

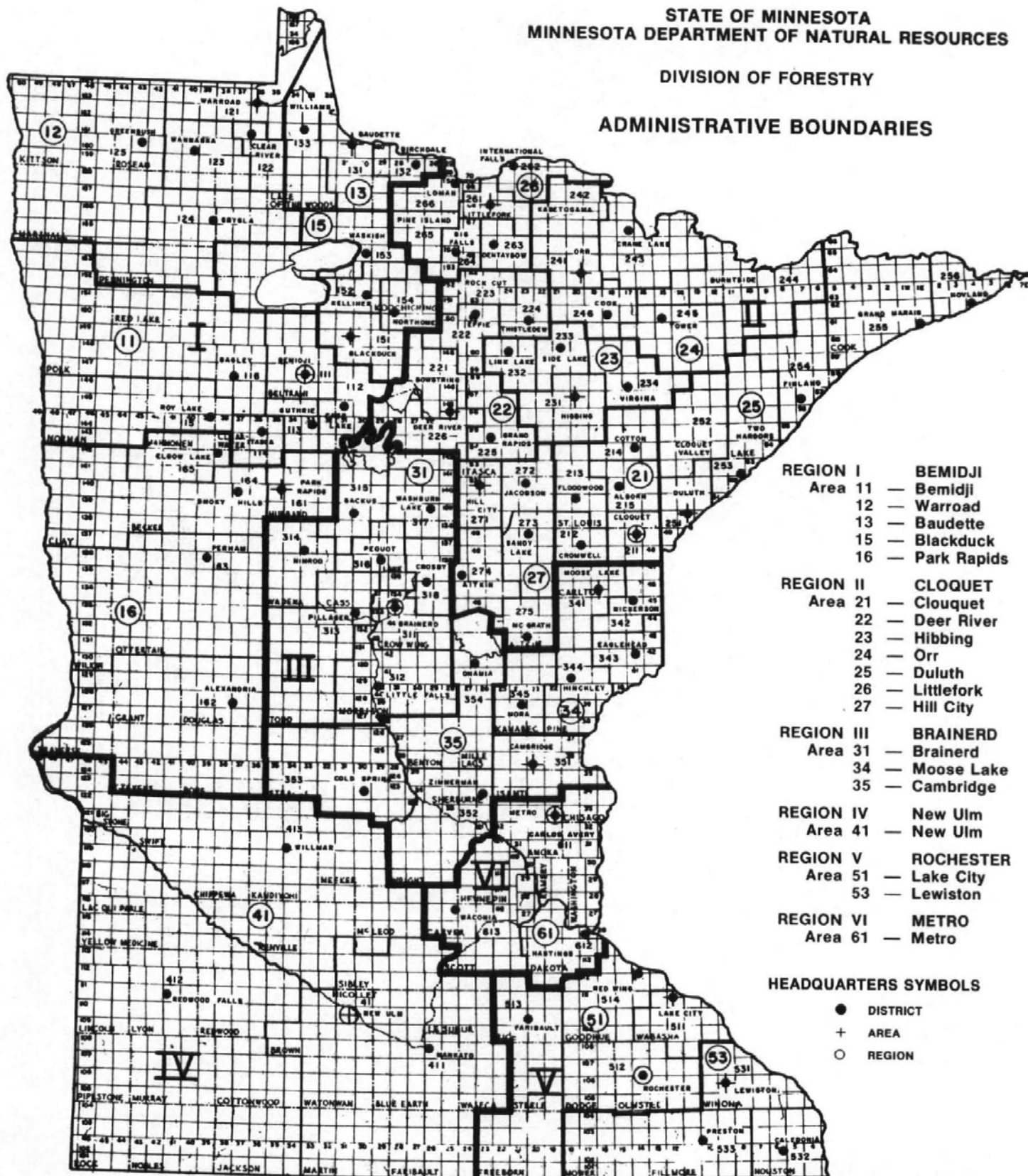
**1977
FOREST PEST REPORT**

**MINNESOTA
DEPARTMENT OF NATURAL RESOURCES**

STATE OF MINNESOTA
MINNESOTA DEPARTMENT OF NATURAL RESOURCES

DIVISION OF FORESTRY

ADMINISTRATIVE BOUNDARIES



- REGION I** **BEMIDJI**
Area 11 — Bemidji
12 — Warroad
13 — Baudette
15 — Blackduck
16 — Park Rapids
- REGION II** **CLOQUET**
Area 21 — Clouquet
22 — Deer River
23 — Hibbing
24 — Orr
25 — Duluth
26 — Littlefork
27 — Hill City
- REGION III** **BRAINERD**
Area 31 — Brainerd
34 — Moose Lake
35 — Cambridge
- REGION IV** **New Ulm**
Area 41 — New Ulm
- REGION V** **ROCHESTER**
Area 51 — Lake City
53 — Lewiston
- REGION VI** **METRO**
Area 61 — Metro

- HEADQUARTERS SYMBOLS**
- DISTRICT
 - + AREA
 - REGION

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JACK PINE BUDWORM DEFOLIATION 1977

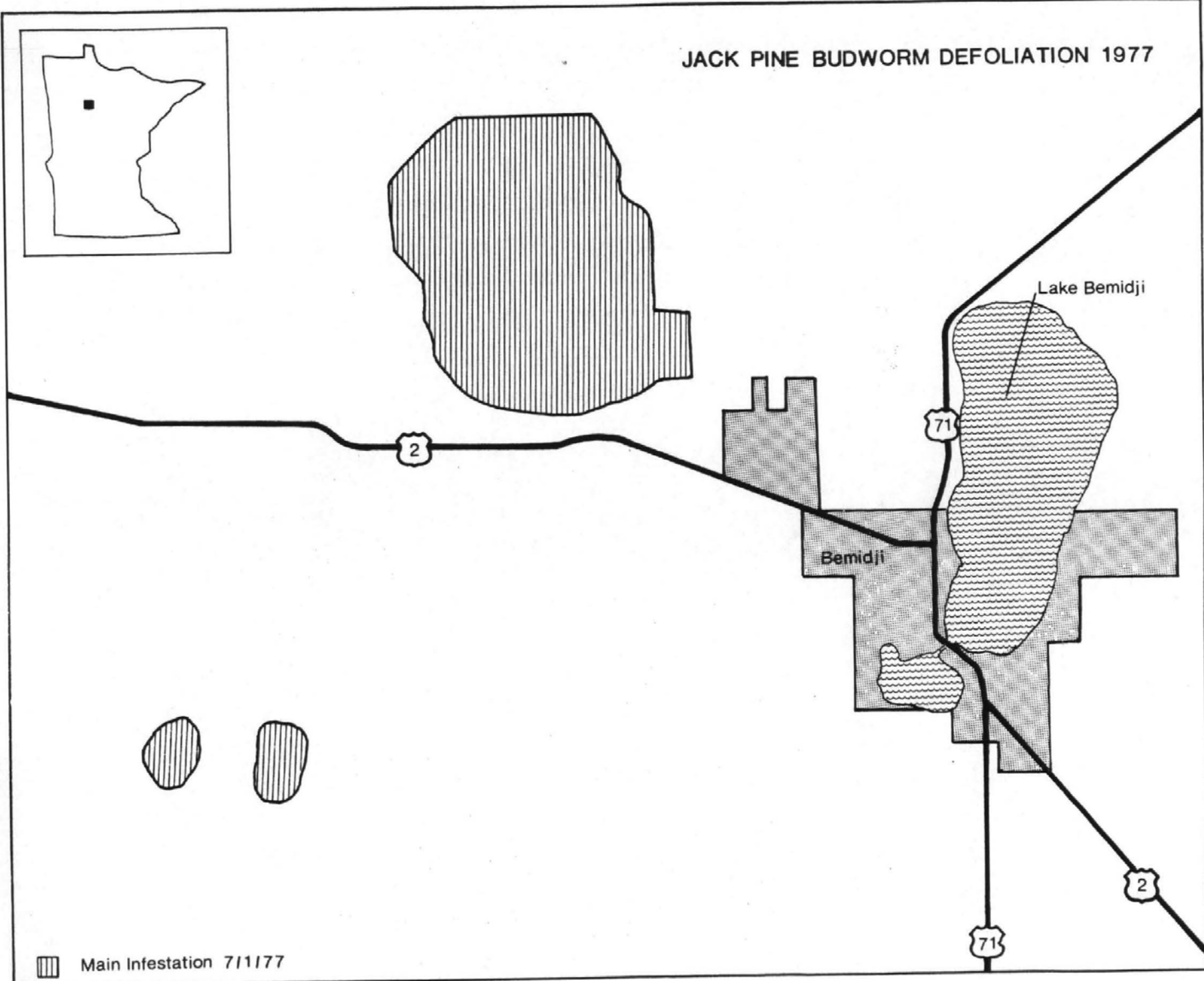


Figure 1
- IV -

Main Infestation 711177

Jack Pine Budworm — *Choristoneura pinus*
(Freeman)

The jack pine budworm had been at low ebb for several years until in 1976 a heavy defoliation of about 5000 acres of jack pine took place in the Beltrami Island State Forest in Roseau County. This infestation collapsed in that same year. Subsequent checks in 1977 indicated that a low level, endemic population is present. No major defoliation is expected in 1978 within this area.

Another area of approximately 6000 acres west of Bemidji was defoliated in 1977. This outbreak was intensively studied.

The outbreak occurred in Eckles Township (T. 147 N, R. 34 W.) and in Jones Township (T. 146 N, R. 35W.) in Beltrami County. (See Figure 1) The Eckles Township outbreak was the larger of the two, covering a 30-section area and including approximately 6,537 acres of pure to predominantly pure merchantable jack pine. The ownership in Eckles Township is divided among state (10%), county (35%), and private (37%). The county-owned jack pine is dominated by the 40 to 49 year age class, the predominant site index range between 45 and 58. The defoliated area in Jones Township covers a 5-section area.

In August an egg mass survey was undertaken in Eckles Township to evaluate budworm population trends and to determine if direct control measures would be necessary in 1978. Results (See Table 1 and 2) of this survey showed that the budworm has successfully laid eggs in the defoliated area as well as in the nondefoliated areas adjacent to and surrounding the defoliated area. The average number of egg masses per branch in the defoliated area was .41, and in the adjacent areas .52 which was significantly higher at the 5% level. The highest average egg mass count was found in an area southeast of the main defoliated area. This count averaged 1.2 egg masses per branch.

Budworm studies in Wisconsin (2) indicate that the numbers of egg masses found within the defoliated area were too low to warrant any direct control measures. This was also true of the adjacent, surrounding areas with the exception of the areas to the southeast. Because no defoliation occurred in 1977 in these areas, no direct control is recommended.

During October a defoliation survey was carried out in Eckles Township to further evaluate the need

for direct control. Eleven hundred trees in sixteen different stands were inspected, placed into crown classes (dominant or codominant), and assigned a defoliation rating based on H.M. Kulman's (1) defoliation classes: light, medium, heavy, and very heavy. Based on a rating of 1.0 for no defoliation, 2.0 for light defoliation, 3.0 for medium defoliation, etc., average defoliation per stand ranged between 1.17 in section 30 and 3.62 in section 9 (See Tables 3 and 4) which was the area of heaviest defoliation. The sample was made up of about 3-1/2 times more codominants than dominants, and no significant difference in defoliation existed between the two classes. In this area, the sections immediately adjacent to it, and in the areas along the roads where the stands are more open, top-killing and mortality from defoliation should be the heaviest. But, generally, top-killing and tree mortality should, at the most, be lightly scattered throughout the defoliated area.

Based on the results of both the egg mass survey and the defoliation survey, no direct control measures were recommended. Indirect control measures, however, were recommended to begin during the winter of 1977-1978. Three measures were recommended as follows: (1) Harvest the merchantable stands in the heavier defoliated areas to reduce the risk of additional mortality due to more budworm defoliation in 1978 and due to secondary insects such as bark beetles invading the weakened trees. (2) Break-up the large uniform jack pine stand by clearcutting blocks or strips within the stand. (3) Do not adhere to the 60 year rotation limit, but accelerate the annual harvest on county-owned lands so that 300 to 500 acres per year are cut, and the entire area is harvested in 10 to 15 years.

LITERATURE CITED

- (1) Kulman, H.M., A.C. Hodson, and D.P. Duncan. 1951. Preliminary observations of an inquiry into the effects of the defoliation of the jack pine by the jack pine budworm. Minnesota Forestry Notes, No. 56, Sci. Jour. Ser. Pap. No. 3715, Minn. Agr. Exp. Sta., 2p.
- (2) Stewart, R.B. 1977. Surveys conducted in northwestern Wisconsin for the jack pine budworm, *Choristoneura pinus* (Freeman) from a paper presented at the Central International Forest Insect and Disease Conference, Duluth, Minnesota.

TABLE 1 EGG MASS SURVEY

Section	# of Trees		# of Branches		# Egg Masses
	# Samples	# Positive	# Samples	# Positive	
Eckles Township T. 147N, R24W					
8	30	19	90	33	48
16	21	13	63	20	33
17	51	24	153	31	43
26	6	6	18	11	23
30	21	16	63	29	39
36	12	12	36	21	39
Lammers Township — 147N, R35W					
2	9	5	27	7	8
11	21	11	63	19	33
Township - T.147 N, R35W					
16	24	10	52	14	15
23	30	17	90	23	29

TABLE 2 SUMMARY

Section	% Trees Positive	% Branches Positive	EM/Branch	EM/Tree
Eckles Township T. 147N, R24W				
8	63.3	36.7	0.5	1.6
16	61.9	31.7	0.5	1.6
17	47.1	20.3	0.3	0.8
26	100.0	61.1	1.3	3.8
30	76.2	46.0	0.6	1.9
36	100.0	58.3	1.1	3.3
Lammers Township T. 147N, R.35W				
2	55.5	25.9	0.3	0.8
11	52.4	30.2	0.5	1.6
Jones Township T. 146N, R.35W				
16	42	27	.3	.6
23	57	25	.3	1.0

TABLE 3

DEFOLIATION SURVEY SUMMARY

Eckles Township T. 147N, R.34W

Section	# of Trees	Defoliation Rating													Ave. Defol.
		Dominant							Codominant						
		Total	Dom	Cod	O	L	M	H	VH	O	L	M	H	VH	
2	40	9	31	7	2	—	—	—	26	5	—	—	—	1.175	
4	65	13	52	1	9	2	1	—	4	30	12	6	—	2.35	
7	85	17	68	10	4	2	1	—	50	13	3	2	—	1.42	
8	75	27	48	—	22	3	2	—	—	33	10	3	2	2.39	
9	50	13	37	—	1	4	3	5	—	6	12	11	8	3.62	
10	60	9	51	—	5	2	—	2	—	25	14	8	4	2.83	
10	40	7	33	3	4	—	—	—	10	22	1	—	—	1.675	
11	65	9	56	6	3	—	—	—	37	18	1	—	—	1.37	
15	105	22	83	—	8	8	5	1	1	40	23	13	6	2.82	
16	75	16	59	—	10	2	3	1	—	32	15	7	5	2.73	
17	155	62	93	—	47	15	—	—	—	67	24	2	—	2.29	
18	25	6	19	3	3	—	—	—	11	7	1	—	—	1.48	
19	70	15	55	4	10	1	—	—	18	31	4	2	—	1.81	
21	75	19	56	—	9	7	2	1	—	32	15	8	1	2.60	
26	55	12	43	5	7	—	—	—	21	21	1	—	—	1.54	
30	60	11	49	9	2	—	—	—	41	8	—	—	—	1.17	
TOTALS	1100	267	833	48	146	46	17	10	219	390	136	62	26		

TABLE 4

DEFOLIATION SURVEY — FREQUENCY DISTRIBUTION OF NUMBERS OF DOMINANTS AND CODOMINANTS BY DEFOLIATION RATINGS.

Ratings	Totals	% of Tot.	Tot. Dom.	% Dom.	% Tot.	Tot. Cod.	% Cod.	% Tot.
O	267	24.3	48	18.5	4.4	219	26.0	19.9
L	536	48.7	140	54.0	12.7	396	47.1	36.0
M	183	16.6	46	17.8	4.2	137	16.3	12.5
H	79	7.2	16	6.2	1.4	63	7.5	5.7
VH	35	3.2	9	5.5	0.8	26	3.1	2.4
TOTALS	1100	—	259	—	—	841	—	—

Percentages

23.5

76.5

Other limited areas of defoliation of jack pine were noticed in various parts of the state. It is expected that these areas may continue to develop.

AREA OF SPRUCE BUDWORM DAMAGE

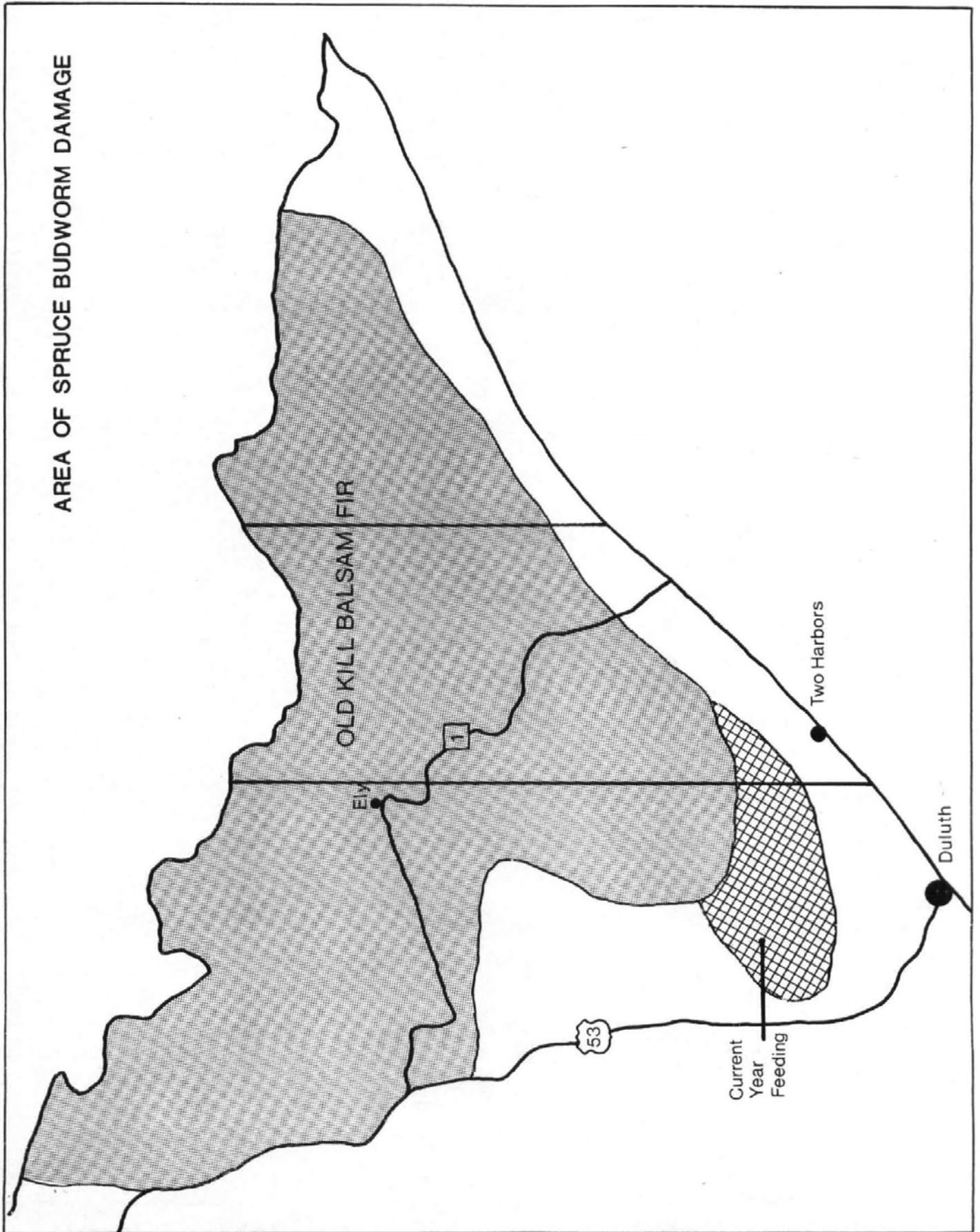


Figure 2

Spruce Budworm - *Choristoneura fumiferana*
(Clemens)

Aerial surveys of spruce budworm activity were not useable because of early cessation of feeding activity and rain and wind reducing the firing effect of dying foliage which determines current year feeding.

Ground surveys indicated that numbers of larvae and the overall area of defoliation were reduced from 1976.

An egg mass survey was conducted in late July and early August. Egg masses were sampled on 26 plots in the infested area. They were concentrated in the area which showed current feeding.

Egg Masses Location of Plot	/15" branch
4-53-14	0.55
3-53-14	0.88
33-55-14	0.88
34-55-14	0.0
1-53-16	2.1
33-54-13	0.1
18-55-10	0.0
36-57-11	0.0
2-55-15	0.0
11-55-13	0.0
30-55-12	0.0
18-54-12	0.4
3-53-16	0.1
4-53-16	0.0
5-54-15	0.0
Manitou State Park	0.1
Cloquet Valley State Forest/North of Island Lake	0.0
Cloquet Valley State Forest/Carroll Forest Road	0.1
Finland State Forest Campgrounds	0.0
Bear Head State Park Plot 1	0.1
Plot 2	0.0
Plot 3	0.2
Plot 4	0.0
Plot 5	0
Plot 6	0.1
25-62-14	0.2

Average # of egg masses/15" branch sample = 0.23. This indicates that the numbers of budworm will continue to decline in 1978. However, the survey was not comprehensive enough for a good 1978 prediction.

Aspen Defoliation

Aerial surveys conducted during early July showed varying degrees of aspen defoliation in Cook, Lake, St. Louis, Koochiching, Itasca, Aitkin and Cass Counties. There was also a large area of heavy defoliation in Lake of the Woods County, as well as scattered areas of lighter defoliation reported from other locations. Many aspens did not re-foliate to the extent which would normally be expected. This may be a result of loss of vigor due to the 1976 drought.

The Forest Tent Caterpillar - *Malacosoma disstria* (Hubner) was found to be the primary cause of defoliation in most areas. Parasitism of larvae and pupae was low with only 15% of sample collections being either parasitised or diseased.

Egg mass surveys show that heavy defoliation can be expected in 1978 in central St. Louis and Lake of the Woods Counties. There will be lower levels in areas throughout the rest of the northern one-half of the state (see figure 3).

**Forest Tent Caterpillar
Egg Mass Survey Locations**

Region I		Number EM/3 trees	Avg. DBH	Predicted Defoliation
Description				
26-141-32		0	4	—
9-140-34		.3	4	L
31-155-29		.6	5	L
9-160-29		1.3	4	L
16-160-32		33	—	VH
23-162-33		6.6	4	M
34-162-36		60	4	VH
1-157-31		4	4	L
21-145-32		0	4	—
28-144-34		0	—	—
17-132-40		0	3	—
36-133-37		.6	3	L
19-147-34		0	5	—
13-149-30		0	3	—
29-151-28		0	5	—
REGION II				
17-54-12		2	3	L
9-53-14		17	5	H
35-54-16		3	4	L
34-57-15		1	3	L
35-59-15		10	3	H
36-61-12		5.6	3	M
17-62-14		6.6	3	M
12-61-17		20	4	H
33-62-16		13	3	H
29-63-18		0	3	—
4-63-17		2	3	L
3-63-20		0	3	—
16-63-22		0	3	—
17-45-23		.3	3	L
13-50-24		.3	2	L
36-52-21		.6	3	L
26-53-21		6.3	4	M
13-57-21		0	6	—
Description		Number EM/3 trees	Avg. DBH	Predicted Defoliation
3-59-24		0	5	—
16-61-21		0	—	—
34-60-21		1.6	3	L
10-57-21		0	5	—
3-68-23		0	4	—
4-68-21		0	3	—
22-66-20		.3	3	L
24-65-18		.6	3	L
36-56-19		5	3	M
19-54-19		4.3	3	M
20-45-25		0	4	—
34-48-26		0	3	—
31-70-25		.6	4	L
30-54-25		.6	3	L
11-62-22		0	4	—

continued on Page 7

PREDICTED DEFOLIATION 1978 FOREST TENT CATERPILLAR

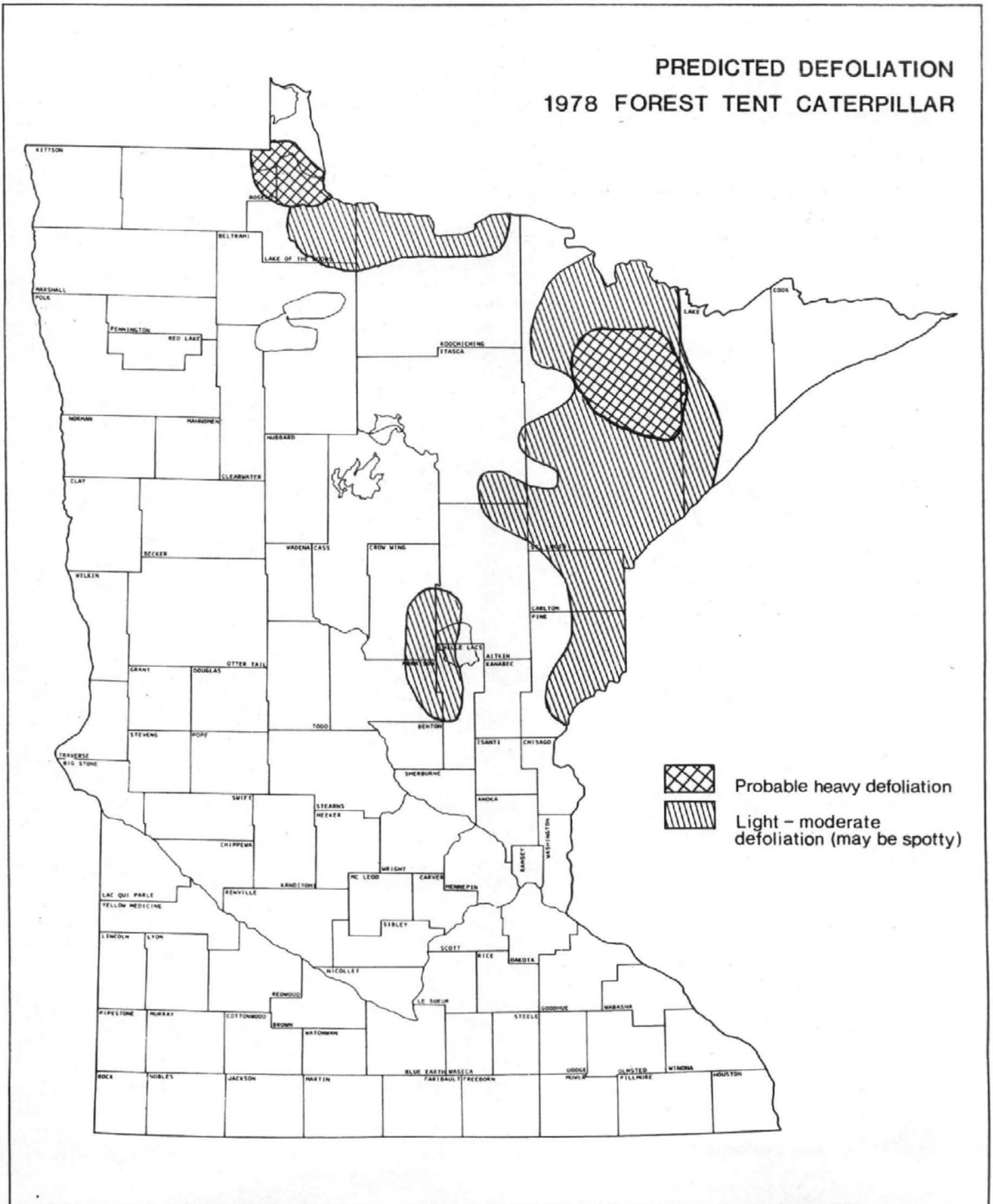


Figure 3

Region II (continued from Page 5)

Description	Number EM/3 trees	Avg. DBH	Predicted Defoliation
24-68-25	0	3	—
7-68-26	0	2	—
36-70-27	.6	5	L
1-65-27	.6	5	L
14-51-26	0	4	—
23-70-24	.3	3	L
10-62-27	0	3	—
Chippewa N.F. 9 Plots — O EM — O Defoliation			
27-57-12	32	6	VH
12-56-11	1	7	L
32-60-10	.3	4	L
19-60-18	.6	3	L
6-65-16	1	L	—
35-65-13	.6	5	L
13-61-13	24	3	H
2-59-8	0	4	—
35-61-8	0	4	—
8-62-1E	0	3	—
7-60-4	0	4	—
4-53-18	1	3	L
4-51-17	6	3	M

REGION III

Description	EM/3 Trees	Avg. DBH	Predicted Defoliation
33-135-30	0	8	—
12-135-31	0	6	—
5-133-33	0	6	—
13-136-35	.6	8	L
33-139-31	4.6	7	L
15-140-28	0	7	—
29-45-29	2.6	6	L
23-140-26	1.6	8	L
24-136-27	1.3	5	L
3-46-28	3.6	6	L
8-42-27	6.6	7	L
36-39-20	.6	5	L
8-10-18	1.3	7	L
16-43-19	.3	6	L
1-44-20	0	6	—

With VH defoliation everything (Hardwoods) except Red Maple will be stripped clean. L will be just noticeable depending on degree, while M and H will grade in between.

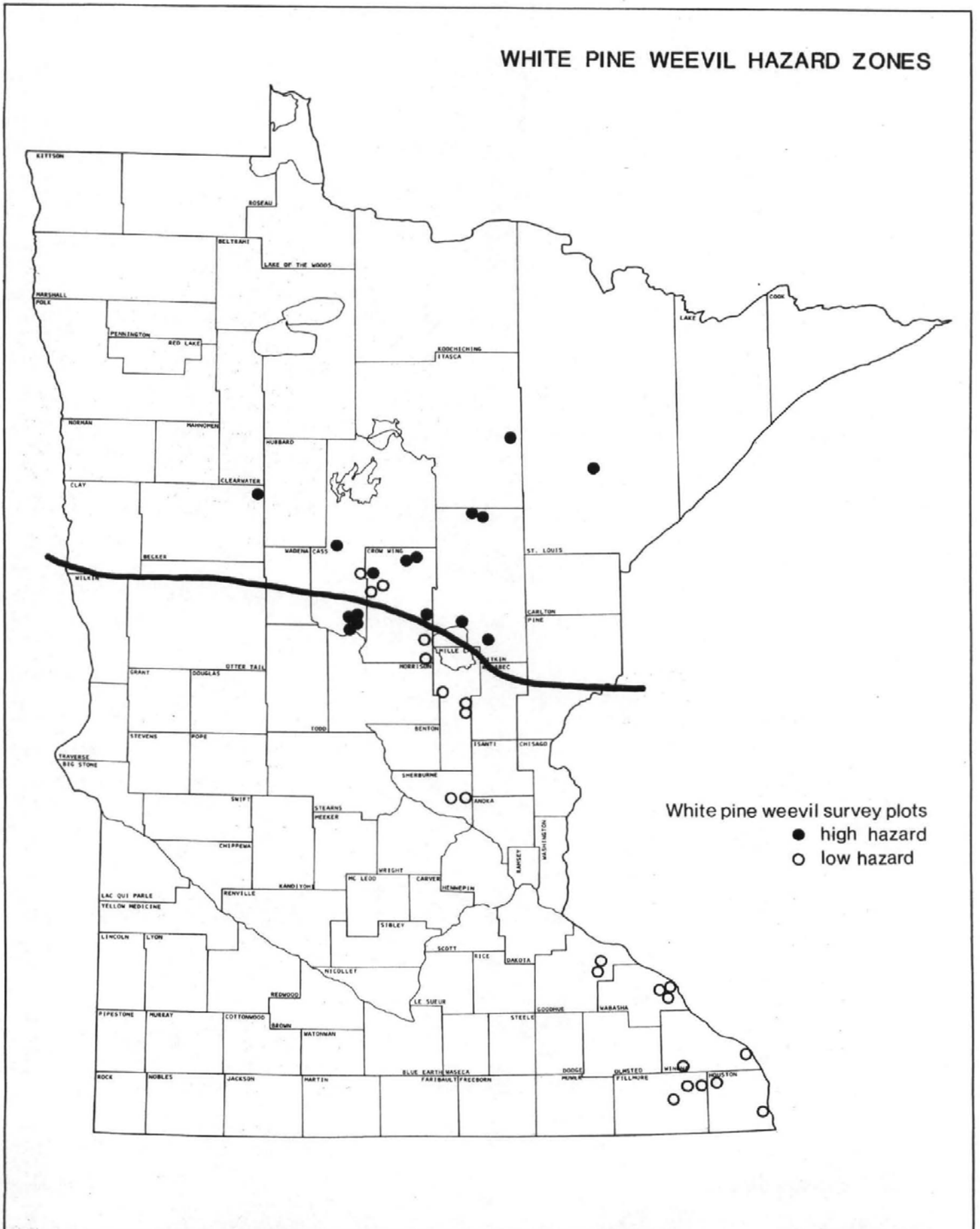
The Large Aspen Tortrix *Choristoneura conflictana* (Walker) and another unidentified tortricid were the primary cause of aspen defoliation in Cook County. Populations of both were very low in other locations.

Populations of the Aspen Leaf Tierer - *Enargia decolor* (Walker) rose over those of 1976. The insect appeared commonly in Carlton and west central and southern St. Louis Counties. It was the major defoliator in northwest Aitkin and southeast Itasca Counties.

Hail caused defoliation of oak, maple and willow as well as understory hazel brush northwest of Jacobson in early June.

The Aspen Blotch Miner — *Lithocolletis tremulodiella* (Braun) was abundant in Carlton, Aitkin, southeast Itasca, St. Louis, Lake and Cook Counties especially on younger trees.

WHITE PINE WEEVIL HAZARD ZONES



White pine weevil survey plots
 ● high hazard
 ○ low hazard

Figure 5

Yellow-headed spruce sawfly — *Pikonema alaskensis* (Rohwer).

Populations again were very high especially in Itasca, Carlton, west St. Louis, and northern Aitkin Counties. Defoliation occurred primarily on white spruce and secondarily on Colorado blue and black spruce throughout the above range from isolated volunteers to ornamentals and plantations. Parasitism did not appear high, weather appeared optimum for development, and with the density and distribution it would appear that we can project high populations again for 1978.

Spruce plantations were field checked in the Hovland, Finland, Cotton, Cloquet, Cromwell, Two Harbors, and Floodwood Districts with no economic level populations occurring on state plantations although moderate to heavy defoliation was noted on privately owned plantations in the Cotton and Cloquet Districts. The Hill City, Jacobson, and McGrath Districts had plantations with heavy defoliation and high mortality. In the Blackduck District scattered defoliation of roadside and private plantations was reported.

1977 Control Applied:

It was necessary to spray a 28 acre plantation in the Side Lake District with Malathion to control populations which had built up over the past few years.

Oak Mortality -

Red Oaks throughout Central Minnesota wilted and died during July and August. Samples for the Oak wilt disease were negative and mortality was thought to be drought caused. Entomologists from the Wisconsin DNR alerted us to check for the presence of the two-lined chestnut borer (*Agilus bilineatus*). A check of dead oaks in the region indicate that this insect is indeed present and killing drought-weakened trees. The larvae girdle the tree by excavating mines throughout the cambium while working down into the main stem. Since this insect has a two-year life cycle, no significant oak mortality is expected in 1978, but with the high populations found in 1977, 1979 may be another bad year, depending upon the success of the previous generation in establishing themselves in oaks that are recovering from drought. Figure 6 illustrates the known distribution of this insect.

Larch Sawfly — *Pristiphora erichsonii* (Hartig)

Light populations were detected throughout Regions I and II with moderate to heavy defoliation

occurring in the following locations in Aitkin County.

Section	Township	Range
21	51	22
15	51	25
9	45	26
34	45	25
1	44	25
9	44	24

Pine Tussock Moth — *Dasychira plagiata* (Walker)

Jack pine area surveys for this insect again resulted in zero populations being detected.

Balsam Fir Sawfly — *Neodiprion abietis* (Harris)

Populations appear to be declining following 1975-76 build-up. Branch firing from larval feeding still observed in Carlton, northern Aitkin, southeastern Itasca, southeastern Cass, and southern St. Louis Counties but with much reduced colonies from those of 1976. Some minor incidence noted in Lake County.

Eastern Tent Caterpillar — *Malacosma americanum* (Fabricius). Was commonly distributed throughout Carlton, Aitkin, and St. Louis Counties defoliating plum, cherry, and junberry. Occasional on aspen and willow. Non-economic.

Fall Webworm — *Hyphantria cunea* (Drury). Light scattered defoliation throughout the northeast on alder and willow. Incidental importance and non-economic.

Bronze Birch Borer — *Agilus anxius* (Gory). Observed adults in birch stands from June 15 through July 15 in Carlton and St. Louis Counties. Abundant in areas having top dieback and likely a contributing factor to unthrifty condition and kill commonly observed in birch in northeast Minnesota.

Birch Leaf Miner — *Fenusa pusilla* (Lepelletier). High populations in Carlton, St. Louis, and Lake Counties especially on ornamental birch planting. Received many inquiries from homeowners relative to control.

Elm Leaf Miner — *Fenusa ulmi* (Sundevall). Mined leaves commonly observed from Malmo to Garrison, Aitkin County, on understory elm.

DISTRIBUTION OF THE TWO-LINED CHESTNUT BORER

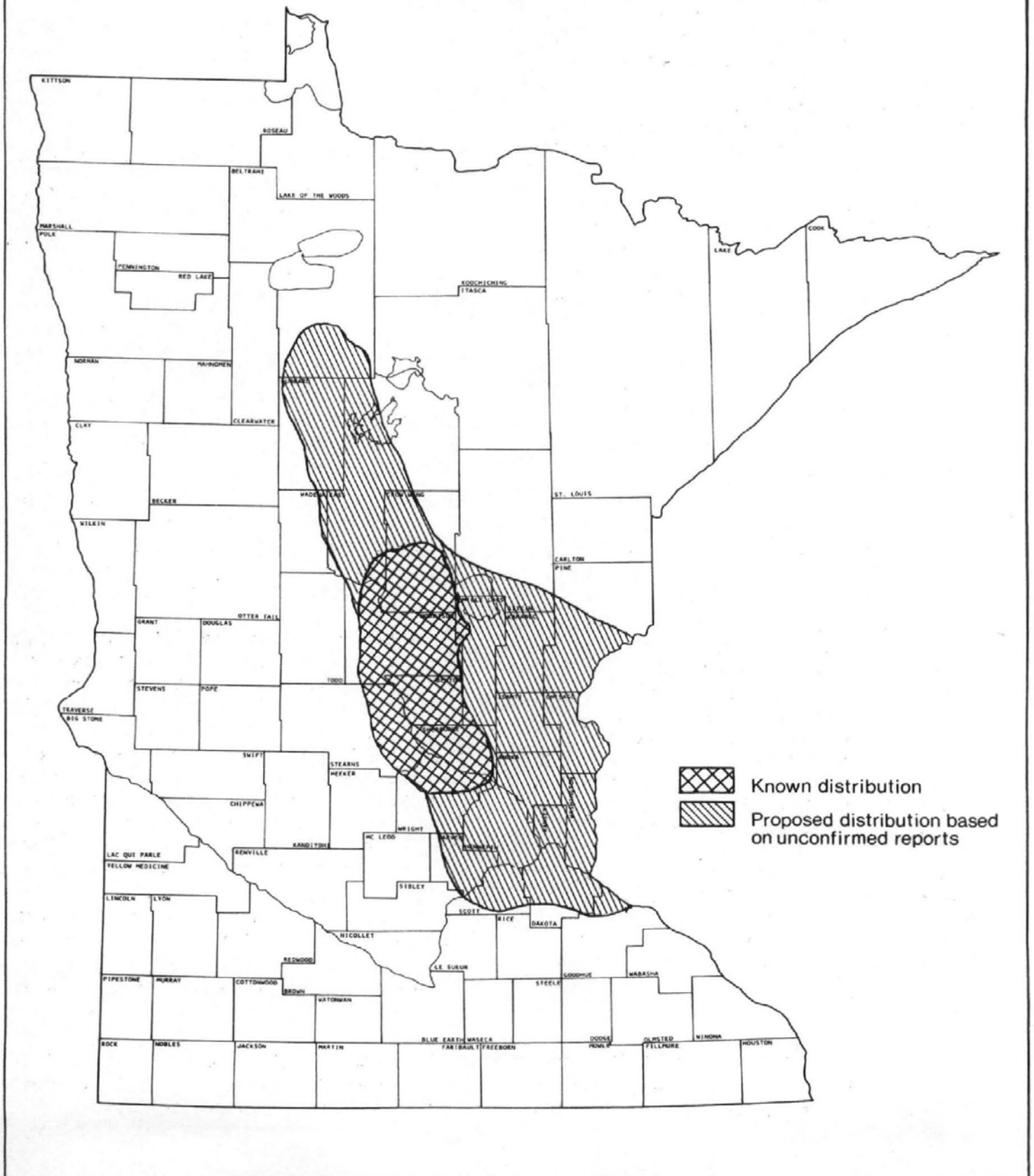


Figure 6

Jack Pine Sawfly — *Neodiprion pratti banksianae* (Rohwer). Low populations with collections from Carlton County, Pine County, and Cloquet Valley Forest in St. Louis County. Incidental importance on open-growing jack pine. Populations of *Neodiprion virginicus* still persisting with collections on open-growing jack pine at various sites in Carlton, St. Louis, and Lake Counties. Non-economic. *Neodiprion maurus* Rohwer collected in Pine County and St. Louis County. Non-economic.

Mountain Ash Sawfly — *Pristiphora geniculata* (Hartig). Populations continue at high levels in St. Louis, Carlton, Cook and Lake Counties with complete defoliation occurring to many understory trees. Non-economic.

Pine Root Collar Weevil — *Hylobius radicis* (Buch)

Scattered mortality in red and Scotch pine was reported due to the Pine Root Collar Weevil in plantations in Regions I and II

Lacebugs — *Corthucha arcuata* (Say)

Were widespread in southern Minnesota especially on Bur Oak, causes leaf browning which the public confuses with Oak wilt.

Spruce Needle Miner — *Taniva albolineana* (Kft.)

Found on ornamental white spruce in Winona County.

Pine Needle Aphid — *Cinara pini* (L) & *Cinara strobi* (Fitch)

Light, widespread infestations.

Ash Twig Borer — *Podosesia syringiae* (Lugger)

Scattered occurrences — causing branch dieback.

Mourning Cloak Butterfly — *Nymphalis antiopa* (Linnaeus). Common throughout Northeast causing branch and terminal defoliation on aspen and willow. Non-economic.

Gypsy Moth — *Lymantria dispar* (Linnaeus)

In 1977, sex lure traps were again placed in many recreational areas to detect any gypsy moths brought into the State by travelers. Again, no moths were picked up in these traps.

Introduced Pine Sawfly — *Diprion similis* (Hartig)

Light, scattered feeding on roadside white pine was observed. A light population was found in a State plantation of mixed red pine and jack pine in the Bemidji

Light, scattered feeding on roadside white pine was observed. A light population was found in a State plantation of mixed red pine and jack pine in

the Bemidji District and a red pine plantation in the Cass Lake District. An unmanaged Scotch pine Christmas tree plantation in the Smokey Hills District was heavily defoliated by the middle of September. No control was undertaken because this plantation was destined to become a potato field.

There was also a report of a heavy second generation defoliation of a white pine plantation in Scott County.

Effects of the 1976 Drought

According to the State Climatologists Office records, the 1976 drought was the most severe in the 60 years that records have been kept. Baker and Kuehnast (1977).

Other droughts occurred in the late 1920's and in the mid 30's. According to Shirley (1930) "Plantations in Minnesota, even as early as 1925 and 1926, sustained losses of 30-50%". The average moisture deficit of stations located in the vicinity of the Chippewa National Forest where this study was conducted was 5.15 inches while for two stations actually on the forest it was 7.0 and 10.9 inches. Drought injury became pronounced in August, 1930, after July and August precipitation was two and three inches, respectively, below the normal for these months. "Herbaceous vegetation died and some of the hardwood trees, particularly aspen and birch, shed a number of their leaves." "Sphagnum moss became almost power dry. The surface of the swamp became so arid that 25 percent of the trees under one inch in diameter breast high were wiped out." "No particular damage to mature trees was noticeable anywhere, but young growth suffered severely. Where forest reproduction was abundant on uplands, large brown patches with occasional green trees interspersed could be observed. Injury was generally well distributed but tended to be more severe on knolls and other opposed situations."

In 1934, 40 percent of all trees in Minnesota's shelterbelts, mostly boxelder, willow, green ash, silver maple, and cottonwood were considered dead or dying. The chief cause was lack of sufficient available water. Albertson and Weaver (1945).

In 1976, symptoms were similar. Approximately 16,000 acres of over-age jack pine in northeastern Minnesota from Ely to Crane Lake suffered severe damage. About 20% of the stands died.

On sandy soils, many conifers of all ages died or were weakened to the point where bark beetles became a problem.

On shallow soils many understory trees, especially

AREAS OF MOST DROUGHT AFFECTED 1967/1972/1976 PLANTATIONS

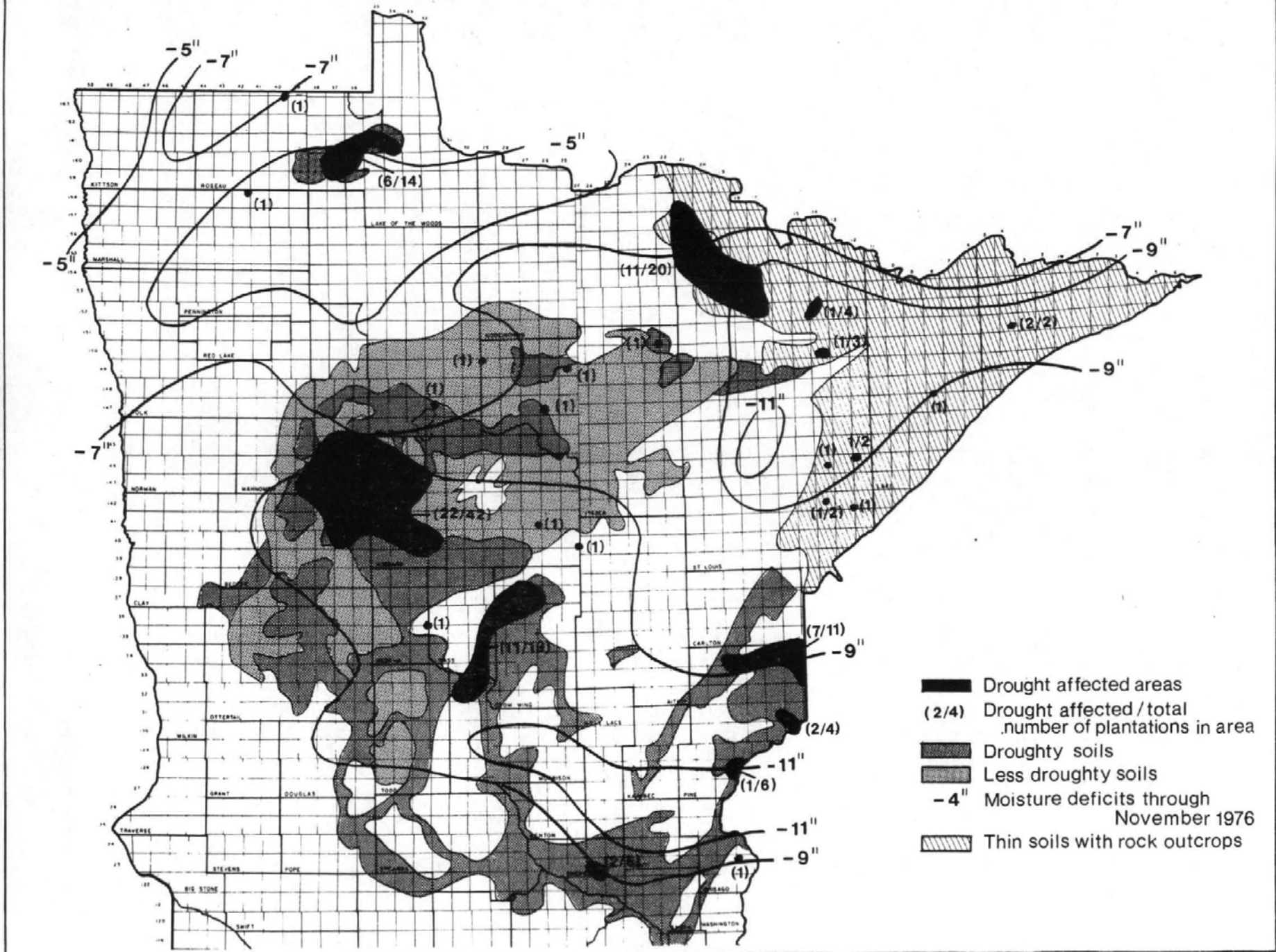


Figure 7

white pine, balsam fir and white cedar on rock out-crops, died.

In order to get an indication of the effect of the drought on young state plantations, a survey was carried out in selected plantations. On each, two hundred trees were checked closely for drought kill.

In Region I, in most plantations checked, most mortality was thought to be due to competition or animal damage.



Understory killed by drought on rock out crop in northeastern Minnesota.

The figures for Regions II and III follow:

Region II

Location	Year Planted	% Drought Mortality	Location	Year Planted	% Drought Mortality
36-55-13	1976	28	29-49-16	1974	7.5
16-53-12	1976	28	36-56-12	1974	6
16-55-14	1976	20	5-61-23	1974	7
34-64-4E	1976	24	32-60-25	1974	12
16-60-24	1976	7.5	12-147-27	1974	0
16-65-19	1975	20	3-55-14	1974	0
35-62-23	1975	30	36-63-21	1974	0
36-60-25	1975	10	16-60-18	1974	8
4-63-19	1975	28	34-52-17	1974	0
36-146-25	1975	8	26/35-66-19	1973	14
21-145-27	1975	16	29-62-24	1973	8
19-60-20	1975	27	16-65-24	1973	19
15-51-24	1975	2	16-57-16	1973	5
26-49-20	1975	1		1973	0

Region III

Location	Year Planted	% Drought Mortality	Location	Year Planted	% Drought Mortality
9-132-30	1975	95	21-137-28	1975	95
29-132-30	1976	45	16-136-29	1975	60
20-132-30	1976	80	8-137-29	1975	95
16-132-30	1975	95	2-130-30	1975	90
36-45-20	1976	80	18-39-19	1976	80
1-44-20	1974	15	29-34-27	1975	66
18-138-33	1973	57	17-34-27	1976	95
36-137-29	1975	95	6-44-19	1975	85
16-44-28	1976	95	5-44-19	1974	95
16-135-28	1975	65	24-45-20	1974	90
16-135-28	1975	50	31-45-19	1975	95

Very little drought related mortality was observed in Regions IV and V. Hardwood species, especially birch and maple, did show smaller foliage, marginal

scorch, thinner crowns, and some top-dieback.

Cores removed from various hardwood species in November in Region V did not indicate any substan-

tial change in growth rate. The following species were sampled: red oak, bur oak, cottonwood, basswood, ash and elm. Cottonwood, ash and basswood showed more reduction than the oaks.

Another source of information on the effects of the drought were comments made on many plantation survival survey reports conducted in 1977. In many cases, comments were made attributing a plantation

failure (less than 30% stocking) or a poorly stocked plantation with 30-60% stocking, directly to the drought.

The following tabulation shows the number of plantations and the acres involved which were described this way. It is probable that many areas where no comments were made still suffered considerable drought damage.

Area	YEAR PLANTED 1976			YEAR PLANTED 1966-68			YEAR PLANTED 1971-73		
	Percent Stocking		Checked but no Drought Comments*	Percent Stocking		Checked but no Drought Comments*	Percent Stocking		Checked but no Drought Comments*
	Less Than 30%	30-60%		Less Than 30%	30-60%		Less Than 30%	30-60%	
# acres	# acres	# acres	# acres	# acres	# acres	# acres	# acres	# acres	
11	(10) 177	(1) 15	(7) 168	—	(2) 61	(11) 323	(2) 22	(1) 16	(4) 68
12	(4) 39	(1) 12	(11) 271	—	—	(12) 446	—	(3) 16	(10) 345
13	—	—	(4) 75	—	—	(4) 211	—	—	(5) 70
15	—	—	(12) 165	—	—	(13) 255	—	—	(9) 140
16	(2) 52	(1) 55	(15) 95	—	—	(5) 454	(3) 75	(2) 51	(10) 288
21	—	—	—	—	—	(17) 551	—	(1) 23	(7) 136
22	—	(4) 110	(1) 11	—	—	(9) 379	—	—	(1) —
23	—	—	—	—	—	(5) 232	—	—	(3) 70
24	(4) 88	(2) 27	(6) 165	—	—	—	(2) 26	(3) 101	(9) 235
25	(5) 128	(3) 215	(8) 256	—	—	(20) 930	—	—	(11) 440
31	(5) 25	(6) 109	(6) 307	(1) —	—	(13) 694	(1) 17	(1) 58	(11) 365
34	(2) 172	(2) 98	(4) 72	(1) 14	—	(5) 152	(3) 153	(2) 114	(6) 199
35	(1) 25	(1) 12	—	—	(1) 20	(3) 37	—	—	—

*Many of these plantations showed lower stocking levels but the comments made indicated other than drought, or there were none.

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Eastern Dwarf Mistletoe Control in Black Spruce

Eastern Dwarf Mistletoe — (*Arceuthobium pusillum* (Peck)) is the most serious pest of black spruce in Minnesota. As black spruce is Minnesota's most valuable species (total dollar income), mistletoe is probably our most important forest problem.

During fiscal year 1977, \$18,000 was allocated for dwarf mistletoe (*Arceuthobium pusillum*) control on selected black spruce timber sales. This money was used to cut residual spruce on clear cuts (see illustration). Removing these trees will hopefully greatly reduce the incidence of mistletoe in infected

stands. This treatment will enable a commercial stand of spruce to develop on sites that might have otherwise been lost because of mistletoe-caused damage. This practice is now becoming a standard timber sale practice.

Practical limits had to be put on the minimum size tree to be cut. Thus, all trees five or more feet in height were cut. This eliminated almost all of the infected residual stems. Most importantly it eliminated all of the taller trees. Mistletoe infections occurring high up in residual trees can disperse the seed in a long distance and infect a great deal of the young regeneration.

cross-section of a black spruce clearcut with mistletoe infected residual trees

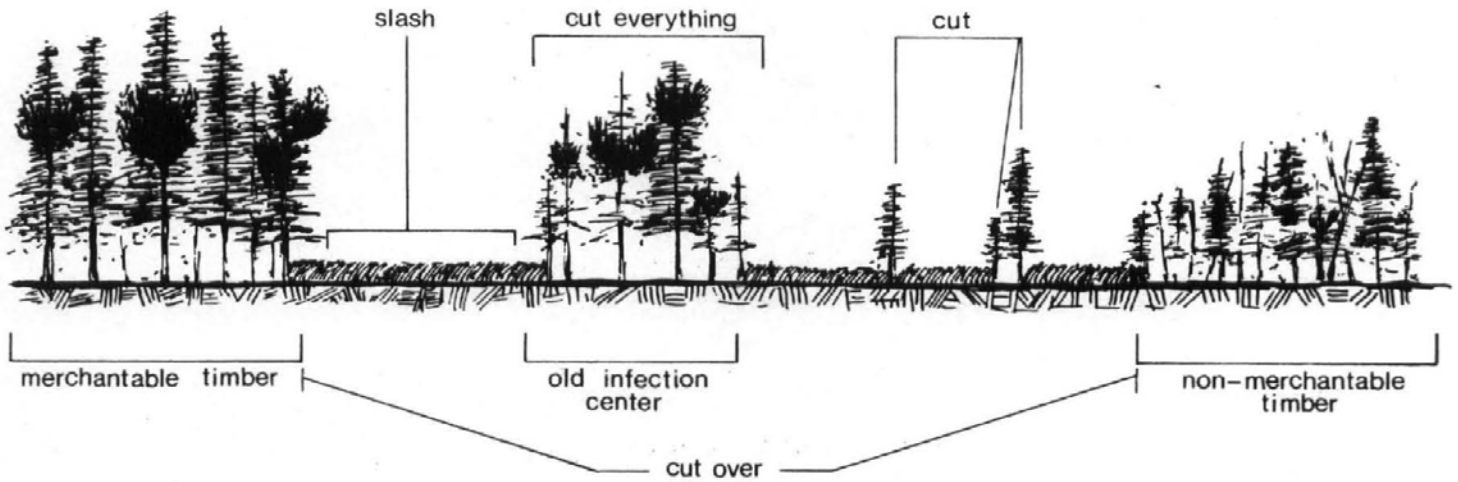


Figure 8

The following is a summary of the dwarf mistletoe control project for fiscal year 1977.

Total Acres treated	= 800
Total number of stands treated	= 30
Average cost per acre	= \$12.86
Average number of acres per stand	= 27

Dutch Elm Disease — *Ceratocystis ulmi* (Buism)

Dutch elm disease is now pretty much established throughout the state. For instance, the cities of Park Rapids, Warroad, and Roseau all have had positive diagnosis of the disease.

DNR has instituted a program of removal and disposal of Dutch elm disease and oak wilt killed trees on its lands. This program was funded in the amount of \$625,000 by the legislature - the objective to provide for the removal and disposal of diseased trees within DNR public use areas, DNR owned land within municipalities, and on buffer zone areas around cities with active shade tree disease programs.

Most high-use state-owned recreational areas were examined for disease at least once during 1977. Trees were marked and removed in Lake Carlos and Itasca State Parks in Region I. Diseased trees on recreational lands in Region II were



Cutting destroys residual mistletoe infected trees after clear cut.

relatively scarce, there being no removals there. In Region III, fire hotshot crews were utilized to cut 2,813 trees. Bids have been let for removal of 875 diseased trees in Region IV.

Among the 890 trees removed in Region V were \$12,000 worth of high quality sawlogs and veneer logs sold at Helmer Myre State Park.

In Region VI there are two 4-man crews, two skid-

ders, and a loader working. 2,257 trees have been cut. 5.71 MBF of cut elm logs were sold at Interstate Park for \$40 per thousand (\$228). 66 MBF of elm stumpage was sold at the Minnesota Valley Trail for \$4 per thousand (\$264). These timber sales provide raw material for the State's forest industries, provide income for the State, and saves the DNR the cost of cutting and disposing of these trees.

DNR Diseased Tree Removal Accomplishments

July 1 - December 9, 1977

Region	Marked	Trees Cut	Trees Contracted to be Cut	Cost to ^a a date	Average Cost Per Tree
II		NO TREE REMOVALS NEEDED			
I	47	0	—	—	—
III	3,333 ^a	2813 ^b	—	\$ 67,492	\$23.99
IV	1,300	0	875	28,000	32.00
V	890	475	415	39,000	43.82
VI	11,094	2257	—	18,979	13.41
Statewide					
Total	16,664	5545	1290	153,471	average 22.45

a. Includes cost of trees contracted, but not yet cut.

b. Includes 1200 trees cut in Metro Region at William O'Brien State Park. The cost for cutting these trees was approximately \$2,500. The cost per tree for the 1613 trees cut so far in Region III is actually \$40.29.

c. Includes an estimated equipment cost of \$5.00 per tree.

6835 trees have been cut or contracted to be cut

\$153,471 has been spent to date

\$22.45 is the state wide average cost per tree cut

Diplodia Tip Blight — *Diplodia pinea*. The causal fungus of this disease has been found in several red pine plantations in Cass and Wadena Counties. This disease does not normally cause tree mortality, but it appears that following the drought, tree mortality is occurring. In one Potlatch Corporation plantation, *Ips pini* is also present, compounding the problem of determining the severity of the disease. However, *Diplodia* is the only pathogen present in two Cass County plantations that are severely infected. Study plots have been set up to observe the disease which could become a problem due to the large source of inoculum in an area with many red pine plantations. Figure 9 shows the known distribution of this disease. The locations of infected plantations are as follows:

Location	Ownership
Sec. 26 - T138R32	Potlatch
Sec. 31 - T138R31	State of Minnesota
Sec. 32 - T138R31	Cass County
Sec. 33 - T137R34	Tree Farm

In addition many roadside windbreaks in Cass and Crow Wing Counties are infected to varying degrees.

Scleroderris Canker — *Gremmeniella abietina* (Lagerberg.) Morelet

Eighty-two red pine plantations in Minnesota were checked for gross symptoms of the scleroderris canker in 1977. Six showed symptoms which were thought to be those of the Lake States strain of the disease (see figure 10). All of the affected plantations are located in Lake and Cook Counties.

Laboratory tests to determine the presence of the disease are planned for 1978.

DISTRIBUTION OF DIPLODIA PINEA

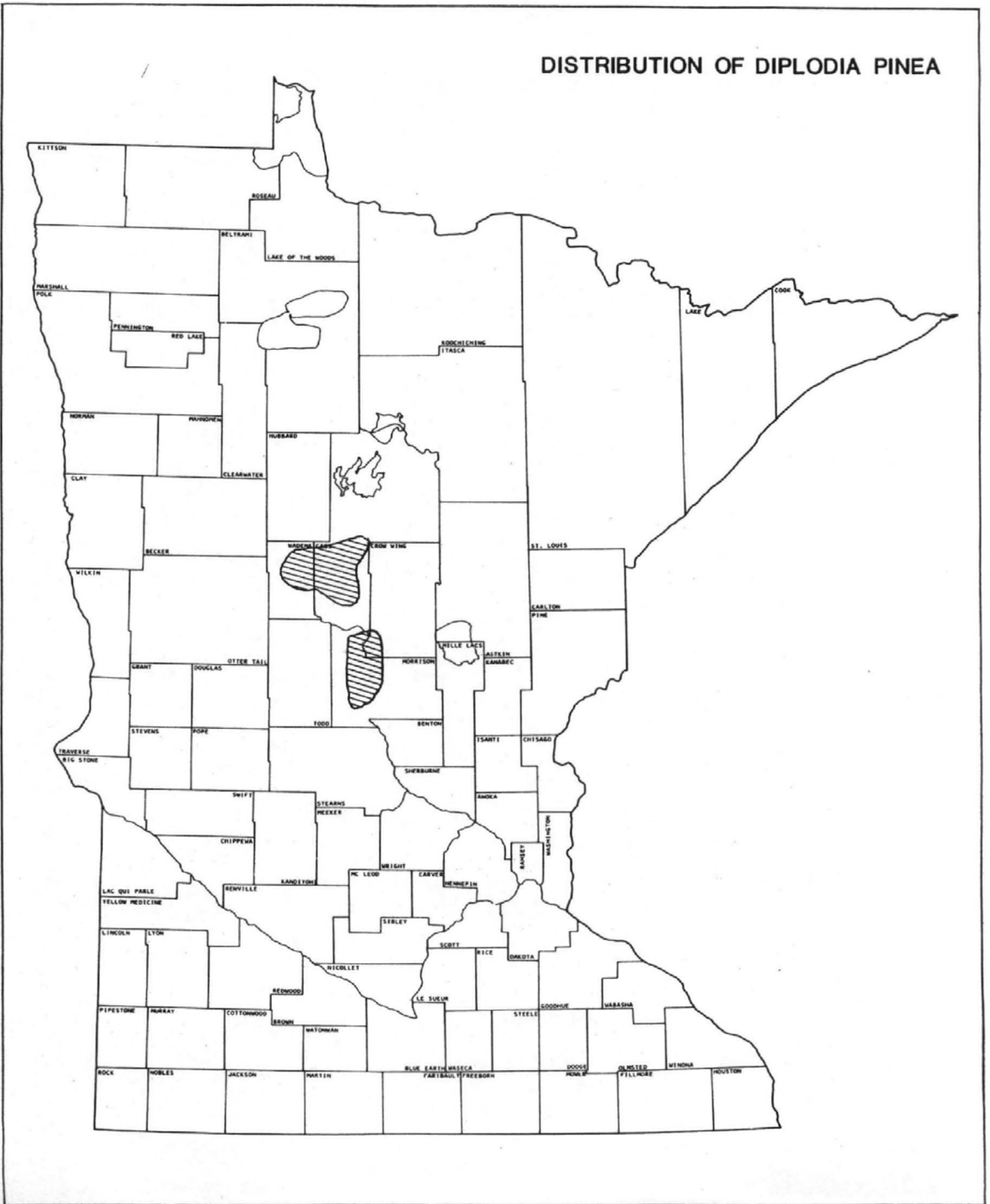


Figure 9

Diseases

Cytospora Canker — *Cytospora kunzei*

A common problem in southern Minnesota windbreaks and ornamental white, blue and Norway spruce.

Anthracnose —

Common on basswood, ash, maple and walnut causing some early leaf drop.

Red Pine Shoot Blight — *Sirococcus strobilinus* (Preuss)

Very light infections of this disease were found in plantations in the Bemidji and Blackduck Districts. Another stand of understory red pine in the Tower District was more heavily infected.

Lophodermium Needlecast — *Lophodermium pinastri* (Schrad. ex. Fr. Chev.)

Light infections of this disease were found in red pine plantations in Regions I and II.

Shoestring Root Rot — *Armillaria mellea* (Vahl ex Fr.)

Shoestring root rot is a fungus that attacks trees already weakened by unfavorable environment, injuries, insects or by other diseases. It can infect most species of hard and soft woods in Minnesota. Damage from this root rot frequently peaks a year or more after several consecutive dry summers.

This root rot has been found to be killing trees in a number of young red pine plantations in Minnesota this year. The damage is particularly severe in cut-over hardwood stands that have been converted to red pine. The fungus invades and grows on the stumps and roots of the harvested hardwoods. Then it can spread from the old stumps to any pine seedlings that are planted nearby.