

RESULTS OF FOREST INSECT AND
DISEASE SURVEYS IN THE
ALGONQUIN REGION OF ONTARIO
1989

(FOREST DISTRICTS: PARRY SOUND, BRACEBRIDGE,
ALGONQUIN PARK, PEMBROKE, MINDEN AND BANCROFT)

C. G. JONES and P.M. BOLAN

FORESTRY CANADA
ONTARIO REGION
GREAT LAKES FORESTRY CENTRE
1990

MISCELLANEOUS REPORT NO. 96

©Minister of Supply and Services Canada 1990
Catalogue No. Fo29-8/96E
ISBN 0-662-17932-3
ISSN 0832-7130

Copies of this publication are available at no charge from:

Communications Services
Forestry Canada
Ontario Region
Great Lakes Forestry Centre
P.O. Box 490
Sault Ste. Marie, Ontario
P6A 5M7

Microfiches of this publication may be purchased from:

Micro Media Inc.
Place du Portage
165, Hotel-de-Ville
Hull, Quebec
J8X 3X2

SURVEY HIGHLIGHTS

This report reviews the more important insect, disease and abiotic conditions encountered during aerial and ground surveys of the forested areas in the Algonquin Region of Ontario in 1989.

Forest tent caterpillar continued to be the pest with the most widespread and noticeable impact on the hardwood forests in the region. A total of 1,319,956 ha of moderate-to-severe defoliation attributed to this pest occurred in 1989, a slight increase over the previous year. The area infested by gypsy moth increased significantly, with 1,234 ha of moderate-to-severe defoliation and 83,082 ha of light infestation being recorded. High populations of the redheaded pine sawfly and the pine false webworm continued to be a problem in pine plantations. Surveys for spruce budworm and jack pine budworm failed to reveal any significant populations.

Surveys for Scleroderris canker, especially the European race, were again conducted and positive identification was made in four areas. One of these areas, in Strong Township, Bracebridge District, was a new extension of the geographic range of this fungus. Another summer of insufficient rainfall had a noticeable impact on the region's forests, especially the hardwoods. Associated foliar discoloration occurred throughout 213,238 ha. As well, 8,920 ha of drought-related, partial and whole-tree mortality were recorded.

The 20 sugar maple health plots, the two oak health plots and the six Acid Rain National Early Warning System (ARNEWS) plots were re-evaluated. An additional seven maple health plots were established and the four North American Maple Project (NAMP) plots were retallied. Eastern white pine was the tree species selected for a special plantation survey and a collection of 100 eastern white pine cones was made at two locations for dissection to determine the impact of pests on seed production.

As in previous years, pests in this report are categorized as follows:

Major Insects/Diseases

capable of causing severe injury to or death of living trees or shrubs

Minor Insects/Diseases

capable of causing sporadic or localized injury but not usually a serious threat to living trees or shrubs

Other Forest Insects/Diseases (Tables)

These tables provide information on two types of pest:

- (1) those that are of minor importance and have not been known to cause serious damage to forest trees
- (2) those that are capable of causing serious damage but, because of low population levels or for other reasons, did not cause serious damage in 1989.

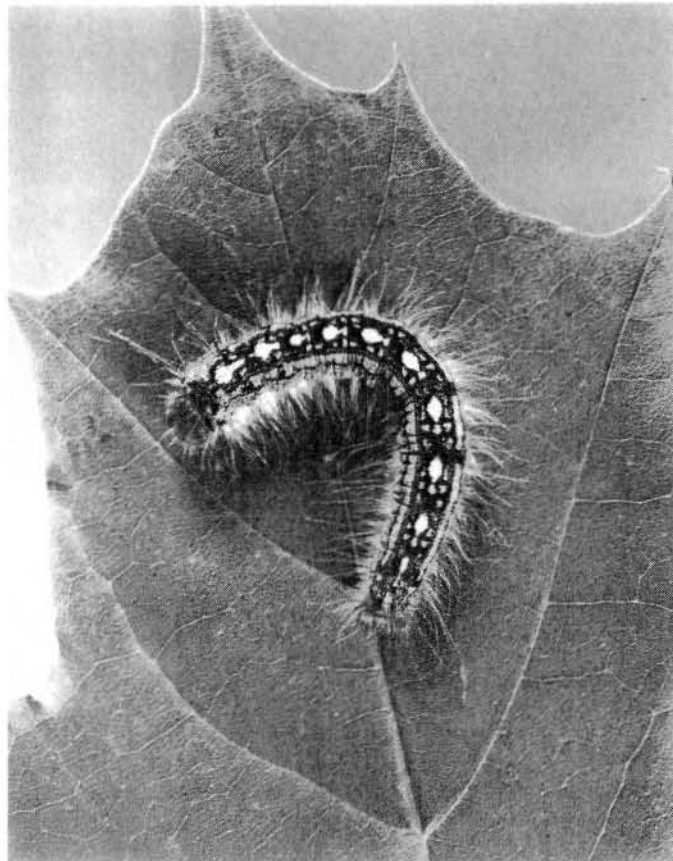
The valuable assistance and cooperation extended to the authors by the Ontario Ministry of Natural Resources during the 1989 field season are gratefully acknowledged.

C.G. Jones
P.M. Bolan

Frontispiece



(Left) Gypsy moth larvae
feeding on leaf



(Right) Forest tent caterpillar
larva feeding on leaf

TABLE OF CONTENTS

	Page
INSECTS	1
Major Insects	1
Pine False Webworm, <i>Acantholyda erythrocephala</i>	1
(All districts)	
Cedar Leafminer Complex, <i>Argyresthia aureoargentella</i> , <i>A. canadensis</i> , <i>A. thuiella</i> and <i>Coleotechnites thujaella</i>	2
(Bancroft and Pembroke districts)	
Eastern Spruce Budworm, <i>Choristoneura fumiferana</i>	3
(All districts and Northwestern Ontario)	
Jack Pine Budworm, <i>Choristoneura pinus pinus</i>	3
(All districts)	
Larch Casebearer, <i>Coleophora laricella</i>	5
(Bancroft, Bracebridge, Minden and Parry Sound districts)	
Pine Engraver Beetle, <i>Ips pini</i>	6
(All districts)	
Gypsy Moth, <i>Lymantria dispar</i>	7
(All districts)	
Eastern Tent Caterpillar, <i>Malacosoma americanum</i>	9
All districts)	
Forest Tent Caterpillar, <i>Malacosoma disstria</i>	9
(All districts)	
Redheaded Pine Sawfly, <i>Neodiprion lecontei</i>	18
(Bancroft, Bracebridge, Minden, Pembroke and Parry Sound districts)	
Other forest insects	20
TREE DISEASES	23
Major Diseases	23
Armillaria Root Rot, <i>Armillaria ostoyae</i>	23
(Bracebridge District)	

TABLE OF CONTENTS (concl.)

	Page
Scleroderris Canker, <i>Ascochyta blight</i>	23
(All districts)	
Other forest diseases	27
FOREST HEALTH	28
Maple Health	28
(All districts)	
North American Maple Project (NAMP)	34
(Bancroft and Bracebridge districts)	
Oak Health	35
(Bracebridge and Pembroke districts)	
ABIOTIC DAMAGE	38
Drought	38
(All districts)	
Road Salt Injury	41
(All districts)	
SPECIAL SURVEYS	41
Pear Thrips, <i>Taeniothrips inconsequens</i>	41
(Algonquin Park, Bancroft and Pembroke districts)	
Eastern White Pine Plantations	42
(All districts)	
Eastern White Pine Seed and Cone Pests	45
(Bancroft and Bracebridge districts)	
Acid Rain National Early Warning System (ARNEWS)	46
(Algonquin Park, Bracebridge, Minden, Parry Sound and Pembroke districts)	
Light Trapping	46
(Pembroke District)	
Climatic Data	46
(Bracebridge and Pembroke districts)	

INSECTS

Major Insects

Pine False Webworm, *Acantholyda erythrocephala* (L.)

Characteristic damage by this introduced pest could be found in most pine (*Pinus* spp.) plantations in the region. Although moderate-to-severe defoliation was recorded in plantations in Bancroft and Pembroke districts the highest populations were encountered more commonly in the western part of the region, in the Minden and Parry Sound districts (Table 1).

Large numbers and associated moderate-to-severe damage recurred in young red pine (*Pinus resinosa* Ait.) plantations in McMurrich and Ryerson townships, Parry Sound District. Two areas in McMurrich Township were typical of those elsewhere in these two townships. The incidence of trees attacked was 67% in one area and 92% in the other, and accompanying defoliation was 20 and 30%, respectively. Single-tree defoliation of 90% was observed in both areas.

Medium-to-heavy infestations were encountered in red pine plantations in Harburn and Somerville townships, Minden District. Surveys at one plantation in each township disclosed that more than 90% of the trees had been attacked and average defoliation of up to 26% was recorded. The white pine (*Pinus strobus* L.) seed orchard in Snowdon Township, Minden District once more hosted moderate-to-high populations. An evaluation in one part of the orchard revealed that 72% of the 1.1-m-tall trees had been attacked, and there was an average of five webmasses per tree.

Red pine trees ranging in height from 0.5 to 5 m were examined at 13 locations in the Algonquin Park, Bancroft and Pembroke districts. All but three areas had associated damage of 5% or less.

Significant populations were recorded at two locations in Bancroft District. In a 5-ha red pine plantation in Monteagle Township, assessment disclosed that 33% of the trees were affected and were sustaining 20% defoliation on average. In a 0.2-ha roadside planting of 4.5-m-tall red pine in Cardiff Township, 80% of the trees sustained an average of 60% defoliation.

In Horton Township, Pembroke District a survey at one location revealed that 67% of the trees were infested and sustained an average of 30% defoliation.

Table 1. Summary of damage caused by the pine false webworm at six locations in the Algonquin Region of Ontario in 1989 (counts based on the examination of 150 randomly selected red pine at each location)

Location (Twp)	Avg ht of trees (m)	Estimated trees per ha	Estimated area affected (ha)	Trees affected (%)	Avg defol'n (%)	Avg no. of webmasses per tree
<u>Bancroft District</u>						
Monteagle	2.3	2200	5	33	20	22
<u>Minden District</u>						
Harburn	2.8	1900	10	95	26	24
Somerville	1.4	2700	10	93	10	6
<u>Parry Sound District</u>						
McMurrich	1.2	3100	15	92	30	10
McMurrich	0.9	3000	5	67	20	-
<u>Pembroke District</u>						
Horton	1.6	2500	8	67	30	20

Cedar Leafminer Complex, *Argyresthia aureoargentella* Brower,
A. canadensis Free., *A. thuiella* (Pack.),
Coleotechnites thujaella (Kft.)

The trend of population increases in the region slowed down somewhat in 1989. Although moderate populations were again recorded in areas previously infested in Bancroft and Pembroke districts, mostly low populations were encountered in host stands of eastern white cedar (*Thuja occidentalis* L.).

Surveys in the southern part of Bancroft District disclosed moderate damage of up to 60% in Cashel, Chandos, Limerick and Methuen townships. Similar damage was encountered in the western part of Pembroke District. Ground checks in Wilberforce and Ross townships revealed stands of host trees experiencing up to 60% foliar damage.

Damage in the form of foliar browning caused by the cedar leafminer complex was further compounded by similar damage caused by the spruce spider mite, *Oligonychus ununguis* (Jac.). Populations of this sucking pest tend to build up during hot, dry summers such as those experienced during the last three years.

Eastern Spruce Budworm, *Choristoneura fumiferana* (Clem.)

Provincial Situation

Again in 1989, spruce budworm dominated the provincial pest scene as the most widespread destructive forest insect. The overall area of medium-to-heavy infestation confined solely to the Northwestern and North Central regions increased to 6,239,636 ha in 1989 (Fig. 1). Whole-tree and top mortality of balsam fir (*Abies balsamea* [L.] Mill.) and white spruce (*Picea glauca* [Moench] Voss) in the province increased by 529,155 ha to 15,044,874 ha. This cumulative total includes the first occurrence of tree mortality, which was recorded in 1971 in the Algonquin Region.

A protection spray program was carried out by OMNR in the North Central Region, where 30,519 ha of crown forests were aerially sprayed with the bacterial insecticide *Bacillus thuringiensis* (B.t.).

Algonquin Region

Surveys in stands of susceptible hosts in the Algonquin Region revealed only very light damage associated with the larval or feeding stage of this pest. A significant increase in the number of adults was recorded, however.

Two clusters, with three Multiplier pheromone traps in each cluster, were deployed at four locations for population monitoring (see photo page). Each cluster used a pheromone of differing potency, one the PVC lure used for a number of years and the other the new Biolure pheromone. The Biolure traps were set out in conjunction with the PVC lures for comparison purposes with a view to the possible future replacement of the PVC lure. These traps are part of a nationwide program to develop a relatively inexpensive and efficient tool for monitoring spruce budworm populations. A comparison of results at PVC trap locations over two years shows that no adults were trapped in 1988 but moths were captured at all locations in 1989 (Table 2).

Branch sampling was carried out at each pheromone trap location for the purpose of population forecasting (see photo page). No egg masses were recovered from the six areas sampled. As a result of the egg mass sampling and pheromone program no significant damage is forecasted for 1990.

Jack Pine Budworm, *Choristoneura pinus pinus* Free.

The last medium-to-heavy infestation of this pest in the region occurred from 1982 to 1986 in stands of jack pine (*Pinus banksiana* Lamb.) in the Parry Sound District. Because of the historical significance of this pest, egg-mass surveys were carried out in 10 stands of jack pine in the region (Table 3). Interpretation of the results presented in Table 2 indicates negligible or trace damage for 1990.

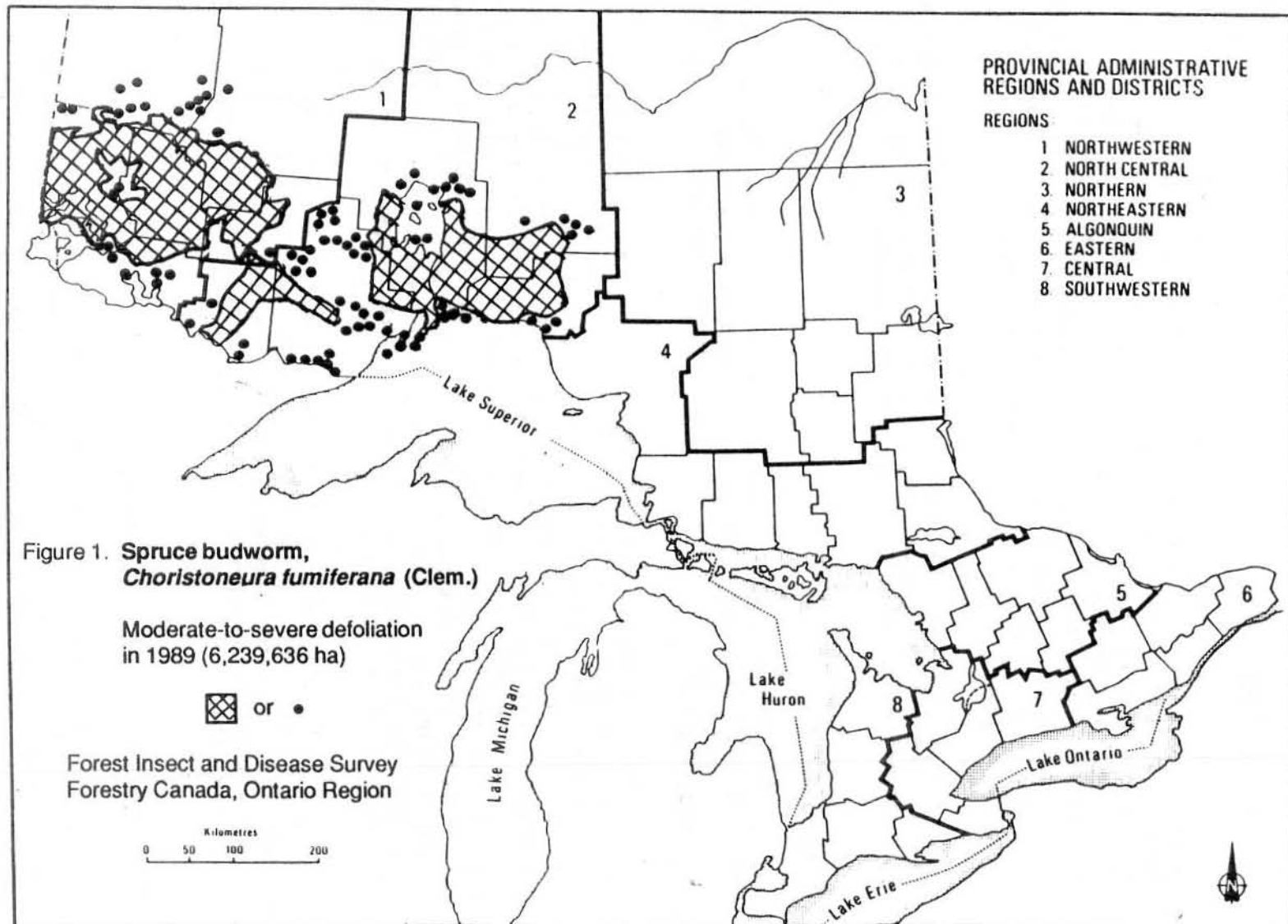


Table 2. A comparison of spruce budworm moth catches at four locations in the Algonquin Region of Ontario (counts based on the total number of moths from each cluster of three traps containing the PVC lure)

Location (Twp)	No. of adults trapped	
	1988	1989
<u>Bracebridge District</u>		
Bethune	0	19 ^a
<u>Minden District</u>		
Hindon	0	3
<u>Parry Sound District</u>		
Spence	0	10
<u>Pembroke District</u>		
Alice Township	0	215
Buchanan	0	62

^a one trap missing

Larch Casebearer, *Coleophora laricella* (Hbn.)

The first Canadian record of this introduced pest was in 1905 in Ontario. Since then its range has expanded considerably and in 1989 light-to-moderate foliar damage attributed to this pest was observed in stands of tamarack (*Larix laricina* [Du Roi] K. Koch) at several locations in the region.

Light-to-moderate defoliation was commonly observed in the southeastern part of Parry Sound District. A survey done in a 5-ha stand of 15-m-tall tamarack in Monteith Township revealed foliar damage averaging 40%; this was typical of the situation throughout the district.

Somewhat lower levels of defoliation were recorded in the central part of Bracebridge District. Examination of stands of host trees averaging 15 m in height in Oakley Township disclosed 20% average defoliation. Foliar damage of individual younger trees (less than 5 m tall) in Stisted and Stephenson townships ranged as high as 80% but on an overall stand basis averaged 10%.

Light-to-moderate discoloration (15-20%) of 11-m-tall roadside trees was observed in Galway Township, Minden District and Cardiff Township, Bancroft District.

Table 3. Summary of jack pine budworm defoliation estimates and egg-mass counts in 1989 and infestation forecasts for 1990 on jack pine in the Algonquin Region of Ontario.

Location (Twp)	Estimated defoliation in 1989 (%)	Total no. of egg masses on six 61-cm branch tips	Infestation forecasts for 1990 ^a
<u>Algonquin Park District</u>			
White	2	0	N
<u>Parry Sound District</u>			
Carling	0	0	N
Carling	0	0	N
Harrison	0	0	N
Mowat	0	0	N
Wallbridge	0	1	L
<u>Pembroke District</u>			
Buchanan	2	0	N
Head	2	0	N
Maria	2	0	N
Petawawa	2	0	N

^a N = nil, L = light

Pine Engraver Beetle, *Ips pini* Say

Population increases of the pine engraver beetle and related whole-tree mortality were recorded in a large number of red pine plantations in the region. Dead trees were observed in plantations in Burleigh, Dungannon and Monteagle townships, Bancroft District; Laurier and Machar townships, Bracebridge District; Lount and Ryerson townships, Parry Sound District; and Hagarty, Ross and Wilberforce townships, Pembroke District. Ground surveys in several affected plantations disclosed pockets or groups of 2-40 infested trees ranging in height from 3 to 17 m.

The increased numbers are a result of drought conditions experienced in 1987 and 1988. In a normal growing season pines produce terpenes, chemicals that are toxic and repel bark beetle attack. When a tree becomes stressed by drought it lacks the energy to produce sufficient amounts of terpenes and in fact produces other chemicals that are attractive to bark beetles. The male bark beetle, while feeding, digests these chemicals and excretes them in its frass, making them a

highly attractive pheromone to females. The females in turn release a pheromone that serves to attract more males. As a result, large numbers of beetles are attracted to the stand (see photo page).

Gypsy Moth, *Lymantria dispar* (L.)

Gypsy moth increased in numbers as well as in range in 1989. A total of 1,234 ha of moderate-to-severe defoliation was aerially mapped in stands of oak (*Quercus* spp.) and aspen (*Populus* spp.), an increase of 740 ha over the previous year and the largest area of damage reported to date in the region. The areas of high populations were confined mainly to Bancroft, Minden and Pembroke districts (Fig. 2). Ground surveys in Bancroft, Bracebridge and Minden districts disclosed approximately 83,082 ha of what was generally considered light defoliation, but within this same area there were also some pockets of light-to-moderate damage. Because the entire area was infested by high populations of forest tent caterpillar (*Malacosoma disstria* Hbn.) as well, accurate defoliation assessment was difficult.

Twelve separate pockets of medium-to-heavy infestation totaling 1,154 ha were observed in the northern part of Pembroke District. The largest area of damage, 990 ha, occurred to the north of Golden Lake in Algona Township. The other 11 areas were all less than 55 ha in size.

Aerial and ground surveys delineated two small areas of moderate-to-severe defoliation affecting some 65 ha of host trees in Harvey Township, Minden District. The larger area was on the Minden-Lindsay district border in the Buckhorn area and the other just north of it. Both pockets also hosted high numbers of forest tent caterpillar. As well, approximately 15,704 ha of light defoliation were detected in the southeast corner of Minden District in the Gold-Mississauga-Catchacoma lakes area, and southward into Lindsay District. An additional 2,012 ha of light and light-to-moderate damage were observed in the Gull Lake area.

Two small pockets of medium-to-heavy infestation totaling 15 ha were observed in Bancroft District, one northeast of McArthur Mills in Mayo Township. A much larger continuous area of light defoliation (65,364 ha), was recorded in the southwest corner of Bancroft District in the Oak-Kasshabog-Jack-Anstruther lakes area, and westward into Minden District.

A 2-ha area of oak on the south shore of Pine Lake, west of Gravenhurst in Wood Township, Bracebridge District experienced light-to-moderate defoliation, and surveys elsewhere in the township disclosed light damage. In neighboring Muskoka Township, in the Muldrew Lake area, light defoliation was also encountered but the size of these affected areas was undetermined. Numerous larvae were observed within the town of Gravenhurst and low numbers were collected in the town of Port Carling.

ALGONQUIN REGION

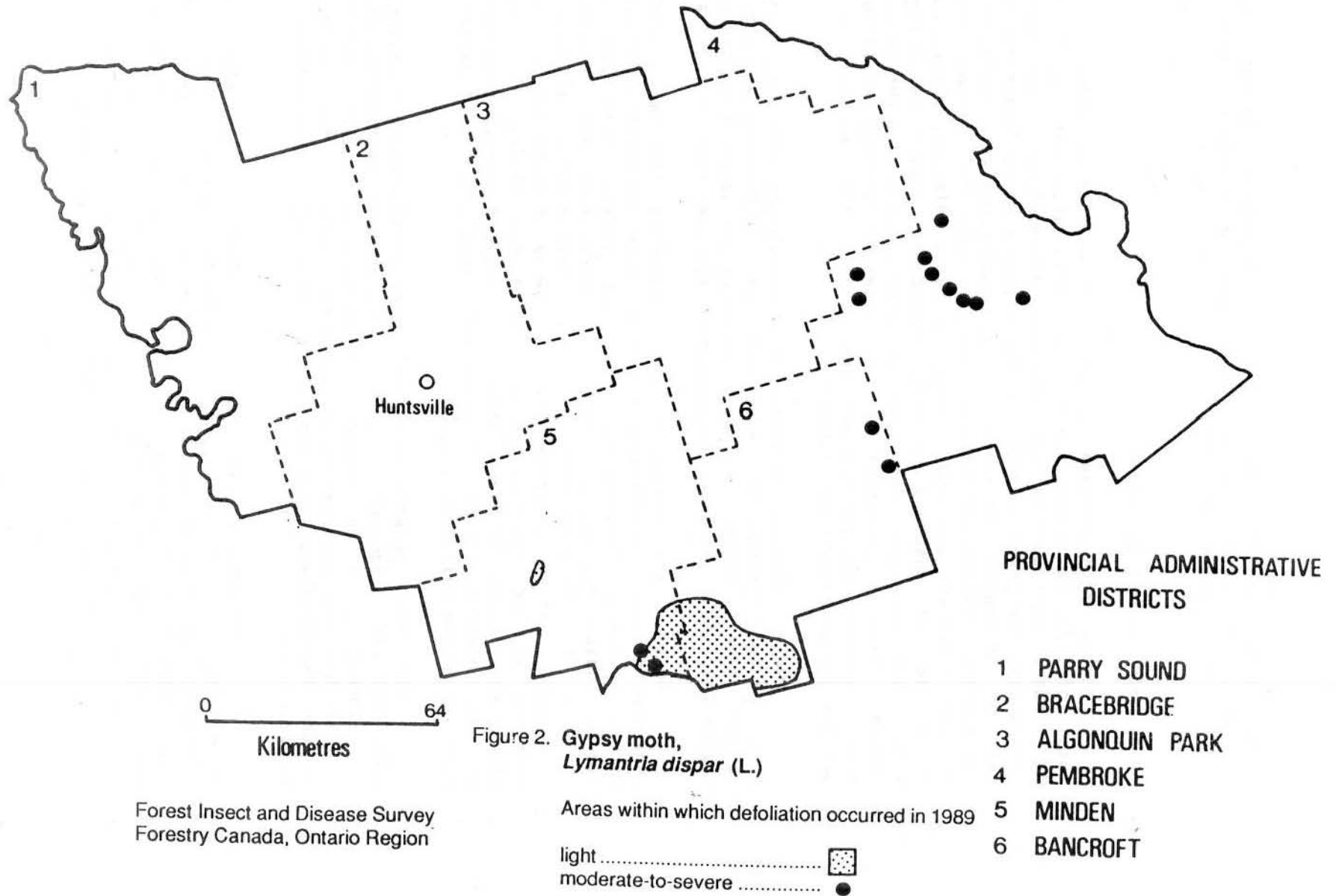


Figure 2. Gypsy moth, *Lymantria dispar* (L.)

Areas within which defoliation occurred in 1989

Forest Insect and Disease Survey
Forestry Canada, Ontario Region

Low populations were common in parts of Parry Sound District. Surveys revealed light defoliation of oak and white pine on the Sans Souci islands of Georgian Bay and in Killbear Provincial Park. Larvae were also noted on ornamentals in the town of Parry Sound.

The burlap larval trapping program carried out with the cooperation of OMNR Parks staff was repeated at the 22 provincial parks in the region. Burlap strips were placed around the boles of 10 trees in each park and larval counts were conducted. Larvae were captured at eight campgrounds as compared with five the previous year. The information presented in Table 4 shows that larvae were collected for the first time in Driftwood Provincial Park, Pembroke District and at Oastler and Sturgeon Bay provincial parks, Parry Sound District.

As well as the burlap strips, two pheromone traps were set out in each provincial park, one near the entrance and the other in the campgrounds. The current results and a comparison of the results for the last five years are included in Table 4. Not only were adults trapped at every location (excepting Opeongo Lake in Algonquin Park where traps were missing) but increased numbers were recorded at all except one location.

Single pheromone traps were also randomly set out at 16 locations in the Region (Table 5). Adult catches ranged from seven to as high as 29 (Fig. 3).

Eastern Tent Caterpillar, *Malacosoma americanum* (F.)

High populations persisted throughout the region for the fourth consecutive year. Medium-to-heavy infestations were observed mainly on black cherry (*Prunus serotina* Ehrh.), pin cherry (*Prunus pensylvanica* L.f.) and choke cherry (*P. virginiana* L.). Especially hard hit was the southwestern part of Minden District where surveys in Carden Township disclosed as many as 35 tents on 4-m-tall host trees. Somewhat lower numbers occurred in the southeastern part of Bancroft District. An assessment at one location in Cashel Township revealed an average of eight tents per 3.5-m-tall tree and 85% defoliation.

Forest Tent Caterpillar, *Malacosoma disstria* Hbn.

The area of hardwoods, mainly red oak (*Quercus rubra* L.), trembling aspen (*Populus tremuloides* Michx.) and to a lesser degree sugar maple (*Acer saccharum* Marsh.), experiencing moderate-to-severe defoliation caused by the forest tent caterpillar in 1988, increased by 62,047 ha to 1,319,956 ha (Fig. 4). This total represents the fourth consecutive year of increased populations. A breakdown, by district, of the area of medium-to-heavy infestation (Table 6) indicates that the overall increase was the result of increases in three districts, Algonquin Park, Bancroft and Pembroke.

Table 4. Results of larval burlap trapping and adult pheromone trapping of gypsy moth over a 5-year period at 22 provincial campgrounds in the Algonquin Region of Ontario (counts based on 10 burlap traps and two pheromone traps set out at each location).

Location (Provincial park)	Burlap trapping					Pheromone trapping					
	Positive (+) or negative (-) trapping of larvae					Total no. of male moths trapped					
	1985	1986	1987	1988	1989	1985	1986	1987	1988	1989	
<u>Algonquin Park District</u>											
Algonquin Park											
Kearny Lake	-	-	-	-	-	0 ^a	2	2	12	0	18 ^a
Pog Lake	-	-	-	-	-	0 ^a	15		22	7	22
Lake of Two Rivers	-	-	-	-	-	0	1 ^a		9 ^a	8	33
Mew Lake	-	-	-	-	-	0	1 ^a		14	3	39
Tea Lake	-	-	-	-	-	1	3 ^a		26	4	16 ^a
Coon Lake	-	-	-	-	-	0 ^a	19		35	18	32
Rock Lake	-	-	-	-	-	1	15		30	4	11 ^a
Whitefish Lake	-	-	-	-	-	0	3 ^a		35	7 ^a	11 ^a
Opeongo Lake	-	-	-	-	-	0	18		- ^b	- ^b	- ^b
Canisby	-	-	-	-	-	0	3		33	4	7 ^a
<u>Bancroft District</u>											
Lake St. Peter	-	-	-	+	-	10	38		44	35	42
Petroglyphs	-	+	+	+	+	41	22 ^a		15 ^a	63	36
Silent Lake	-	-	-	+	+	13	41		31	7 ^a	36
<u>Bracebridge District</u>											
Arrowhead	-	-	-	-	-	0 ^a	19		23	20	41
Mikisew	-	-	-	-	-	0	18		1 ^a	1	24

(cont'd)

Table 4. Results of larval burlap trapping and adult pheromone trapping of gypsy moth over a 5-year period at 22 provincial campgrounds in the Algonquin Region of Ontario (counts based on 10 burlap traps and two pheromone traps set out at each location) (concl.)

Location (Provincial park)	Burlap trapping					Pheromone trapping				
	Positive (+) or negative (-) trapping of larvae					Total no. of male moths trapped				
	1985	1986	1987	1988	1989	1985	1986	1987	1988	1989
<u>Parry Sound District</u>										
Grundy Lake	-	-	-	-	-	0	24	9 ^a	6	24
Killbear	-	-	-	+	+	2	37	29 ^a	27	49
Oastler	-	-	-	-	+	1	14	23 ^a	32	34
Sturgeon Bay	-	-	-	-	+	0	19	18	30	40
<u>Pembroke District</u>										
Bonnechere	+	+	+	+	+	39	22 ^a	22 ^a	33	49
Carson Lake	-	-	+	+	+	21 ^a	40	43	30	34
Driftwood	-	-	-	-	+	24	17 ^a	33	4	27

^a one pheromone trap missing at each location

^b two pheromone traps missing at each location

Table 5. Results of adult pheromone trapping of gypsy moth at 16 locations in the Algonquin Region (counts based on a single trap set out at each location).

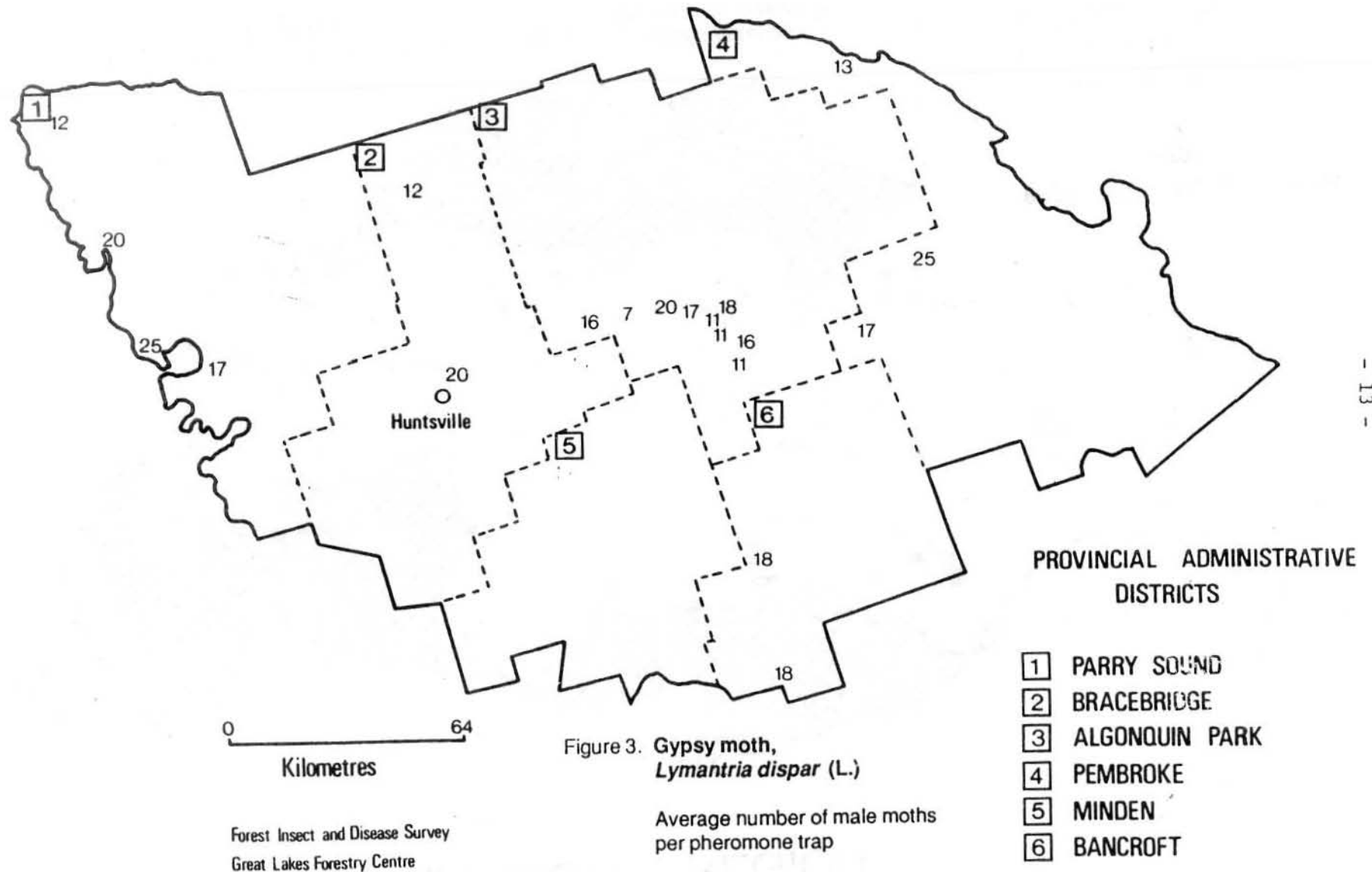
Location (Twp)	Total no. of moths trapped
<u>Algonquin Park District</u>	
Airy	18
Peck	10
Sproule	16
<u>Bancroft District</u>	
Anstruther	7
Cardiff	16
Limerick	18
Methuen	29
<u>Bracebridge District</u>	
Medora (Port Carling)	19
Medora (Bala)	22
<u>Minden District</u>	
Cavendish	13
Lutterworth	14
Minden	18
<u>Pembroke District</u>	
Petawawa (CFB Borden)	69
Ross	21 ^a
Wilberforce	19
Wylie (PNFI)	21 ^b

^a 3 traps used

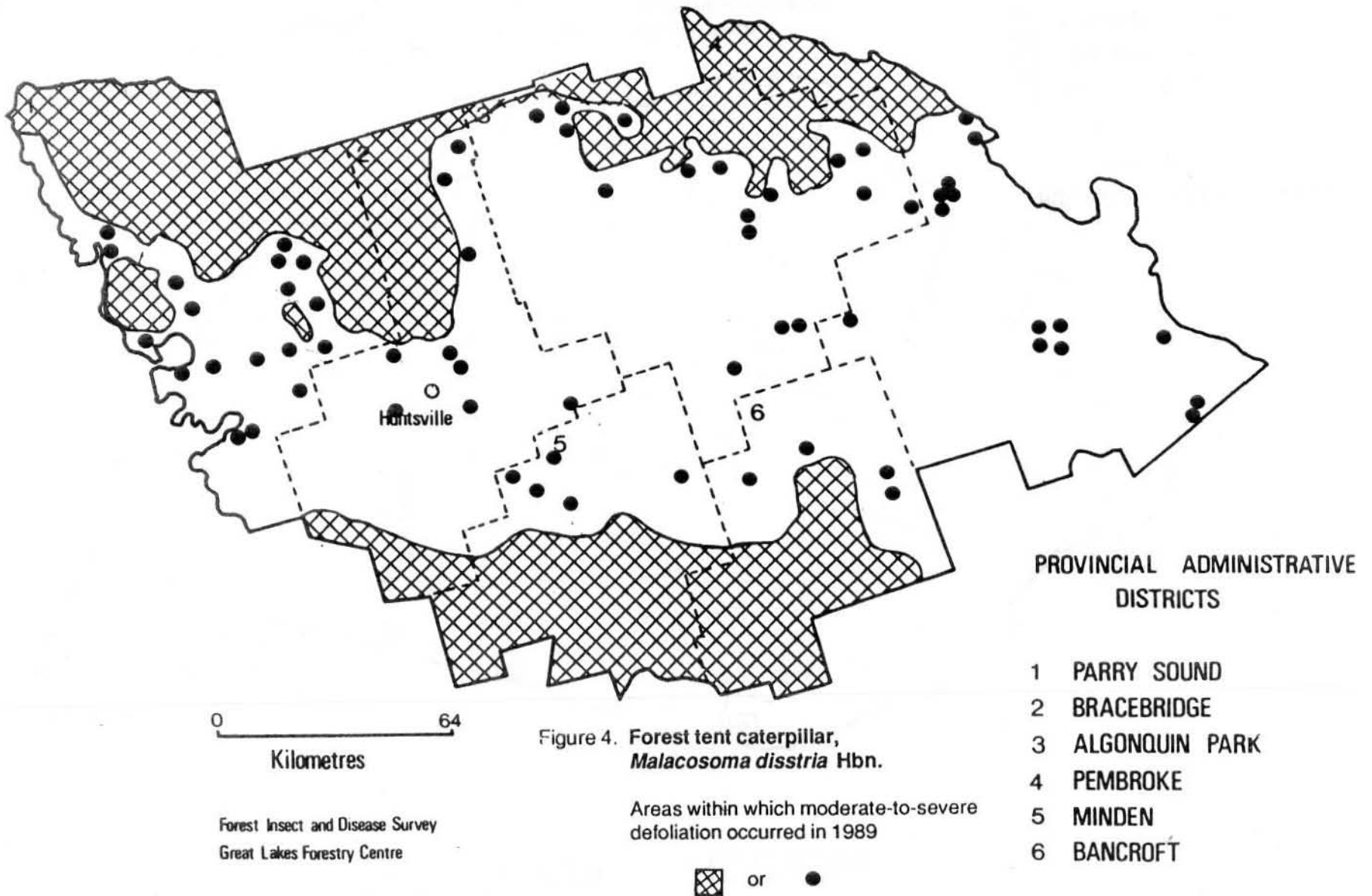
^b 2 traps used

Algonquin Park District hosted the largest increase in area of medium-to-heavy infestation. The affected area expanded from 62,579 ha in 1988 to 171,988 ha in 1989 (Fig. 5). As in the previous year the main body of damage was confined to the northern part of the district. The 212,540 ha of moderate-to-severe defoliation mapped in the central and southern parts of Bancroft District represented a substantial (64,415 ha) increase over the previous year. Increased but sporadic high populations typified the situation in Pembroke District. Except

ALGONQUIN REGION



ALGONQUIN REGION



ALGONQUIN REGION

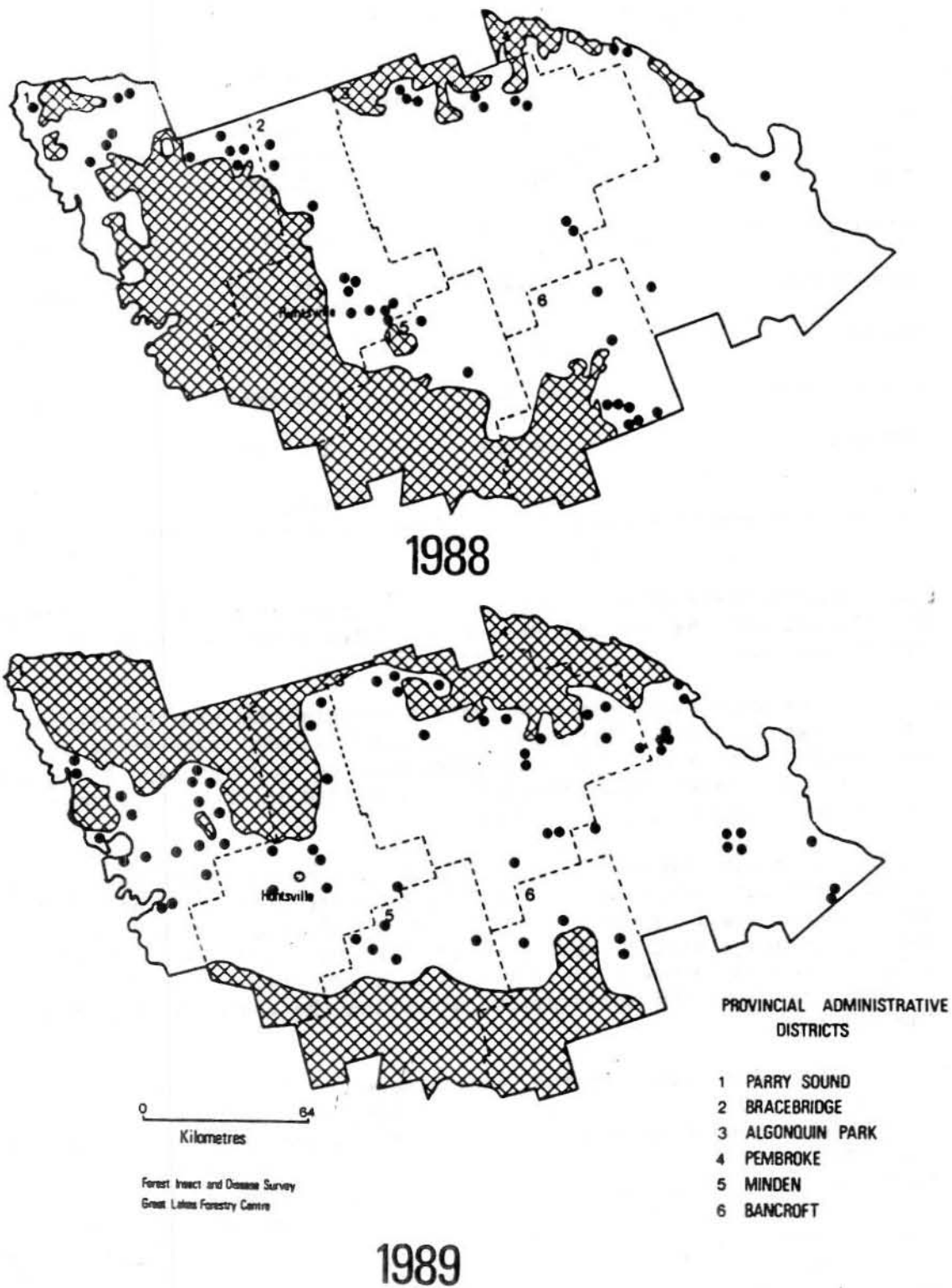


Figure 5. A comparison of the area of damage caused by the forest tent caterpillar, *Malacosoma disstria* Hbn. in 1988 and 1989

Table 6. A comparison of the gross area of moderate-to-severe defoliation caused by the forest tent caterpillar in 1988 and 1989 in the Algonquin Region of Ontario.

District	Area of moderate-to-severe defoliation (ha)		Change (ha)
	1988	1989	
Algonquin Park	62,579	171,988	+109,409
Bancroft	148,125	212,540	+ 64,415
Bracebridge	330,845	174,171	-156,674
Minden	268,633	267,576	- 1,057
Parry Sound	408,302	390,886	- 17,416
Pembroke	39,425	102,795	+ 63,370
Total	1,257,909	1,319,956	+ 62,047

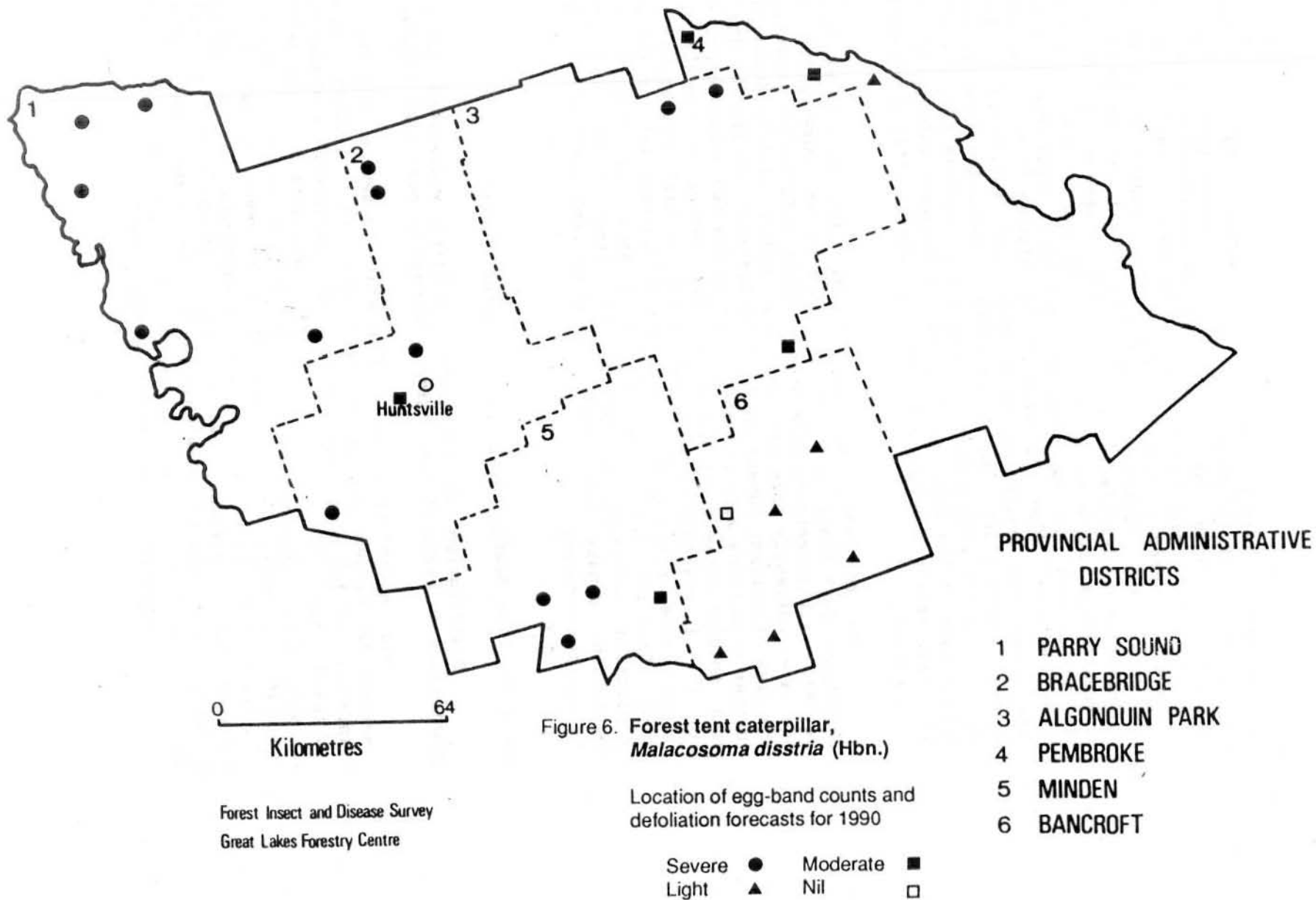
for a fairly large area in the northwest corner of the district the rest of the 102,795 ha of medium-to-heavy infestation was composed of 20 small pockets.

The most significant decrease in populations was observed in the Bracebridge District. The previous medium-to-heavy infestation centered in the Muskoka Lakes area collapsed, leaving a large gap between the 174,174 ha of observable defoliation recorded in the northernmost and southernmost parts of the district.

Although increases were recorded in the northern part of Parry Sound District, there was an overall decrease of 17,416 ha, mostly in the southern half of the district; the total area infested was 390,886 ha. Although a slight decrease was recorded in Minden District, the area of medium-to-heavy infestation remained relatively unchanged at 267,576 ha, with the infestation occupying the southern two thirds of the district.

Egg-band sampling for the purpose of forecasting defoliation levels in 1990 was conducted at 26 locations (Fig. 6). One to three trembling aspen or largetooth aspen (*Populus grandidentata* Michx.) were cut down at each location and the number of new egg bands was recorded. As a result of these egg-band surveys it was discovered that there were fewer eggs than in the previous year. In 1988 as many as 92 egg bands were recovered from one tree, whereas in the current survey, the highest number was 27 egg bands. Also noted at several locations were smaller and/or incompletely formed egg bands. The reduction in numbers of egg

ALGONQUIN REGION



bands was a result, in part, of activity by the parasitic fly, *Sarcophaga aldrichi* Park., and the widespread presence of a nuclear polyhedrosis virus (NPV), which reduced the potential adult population. The egg-band survey results were then used to predict the defoliation levels presented in Table 7. When these results are being interpreted it should be understood that the forecast procedure used tends to underestimate defoliation in the early stages of an infestation and overestimates it in an aging infestation such as the current one. This is due in part to egg parasites that have increased in numbers along with the host. When this fact and the history of previous infestations are taken into consideration, a breakup and subsequent decrease in the current infestation can be expected. Moderate-to-severe defoliation will occur (barring unforeseen occurrences such as a late spring frost) within many of the areas in which medium-to-heavy infestation was mapped in 1989, except for Bancroft District, where little appreciable damage is expected.

The forecast on a district-by-district basis is as follows: in Algonquin Park District a breakup in the current infestation can be expected, with pockets of moderate-to-severe defoliation occurring within the area currently infested; only low numbers will be found throughout the area of current damage in Bancroft District; in Bracebridge District further reductions will probably occur in the two separate infestations, with holdout pockets of medium-to-heavy damage; a breakup in Minden District is possible as well, with areas of high populations still expected; some erosion and breakup of the current infestation in Parry Sound District are predicted, with areas of moderate-to-severe defoliation occurring in the general area currently infested; no significant damage is expected in most of Pembroke District except in the northwest corner.

Redheaded Pine Sawfly, *Neodiprion lecontei* (Fitch)

Distribution of this pest was fairly widespread and red pine plantations in parts of the region continued to host high populations.

"Hot spots" or pockets of moderate-to severe defoliation were observed in Minden and Parry Sound districts. A survey in a 2-ha plantation of 2.8-m-tall red pine in Harburn Township, Minden District disclosed that 12% of the trees had been attacked and defoliation averaged 15%. Another assessment in a 5-ha red pine plantation in McMurrich Township, Parry Sound District revealed that 25% of the 0.9-m-tall trees were affected and accompanying current defoliation averaged 25%. Individual tree defoliation of 90% as well as whole-tree mortality (less than 1%) were observed in both of the above plantations. The two areas also hosted high populations of the pine false webworm, which contributed additional stress to the trees.

Table 7. Summary of forest tent caterpillar egg-band counts at 26 locations in the Algonquin Region of Ontario and infestation forecasts for 1990.

Locations (Twp)	Host ^a	Avg DBH of sample tree (cm)	No. of trees sampled	Avg no. of egg bands per tree	Infestation forecasts for 1990 ^b
<u>Algonquin Park District</u>					
Deacon	tA	11.0	3	9	S
Fitzgerald	tA	12.0	3	6	S
Lyell	tA	12.0	3	2	M
<u>Bancroft District</u>					
Burleigh	lA	12.0	3	1	L
Cardiff	lA	13.0	1	0	N
Faraday	tA	11.0	3	1	L
Limerick	tA	11.0	3	1	L
Methuen	tA	11.0	3	1	L
Monteagle	tA	12.0	3	1	L
<u>Bracebridge District</u>					
Chaffey	tA	10.0	3	13	S
Stephanson	tA	10.0	3	5	M
Strong	tA	9.0	3	7	S
Wood	tA	10.0	3	6	S
Machar	tA	10.0	3	8	S
<u>Minden District</u>					
Cavendish	tA	13.0	3	2	M
Lutterworth	tA	11.0	3	16	S
Snowdon	tA	10.0	3	8	S
Somerville	tA	10.0	3	6	S
<u>Parry Sound District</u>					
Blair	tA	11.0	3	14	S
Carling	tA	9.0	3	8	S
Monteith	tA	12.0	1	19	S
Mowat	tA	11.0	3	7	S
Wallbridge	tA	9.0	1	27	S
<u>Pembroke District</u>					
Clara	tA	9.0	3	5	M
Head	lA	10.0	3	5	M
Rolph	tA	12.0	3	1	L

^a tA = trembling aspen, lA = largetooth aspen

^b N = nil, L = light, M = moderate, S = severe

Other "hot spots" were recorded in Pembroke District. Surveys in a 6-ha plantation of 2.0-m-tall red pine in Sebastopol Township revealed that 50% of the trees were damaged and defoliation averaged 30%. Defoliation averaged 15% at each of two other locations, one a 2-ha section of 2.3-m-tall red pine in Westmeath Township, the other a 5-ha plantation of 3.5-m-tall trees in Lyndoch Township.

Control operations with the Lecontvirus were carried out by OMNR in Bancroft, Bracebridge, Minden and Parry Sound districts.

Table 8. Other forest insects

Insect	Host(s)	Remarks
<i>Diprion similis</i> (Htg.) Introduced pine sawfly	rP	A survey revealed that 1% of 1.4-m-tall trees in a 10-ha plantation in Somerville Twp, Minden District experienced less than 5% defoliation.
<i>Elaphidionoides</i> sp. Twig Pruner	rO	Moderate populations were encountered at several locations in Bracebridge and Parry Sound districts. Assessment at one location in Carling Twp, Parry Sound District disclosed that 64% of the 6-m-tall trees had been attacked and had an average of two "pruned" branches each. Another survey in Medora Twp, Bracebridge District revealed that 62% of the 6-m-tall hosts were affected and an average of two branches per tree were damaged.
<i>Ennomos subsignaria</i> (Hbn.) Elm spanworm	sM	A survey of 25 18-m-tall trees in Ross Twp, Pembroke District disclosed an average of 10% defoliation.
<i>Fenusa pusilla</i> (Lep.) Birch leafminer	wB	Examination disclosed 70% foliar damage in a 1-ha stand of 10-m-tall trees in McDougall Twp, Parry Sound District.

(cont'd)

Table 8. Other forest insects (cont'd)

Insect	Host(s)	Remarks
<i>Gonipterus americana</i> (Schaeff.) American aspen beetle	tA	Assessment of 50 5-m-tall trees in Buchanan Twp, Pembroke District revealed 20% defoliation.
<i>Hyphantria cunea</i> (Drury) Fall webworm	hardwoods	In Bromley Twp, Pembroke District, a 5-ha stand of 15-m-tall white ash (<i>Fraxinus americana</i> L.) sustained 80% defoliation. Low numbers and usually single tents were observed in Bracebridge, Minden and Parry Sound districts.
<i>Mesa nana</i> (Klug) Early birch leaf edgeminor	wB	A survey of 10 5-m-tall trees in Wylie Twp, Pembroke District disclosed an average of 10% foliar damage.
<i>Neodiprion sertifer</i> (Geoff.) European pine sawfly	rP, muP	A survey of 1.4-m-tall red in a 10-ha plantation in Somerville Twp, Minden District, revealed that 11% of the trees had been attacked and associated defoliation was less than 10%. Light-to-moderate damage (<25%) was observed on ornamental mugho pine (<i>Pinus mugo</i> Turra var. <i>mughus</i> Zenari) in the towns of Minden and Gravenhurst.
<i>Pikonema alaskensis</i> (Roh.) Yellowheaded spruce sawfly	wS	Examination of 15 1.5-m-tall trees in Faraday Twp, Bancroft District revealed an average of 15% defoliation; a roadside survey of 50 2.5-m-tall trees in Snowdon Twp, Minden District disclosed that 96% had been attacked and defoliation averaged 50%. Severe defoliation (>75%) of ornamentals was observed at several locations in Minden Twp, Minden District.

(cont'd)

Table 8. Other forest insects (concl.)

Insect	Host(s)	Remarks
<i>Pineus floccus</i> (Patch) Red spruce adelgid	rS	A survey of 25 1.5-m-tall trees in Buchanan Twp, Pembroke District disclosed an average of 13 galls per tree.
<i>Zellaria haimbachi</i> (Bsk.) Pine needle sheathminer	jP	Low numbers causing less than 5% defoliation were recovered from 3- to 10-m-tall trees in Mowat Twp, Parry Sound District.



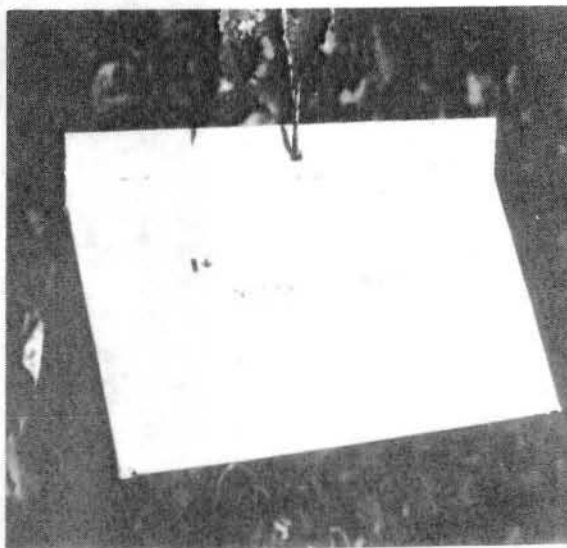
Spruce budworm multiplier trap



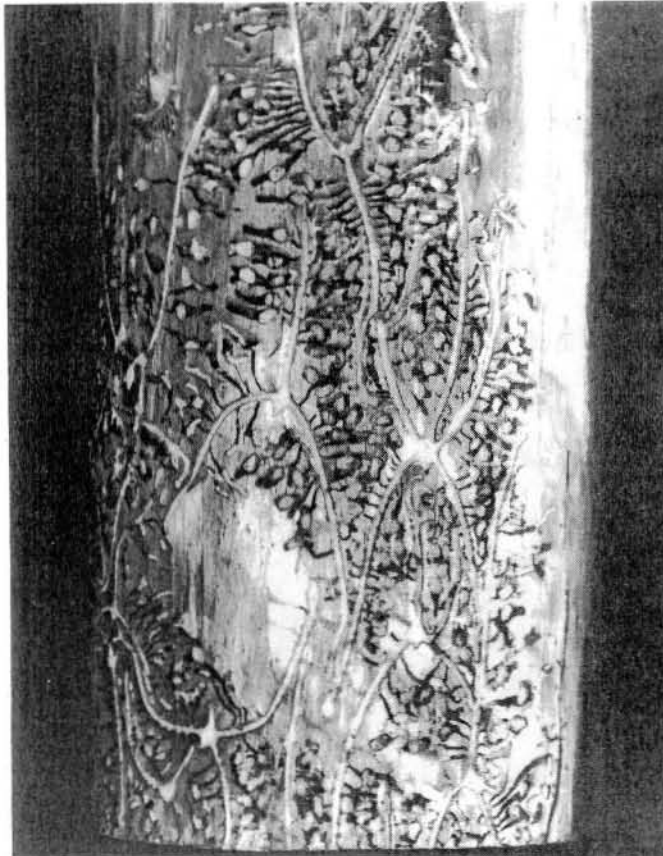
Pole clipping, spruce budworm egg-mass sampling



Gypsy moth burlap trapping



Gypsy moth pheromone traps



(Left) Pine engraver beetle galleries



(Right) Pear thrips damage

TREE DISEASES

Major Diseases

Armillaria root rot, *Armillaria ostoyae* (Romagn.) Herink

This root disease has both hardwoods and conifers as its hosts and can affect trees from the seedling stage to maturity. Often it attacks stressed or weakened trees. Such was the case in Laurier Township, Bracebridge District, where for the past few years many semimature-to-mature white spruce appeared to be declining and dying. Root sections from a living white spruce exhibiting symptoms typical of the disease were collected and submitted to Forestry Canada, Ontario Region for examination. Culturing yielded the *Armillaria* root rot fungus. A couple of standing, dead white spruce were also examined on site and were found to be affected by *Armillaria* root rot. Spruce budworm was probably the major factor predisposing these trees to attack by *Armillaria*. Host stands in Laurier Township had been subjected to moderate-to-severe defoliation from 1978 to 1985, inclusive. Other contributing factors may have been tree age, site and dry summers.

The *Armillaria* root rot fungus was the only destructive organism recovered from dead red pine in a plantation in Watt Township, Bracebridge District. The affected trees averaged 23.0 cm DBH and were confined to an area roughly 50 m x 50 m. Within this area 40% of the standing trees were dead and recent whole-tree mortality averaged 6%.

Scleroderris Canker, *Ascocalyx abietina* (Lagerb.) Schlöpfer-Bernhard

In all, 55 red pine plantations ranging in height from 0.5 to 22.0 m were surveyed in 1989 for evidence and distribution of the *Scleroderris* canker fungus, the North American as well as the more virulent European race (Table 9). Serological testing confirmed the presence of the European race of the fungus at five locations. As well, the North American race was confirmed at two of these locations. Four of the confirmed plantations, two in Ryerson Township, Parry Sound District, one in McMurrich Township, Parry Sound District, and one in Mayo Township, Bancroft District, were in townships with a previous history of the disease. A confirmed location in Strong Township, Bracebridge District, however, represented a new northward extension of the European race of the fungus (Fig. 7).

Both races of the fungus were found infecting trees in a young plantation of 2.1-m-tall red pine in Lot 25, Concession IV, Ryerson Township, Parry Sound District. Assessment disclosed that the incidence of infection was less than 1% and partial tree mortality was observed. A similar incidence of infection was recorded in a plantation of 0.8-m-tall red pine in Lot 26, Concession X, Ryerson Township. Recent whole-tree mortality (trees dying in the past year) was observed off the survey plots.

Table 9. Results of a special survey for Scleroderris canker at 55 locations in the Algonquin Region of Ontario in 1989 (counts based on the examination of 500+ red pine trees at each location).

Location (Twp)	Tree height (m)	Total trees per ha	Total area examined (ha)	Trees affected (%)	Trees dead (%)
<u>Algonquin Park District</u>					
Guthrie	9.0	1,200	10	0	0
Lyell	10.0	1,900	10	0	0
Sabine	12.0	2,400	5	0	0
Sproule	22.0	1,600	1	0	0
Stratton	5.5	2,400	1	0	0
White	5.0	2,500	4	0	0
<u>Bancroft District</u>					
Burleigh	8.0	1,700	2	0	0
Dungannon	10.0	2,500	3	0	0
	8.0	2,400	3	0	0
	5.5	1,900	3	0	0
	5.1	2,100	6	0	0
	19.5	1,600	6	0	0
Mayo	4.0	1,600	6	0	0
	1.0	2,000	2.5	0	0
	10.0	2,100	6	0	0
	0.5	2,400	2	0	0
	5.1	300	1.5	8 ^a	0
<u>Bracebridge District</u>					
Strong	20.0	1,000	3	0	0
	1.4	2,500	5	16 ^a	<1
<u>Parry Sound District</u>					
Hagerman	13.0	2,200	4	0	0
Lount	6.8	3,000	5	0	0
McKenzie	11.0	2,500	3	0	0
McMurrich	1.2	3,100	10	0	0
	1.2	3,100	15	0	0
	2.5	1,500	10	0	0
	1.9	2,500	20	0	0
	0.9	3,000	5	0	0
	0.9	2,800	10	<1 ^a	<1

(cont'd)

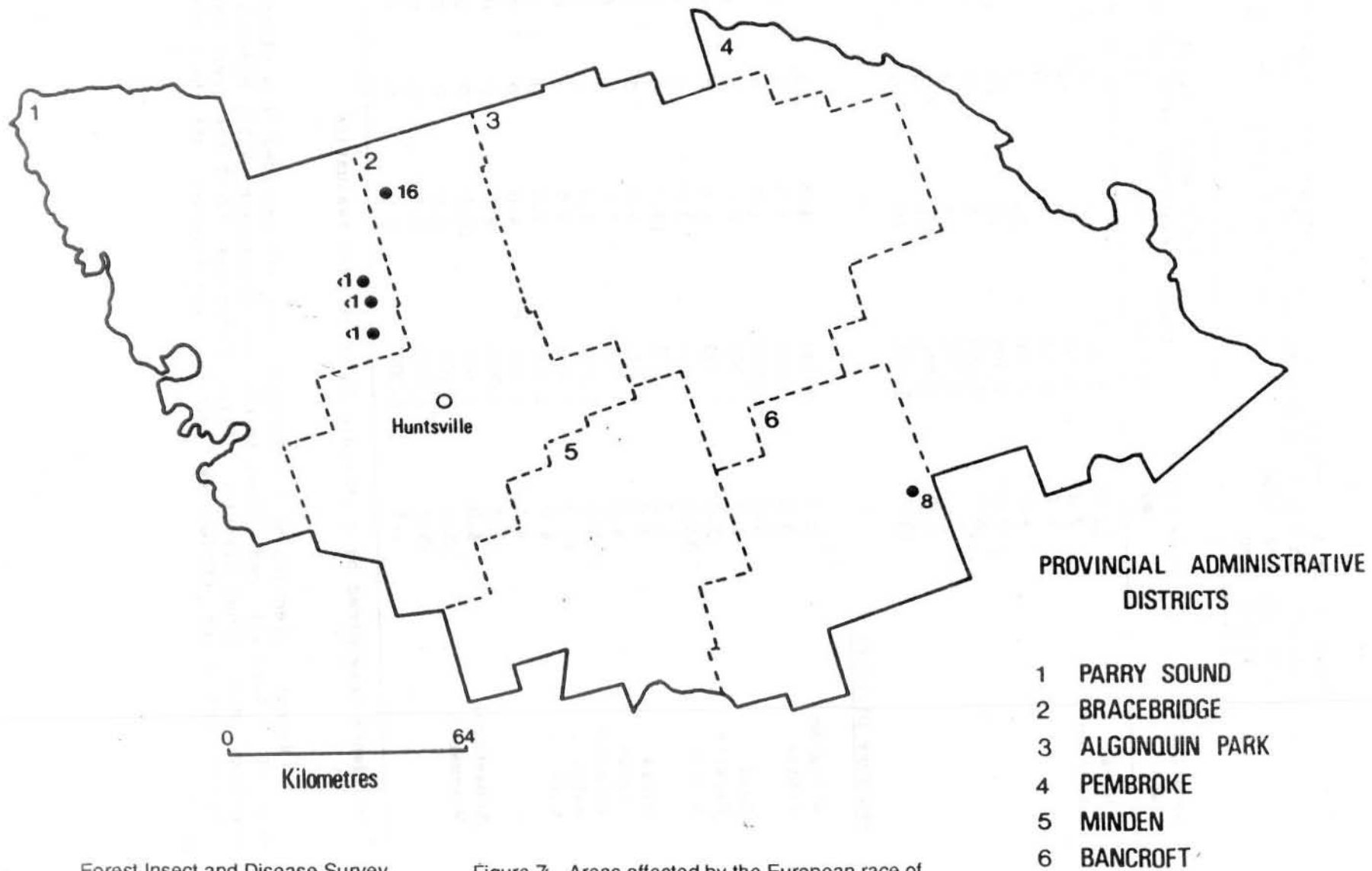
Table 9. Results of a special survey for Scleroderris canker at 55 locations in the Algonquin Region of Ontario in 1989 (counts based on the examination of 500+ red pine trees at each location) (concl.).

Location (Twp)	Tree height (m)	Total trees per ha	Total area examined (ha)	Trees affected (%)	Trees dead (%)
Mowat	11.0	2,500	4	0	0
Ryerson	2.1	2,100	10	<1 ^a	0
	4.0	1,700	5	0	0
	4.0	3,500	10	0	0
	0.8	3,300	10	<1	<1
	0.8	2,000	5	0	0
	1.4	3,100	15	0	0
	1.0	2,500	15	0	0
	15.0	1,000	20	0	0
<u>Pembroke District</u>					
Brougham	0.7	2,500	3.0	0	0
Fraser	8.0	2,200	3.0	0	0
	0.6	2,100	1.5	0	0
Head	1.2	1,700	6.0	0	0
Hagarty	5.0	1,700	8.0	0	0
Horton	15.0	1,600	2.0	0	0
	1.0	2,500	10.0	0	0
Maria	5.0	2,500	4.0	0	0
Raglan	8.0	2,500	5.0	0	0
Richards	6.0	2,000	8.0	0	0
Rolph	10.5	2,500	2.0	0	0
Ross	6.0	2,500	2.0	0	0
	4.5	2,000	4.0	0	0
	5.1	2,500	8.0	0	0
Sebastopol	6.0	2,500	10.0	0	0
Westmeath	5.0	1,800	1.0	0	0
	6.0	2,400	6.0	0	0
	1.5	2,500	2.0	0	0

^a incidence determined by a standard 150-tree pest evaluation

Recent infection by the European race was recorded in a plantation of 0.9-m-tall red pine in Lot 14, Concession VIII, McMurrich Township, Parry Sound District. Again, fewer than 1% of the trees were affected and recent whole-tree mortality was observed off the survey plots.

ALGONQUIN REGION



Forest Insect and Disease Survey
Forestry Canada, Ontario Region

Figure 7: Areas affected by the European race of Scleroderris canker, *Ascolalyx abietina* (Lagerb.) Schläpfer-Bernhard.

The European race was positively confirmed on samples from a 1.5-ha plantation of 5.1-m-tall red pine in Lot 26, Concession XV, Mayo Township, Bancroft District, that had been sanitized previously in 1986.

The highest incidence of Scleroderris canker was in Lot 20, Concession XIV, Strong Township, Bracebridge District, the first record of the disease in this township. An evaluation of the 1.4-m-tall red pine disclosed that 16% of the trees were infected by one or both strains of the fungus. Recent whole-tree mortality was observed off the survey plots.

A sanitation program involving the removal of trees exhibiting symptoms of the disease was carried out in each of the above plantations.

Table 10. Other forest diseases

Disease	Host(s)	Remarks
<i>Eutypella parasitica</i> Davidson & Lorenz Eutypella canker	sM	Surveys in natural stands disclosed 4% infection in Gibson Twp, Parry Sound District, and 8% in Wood Twp, Bracebridge District.
<i>Fomes fomentarius</i> (Fr.) Kickx Tinder fungus	sM	Light infections were recorded in Ridout Twp, Bracebridge District.
<i>Irpex lacteus</i> (Fr.:Fr.) Fr. Milk-white toothed polypore	rO	A 1% incidence was detected in the oak plot in Macaulay Twp, Bracebridge District.
<i>Oxyporus populinus</i> (Schumacher: Fr.) Donk Mossy maple polypore	sM	Commonly found in stands of hosts in Minden and Monmouth twps, Minden District, Chaffey Twp, Bracebridge District and Carling Twp, Parry Sound District
<i>Phellinus igniarius</i> (L.:Fr.) Quelet False tinder fungus	sM	Observation disclosed an 8% incidence in a stand in Carling Twp, Parry Sound District.

FOREST HEALTH

Maple Health

In 1987, 20 plots, each consisting of 25 semimature or mature sugar maple trees, were randomly established in stands with a heavy sugar maple content to monitor tree health. The crown condition of each tree was rated by means of a dieback classification that separated current and total dieback into five categories: 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = >60%, 5 = dead tree (Table 11).

The results summarized in Table 11 indicate that, over all, 96% of the sugar maple had 20% or less current dieback, while 78% of these trees had 20% or less total dieback. Only 3% of the living plot trees had 41% or more total crown dieback. Four trees died and two trees were cut down between the 1988 and 1989 assessments.

Defoliation by the forest tent caterpillar was recorded on 35% of the plots, where it ranged from 5% to 45%. Gypsy moth defoliation occurred on two plots, both in Bancroft District, and associated foliar damage averaged 5%. Stem decay, signs of which included actual fruiting, was observed on 5% of the plot trees. Stem cankers were recorded on 2% of the trees and damage characteristic of the sugar maple borer, *Glycobius speciosus* (Say), was noted on 3% of the plot trees. Main-stem injury, which included such things as seams, frost cracks, and open and closed wounds, was found on 44% of the survey trees. A heavy seed crop was observed in 48% of the plots.

Seven additional plots were established in 1989 to assess crown dieback of semimature or mature ornamental sugar maple in the region. An attempt was made to use 25 trees in each plot, but there was not always a sufficient number of available hosts. Two of the plots were located in an urban environment, one in Eganville, the other in Pembroke. The other five plots consisted of roadside plantings (Table 12). The Eganville plot had much more cumulative or total dieback than any of the other plots: 40% of the trees there experienced more than 20% cumulative branch dieback. Of the trees in the two urban locations, 98% had 20% or less current dieback and 78% had 20% or less total dieback. This is comparable with the situation in the plots located in natural stands. Table 12 shows that 98% of roadside trees had 20% or less current dieback while 97% had 20% or less total dieback.

Other problems on the seven plots were recorded as encountered. These included forest tent caterpillar, which occurred on one plot; associated defoliation averaged 10%. As well, fungal fruiting bodies, indicators of stem decay, were noted on 4% of the trees and cankers were recorded on 2%. Sugar maple borer damaged the main stems of 1% of the plot trees and stem damage in the form of seams, frost cracks, etc., was found on 46% of the survey trees.

Table 11. A three-year summary of data collected from 20 semipermanent sugar maple plots established in 1987 in the Algonquin Region of Ontario to monitor crown condition (counts based on the examination of 25 host trees at each location).

Location (Twp)	Avg ht (m)	Avg DBH (cm)	Year	Current dieback ^a						Cumulative dieback ^a						Trees blown down or cut
				0	1	2	3	4	5	0	1	2	3	4	5	
<u>Algonquin Park District</u>																
Deacon	19	32.5	1987	14	11	0	0	0	0	0	3	18	4	0	0	0
			1988	23	1	0	1	0	0	0	3	16	6	0	0	0
			1989	25	0	0	0	0	0	0	16	8	1	0	0	0
Peck	21	36.3	1987	15	10	0	0	0	0	4	17	4	0	0	0	
			1988	21	4	0	0	0	0	0	5	16	4	0	0	0
			1989	7	17	1	0	0	0	0	13	11	1	0	0	0
Murchison	22	41.0	1987	17	8	0	0	0	0	9	16	6	0	0	0	
			1988	18	7	0	0	0	0	0	9	16	0	0	0	0
			1989	25	0	0	0	0	0	0	21	4	0	0	0	0
<u>Bancroft District</u>																
Bangor	23	44.9	1987	13	12	0	0	0	0	6	13	6	0	0	0	
			1988	23	2	0	0	0	0	0	6	13	6	0	0	0
			1989	15	9	0	0	0	0	0	16	6	1	1	0	1
Cardiff	22	32.3	1987	11	12	2	0	0	0	3	13	9	0	0	0	
			1988	22	3	0	0	0	0	0	3	15	7	0	0	0
			1989	17	8	0	0	0	0	1	18	4	1	0	1	0

(cont'd)

Table 11. A three-year summary of data collected from 20 semipermanent sugar maple plots established in 1987 in the Algonquin Region of Ontario to monitor crown condition (counts based on the examination of 25 host trees at each location) (cont'd).

Location (Twp)	Avg ht (m)	Avg DBH (cm)	Year	Current dieback ^a						Cumulative dieback ^a						Trees blown down or cut
				0	1	2	3	4	5	0	1	2	3	4	5	
<u>Bancroft District (cont'd)</u>																
Limerick	23	31.8	1987	21	4	0	0	0	0	0	6	16	3	0	0	0
			1988	24	1	0	0	0	0	0	6	16	3	0	0	0
			1989	25	0	0	0	0	0	0	19	6	0	0	0	0
<u>Bracebridge District</u>																
Chaffey	24	31.6	1987	24	0	0	1	0	0	14	10	0	0	1	0	0
			1988	21	3	1	0	0	0	11	12	1	0	1	0	0
			1989	19	3	1	0	1	1	16	6	1	0	1	1	0
Machar	25	34.4	1987	24	1	0	0	0	0	12	11	2	0	0	0	0
			1988	19	5	1	0	0	0	9	13	3	0	0	0	0
			1989	5	15	5	0	0	0	3	17	5	0	0	0	0
Stisted	24	29.9	1987	16	9	0	0	0	0	10	15	0	0	0	0	0
			1988	4	10	9	2	0	0	2	12	9	2	0	0	0
			1989	2	17	5	0	1	0	1	16	6	1	1	0	0
Wood	22	31.3	1987	24	1	0	0	0	0	17	7	1	0	0	0	0
			1988	17	5	3	0	0	0	14	8	3	0	0	0	0
			1989	17	7	0	0	0	1	15	8	0	0	1	1	0

(cont'd)

Table 11. A three-year summary of data collected from 20 semipermanent sugar maple plots established in 1987 in the Algonquin Region of Ontario to monitor crown condition (counts based on the examination of 25 host trees at each location)

Location (Twp)	Avg ht (m)	Avg DBH (cm)	Year	Current dieback ^a						Cumulative dieback ^a						Trees blown down or cut
				0	1	2	3	4	5	0	1	2	3	4	5	
<u>Minden District</u>																
Hindon	26	35.9	1987	24	1	0	0	0	0	9	16	0	0	0	0	0
			1988	13	11	1	0	0	0	7	17	1	0	0	0	0
			1989	14	11	0	0	0	0	11	12	2	0	0	0	0
Minden	25	41.0	1987	6	11	5	3	0	0	5	12	5	3	0	0	0
			1988	20	4	1	0	0	0	5	15	4	1	0	0	0
			1989	9	16	0	0	0	0	8	16	1	0	0	0	0
Monmouth	23	30.4	1987	21	4	0	0	0	0	12	11	2	0	0	0	0
			1988	14	8	3	0	0	0	9	12	4	0	0	0	0
			1989	8	13	3	0	0	1	7	12	3	2	0	1	0
<u>Pembroke District</u>																
Richard	28	40.5	1987	16	9	0	0	0	0	0	10	15	0	0	0	0
			1988	22	3	0	0	0	0	0	7	17	1	0	0	0
			1989	14	11	0	0	0	0	0	16	9	0	0	0	0
Ross	25	43.5	1987	13	12	0	0	0	0	0	12	13	0	0	0	0
			1988	18	7	0	0	0	0	0	11	14	0	0	0	0
			1989	19	5	0	0	0	0	0	18	6	0	0	0	1

(cont'd)

Table 11. A three-year summary of data collected from 20 semipermanent sugar maple plots established in 1987 in the Algonquin Region of Ontario to monitor crown condition (counts based on the examination of 25 host trees at each location) (concl.).

Location (Twp)	Avg ht (m)	Avg DBH (cm)	Year	Current dieback ^a						Cumulative dieback ^a						Trees blown down or cut
				0	1	2	3	4	5	0	1	2	3	4	5	
<u>Pembroke District (cont'd)</u>																
Sebastopol	22	40.2	1987	18	7	0	0	0	0	0	15	9	1	0	0	0
			1988	22	3	0	0	0	0	0	15	9	1	0	0	0
			1989	23	2	0	0	0	0	0	23	1	1	0	0	0
Wylie	25	37.0	1987	23	2	0	0	0	0	0	5	17	3	0	0	0
			1988	15	9	1	0	0	0	0	4	14	7	0	0	0
			1989	20	5	0	0	0	0	0	15	7	3	0	0	0
<u>Parry Sound District</u>																
Carling	23	30.6	1987	25	0	0	0	0	0	25	0	0	0	0	0	0
			1988	24	1	0	0	0	0	24	1	0	0	0	0	0
			1989	22	3	0	0	0	0	21	4	0	0	0	0	0
Christie	20	31.7	1987	8	10	7	0	0	0	3	14	7	1	0	0	0
			1988	12	11	2	0	0	0	2	16	6	1	0	0	0
			1989	5	17	3	0	0	0	1	13	11	0	0	0	0
Gibson	21	27.1	1987	22	3	0	0	0	0	15	8	2	0	0	0	0
			1988	22	3	0	0	0	0	16	8	1	0	0	0	0
			1989	20	5	0	0	0	0	18	6	1	0	0	0	0

^a Dieback classes: 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = 61%+, 5 = dead tree

Table 12. Summary of data collected from two urban and five rural roadside sugar maple plots established in the Algonquin Region of Ontario in 1989 to monitor crown conditions (counts based on the examination of 18-25 host trees at each location).

Location	Plot type ^a	Avg ht (m)	Avg DBH (cm)	Current dieback ^b						Cumulative dieback ^b						Trees blown down or cut
				0	1	2	3	4	5	0	1	2	3	4	5	
				No. of trees												
<u>Bancroft District</u>																
Dungannon Twp	R	20	67.7	25	0	0	0	0	0	23	2	0	0	0	0	0
<u>Minden District</u>																
Somerville Twp	R	25	49.4	13	11	1	0	0	0	7	16	2	0	0	0	0
<u>Pembroke District</u>																
Pembroke	U	17	63.2	25	0	0	0	0	0	21	2	1	1	0	0	0
Eganville	U	17	54.3	7	12	1	0	0	0	1	11	7	1	0	0	0
Ross Twp	R	17	67.1	25	0	0	0	0	0	21	4	0	0	0	0	0
Westmeath Twp	R	17	58.3	25	0	0	0	0	0	20	5	0	0	0	0	0
Westmeath Twp	R	16	65.9	6	11	1	0	0	0	1	15	1	0	1	0	0

^a U = urban, R = rural (roadside)

^b 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = ≥61%, 5 = dead tree

North American Maple Project (NAMP)

As outlined in the 1988 Algonquin Region report, a cooperative project initiated in that year by the United States Forest Service and Forestry Canada to study the extent and causes of sugar maple decline had the following objectives:

- 1) to determine the rate of change in sugar maple tree-condition ratings from 1988 through 1990
- 2) to determine if the rate of change in sugar maple tree condition ratings differs, depending on:
 - a) the various levels of pollution measured as wet deposition
 - b) whether the trees are in sugar bushes or in undisturbed forest
 - c) the various levels of initial stand decline.
- 3) to determine the possible causes of sugar maple decline and the geographical relationship between causes and extent of decline. In all, 106 plots were established in the northeastern United States, and 60 plots were set up in Canada in the provinces of Ontario, Quebec, Newfoundland and Nova Scotia.

Ontario was responsible for 24 plots, the plots being paired in each deposition zone, one in an undisturbed stand and one in a bush being tapped for maple syrup production. Four are in the Algonquin Region, one each in Cardiff and Wicklow townships, Bancroft District, and one each in Ridout and Franklin townships, Bracebridge District.

Although sugar maple was the tree species of primary interest, all trees on the plot, deciduous and coniferous, were examined, and the following quantitative and qualitative information was recorded for each tree: DBH, vigor (five ratings), crown condition, tapping status (sugar maple only), bole quality (hardwoods only), location of bole defects, type of bole injury, percentage of crown dieback (hardwoods), foliage transparency (hardwoods), foliage discoloration (hardwoods), dwarfed foliage (hardwoods), defoliation (hardwoods). This information was obtained by a minimum of two FIDS rangers, according to strict guidelines. Table 13 compares the results of the two years of assessment. Basically, there was very little change, except for two trees dying in the Cardiff Township plot. The plots are relatively healthy: more than 80% of the sugar maple in all four plots in 1989 had 15% dieback or less.

Oak Health

The three red oak plots established in 1977 to monitor changes in crown condition, one in Macaulay Township, Bracebridge District, and one in each of Alice and Wylie townships, Pembroke District, were reassessed in 1989 (Table 14).

In the Macaulay Township plot, the bulk of current dieback affecting 74% of the trees occurred in the "0" category (0-5%), while under the cumulative dieback heading most of the trees (61%) were found in the "1" category (6-20%).

This pattern held true for the current dieback situation in the Alice and Wylie township plots, where 53% and 64%, respectively, fell into the "0" category. However, the largest number of trees assessed for total crown dieback fell into the "2" category (21-40%), 58% in the plot in Alice Township and 71% in the plot in Wylie Township. No tree mortality was recorded in Alice Township, but three trees died in the Wylie Township plot, all of them in category "4" the previous year.

Table 13. A two-year summary of sugar maple crown conditions recorded in four North American Maple Project (NAMP) plots established in 1988 in the Algonquin Region of Ontario.

Location (Twp)	Avg DBH (cm)	Year	No. of trees examined	Total percentage of dead crown												Trees	
				0	1-5	6-15	16-25	26-35	36-45	46-55	56-65	66-75	76-85	86-95	96-100	Trees	blown down
				No. of trees												dead	or cut
<u>Bancroft District</u>																	
Cardiff ^a	20.2	1988	94	1	54	24	11	2	1	0	0	0	0	1	0	0	0
		1989	94	0	28	50	12	2	0	0	0	0	0	0	2	2	0
Wicklow ^b	37.1	1988	53	0	13	27	11	2	1	0	0	0	0	0	0	0	0
		1989	50	0	18	25	6	1	0	0	0	0	0	0	0	0	3
<u>Bracebridge District</u>																	
Ridout ^a	25.4	1988	61	0	36	15	5	2	1	0	0	0	0	0	2	2	0
		1989	61	0	42	10	4	3	0	0	0	0	0	0	2	2	0
Franklin ^b	32.3	1988	44	0	32	8	3	1	0	0	0	0	0	0	0	0	0
		1989	44	0	29	12	1	1	1	0	0	0	0	0	0	0	0

^a Undisturbed woodlot

^b Trees currently tapped for maple syrup

Table 14. Summary of data collected in 1989 from three semipermanent plots established in the Algonquin Region of Ontario in 1977 to monitor red oak decline (data based on the examination of 100 host trees at each location)

Location	Avg ht (m)	Avg DBH (cm)	Current dieback ^a						Cumulative dieback ^a						Trees blown down or cut
			0	1	2	3	4	5	0	1	2	3	4	5	
			----- No. of trees -----												
<u>Bracebridge District</u>															
Macaulay	21	35	66	22	1	0	0	11	2	54	29	4	0	11	0
<u>Pembroke District</u>															
Alice	15	18	48	36	4	0	3	5	0	25	53	7	6	5	4
Wylie	16	25	58	33	0	0	0	9	0	11	65	15	0	9	0

^a Dieback classification: 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = 61%+, 5 = dead tree

ABIOTIC DAMAGE

Drought

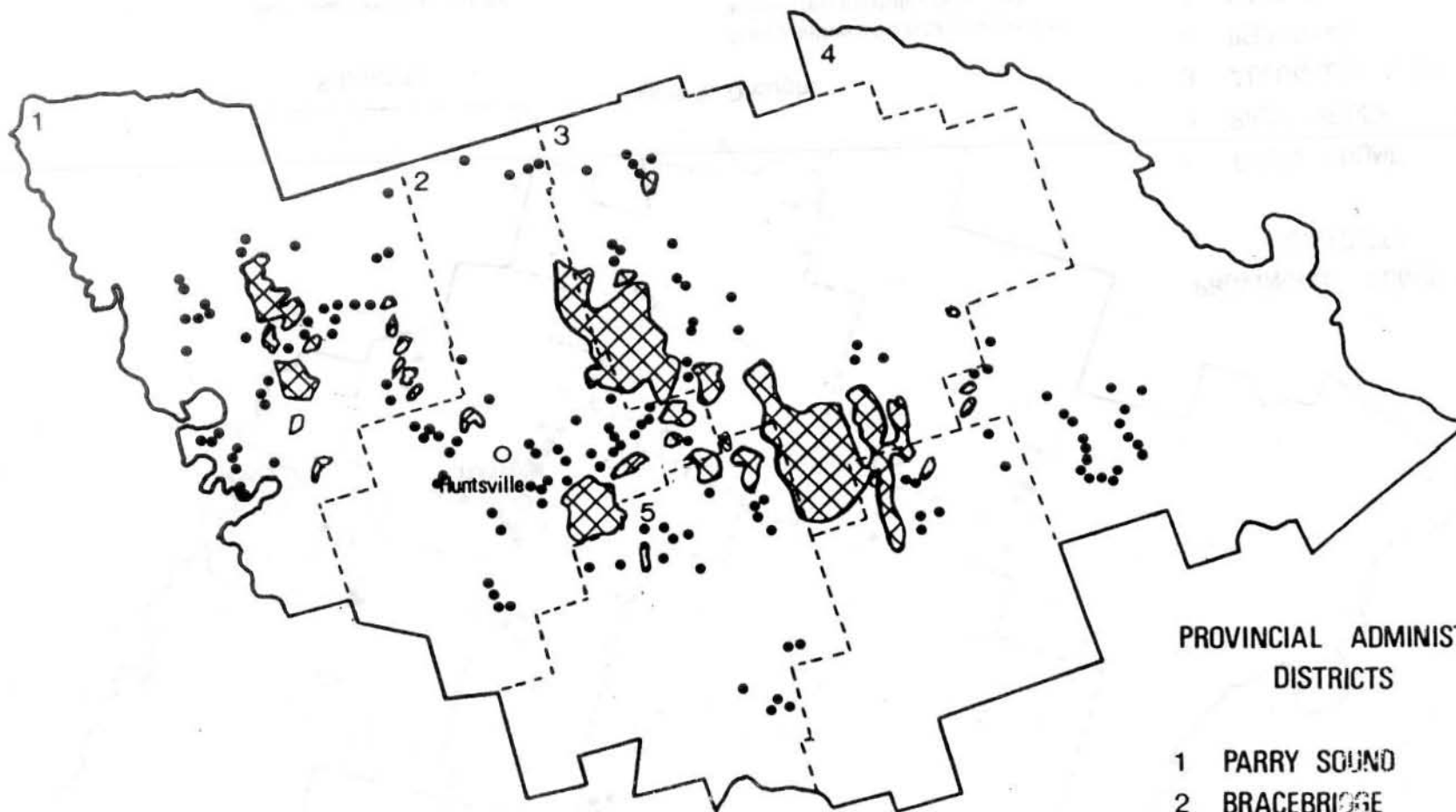
Below-normal precipitation in 1989 resulted in the third consecutive year of drought in the Algonquin Region (Table 18, summary of climatic data). The resultant stress on the trees, especially those growing on shallow soils, manifested itself in a number of ways (e.g., as premature foliar discoloration, early leaf/needle drop, crown dieback and whole-tree mortality).

Aerial observation of the hardwood component disclosed a total of 213,148 ha of premature discoloration and leaf fall in the region (Fig. 8). Table 15 presents a breakdown of the affected area on a district basis. As well, a total of 8,920 ha of crown dieback and/or whole-tree mortality of hardwoods was mapped in the six districts, with the largest areas, 4,009 and 2,972 ha, being recorded in the Parry Sound and Bracebridge districts, respectively (Fig. 9). In the remaining four districts, branch and/or whole-tree mortality was located as follows: 768 ha in Minden District, 511 ha in Algonquin Park District, 504 ha in Bancroft District and 156 ha in Pembroke District. Oak, sugar maple and trembling aspen were the hardwood species most adversely affected by the drought. The majority of whole-tree and branch mortality was confined to open-growing oak on rocky exposed sites such as in the Gull and Mississauga lakes area of Minden District, the Muskoka Lake area of Bracebridge District and the southwestern part of Parry Sound District.

Damage to oak encountered in a ground survey in one drought-affected area in Carling Township, Parry Sound District was typical of such damage throughout the region. Complete foliar browning and early leaf drop as well as 60% and 70% total branch mortality were noted. Groups of 10 to 15 dead oak averaging 4 m in height and whole-tree mortality of oak regeneration (<1.0 m in height) were also observed. A ground check of about 45 red oak in a 2-ha area in Anstruther Township, Bancroft District disclosed 20% recent whole-tree mortality, while the remaining trees experienced 70% to 90% total branch mortality.

A stand of sugar maple assessed in Christie Township, Parry Sound District, was typical of many such stands growing on shallow soils. Foliar browning was evident on 90% of understory 10-m-tall sugar maple and up to 60% discoloration of the 20-m-tall codominant trees was recorded. About 6% of these larger trees had 20-40% recent branch mortality. Evaluation of 100 regeneration sugar maple in this stand that were 2.0 m or less in height revealed 20% whole-tree mortality, and 31% of the trees had one or more dead branches. A similar situation was encountered in a 2-ha area of sugar maple in Stisted Township, Bracebridge District, where the complete sugar maple component, ranging in height from 0.5 m to 15 m, experienced 100% foliar browning as well as premature leaf fall. Another survey, in a 3-ha pocket of damaged sugar maple in Bangor Township, Bancroft District, revealed recent or current branch mortality ranging from 40% to 80%.

ALGONQUIN REGION

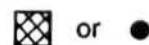


0 64
Kilometres

Forest Insect and Disease Survey
Great Lakes Forestry Centre

Figure 8. Drought

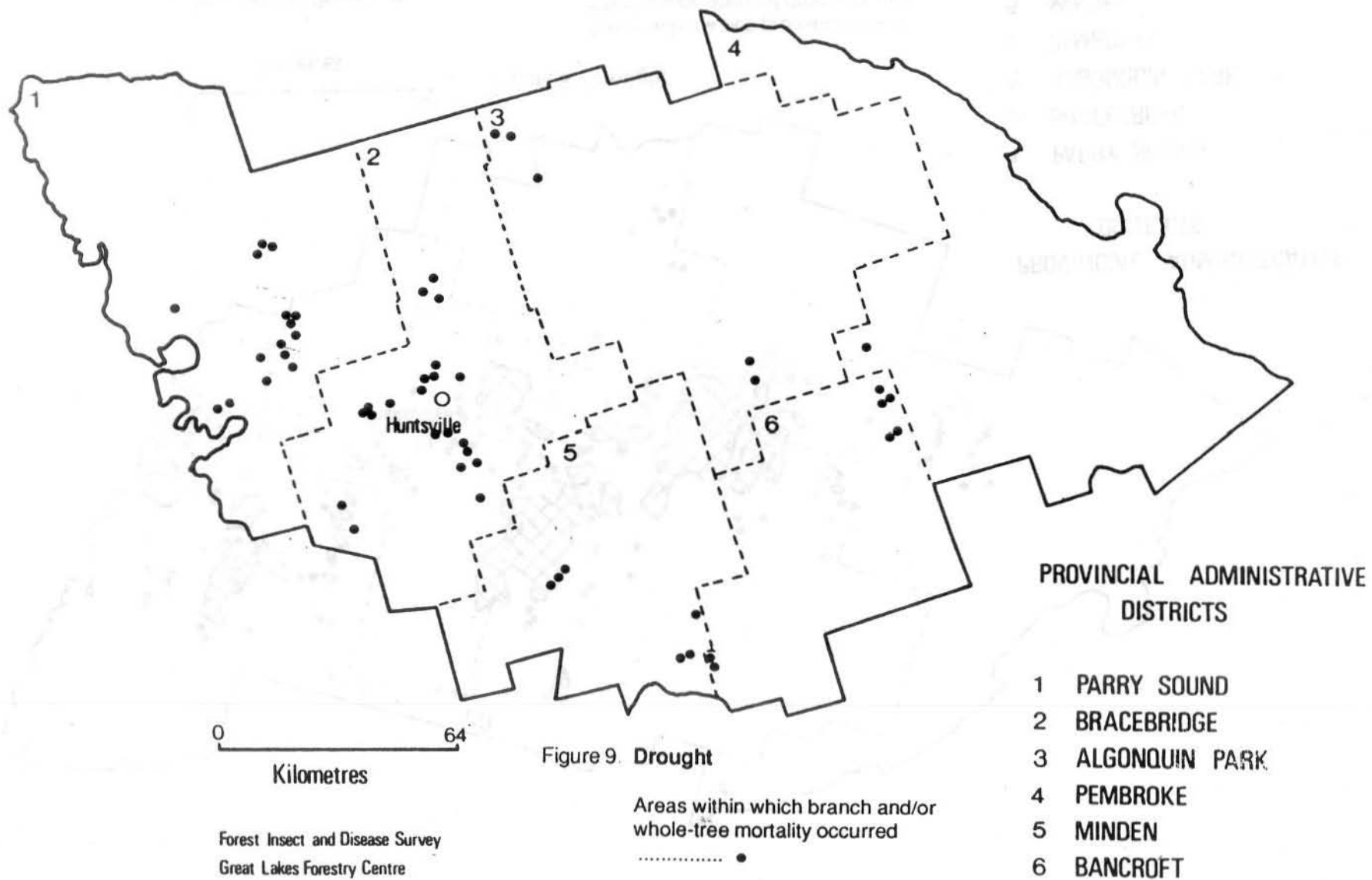
Areas within which premature foliar
discoloration and leaf drop occurred



PROVINCIAL ADMINISTRATIVE DISTRICTS

- 1 PARRY SOUND
- 2 BRACEBRIDGE
- 3 ALGONQUIN PARK
- 4 PEMBROKE
- 5 MINDEN
- 6 BANCROFT

ALGONQUIN REGION



Crown dieback and whole-tree mortality of trembling aspen growing on shallow sites were also noted at a number of locations. Assessment at one such 5-ha site in Monteith Township, Parry Sound District disclosed 1% whole-tree mortality and up to 50% recent branch mortality.

Drought-related stress was also evident in the conifer component of the forest. Mortality of white pine regeneration growing on shallow-soil sites was observed in Bracebridge, Minden and Parry Sound districts. A 10-m x 10-m plot was set up at one affected location in Blair Township, Parry Sound District. The trees within this plot ranged from 0.15 to 0.7 m in height. In all, 27 trees were counted, 26% were unaffected, 30% had branch mortality and 44% were recently dead. Light mortality of jack pine (less than 1%) ranging in height from 6 m to 10 m was recorded in Carling, Wallbridge and Harrison townships, Parry Sound District.

Much of the drought-damaged hardwood forest was also subjected to one or more years of moderate-to-severe defoliation by forest tent caterpillar. Another summer of below-normal precipitation, with or without the added stress of forest tent caterpillar, will certainly increase crown dieback and whole-tree mortality, especially in those areas with shallow soils.

Table 15. Areas in the Algonquin Region of Ontario in which drought-related damage to hardwoods was encountered in 1989.

District	Premature foliar discoloration (ha)	Branch and/or whole-tree mortality (ha)
Algonquin Park	104,400	511
Bancroft	11,600	504
Bracebridge	43,289	2,972
Minden	15,322	768
Parry Sound	34,900	4,009
Pembroke	3,637	156
TOTAL	213,148	8,920

Road Salt Injury

This problem was common wherever trees of susceptible species such as red pine, eastern white pine and eastern white cedar could be found growing in close proximity to heavily traveled routes where deicing salt is used. The problem was especially evident on red pine planted along roadsides, where the older foliage was orange-red. The following damage was recorded: 90% foliar discoloration on 41 15-m-tall roadside trees in Chaffey Township, Bracebridge District; 40% foliar damage to 47 12-m-tall trees in Monteagle Township, Bancroft District; 80% foliar discoloration on 50 13-m-tall trees in Richards Township, Pembroke District. Buds were not damaged and the new foliage lessened the visual impact of the foliar discoloration.

SPECIAL SURVEYS

Pear Thrips

This introduced pest was first reported in the United States in California in 1904, but since then has expanded its range considerably, attacking a number of plants, but particularly fruit trees. However, since 1979 pear thrips has been recognized as a serious pest of hardwood forests, attacking maples (*Acer* spp.), ash (*Fraxinus* spp.), birches (*Betula* spp.), beech (*Fagus grandifolia* Ehrh.) and black cherry. Medium-to-heavy infestations have been reported in several states in the northeastern United States, including New York, Pennsylvania, Vermont, Massachusetts and New Hampshire.

Pear thrips adults, which are all female, are small, comparable in size to the head of a common pin. They emerge early in the spring and attack the expanding bud, sucking the fluids out. The resultant damage resembles that caused by frost. Eggs are laid in the petiole and along the midvein. Larvae emerge after the leaves have unfurled to about one third their normal size. Shortly afterwards (in two to three weeks) they drop to the ground, enter the soil, mature, and overwinter.

Typical damage consists of mottled, tattered leaves, smaller-than-normal foliage, puckered and wrinkled foliage and fallen green leaves. Growth loss and dieback have occurred in areas in which infestations have persisted the longest. According to the literature, thrips seem to exhibit a preference for stressed trees.

A concerted effort was made by Forest Insect and Disease Survey technicians to determine the status and distribution of pear thrips within the range of sugar maple. Only sugar maple was sampled in this initial survey. Flower clusters were collected early in the spring from trees of all ages at 101 locations and were sent to Forestry Canada, Ontario Region in Sault Ste. Marie. Pear thrips adults were confirmed at 38 locations and larvae at two others in the following regions: Algonquin, Central, Eastern, Northeastern and Southwestern. Adults were collected at eight locations in the Algonquin Region. No appreciable

associated damage was recorded at any of the sample locations. Now that its presence is confirmed and its distribution fairly well defined, more intensive surveys are planned for the 1990 field season.

Eastern White Pine Plantations

The tree species selected for the special survey in 1989 was white pine. In all, 11 plantations ranging in height from 0.7 to 28.5 m were randomly selected and at each location 150 trees were surveyed. Two visits were made to each plot, the first by 15 June and the second between 14 July and 15 August. The results from the survey are presented in Table 16. Each stand was assessed to determine the presence and impact of the following selected pests.

Insects: pine spittlebug, *Aphrophora cribrata* (Wlk.), white pine weevil, *Pissodes strobi* (Peck), eastern pine shoot borer, *Eucosma gloriola* Heinr., pine bark adelgid, *Pineus strobi* (Htg.)

Diseases: armillaria root rot, white pine blister rust *Cronartium ribicola* J.C. Fischer, black root stain, *Verticicladiella* sp., foliar diseases.

All of the selected insects were encountered at one or more locations; white pine blister rust was the only disease detected on the survey plots.

Summary of Pest Problems

The most commonly occurring and most damaging insect pest was the white pine weevil. It was found in seven of the 11 survey plantations, the incidence of leader attack ranging from 1.3% to 27% (Fig. 10). Terminal shoot damage by the eastern pine shoot borer was recorded in six plantations, with up to 12.7% of the trees affected (Fig. 10). The entire sample at one plantation in Bracebridge District was attacked by the pine spittlebug but associated damage was light. Low numbers of the pine bark adelgid were found at one location.

White pine blister rust caused the most destruction, and was detected at nine of the 11 plantations. The incidence of main-stem attack ranged from 0.7% to 7% and associated recent whole-tree mortality was recorded at two locations.

ALGONQUIN REGION

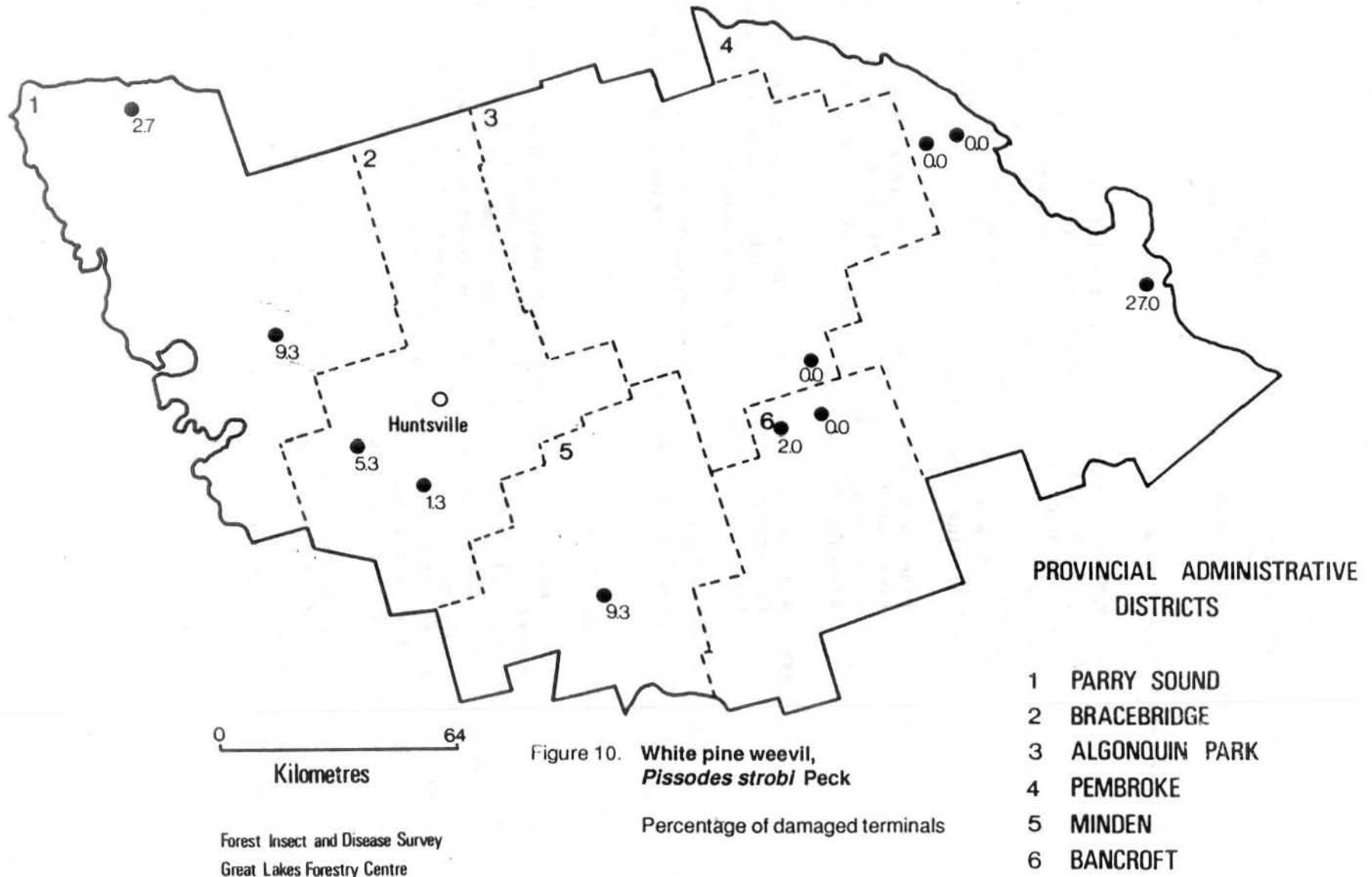


Table 16(a). Summary of the results of an eastern white pine plantation survey conducted at 11 randomly selected locations in the Algonquin Region of Ontario in 1989 (counts based on the examination of 150 trees at each location).

				Pine Spittlebug	White Pine Weevil	Eastern Pine Shoot Borer	Pine Bark Adelgid
Location	Avg ht	Estimated	Estimated	Trees	Trees	Terminal shoot	Trees
(Twp)	of trees	trees per	area affected	attacked	attacked	attacked	attacked
	(m)	ha	(ha)	(%)	(%)	(%)	(%)
<u>Algonquin Park District</u>							
Lyell	9.9	1,500	1.5	0	0	0	0
<u>Bancroft District</u>							
McClure	5.9	250	2	0	2	0	0
Wicklow	0.7	300	4	0	0	0	0
<u>Bracebridge District</u>							
Macaulay	6.5	2,500	1	100	1	1	0
Watt	2.7	1,000	3	10	5	5	0
<u>Minden District</u>							
Snowdon	1.1	600	2	0	9	13	2
<u>Parry Sound District</u>							
Blair	1.5	1,600	25	5	3	1	0
McKellar	6.1	2,000	2	0	9	5	0
<u>Pembroke District</u>							
Buchanan	1.3	800	1.5	0	0	0	0
Ross	4.1	2,200	3.5	11	27	2	0
Wylie	28.5	50	8	0	0	0	0

(cont'd)

Table 16(b). Summary of the results of an eastern white pine plantation survey conducted at 11 randomly selected locations in the Algonquin Region of Ontario in 1989 (counts based on the examination of 150 trees a each location) (concl.).

Location (Twp)	Avg ht of trees (m)	Estimated trees per ha	Estimated area affected (ha)	White Pine Blister Rust			Foliar Diseases		Armillaria Root Rot
				Branch canker (%)	Stem canker (%)	Recent mortality (%)	Trees affected (%)	Foliar damage (%)	Trees affected (%)
<u>Algonquin Park District</u>									
Lyell	9.9	1,500	1.5	0	3	0	0	0	0
<u>Bancroft District</u>									
McClure	5.9	250	2	0	1	0	0	0	0
Wicklow	0.7	300	4	2	7	1	0	0	0
<u>Bracebridge District</u>									
Macaulay	6.5	2,500	1	4	2	0	0	0	0
Watt	2.7	1,000	3	3	1	0	0	0	0
<u>Minden District</u>									
Snowdon	1.1	600	2	5	0	0	0	0	0
<u>Parry Sound District</u>									
Blair	1.5	1,600	25	9	5	1	0	0	0
McKellar	6.1	2,000	2	3	1	0	0	0	0
<u>Pembroke District</u>									
Buchanan	1.3	800	1.5	0	0	0	0	0	0
Ross	4.1	2,200	3.5	10	4	0	0	0	0
Wylie	28.5	50	8	0	0	0	0	0	0

Eastern White Pine Seed and Cone Pests

A special survey was conducted in the region to determine which insects and diseases were currently attacking the cones of eastern white pine and to assess their impact on seed production. A collection of 100 second-year white pine cones in the green, succulent stage was made during the first week of July in a stand of 18-m-tall trees in Macaulay Township, Bracebridge District, and in a stand of 20-m-tall trees in Wylie Township, Pembroke District. At least three trees were sampled and cones were removed from the entire cone-bearing portion of the crown. The dissection results show that 24% and 72% of the cones from Macaulay and Wylie townships, respectively, were damaged, and that there was an accompanying seed loss of 3% and 34% (Table 17). No diseases were recovered from the samples but the responsible insect agents are listed below, and a brief description of their characteristic damage is given.

White pine cone beetle, *Conophthorus coniperda* (Schw.) - It is a common pest of white pine that bores into the cone axis and across it, feeding on the seeds and cone tissues.

Fire coneworm, *Dioryctria abietivorella* (Grt.) - The larvae mine and riddle the cones.

White pine cone borer, *Eucosma tocullionana* Heinr. - The larvae hollow out the cone and feed on scales and seeds.

Lepidopterous larvae - Damage is usually confined to the exterior of the cone, and results in slight deformities.

Damage caused by unknown factors - As implied, the cause of damage, insect or mechanical, is unknown.

Table 17. Summary of the results of an eastern white pine cone survey conducted at two locations in the Algonquin Region of Ontario in 1989 (counts based on the examination of 100 mature cones at each location)

Location (Twp)	Cones damaged (%)	Seed loss within damaged cones (%)	Causal agent in order of importance
<u>Bracebridge District</u>			
Macaulay	24	3	Unknown Lepidoptera
<u>Pembroke District</u>			
Wylie	72	34	<i>Eucosma tocullionana</i> <i>Conophthorus coniperda</i> <i>Dioryctria abietivorella</i>

Acid Rain National Early Warning System (ARNEWS)

The six ARNEWS plots in the region are part of a nationwide network of monitoring plots established for the purpose of detecting changes in forest trees, ground vegetation and soil. Conditions are monitored in a variety of stand types. The plot located in Sproule Township, Algonquin Park District consists primarily of red oak; the two plots in Wylie Township, Pembroke District are in plantations of immature white spruce and Norway spruce (*Picea abies* [L.] Karst.); the Ridout Township plot in Bracebridge District consists of mature sugar maple and yellow birch (*Betula alleghaniensis* Britton); the ARNEWS plot in Sherbourne Township, Minden District is in a mature stand of sugar maple and eastern white pine; the plot in Mowat Township, Parry Sound District is located in a mixed immature stand of white birch (*Betula papyrifera* Marsh.), red maple (*Acer rubrum* L.) and trembling aspen. Information on branch and crown condition, current insect- or disease-related defoliation, woody-tissue damage, and acid rain symptoms was recorded for each tree in the plots. Ground vegetation was also examined as certain ground plants are sensitive indicators of changes in soil acidity. There were no visible signs of damage by airborne pollutants in any of the plots. However, an average of 20% defoliation by forest tent caterpillar was encountered in the Mowat Township plot in Parry Sound District.

Light Trapping

Every year a light trap is operated on the grounds of Petawawa National Forestry Institute in Pembroke District. In 1989, the trap was operated from 16 June to 12 July to monitor the population and flight times of spruce budworm adults. In 1989, 151 spruce budworm moths were captured in comparison with 428 in 1988 and none in 1987.

Spruce budworm moths were trapped throughout the period that the light trap was active, the majority (74%) being captured between 16 June and 4 July.

In addition to spruce budworm moths, 2,683 forest tent caterpillar moths were captured, a significant decrease from the 26,903 moths trapped in 1988.

Climatic Data

Temperature and precipitation have a direct effect on both biotic and abiotic conditions as evidenced by the drought-related forest damage recorded in the region in 1989. Above-average temperatures and below-normal precipitation occurred during the summer of 1989 in the Algonquin Region. Temperatures averaged 0.5°C higher than normal and precipitation was 8.0 mm less than normal at the two weather stations monitored, the Muskoka Airport and the Petawawa Weather Station, for the five-month period of May through September. An examination of the

weather information generated at the Muskoka Airport for the month of July disclosed that the area received only 7.5 mm of precipitation, a significant decrease from the normal 77.5 mm. Table 18 summarizes the weather data at these two stations for 1989.

Table 18. Summary of mean temperature and total precipitation at two locations in the Algonquin Region in 1989.

Location	Month	Mean temperature (°C)		Deviation from normal (°C)	Total Precipitation (mm)		Deviation from normal (mm)
		Normal	Actual		Normal	Actual	
<u>Bracebridge District</u>							
Muskoka Airport	January	-10.4			85.9	98.7	+12.8
	February	-9.4	-11.4	-2.0	62.4	60.5	-1.9
	March	-3.8	-6.1	-2.3	66.3	90.5	+24.2
	April	+4.5	+1.9	-2.6	73.3	48.6	-24.7
	May	+10.9	+11.7	+0.8	77.8	125.8	+48.0
	June	+15.9	+16.6	+0.7	81.9	115.4	+33.5
	July	+18.3	+19.4	+1.1	77.5	7.4	-70.1
	August	+17.4	+17.6	+0.2	89.0	68.7	-20.3
	September	+13.2	+12.6	-0.6	102.4	82.8	-19.6
	October	+7.5	+7.7	+0.2	93.9	116.7	+22.8
	November	-1.1			101.0		
	December	-7.1			97.8		
<u>Pembroke District</u>							
Petawawa Weather Station	January	-12.8	-9.8	+3.0	46.7	52.5	+5.8
	February	-11.2	-12.9	-1.7	51.0	19.2	-31.8
	March	-4.6	-6.9	-2.3	50.5	70.2	+19.7
	April	+4.2	+2.3	-1.9	59.6	15.2	-44.4
	May	+11.5	+12.1	+0.6	60.0	102.2	+42.2
	June	+16.3	+16.6	+0.3	87.5	54.8	-32.7
	July	+18.7	+19.8	+1.1	84.5	51.8	-32.7
	August	+17.6	+17.9	+0.3	79.8	37.0	-42.8
	September	+12.6	+12.9	+0.3	83.1	97.2	+14.1
	October	+7.1	+7.4	+0.3	66.7	82.6	+15.9
	November	-0.1			65.8		
	December	-9.7			64.8		