exists for jack pine stands in and around St. Croix State Park. Heavy budworm defoliation occurred in 1985, and bark beetles could move in to cause heavy mortality.

SURVEYS: Traditionally, the early larval and the egg mass surveys are conducted to monitor the population and predict impact severity (see Table 1). The early larval survey consists of counting the number of infested shoots out of a total of 30 collected at each sampling location. A count of at least 20 infested shoots indicate a population great enough to cause heavy defoliation.

The egg mass survey consists of collecting 2 branches from the midcrown of 3 or 4 trees of different crown classes at each sampling location. Eighteen inches of needle-bearing surface on each branch is the sampling unit. An average of 1 egg mass per tree indicates a population great enough to cause noticeable defoliation the following growing season. The egg mass survey is often erratic in its predictive abilities and is being replaced with an overwintering larval survey. Plans are being made to try to utilize the overwintering larval survey in Minnesota in 1986-87.

A new survey method employed in 1985 used pheromone baited traps. Trap placement at each trapping location consisted of three traps spaced 40 meters apart in a triangular configuration. Each trap had different pheromone concentration: 0.3%, 0.03%, and 0.003%. There were 23 trap locations in 9 counties in 3 Regions. Trapping results are listed in Table 2.

There seemed to be little correlation between pheromone concentration and trap catches. The 0.03 concentrating caught the most moths averaging 5.9 moths per trap, while the traps with the strongest concentration, 0.3, averaged the least number of moths, 0.6 per trap. No correlations were made between trap catches, defoliation, and survey results. More baseline data will have to be collected over a period of several growing seasons before reliable predictions can be made based on trap catches.

PHENOLOGICAL NOTES:

May 13 - Second instar larvae were found at Lenore, central St. Louis County.

June 4 - Second and third instar larvae were found in Hubbard County, 6-139-32 and 28-139-33.

June 13 - Second through 4th instar larvae were found at Crane Lake, Echo Trail, and Winton in St. Louis County. The larvae were found primarily in the cones with very little webbing of new growth observed.

June 27 - Fifth instar larvae were present in the Virginia District, St. Louis County.

July 4 - Approximately 25% of the population had pupated at Sand Lake in central St. Louis County.

July 10 - Foliage firing from budworm feeding was evident in Hubbard, Cass, Wadena, and Crow Wing Counties.

July 14-27 Foliage firing was evident in northern St. Louis and Lake Counties.

TABLE 1. JACK PINE BUDWORM EARLY LARVAL AND EGG MASS SURVEY RESULTS

County	Description	Larval Survey # Shoots Infested	Avg. # Egg Masses/Tree	1985 Defoliation[2]
Pine (St. Croix St. Park)	Gate 8	-	0.7	Heavy
	0.5 mi. NE-Info Ctr.	-	0.7	Heavy
	0.6 mi. N-Info Ctr.	-	0.3	Heavy
Crow Wing	25-44-31	20	3	-
	32-44-31	12	-	-
	10-44-31	-	0.3	-
	11-44-31	-	0.3	L
	16-44-31	17	-	-
	8-44-31	6	-	-
	13-133-29	-	0.7	L
	6-135-28	6	-	-
	23-136-27	10	-	-
	6-136-28	6	-	-
	26-138-28	1	-	-
	36-134-29	13	-	-
Morrison	5-135-30	13	-	-
Wadena	24-135-34	7	-	-
	22-136-33	-	1.3	-
	12-137-34	14	-	-
	7-138-33	-	1.7	M
	10-138-33	19	2.0	-
	14-138-34	16	-	-
	15-138-34	-	1.3	-

County	Description	LARVAL SURVEY # Shoots Infested	Avg. # Egg Masses/Tree	1985 Defoliation
Cass	8-133-29	12	-	-
	9-133-29	9	-	-
	17-135-32	-	0.7	-
	3-136-29	10	-	-
	17-138-29	3	-	-
	19-138-32	8	-	-
	24-138-32	-	1.0	-
Hubbard	1-139-32	-	1.7	Light
	3-139-32	6	0	Light
	4-139-32	-	1.0	Moderate
	5-139-32	-	1.4	Moderate
	6-139-32	23	1.0	Moderate
	9-139-32	12	1.0	Moderate
	10-139-32	7	2.0	Light
	12-139-32	3	-	Light
	15-139-32	5	-	Light
	16-139-32	4	-	Light
	17-139-32	17	-	Moderate
	19-139-32	6	0.7	Light
	28-139-32	28	-	Moderate
	30-139-32	-	0.3	Moderate
	1-139-33	-	2.0	Moderate
	2-139-33	2	0	Light
	12-139-33	-	1.7	Moderate
	13-139-33	-	0.7	Moderate
	17-139-33	-	0.3	Light
	24-139-33	-	0.7	Moderate

County	Description	LARVAL SURVEY # Shoots Infested	Avg. # Egg Masses/Tree	1985 Defoliation
Hubbard	25-139-33	18	1.5	Moderate
	26-139-33	20	0.7	Heavy
	27-139-33	28	-	Heavy
	28-139-33	12	-	Moderate
	36-139-33	-	1.3	Moderate
	5-139-34	-	0.7	None
	26-139-34	2	-	None
	32-134-35	4	-	None
	34-139-35	4	-	None
	35-139-35	1	0.7	None
	21-140-32	2	-	Light
	22-140-32	2	-	Light
	23-140-32	3	-	Light
	26-140-32	7	1.0	Light
	30-140-32	4	-	Light
	31-140-32	-	0.3	Moderate
	33-140-32	2	2.0	Moderate
	34-140-32	-	2.7	Moderate
	36-140-32	6	0.3	Light
	23-140-33	-	0.7	Light
	25-140-33	7	0.3	Light
	26-140-33	-	0.3	None
	27-140-33	8	0	None
	3-143-34	5	0	None
	6-143-34	-	0.3	Light
	8-143-34	2	0	None
	10-143-34	4	0	None

County	Description	Larval Survey # Shoots Infested	Avg. # Egg Masses/Tree	1985 Defoliation
Hubbard	16-143-34	2	0	None
	3-144-34	-	0.3	None
	10-144-34	3	0	None
	20-144-34	1	-	None
	22-144-34	3	0	None
	26-144-34	1	0	None
	27-144-34	2	0	None
	32-144-34	2	0	None
	27-144-35	2	-	None
	2-145-34	2	0	None
	22-145-34	6	-	None
	23-145-34	1	-	None
	24-145-34	3	-	None
	27-145-34	2	-	None
	2-145-35	4	-	None
Becker	22-139-36	6	0	Light
	23-139-36	3	0.3	None
	9-140-36	2	-	None
	14-140-36	1	-	None
	34-140-36	1	-	None
	27-141-36	5	0	None
	30-145-38	1	-	None
Beltrami	14-146-34	4	-	None
	21-146-35	2	-	None
	27-146-35	1	-	None
	9-147-34	1	-	None
	8-147-34	2	-	None

County	Description	Larval Survey # Shoots Infested	Avg. # Egg Masses/Tree	1985 Defoliation
Beltrami	17-147-34	2	-	None
	22-147-34	2	-	None
	29-148-35	2	-	None
	30-148-35	2	-	None
	31-148-35	1	-	None
	33-148-35	4	-	None
	34-148-35	4	-	None
	36-148-35	3	-	None
Lake of The Woods	28-159-33	1	-	None
	36-159-33	1	-	None
	10-159-34	1	-	None
	7-159-35	3	-	None
	8-159-35	2	-	None
	13-159-36	2	-	None
Roseau	4-160-37	-	0.3	None
	6-160-37	13	0.3	None
	31-160-37	-	0.5	None
	12-160-38	4	0	None
	15-160-38	3	-	None
	33-160-38	3	0	None
	18-161-36	4	-	None
	20-161-36	-	2.0	None
	27-161-36	1	0	None
	29-161-36	-	0.3	None
	30-161-36	6	-	None
	26-161-37	3	-	None
	31-161-37	3	0.3	None
	32-161-37	7	-	None

County	Description	Larval Survey # Shoots Infested	Avg. # Egg Masses/Tree	1985 Defoliation
St. Louis	4-57-16	9	0	Light
	9-57-16	21	0.4	Light
	35-58-15	9	0	Light
	Va. Falls	+	-	-
	26-60-18	2	0	Moderate
	29-61-15	2	0	None
	33-62-15	1	0	Light
	2-62-13	1	0	Light
	19-63-12	+	0.4	Heavy
	7-65-15	+	0.4	Light
	14-65-14	+	0.2	Moderate
Lake	8-63-9	+	0.4	Heavy
	8-63-9	1	0.4	Heavy

1. The total number of shoots sampled at each location was 30.
2. Defoliation classes are: LIGHT: 1-20% defoliated, MODERATE, 21-50% defoliated, and HEAVY, 51-100% defoliated.
3. A dash means no data was collected.
4. The early larval survey was based on the average number of larvae per nine branches on the plot. A + means that larvae were found at the particular sampling location.

TABLE 2. JACK PINE BUDWORM PHEROMONE TRAPPING RESULTS

County	Description	# Moths Pheromone Conc. 0.3	0.03	0.003	Survey Result Larval # Shoots	Egg Mass # EM/Tree	1985 Defoliation
Pine	24-45-20	0	2	2	-*	-	Light
	24-45-20	0	3	0	-	-	Light
	36-45-20	1	6	3	-	-	None
Crow Wing	16-44-31	3	21	15	17	-	Moderate
	11-136-29	0	2	0	-	-	None
Wadena	19-138-33	3	8	2	-	-	Heavy
	2-138-34	0	11	0	-	-	None
Hubbard	10-139-32	0	0	1	7	2.0	Light
	35-139-37	3	43	6	-	0	Heavy
	16-143-34	0	0	0	2	0	None
	34-144-34	1	27	5	-	0	None
Becker	23-139-36	0	1	0	3	0.3	None
Beltrami	17-147-34	-	0	0	2	-	None
Low	10-159-34	0	0	0	1	-	None
Roseau	6-160-37	0	0	0	13	0.3	None
St. Louis	4-57-16	1	0	0	9	0	Light
	9-57-16	0	0	0	21	0.4	Light
	35-58-15	1	5	11	9	0	Light
	26-60-18	0	0	1	+**	0	Moderate
	19-63-12	0	3	2	+	0.4	Heavy
	14-65-14	0	0	4	+	0.2	Moderate
	7-65-15	0	0	0	+	0.4	Light
	8-63-9	0	4	0	+	0.4	Heavy
	Avg. Catches	0.6	5.9	2.3			

* = No data collected
** = Survey counted larvae on 9 branches; a + means larvae were present.

PINE TUSSOCK MOTH

Dasychira Pinicola Dyer

SUMMARY: Populations remained low in the historic outbreak areas in Pine County. Pheromone trap collections in Crow Wing, Cass, Wadena, and Pine Counties indicated continuing endemic populations. Records indicate previous outbreaks have occured in 5 to 7 year cycles. The last major outbreak occurred in 1980.

SURVEYS: Pheromone trapping was the major survey conducted for the pine tussock moth. Traps were placed on July 10 and 11, and inspected on or about July 19 and 29, and August 6 and 13. This was the 6th consecutive year of pheromone trapping, and trap catches were similar to those made in 1985 when trap catches dramatically increased. No major defoliation, however, was detected.

TABLE 3 — 1985 Pine Tussock Moth Pheromone Trapping Summary

COUNTY	DESCRIPTION	JULY 18/19	JULY 29/30	AUG 6/7	AUG 13/14	1985 SUM	1984 SUM[1]
Pine	6-44-19	6	4	20	12	42	11
	6-44-19	2	5	17	14	38	30
	30-45-19	5	3	18	13	39	-
	30-45-19	11	3	25	14	53	-
	25-45-20	6	4	17	16	43	18
	13-45-20	2	0	0	3	5[2]	21
	18-45-23	5	5	10	4	24	-
	Nursery	1	2	9	9	21	-
	Nursery	5	2	12	9	28	-
	Nursery	2	3	12	10	27	-
Crow Wing	23-136-27	10	11	13	9	43	33
	11-136-27	9	7	18	23	57	59
	11-136-27	11	11	9	24	55	85
	10-136-27	11	10	10	19	49	60

Crow Wing (Continued)	9-136-27	10	9	17	9	45	57
	9-136-27	13	17	10	18	58	57
	9-136-27	4[3]	12	9	14	39	57
Cass	25-138-31	25	8	5	10	48	-
	35-137-32	17	17	14	10	58	-
Wadena	15-138-33	17	11	8	4	40	-
	10-138-33	23	13	22	16	74	-
	10-138-33	21	16	18	22	77	-
	3-138-33	22	10	22	22	76	45

1- 1984 Sum is the actual trap summation if there was 1 trap at that description in 1984; if there was more than 1 trap in 1984, the sum is an average.

2- A bird was found in the trap and was responsible for less moth catches.

3- The trap was found on the ground during the July 19th inspection.

BARK BEETLES

Ips spp.

The cool, wet growing season in 1985 led to good growing conditions and poor bark beetle conditions. Generally, little activity was noted statewide. There was bark beetle activity and tree mortality noticed in two locations in Becker County and at one location in Hubbard County. All three locations had experienced bark beetle activity for 2 to 4 years previously, and populations may have built up high enough to successfully attack healthy trees. The three locations also were associated with homes or cabins. Human activity may have caused enough tree stress to predispose the trees to bark beetle attacks.

MISCELLANEOUS JACK PINE PESTS

While conducting the jack pine budworm early larval survey, other insect and disease pests were also recorded. Pine spittlebug (Aphrophora parallela [Say]), pitch midges (Cecidomyia spp.) and the pitch nodule maker (Petrova albicapitana [Busck]) were the insect pests detected during budworm surveys. Populations were generally low (see Table 4) and caused very little damage.

TABLE 4 MISCELLANEOUS JACK PINE PEST SUMMARY

PEST	AREA	NUMBER SHOOTS/BRANCHES INFESTED	TOTAL SHOOTS/BRANCHES SURVEYED	PER-CENT INFESTED
Pine Spittlebug	Park Rapids	299	1920	15
	Bemidji	49	330	15
	Baudette/Warroad	64	690	10
	TOTALS	417	2940	14
Pitch Midges	Park Rapids	25	320	8
	Bemidji	3	55	5
	Baudette/Warroad	3	115	3
	TOTALS	31	490	16
Nodule Maker	Park Rapids	25	215	12
	Bemidji	8	55	15
	Baudette/Warroad	10	115	9
	TOTALS	43	385	11

JACK PINE SAWFLIES

Neodiprion pratti Banksiana Rohwer

First instar larvae and unhatched eggs were noted in jack pine sampled along the Echo Trail in northern St. Louis County. Some of the previous defoliation to jack pine in this area can likely be attributed to sawflies rather than to the jack pine budworm. The sawflies feed on old needles in contrast to budworm which largely feeds on current year needles. On a shelterbelt in north central Koochiching County, jack pine sawflies had completely stripped off the old foliage on declining jack pines. Generally, this defoliator seems to be on the increase, particularly in Koochiching and St. Louis Counties.

WHITE GRUBS

Phyllophaga spp.

White grubs continued to be a problem in newly planted fields, particularly fields which had been in grass cover prior to planting. Scots pine mortality due to grub feeding was evident in Pope County, and mortality was noted in Aitkin, Cass and Crow Wing Counties. The plantations were established in 1984.

SPRUCE BUDWORM

Choristoneura fumiferana (Clemens)

During the first week of July, aerial surveys were conducted to detect and assess spruce budworm-caused defoliation. Within the outbreak areas (see Map 2), 307,275 acres were defoliated. Outside the outbreak area, very light budworm activity was noted but not mapped (see VL on the map). From the Kabetogema Peninsula in St. Louis County through north Lake County and down to the North Shore, very light budworm activity was detected. The observers had some difficulty in detecting and mapping defoliation due to the lack of crown discoloration. Ground surveys showed that trees which had been heavily defoliated in many areas did not show as much of the "firing-up" or brown discoloration of the crown as would normally be expected. Apparently the strong winds and heavy rains knocked down the clipped needles which are normally detected from the air as discoloration in the crowns.

The defoliated acreage in each county for all ownerships was:

	LIGHT	MEDIUM	HEAVY
Cook County	15,620	12,545	2,583
Lake County	4,517	3,282	27,491
St. Louis County	27,572	84,691	128,972
TOTALS	47,572	100,518	159,046

This year in Cook County budworm activity spread east into the Grand Portage Indian Reservation and southwest toward the county line.

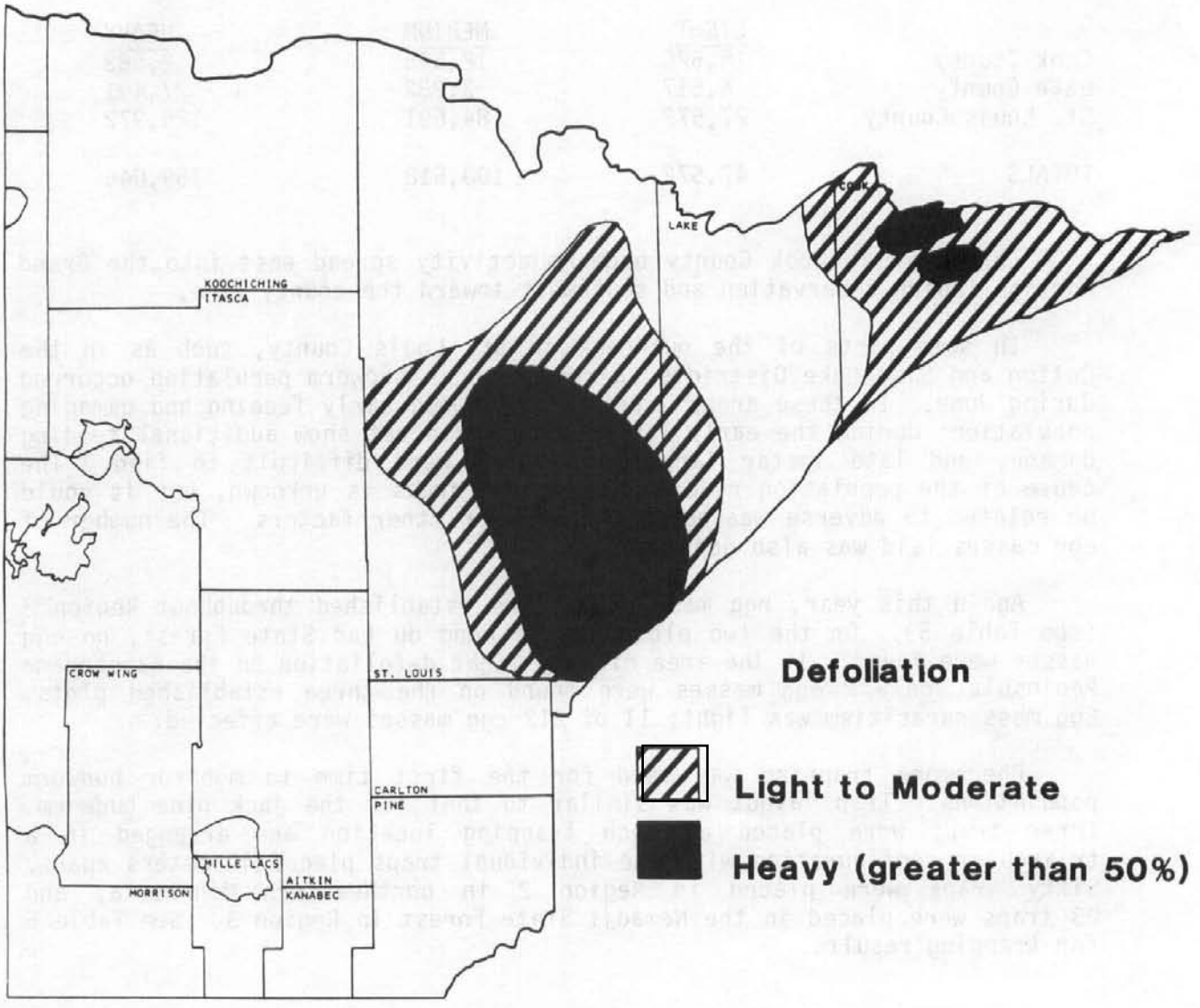
In some parts of the outbreak in St. Louis County, such as in the Cotton and Side Lake Districts, a reduction in budworm population occurred during June. In these areas trees which showed early feeding and damaging populations during the early larval survey did not show additional feeding damage, and late instar larvae and pupae were difficult to find. The cause of the population reduction in these areas is unknown, but it could be related to adverse weather, predators or other factors. The number of egg masses laid was also depressed.

Again this year, egg mass plots were established throughout Region 2 (see Table 5). On the two plots in the Fond du Lac State Forest, no egg masses were found. In the area of very light defoliation on the Kabetogama Peninsula, only 2 egg masses were found on the three established plots. Egg mass parasitism was light; 11 of 212 egg masses were affected.

Pheromone trapping was used for the first time to monitor budworm populations. Trap layout was similar to that for the jack pine budworm. Three traps were placed at each trapping location and arranged in a triangular configuration with the individual traps placed 40 meters apart. Sixty traps were placed in Region 2 in northeastern Minnesota, and 23 traps were placed in the Nemadji State Forest in Region 3. See Table 5 for trapping results.

MAP 2

Spruce Budworm Defoliation 1985



At the present time, no correlations can be made between the number of moths trapped and other survey data such as early larval or egg mass numbers, or defoliation levels. More baseline data will have to be collected over several season before there is enough information to make reliable predictions based solely on trap catches.

Phenological Notes

May 20 Second and 3rd instar larvae were scarifying and curling shoots; some webbing present. Northern St. Louis County.

May 31 Second and 3rd instar larvae were present in Knife River.

June 11 Second to 4th instar larvae were found along the North Shore; 4th and 5th instar larvae were found inland away from the cooling effects of Lake Superior.

June 27 The population was 80% pupated in the Cloquet Valley, St. Louis County.

June 28 Mostly late instar larvae were present with pupation commencing in Cook County.

July 12 The population was mostly pupated at Hovland, Cook County.

July 12 Many adults were noted in fir stands in the Knife River area.

TABLE 5 SPRUCE BUDWORM SURVEY SUMMARY

COUNTY	DESCRIPTION	DEFOLIATION 1984	DEFOLIATION 1985	EGG MASS COUNT 1984	EGG MASS COUNT 1985	1985 Average # of Larvae	Total Traps[1]
Pine	14-44-17	-	-	-	-	-	0
	13-44-17	-	-	-	-	-	0
	12-44-17	-	-	-	-	-	0[2]
	10-45-17	-	-	-	-	-	0
	2-45-17	-	-	-	-	-	0
	7-45-16	-	-	-	-	-	0
	6-45-16	-	-	-	-	-	0
Carlton	34-46-16	-	-	-	-	-	0
	12-49-19	0	0	-	0	0.1	1
	11-49-19	0	0	-	0	0	0
Itasca	1-59-22	0	L	-	4.1	0	4
St. Louis	4-59-21	0	M	-	5.9	0.4	230

TABLE 5 SPRUCE BUDWORM SURVEY SUMMARY

COUNTY	DESCRIPTION	DEFOLIATION 1984	DEFOLIATION 1985	EGG MASS COUNT 1984	EGG MASS COUNT 1985	1985 Average # of Larvae	Total Traps[1]
	12-68-21	L	VL	-	0	10.4	73
	13-59-20	0	L	-	0	3.2	264
	31-69-19	0	VL	-	0.1	1.8	96
	5-68-19	L	VL	-	0.1	8.7	78
	25-56-17	M/H	M/H	3.4	0.4	6.9	95
	8-53-17	-	H	-	1.6	-	-
	2/3-53-17	H	H	4.0	0.7	17.0	128
	14-52-16	H	H	4.0	5.9	17.0	63
	3-53-16	H	H	2.7	1.1	14.7	323
	36-52-12	H	H	4.6	1.7	30.2	819
	25-59-11	-	L/M	-	1.1	-	-
Lake	24-55-11	-	H	-	1.4	-	-
	34-61-3W	L	L	1.3	2.4	6.0	119
Cook	1-61-2W	L	L/M	1.3	0.6	6.6	470
	34-65-3W	H	L/M	3.9	1.8	24.0	89[2]
	16-63-3E	L	VL	2.7	0.6	15.0	38
	32-63-3E	H	M/H	4.2	1.9	21.0	136
	27-64-3E	H	M	6.6	1.7	21.0	204
	35-64-3E	L	L/M	7.0	1.7	11.4	25

[1]Total number of moths caught in 3 traps at each trapping location.
[2]Trap results based on 2 traps.

YELLOW-HEADED SPRUCE SAWFLY

Pikonema alaskensis (Rohwer)

This defoliator can be found in most young, open-grown white spruce plantations, but most populations remain at sub-economic levels. However, populations are increasing in northeastern Minnesota. The Canadians also reported increased sawfly populations near Thunder Bay, Ontario.

Active populations were found during routine checks on plantations in St. Louis and Cook Counties, and feeding larvae were found during causal observations on roadside plantings in Carlton, Lake, and Cook Counties. At the Cotton white spruce seed orchard in central St. Louis County, light defoliation of current year's growth was observed in the southeast quarter of the plantation. Nearby in Melrude, NWSE of 29-55-16, heavy sawfly feeding occurred on 6 to 7 foot tall white spruce. Complete defoliation was observed, and these trees had 100 or more larvae feeding on them.

Two plantations in Cook County, 28 and 33-64-4E, have had a history of sawfly feeding along their edges and scattered throughout the plantings. The spruce are now 8 to 12 feet tall which should minimize both the incidence and impact of sawflies. A plantation ½ mile south in 34-64-4E has spruce that are only 2 to 3 feet tall, and the trees have recently been released from overtopping competition. These trees are in a size range where they are very susceptible to sawfly feeding, and they are now in full sunlight making them attractive to sawflies. This plantation is particularly vulnerable to a damaging buildup of yellow-headed spruce sawfly, and will be checked closely to monitor populations before serious damage occurs. Trees which experience heavy feeding damage one year and heavy populations feeding during the next year should be treated with an insecticide.

PHENOLOGICAL NOTES:

Early stages of sawfly development were 1 to 1½ weeks earlier than normal, but cool weather in June delayed development so that the later stages occurred at about the normal time.

May 21: Adults were laying eggs in Carlton County.

June 25: Second instar larvae were present in Carlton County.

June 27: Mostly 4th instar larvae were present, but some 3rd and 5th instars were also found feeding in the Cotton seed orchard in St. Louis County.

July 8: Complete defoliation was observed on 6-7 foot tall spruce at Melrude in St. Louis County.

LARCH SAWFLY

Pristiphora erichsonii (Hartig)

Larch sawfly populations continued to be low throughout Minnesota. There were two areas observed that did show obvious tamarack defoliation from larch sawfly feeding. One area was in St. Louis County at Lion Springs near Eveleth, and the other area was in central St. Louis County at Sparta.

FOREST TENT CATERPILLAR

Malacosoma disstria (Huber)

Overall statewide, the forest tent caterpillar was at low levels causing little defoliation. There were exceptions, and those exceptions caused localized areas of defoliation. Those localized infestations included the following:

Region 1: Basswood was moderately to heavily defoliated around Gilchrist Lake in southern Pope County. This is at least the third straight year of defoliation, but the intensity of defoliation was less than that seen in 1984.

Region 2: Total defoliation from the forest tent caterpillar feeding in this region amounted to 15,570 acres. This acreage represented a decline over last year's defoliated area. Most of the defoliation occurred in extreme southern St. Louis County and in northern Carlton County along Highway 2 between Highway 31 and Highway 33. This was the 9th consecutive year of defoliation for stands in this locality. Other isolated pockets of forest tent caterpillar defoliation were observed from Paupore to Cotton in St. Louis County to Jay Cooke State Park in Carlton County. See Map 3.

Region 3: Visible aspen defoliation was limited to a band between Sandstone and Hinckley along the Kettle River. The defoliation was caused by a combination of the forest tent caterpillar and the large aspen tortrix.

Region 5: The forest tent caterpillar was again active in Kanlyohi County. Defoliation to some extent has been going on in this area for 7 to 8 years. Aerial surveys in early June found four separate large areas of moderate to heavy defoliation. The defoliated areas were found around Norway and Games Lakes in sections 17, 29, and 32 of Colfax Township; in section 32 of Burbank Township; and in sections 5 and 6 of New London Township including part of Sibley State Park. Egg mass surveys indicate continued defoliation in section 32 of Colfax Township and in section 1 of Andrew Township.

PHENOLOGICAL NOTES:

April 30: Aspen began to leaf out in Carlton County.

May 6: Aspen were completely leafed out, and FTC had hatched.

May 14: Second instar larvae (½ inch in length) were feeding on leaves and, webbing was obvious.

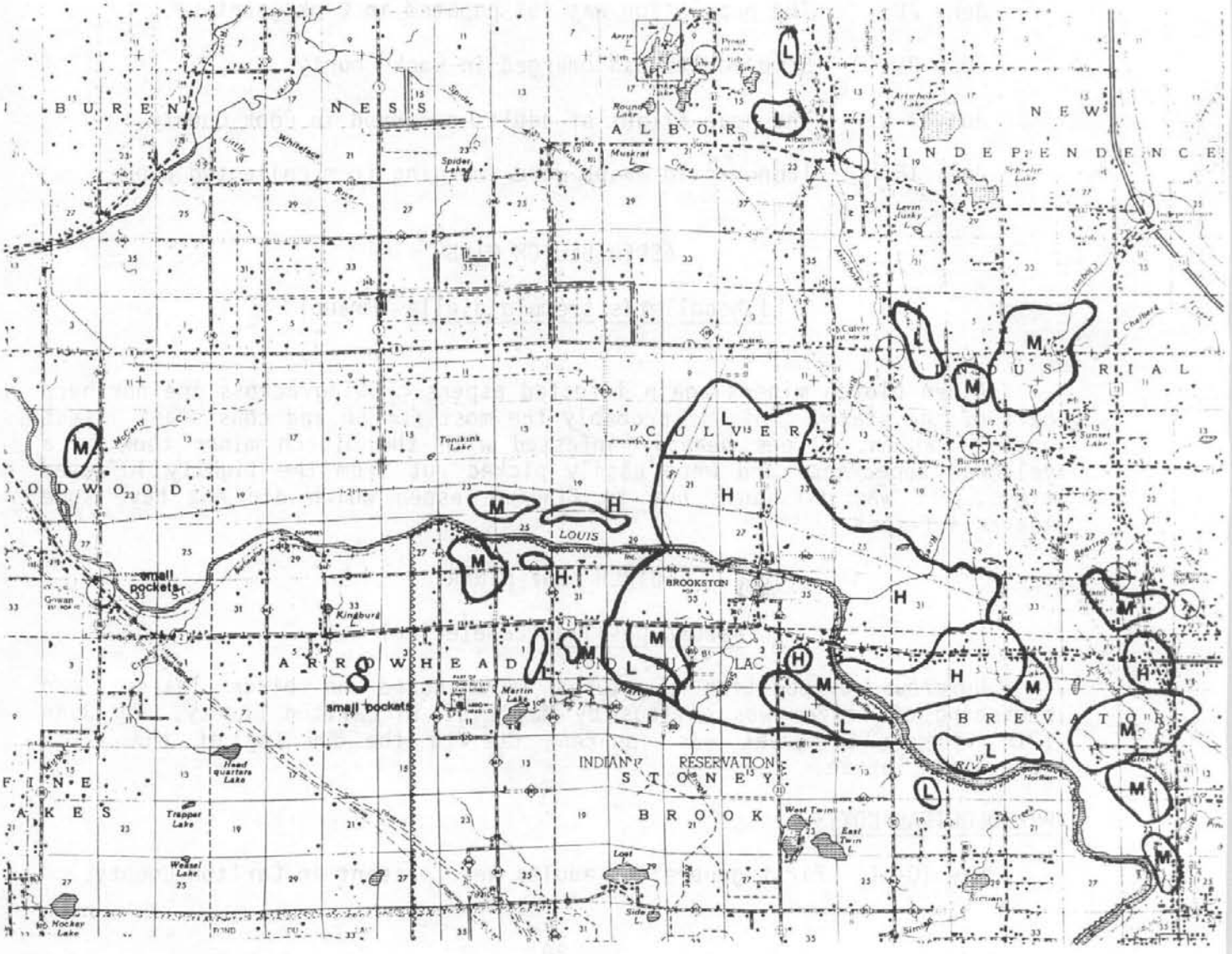
June 15: Late instar larvae (1 to 1½ inches in length) were still feeding.

June 20: Some late larvae were still active, and cocoons were present.

MAP 3

1985
Forest Tent Caterpillar
Defoliation of Aspen
Aerial Survey: July 2nd

15,500 ac.



LARGE ASPEN TORTRIX

Choristoneura conflictana (Walker)

The number of acres defoliated by the large aspen tortrix greatly expanded in 1985. In 1984, the affected acres were largely confined to the area just north and east of Hovland in Cook County along the North Shore. In 1985, most of the eastern half of Cook County was affected. Aspen defoliation occurred on 134,150 acres. Individual stands were not mapped but the three levels of defoliation are indicated on Map 4 . No losses were observed. Scattered pockets of defoliation were observed in Lake and St. Louis Counties and accounted for an additional 14,600 acres of defoliated aspen.

PHENOLOGICAL NOTES:

May 20: Second and third instar larvae were rolling aspen leaves in northern St. Louis County.

June 10: Fourth and fifth instars were present in Cook County.

June 28: The population was 75% pupated in Cook County.

June 29: Some adults had emerged in Cook County.

July 3-5: The peak flight of adults occurred in Cook County.

July 15: Ichneumonid wasps were emerging from collected pupae.

ASPEN BLOTCH MINER

Lithocolletis tremuloidiella (Braun)

Aspen blotch miners again infested aspens growing across the northern part of the state. This is probably the most common and consistant insect pest of aspen. Trees heavily infested with the blotch miner took on a yellowed appearance and were easily picked out from the lightly infested trees. It was difficult not to find an aspen which did not have some leaves infested.

BIRCH LEAF MINER

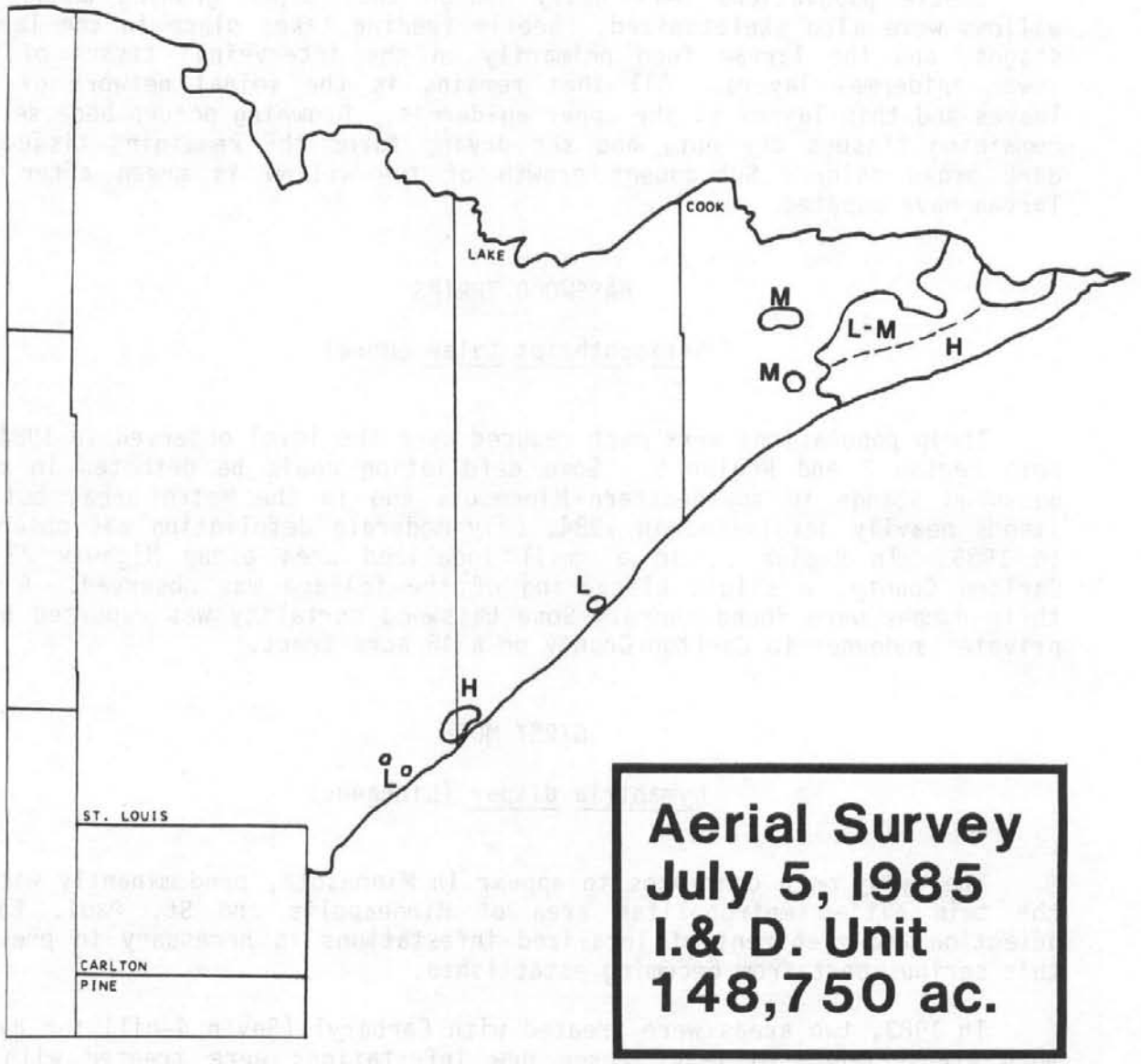
Fenusa pusilla (Lepeletier)

Numerous oviposition punctures were noted on birch leaves, and blotching of leaves was obvious by May 21st in Carlton County. By June 17th, injury to trees was apparent due to the feeding of the first generation larvae.

PHENOLOGICAL NOTES:

May 10-21: First generation adults were present in Carlton County.

Aspen Defoliation by Large Aspen Tortrix.



Aerial Survey
July 5, 1985
I.& D. Unit
148,750 ac.

WILLOW LEAF BEETLES

Chrysomela spp.

Heavy leaf skeletonizing by beetle larvae in the family Chrysomelidae caused swamp and bog willow leaves to turn brown. By min-July, brown foliage was very noticeable in Roseau, Lake of the Woods, Koochiching, Itasca, St. Louis, and Lake Counties

Beetle populations were heavy enough that aspen growing among the willows were also skeletonized. Beetle feeding takes place in the larval stages, and the larvae feed primarily on the interveinal tissue of the lower epidermal layers. All that remains is the veinal network of the leaves and thin layers of the upper epidermis. Browning occurs because the remaining tissues dry out, and the drying turns the remaining tissues a dark brown color. Subsequent growth of the willow is green after the larvae have pupated.

BASSWOOD THRIPS

Seriocothrips tilae (Hood)

Thrip populations were much reduced over the level observed in 1984 in both Region 2 and Region 5. Some defoliation could be detected in most basswood stands in southeastern Minnesota and in the Metro area, but in stands heavily defoliated in 1984, only moderate defoliation was observed in 1985. In Region 2, in a small localized area along Highway 23 in Carlton County, a slight blackening of the foliage was observed. A few thrip nymphs were found there. Some basswood mortality was reported by a private landowner in Carlton County on a 40 acre tract.

GYPSY MOTH

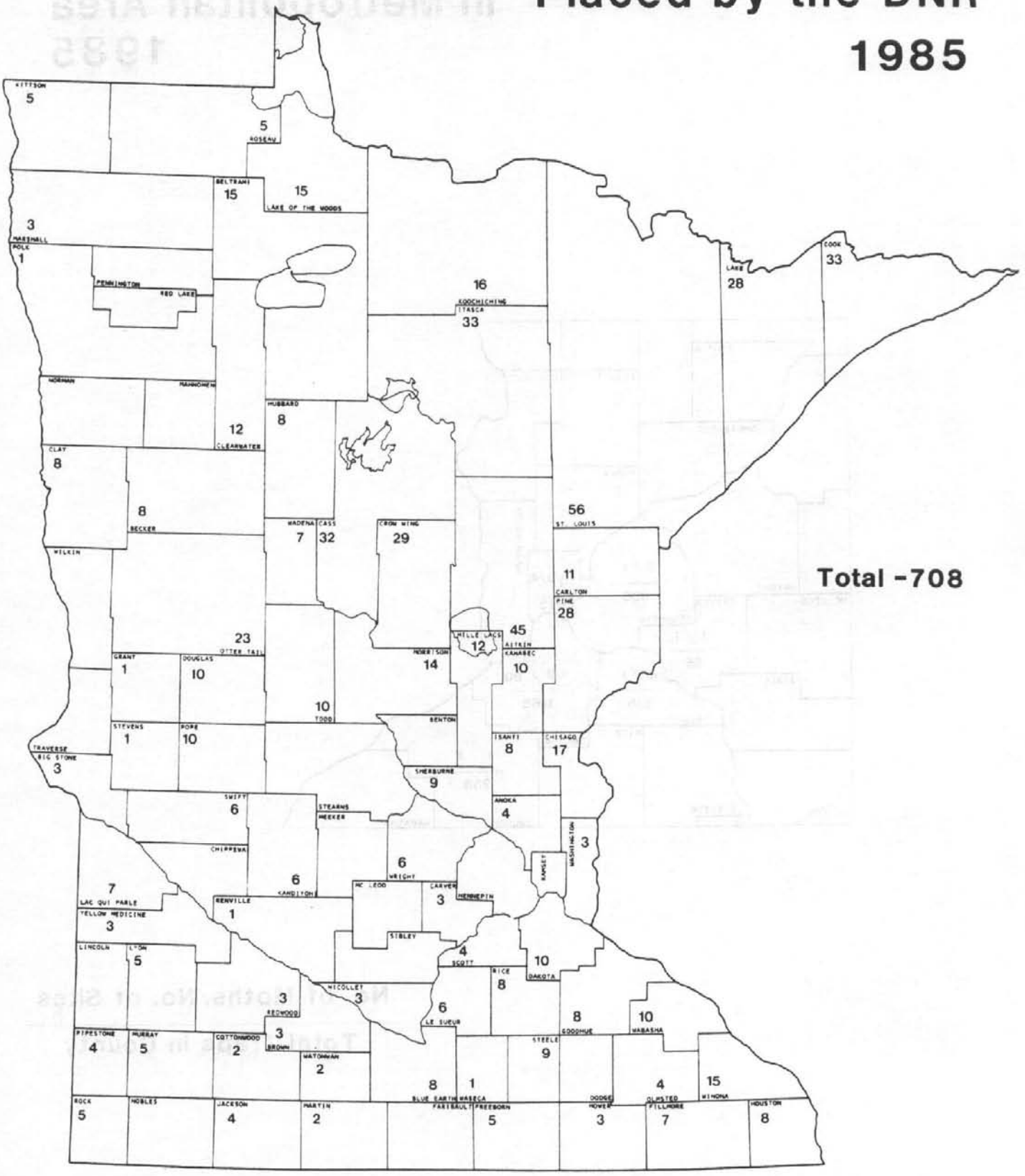
Lymantria dispar (Linnaeus)

The gypsy moth continues to appear in Minnesota, predominantly within the twin cities metropolitan area of Minneapolis and St. Paul. Early detection and treatment of localized infestations is necessary to prevent this serious pest from becoming established.

In 1983, two areas were treated with Carbaryl (Sevin 4-oil) for gypsy moth eradication. In 1984, three new infestations were treated with Bt (Thuricide 48LV). In both of those years treatments were completely successful without further detection of gypsy moth in or around the treated areas.

In 1985, the Minnesota Department of Agriculture in cooperation with the USDA and the DNR-Divison of Forestry, treated four new areas with Bt (Thuricide 48LV). The were two areas totalling 108 acres in Apple Valley, one 38-acre site in Lakeville, and one 41-acre site in White Bear Lake.

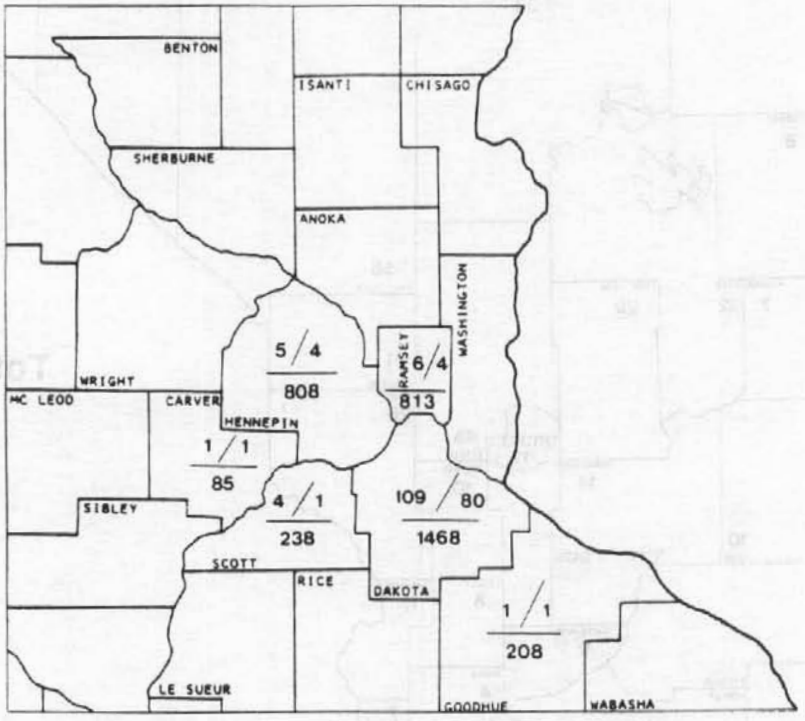
Number of Gypsy Moth Traps Placed by the DNR 1985



Total -708

MAP 6

Number of Gypsy Moths Trapped in Metropolitan Area 1985



No. of Moths/No. of Sites

Total Traps in County

The Apple Valley and Lakeville sites are in Dakota County while the White Bear Lake site is in Ramsey County. During the subsequent field season, male moths and viable egg masses were recovered from the Apple Valley sites, and male moths were trapped at the Lakeville site. Both areas will have to be retreated during 1986.

Detection surveys for male moths using pheromone traps increased in 1985 with 11,075 traps placed in 79 Minnesota counties. This effort was accomplished mainly through seasonal personnel from the Minnesota Department of Agriculture. Through the efforts of Forestry, Parks, and Wildlife personnel from the Department of Natural Resources, 708 traps were placed and monitored (see Map 5). The 1985 trapping program resulted in 126 male moths caught at 91 trapping sites in five counties (see Map 6). These 1985 levels were greatly reduced over the 1984 level of 580 trapped on 92 sites.

In Goodhue County, one moth was trapped in Red Wing. This brings to fourteen the number of counties where gypsy mosth has been detected. In addition to the two Apple Valley sites, multiple trap catches were also found in Burnsville, Edina, Mounds View, and Savage. However, ground surveys did not find sufficient evidence in these areas to designate them as infestations in 1985, and control will not be necessary in 1986.

.....DISEASE.....

PINE NEEDLE RUSTS

Coleosporium spp.

Pine needle rust incidence was recorded during branch collections for the early larval surveys for the jack pine budworm in Region 1. Total branches collected were 490, and 119 or 24% of the branches had needles infected with this rust disease. This level of infection represents a normal find.

PINE GALL RUSTS

Cronartium spp.

Gall rust surveys were conducted along with the early larval survey for the jack pine budworm in the Bemidji, Baudette and Warroad Areas. Twenty-eight branch galls were found on a total of 170 branches collected for the budworm survey. This represents a 16% infection rate. Differentiation between the pine-pine and the pine-oak rusts was not made. Disease distribution maps show that both rusts are found in the Bemidji Area, but only the pine-pine rust is found in the Baudette and Warroad Areas.

DIPLODIA TIP BLIGHT

Sphaeropsis ellisii Sacc.

Diplodia continued to be a localized problem in the Park Rapids Area. Understory pine are showing annual shoot infections. An area in the Two Inlets State Forest in Becker County in which red pine was established under a residual overstory of red pine was heavily infected with shoot blight. A timber sale was set up to take out the overstory which should reduce the disease incidence in the plantation.

In the Bemidji District a private landowner experienced top kill and tree mortality to 30-feet tall red pine growing adjacent to larger red pine. *Sphaeropsis* infections were abundant on the trees, and the large red pine had brown tips scattered throughout the crown which would indicate the source of infection. This fungus also lives on the cones, and this source is an important reservoir for fungal spores. Sanitation was being carried out to stop the spread of this disease.

In the Nimrod District Diplodia tip blight was widespread in red pine plantings in section 36 of Lyons Township in Wadena County. These planted areas were part of the area that had sustained major jack pine kill during the 1970's from a combination of the jack pine budworm and drought. As the areas were salvaged, they were replanted to red pine over a five year period. Original plantings were interplanted as planting losses occurred. Branch mortality and top kill as high as 25% of the trees have been observed in these plantings. The surrounding, uncut jack pine probably is the source of the *Sphaeropsis* spores to cause the tip blight and branch dieback.

ASPEN SHOOT BLIGHT

Venturia tremulae Aderh.
Venturia populina (Vuill.) Fabric.

Heavy infections of aspen shoot blight (also called shepherd's crook) were observed in young aspen stands in St. Louis and Itasca Counties. *V.tremulae* infects quaking and bigtooth aspen and *V. populina* infects balsam poplar. The heavy rains and wet weather in May were ideal conditions for infection and disease development. Aspen shoot blight is generally not a serious problem in young stands since straight new leaders usually develop rapidly.

OAK WILT

Ceratocystis fagacearum (Bretz.) Hunt

In Region 5, active oak wilt pockets exist in residential areas in Southeast Rochester. Regionwide known infection centers were checked in O'Brian and Nerstrand Woods State Parks.

OAK DECLINE

A decline of red oak was observed in Itasca County. The oaks are growing on a productive upland site in a mixed hardwood stand with birch, maple, and basswood. The crowns of affected trees showed more that 75% dieback with only a few green leaves on inner branches near the bole and on the bole itself. These stands were defoliated by caterpillars of the fall defoliator complex in 1983 and 1984, hit by severe frost in May of 1985, and infected with Anthracnose disease during the summer of 1985. Mycelial fans of Armillaria mellea were observed on the majority of dead and dying trees that were sampled. The oak wilt fungus was not found in any of the branches that were cultured.

It was suggested that diminished carbohydrate synthesis brought about by defoliation, depletion of carbohydrate reserves brought about by refoliation, and the presence of Armillaria were sufficient to cause the decline.

OAK ANTHACNOSE

Gnomonia quercina Kleb. (Fr.) Ces, & de Not

Rainy weather in May and June produced ideal conditions for the infection and spread of oak anthracnose. White oaks in Aitkin, Itasca, and southern St. Louis Counties were hit the hardest. Many homeowner inquiries were received.

AMERICAN CHESTNUT BLIGHT

Endothia parasitica (Murr.)

In 1984, chestnut blight was reported for the first time in Minnesota. The disease was found in a windbreak of American chestnuts ten miles east of Rochester in Olmsted County. The legal description of this windbreak was section 23, Township 107 North, Range 12 West. In 1985, chestnut trees throughout southeastern Minnesota and in northwestern Iowa. were surveyed for this disease. No additional chestnut blight infections have been found.

The trees at the site east of Rochester contine to decline with most now dead. In 1986 the merchantable volume of chestnut will be harvested. In an effort to avoid spreading the fungus, the trees will be felled and a portable mill on the site will saw the logs into lumber. The bark will be removed and burned.

The fungus found at the Olmsted County site is being studied at the University of Minnesota and the University of West Virginia at Morgantown. All of the isolates obtained to date are a single strain of the fungus. This fact presents a unique opportunity to evaluate hypovirulence as a control strategy.

FROST DAMAGE

Unseasonably warm weather in May induced spruces, firs, and other trees to break bud and begin candling. Severe frosts in late May killed the candles on young conifers in Koochiching, Itasca, St. Louis, and Carlton Counties. At the white spruce seed orchard near Cotton, more than 50% of the developing cones were killed by frost. Frost damage was also noted on black ash in Region 2.

.....SPECIAL STUDIES AND SURVEYS.....

NURSERY OPERATIONS

In order to preempt the potential buildup of Lophodermium needlecast disease in hard pines nursery stock, late summer and fall sprays of chlorothalonil were conducted in the General Andrews and Badoura State Nurseries in 1984. Checks of the treated beds during the 1985 growing season indicated no disease buildup.

Test studies on the control of pine-oak gall rust and Dipodia tip blight continued at the General Andrews Nursery. No new infections were detected in 1985.

Direct control operations were conducted in 1985 to protect pine stock from jackpine budworm defoliation in beds adjacent to heavily infested windrows.

The open winter of 1984-85 resulted in widespread winterburn to exposed tips of nursery stock. While little mortality occurred, much of the spruce stock was culled to avoid sales' complaints.

Other problems encountered were deer damage, frost heaving in 1-0 spruce beds, and fertilizer burn on succulent tissue.

SEED ORCHARD SURVEY

Surveys of grafted white and black spruce at the Sturgeon Lake site, 16-45-21, detected the following pests:

Cooley spruce gall aphid (Adelges cooleyi (Gill.)): Light occurence

Frost: Moderate damage

Yellow-headed spruce sawfly (Pikonema alaskensis (Rohwer)): Light feeding

Needle rust (Chrysomyxa spp.): Light occurence

CONE PEST STUDIES - COTTON, MN

Cone production at the seed orchard was poor in 1985 despite a bumper crop of cones produced in 1984. The number of seed producing cones were further reduced by two late season frosts on May 21 and June 3. The majority of trees lost all of their female conelets and had frost damage to the new vegetative growth.

The entire surviving cone crop (n=400) was picked in August to prevent the cones and their pests from overwintering in the orchard. Two hundred and eighty-one cones were dissected to determine the incidence of cone pests.

The results of the cone dissection are as follows:

	INCIDENCE
Totally healthy:	42%
Spruce budworm damaged:	26%
Other insects:	13%
Frost damage*	14%
Pucciniastrum rust:	5%
Chrysomyxa rust:	0

* = Cones that initially appeared to survive the frosts later dried out and became shriveled.

Cone damage due to insects has remained fairly constant at about 40% over the past 5 years. The incidence of cone rust plummeted in 1985 to 5% and only Pucciniastrum infected cones could be found. We don't know why Chrysomyxa infected cones were not found. Perhaps Chrysomyxa spores infected cones earlier, and they were lost due to frost. The frost damage on the cones may have prevented the Chrysomyxa infections to progress to the point of causing cone rust. Four more clumps of systemically-infected Pyrola plants were found nearby; so, it appears that there were enough spores in the vicinity to infect the conelets.

Cones were also ranked as "good" or "no good" for seed production. The "no good" rating was made on 58% of the cones which compares closely to the 60% rating in 1984. Despite the similar ratings, it must be remembered that 14% of the "no good" rating was due to abiotic (frost) causes; whereas, in 1984 all losses were from biotic causes (insects and diseases).

Inoculation experiments were conducted in 1985 to verify the species of Pucciniastrum rust in the white spruce seed orchard. There was confusion between P. americanum and P. arctium as to which species was present in the orchard based on spore and pustule morphology since they both infect Rubus spp. We sought to clarify the situation by inoculating red raspberry leaves with the aeciospores produced on spruce needles and cones. If Pucciniastrum urediospores are produced, then P. americanum spores were the inoculum, not P. arctium since red raspberry, Rubus idaeus, is the alternate host for P. americanum.

The common species of raspberry found around the seed orchard is Rubus strigosus. R. strigosus and R. idaeus are very closely related species, and some taxonomists frequently label R. strigosus as a subspecies of R. idaeus. Aeciospores from infected cones and needles were inoculated onto R. strigosus leaves. Both primocane and floricane leaves produced abundant uredia and urediospores. The conclusion was that the species of Pucciniastrum infecting the cones in the seed orchard was P. americanum. Dr. Y. Hiratsuka, rust research scientist at the Northern Forest Research Centre in Edmonton, Alberta, has confirmed this identification.

Determining that P. americanum was the species of rust involved, told us that the raspberry in and around the seed orchard was the alternate host for this rust fungus and contributed to the losses due to this rust. Garlon herbicide at the rate of 1½ quarts per acre was applied to the seed orchard to kill the raspberry with the objective of reducing the rust infections in 1986.

Three fungicide trials using Ferbam, Bravo 500, and Bayleton were continued in 1985. These trials were attempted to establish fungicide recommendations for controlling cone rusts. Trees were treated from May 6 to May 26 and applied as directed by the label. Frosts after the applications destroyed 65% of the cone crop and only limited data could be collected. Four pairs of treatments and controls were salvaged for each of the three fungicide treatments. Using the t-test for pairs, there was not a significant difference between treated and control cone infections for any individual fungicides. Looking at all of the treated cones (n=144) versus all of the control, non-treated cones (n=100), treated cones had 0% rust infections and non-treated cones had 7% infections. It appears that the treatments were somewhat effective; however, the low levels of rust infection and the small number of developed cones resulted in a difference which can not be construed as significant.

GYPSY MOTH HAZARD RATING

In an effort to prepare a long range management plan for the gypsy moth in Minnesota, a pilot study has been initiated in southeastern Minnesota to determine acceptable methods to risk and hazard rate hardwood stands for gypsy moth.

Two popular concepts in predicting the gypsy moth threat are risk rating and hazard rating. Risk rating involves determining those stands likely to harbor outbreak numbers and sustain some form of annual defoliation. Hazard rating deals with predicting the amount of mortality, and where it will occur. In short, risk rating asks where will the outbreaks occur and hazard rating asks where the mortality takes place. The two do not always coincide in the same stands. In fact, records show that high risk stands are often located on dry, westerly aspects with a low site index while high hazard stands are frequently those on good growing sites which are infrequently distrubed.

Present plans include using a computerized geographical information system (G.I.S.) to risk rate state forests in several townships. The G.I.S. can be used to locate those stands consisting of oak species on westerly aspects and ridgetops, i.e. high risk stands. Also, risk and

hazard rating will be conducted in the field. Data collected from stands as delineated by Phase II inventory maps will be input into equations which produce numerical values describing the susceptibility (risk) and vulnerability (hazard) of each stand. These values can then be compared with existing Phase II inventory data, such as site index, to determine any correlations that might prove useful for future risk/hazard evaluations.

RED RIVER ELM RESOURCE AND DUTCH ELM DISEASE STUDY

In response to industry inquiries, a cooperative survey project involving the MN DNR and the North Dakota Forest Service was conducted along the Red River separating the two states. The industry was concerned with how long the elm resource would exist and how much elm resource is present along both sides of the Red River.

The objectives of the cooperative project were:

1. To determine the impact of Dutch elm disease and other major insect and disease problems;

2. To determine acres and volumes of commercial woodlands;

3. To determine the condition and location of downed trees and slash impacting the waterways; and

4. To determine where harvesting has occurred in order to target reforestation efforts.

To meet these objectives, 35 mm aerial photography of the Red River corridor was conducted during August, and follow-up ground checking of selected stands was under-taken during late summer and early fall. The aerial photography was done with color IR film with the hope that this kind of photography would be better for locating diseased and dead elms. The follow-up ground survey was designed to measure pockets of elm disease and/or mortality as well as estimate volume of timber throughout the woodlot.

In late June, a test area south of Fargo was photographed and ground checked to determine whether or not the combination of color IR aerial photography and groundchecking the DED pockets would be able to meet the objectives. The photographs were clear and sharp enough to pick out individual trees and to see trees that were dead (no leaves) and trees which were experiencing leaf color change. Type mapping could not be done from the summer color IR photography because the tree species were not differentiated. Areas of elm or individual healthy elms also could not be identified. Inferences based on topography and experience did allow some general typing to be done.

The pattern of diseased and dead elms was not what was expected. There were no discreet, discernible pockets of dead and diseased elms. Rather, dead and diseased elms were scattered throughout the woodlots, except on the highest benches next to the fields. These areas were normally dominated by bur oak. The majority of the elm was located on on the lowest bench next to the river (the floodway) and on the slope immediately above the floodway. Active DED and elm mortality were not

confined to a pocket pattern, but infections and mortality were scattered throught the elm areas. Because discreet pockets were not found, an objective to measure DED spread by measuring disease pocket increase could not be done.

Rather than picking out pockets of infection, woodlots were chosen at random and cruised. Variable plot cruising was used, and the information collected included DBH, merchantable heights, site index, growth, tree grade, tree condition, tree defects and causes, an estimate of years since tree death, reproduction species and densities, and ground cover species and densities. Woodlots were chosen for cruising by selecting the first 20-acre or larger woodlot north of the southern township line. Seventeen woodlots were selected in Minnesota, and 14 woodlots were selected in North Dakota.

As part of the test conducted south of Fargo, three woodlots were ground checked. Two of the woodlots were in Minnesota, and one was in North Dakota. All 3 woodlots had been logged to some degree, and the woodlots in Minnesota had been high graded with only the choice elms removed. In one of the Minnesota woodlots 31% of the trees were elm, 33% of those elms were infected, and 5% were dead within one year. In the other woodlot, only 19% of the trees were elm, 7% infected, and no dead elm were found on the survey. The other major insect and disease problem found was heart rot in green ash. A combined average of 27% of the ash on both plots had Fomes fraxinophilus conks on the main boles.

MINOR AND INCIDENTAL PESTS ENCOUNTERED

INSECTS

COMMON NAME	SCIENTIFIC NAME	HOST
Arborvitae needle miner	*Argyresthia* sp.	Arborvitae
Bark Beetles	*Ips pini* Say	Pines
Birch borers	*Agrilus anxius* Gory	Paper birch
Carpenter ants	*Camponotus pennsylvanicus* (DeGeer)	Pine
Fall webworm	*Hyphantria cunea* (Drury)	Mixed hardwoods
Flatheaded woodborer	*Chalcophora* sp.	Lumber
Maple petiole borer	*Caulocampus acericaulis* (MacGillivray)	Maple
Mountain ash sawfly	*Pristiophora geniculata* (Hartig)	Mountain ash
Northern pine weevil	*Pissodes approximatus* Hopkins	Red pine
Orangestriped oakworm	*Anisota senatoria* (JE Smith)	Mixed hardwoods
Pine bark aphid	*Pineus strobi* (Htg.)	White pine
Pine tip moth	*Rhyacionia adana* Heinrich	Red pine
Redheaded pine sawfly	*Neodiprion lecontei* (Fitch)	Blue/White spruce
Red-humped caterpillar	*Schizura concinna* (JE Smith)	Mixed hardwoods
Root collar weevil	*Hylobius radicis* Buchanan	Red pine
Scale	*Lecanium* sp.	Oak
Spiny elm caterpillar	*Nymphalis antiopa* (Linnaeus)	Willow
Spring Cankerworm	*Paleacrita vernata* (Peck)	Elm/Mixed hardwoods
Spruce gall midge	*Mayetiola piceae* (Felt)	White spruce

Spruce needle miners	Epinotia nanana (Treit.)	White spruce
	Taniva abolineana (Kft.)	White spruce
Spruce false looper	Syngrapha alias (Orrol.)	Jack pine
White pine weevil	Pissodes strobi (Peck)	White and jack pines
Zimmerman pine moth	Dioryctria zimmermani (Grote)	White pine

MINOR AND INCIDENTAL PESTS ENCOUNTERED

DISEASES

COMMON NAME	SCIENTIFIC NAME	HOST
Bacterial canker	Pseudomonas syringe	Cherry
Cytospora canker	Cytospora kunzei Sacc.	White spruce
Dutch elm disease	Ceratocystis ulmi (Buism) C. Mor	Elm
Fusarium blight	Fusarium spp.	White pine balsam fir
Flooding		Birch
Herbicide damage		Red pine white spruce
Maple anthracnose	Gloeosporium spp.	Maple
Maple decline		Sugar maple
Molding (containers)	Botrytis cinerea Pers, ex. Fr.	Jack pine
Needlecasts	Lophodermium spp. Rhizosphaera kalkhoffii Bud. Cyclaneusma minus Lirula macrospora (Hartig)Dark. Phaeocryptus gaummanni (Rohde) Petrak	Red pine Blue spruce Scots pine White spruce Douglas Fir
Nematodes and Fusarium spp.		Red pine
Physiological damage		Blue spruce
Root compaction		Red pine basswood
Root rot	Armillaria mellea Vahl. Cylindrocarpon didymum (Hartung) Wr.	Red pine Red pine
Smooth patch	Corticium spp.	Green ash
Spruce decline		Black Hills Blue/white

Spruce needle rust	Chrysomyxa spp.	White spruce
Storage molds	Phytophthora spp. Pythium spp. Rhizopus spp. Mucoraceae	Fungi over-wintering in storage containers
Walnut canker	Fusarium sporotrichioides	Black walnut
WP Blister rust	Cronartium ribicola Fisch.	White pine