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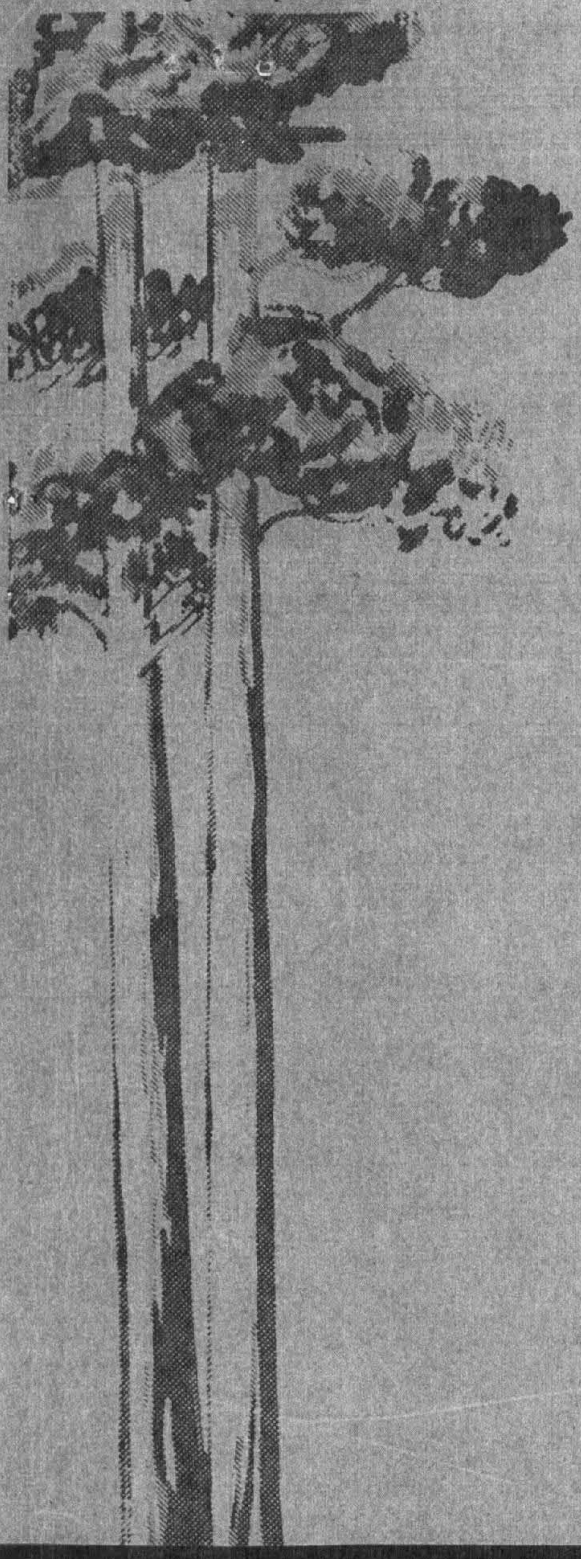
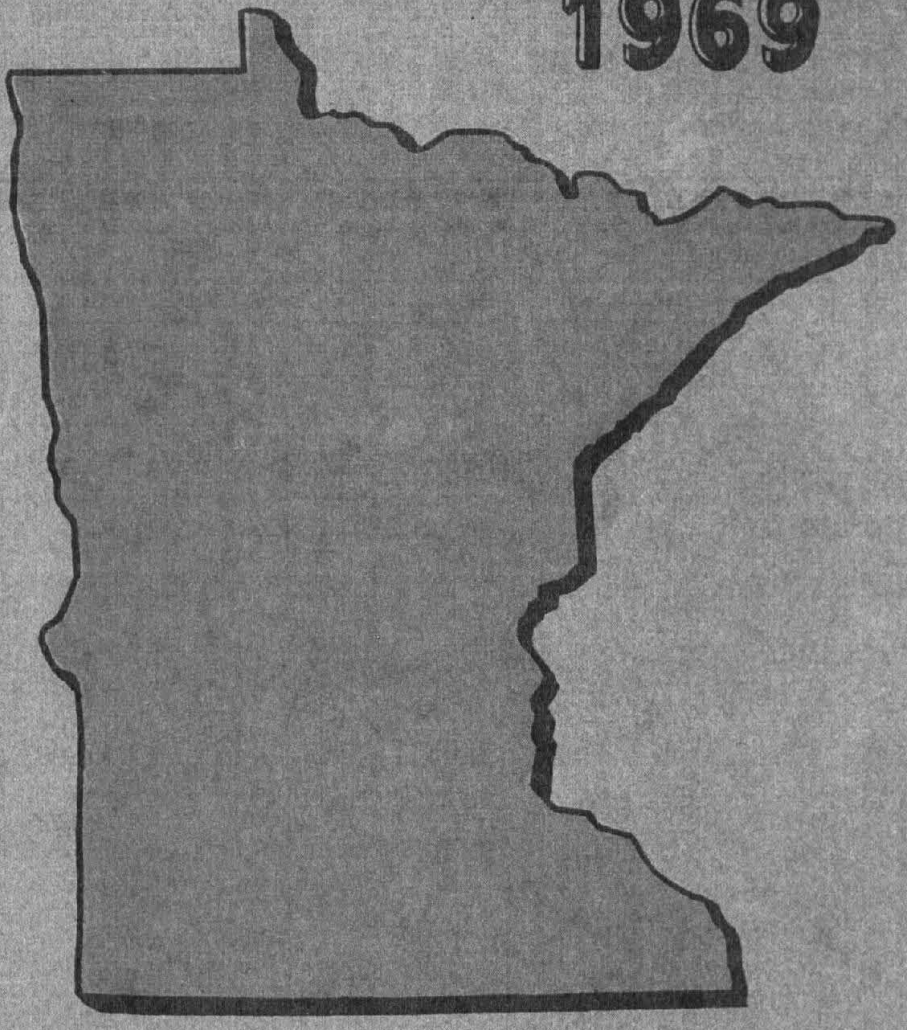


# Forest Pest Report

# 1969



## MINNESOTA

## DEPARTMENT OF AGRICULTURE
## DIVISION OF PLANT INDUSTRY

670 STATE OFFICE BLDG
ST. PAUL, MINNESOTA 55101

# INTRODUCTION

The following reports are condensations of the 1969 forest pest surveys, observations, and controls compiled by personnel from the Forest Pest Survey and Control Section, Division of Plant Industry, Minnesota Department of Agriculture, and also from reports and observations by other cooperative agencies, especially the Minnesota Division of Lands and Forestry, the U. S. Forest Service, Forest Pest Control Division, and the University of Minnesota, Department of Entomology, Fisheries, and Wildlife. Other agencies that have helped considerably in the 1969 season were:

Boise Cascade Corporation, International Falls

U. S. Department of Interior, Fish and Wildlife Service

Minnesota Department of Conservation, Division of Game and Fish

North Central Forest Experiment Station, St. Paul

Koochiching County, Land Commissioner's Office

Agricultural Extension Service, University of Minnesota

Minnesota Christmas Tree Growers' Association

Chemagro Corporation

American Cyanamid Company

Union Carbide Corporation

Personnel in the Section of Forest Pest Survey and Control in 1969 were:

Raymond Dolan, Cloquet, Minnesota

Eugene Schmidt, Virginia, Minnesota

Jordan Wheeler, Fosston, Minnesota

Albert Pruszinske, St. Paul, Minnesota

Gerald Hecht, St. Paul, Minnesota

Robert Tiplady, Brainerd, Minnesota

Other Division of Plant Industry personnel that helped on special forest projects were:

John Berends

Hilbert Hoger

Gary Miller

Milton Marinos

Gerald Beach, Supervisor
Forest Pest Survey and Control

SPRUCE BUDWORM, Choristoneura fumiferana (Clem.)

The spruce budworm has been, and still is, the most destructive forest pest in Minnesota. This insect is native to North America, with recorded population outbreaks going back to the late 1700's in Canada. The earliest recorded damage in Minnesota goes back to 1912. It can be reasonably assumed that damage occurred in this state long before 1912 since the balsam fir - white spruce forests in northern Minnesota are continuous with the same type stands in Ontario.

Graham and Orr (1923, 1940) estimated twenty million cords of balsam fir alone that were destroyed in the 1912-1918 defoliation period in Koochiching, Cook, Lake, and St. Louis Counties. White spruce mortality occurred in succeeding high budworm population periods in 1923, 1950-1964, and 1967-1969. Even though the tree loss is staggering, much of the area with heavy mortality was inaccessible. In the past there was also little demand for this wood. At the present time some of the problem areas are still inaccessible, and the demand for balsam fir - white spruce fluctuates greatly. With the intensified use of aspen (poplar) as the pulp tree in northern Minnesota, we are in a period now where only a small percentage of the balsam fir - white spruce type is being used.

A balsam fir - white spruce forest usually takes some sixty-five years to grow to maturity. How many more years will it be before we will be unable to afford such losses? A hard look must be made at medium to long-range futures, rather than only what market is available at the present time, or a few years hence.

The present spruce budworm population increase began in 1967, with some light to moderate defoliation in SE Koochiching and northern St. Louis

counties. In 1968, defoliation was moderate to severe over a 275,000 acre area in the same area with about the same acreage in a light defoliation category. Aerial and ground surveys were made to evaluate the damage, and meetings were held with private, state, county, and federal land managers in International Falls and Duluth to determine whether control was economically feasible. A 32,000 acre block was proposed for further evaluation in SE Koochiching County. Type mapping and ground surveys reduced the control area to 9,900 acres.

## 1969 SPRUCE BUDWORM CONTROL PROGRAM

### TECHNICAL INFORMATION

Causal Agent - Spruce Budworm, Choristoneura fumiferana

Host - Balsam fir and white spruce

Type of Damage - Defoliation, needle mining, and bud mining. Several years of successive defoliation causes extensive host mortality.

Surveys and Observations (Basis for Control).

A. Aerial Survey - August 2 and August 15, 1968. The area covered included state, county, and private lands outside of the boundaries of the Superior National Forest and Indian lands in Koochiching and St. Louis counties. All of the balsam fir in the projected 1969 control area showed heavy to severe defoliation (50 - 95%).

B. Ground defoliation survey - conducted July through September of 1968. This survey showed heavy defoliation in the gross 32,000 acre area in SE Koochiching county. The tops of the balsam fir were severely defoliated in most of this area with an average of 80%. Balsam fir trees examined in a number of

locations in SE Koochiching county showed healthy buds even though less than 20% foliage remained in most cases.

C. Egg Mass Survey - August 1 - September 15, 1968. Fifteen inch twig samples based on standard survey procedures, were cut from the plots in the projected control area. Twenty-two plots were checked in SE Koochiching county. Sixteen of these plots were near or within the gross 32,000 acre heavy defoliation area. Ninety-three 15 inch balsam fir twig samples taken from the 16 plots averaged 1.2 egg masses per twig. Since many of these plots were checked in late August and early September (which is quite late) and since all counts were made in the field, the average egg masses per 15 inch twig is most likely somewhat higher than 1.2. This 1.2 average still indicated a heavy budworm population for 1969.

D. Parasitism. No investigation was made on any parasitism in 1968. Previous publications indicate this is not an effective control agent.

Discussion

The 9,900 acre proposed control area was selected from the 32,000 gross area of heavy balsam fir defoliation by Boise Cascade and Koochiching county. The control area contains approximately 30 - 40% merchantable balsam fir, mixed with approximately 5% white spruce, 30% aspen and 10 - 20% black spruce. The remainder is brush, tamarack, and other tree species. Boise Cascade and Koochiching county stated that to lose the balsam fir from this forest area would make

the remaining stand too costly to cut. Protection of the balsam fir would enable several years of management and an annual programmed cut.

The inclusion of slightly over 2,000 acres of state lands in this project was approved by the Division of Lands and Forestry, Minnesota Department of Conservation.

Recommendation

Control was recommended, based on the value of balsam fir in the proposed area versus the cost of control. This area could not sustain another heavy defoliation in 1969 without virtual complete balsam fir mortality. This decision was arrived at by comparing similar balsam fir areas in 1957, 1958, 1959, 1960, 1961, 1962, and 1963 where no control was initiated and almost complete mortality resulted.

Values

Boise Cascade Corporation estimated the value that might be lost if chemical control was not instituted June of 1969 at $38,000 for white spruce and balsam fir alone. Most of the other types would not be salvageable then due to the low stumpage per acre, thus, that could add an estimated $20,000-$30,000 loss to the above figure.

Boise Cascades' records show that $100,000 was spent to develop the Galvin and Haney Roads leading into this area to sustain operations. This road system covers more than just the control area. In addition, they have had annual expenditure of 40¢ per acre for taxes and administrative costs.

The county and state figures are similar, as the types within the projected control areas are virtually the same. Thus, the total balsam and white spruce values that could be lost if there was 100% mortality

would be an estimated $50,000-$60,000. Add to that the value of other types that would be lost due to the total reduced stumpage per acre.

Acreage Breakdown

| | |
|---|---|
| State of Minnesota | 2,112 |
| Koochiching County | 1,040 |
| Boise Cascade | 6,738 |
| Total | 9,890 |

Insecticide

Technical malathion (9.7 lbs. actual malathion per gallon) applied at 13 fluid ounces per acre.

Cost of Treatment

$2.00 per acre for aerial application and chemicals.

Application Date

June 15 - 17

PRE SPRAY COUNTS - JUNE 11-13

Fifteen inch twig sample, counting all larvae and new foliage defoliation. Three to six 15 inch twigs were taken from 12 plots within the spray area. Four plots were taken from one to five miles outside of the spray area.

12 Plots Within Spray Area - 54 twig samples

Average 5.1 larvae per twig

Average 10.5% new foliage defoliation

4 Plots Outside Spray Area - 15 twig samples

Average 6 larvae per twig

Average 8% new foliage defoliation

Instar Percentages Taken On June 13

| 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|
| 4% | 7% | 37% | 46% | 6% |

Head capsule measurements were used to determine instars.

POST SPRAY COUNTS - JUNE 18-22

8 Plots Within Spray Area - 30 twig samples

Average 1.9 larvae per twig

Average 50 - 65% new needle loss

PHYSICAL EVENTS

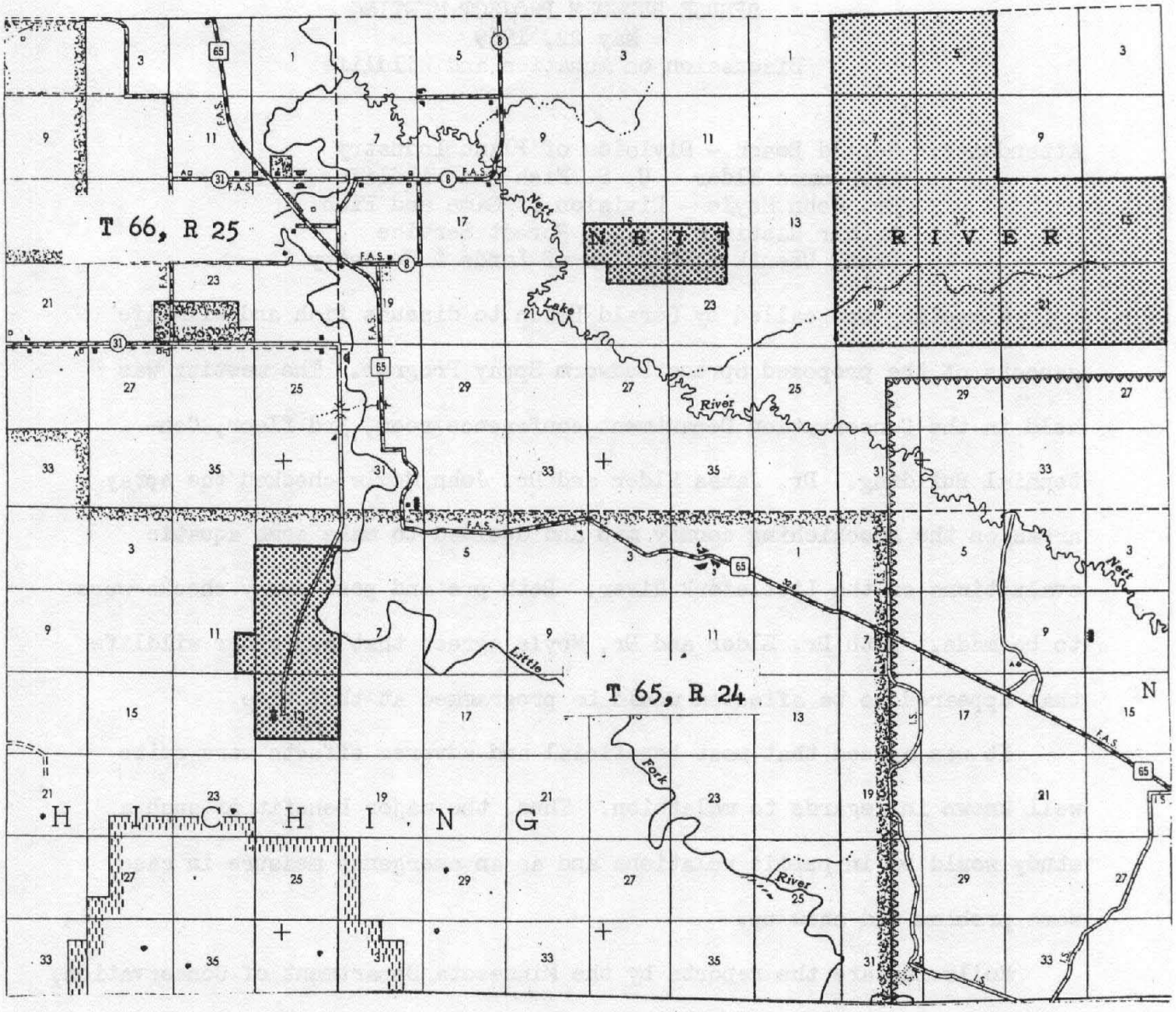
Wind velocity during spray applications was recorded at 3 to 7 m.p.h. at International Falls airport. Spray temperatures were from 52° to 68°. Precipitation was virtually nil, but one rain cloud passed over the spray area before application on June 15. The amount of moisture was not enough to hold up application. Also recorded was a large gust of wind while application was being made adjacent to the Littlefork River. Spray operations were held up for a few minutes until conditions returned to normal.

SUMMARY

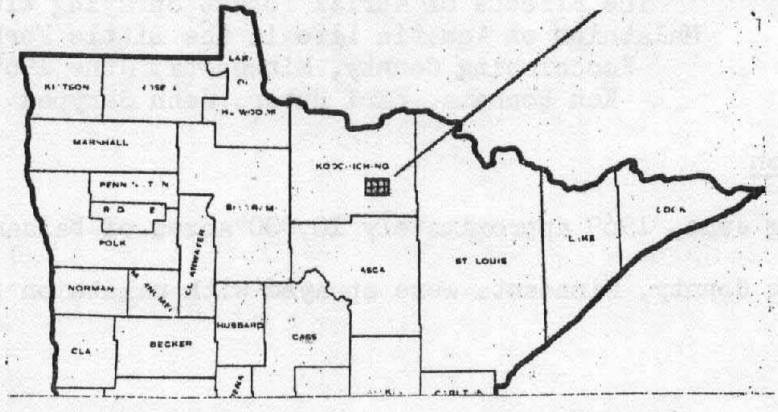
The pre to post spray population population reduction was 63%. This figure is just an approximation, as it is virtually impossible to estimate populations unless entire trees were sampled. A much better indication of control success was in new needle retention after the larval stages completed feeding. This was estimated at an average of 40%, with much spotty variation. The new needle retention in plots outside the spray area was an estimated average of 15 - 20%.

Population reduction was 63%. New foliage retention in the spray area doubled that over non-control areas and is the best success indicator.

# SPRUCE BUDWORM SPRAY AREAS




Location of above map



SPRUCE BUDWORM PROJECT MEETING
May 22, 1969
Discussion on Aquatics and Wildlife

Attendance: Gerald Beach - Division of Plant Industry
Dr. James Elder - U. S. Fish and Wildlife
Dr. John Moyle - Division of Game and Fish
Arthur Hastings - U. S. Forest Service
Frank Usenik - Division of Lands & Forestry

A meeting was called by Gerald Beach to discuss fish and wildlife aspects of the proposed Spruce Budworm Spray Program. The meeting was held in the Conservation Department conference room, 3rd floor, Centennial Building. Dr. James Elder and Dr. John Moyle checked the spray areas on the Koochiching county map and decided to make some aquatic evaluations on the Littlefork River. Both pre and post spray checks were to be made. Both Dr. Elder and Dr. Moyle agreed that any other wildlife that appeared to be affected would be programmed at that time.

It was agreed that most beneficial and adverse effects were quite well known in regards to malathion. Thus, the major benefit of such a study would be in public relations and as an emergency measure in case some problem did show up.

Following are the reports by the Minnesota Department of Conservation, Division of Game and Fish and by the U. S. Department of Interior, Fish and Wildlife Service.

Excerpts from Special Publication No. 70
Division of Game and Fish
The Effects of Aerial Forest Spraying With
Malathion on Aquatic Life in the Little Fork River,
Koochiching County, Minnesota, June 1969
Ken Bonnema, Earl Huber, John Skrypek

Introduction

During June, 1969 approximately 10,000 acres of balsam-fir forest in Koochiching County, Minnesota were sprayed with malathion for control of

spruce budworm. One spray tract of approximately 1000 acres was located immediately adjacent to the Little Fork River about thirty miles south of International Falls, Minnesota. The location of the spray tract is shown in Figure 1. An evaluation of the effects of this spraying on aquatic life in the Little Fork River was made by the Technical Services Section of the Minnesota Division of Game and Fish.

The Little Fork River

The Hydrologic Atlas of Minnesota (1959) gives the following description of the river and watershed. "The Little Fork River rises in a rather flat region of St. Louis County south of Vermillion Lake. It follows a meandering course to the northwest through the eastern part of Koochiching County to its junction with the Rainy River about 12 miles below International Falls... Throughout its length the main stem of the Little Fork has numerous falls and rapids the largest of which, located in T. 62 N., R. 20 W., about 8 miles east of the western boundary of St. Louis County, has a fall of 23 feet in less than half a mile. From the crest of these falls to the mouth, the stream has a total fall of 195 feet....Almost the entire area is forested with good stands of mixed conifers and hardwoods on the highlands, and spruce, tamarack, and cedar in the swamps. Peat bogs and muskeg swamps are scattered throughout the watershed."

The average flow of the river which occurred at the town of Little Fork for the period 1909-17, 1928-67 is 988 cubic feet per second. The maximum recorded discharge for the period 1909-17, 1928-67 is 25,000 cfs which occurred in April of 1916. The minimum recorded flow is 21 cfs which occurred in August, 1936. During 1966 the mean flow was 1,551 cfs with a maximum discharge of 14,600 cfs and a minimum of 110.

The Little Fork is a hard-water river and has fairly high chemical fertility. The water is light brown in color due to suspended organic matter, a common characteristic of lakes and streams in the area. In as much as the area is sparsely populated the river is in an essentially unpolluted condition.

There is little information available on fish in the Little Fork River. It is fished primarily by local residents for walleyed pike, muskellunge, northern pike, rock bass and lake sturgeon. Fishing pressure is very light.

The Spray Program

Land in the spray project area is under private, county, and state ownership. The largest private owner is Boise Cascade Paper Company. The original project proposal called for aerial application of DDT. Minnesota Department of Conservation policy forbids the use of DDT on state-owned lands. It was deemed necessary to spray all lands in the budworm infestation area to achieve an effective control program so it was decided that malathion would be used in place of DDT.

Spraying was done with fixed wing aircraft on June 15, 1969 at the rate of 13 fluid ounces of malathion per acre. Ultra low volume spray techniques were used.

Malathion

Malathion is an organophosphate insecticide of short residual life and low avian and mammalian toxicity. It is, however, relatively toxic to fish and other aquatic life when applied directly to the water. "Water Quality Criteria" (1968), a report of the National Technical Advisory Committee to the Secretary of Interior, reports 48 hour $TI_M$ values for malathion of 6 ppm to the stonefly Pteronarchys badia, 1.8 ppm to the

cladoceran Daphnia pulex, 1.8 ppm to the crustacean Gammarus lacustris and 19.5 ppm to the brook trout.

Field Methods

It was originally planned that three river sampling stations would be used, one within the spray area, one downstream of the spray area and a control station to be located upstream. Due to low water it was impossible to negotiate the large rapids located in the southeast corner of Section 1 so an upstream station was not established. The locations of the sampling stations used are shown in Figure 1.

Effects on fish were evaluated by making visual observations during and after spraying. The effect on bottom fauna was evaluated by sampling with drift nets and fixed, artificial-substrate mats. No attempt was made to measure the amount of pesticide that actually reached the forest floor and river, so observed effects cannot be related to a given malathion concentration.

The drift nets used were constructed of nylon bobbinet mesh with openings of approximately 1/32 of an inch. They were mounted on an 18 inch square metal frame and floated by attaching a wooden frame to the upper portion of the net. Details of the net are shown in Figure 2. The nets were anchored in approximately three feet of water immediately below a riffle area at each station. A boat anchor and nylon cord were used to anchor them in position. The nets were placed in the stream one day before spraying and left in until one day after spraying. They were lifted and the contents removed each morning and evening. The net contents were put in glass jars and preserved with 10% formalin for later laboratory analysis.

The fixed samplers were made by fastening 4 x 8 inch pieces of plastic mesh webbing to 4 x 8 inch building bricks. The webbing was manufactured

by the 3M Company of St. Paul, Minnesota and is normally used in a floating aquatic sampler. The material provides an excellent substrate for colonization by aquatic invertebrates.

Twelve samplers were placed on the bottom in about two feet of water at each station five days before the proposed date of spraying. Half of the samplers were removed shortly before spraying and the rest one day after spraying. The mat and accumulated organisms were removed from the brick and preserved with 10% formalin for later laboratory analysis.

Results and Discussion

No mortality of fish was observed during spraying or the 24 hour period following spraying.

The results of the drift net sampling are shown in Tables 1, 2, and 3. If the spraying had an effect on stream invertebrates the number of organisms drifting in the stream should be significantly higher after spraying than before. The drift of organisms is usually higher at night than during daylight hours so the data was arranged so that daylight hours before spraying could be compared with daylight hours after spraying and likewise for nighttime hours.

Ideally much more data would be required to establish the normal variation in drift of aquatic organisms in the Little Fork River. The drift nets were in place at each station for approximately thrity hours before spraying and twenty-four hours after spraying. The post spray drift rate of aquatic organisms increased during daylight hours at all three stations. These changes are probably within normal variation. The tract was sprayed at approximately 1600 Hour on June 15 so any pesticide-caused mortailty of bottom organisms should have been reflected in increased drift rates that evening. The post-spray rate was actually lower at all three stations than the preceding night.

Data from the stationary plastic mat samplers at Station 2 is shown in Table 4. Dropping water levels made the samplers at Station 1 and 3 unusable. Half of the samplers (N=6) were removed at spraying time and the rest (N=6) one day after spraying. If the pesticide had caused any significant mortality of bottom organisms it should have been reflected by decreased numbers of organisms on the samplers removed one day after spraying. The numbers found were approximately the same or actually slightly higher than on the samplers removed at spraying time.

## Conclusion

Aerial spraying of malathion for spruce budworm control on a 1000 acre tract adjacent to the Little Fork River caused no apparent harm to the fish population or aquatic invertebrates of the river.

## Literature Cited


Minnesota Divison of Waters

1959. Hydrologic Atlas of Minnesota, Bulletin Number 10.

U. S. Department of Interior, FWPCA

1968. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of Interior, April 1.

Table 1. Drift Organisms - Little Fork River - June 1969

Number of organisms per net hour

Station 1

| | Drift/hr. daylight before spraying | Drift/hr. daylight before spraying | Drift/hr. daylight after spraying | Drift/hr. nighttime before spraying | Drift/hr. nighttime after spraying |
|---|---|---|---|---|---|
| 1. Ephemeroptera | | | | | |
| nymphs | .80 | .47 | 1.00 | .75 | .31 |
| adults | 0 | 0 | 0 | .06 | .06 |
| 2. Plecoptera | | | | | |
| nymphs | .13 | .12 | .20 | 1.25 | .44 |
| adults | 0 | .12 | .40 | 0 | 0 |
| 3. Diptera | | | | | |
| larvae | .27 | .12 | .20 | 0 | .13 |
| pupae | .13 | .12 | .20 | 0 | .06 |
| adults | 0 | 0 | 2.60 | 0 | 0 |
| 4. Odonata | | | | | |
| nymphs | 0 | 0 | .40 | .19 | 0 |
| 5. Trichoptera | | | | | |
| larvae | 0 | 0 | .40 | .13 | .06 |
| adults | | | | | |
| 6. Coleoptera | | | | | |
| larvae | | | | | |
| adults | | | | | |
| 7. Hemiptera | | | | | |
| larvae | | | | | |
| adults | | | | | |
| 8. Lepidoptera | | | | | |
| larvae | | | | | |
| 9. Crustacea | | | | | |
| Gammarus | | | | | |
| Orconectes | | | | | |
| 10. Hydracarina | | | | | |
| 11. Leeches | | | | | |
| 12. Fish fry | .67 | .71 | .60 | .19 | .13 |
| 13. Fish eggs | | | | | |
| 14. Mollusca | .13 | 0 | .20 | 0 | 0 |
| 15. Oligochaeta | | | | | |
| 16. Terrestrial organisms | | | | | |
| Hymenoptera | 0 | .12 | .20 | 0 | 0 |
| Arachnida | .13 | .12 | .40 | 0 | 0 |
| Coleoptera | | | | | |
| Hemiptera | 0 | 0 | 0 | 0 | .20 |
| 17. Total aquatic organisms | 2.13 | 1.64 | 6.40 | 2.56 | 1.18 |

Table 2. Drift Organisms - Little Fork River - June 1969

Number of organisms per net hour

Station 2

| | Drift/hr. daylight before spraying | Drift/hr. daylight before spraying | Drift/hr. daylight after spraying | Drift/hr. nighttime before spraying | Drift/hr. nighttime after spraying |
|---|---|---|---|---|---|
| 1. Ephemeroptera | | | | | |
| nymphs | 1.00 | .82 | .75 | 8.43 | 2.18 |
| adults | | | | | |
| 2. Plecoptera | | | | | |
| nymphs | .14 | .47 | 0 | 2.62 | .68 |
| adults | 0 | 0 | .25 | 0 | 0 |
| 3. Diptera | | | | | |
| larvae | 0 | .59 | 1.25 | 0 | 0 |
| pupae | 0 | .11 | 0 | .12 | 0 |
| adults | .14 | 0 | 1.50 | 0 | 0 |
| 4. Odonata | | | | | |
| nymphs | 0 | 0 | 0 | .12 | 0 |
| 5. Trichoptera | | | | | |
| larvae | 1.00 | .11 | 1.00 | .56 | .37 |
| adults | 0 | 0 | 0 | 0 | .06 |
| 6. Coleoptera | | | | | |
| larvae | .14 | 0 | .50 | .06 | .18 |
| adults | | | | | |
| 7. Hemiptera | | | | | |
| larvae | | | | | |
| adults | 0 | .11 | 0 | 0 | 0 |
| 8. Lepidoptera | | | | | |
| larvae | .14 | 0 | .50 | 0 | 0 |
| 9. Crustacea | | | | | |
| Gammarus | | | | | |
| Orconectes | .14 | 0 | 0 | 0 | 0 |
| 10. Hydracarina | .14 | 0 | 0 | 0 | 0 |
| 11. Leeches | .14 | 0 | 0 | 0 | 0 |
| 12. Fish fry | .71 | 1.17 | 2.00 | 2.18 | .06 |
| 13. Fish eggs | .85 | .94 | .50 | .62 | .25 |
| 14. Mollusca | 0 | .11 | .25 | 0 | 0 |
| 15. Oligochaeta | | | | | |
| 16. Terrestrial organisms | | | | | |
| Hymenoptera | 0 | .11 | 0 | 0 | 0 |
| Arachnida | | | | | |
| Coleoptera | 0 | 0 | 0 | .06 | .06 |
| Hemiptera | 0 | 0 | .25 | 0 | 0 |
| 17. Total aquatic organisms | 4.57 | 4.47 | 8.75 | 14.81 | 3.87 |

Table 3. Drift Organisms - Little Fork River - June 1969

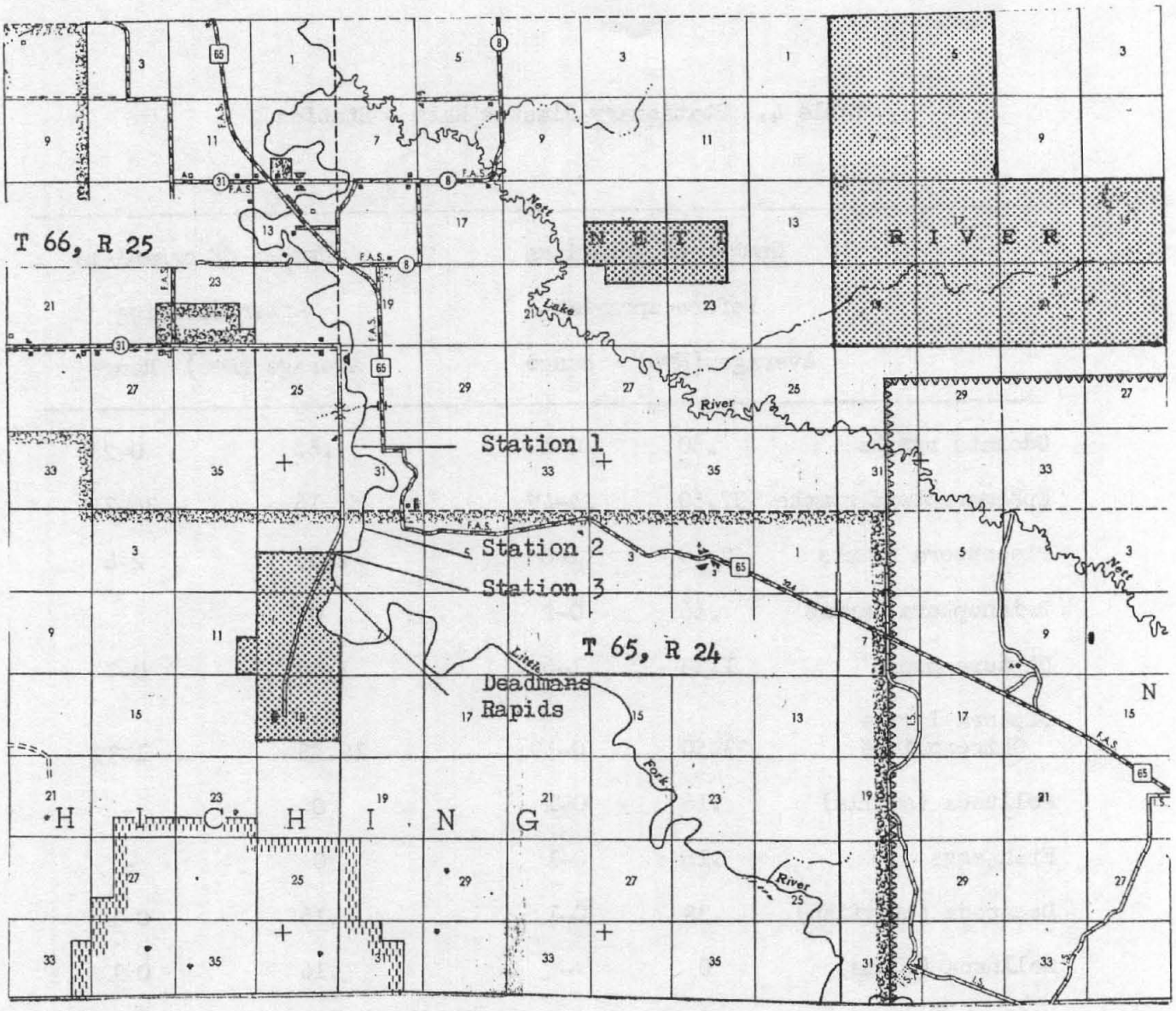
Number of organisms per net hour

Station 3

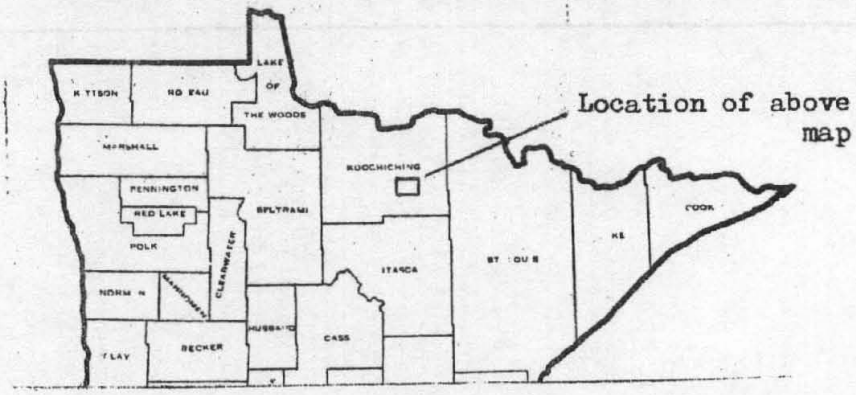
| | Drift/hr. daylight before spraying | Drift/hr. daylight before spraying | Drift/hr. daylight after spraying | Drift/hr. nighttime before spraying | Drift/hr. nighttime after spraying |
|---|---|---|---|---|---|
| 1. Ephemeroptera | | | | | |
| nymphs | 1.25 | 1.17 | 2.00 | 5.68 | 2.00 |
| adults | .25 | 0 | 0 | 0 | .19 |
| 2. Plecoptera | | | | | |
| nymphs | 1.00 | .58 | 1.33 | 2.18 | .93 |
| adults | .50 | 0 | 1.00 | .25 | .56 |
| 3. Diptera | | | | | |
| larvae | 0 | .11 | 0 | .13 | 0 |
| pupae | | | | | |
| adults | .50 | .22 | 3.66 | 0 | .81 |
| 4. Odonata | | | | | |
| nymphs | 0 | 0 | 0 | .06 | 0 |
| 5. Trichoptera | | | | | |
| larvae | 1.00 | .94 | .66 | .62 | 1.18 |
| adults | 0 | 1.41 | 0 | 0 | .81 |
| 6. Coleoptera | | | | | |
| larvae | 0 | 0 | .33 | .06 | .13 |
| adults | .25 | 0 | 0 | .13 | .19 |
| 7. Hemiptera | | | | | |
| larvae | | | | | |
| adults | | | | | |
| 8. Lepidoptera | | | | | |
| larvae | 0 | .11 | 0 | 0 | 0 |
| 9. Crustacea | | | | | |
| Gammarus Orconectes | 0 | 0 | 0 | .06 | 0 |
| 10. Hydracarina | | | | | |
| 11. Leeches | | | | | |
| 12. Fish fry | .75 | 1.17 | 1.33 | .56 | .19 |
| 13. Fish eggs | 0 | 0 | 0 | .06 | 0 |
| 14. Mollusca | | | | | |
| 15. Oligochaeta | | .11 | | | |
| 16. Terrestrial organisms | | | | | |
| Hymenoptera | | | | | |
| Arachnida | | | | | |
| Coleoptera | 0 | 0 | 0 | .13 | 0 |
| Hemiptera | | | | | |
| 17. Total aquatic organisms | 5.50 | 5.88 | 11.33 | 9.93 | 7.12 |

Table 4. Stationary Plastic Mats - Station 2

| | Number of organisms Before spraying | | Number of organisms After spraying | |
|---|---|---|---|---|
| | Average (N=6) | Range | Average (N=6) | Range |
| Odonata nymphs | .50 | 0-1 | .66 | 0-2 |
| Ephemeroptera nymphs | 37.50 | 24-49 | 52.16 | 36-71 |
| Plecoptera nymphs | 2.50 | 1-8 | 2.83 | 2-4 |
| Trichoptera larvae | .66 | 0-2 | 0 | |
| Diptera pupae | 1.33 | 1-6 | 1.66 | 0-7 |
| Diptera larvae - Chironomidae | 23.50 | 0-59 | 19.83 | 1-39 |
| Mollusca (snails) | .16 | 0-1 | 0 | - |
| Fish eggs | .16 | 0-1 | 0 | - |
| Decapoda (crayfish) | .33 | 0-1 | .16 | 0-1 |
| Mollusca (clams) | 0 | - | .16 | 0-1 |
| Collembola | 0 | - | .33 | 0-2 |
| Hirundinea (leeches) | 0 | - | .16 | 0-1 |




LOCATION OF SPRAY TRACT AND RIVER SAMPLING STATIONS



THE FOLLOWING IS A REPORT FROM DR. JAMES ELDER
U. S. DEPARTMENT OF THE INTERIOR, FISH AND WILDLIFE SERVICE

Following is a chronology and summary of activities by the Bureau of Sport Fisheries and Wildlife in connection with a cooperative spruce budworm control project in Koochiching County, June 1969.

Early in May 1969 the spruce budworm project proposal was discussed with personnel of the Denver Wildlife Research Center to determine what facets of the project might be of interest from a research standpoint. One of the main environmental aspects of malathion treatments yet to be studied in depth was the effect on nesting birds of large scale reductions of insect populations. It was determined that the researchers would be unable to provide this program in connection with the Koochiching County project.

In the May 22 meeting with Gerald Beach, Dr. John Moyle, Frank Usenik, and Arthur Hastings, fish and wildlife aspects were considered. It was pointed out that based on field studies in many parts of the country, there apparently was little hazard to terrestrial wildlife from applications of 13 to 16 ounces malathion actual per acre. However, this amount might be hazardous to some fish species and most certainly would cause heavy destruction of aquatic insects important as fish food. It was pleasant to learn that project plans provided for a 200 foot buffer strip along the only major stream in the project areas, the Little Fork River. It was agreed that the only potential hazard to fish and wildlife would be from an accidental misapplication. It was agreed further that inasmuch as this would be a publicly sponsored project, every effort should be made to observe and document effects of the spray application on fish and wildlife.

I traveled to the Koochiching County project on June 11 and remained in the area until June 18. Manpower and other limitations precluded

meaningful attempts to estimate pre or post-spray populations of non-target species. Expectations were at best to be able to detect and document qualitatively any adverse effects that might occur as a result of gross misapplication of spray material. To this end, an extensive reconnaissance of the Little Fork spray plot was made, the only one of the three spray areas that was accessible. Transects were established along and perpendicular to a logging trail in the south half of the plot. In the course of the reconnaissance, the attempt was made primarily to estimate the level of bird activity, which turned out to be heavy. The area had great diversity and numbers of warblers and other songbirds and many other non-game and game bird species. The nesting season was in full swing.

The Little Fork area was sprayed on June 15. During the next three days there was no detectable diminution in bird singing, calling or other activity. Systematic search of likely cover along the pre-established transects failed to turn up affected birds or other vertebrates. A few moribund insects were noted, principally small butterflies, but mosquitoes and other insect populations remained at high levels.

Inasmuch as these filed observations perforce were limited in scope, it cannot be stated with certitude that there were no adverse effects on non-target organisms that occurred as a result of malathion application. I am confident, however, that had major damage occurred the above observations and those of the Minnesota Game and Fish biologists would have disclosed some evidence to that effect. No such evidence was found, and I concur in the state biologist's conclusions that the aerial spraying with malathion caused no apparent damage to fish or wildlife on the Little Fork plot.

Dr. James B. Elder, Staff Specialist
Pesticides Appraisal and Monitoring
Division of Wildlife Services

SPECIFICATIONS FOR NETT LAKE RIVER
SPRUCE BUDWORM CONTROL PROJECT 1969

The Minnesota Department of Agriculture, Division of Plant Industry, requires for the purposes of controlling a spruce budworm infestation the spraying by airplane, including the furnishing of insecticides, about 9,900 acres of forested area located northwest of the Nett Lake Indian Reservation. The three areas located northwest of Nett Lake are twenty-three miles at its closest point and thirty-three miles at its farthest point from the International Falls airport. The topography is level to slightly rolling and the timber in the area to be sprayed varies from 20 feet to 70 feet in height. The International Falls airport will serve as the base for all operations including loading of spray airplanes. The successful bidder shall be required to make all arrangements financial and otherwise for the use of the International Falls airport.

TIME AND TERMINATION OF SPRAYING

Due to the habits of the insects to be treated, the period during which effective control can be achieved will not exceed 10 to 14 days. The exact time for the commencement of spraying operations and the sequence of treatment of individual blocks will be determined by insect development. Continuous entomological observations will be made prior to and during spraying operations and all decisions relative to timing and sequence of applications will be made by the project director. In no event will spraying begin earlier than June 1, 1969 or later than July 10, 1969.

AIRCRAFT SPECIFICATIONS

Basic Aircraft - All aircraft shall comply with all Civil Air Regulations, Minnesota Department of Aeronautics, and Minnesota Statutes regulations.

All aircraft shall have an insecticide capacity of not less than 100 gallons and shall be equipped with engines not exceeding 450 horsepower.

AIRCRAFT SPRAY SYSTEM

All aircraft herein specified shall be equipped with leakproof spray distribution system of the boom type capable of applying the insecticide in uniform swath and capable of producing an atomization of the insecticide with an average mass median diameter of 40 microns. The nozzles must be number 8001 for fixed wing aircraft and 830077 or 8000067 for helicopters, adjusted to spray at a rate of 13 fluid ounces per acre. All nozzles and screens must be new and unused.

Spraying apparatus shall include the following specific parts and features:

1. Leakproof insecticide tanks with exterior inlets. The filler necks and vents shall be of such design and size as to permit rapid filling or pumping of tanks and to prevent spillage from surging.
2. Pumping systems capable of maintaining a constant set pressure of at least 40 pounds per square inch at varying flying speeds. All wind-driven pumps must be equipped with brakes capable of stopping the pumps and fan. The by-pass system must re-circulate through the pump to prevent air bubble formation.
3. Each nozzle should be equipped with a diaphragm valve.
4. A means must be provided: 1. To determine spray tanks are completely emptied before refilling. 2. A means of measuring insecticide quantity in the tanks.
5. An accurate gauge that will indicate the pressure of the spraying system while it is in operation shall be located in

the cockpit where it can be conveniently read by the pilot. The spray pressure line that is route to the gauge shall have a maximum orifice of approximately 1/32 inch at the pressure source.

INSECTICIDE SPECIFICATIONS

The spray material to be used shall consist of technical malathion (9.7 lbs., 1 gal.) and applied undiluted at the rate of 13 fluid ounces per acre. This material will be delivered to and stored at the airfield without cost to the state. The weight of the insecticide will be 10.25 lbs. per gallon, with 9.7 lbs. actutal malathion per gallon and the insecticide shall be free of lint, silt, and foreign matter of all kinds. The state may take such samples and make such tests as may be necessary to determine conformity of the furnished insecticide with the above specifications.

RATE AND METHOD OF APPLICATION

Insecticide shall be applied at a uniform rate of 13 fluid ounces over the entire project area. Checking stations will be maintained by the State Department of Agriculture in all areas as spray is applied, and any inadequacies in spray distribution shall be corrected by the successful bidder without additional cost to the state.

Spray applications shall be made from a height between 25 and 75 feet above tree top level. Within these limits (25 and 75 feet) variations in spray application heights will be specifically agreed upon by the State Department of Agriculture entomologist or his authorized representative and the contractor's representative for each portion of the spray project.

Whenever the wind velocity exceeds six (6) miles per hour, or whenever, in the judgment of the project director, excessive turbulence, rain,

or other atmospheric conditions will diminish the effectiveness of the spray, or make flying operations unduly hazardous, and spraying operations shall be discontinued.

## 1969 SPRUCE BUDWORM SURVEYS

### AERIAL SURVEY - AUGUST 12-14

The aerial survey covered a gross area of 5,542,120 acres of mixed balsam fir, white spruce, black spruce, aspen, and birch forest. The objective was to record the 1969 Spruce Budworm intensity and spread. This was a cooperative survey between the Minnesota Department of Agriculture, and the U. S. Forest Service, State and Private Forestry.

Moderate to heavy defoliation - 437,760 acres

Light, with moderate pockets - 1,958,400 acres

Balsam fir - white spruce type averages about 20 - 35% of the type in the heavy defoliation area and somewhat less than that in the light area. The areas with severe defoliation were those with mature trees, bringing up the often emphasized point of the need to cut these stands when they reach maturity. Volume loss from 1969 defoliation of balsam fir - white spruce was not accurately estimated, but with top kill and virtually complete defoliations it should exceed 200,000 cords.

Ground spot checking followed the aerial survey in the moderate to heavy defoliation areas to make more accurate defoliation, potential top kill, and potential mortality estimates.

### EGG MASS SURVEY - AUGUST 5 - SEPTEMBER 1, 1969

Sample unit - three 15 inch twig samples/plot - 1969 Spruce Budworm Control Area.

15 plots - 45 twig samples.

Average .7 egg masses per 15" twig sample.

Sample area outside and adjacent to the control area.

21 twig samples - average 1.8 egg masses per 15" twig samples.

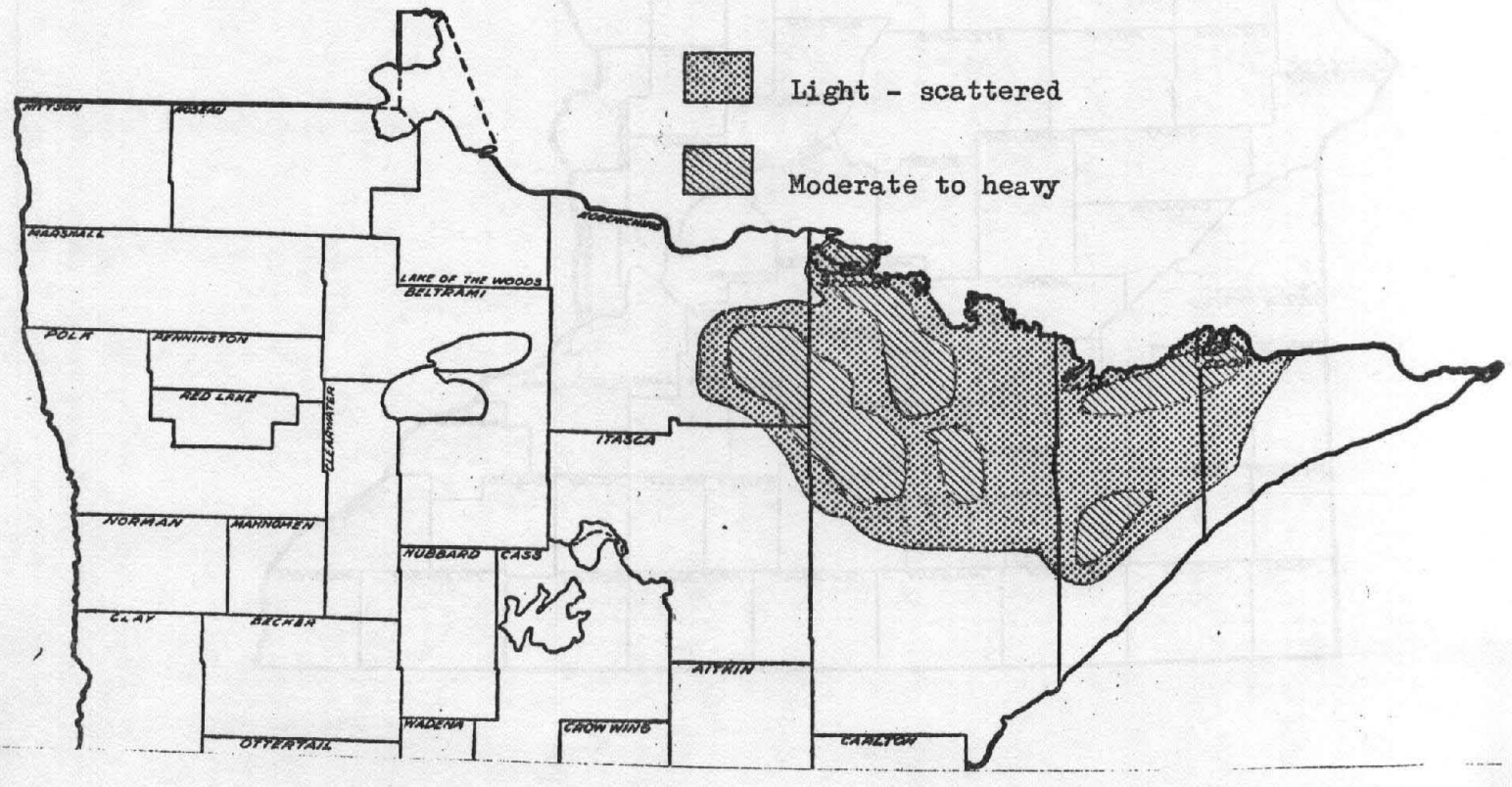
OUTLOOK FOR 1970

The defoliation acreage increased in the moderate-heavy population areas in 1969 with a marked spread in the lighter budworm population areas.

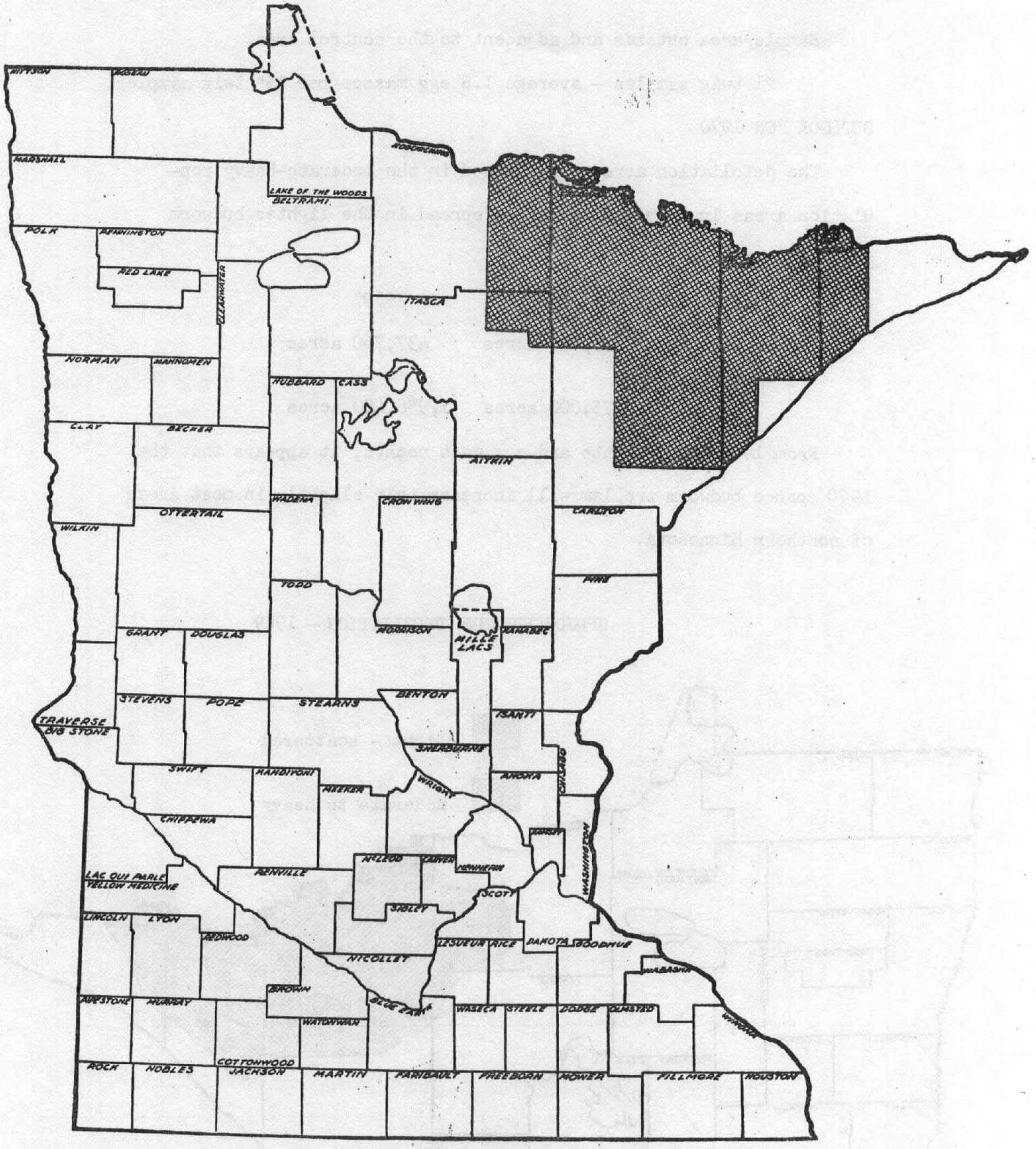
| Defoliation | 1968 | 1969 |
|---|---|---|
| Light | 275,000 acres | 437,760 acres |
| Moderate-Heavy | 275,000 acres | 1,958,400 acres |

From 1969 moth flights and egg mass counts, it appears that the 1970 spruce budworm problem will increase only slightly in most areas of northern Minnesota.

SPRUCE BUDWORM DEFOLIATION - 1969



1969 SPRUCE BUDWORM AERIAL SURVEY - GROSS AREA COVERED



FOREST TENT CATERPILLAR - Malacosoma disstria

The present high population cycle started in 1963 in northern Minnesota with an upsurge in adults moth numbers in light trap collections and larval observation reports. The area of light infestation in 1963 bordered Canada from the eastern Kabetogama Penninsula to the south shore of Namakan Lake.

In 1964, defoliation was light to moderate from a point several miles east of International Falls to Crane Lake and up to 15 miles "South of the border."

The years of 1965 through 1968 were quite similar. The heavy defoliation area centered east and west of International Falls and scattered light to moderate defoliation pockets extended as far south as Virginia, Minnesota. Erratic spring weather was the most obvious factor containing a widespread population explosion in this period.

The year of 1969 was quite similar to the 1965 - 1968 period in many respects. The heavy defoliation area remained almost the same as previous years. Light defoliation moved westward to Lake of the Woods in a narrow strip adjacent to the Canadian Border. A small new outbreak occurred east of Fergus Falls, Minnesota, with 50 - 70% defoliation on ash and basswood over a 200 acre area.

AERIAL SURVEY

An aerial survey was conducted cooperatively by the Minnesota Department of Agriculture and the U.S.D.A. Forest Service, State and Private Forestry, St. Paul office on July 8-9. The map shows the coverage of this flight over northern Lake of the Woods, north and eastern Koochiching, northeast Itasca, Cook, Lake, and most all of St. Louis Counties. As is usual, defoliation was very spotty, with heavy-moderate interspersed with light to

none. A map also depicts the heavy defoliation area in Koochiching county. The spread from 1968 to 1969 was in a westerly direction with the eastern fringe again receding slightly. Light defoliation was evident over to the eastern edge of Roseau county.

Another aerial survey was conducted by the Minnesota Department of Agriculture on July 9th, in the second region indicated on the map, from southern Ottertail county as far north as the southwest tip of Koochiching county over to southwest Itasca county. A number of "defoliation" areas were reported, and the survey was set up to cover such locations. In addition ground observations had already been made in the Clitheral Lake infestation area and part of the survey objective was to look at this small location from the air to see if there were any nearby defoliation spots.

A Cessna 182 was used for the more northern area and a Cessna 172 was flown from Grand Rapids in the second survey (see map of FTC Survey Areas). In both cases 6 to 12 mile flight lines were used, with 1 to 3 mile lines used in areas where close observation was necessary. Height was 1,000 feet. Large scale county maps were used to navigate along predetermined lines, and also to sketch levels of defoliation.

Defoliation Areas Determined from Aerial Observation

| | | |
|---|---|---|
| Heavy defoliation | (61 - 100%) | 84,775 acres |
| Light - Moderate | (30 - 60%) | 1,380,000 acres |

The heavy and light defoliation acres include many forest types that were not defoliated, or were attacked to a very minor degree (conifers, maple, ash, elm, birch, etc.). Most all of the observable damage was on aspen. The one exception to this is the Lake Clitherall infestation in Ottertail county, where ash and basswood were heavily defoliated, and elm, oak, maple, and aspen to a lesser degree.

EGG MASS SURVEY

An egg mass survey was initiated October 15, 1969 to determine the spread and population potential of the Forest Tent Caterpillar for 1970.

Three co-dominant aspen trees were selected per plot. The plots are predetermined to give a random distribution pattern over the northern half of Minnesota. The trees were felled and twigs systematically checked for the egg masses which encircle the small twigs approximately 1/4" in diameter. All egg masses were collected from each tree and placed in a bag, along with a collection form, which included information as to section, township, range, tree number, DBH, and plot numbers.

The average count per plot was then transcribed to a map with the combined information from aerial surveys, ground observations, and parasitism. A forecast map will be set up for the forthcoming season.

PARASITISM - NATURAL CONTROLS

A total of over 2,000 cocoons were collected from seven different locations near International Falls, with the following results:

| Cocoons | Healthy | Parasitized by Sarcophaga Aldrichi | Other Parasites | Dead from Unknown Causes |
|---|---|---|---|---|
| 2,117 | 745 | 921 | 97 | 354 |

Overall parasitism was only 48.1%, which is considerably less than the 60.5% parasitism found in 1968. The pupal and pre-pupal mortality from unknown causes was 16.7% bringing the total mortality to 64.8%.

Cool weather prevailed again in early July of 1969, as it did in the same period of 1968, when Sarcophaga aldrichi, the primary parasite of the Forest Tent Caterpillar is at its peak. This is the time when the adult fly deposits the live maggots on the Forest Tent Caterpillar cocoons.

An egg parasitism study was made of the eggs collected during the October-December distribution survey. Eggs were decapped with a razor blade on two sides of the mass and counts were made on the categories below.

| Average Eggs Per Mass | Dead Larvae | Dead Eggs | Parasitized Larvae | Total Larvae and Eggs Inspected |
|---|---|---|---|---|
| 222 | .77% | 5.63% | 3.93% | 10,023 |

Since parasitism has dropped considerably in both 1968 and 1969, cool weather appears to affect Sarcophaga aldrichi adversely. Empusa sp., a fungus disease again was notably affecting the fly.

FOREST TENT CATERPILIAR LIGHT TRAP COLLECTIONS

F = female moths M = male moths

| Date | Orr | Northome | Willow River | Thistledew |
|---|---|---|---|---|
| July 26 | | | 1M | |
| July 9 | | | 1M | |
| July 16 | | 2F, 21M | 2M | 3F, 4M |
| July 24 | 178F, 424M | 3F, 6M | | |
| July 25 | | | | 5M |
| July 30 | 5M | | | 1F |
| July 31 | | 1F, 3M | | |
| August 6 | 2M | | | |

FOREST TENT CATERPILIAR DEVELOPMENT

April 30 - FTC eggs just beginning to hatch in the town of International Falls.

May 4 - Eggs hatching in forested areas in northern Minnesota.

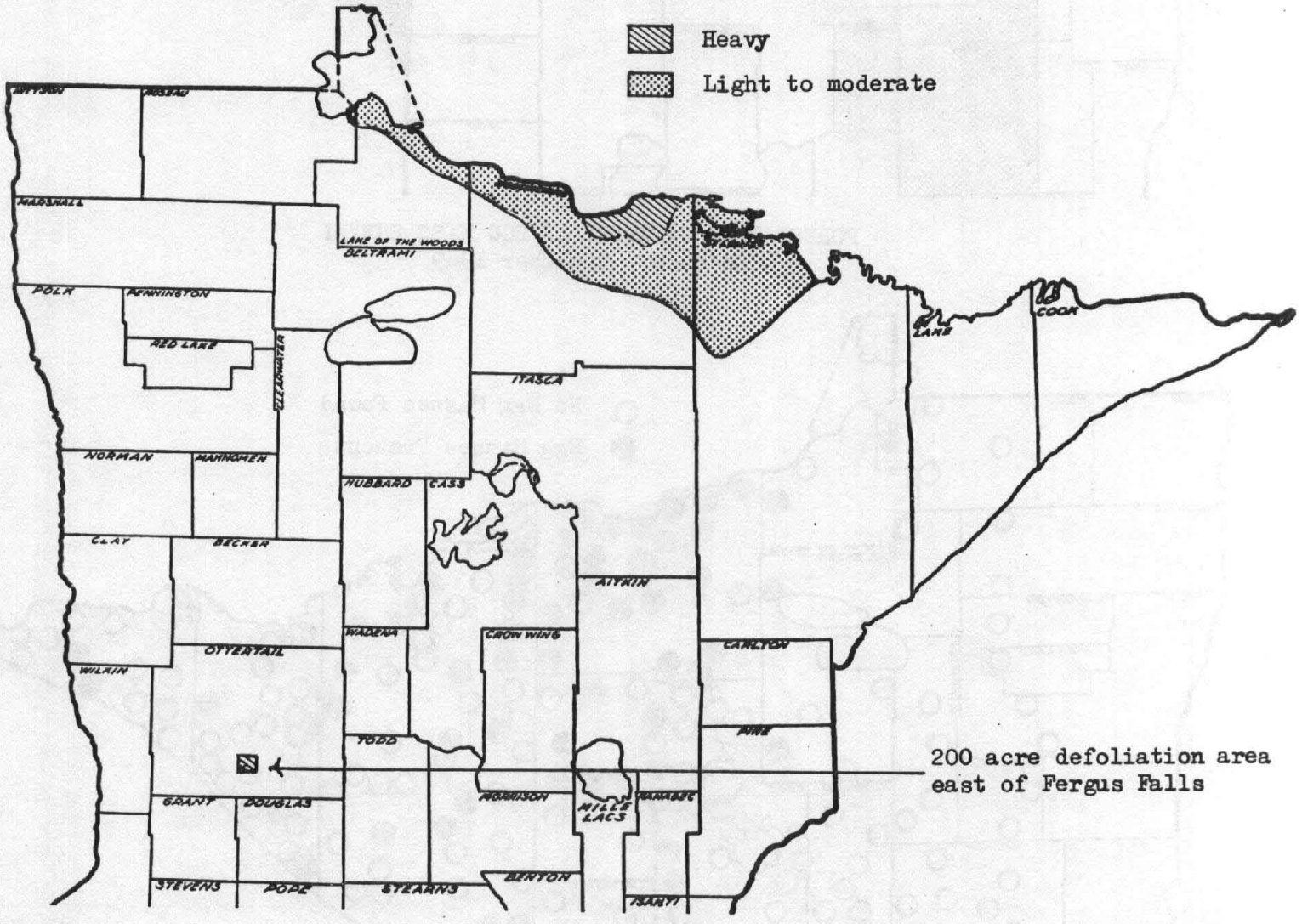
May 7 - Over 50% of eggs hatched.

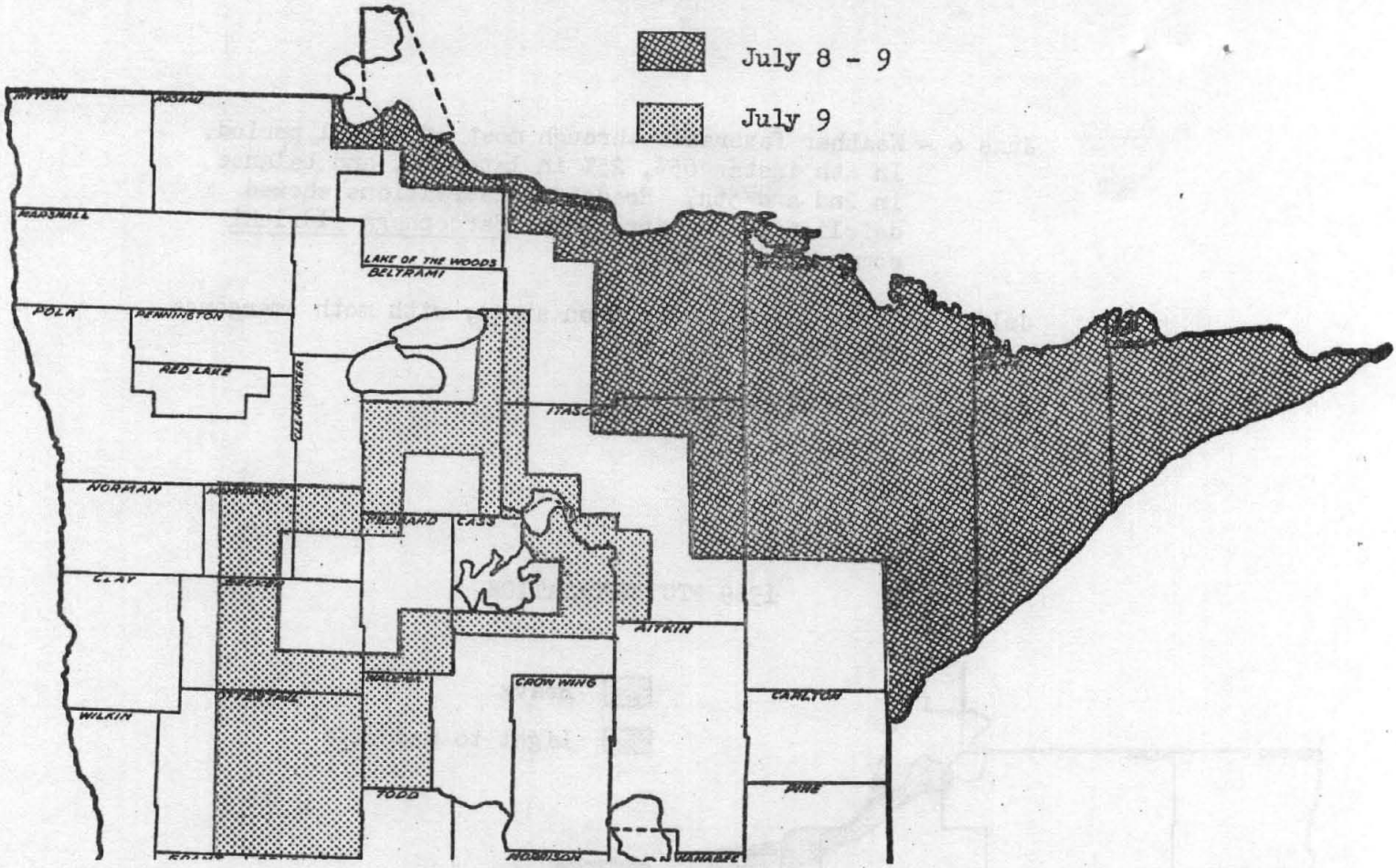
June 6 - Weather favorable through most of larval period. In 4th instar 65%, 25% in late 3rd, and balance in 2nd and 5th. Roadside observations showed defoliation now apparent. Sarcophaga aldrichi commonly observed.

July 8 - Virtually all in cocoon stage, with moth emergence beginning.

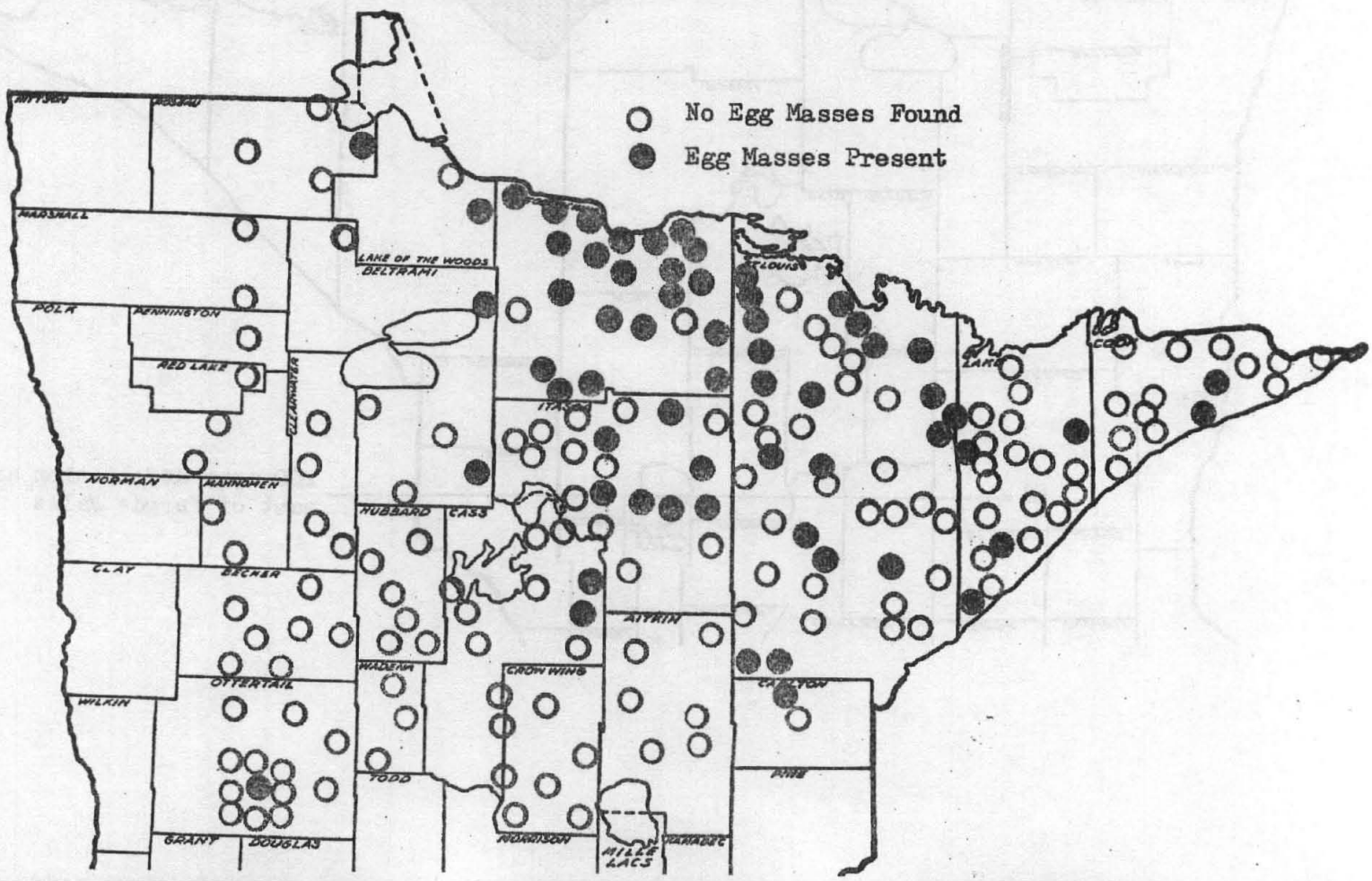
July 24 - Moth flight at peak.

1969 FTC DEFOLIATION






FOREST TENT CATERPILLAR EGG MASS SURVEY
October - December 1969



FOREST TENT CATERPILLAR EGG MASS SURVEY
October - December 1969
(shows only locations where 1969 masses were found)

| County | Closest Location | S | T | R | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|
| Beltrami | N. of Waskish | 24 | 155 | 31 | 0 | 0 | .3 |
| " | Pennington | 21 | 147 | 30 | .3 | 0 | .3 |
| Carlton | Cloquet | 22 | 49 | 18 | | 0 | .33 |
| Cass | Pine River | 8 | 137 | 29 | 0 | 0 | .7 |
| " | Remer | 21 | 142 | 26 | 0 | .3 | .3 |
| " | N. of Outing | 23 | 140 | 26 | 0 | .3 | .3 |
| Cook | SW of Grand Marais | 32 | 61 | 1 | 0 | 0 | .3 |
| Itasca | S. of Marcell | 4 | 57 | 26 | .3 | 0 | .7 |
| " | S. of Big Fork | 8 | 60 | 26 | 0 | 0 | .7 |
| " | Spring Lake | 16 | 148 | 25 | 0 | .7 | .3 |
| " | Bowstring | 3 | 146 | 25 | 0 | 0 | .3 |
| " | N. of Taconite | 16 | 57 | 24 | 0 | 0 | .3 |
| " | N. of Nashwauk | 18 | 57 | 22 | 3.0 | 0 | .7 |
| " | N. of Nashwauk | 12 | 59 | 23 | .7 | .3 | 1.0 |
| " | E. of Effie | 32 | 62 | 24 | 0 | .7 | 1.6 |
| Koochiching | NW Ray | 22 | 69 | 23 | 36 | 9.7 | 5.0 |
| " | E. of Littlefork | 9 | 68 | 24 | 8.3 | 3.7 | 1.3 |
| " | SW of Littlefork | 23 | 68 | 26 | 2.3 | 3.3 | 5.0 |
| " | S. of Clementson | 19 | 160 | 29 | 0 | 0 | 3.3 |
| " | SW Birchdale | 5 | 159 | 27 | .3 | 0 | 2.7 |
| " | S. of Birchdale | 22 | 158 | 27 | .3 | 0 | 6.0 |
| " | W. of Loman | 26 | 159 | 25 | 1.7 | 4.7 | 19.0 |
| " | S. of Loman | 11 | 157 | 25 | 3.0 | 1.3 | 7.0 |
| " | Jct. 71 & 11 | 32 | 70 | 25 | 15.7 | 23 + | 39.0 |
| " | International Falls | 25 | 70 | 24 | 50 + | 31 + | 20.7 |
| " | NE Margie | 31 | 154 | 25 | 1.3 | 0 | 2.7 |
| " | S. of Gemmell | 33 | 152 | 27 | 0 | .3 | .7 |
| " | E. of Northome | 24 | 151 | 27 | 0 | .3 | 1.3 |
| " | E. of Northome | 19 | 151 | 25 | 0 | 3.7 | 1.0 |
| " | S. of Big Falls | 28 | 65 | 26 | 1.0 | 2.0 | 1.3 |
| " | Rauch | 16 | 63 | 22 | 1.7 | .3 | .3 |
| " | W. of Nett Lake | 18 | 65 | 22 | 3.7 | 1.7 | 7.3 |
| " | Dentaybow | 16 | 67 | 24 | 1.3 | 1.0 | 3.0 |
| " | S. of Ray | 3 | 67 | 23 | 5.3 | 1.7 | 7.0 |

| County | Closest Location | S | T | R | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|
| Lake | | 31 | 62 | 11 | .7 | 0 | 1.0 |
| " | NE of Two Harbors | 18 | 55 | 9 | 2.0 | 0 | 1.0 |
| " | N. of Two Harbors | 36 | 53 | 11 | | | .33 |
| " | Windy Lake, E. Isabella | 28 | 61 | 6 | | .3 | .3 |
| " | N of Two Harbors | 32 | 60 | 10 | 1.3 | 0 | .7 |
| Lake O'Woods | Baudette | 20 | 159 | 30 | 0 | 0 | .7 |
| Ottertail | Fergus Falls | | 133 | 40 | | | .3 |
| Roseau | Roosevelt | 15 | 162 | 35 | 0 | 0 | .3 |
| St. Louis | Brookston | 11 | 50 | 19 | .7 | 0 | .33 |
| " | N. of Cromwell | 21 | 50 | 20 | 0 | 0 | .33 |
| " | N. of Cotton | 3 | 55 | 17 | 1.3 | 0 | 1.70 |
| " | Zim | 14 | 56 | 18 | .7 | .7 | .3 |
| " | N. Ash Lake | 12 | 67 | 21 | 4.3 | 3.7 | 9.7 |
| " | S. Kabetogama | 11 | 68 | 21 | 19.0 | .7 | 1.3 |
| " | Kabetogama | 18 | 69 | 21 | 30.7 | .7 | 1.3 |
| " | Jct. 803 & Echo Trail | 8 | 63 | 12 | 2.3 | .3 | 1.0 |
| " | N. of Duluth | 27 | 55 | 14 | 0 | 0 | .3 |
| " | Ash Lake | 22 | 66 | 20 | 1.3 | 0 | .3 |
| " | Crane Lake | 26 | 67 | 17 | 2.7 | 0 | 1.3 |
| " | S. of Gheen | 11 | 62 | 20 | .7 | 1.0 | .7 |
| " | NE of Cook | 29 | 63 | 18 | .7 | 0 | .3 |
| " | E. of Side Lake | 34 | 60 | 20 | 1.3 | 0 | .3 |
| " | W. of Tower | 16 | 61 | 17 | 2.7 | .7 | .3 |
| " | SW of Ely | 16 | 62 | 14 | | 0 | .3 |
| " | N. of High Lake | 1 | 65 | 16 | 4.3 | 0 | 1.3 |
| " | NW of Ely | 19 | 65 | 13 | 2.7 | 0 | .3 |
| " | Jct. Hwy. 16 & Hwy. 5 | 6 | 56 | 19 | 1.3 | 0 | .3 |

## LARGE ASPEN TORTRIX - *Choristoneura conflictana*

In recent years, aspen defoliation by the large aspen tortrix has been widely scattered and of a light to moderate level. In the early 1960's there were reports of many areas of heavy defoliation in Koochiching, St. Louis, Lake, and Cook Counties. These were not well described, with no aerial surveys and minimal gound observation. Very few of these locations had successive years of complete or nearly complete defoliation. From 1965 through 1968, most all reports and observations revealed small pockets of light to moderate defoliation, mostly in Koochiching and St. Louis Counties.

In 1969, widespread reports were received of moderate to heavy defoliation in scattered locations in Beltrami, Lake of the Woods, Hubbard, Koochiching, Cass, Itasca, Carlton, St. Louis, Cook, and Lake Counties; as indicated on the map. There was an estimated 150,000 acres of aspen type with defoliation in excess of 70%, principally in St. Louis and Cook Counties.

A number of areas, especially in Carlton, Beltrami, and Itasca Counties had *Enargia decolor* and *C. conflictana* defoliating the same aspen stands.

On June 17 and 18, 1400 pupae were collected to determine parasitism, as follows:

490 emerged as adults - 35%
390 parasitized by Tachinids and Sarcophagids
220 parasitized by Ichneumonids
70 parasitized by Braconids
680 total parasitized - 48%
230 cause of mortality unknown - 17%

AERIAL SURVEY - JULY 9-10, 1969

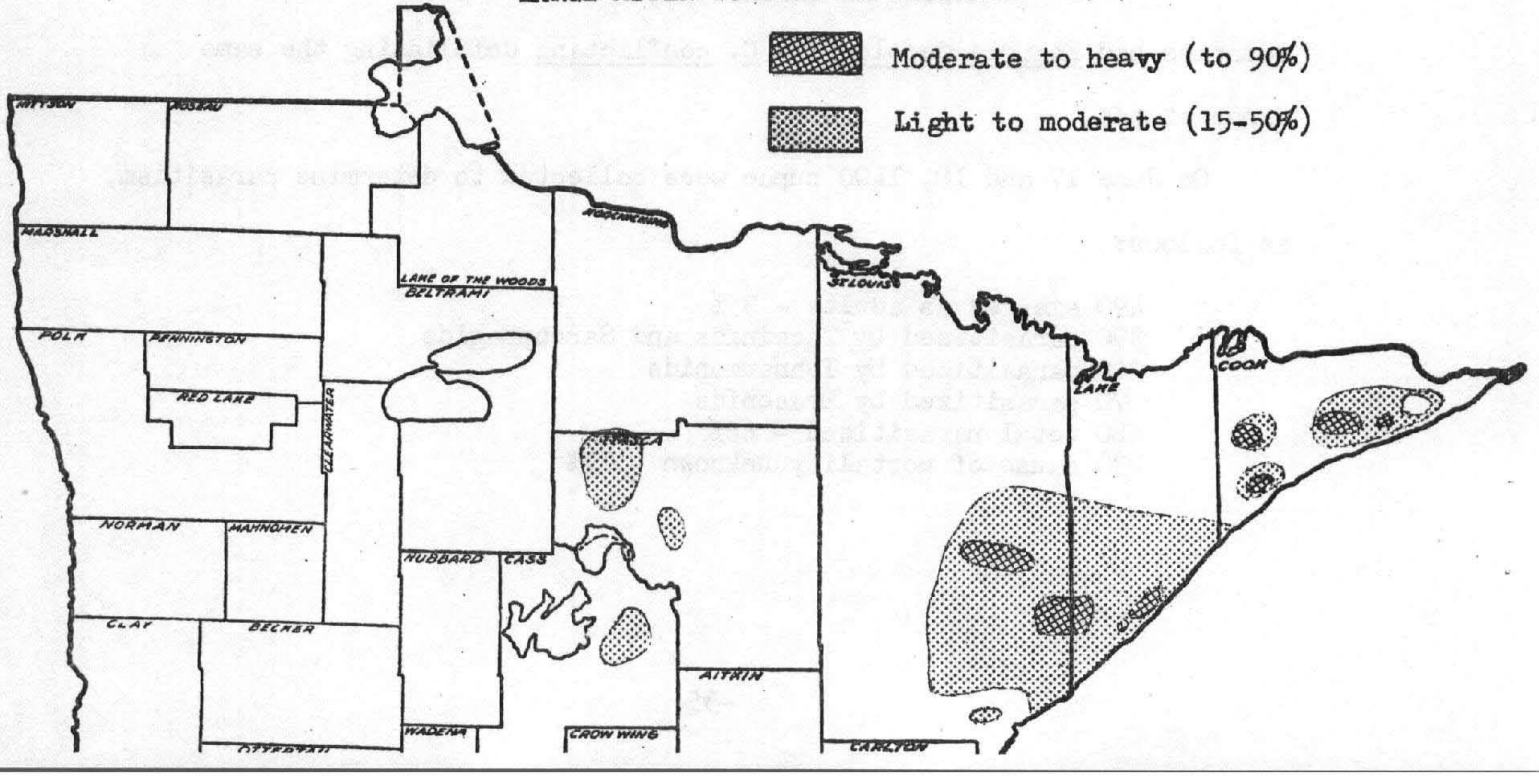
An aerial survey was conducted on July 9 and 10 in cooperation with the United States Department of Agriculture, Northeastern Area, Division of Forest Pest Control.

Methods

Flight lines were east and west at 6 to 12 mile intervals and at 1000 feet altitude. Six mile lines were flown over the more heavily defoliated areas, or those suspect areas from various reports. A Cessna 182 was used with a navigator and two observers. Large scale county maps were used with predetermined flight patterns and defoliation was sketched light to moderate (15 - 50%) and heavy (50 - 100%).

The following map indicates the areas of light to moderate and heavy defoliation. Much of this was in scattered patches, as there were many forest types other than aspen. The largest blocks of defoliation were in St. Louis and Lake Counties. There was additional light to very light defoliation (up to 15%) in Koochiching, Beltrami, Cass, Itasca, St. Louis, Lake, Cook, and Carlton Counties. Some of this exceeded 15%, but the areas were very small.

LARGE ASPEN TORTRIX DEFOLIATION - 1969



GROUND SURVEY AND OBSERVATIONS

Surveys were made on the ground following the aerial survey to determine whether the defoliator was the forest tent caterpillar, large aspen tortrix, or others. In the light to moderate and heavy defoliation areas, very few forest tent caterpillar cocoons were found; some E. decolor and only minor levels of other defoliators.

EGG MASS SURVEY - JULY 21-25

An egg mass survey was made in St. Louis, Cook, and Lake Counties in an attempt to make determinations of 1970 population possibilities. Counts were made on 3" to 4" DBH trees. Three 15 to 20 inch branches with average foliage were checked per tree. The same locations will be checked early in 1970 for overwintering larval success and will also possibly relate what values both the egg mass and early larval surveys may have in defoliation predictions.

An average of egg masses per 15 inch twig sample is given for a number of locations in the following tabulations.

LARGE ASPEN TORTRIX EGG MASSES
PER 15 INCH TWIG SAMPLE

| Location | T | R | Egg Masses/Sample |
|---|---|---|---|
| Hovland | 62N | 4E | 1.8 |
| Cloquet Valley State Forest | | | 1.1 |
| Carlton County | 48N | 17W | 1.4 |
| St. Louis County | 57N | 15W | 1.2 |
| " | 58 | 15 | 3.7 |
| " | 59 | 15 | 0.0 |
| " | 60 | 15 | 1.7 |
| " | 61 | 15 | 1.0 |
| " | 62 | 15 | 1.7 |
| " | 62 | 15 | 0.0 |
| " | 62 | 13 | 0.0 |
| " | 62 | 18 | .3 |
| " | 64 | 18 | 0.0 |
| " | 64 | 17 | 0.0 |

| Location | T | R | Egg Masses/Sample |
|---|---|---|---|
| St. Louis County | 65 | 17 | 0.0 |
| " | 65 | 18 | 0.0 |
| " | 57 | 19 | 0.0 |
| " | 60 | 18 | 0.0 |
| " | 64 | 21 | 0.0 |
| " | 58 | 15 | 3.7 |
| " | 59 | 14 | 7.3 |
| Koochiching County | 69 | 23 | 0.0 |
| " | 66 | 24 | 0.0 |
| " | 65 | 22 | 0.0 |
| Beltrami County | 147 | 30 | 0.0 |
| " | 148 | 30 | 0.0 |
| " | 150 | 30 | 0.0 |
| N. of Waskish | | | 0.0 |
| N. of Blackduck | | | 0.0 |
| Rapid R. Crossing on State #72 | | | 0.0 |
| Cass County, N. of Williams | | | 0.0 |
| Hubbard | 143 | 33 | 0.0 |
| Hubbard | 145 | 33 | 0.0 |

All plots were selected in light to heavy defoliation areas, or in that vicinity where foliage was available. The survey was made in a number of the defoliation areas in a random pattern, so this survey will not give any prediction basis for overall 1970 defoliation. Even so, it may be used as an indicator in certain locations.

LARGE ASPEN TORTRIX DEVELOPMENT

June 6 - middle instar

June 27 - moths beginning to emerge in east central Minnesota. Last instars and pupating in areas further north.

July 11 - mostly in adult moth stage.

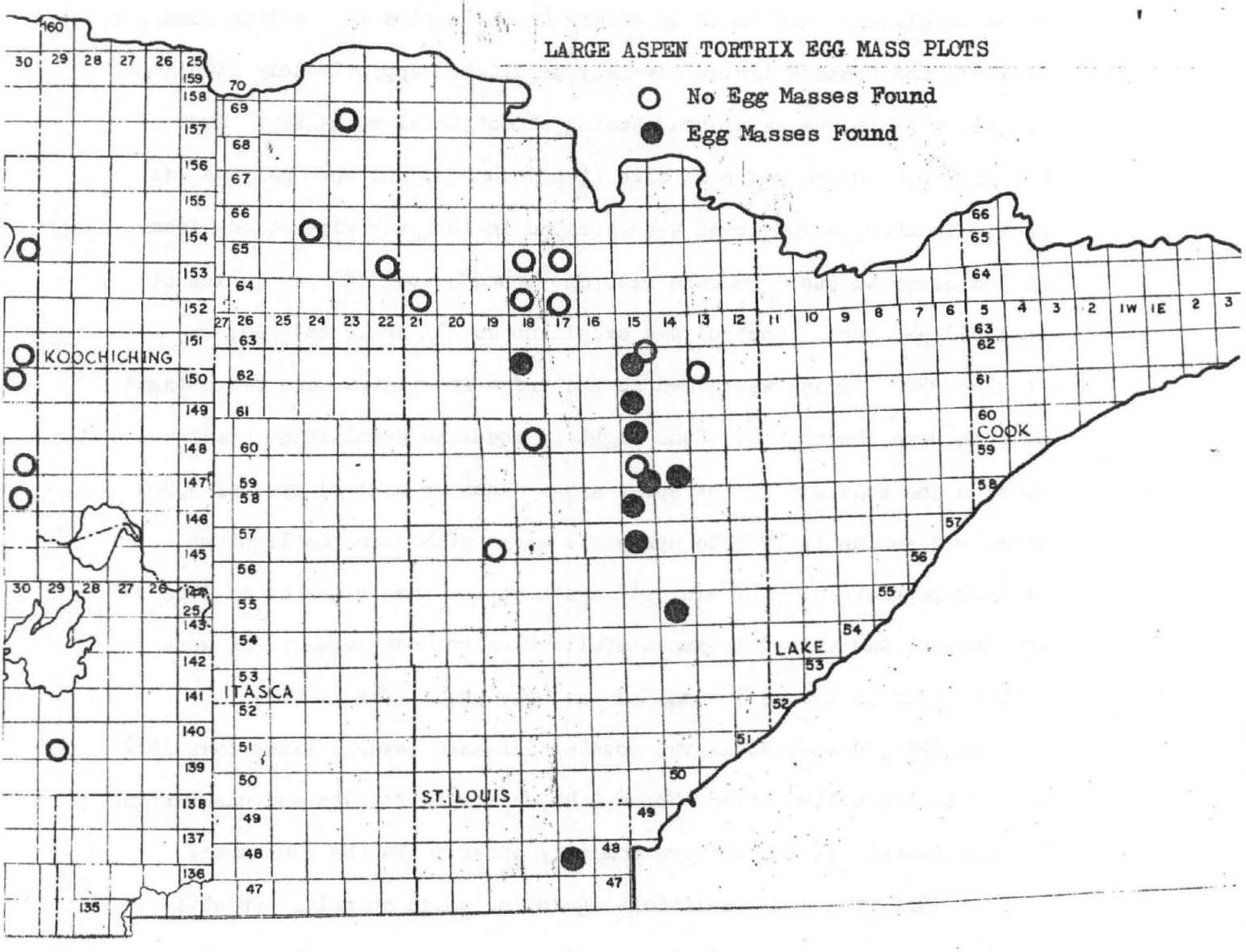
July 18 - heavy moth flight in Duluth, Minnesota, accumulating in high numbers around lights and homes.

August 1 - egg masses commonly observed on upper side of aspen leaves. No hatch so far.

SUMMARY

Previous records of serious large aspen tortrix outbreaks in Minnesota show that they seldom persist for more than one year in the same locations.

In 1970 follow-up will be made in all areas of 1969 defoliation and with combined survey information it is hoped that a better prediction method will result.



PINE TUSSOCK MOTH - Dasychira plagiata

First indications of the previous high population cycle of the pine tussock moth were noted in 1959. In 1960, the larvae were causing some light defoliation northeast of Willow River in Pine and Carlton Counties. In 1961, the tussock larvae severely defoliated approximately 1500 acres of jack pine in the same area causing almost total mortality. Much of the jack pine stand was pole size (4-6 inch DBH) and some salvage was made. In 1962, 4,200 acres were sprayed in the jack pine stands from Willow River to Sturgeon Lake with one pound actual DDT per gallon of fuel oil per acre. Control was excellent in all areas covered; exceeding 98%. Timing was aimed at the 3rd - 4th instar when percentages of both were about even. Some light to moderate defoliation remained outside and adjacent to the spray area. Another control area of 5,600 acres was set up in 1963 to spray all areas with even the lightest tussock population. DDT was used again at the same rates as in 1962 and control was extremely successful. Pine tussock populations were normal again in 1964 and remained that way until 1968.

In 1968, dropcloth larval counts increased several times over 1967 counts in the Willow River-Moose Lake jack pine forests and plantations. In late August egg masses were commonly observed in the same area.

In 1969, tussock populations again increased sharply, but still not to a level where chemical controls would be needed. The maximum defoliation was very light, up to 10 or 15%.

Approximately 17,000 acres were found to have very light to moderate populations of the pine tussock larvae after all surveys were

completed in 1969. Approximately 25 - 40% of this total area is in jack pine. It appears that 1970 defoliation will be very light to moderate in this area with a few spots that will have to be watched closely for heavier defoliation. No chemical control is projected at the present time, but an emergency operation will be ready if needed. An intense survey is planned in northern Pine and Carlton Counties in May and early June of 1970 to locate additional small infestation pockets.

TUSSOCK DEVELOPMENT IN 1969

June 27 - 4th and 5th instars, Pine County.

July 3 - mostly 5th instar, some 6th.

July 18 - 30% pupated.

July 25 - 90% in pupation, moth emergence just beginning.

July 28 - 15% moth emergence, some last instar still feeding, some egg masses observed.

August 13 - high egg mass counts in Pine County, some 1st instar larvae adjacent to eggs - about 1% hatch.

August 22 - almost complete hatch, larvae in 1st and 2nd instar.

MATACIL TEST ON PINE TUSSOCK

Area - 122 acres in north Pine County.

Rate - 8 fluid ounces of 3.0 lbs. Matacil mixed with 8 fluid ounces of Panasol.

Date - June 20

Equipment - helicopter with 830077 nozzles calibrated to spray 16 fluid ounces per acre, swath width 125 feet.

Wind velocity - 4 to 8 mph., with several gusts to 12 mph.

Temperature - 50°-55° during application.

Sampling methods - pre and post spray drop cloth sampling, 3 trees per plot.

Control success - 67 - 71% tussock mortality.

LIGHT TRAP COLLECTIONS - General Andrews Nursery
Willow River, Minnesota

Dark light trap with a combination of Vapona EC and Carbon tetrachloride for the killing agent, operated one day per week.

July 23 - 4 females

July 30 - 7 females, 34 males

August 7 - 13 females, 22 males

August 13 - 4 females, 9 males

PINE TUSSOCK CONTROL IN GENERAL ANDREWS NURSERY

General Andrews State Nursery is in the center of the infestation area. Thus, in October of 1969, 1,535 pine seedlings were taken from beds to be lifted in the spring of 1970 and checked for overwintering populations of the pine tussock. The larvae are in the 2nd instar at this stage and are found in the dense whorl at the top of the seedlings. The seedlings were collected from 70 plots distributed throughout the nursery. After combing through all of the seedlings a total of only 7 larvae were found., although the margin of error in larvae that were not detected could be quite high. A chemical control will be made on all of the seedlings, some 6 to 8 million, next spring (1970) either before or at the time of lifting. Both fumigation and spray application methods are being considered at the present time.

1969 TUSSOCK LARVAL AND EGG MASS COUNTS - Pine & Carlton Counties

| Plot # | Location | S | T | R | Larval Counts | | | Egg Mass Count | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | NE¼ of NW¼ | 12 | 45 | 20 | 1 | 0 | 2 | 0 | 0 | 1 |
| 2 | SE¼ of NW¼ | 12 | 45 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | SE¼ of SE¼ | 11 | 45 | 20 | | | | 0 | 0 | 0 |
| 4 | SW¼ of NE¼ | 12 | 45 | 20 | 0 | 2 | 1 | 1 | 0 | 0 |
| 5 | SW¼ of NW¼ | 7 | 45 | 19 | 2 | 0 | 0 | 2 | 5 | 0 |
| 6 | NE¼ of SW¼ | 6 | 45 | 19 | | | | 0 | 0 | 0 |
| 7 | NE¼ of SE¼ | 7 | 45 | 19 | | | | 0 | 1 | 0 |
| 8 | NW¼ of SW¼ | 17 | 45 | 19 | | | | 1 | 2 | 0 |
| 9 | SW¼ of SW¼ | 17 | 45 | 19 | | | | 5 | 3 | 7 |
| 10 | NW¼ of NE¼ | 19 | 45 | 19 | 0 | 0 | 1 | 2 | 0 | 1 |
| 11 | SE¼ of SW¼ | 18 | 45 | 19 | 17 | 33 | 7 | 28 | 70 | 31 |
| 12 | SW¼ of SE¼ | 13 | 45 | 20 | 14 | 3 | 0 | 13 | 7 | 3 |
| 13 | SW¼ of SW¼ | 18 | 45 | 19 | | | | 4 | 9 | 5 |
| 14 | NW¼ of SE¼ | 24 | 45 | 20 | 2 | 22 | 9 | 7 | 17 | 11 |
| 15 | SW¼ of NE¼ | 23 | 45 | 20 | | | | 3 | 5 | 1 |
| 16 | NW¼ of NW¼ | 13 | 45 | 20 | 7 | 0 | 2 | 1 | 4 | 0 |
| 17 | NE¼ of SW¼ | 24 | 45 | 20 | 2 | 16 | 21 | 13 | 29 | 9 |
| 18 | SW¼ of SW¼ | 19 | 45 | 19 | 20 | 13 | 12 | 19 | 7 | 11 |
| 19 | SW¼ of SW¼ | 25 | 45 | 20 | 2 | 4 | 13 | 13 | 5 | 9 |
| 20 | SE¼ of NW¼ | 36 | 45 | 20 | | | | 3 | 7 | 5 |
| 21 | SW¼ of SE¼ | 26 | 45 | 20 | | | | 1 | 0 | 2 |
| 22 | SW¼ of NE¼ | 35 | 45 | 20 | | | | 0 | 0 | 0 |
| 23 | NW¼ of NE¼ | 2 | 44 | 20 | 0 | 1 | 0 | 2 | 0 | 0 |
| 24 | NE¼ of NE¼ | 2 | 44 | 20 | 1 | 2 | 1 | 0 | 1 | 0 |
| 25 | NE¼ of NW¼ | 11 | 44 | 20 | | | | 1 | 0 | 0 |
| 26 | SE¼ of NE¼ | 11 | 44 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| 27 | NW¼ of SW¼ | 12 | 44 | 20 | | | | 0 | 0 | 0 |
| 28 | NE¼ of NE¼ | 13 | 44 | 20 | 0 | 1 | 0 | 0 | 0 | 1 |
| 29 | NE¼ of SW¼ | 7 | 44 | 19 | | | | 0 | 0 | 0 |
| 30 | NE¼ of NW¼ | 8 | 44 | 19 | | | | 0 | 2 | 0 |
| 31 | NE¼ of SW¼ | 5 | 44 | 19 | 0 | 0 | 0 | 0 | 1 | 4 |
| 32 | NW¼ of NW¼ | 4 | 44 | 19 | | | | 0 | 0 | 1 |
| 33 | SW¼ of NW¼ | 5 | 44 | 19 | | | | 0 | 2 | 5 |
| 34 | SE¼ of NW¼ | 6 | 44 | 19 | | | | 7 | 18 | 5 |
| 35 | SW¼ of NW¼ | 6 | 44 | 19 | 0 | 0 | 1 | 19 | 8 | 12 |
| 36 | NE¼ of NE¼ | 12 | 44 | 20 | | | | 0 | 3 | 4 |
| 37 | SE¼ of SW¼ | 27 | 45 | 19 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | NE¼ of NW¼ | 29 | 45 | 19 | | | | 0 | 1 | 0 |
| 39 | SE¼ of NW¼ | 30 | 45 | 19 | 4 | 1 | 2 | 13 | 7 | 6 |
| 40 | SW¼ of SW¼ | 29 | 45 | 19 | 0 | 3 | 1 | 1 | 5 | 0 |
| 41 | SE¼ of SE¼ | 25 | 45 | 20 | 10 | 31 | 19 | 29 | 13 | 91 |
| 42 | SE¼ of SE¼ | 15 | 44 | 20 | | | | 0 | 0 | 0 |

PINE TUSSOCK DROPCLOTH COLLECTIONS
Other than Pine & Carlton Counties

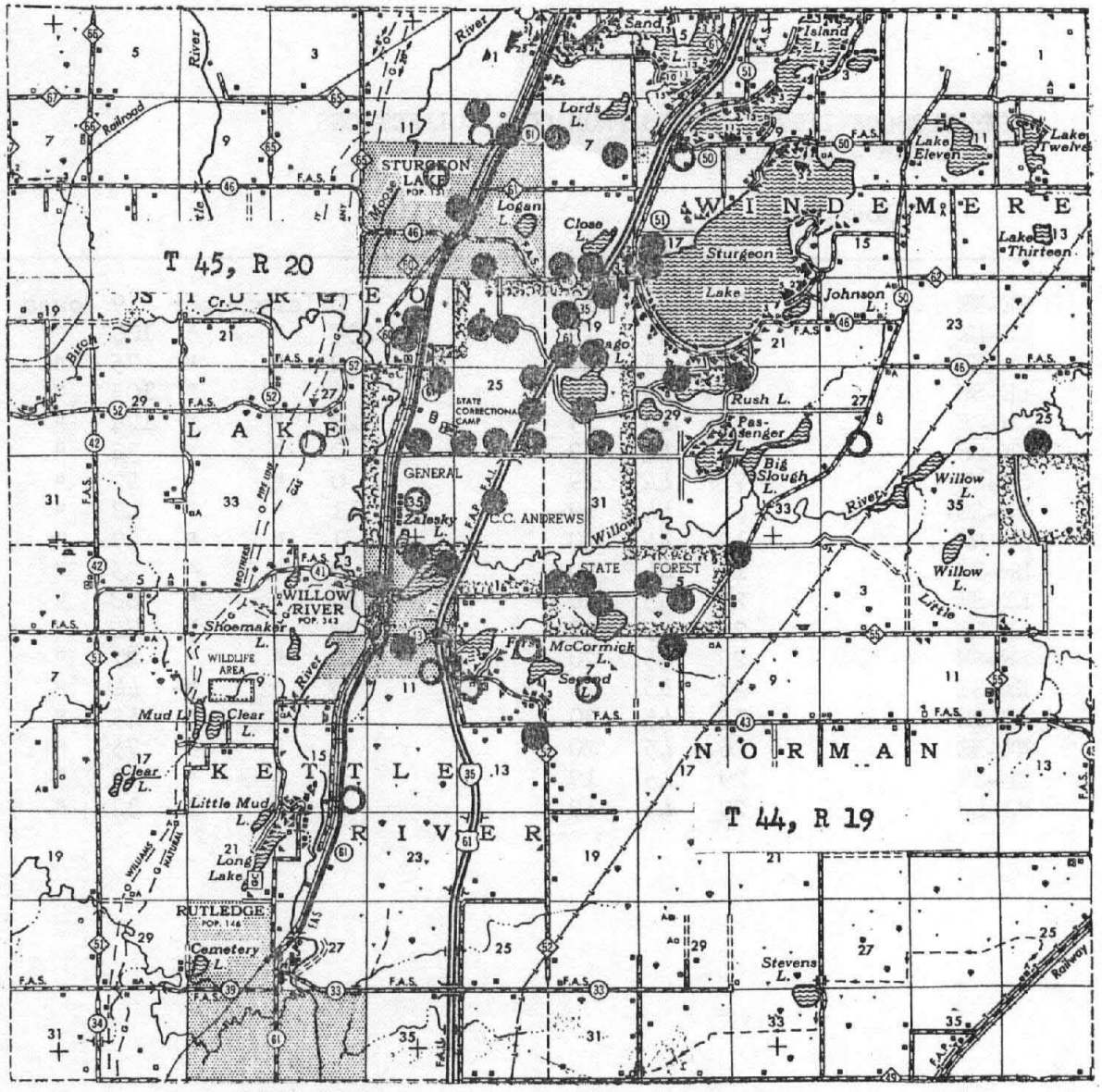
| Location | S | T | R | County | No. of Larvae* |
|---|---|---|---|---|---|
| SE-NW | 11 | 40 | 18 | Pine | 1 |
| SE-NE | 17 | 40 | 18 | Pine | 1 |
| SE-NE | 36 | 141 | 33 | Hubbard | 1 |
| SW-SW | 29 | 136 | 29 | Cass | 1 |
| NW-SE | 21 | 133 | 29 | Cass | 1 |
| SE-SW | 11 | 138 | 32 | Cass | 3 (on 7 trees) |
| NW-SE | 26 | 140 | 31 | Cass | 1 |
| Nisswa, on 13, ¼ mile W. of 371 | | | | Crow Wing | 1 |
| St. Regis Paper Co. Tree Farm, just N. of Little Rock Lake | | | | | 1 (on 4 trees) |
| Rice, Hwy. 371, 1 mile E., then 2 miles S. | | | | | 1 (on 4 trees) |
| NW-SE | 2 | 44 | 31 | Crow Wing | 1 |
| SW-NW | 19 | 133 | 30 | Cass | 2 (on 6 trees) |
| SE-NW | 32 | 133 | 32 | Todd | 1 |
| SW-NE | 25 | 136 | 27 | Crow Wing | 1 (on 5 trees) |
| NW-SW | 1 | 136 | 27 | Crow Wing | 1 (on 4 trees) |
| SE-SW | 34 | 141 | 31 | Cass | 1 |
| NW-NE | 5 | 133 | 28 | Crow Wing | 1 |
| NE-NE | 5 | 132 | 30 | Morrison | 1 |
| NW-SE | 10 | 44 | 31 | Crow Wing | 1 |
| NW-SE | 8 | 139 | 30 | Cass | 1 |
| SE-SW | 12 | 139 | 33 | Hubbard | 1 |
| SE-NW | 34 | 139 | 35 | Hubbard | 1 |
| NW-NW | 17 | 133 | 30 | Cass | 2 (on 5 trees) |
| SE-SE | 10 | 133 | 29 | Crow Wing | 2 |
| SW-SW | 22 | 137 | 28 | Crow Wing | 1 |
| NE-SE | 31 | 134 | 28 | Crow Wing | 2 |
| NE-SW | 21 | 139 | 29 | Cass | 1 |
| SW-SE | 10 | 139 | 30 | Cass | 1 |
| SW-SE | 2 | 140 | 27 | Cass | 2 |
| NE-SE | 2 | 46 | 29 | Crow Wing | 1 |
| NE-SW | 20 | 46 | 29 | Crow Wing | 1 |
| SW-NE | 25 | 136 | 27 | Crow Wing | 1 |
| SW-SW | 1 | 137 | 29 | Cass | 1 |
| NW-NW | 17 | 43 | 30 | Crow Wing | 2 (on 4 trees) |
| SE-SW | 21 | 44 | 31 | Crow Wing | 1 |
| E of County Rd. 21 | 44 | 23 | 31 | Crow Wing | 2 |
| NW-NW | 14 | 44 | 31 | Crow Wing | 3 |
| NE-NE | 9 | 45 | 30 | Crow Wing | 8 (on 4 trees) |
| NE-SE | 9 | 45 | 30 | Crow Wing | 2 |
| NE-NE | 9 | 45 | 30 | Crow Wing | 4 (on 6 trees) |
| NE-SE | 35 | 46 | 30 | Crow Wing | 2 (on 4 trees) |
| SE-SE | 36 | 138 | 31 | Cass | 1 (on 4 trees) |
| SE-SE | 8 | 33 | 28 | Crow Wing | 1 |
| SE-SE | 36 | 138 | 31 | Cass | 1 |
| SW-NE | 24 | 137 | 27 | Crow Wing | 1 |
| NE-SW | 5 | 133 | 28 | Crow Wing | 1 |
| SE-NW | 11 | 57 | 16 | St. Louis | 1 |

* collected on 3 trees unless otherwise noted

PINE TUSSOCK LARVAL COUNTS FROM CONE COLLECTIONS
November - December 1969

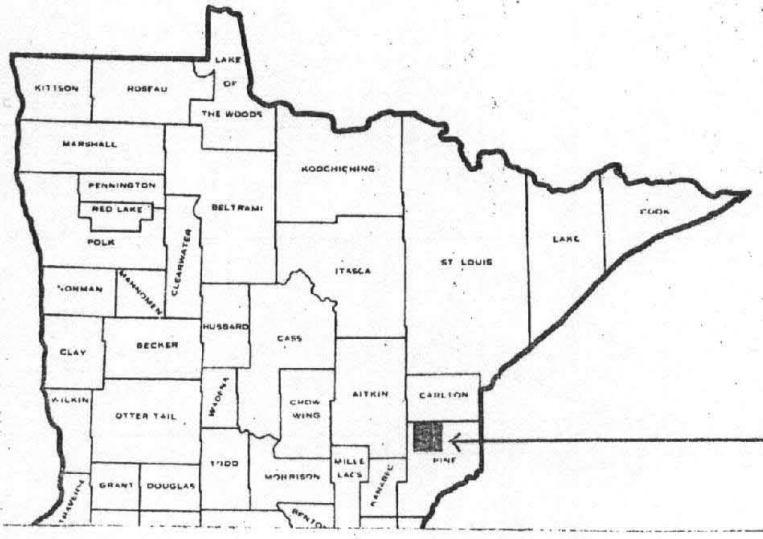
| Location | S | T | R | | | | | |
|---|---|---|---|---|---|---|---|---|
| SE-NE | 7 | 45 | 19 | 0 | Larvae | per | 19 | cones |
| SE-NW | 19 | 45 | 19 | 237 | " | " | 100 | " |
| NW-NW | 28 | 45 | 19 | 2 | " | " | 75 | " |
| SE-SW | 25 | 45 | 19 | 6 | " | " | 105 | " |
| SW-SE | 30 | 45 | 19 | 128 | " | " | 124 | " |
| NW-SE | 5 | 44 | 19 | 0 | " | " | 38 | " |
| SE-SW | 7 | 44 | 19 | 0 | " | " | 42 | " |
| NW-SE | 6 | 44 | 19 | 11 | " | " | 48 | " |
| SW-NW | 12 | 44 | 20 | 1 | " | " | 39 | " |
| NW-SE | 15 | 44 | 20 | 0 | " | " | 25 | " |
| NE-SE | 25 | 45 | 20 | 24 | " | " | 88 | " |
| NE-NE | 25 | 45 | 20 | 39 | " | " | 74 | " |
| SW-SW | 25 | 45 | 20 | 54 | " | " | 27 | " |
| NW-SE | 23 | 45 | 20 | 5 | " | " | 44 | " |
| SE-NW | 35 | 45 | 20 | 0 | " | " | 45 | " |
| NE-NE | 26 | 45 | 20 | 3 | " | " | 75 | " |
| SE-SW | 29 | 45 | 19 | 2 | " | " | 30 | " |
| SE-SW | 29 | 45 | 19 | 4 | " | " | 32 | " |

# PINE TUSSOCK INFESTATION MAP




○ No Larva Found

● Larvae From Dropcloth or Cone Survey Found or Egg Masses Found




Pine Tussock Infestation Area in Northern Pine County

## JACK PINE BUDWORM - *Choristoneura pinus*

In 1968, jack pine budworm populations were low, with the exception of the east central area in Minnesota between Rutledge and Barnum. There was erratic defoliation from light to heavy in this area. Moderate to heavy defoliation totaled approximately one thousand acres.

The 1969 population was even lower with extremely low counts in the Brainerd-Bemidji and Baudette-Warroad areas and light with some moderate defoliation pockets in east central and northeast Minnesota.

A 200 acre area was sprayed with Matacil on June 20, 1969 with moderate results shown below. This contrasts with excellent Matacil results in 1968. There are a number of possible factors that could be responsible for the poorer 1969 results, such as cooler temperature, higher average wind velocity, and instar spread (2nd through 5th instar present). The budworms were developing rapidly until June 12-14, when cool weather set in. Unfortunately, sprayers have to be notified at least a short time in advance, so it is almost impossible to change timing on such a tiny control program.

MATACIL CONTROL TEST

One hundred twenty-two acres of jack pine were sprayed in the vicinity of Willow River, Minnesota, using 8 fluid ounces of 3.0 lb. Matacil mixed with 8 fluid ounces of Panasol per acre. Application was on June 20, 1969 using a helicopter equipped with 830077 nozzles calibrated to spray sixteen fluid ounces per acre with a swath width of 125 feet. The wind velocity was to 8 mph. with several gusts to 12 mph. The temperature range was 50 - 55°.

Eleven plots were sampled pre and post spray with a dropcloth using beating methods. Budworm mortality in the treated area was 59% in a 62 acre location and 47% in a 60 acre plot.

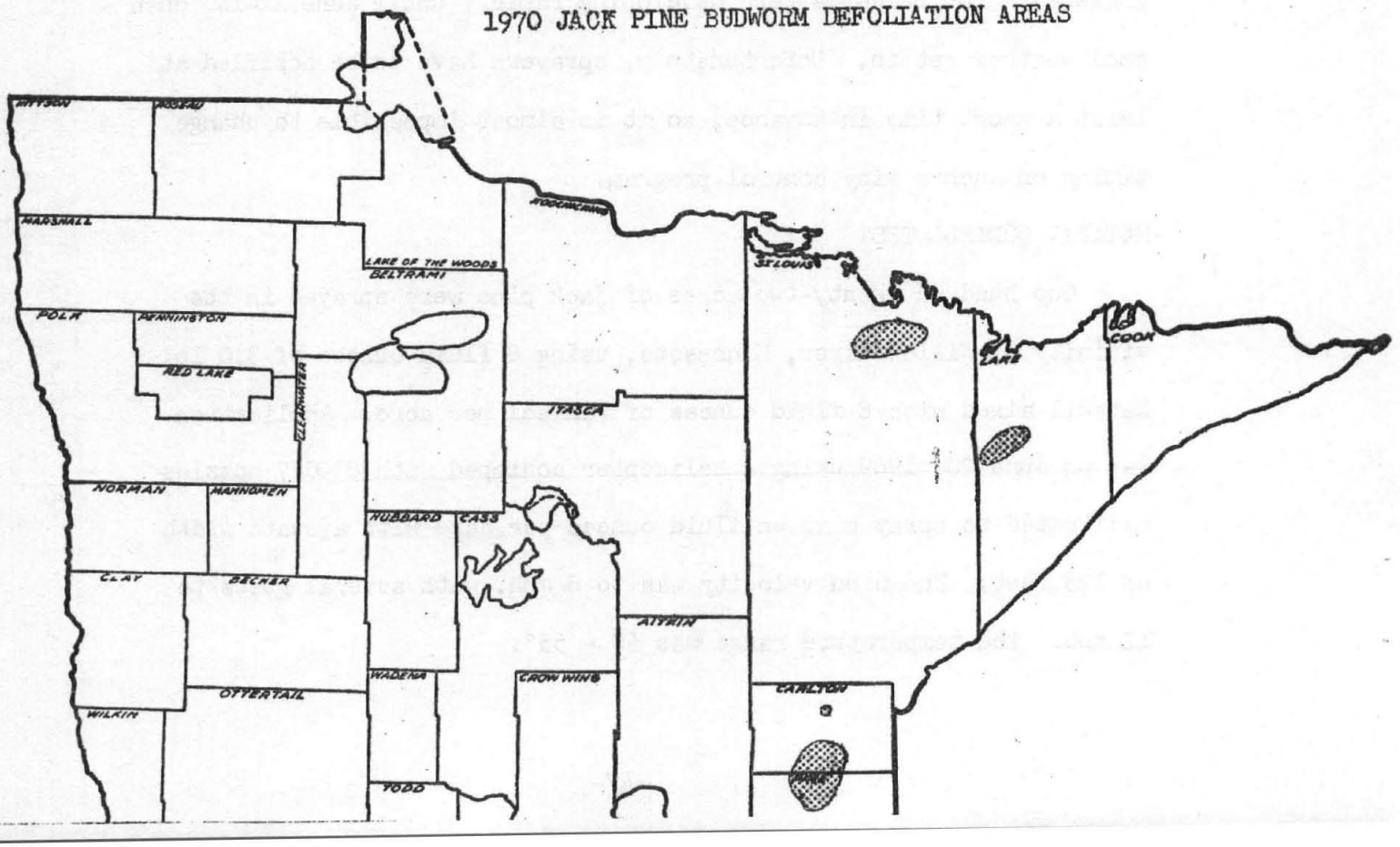
Since Matacil effectiveness was approximately 90% or more in 1968, and with so many adverse factors in 1969, this chemical still appears to have very good potential even though the percentage budworm control was only 47 - 59%.

1969 SUMMARY AND 1970 PROJECTION

The map below indicates the light to moderate jack pine budworm defoliation areas in 1969. The light to moderate areas in the Superior National Forest were compiled from surveys conducted by the United States Department of Agriculture, Forest Service.

In 1970, it appears that the only moderate or higher defoliation will be in the Superior National Forest and a few small locations in the Brainerd area.

1970 JACK PINE BUDWORM DEFOLIATION AREAS



JACK PINE BUDWORM DROPCLOTH SURVEY - July, 1969

| County | "40" | S | T | R | Budworm Larvae |
|---|---|---|---|---|---|
| Becker | SW-SE | 10 | 140 | 37 | 0 |
| " | | 11 | 141 | 36 | 0 |
| " | SE-SE | 12 | 141 | 37 | 0 |
| " | NW-NW | 35 | 140 | 36 | 0 |
| Beltrami | NE-NE | 4 | 147 | 35 | 20 |
| " | NE-SW | 16 | 146 | 35 | 0 |
| " | | 17 | 146 | 31 | 1 |
| " | NE-SE | 17 | 147 | 32 | 0 |
| " | SE-SE | 17 | 147 | 34 | 5 |
| " | SW-NW | 21 | 147 | 33 | 0 |
| " | SE-SW | 29 | 148 | 32 | 0 |
| Cass | SW-SW | 1 | 137 | 29 | 3 |
| " | SW-SE | 2 | 140 | 27 | 0 |
| " | SW-SW | 3 | 141 | 30 | 0 |
| " | NW-NW | 5 | 139 | 30 | 1 |
| " | NW-SE | 5 | 139 | 30 | 0 |
| " | SE-NE | 5 | 140 | 27 | 0 |
| " | NW-SW | 7 | 134 | 31 | 4 |
| " | NE-SW | 7 | 134 | 29 | 0 |
| " | NW-NW | 8 | 137 | 29 | 43 |
| " | NW-SW | 8 | 134 | 30 | 0 |
| " | SW-NE | 8 | 137 | 29 | 0 |
| " | SE-NE | 8 | 141 | 27 | 0 |
| " | NW-NW | 9 | 141 | 29 | 0 |
| " | SW-SE | 10 | 139 | 30 | 0 |
| " | SE-SW | 13 | 139 | 27 | 0 |
| " | SE-SE | 13 | 139 | 30 | 0 |
| " | NE-NE | 14 | 133 | 30 | 0 |
| " | NW-NW | 17 | 133 | 30 | 1 |
| " | NW-SW | 17 | 139 | 30 | 7 |
| " | NW-NW | 17 | 141 | 31 | 0 |
| " | SW-SW | 17 | 138 | 30 | 0 |
| " | NE-SW | 21 | 139 | 29 | 0 |
| " | NE-SE | 21 | 137 | 29 | 1 |
| " | SE-NW | 27 | 140 | 27 | 0 |
| " | SE-NW | 28 | 143 | 31 | 0 |
| " | SE-SE | 28 | 143 | 31 | 0 |
| " | SE-SW | 33 | 140 | 30 | 1 |
| " | SE-NE | 36 | 139 | 27 | 0 |
| " | SE-SE | 36 | 138 | 31 | 7 |
| " | E-SE | 36 | 138 | 31 | 14 |
| Clearwater | SW-SE | 6 | 144 | 37 | 0 |
| " | NW-SE | 16 | 147 | 36 | 3 |
| " | NW-SE | 17 | 147 | 37 | 2 |
| " | SE-SW | 19 | 145 | 38 | 0 |
| " | SW-SE | 29 | 144 | 36 | 0 |

Jack Pine Budworm Dropcloth Survey continued:

| County | "40" | S | T | R | Budworm Larvae |
|---|---|---|---|---|---|
| Crow Wing | NE-SE | 2 | 46 | 29 | 0 |
| " | SE-NW | 2 | 134 | 28 | 0 |
| " | NW-SE | 2 | 136 | 28 | 0 |
| " | SW-SW | 4 | 45 | 30 | 18 |
| " | NW-SW | 5 | 33 | 28 | 2 |
| " | NW-SW | 5 | 33 | 131 | 1 |
| " | NE-SW | 5 | 133 | 28 | 2 |
| " | NW-SW | 6 | 133 | 28 | 2 |
| " | SE-SE | 8 | 33 | 28 | 14 |
| " | NW-SE | 9 | 45 | 30 | 0 |
| " | NE-NE | 9 | 45 | 30 | 1 |
| " | NE-SW | 9 | 45 | 30 | 0 |
| " | NE-SE | 9 | 45 | 30 | 0 |
| " | S-NE | 9 | 45 | 30 | 59 |
| " | SE-SE | 10 | 133 | 29 | 2 |
| " | SE-NW | 10 | 136 | 27 | 0 |
| " | SW-SW | 11 | 44 | 31 | 4 |
| " | NW-NW | 14 | 44 | 31 | 8 |
| " | NW-SE | 14 | 134 | 29 | 1 |
| " | SE-NW | 16 | 136 | 28 | 0 |
| " | NW-NW | 17 | 43 | 30 | 1 |
| " | SE-SE | 18 | 135 | 28 | 0 |
| " | SE-NW | 19 | 136 | 27 | 0 |
| " | NE-SW | 20 | 46 | 29 | 3 |
| " | SE-SW | 21 | 44 | 31 | 0 |
| " | SW-SW | 22 | 137 | 28 | 0 |
| " | NE-SE | 23 | 136 | 27 | 0 |
| " | SW-NW | 23 | 136 | 29 | 4 |
| " | SE-SE | 24 | 134 | 29 | 0 |
| " | SW-SE | 24 | 137 | 27 | 2 |
| " | SW-NE | 24 | 137 | 27 | 6 |
| " | SW-NE | 25 | 136 | 27 | 1 |
| " | SW-NW | 25 | 138 | 27 | 0 |
| " | SE-SE | 26 | 29 | 134 | 0 |
| " | NE-NE | 26 | 137 | 29 | 0 |
| " | NW-SE | 26 | 137 | 29 | 0 |
| " | NE-NE | 29 | 136 | 27 | 0 |
| " | SW-NE | 30 | 137 | 28 | 0 |
| " | NE-SE | 31 | 134 | 28 | 1 |
| " | NW-NE | 32 | 136 | 26 | 0 |
| " | SE-SW | 34 | 136 | 27 | 0 |
| " | NE-SE | 35 | 46 | 30 | 24 |
| " | | 44 | 23 | 31 | 0 |
| Hubbard | SW | 10 | 144 | 32 | 0 |
| " | NE-SE | 11 | 143 | 33 | 0 |
| " | SE-SW | 12 | 139 | 33 | 0 |
| " | SW-SE | 15 | 140 | 34 | 0 |

Jack Pine Budworm Dropcloth Survey continued:

| County | "40" | S | T | R | Budworm Larvae |
|---|---|---|---|---|---|
| Hubbard | NE-SE | 16 | 138 | 35 | 0 |
| " | NE-SW | 17 | 141 | 33 | 0 |
| " | NW | 22 | 144 | 35 | 0 |
| " | NW-NE | 27 | 144 | 34 | 0 |
| " | NE-SW | 29 | 141 | 32 | 0 |
| " | NE-NE | 33 | 142 | 34 | 0 |
| " | SE-NW | 34 | 139 | 35 | 0 |
| Itasca | NW-SE | 12 | 53 | 26 | 0 |
| Koochiching | NW-NW | 19 | 66 | 26 | 1 |
| " | NW-SW | 23 | 155 | 25 | 3 |
| " | SE-SE | 32 | 154 | 25 | 1 |
| Mahnomen | SW-NE | 35 | 146 | 39 | 0 |
| Morrison | SE-NE | 5 | 132 | 30 | 0 |
| Pine | NE-NW | 2 | 40 | 18 | 11 |
| " | SW-SW | 10 | 40 | 18 | 21 |
| " | SE-NW | 11 | 40 | 18 | 20 |
| " | SW-SW | 15 | 40 | 18 | 28 |
| " | SE-NE | 17 | 40 | 18 | 65 |
| " | SE-NE | 18 | 40 | 18 | 16 |
| Todd | SE-SE | 14 | 133 | 32 | 0 |
| " | NW-SW | 18 | 133 | 32 | 0 |

ASPEN LEAF TIER - Enargia decolor

An aspen leaf-tier has been causing light to moderate defoliation on aspen in central to north central Minnesota in 1968 and 1969. Moths were reared from larval collections in 1969 and tentatively identified as Enargia decolor (wlk). The descriptions are as follows:

1. Larvae (Larvae of the Phalaenidae - S. E. Crumb, 1956). "Head 3.1 to 3.2 mm. broad. Body 30 mm. long and 5mm. broad at middle, tapering posteriority, skin smooth, general color uniform, pale yellowish green. A small continuous but inconspicuous whitish mid-dorsal line. A more slender, inconspicuous pale line ventral of setigerous tubercle II. Spiracles dull white, included in the subventral stripe which is scarcely different in color from the remainder of the body except that it is margined by distinct white lines. Setigerous tubercles minute. Head pale, unmarked. The larvae live in a flat case made by fastening two leaves together."
2. Adult. Called the "Angle Striped Sallow" in The Moth Book by W. J. Holland. "The adult moth is buff colored, with two transverse lines on each forewing, which are deeply angled. Also, there are two lighter spots on each forewing. There is much variation among the moths. Sometimes the lines and spots are very distinct, and at other times very obscure."
3. Larval Habits (from 1968-1969 field observations). A solitary feeder, prefers reproduction size aspen, but also defoliates mature forest trees. Ties two aspen leaves together very well

at the margins where it apparently resides without feeding during daylight hours. The larvae were never observed feeding, thus it is assumed that any feeding would be done at night. Whether the larvae feeds from within the tied leaves or crawls out and defoliates other than its "home" was not observed. The last instar larvae are large, over one inch in length.

4. History. Information was not available on this problem in Minnesota, although it apparently must have been a "resident," at least in low population numbers. Canada reported the problem in a number of publications (see references). "Collected from New Brunswick to British Columbia. Pattern suggests this species is most common in Manitoba and Saskatchewan. Hosts: Trembling Aspen, White Birch, Balsam, Poplar, Willow, Largetooth Aspen, Speckled Alder. Larval collections were made in May through July in Ontario west to British Columbia, pupae late June through July, and the adult samples were from June through September." In annual reports of insect and disease surveys, widespread defoliation was reported in 1959 in central Canada, which decreased to scattered areas in subsequent years.

MINNESOTA INFESTATION - 1968

Moderate defoliation by an aspen leaf tier was commonly observed throughout Aitkin County, and in portions of Itasca and Cass in 1968. Some mature aspen forest defoliation in excess of 50% was observed in Aitkin County. Most damage occurred on reproduction aspen.

Light Trap Collections - 1968

Collections of Enargia decolor were tabulated from the following sources:

| Date | Northome (Koochiching Co.) | Thistledew (NE Itasca Co.) | Orr (St. Louis Co.) | Willow River (Pine Co.) |
|---|---|---|---|---|
| July 17 | 1 | | | |
| July 22 | | | 13 | |
| Aug. 20 | | 8 | | 15 |
| Aug. 21 | | | | |
| Aug. 22 | | | 11 | |
| Aug. 23 | | | | 4 |
| Aug. 28 | | | | 5 |
| Aug. 29 | 26 | | 164 | |
| Aug. 30 | | | | 38 |
| Sept. 6 | | | 76 | 1 |
| Sept. 12 | | 152 | 52 | |

MINNESOTA INFESTATION - 1969

Defoliation was less intense than in 1968, but more widespread, with little defoliation on aspen forest trees, and most on reproduction size in scattered locations across ten counties as shown on the following map. Defoliation was noted in June into August. Pupation was common throughout August and September.

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Canadian Department of Agriculture, Forest Biology Division, Annual Report of the Forest Insect and Disease Survey, p. 57, 1959.

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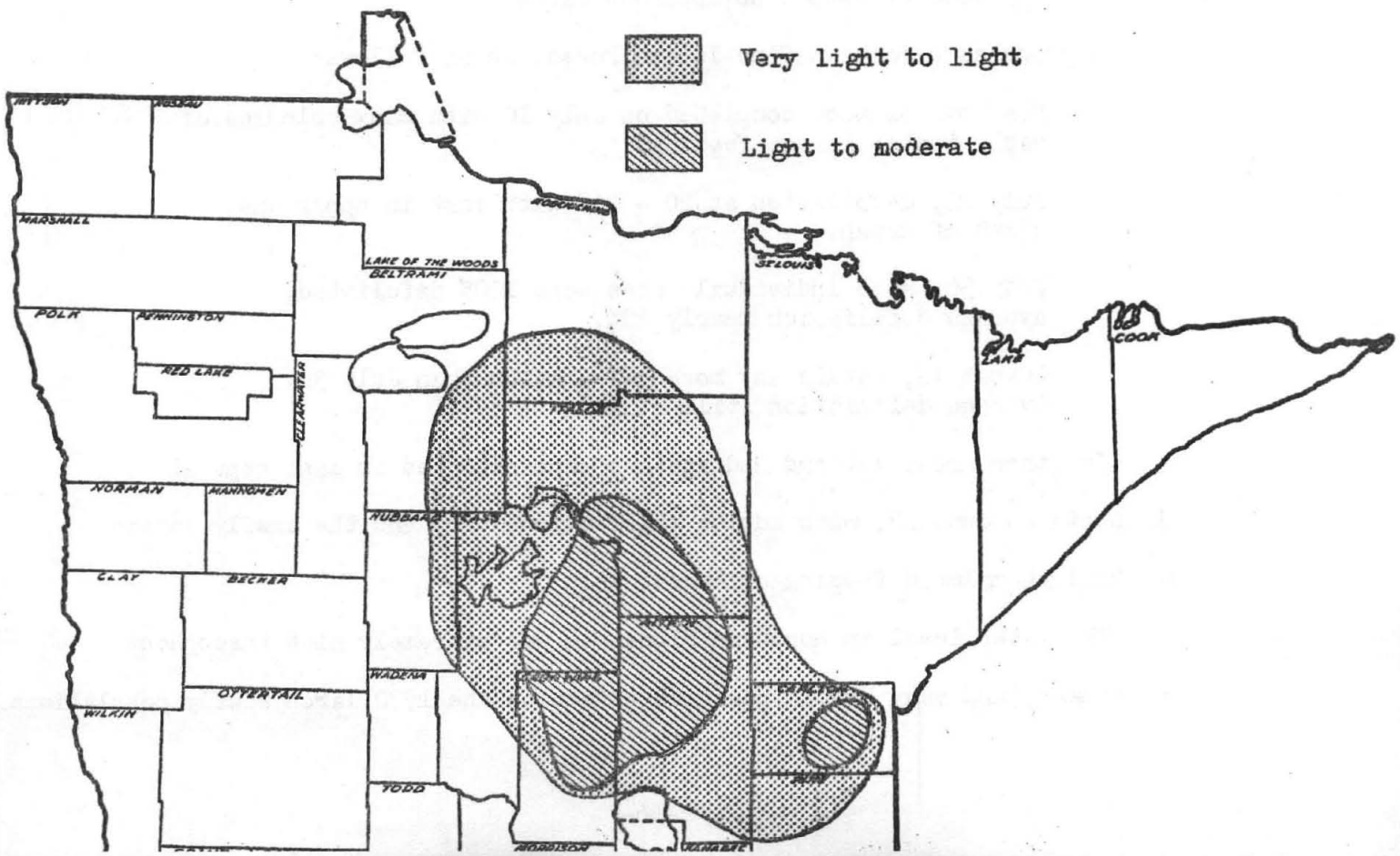
"ASPEN LEAF TIER" DEFOLIATION MAP



## LARCH SAWFLY - Pristiphora erichsonii

Larch sawfly defoliation was heavy over most of the 500,000 acres of tamarack in Minnesota again in 1969, but the overall problem decreased slightly from 1968.

Damage was approximately the same as in 1968 in central and east central Minnesota and reduced slightly in far northern and northeastern portions of the state. The reasons for the population decrease were not evaluated.

A small study of parasitism and predation was made on cocoons collected from plots in the Pine Island Forest, east of Big Falls. One square meter in each of two plots was sifted thoroughly for cocoons, with the following results.

24% parasitism

16% predation (primarily shrews, mice)

9% dead pre-pupa, no apparent cause

A progress report in Pine Island Forest is as follows:

Most oviposition completed on July 10 with many colonies of early instar larvae feeding.

July 23, defoliation at 20 - 25% with most in upper one sixth of crown.

July 30, some individual trees were 100% defoliated, average defoliation nearly 80%.

August 12, hardly any more defoliation than July 30. Average defoliation still at 80%.

In other areas 1st and 2nd instars were reported in east central Minnesota on June 27, with adults still ovipositing and the sawfly larvae virtually completed feeding on August 13.

The water level in northern Minnesota was extremely high throughout the summer, and many have a negative effect on the 1970 larch sawfly populations.

ASH BORER - Podosesia fraxini

Infestations of the ash borer became increasingly apparent in 1969 in several areas of the southern half of Minnesota. All reported and observed damage was on green ash in roadside highway plantings and municipal boulevard and yard trees.

In July, a Twin City suburb reported dying and dead ash on both boulevard and yard plantings. Follow-up investigations revealed that virtually all of the ash less than 5" DBH were badly damaged, with approximately 20% mortality. An additional 50% of the trees were apparently destined for the same fate and unless immediate action was undertaken, probably all of the ash trees would succumb within a year or two.

It appeared that the trees had been attacked for at least the previous two summers. Ordinarily, the ash borer cannot successfully invade healthy, high-vigor trees unless there is an intense nearby build-up or some factors that reduce the vigor of the host trees to a susceptible level. In this case, low annual rainfall for the past two years, plus a very shallow soil with a gravel base reduced the tree vigor. Virtually all of the top soil had been scraped off in a leveling process.

All of the dead and heavily damaged trees were removed and burned in August and September. The balance was set up on a periodic watering schedule during dry periods. All of the remaining trees were also treated with a carbon tetrachloride injection. Recommendations were made to mix tree species in future plantings.

Adult moths were emerging on June 27 from samples of ash sent in from Rochester, Minnesota.

YELLOW-HEADED SPRUCE SAWFLY - Pikonema alaskensis

The yellow-headed spruce sawfly has been causing widespread defoliation on ornamental, roadside, and plantation white spruce in northern Minnesota for many years. Ordinarily, an infestation persists in a portion of a plantation until those trees are completely defoliated. This takes several years in most cases. Part of the reason for this is that the female sawflies lay their eggs on trees that have had some previous defoliation. Thus, such infestations do not spread rapidly through the plantations and control has to be directed at only a fraction of the acreage.

There has been scattered chemical control on state, county, and private plantations in northern Minnesota in the last 10 to 15 years. Much acreage has suffered serious loss because no effort was made to reduce the population of sawflies.

In 1969, populations of the yellow-headed spruce sawfly dropped, especially in Koochiching and northern St. Louis Counties. The reasons for the reduced population are not known at this time. In southern Itasca, Aitkin, Cook, Lake, and southern St. Louis Counties populations remained about the same as in 1968. Since the infested plantations are so scattered and only a small percentage demanded control attention, it is virtually impossible to give an acreage or defoliation estimate.

Sawfly Development

June 27 - 1st and 2nd instar

July 25 - 28 virtually completed feeding, mostly in cocoon stage in topsoil.

## WALKINGSTICK - *Diapheromera femorata*

An infestation of walkingstick has occurred on the west shore of Gull Lake (northwest of Brainerd, Minnesota) for several years on the odd numbered years of 1965, 1967, and again in 1969. The infestation has been present in this area for a long period of time. But, when the defoliation area has been small, with a light to moderate level of feeding, no observations were made.

In 1969, the acreage and defoliation level increased substantially to a point where the heavy feeding included a five square mile area located approximately 1.25 miles west of the west Gull Lake shoreline. The exact locations are listed below:

Township 134, Range 30, Sections 18, 19, 30, and the north half of 31.

Township 134, Range 30, Sections 13 (NE & SE), 36 (NE), 25 (NE & SE).

Since this location is near a high value resort area and the infestation spread considerably eastward towards the lake in 1969, there is some concern over the 1971 potential. Plots were set up on the eastern perimeter of the infestation for early instar checks in 1971.

Primary hosts - oak, hazelbrush, birch, aspen

Defoliation level - 40 to 90%

August 20-30 - mating commonly noted

## GYPSY MOTH - *Porthetria dispar*

Egg masses and several empty pupal cases were found on a house trailer at Duluth, Minnesota in April of 1969. The trailer arrived from Connecticut on April 4th. A total of 4 egg masses were found. The trailer was sprayed with a 2% DDT oil. Gypsy moth traps were operated in the area throughout the summer with negative results.

CANKERWORMS - Alsophila pometaria, Paleacrita vernata

Many reports were received in early April of heavy male moth flights in the Twin City area. Severe defoliation resulted in scattered locations in Minneapolis, St. Paul, the suburban municipalities, and some control was instituted in late May. St. Paul sprayed a 40 block area with sevin and malathion with excellent control.

May 16 larvae 1/2" long in central Minnesota, populations widely scattered.

May 21 larvae in 3rd and 4th instar, approximately 3/8" to 5/8" long.

May 29 larvae 3/4" long. Heavy defoliation in Twin City area on elms, less on green ash, also in suburbs of Arden Hills, New Brighton, Mounds View, and Blaine.

SARATOGA SPITTLEBUG - Aphrophora saratogensis

Very little flagging on Norway pine was observed or reported in 1969. In no reported cases was flagging caused by the Saratoga spittlebug.

A winter damage survey was initiated on December 1, 1969 and will be conducted through March of 1970. Approximately 100 plantations will be sampled and damage scars counted. If necessary those plantations will be surveyed for nymphs in June and July to determine potential 1970 damage.

WESTERN TENT CATERPILLAR - Malacasoma pluviale

A small infestation of western tent caterpillar was reported by John Witter, University of Minnesota, in 1968 on a 2 - 3 acre area just west of International Falls. In 1969, the populations reduced slightly, but defoliation and tents were again commonly observed on the same acreage. Hosts were willow and plum. Defoliation was not observed in excess of 50% on scattered trees.

## PINE BARK APHID - *Pineus strobi*

The overall distribution of the pine bark aphid was less commonly observed than in the preceding two years. Hosts recorded in 1969 were Norway, white, and jack pine.

Two state nurseries, Badoura and General Andrews, had light to moderate infestations of the pine bark aphid. But, several applications of malathion in 1968 and 1969 virtually eliminated the infestations. Seedling checks made with a binocular scope in July, August, and December of 1969 revealed no live aphids. Similar checks will be conducted through 1970.

OTHER FOREST PEST PROBLEMS

| Forest Pest | Host | Location | Observation Date | Comments |
|---|---|---|---|---|
| Pine Spittlebug *Aphrophora pini* | Scotch Pine | Scattered over state | June | Problem was less intense than preceding year. Twig mortality on Christmas tree plantation Pine Co. |
| Maple Leaf Spot *Cecidomyia occellaris* | Red Maple | Crow Wing County | Mid-June | Heavy on a single tree. |
| Birch Sawfly *Arge pectoralis* | Paper Birch | Beltrami County | Sept. 2 | Heavy defoliation on ornamentals. |
| Zimmerman Pine Moth *Dioryctria zimmermani* | White Pine | Mille Lacs & Cass County | Aug.-Sept. | Scattered heavy damage on leader & trunk of ornamental & roadside trees. |
| Woolly Elm Aphid *Eriosoma americanum* | Elm | Isanti County | Mid-July | Shade trees. |
| Hickory Gall Aphid | Bitternut Hickory | Chisago County | Oct. 2 | Light in mixed hardwood forest. |
| Maple Webworm *Tetralopha asperatella* | Sugar Maple | Morrison County | Sept. 17 | Moderate to heavy over a 40 acre area. |
| False Pine Webworm *Pamphiliidae* | Norway Pine | Crow Wing County | Mid-August | Very light infestation in mature Norway Pine forest. |
| Eastern Spruce Gall Aphid *Chermes abietis* | White & Black Spruce | | Sept.-Oct. | Scattered reports of light infestations. |
| Woolly Alder Aphid *Prociphilus tessallatus* | Alder | Northern Minnesota | Oct.-Nov. | Commonly observed, especially after leaf fall. |

| Forest Pest | Host | Location | Observation Date | Comments |
|---|---|---|---|---|
| Oak Skeletonizer *Buccalatrix ainsliella* | Red & White Oak | Wabasha County | Early Oct. | Widespread throughout county. Light to moderate. |
| White Pine Aphid *Cinara strobi* | White Pine | Morrison & Beltrami Counties | Sept.-Oct. | Light populations on ornamentals. |
| Red-humped Caterpillar *Schizura concinna* | Apple | | August | Scattered samples and reports throughout the state. Also reported from some nurseries. |
| Birch Leaf Miner *Fenusa pusilla* | Birch | Many areas of the state | June-Aug. | Some heavy damage apparent in NE Minnesota. |
| Spruce Needle Miner | Spruce | Central Minnesota | June 13 | Reported in active larval feeding stage. |
| Eastern Tent Caterpillar *Malacosoma americanum* | Prunus spp. | Northern Minnesota | June | Very light population, scattered June 6, mostly fourth instar. |
| Spiny Elm Caterpillar *Nymphalis antiopa* | Elm, Aspen | Scattered | June-July | Light feeding reported from many areas of the state. |
| Hackberry Nipple Gall *Pachypsylla celtidismamma* | Hackberry | Twin Cities Area | May 16 | Both adults and nymphs very common. |
| Ugly-Nest Caterpillar *Archips cerasivoranus* | Chokecherry & Black cherry | NE Minnesota | July | Moderate populations in south Lake County, light elsewhere. |
| Bronze Birch Borer *Agrilus anxius* | Birch | Scattered | July-Sept. | Droughty 1969 conditions may predispose 1970 outbreak. Adult emergence at peak July 3 |

| Forest Pest | Host | Location | Observation Date | Comments |
|---|---|---|---|---|
| White-Marked Tussock *Hemerocampa leucostigma* | Elm & Bass-wood | Southern Minnesota | June-Aug. | Some heavy, but spotty defoliation in Ramsey County in July. |
| Vagabond Gall Aphid *Mordwilkoja vagabunda* | Aspen | Northern Minnesota | June-Sept. | Commonly observed, but down in population from 1968. |
| Poplar leaf Beetle *Chrysomela scripta* | Aspen | Throughout state | June-July | All light scattered defoliation. |
| Elm Spanworm *Ennomos subsignarius* | Elm, Maple, Ash, Bass-wood | Aitkin Co. | Late June Early July | Light to moderate along Mississippi River. |
| Black Pine Leaf Scale *Aspidiotus californicus* | Jack Pine | Sherburne County | June-July | Light infestation in Sand Dunes State Forest. |
| Pine Tortoise Scale *Toumeyella numismaticum* | Jack Pine | Scattered | June-July | Very light and scattered populations. |
| Elm Leaf Miner *Fenusa ulmi* | Elm | Becker and Mille Lacs County | June-July | 50% leaf damage along north shore of Mille Lacs Lake. |
| Swaine Jack Pine Sawfly *Neodiprion swainei* | Jack Pine | Crow Wing County | Sept. | One moderate count in section 24, township 134, Range 27. |
| Introduced Pine Sawfly *Diprion similis* | Jack, White, Norway Pine | Northern half of Minnesota | July-Sept. | 1st generation very low. Scattered high 2nd generation counts, especially in NE Todd and NW Morrison Counties. |

| Forest Pest | Host | Location | Observation Date | Comments |
|---|---|---|---|---|
| Jack Pine Shoot Borer *Eucosma sonomana* | Jack Pine, Scotch Pine | Beltrami, Hubbard, Cass, Crow Wing Counties | July-Aug. | Causing scattered plantation "flagging." |
| Pine Pitch Midge *Thecodiplosis pini resinosae* | Jack Pine | Northern half of state | June-Aug. | Much lighter than 1968. Still causing low percentage flagging in most areas. |
| Pine Root Collar Weevil *Hylobius radicis* | Pines | Hubbard County | July | Scotch pine plantation damage much more apparent than in 1968. |
| Fruit Tree Leaf Roller *Archips argyrospilus* | Bass-wood | Pine County | June-July | Moderate defoliation along Willow River north of Sandstone, Askov. |
| Jack Pine Sawfly *Neodiprion banksianae* | Jack Pine | Scattered | June | Very light and scattered generally. A moderate infestation on roadside jack pine in central Cass County. Mostly in cocoon stage by June 27. |
| Red-headed Pine Sawfly *Neodiprion lecontei* | Jack Pine | Central & East Central Minnesota | August | Populations very low, & reduced from 1968. Mostly in egg stage & hatching on August 1. |
| Pine Tube Moth *Argyrotaenia pinatubana* | White Pine | Chisago County | August | Very low populations. |
| Pine Engraver *Ips pini* | Jack Pine | Sherburne County | Nov. | Population buildup from 1968 thinning & pruning. Caused scattered mortality. |
| Walnut Caterpillar *Datana integerrima* | Butternut, Black, Walnut | SE Minnesota | August | Scattered defoliation, mostly yard & boulevard trees. |
| White Pine Weevil *Pissodes strobi* | White Pine, Jack Pine, Blue Spruce | Central & NC Minnesota | June-Sept. | Very light plantation damage. Most reports on ornamentals. |

## JACK PINE DROPCLOTH SURVEY - 1969

| Date of Survey | County & Description | Pine Tussock Moth | Introduced Pine Sawfly | Unidentified Neodiprion Species | Pine Chafer |
|---|---|---|---|---|---|
| 6/20/69 | Cass | | | | |
| | 8-137-29 | | | | 5 |
| | 17-139-30 | | | 2 | 17 |
| | Crow Wing | | | | |
| | 5-133-28 | 1 | 7 | 5 | |
| 6/23 | 6-133-28 | | | | 9 |
| | 24-137-27 | 1 | | 40 | 7 |
| | Cass | | | | |
| 6/24 | 17-141-31 | | | 4 | |
| | 5-139-30 | | | | 5 |
| | 36-138-31 | 1 | 1 | 8 | |
| | Crow Wing | | | | |
| 6/26 | 8-33-28 | 1 | | | 8 |
| | 5-33-28 | | | | 2 |
| | Cass | | | | |
| 6/27 | 21-137-29 | | 1 | 6 | 2 |
| | 36-138-31 | 1 | 1 | 10 | |
| 6/30 | 8-141-27 | | 2 | 23 | 3 |
| | 9-141-29 | | | 40+ | |
| | 3-141-30 | | 2 | | |
| | Crow Wing | | | | |
| | 9-45-30 | | 5 | | |
| | 35-46-30 | 2 | | | 10 |
| 7/1 | 9-45-30 | 4 | 2 | | 11 |
| 7/3 | 4-45-30 | | | | 9 |
| | 9-45-30 | 8 | 15 | 1 | 12 |
| | 9-45-30 | 2 | 15 | | 14 |
| | 21-44-31 | 1 | | | 2 |
| 7/7 | 11-44-31 | | 2 | | 2 |
| | 17-43-30 | 2 | 8 | 1 | 6 |
| | 14-44-31 | 3 | 9 | | 7 |
| | 23-44-31 | 2 | 24 | | 4 |
| | Cass | | | | |
| 7/8 | 8-134-30 | | 3 | 2 | |
| | 1-137-29 | | | 1 | |
| | 17-138-30 | | | 4 | |
| | Pine | | | | |
| 7/10 | 17-40-18 | 1 | | | |

| Date of Survey | County & Description | Pine Tussock Moth | Introduced Pine Sawfly | Unidentified Neodiprion Species | Pine Chafer |
|---|---|---|---|---|---|
| 7/11 | Beltrami | | | | |
| | 21-147-33 | | | 2 | |
| | Crow Wing | | | | |
| | 2-139-28 | | 14 | 2 | |
| | 10-136-27 | | | | 2 |
| | 19-136-27 | | | | 1 |
| | 23-136-27 | | | | 1 |
| | Hubbard | | | | |
| 7/13 | 15-140-34 | 1 | | | |
| | Cass | | | | |
| 7/19 | 8-137-29 | | 5 | | 3 |
| | 21-139-29 | 1 | 13 | 2 | 3 |
| | 5-139-30 | | 1 | | 1 |
| | 2-140-27 | | | | 1 |
| | Crow Wing | | | | |
| | 2-46-29 | 1 | | 3 | 2 |
| | 9-45-30 | | | | 2 |
| | 20-46-29 | 1 | 1 | | 2 |
| | 25-138-27 | | | | 1 |
| | Cass | | | | |
| 7/15 | 7-134-29 | | | | 2 |
| | Crow Wing | | | | |
| | 26-134-29 | | 9 | 10 | 3 |
| | 26-137-29 | | | | 7 |
| | 30-137-28 | | | | 1 |
| | 31-134-28 | 2 | 33 | 2 | |
| | 10-133-29 | 2 | 9 | 3 | |
| | 14-134-29 | | | 1 | 1 |
| | 16-136-28 | | 2 | | |
| | 18-135-28 | | 8 | 4 | |
| | 22-137-28 | 1 | 1 | 1 | |
| | 24-134-29 | 12 | | | |
| | 2-136-28 | | | | 4 |
| | Cass | | | | |
| 7/21 | 17-133-30 | 2 | 2 | 5 | |
| | 14-133-30 | | 5 | 3 | |
| | 18-133-32 | | 6 | 3 | |
| | 14-133-32 | | 19 | 1 | |
| | Hubbard | | | | |
| 7/23 | 34-139-35 | 1 | | 2 | 4 |
| | 12-139-33 | | | | 1 |

| Date of Survey | County & Description | Pine Tussock Moth | Introduced Pine Sawfly | Unidentified Neodiprion Species | Pine Chafer |
|---|---|---|---|---|---|
| 7/25 | Cass | | | | |
| | 26-140-31 | 1 | | | |
| | Crow Wing | | | | |
| | 2-135-28 | | | 2 | |
| | 1-136-27 | | 2 | 2 | |
| | 25-138-28 | | | 1 | |
| | Hubbard | | | | |
| | 24-140-32 | | | 1 | |
| | Cass | | | | |
| | 21-133-29 | | 7 | 1 | |
| | Crow Wing | | | | |
| | 13-130-29 | | | 4 | |
| 7/28 | Morrison | | | | |
| | 25-133-31 | | | 1 | |
| 7/29 | Crow Wing | | | | |
| | 20-144-31 | | 1 | | 2 |
| 7/31 | Cass | | | | |
| | 29-136-29 | | | 1 | 2 |
| | 9-141-31 | | | 10 | |
| | Crow Wing | | | | |
| | 11-135-29 | | | 2 | |
| | Hubbard | | | | |
| | 36-141-33 | | | 3 | |
| | 15-139-33 | | | 3 | 1 |
| 8/1 | Crow Wing | | | | |
| | 8-145-30 | | | 2 | 4 |
| 8/5 | Cass | | | | |
| | 16-134-29 | | | 1 | 1 |
| 8/11 | Crow Wing | | | | |
| | 10-137-26 | | | 2 | |
| 8/12 | 10-133-29 | | | 10 | |
| 8/13 | 33-45-29 | | | 1 | |
| | 18-43-30 | | | 1 | |
| 8/14 | 26-134-29 | | 2 | | |

| Date of Survey | County & Description | Pine Tussock Moth | Introduced Pine Sawfly | Unidentified Neodiprion Species | Pine Chafer |
|---|---|---|---|---|---|
| 8/27 | Crow Wing | | | | |
| | 31-134-28 | | 172 | | |
| | 5-133-28 | | 16 | | |
| 8/28 | 10-133-29 | | 69 | 1 | |
| | 22-136-29 | | 5 | 1 | |
| 8/29 | Cass | | | | |
| | 21-139-29 | | 8 | 9 | |
| | 3-126-29 | | 1 | | |
| 9/2 | Crow Wing | | | | |
| | 2-145-30 | | 12 | 1 | |
| 9/3 | 11-44-31 | | 4 | 1 | |
| | 10-4-31 | | 28 | 2 | |
| | 9-133-28 | | 5 | 3 | |
| | 17-133-28 | | 1 | 2 | |
| | Morrison | | | | |
| | 5-132-30 | | 4 | 1 | |
| | 22-133-30 | | 15 | 1 | |
| 9/5 | Cass | | | | |
| | 34-141-31 | | | 7 | |
| | Crow Wing | | | | |
| | 5-133-28 | | 46 | 7 | |
| 9/8 | 23-44-31 | | 100 | 5 | |
| | 17-43-30 | | 23 | 2 | |
| 9/9 | 22-134-28 | | 11 | 1 | |
| | 9-134-28 | | 24 | 1 | |
| | 28-136-27 | | 1 | | |
| | 30-136-27 | | 1 | | |
| | 8-136-27 | | 5 | | |
| | 9-136-27 | | 1 | 1 | |
| | 11-136-27 | | | 1 | |
| | 19-137-26 | | 2 | 1 | |
| | 24-137-27 | | 1 | 16 | |
| | 2-136-28 | | 1 | | |
| | 9-136-28 | | 2 | 1 | |
| 9/10 | Cass | | | | |
| | 8-135-31 | | 21 | 2 | |
| | 19-133-30 | | 15 | | |
| | 8-133-31 | | 5 | | |
| | Morrison | | | | |
| | 7-132-31 | | 758+ | 5 | |

| Date of Survey | County & Description | Pine Tussock Moth | Introduced Pine Sawfly | Unidentified Neodiprion Species | Pine Chafer |
|---|---|---|---|---|---|
| | Todd | | | | |
| | 11-132-32 | | 300+ | 1 | |
| | 32-133-32 | | 42 | 1 | |
| 9/11 | Cass | | | | |
| | 16-139-29 | | 1 | | |
| | 8-139-30 | | 3 | | |
| | Crow Wing | | | | |
| | 11-136-29 | | 1 | | |
| | 27-137-29 | | 4 | | |
| | 8-133-28 | | 13 | 1 | |
| 9/13 | Benton | | | | |
| | 28-38-31 | | 2 | | |
| | 28-38-31 | | 1 | 2 | |
| | 20-38-31 | | 6 | | |
| | Crow Wing | | | | |
| | 30-45-30 | | 68 | | |
| | 16-44-31 | | 31 | 2 | |
| | 2-44-31 | 1 | 100 | 2 | |

## FOREST AND SHADE TREE DISEASES

DUTCH ELM DISEASE - Ceratocystis ulmi - 1969

There were 549 positive cases of Dutch elm disease diagnosed from a total of 1,571 samples received in 1969. Positive cases were found in seven new counties and in 48 new municipal locations. Of the 549 positive trees, 443 or 83% have been officially removed by December 31, 1969.

The laboratory diagnosed cases by year are as follows:

| | | |
|---|---|---|
| 1961 - 8 | 1962 - 2 | 1963 - 43 |
| 1964 - 54 | 1965 - 23 | 1966 - 49 |
| 1967 - 136 | 1968 - 283 | 1969 - 549 |

See the following map for Dutch elm disease municipal locations.

OAK WILT - Ceratocystis fagacearum

Most of the oak wilt mortality in the areas shown on the map is, and has been, affecting oaks of little or no commercial value in Minnesota. The only high value oak forested area is in southeastern Minnesota. Probably the largest concern is in the greater Metropolitan areas of Minneapolis, St. Paul, and suburbs where the oak trees have high aesthetic and real values. Only one suburban community conducts a control program in which trees are removed and destroyed when flagging is noted and laboratory diagnosis is made.

The number of the oaks lost per year is vast in this area, even though the annual spread of the disease appears very slow. A good estimate of the loss and values has never been made in Minnesota.

See the following map for the oak wilt areas in Minnesota.

SPRUCE NEEDLE RUST - Chrysomyxa ledicola

A moderate to severe outbreak of this rust disease has existed for the past three or more years in stagnated black spruce swamps. These small spruce trees have been harvested for many years and processed for Christmas trees with wide distribution across the United States and other countries. Defoliation caused by the rust was severe enough to hamper the Christmas tree cutting processes in a number of locations.

The areas affected included black spruce locations in Lake of the Woods, Beltrami, Koochiching, Itasca, Cass, and St. Louis Counties. The distribution may have been wider than this, but it was not reported or observed from any other area. The most severe problem noted was near Baudette, Minnesota.

EASTERN OAK GALL RUST - Cronartium cerebrum

This problem is very widespread in Minnesota causing moderate to severe damage on plantation jack pine in Hubbard, Becker, Beltrami, and Cass Counties. The most severe damage was noted in Hubbard.

Two state nurseries conducted small control programs, using Maneb and Ferbam in 1968. On checking the seedlings through 1968 and in 1969 before stock lifting procedures, the following counts were made from the seedling beds.*

| | Host | Host Number | Infected | Percent Infected |
|---|---|---|---|---|
| Sprayed | | | | |
| | Scotch Pine | 9,750 | 0 | 0.0 |
| | Scotch Pine | 59,000 | 94 | 0.159% |
| Unsprayed | | | | |
| | Jack Pine | 48,050 | 139 | 0.289% |

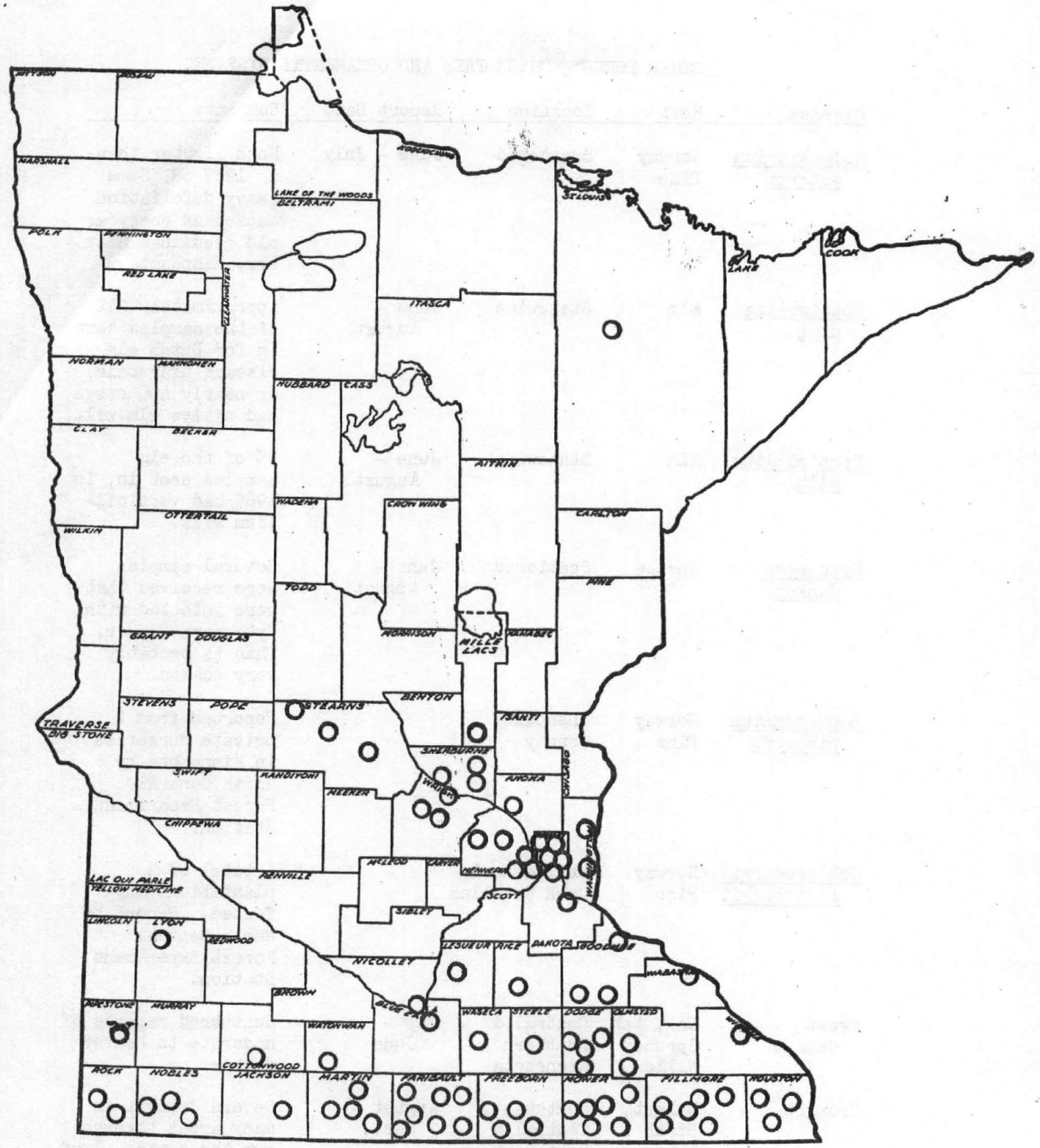
With the low incidence, no controls were projected for 1969 nor for 1970. An oak eradication program was conducted around the perimeter of both nurseries.

*Information from: Robert Hance, Supt., General Andrews Nursery
Archie Hakala, Supt., Badowa Nursery

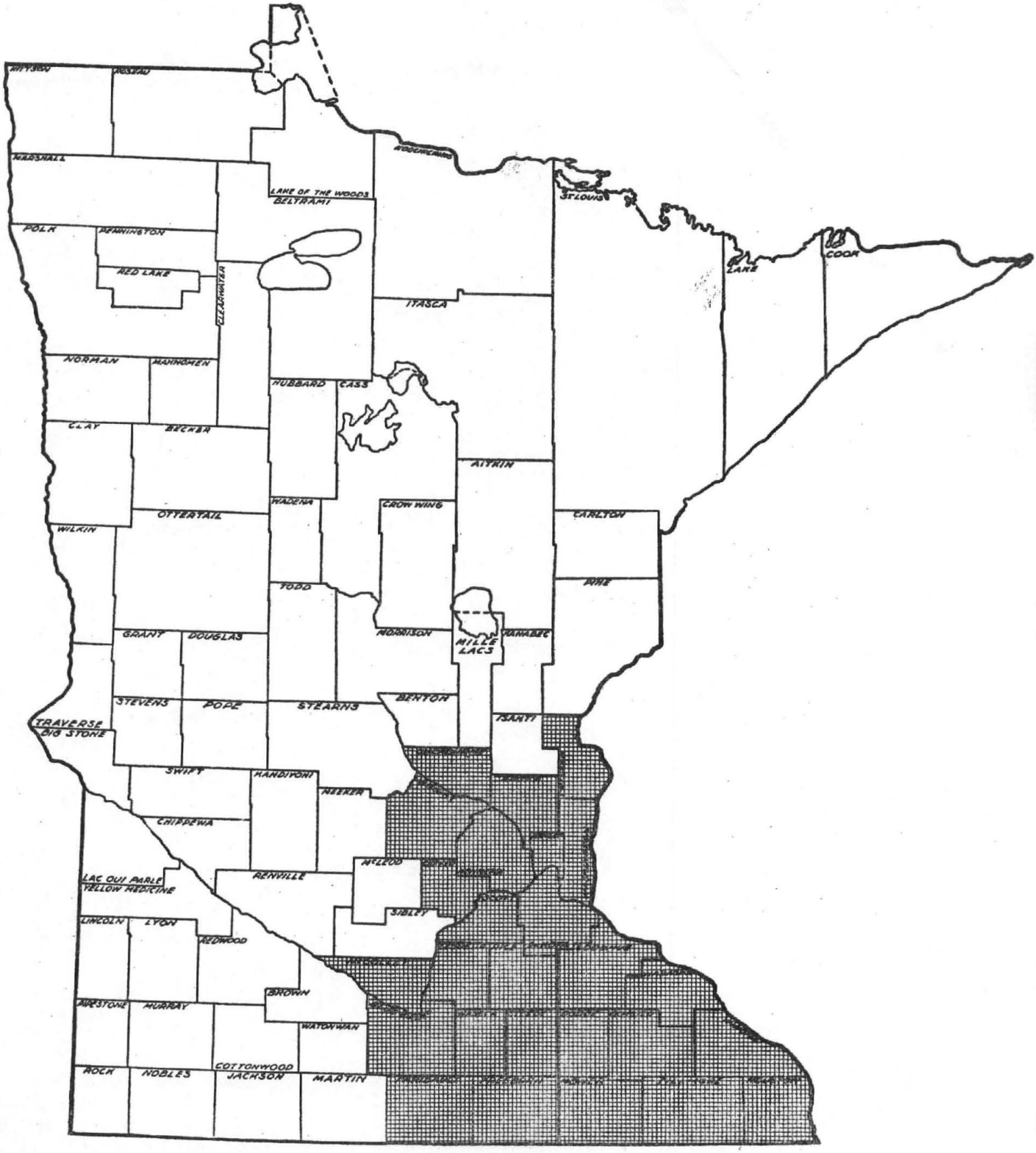
OTHER FOREST, SHADE TREE AND ORNAMENTAL DISEASES

| Disease | Host | Location | Report Date | Comments |
|---|---|---|---|---|
| *Coleosporium asterum* | Norway Pine | Scattered | June - July | Much lighter than in 1967-68. Some heavy defoliation caused on one year old seedlings near Orr, Minnesota |
| *Dothiorella ulmi* | Elm | Statewide | June - August | Approximately 24% of the samples sent in for Dutch elm disease diagnosis, or nearly 400 cases had native elm wilt. |
| *Verticillium wilt* | Elm | Statewide | June - August | 9% of the elm samples sent in, in 1969 had verticillium wilt. |
| *Cytospora Canker* | Spruce | Scattered | June - August | Several samples were received that were infected with Cytospora Canker. This is probably very common. |
| *Lophodermium pinastri* | Norway Pine | Sherburne County | | Reported from 2 private nurseries in Minnesota by North Central Forest Experiment Station. |
| *Schleroderris lagerbergii* | Norway Pine | St. Louis & Cook Counties | | A total of 3 plantations infected. Report by North Central Forest Experiment Station. |
| Frost damage | Oak, Ash, Spruce, Willow | Central & Northern Minnesota | May - June | Scattered reports of moderate to heavey damage |
| Drought | Walnut, Birch | Southeast, Central & East Central Minnesota | August - Sept. | Severe drought in many areas throughout the summer. Leaf drop occurred very early. |

MUNICIPAL LOCATIONS OF DUTCH ELM DISEASE IN MINNESOTA



# OAK WILT DISTRIBUTION IN MINNESOTA




Circ. 911