

**RESULTS OF FOREST INSECT
AND DISEASE SURVEYS IN THE
CENTRAL REGION OF ONTARIO
1994**

*Forest Districts: Algonquin Park, Bancroft, North Bay,
Parry Sound, Pembroke, Sault Ste. Marie,
Sudbury, and Temagami*

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SURVEY HIGHLIGHTS

This report summarizes forest insects, diseases, and abiotic problems and conditions encountered in the Ontario Ministry of Natural Resources (OMNR), Central Region, in 1994. It also records the results of special surveys and forest health monitoring.

There were no changes in staff in 1994; however, Chuck Jones and Wayne Ingram exchanged areas. Chuck transferred to the Temagami District. Wayne relocated to Minden and covered the Parry Sound District and the western half of the Bancroft District. Hugh Evans remained in the Sault Ste. Marie District, Tim Bouwmeester worked in the Sudbury and North Bay districts, and Steve Payne covered the Algonquin Park, Pembroke, and eastern part of the Bancroft districts.

The outbreak of jack pine budworm recurred through most of the areas previously infested. Spruce budworm numbers were up in some areas, but were down in others. Gypsy moth infestations continued in the Sudbury District, but the rest of the region remained relatively free from this pest. A new infestation of the hemlock looper was discovered in the Bancroft District and red pine needle midge was recorded in the Sault Ste. Marie District. A reduction occurred in the birch leaf skeletonizer infestation and the forest tent caterpillar infestation completely collapsed.

Scleroderris canker was still the most important disease in the region and infection levels were up, particularly in the Parry Sound District. Surveys were also performed for plantation diseases such as white pine blister rust, western gall rust, and Armillaria root rot. The hardwood decline reported for the past few years appears to have stabilized.

The year was distinct in that it was exceptionally cold during the months of January and February. This resulted in considerable tree damage due to winterkill. There were also reports of damage to trees from winter drying and frost.

The numerous plots that have been established in recent years were all re-tallied in 1994. These plots measure tree and stand conditions with regard to spruce and jack pine budworm populations, oak and maple health, and acid precipitation.

Insects and diseases described in this report are categorized on the basis of their importance:

Major Insects/Diseases

capable of causing serious 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, and
- (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 1994.

The authors would like to express their gratitude to OMNR and forest industry staff for their assistance and cooperation during the 1994 field season.

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INSECTS

Major Insects

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

Persistent, high populations of the pine false webworm (Fig. 1) continued to devastate red pine (*Pinus resinosa* Ait.) plantations across the Bancroft, Parry Sound, and Pembroke districts. Although population levels remained much the same in 1994 as in 1993, accumulative damage on infested plantations has brought some trees near death (Table 1).

Similar to 1993, the heaviest damaged plantation was recorded in McMurrich Township, Parry Sound District. Here, 30 ha of 3-m trees now has virtually no old foliage and over half the new shoots are severely defoliated. Throughout many of the plantations evaluated for *Gremmeniella abietina* (Scleroderris canker) in McMurrich Township, pine false webworm populations were apparent.

Elsewhere in the region, light defoliation levels were recorded on 1.4-m red pine in Airy Township, Algonquin Park District and on 3.0-m white pine in the Snowdon Township Orchard, Bancroft District.

Birch Skeletonizer, *Bucculatrix canadensisella* Cham.

In 1994, the area infested by this late season pest of white birch (*Betula papyrifera* Marsh.) declined severely.

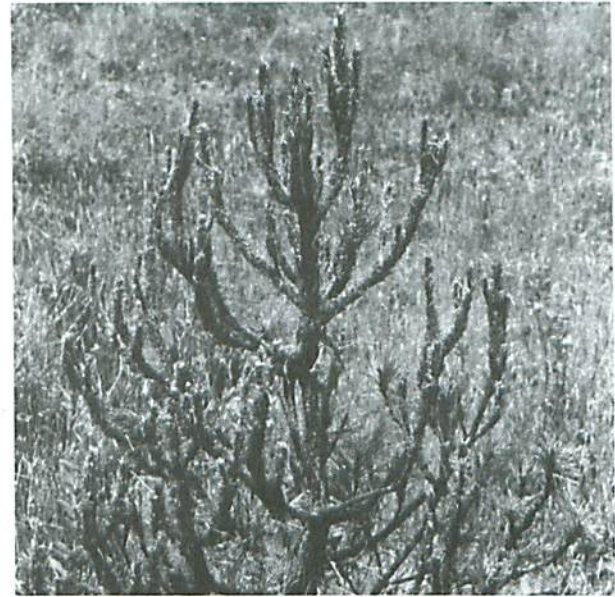


Figure 1. Damage to red pine caused by the pine false webworm, *Acantholyda erythrocephala* (L.).

A total of 491,846 ha was infested in the region. Moderate to severe damage was restricted to two main areas and one small one. One area was located in the central part of the Bancroft District and included all or part of the following townships: Anstruther, Cardiff, Chandos, Dungannon, Faraday, Harcourt, Monmouth, and Monteagle. The second area was located in the northern section of the North Bay

Table 1. Damage caused by the pine false webworm at ten locations in the Central Region of Ontario in 1994. (Counts are based on an examination of 150 randomly selected red pine at each location.)

Location (Township)	Average height of trees (m)	Estimated trees per ha	Estimated area affected (ha)	Trees affected		Average defoliation	
				New growth (%)	Old growth (%)	New growth (%)	Old growth (%)
<i>Algonquin Park District</i>							
Airy	1.4	2,500	5	0	4.7	0	9
<i>Bancroft District</i>							
Carlow	1.7	2,500	2	0	12.0	0	17
Monteagle	1.7	2,250	5	4.7	94.0	6	31
Snowdon ^a	3.0	2,500	5	0	5.0	0	30
Somerville	2.1	2,500	2	0	6.7	0	25
Somerville	1.2	2,800	5	0	10.7	0	5
<i>Parry Sound District</i>							
Ballantyne	2.1	2,300	5	0	0.3	0	1
McMurrich	3.0	2,500	30	90.0	98.0	60	100
<i>Pembroke District</i>							
Horton	1.2	2,500	20	0	82.0	0	30
Horton	2.1	2,000	6	10.0	94.0	9	47

^a White pine (seed orchard).

District and damage was found in Hobbs, McCallum, and Sisk townships. This infestation extended into the central and western portions of the Temagami District. There was also a small pocket of damage observed in Grant and Sisk townships in the central part of the North Bay District. Outside of these sites, light damage was found in many areas across the region.

It appears that the infestation of this insect, which began in the Central Region in 1991, is declining and should disappear within the next couple of years. Infestations are generally of 3 to 4 years in duration.

Large Aspen Tortrix, *Choristoneura conflictana* (Wlk.)

Moderate to severe defoliation caused by the large aspen tortrix was aerially mapped over 5,070 ha in the Central Region in 1994 (Fig. 2). Elsewhere in Ontario, 192,686 ha of moderate to severe defoliation occurred in the Northeast Region in the Wawa, Hearst, and Chapleau districts.

In the Central Region, the infestation was confined to the Sudbury and North Bay districts, with 2,590 and 2,480 ha of damage recorded, respectively. The heaviest damage occurred north of the town of Markstay in

Loughrin and Hagar townships, Sudbury District. Defoliation here ranged from 60 to 100%. Smaller pockets, with generally lighter damage (30 to 80% defoliation), occurred in Ulster, Moncrieff, Aylmer, and Davis townships, Sudbury District and in McNish, Pardo, Janes, Dana, and Henry townships, North Bay District.

With the exception of the forest tent caterpillar (*Malacosoma disstria* Hbn.), no insect is more widespread or consumes more trembling aspen (*Populus tremuloides* Michx.) leaves than does the large aspen tortrix. Epidemics, however, tend to be short lived (2 to 4 years) and seem to have little effect on the trees. Many parasites and some predators and disease organisms have been associated with declining populations of this pest.

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

Provincial Situation

In 1994 the area infected by the eastern spruce budworm in Ontario declined by over 50%, dropping from 8,991,177 ha in 1993 to a new total of 4,266,656 ha. This is the second consecutive year that a decline in the area infested has been recorded. The largest area of decline,

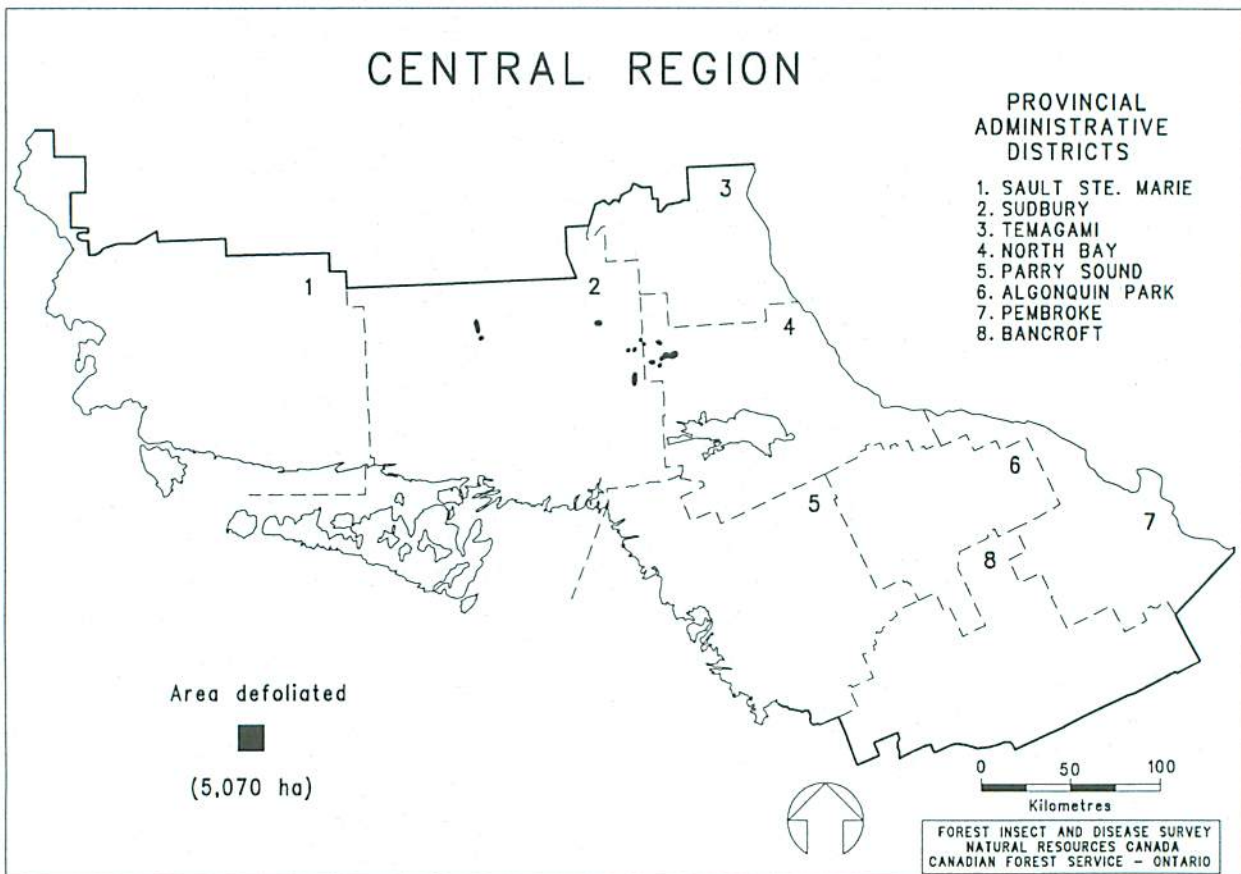


Figure 2. Areas of moderate to severe defoliation caused by the large aspen tortrix (*Choristoneura conflicana* [Wlk.]) in 1994.

3,415,312 ha, occurred in the Northwest Region. A large area of decline, 1,367,087 ha, also occurred in the Northeast Region. In the Central Region, there was a recorded increase of 64,293 ha in the size of the infestation. In the Southern Region, the area of damage increased from 102 ha in 1993 to 687 ha in 1994 (Table 2) (Fig. 3).

Table 2. Gross area of moderate to severe defoliation caused by the eastern spruce budworm in Ontario in 1993 and 1994.

Region	Area of defoliation (ha)		Change (ha)
	1993	1994	
Northwest	7,295,736	3,873,424	-3,712,312
Northeast	1,650,677	283,590	-1,367,087
Central	44,622	108,955	+64,333
Southern	102	687	+585
Total	8,991,177	4,266,656	-4,724,521

Central Region

Moderate to severe damage by eastern spruce budworm was observed in four districts in the Central Region. The

area of damage increased 144%, from 44,662 ha in 1993 to 108,955 ha in 1994 (Fig. 4).

The area of moderate to severe damage recorded in the Algonquin Park District for the past 5 years expanded from 20,400 ha in 1993 to 57,505 ha in 1994 (Table 3). This infestation was in one single area and encompassed all or part of the following townships: Biggar, Bishop, Butt, Osler, Paxton, Pentland, and Wilkes. While the area of damage increased here, there was a reduction in the intensity of defoliation. In most areas the damage averaged 30 to 40%. Within the infestation, a cumulative total of 108,955 ha of balsam fir (*Abies balsamea* [L.] Mill.) tree and top mortality was mapped.

Defoliation was observed for the first time in recent years in the southeastern portion of the North Bay District. The infestation in the northwest corner of the Algonquin Park District now extends into the southeast portion of Boulter Township, North Bay District.

The infestation along the Sudbury–North Bay district boundary expanded and the intensity of damage increased. In the North Bay District, the infestation covered all of Hugel Township and extended into portions of Badgerow,

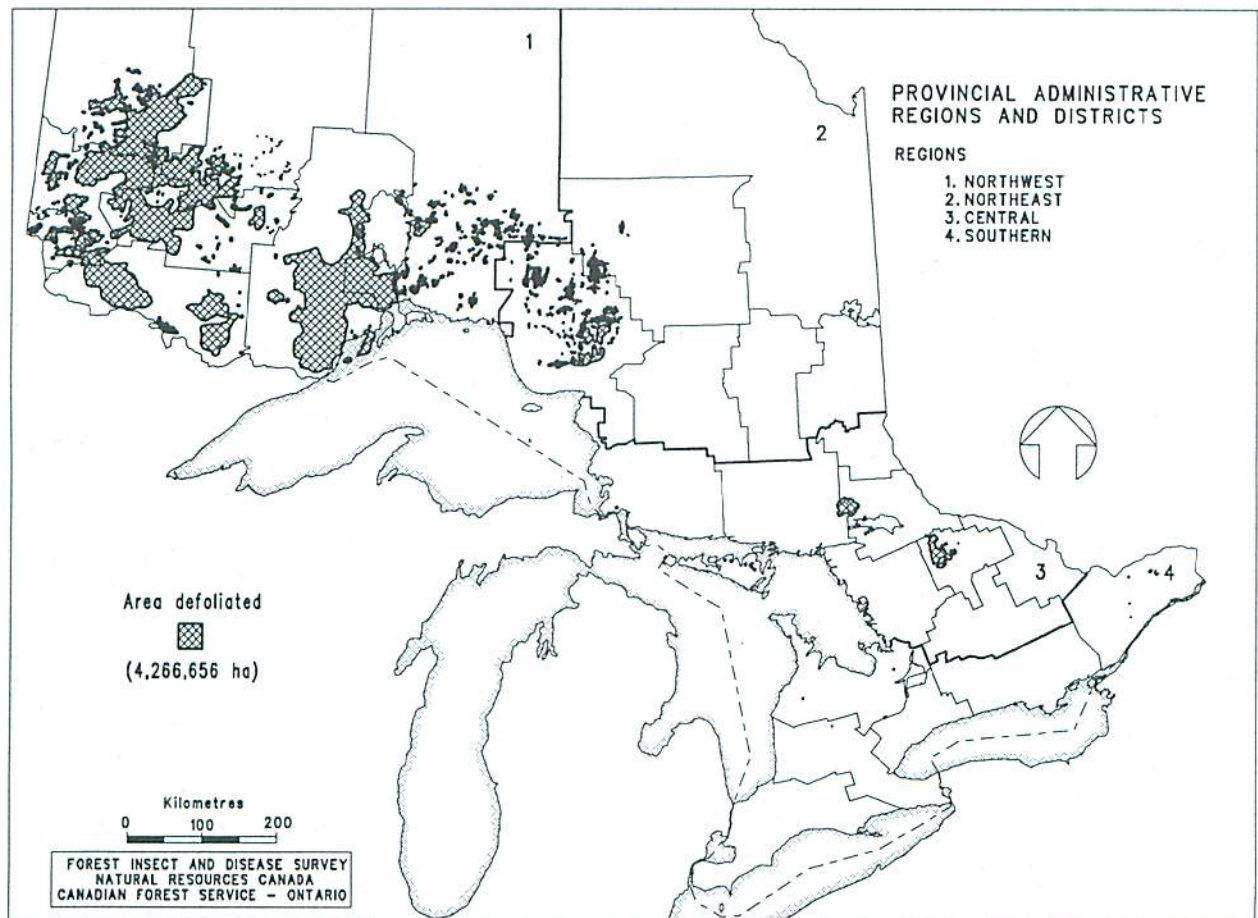


Figure 3. Area of moderate to severe defoliation caused by the eastern spruce budworm (*Choristoneura fumiferana* [Clem.]) in 1994.

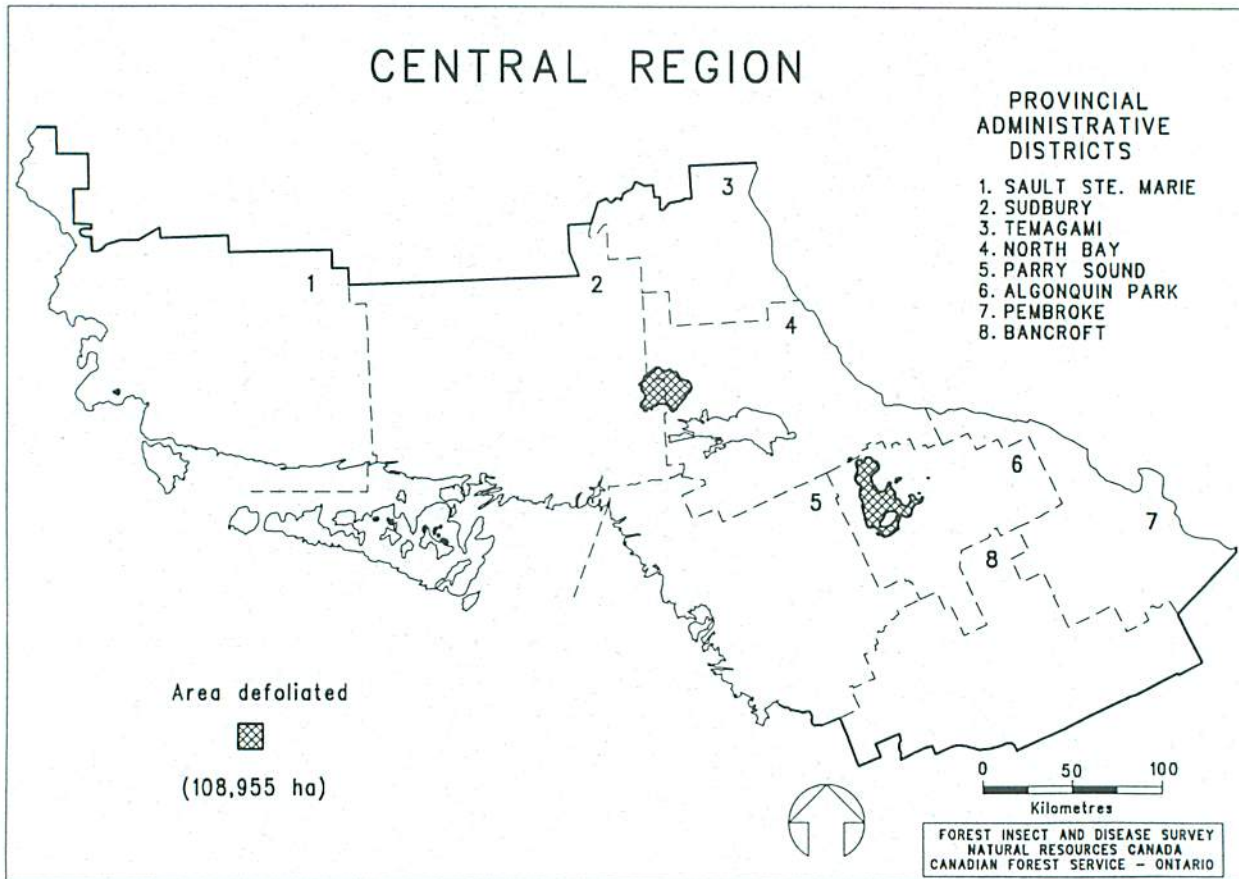


Figure 4. Areas of moderate to severe defoliation caused by the eastern spruce budworm (*Choristoneura fumiferana* [Clem.]) in 1994.

Table 3. Gross area of moderate to severe defoliation caused by the eastern spruce budworm in the Central Region from 1992 to 1994.

District	Area of defoliation (ha)			Change (ha)	
	1992	1993	1994	1993	1994
Algonquin Park	26,900	20,405	57,505	-6,495	+37,100
North Bay	1,545	10,468	27,995	+8,923	+17,527
Sault Ste. Marie	965	4,639	915	+3,674	-3,724
Sudbury	1,365	9,150	22,640	+7,785	+13,490
Total	30,775	44,622	108,955	+13,887	+64,333

Crerar, Henry, and Kirkpatrick townships. In the Sudbury District, all of Ratter Township was infested as were parts of Appleby, Dunnet, Hagar, and Loughrin townships. Defoliation was less extreme in the western portion of the infestation.

The infestations on Manitoulin Island, Sudbury District, expanded in 1994. Defoliation was observed along the north shore of Lake Manitou in Assiginack and Howland townships. Defoliation was also recorded in the area east of Gore Bay and a new pocket was discovered in Billings Township.

The infestation in the Sault Ste. Marie District was reduced in intensity and size in 1994 and defoliation was restricted to a small area in the north part of the city of Sault Ste. Marie.

Egg-mass sampling was carried out in 1994 in an effort to forecast 1995 populations of this insect. Results of these samples are included in Table 4.

In 1994, the pheromone trapping program was conducted in a total of 30 locations and three traps were deployed at each site (Table 5).

Table 4. Central Region—Eastern Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1994 and infestation forecasts for 1995.

Location	Host ^a	Estimated defoliation in 1994 (%)	Number of egg masses per 9.29 sq. m of foliage	Infestation forecasts for 1995 ^b	Accumulated damage ^c
<i>Algonquin Park District (10 locations)</i>					
Airy Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Finlayson Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Lister Township ^d	bF				
	wS				
Sproule Township ^d	wS	0	0	N	0
Stratton Township ^d	bF	0	0	N	0
	wS	0	17	L-M	0
White Township ^d	bF	0	0	N	0
<i>Bancroft District (2 locations)</i>					
Cavendish Township	bF	1	0	N	0
Denbigh Township	bF	0	0	N	0
<i>North Bay District (15 locations)</i>					
Clement Township ^d	bF	1	0	N	0
	wS	0	6	L	0
Gurd Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Henry Township ^d	bF	74	210	S	1
	wS	66	738	S	1
Hugel Township ^d	bF	64	96	M-S	1
	wS	50	512	S	1
Jocko Township ^d	bF	0	0	N	0
	wS	0	0	N	0
	bS	0	0	N	0
McWilliams Township	bF	0	0	N	0
Papineau Township ^d	bF	0	0	N	0
Thistle Township ^d	bF	0	0	N	0
	wS	0	8	L	0
<i>Parry Sound District (11 locations)</i>					
Bethune Township ^d	bF	0	0	N	0
	wS	1	0	N	0
Chaffey Township ^d	bF	0	0	N	0
East Burpee Township ^d	bF	0	0	N	0
Laurier Township ^d	bF	0	0	N	0
MacAulay Township ^d	bF	0	0	N	0
Mowat Township ^d	bF	0	0	N	0
	wS	0	14	L	0
Ridout Township ^d	bF	0	0	N	0
Spence Township ^d	bF	0	0	N	0
	wS	0	0	N	0

(cont'd)

Table 4. Central Region—Eastern Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1994 and infestation forecasts for 1995 (cont'd).

Location	Host ^a	Estimated defoliation in 1994 (%)	Number of egg masses per 9.29 sq. m of foliage	Infestation forecasts for 1995 ^b	Accumulated damage ^c
<i>Pembroke District (5 locations)</i>					
Alice Township	bF	0	0	N	0
Maria Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Wylie Township ^d	bF	0	0	N	0
	wS	0	0	N	0
<i>Sault Ste Marie District (23 locations)</i>					
Asselin Township ^d	bF	1	0	N	0
	wS	1	0	N	0
Aweres Township ^d	bF	0	0	N	0
	wS	2	0	N	0
Bridgland Township ^d	bF	0	0	N	0
	wS	0	12	L	0
Herrick Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Jollineau Township ^d – Stand 51	bF	0	0	N	0
	wS	0	0	N	0
Jollineau Township ^d – Stand 192	bF	0	0	N	0
LaRonde Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Lewis Township ^d	bF	1	0	N	0
	wS	0	0	N	0
Nicholas Township	bF	0	0	N	0
Peever Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Shields Township ^d	bF	0	8	L	0
	wS	0	0	N	0
Tarbutt Additional Township	bF	1	0	N	0
Villeneuve Township ^d	bF	0	0	N	0
	wS	0	0	N	0
<i>Sudbury District (18 locations)</i>					
Allen Township	bF	61	83	M–S	1
Antrim Township	bF	1	6	L	0
Boon Township ^d	bF	0	0	N	0
Foster Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Hart Township ^d	wS	1	0	N	0
Hawley Township ^d	bF	0	0	N	0
Howland Township	bF	84	120	N	0
Killarney Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Nairn Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Parkin Township ^d	bF	0	0	N	0

(cont'd)

Table 4. Central Region—Eastern Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1994 and infestation forecasts for 1995 (concl.).

Location	Host ^a	Estimated defoliation in 1994 (%)	Number of egg masses per 9.29 sq. m of foliage	Infestation forecasts for 1995 ^b	Accumulated damage ^c
<i>Sudbury District (concl.)</i>					
Salter Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Servos Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Weeks Township ^d	bF	0	0	N	0
<i>Temagami District (5 locations)</i>					
Barr Township	bF	0	0	N	0
Best Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Strathcona Township ^d	bF	1	0	N	0
	wS	1	0	N	0

^a bF = balsam fir, bS = black spruce, wS = white spruce.

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

^c 0 = undamaged; 1 = light damage, <25% total defoliation, usually one season of severe defoliation; 2 = moderate damage, 25 to 60% total defoliation, two or three seasons of severe defoliation; 3 = severe damage, 60 to 80% total defoliation, three to five seasons of severe defoliation, will recover; 4 = moribund or dying, 80 to 100% total defoliation, crowns gray in appearance, 50–150 cm top dead or bare; 5 = <25% of stand dead; 6+ = 25 to 50% dead; 7 = 50 to 70% of stand dead; 8 = >70% stand dead; 9 = <25% of stand dead, no significant (0–25%) defoliation for several years; + = 25 to 50% of stand dead, no significant defoliation for several years; - = 51 to 50% of stand dead, no significant defoliation for several years.

^d Eastern Spruce Budworm NFP plot.

Jack Pine Budworm, *Choristoneura p. pinus* Free.

Provincial Situation

In 1994, the area of moderate to severe defoliation caused by the jack pine budworm in Ontario totaled 419,344 ha. This was an increase of 137,097 ha from the 282,247 ha mapped in 1993. The majority of the defoliation, 415,894 ha, was confined to the Central Region in the following districts: Algonquin Park, North Bay, Parry Sound, Pembroke, Sault Ste. Marie, Sudbury, and Temagami (Fig. 5). For the second consecutive year, damage was not recorded in the Northwest Region. The infestation in the Sudbury District, Central Region, has however extended north into the Timmins District, Northeast Region, and now covers 3,450 ha.

Central Region

The area of moderate to severe defoliation of jack pine (*Pinus banksiana* Lamb.) in the Sudbury District increased

substantially from 165,840 ha in 1993 to 277,129 ha in 1994 (Table 6). Most of the areas infested in 1993 were defoliated again this year, and many of the smaller pockets west of Lake Wanapitei coalesced to form larger, more continuous areas of damage. One such infestation, encompassing 60,204 ha, stretched from Beebe Township in the north to Bigelow Township in the south. It included much of Gervais, Hotte, Monestime, Olinyk, Oshell, Prescott, Redden, Rowat, Solski, Teasdale, Strain, Moses, Acheson, and Weeks townships. Another large area of heavy damage occurred between the towns of Capreol and Cartier and covered 66,711 ha. This infestation was located in the townships of Cartier, Cascaden, Leinster, Harty, Levack, Tyrone, Foy, Morgan, Kitchener, Howell, Lumsden, Rayside, Hutton, Wisner, and Hamner. Numerous smaller pockets of defoliation occurred in the eastern and central portions of the Sudbury District. These ranged from 50 to 16,830 ha in area. The heaviest damage occurred in the Windy Lake area in Cartier, Cascaden, and Levack townships, Sudbury District, where severe

Table 5. Results of eastern spruce budworm pheromone trapping in eight districts of the Central Region of Ontario, 1992 - 1994.

Location (Township)	Number of adults trapped		
	1992	1993	1994
<i>Algonquin Park District</i>			
Stratton	643	482	112 ^a
White	962	501	194 ^a
<i>Bancroft District</i>			
Denbigh	193	53	101
Ridout	-	-	203 ^a
<i>North Bay District</i>			
Clement	-	-	1,002 ^a
Hugel	-	-	1,554 ^a
Thistel	-	-	219 ^a
<i>Parry Sound District</i>			
Bethune	1,169	251	426 ^a
Spence	414	117	226 ^a
<i>Pembroke District</i>			
Alice	2,447	619	281
<i>Sault Ste. Marie District</i>			
Asselin	117	147	101 ^a
Aweres	520	710	370 ^a
Herrick	-	-	286 ^a
Laronde	635	412	340 ^a
Nicholas	397	250	204 ^a
Peever	175	532	244 ^a
Tarbutt	175	532	387 ^a
<i>Sudbury District</i>			
Antrim	811	547	444 ^a
Boon	-	-	170 ^a
Drury	293	221	92 ^a
Gervais	294	39	321 ^a
Hart	-	-	261 ^a
Jocko	-	-	160 ^a
Nairn	-	-	317 ^a
Parkin	-	-	200 ^a
Servos	-	-	119 ^a
<i>Temagami District</i>			
Barr	222	35	107
Best	-	-	67 ^a
Brewster	55	57	133
Stathcona	71	35	12 ^a

^a Eastern Spruce Budworm NFP plot.

backfeeding on older foliage was observed. Population levels decreased in the areas north and east of Lake Wanapitei. These sites sustained severe damage in 1993.

In the Parry Sound District, high jack pine budworm populations were recorded for the fifth consecutive year and moderate to severe defoliation was noted in much of the same area that was infested in 1993. The largest single body of medium to heavy infestation extended north of the Pointe Au Baril area, Parry Sound District and along the Georgian Bay coast to Cox and Delamere townships, Sudbury District. Generally, the infestation was contained west of Highway 69 but it did extend east into Blair, Brown, and Burton townships. In total, 94,713 ha were affected in the Parry Sound District and 38,186 ha were damaged in the Sudbury District. A second infestation in the eastern section of the Parry Sound District occupied 10,655 ha in McKenzie, Wilson, and Ferrie townships, as well as 755 ha in adjacent East Mills Township, North Bay District.

Most of the defoliation in the North Bay District occurred in scattered patches around the west end of Lake Nipissing. The largest pocket of moderate to severe defoliation (13,666 ha) covered most of Latchford Township and extended into Loudon, Falconer, and Bertram townships and into the Dokis First Nation lands. Smaller areas of defoliation were recorded further north in Dana, McWilliams, and Afton townships.

In 1994, single jack pine budworm infestations in the Sault Ste. Marie and Temagami districts were recorded in much the same areas as in 1993. In the Sault Ste. Marie District, the area of moderate to severe defoliation expanded slightly to 1,240 ha, but was contained within Sagard Township. The infestation in Armagh Township, Temagami District, extended to Clary and Sheppard townships, Sudbury District and into Afton Township, North Bay District.

In the Pembroke District, many of the areas infested in 1993 were reinfested in 1994, and a new infestation appeared in the Lake Traverse area in the Algonquin

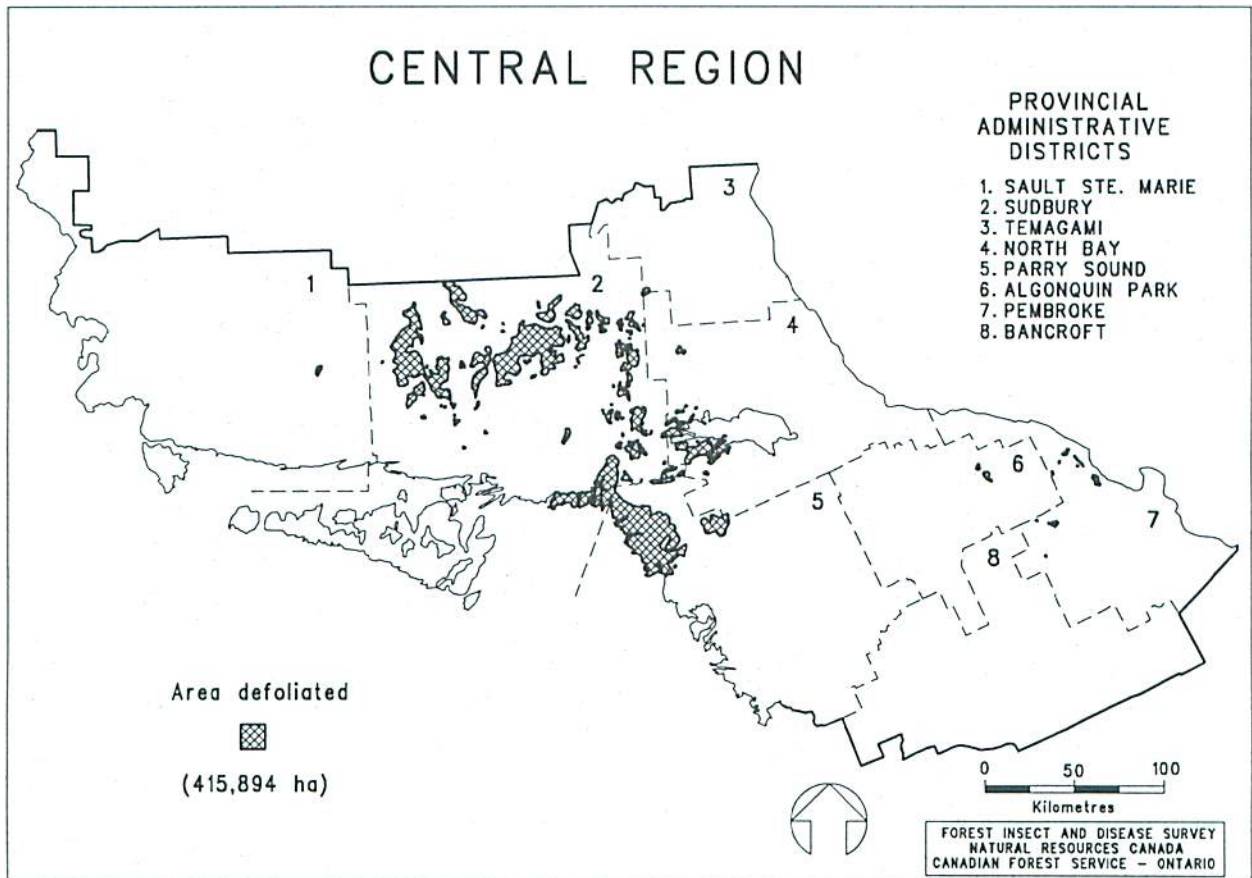


Figure 5. Areas of moderate to severe defoliation caused by the jack pine budworm (*Choristoneura p. pinis* Free.) in 1994.

Table 6. Gross area of moderate to severe defoliation by the jack pine budworm in the Central Region of Ontario, 1991-1994.

District	Area of moderate to severe defoliation (ha)			
	1991	1992	1993	1994
Algonquin Park	0	465	380	1,590
Bancroft	20	30	0	0
North Bay	290	16,379	19,035	25,052
Parry Sound	51,276	77,551	91,645	106,898
Pembroke	0	2,704	4,202	3,875
Sault Ste. Marie	0	0	1,095	1,240
Sudbury	9,518	60,349	165,840	277,129
Temagami	0	0	50	110
Total	61,104	157,478	282,247	415,894

Park District. A number of small infestations were recorded in the Pembroke District as follows: in the vicinity of the Bonnechere Provincial Park in Hagarty, Richards, and Burns townships; north of Barry's Bay in Jones Township; and in the Deep River and Petawawa areas in Petawawa, Buchanan, and Wylie townships. In the Algonquin Park District, moderate to severe defoliation was mapped

northwest and southeast of Lake Traverse in White, Barron, and Edgar townships.

Damage to eastern white pine (*Pinus strobus* L.), growing in proximity to heavily infested jack pine, was observed in the Parry Sound District and in the southern portion of the Sudbury District. At several locations in Wallbridge and Harrison townships, Parry Sound District

and in Bigwood, Allen, Cox, Delamere, and Scollard townships, Sudbury District, 4- to 16-m trees sustained current defoliation ranging from 60 to 100%.

E.B. Eddy Forest Products Ltd., Espanola and the Ontario Ministry of Natural Resources aerially sprayed 21,500 ha of jack pine forest for the jack pine budworm on the Lower Spanish Forest Management Agreement (FMA). Spraying started on 19 June 1994 and was completed 27 June 1994. The treatment was a single application of Foray 76B at 30 BIU/ha.

Whole-tree and top mortality of jack pine caused by the jack pine budworm was observed in the Parry Sound, Sudbury, and North Bay districts in 1994. High population levels of this budworm have been present in parts of the Parry Sound District for 5 consecutive years and for 4 consecutive years in the Sudbury and North Bay districts. Much of the area currently infested, particularly in the Parry Sound District, had previously been subjected to 5 consecutive years (1982–1986) of moderate to severe defoliation by the jack pine budworm. Therefore, some areas have experienced only a brief respite from the repeated stress of defoliation. Jack pine within the area of

infestation are, for the most part, growing on shallow, rocky sites and have been subjected to additional stress by below-normal precipitation for a number of years. The result has been a large area (77,525 ha) of jack pine mortality (Fig. 6). A single, large body of dead or moribund jack pine was mapped north of Point Au Baril, along the Georgian Bay coast. It extended north into the Hartley Bay area in the Sudbury District and west to the western channel of the French River. At one point, it extended east to the Wallbridge–Brown township boundary, Parry Sound District. Smaller, separate pockets of dead jack pine were recorded in Shawanaga, Harrison, Mowat, Wallbridge, Blair, and Brown townships, Parry Sound District; in Allen, Cox, Bigwood, and Scollard townships, Sudbury District; and in Latchford and Bertram Townships, North Bay District.

Four 100-tree mortality plots were tallied in the Parry Sound District in 1994 (Table 7); one in each of Brown and Harrison townships and two in Wallbridge Township. At all locations mortality ranged between 32 and 42%. The heaviest mortality occurred in Wallbridge Township. In the Sudbury and North Bay districts an extensive

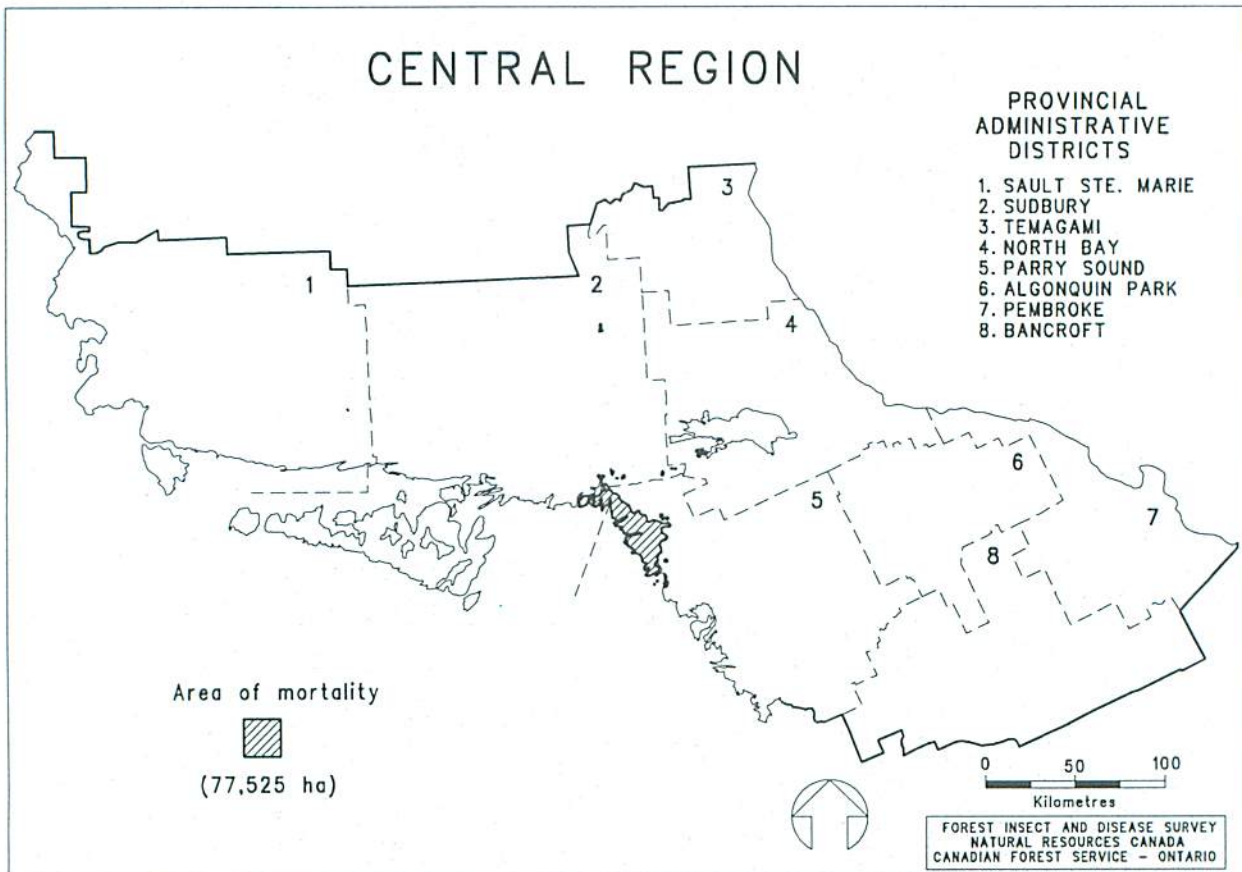


Figure 6. Areas within which jack pine whole-tree and top mortality was caused by the jack pine budworm (*Choristoneura pinus Free.*) in 1994.

network of jack pine budworm impact plots were set up in 1992 and 1993. Funded under the Northern Ontario Development Agreement (NODA) through the Northern Forestry Program (NFP), one of the functions of this plot network is to monitor the affect of the jack pine budworm on stands of different age groups and site classes. A more detailed description of the jack pine budworm NFP plot work can be found in the "Special Surveys" section of this report. Three of the 50-tree jack pine budworm NFP plots in the Sudbury District and one in the North Bay District are located within or close to areas with heavily damaged stands (Table 7). Surveys along the French River in Allen and Scollard townships, Sudbury District and Latchford Township, North Bay District, revealed that between 16 and 42% of the trees are dead or moribund (near death or severely stressed). The heaviest damage occurred in Allen Township, where an additional 40% of the trees had bare tops (heavy crown defoliation).

One final pocket of mortality was located north of Lake Wanapitei in Aylmer and Rathbun townships. In contrast to the area of damage in the Parry Sound District

and along the French River, these trees are growing on good sites and have been severely defoliated for only 1 year. Extremely high insect populations in 1993, and a lack of any control measures, have resulted in 10% tree mortality and bare tops on 88% of the trees. Of the trees with bare tops, 18% were moribund.

Egg-mass sampling to forecast 1995 budworm population levels was carried out at 108 locations in the region (Table 8). In the Sudbury District, moderate or heavy infestation levels are forecast for 58% of the 55 mature or overmature sample sites. Some expansion may also occur in the area of moderate to severe defoliation in the northern portion of this district. Elsewhere in the region, little change is expected. In the Parry Sound District all of six sample points are predicted to have medium to heavy population levels, although the intensity of the defoliation should again decrease. In the North Bay, Sault Ste. Marie, Pembroke, Algonquin Park, and Temagami districts, areas infested in 1994 are likely to be reinfested in 1995. Some possible expansion of the outbreak may also occur.

Table 7. Summary of whole-tree mortality and incidence of damage caused by the jack pine budworm in the Central Region in 1994.

Location (Township)	Number of trees examined	Average height (m)	Average dbh (cm)	Bare tops (%)	Moribund (%)	Mortality (%)
<i>North Bay District</i>						
Latchford	50	12.6	13.7	8	6	10
<i>Parry Sound District</i>						
Brown	100	16.0	20.2	9	8	37
Harrison	100	12.5	17.7	39	2	34
Wallbridge	100	8.0	18.2	17	2	42
Wallbridge	100	9.0	16.7	15	1	32
<i>Sudbury District</i>						
Allen	50	11.9	16.3	40	34	8
Aylmer	50	18.1	22.5	88	18	10
Scollard	50	10.1	9.8	2	12	6

Table 8. Jack pine budworm in the Central Region of Ontario: Defoliation estimates and egg-mass counts in 1994 and infestation forecasts for 1995 on jack pine.

Location	Estimated % defoliation 1994	Total number of egg masses on six 61-cm branch tips	Infestation forecasts for 1995 ^a
<i>Algonquin Park District</i>			
Guthrie Township	22	8	H
White Township	49	8	H
<i>North Bay District</i>			
Latchford Township – Stand 168 ^b	18	5	M
McNish Township	0	0	N
Merrick Township	10	5	M
<i>Parry Sound District</i>			
Harrison Township – Hwy 529A	33	64	H
– I.R. 17A	58	11	H
Henvey Township	55	17	H
Mowat Township – Pickerel River	25	12	H
Wallbridge Township – Harris Lake Road	42	6	H
– Magnetawan River	48	4	M
<i>Pembroke District</i>			
Buchanan Township	29	5	M
Fraser Township	12	5	M
Richards Township – Bonnechere	48	8	H
Wylie Township – Frontier Lake	10	1	L
<i>Sault Ste. Marie District</i>			
Bouck Township – Stand 198 ^b	0	0	N
Gaunt Township – Stand 118	0	0	N
Lane Township – Stand 64 ^b	0	0	N
Lane Township – Stand 40 ^{bc}	0	0	N
Laughren Township – Stand 135 ^b	0	0	N
Martel Township – Stand 56 ^b	0	0	N
Martel Township – Stand 178 ^{bc}	0	0	N
Nicholas Township	0	0	N
Poulin Township – Stand 93 ^b	0	0	N
Rioux Township – Stand 31 ^b	0	0	N
Sagard Township – Stand 3 ^b	0	0	N
– Stand 113 ^b	30	17	H
– Stand 132	42	5	M
– Stand 136 ^{bc}	2	20	H
Vance Township – Stand 130 ^{bc}	2	0	N
Villeneuve Township – Stand 200 ^b	0	0	N
Villeneuve Township – Stand 218 ^{bc}	0	1	L
Wardle Township – Stand 99 ^{bc}	0	0	N
Wardle Township	0	0	N
Wells Township – Stand 69 ^b	0	0	N
Winkler Township – Stand 95 ^{bc}	0	0	N
Winkler Township – Stand 180 ^b	0	0	N

(cont'd)

Table 8. Jack pine budworm in the Central Region of Ontario: Defoliation estimates and egg-mass counts in 1994 and infestation forecasts for 1995 on jack pine (cont'd).

Location	Estimated % defoliation 1994	Total number of egg masses on six 61-cm branch tips	Infestation forecasts for 1995 ^a
<i>Sudbury District</i>			
Allen Township – Stand 82 ^b	46	18	H
Antrim Township – Stand 235 ^b	31	12	H
Avis Township – Stand 62	0	1	L
Aylmer Township – Stand 143 ^b	12	0	N
Bigwood Township – Murdock River	7	7	H
Cartier Township – Stand 236 ^b	24	11	H
Cartier Township – Stand 367 ^b	38	21	H
Cox Township	45	10	H
Dunbar Township – Stand 227 ^{bc}	0	0	N
Dunlop Township – Stand 13 ^{bc}	13	23	H
Durban Township – Stand 72 ^{bc}	0	0	N
Ermatinger Township – Stand 50 ^b	31	9	H
Ermatinger Township – Stand 70 ^b	58	9	H
Foucault Township – Stand 103 ^b	17	2	L
Hanmer Township	48	8	H
Hart Township – Mimic Plot 1 ^d	22	0	N
Hart Township – Mimic Plot 7 ^d	22	0	N
Hart Township – Stand 73 ^{bc}	2	1	L
Hart Township – Stand 137 ^{bc}	0	5	M
Hart Township – Stand 139 ^b	47	7	H
Hutton Township – Stand 402 ^b	32	10	H
Lefebvre Township – Stand 234 ^{bc}	21	21	H
Leinster Township – Stand 297 ^{bc}	24	4	M
Lumsden Township	28	9	H
Mandamin Township – km 39.2	28	5	M
– Check Plot 3	9	5	M
Merritt Township – Queensway Rd. west	23	5	M
Moncrieff Township – Stand 429 ^{bc}	9	2	L
Moncrieff Township – Stand 441 ^b	28	6	H
Moncrieff Township – Stand 144 ^{bc}	6	2	L
Monestime Township – Stand 210 ^{bc}	15	7	H
Monestime Township – B16 – Plot 8 ^c	5	0	N
Moses Township – B22 – Plot 1 ^e	44	1	L
Moses Township – Stand 22 ^{bc}	3	16	H
Moses Township – Stand 120 ^{bc}	54	1	L
Moses Township – Mimic Plot 2 ^d	6	2	L
Moses Township – Mimic Plot 5 ^d	4	2	L
Moses Township – Stand 260 ^{bcc}	3	0	N
Munster Township – Stand 66 ^{bc}	0	0	N
Munster Township – Stand 107 ^{bc}	4	0	N
Nairn Township – Stand 28	3	0	N
Nairn Township – Stand 125	7	0	N
Olinyk Township – Stand 90 ^b	26	5	M
Olinyk Township – Stand 290 ^{bc}	3	8	H

(cont'd)

Table 8. Jack pine budworm in the Central Region of Ontario: Defoliation estimates and egg-mass counts in 1994 and infestation forecasts for 1995 on jack pine (concl.).

Location	Estimated % defoliation 1994	Total number of egg masses on six 61-cm branch tips	Infestation forecasts for 1995 ^a
<i>Sudbury District (concl.)</i>			
Olinyk Township – B17 – Plot 4 ^c	9	1	L
Olinyk Township – Check Plot 1	38	11	H
Prescott Township – Stand 73 ^c	6	6	H
– Stand 333 – Check Plot 4	36	5	M
Prescott Township – Stand 148 ^{bc}	5	12	H
Rathbun Township – Stand 129 ^b	21	2	L
Rhodes Township – Stand 139 ^b	2	1	L
Rhodes Township – Stand 247 ^b	18	9	H
Rowat Township – B21 – Plot 3 ^c	31	2	L
Rowat Township – B23 – Plot 5 ^c	34	1	L
Rowat Township – Stand 47 ^b	53	4	M
– Stand 316 ^{bc}	1	4	M
Scadding Township – Stand 20 ^b	13	0	N
Scadding Township – Stand 33 ^b	23	2	L
Scadding Township – Stand 71 ^{bc}	7	3	M
Scollard Township – Stand 50 ^b	49	5	M
Solski Township – Stand 36 ^{bc}	1	2	L
Solski Township – B24 – Plot 2 ^c	6	1	L
Strain Township – B38 – Plot 4 ^c	5	3	M
Street Township – Stand 60 ^{bc}	32	6	H
Teasdale Township – B36 – Plot 1 ^c	16	0	N
Teasdale Township – Stand 94 ^{bc}	7	3	M
Teasdale Township – Stand 185 ^{bc}	20	2	L
Ulster Township – Stand 308 ^b	16	1	L
– east	11	6	H
Weeks Township – Stand 271 ^{bc}	15	2	L
<i>Temagami District</i>			
Armagh Township	68	8	H

^a N = nil, L = light, M = moderate, H = heavy.

^b NFP plot.

^c Immature jack pine stand sampled (age <40 years).

^d Aerially sprayed, mimic, 1994.

^e Aerially sprayed, *B.t.*, 1994.

Introduced Pine Sawfly, *Diprion similis*. (Htg.)

Population levels of the introduced pine sawfly (Fig. 7) were up across the Parry Sound District in 1994. Populations that began to build in 1990 have now exploded, and in 1994 resulted in a total of 360 ha of moderate to severe defoliation in eastern white pine along the Georgian Bay coast in the Parry Sound area (Fig. 8).

The infestation at Parry Sound now extends along the coastal area of Georgian Bay from South Bay in the upper portion of Carling Township, south along the mainland and coastal islands, and in the O'Donnell Point Provincial Nature Reserve in the general area of Peacock Island. Throughout the infested area mature white pine trees were completely defoliated in the area of 1993 damage. In most of the newly infested sites, heavy damage was restricted



Figure 7. Damage to eastern white pine caused by the introduced pine sawfly, *Diprion similis* (Htg.).

to the upper crowns of mature trees. Damage was also confined to coastal areas up to 0.5 km inland, with the exception of Carling Township; here, the infestation has been established the longest.

Whole-tree mortality and some top mortality were, in 1994, recorded for the first time in the Dillon-Franklin Island area, Carling Township. A total of 36 ha of mortality was noted on mature, 23-m trees on coastal islands out as far as Franklin Island (Fig. 9). This is in the older portion of the infestation.

Throughout the remainder of the Parry Sound District, trace to light defoliation levels were recorded on open-grown white pine in Brown Township and on shoreline trees in the Muskoka lakes area. Sawfly population levels in this later area appear to be building, particularly in the Bala and Foot's Bay regions on the west side of Lake Muskoka and at Port Carling on the east side of the lake.

In the Bancroft District, light defoliation was recorded on 3-m trees in the white pine seed orchard in Snowdon Township and on open-grown, 4-m trees adjacent to larger lakes in Methuen and Chandos townships.

In the Sault Ste. Marie District, 5-m trees on Garden River First Nation lands received approximately 10% defoliation. An expansion in the distribution of this insect was noted when sawflies were collected at the Kirkwood Forest Station and in Long Township. There were also reports of the insect in the Lake Duborne area. Damage was not noticeable at these locations.

Greenstriped Mapleworm, *Dryocampa r. rubicunda* (F.)

There was a dramatic increase in the population level of greenstriped mapleworm (Fig. 10) in 1994. The largest zone of infestation was in the Elliot Lake area of the Sault Ste. Marie District and in the adjoining area of the Sudbury District. This zone extended south from Esten and Tennyson

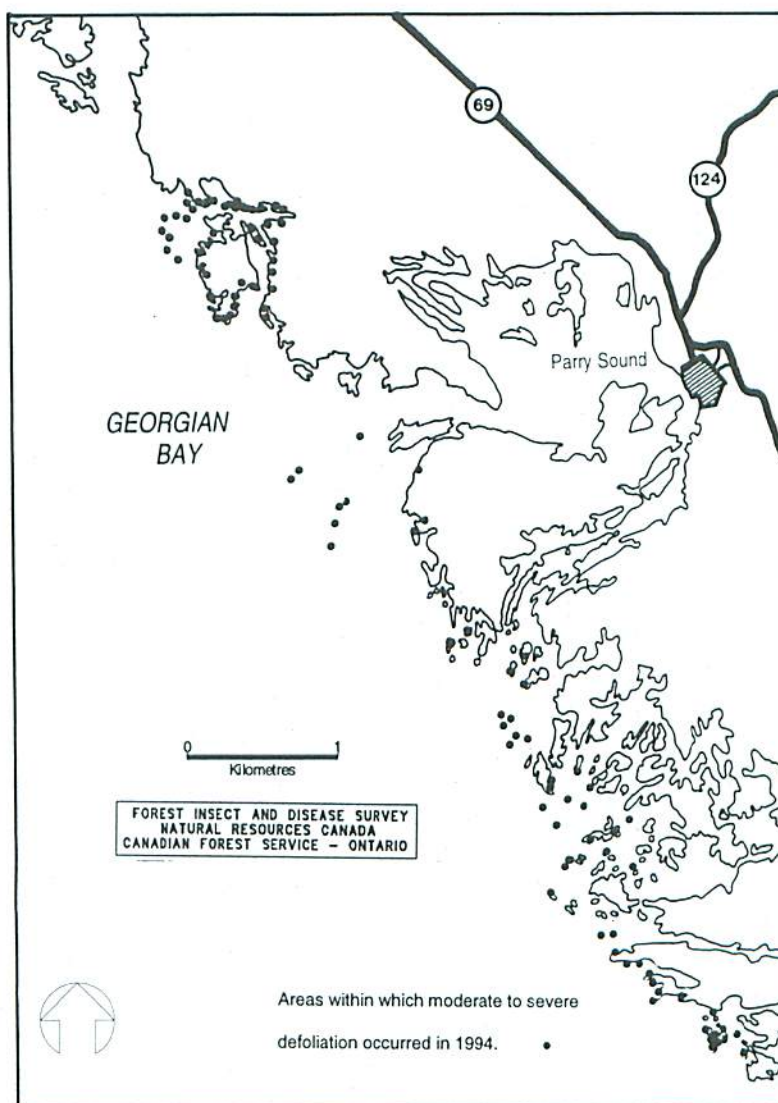


Figure 8. Areas within which moderate to severe defoliation was caused by the introduced pine sawfly, *Diprion similis* (Htg.), in 1994.

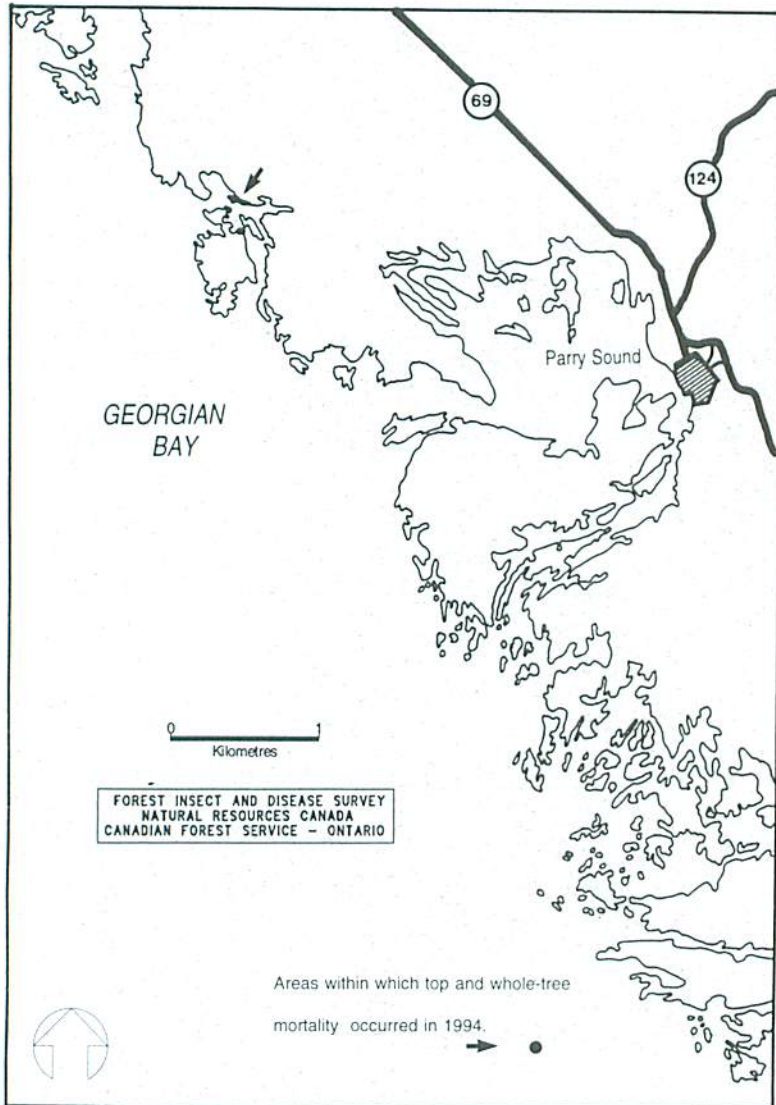


Figure 9. Areas within which top and whole-tree mortality was caused by the introduced pine sawfly, *Diprion similis* (Htg.), in 1994.

townships and north to Sagard and Prescott townships (Fig. 11). Damage was exclusively to red maple (*Acer rubrum* L.). Although red maple does not comprise a major component of stands in the area, the insect has an ability to seek out its host. Most trees were infested to some degree wherever this host occurred, either singly or in groups. All sizes of trees, regardless of their position in the stand, were infested. Defoliation of up to 100% was recorded; however, average damage was generally in the 50–60% range.

Elsewhere, small pockets of medium to heavy infestation occurred in Lewis, Kirkwood, and Thompson townships, Sault Ste. Marie District; in Norman, Capreol, Broder, Tilton, Eden, Attlee, Carlyle, and Humbolt townships, Sudbury District; and in Maria Township, Pembroke District.

Eastern Pine Shoot Borer, *Eucosma gloriola* Heinr.

The eastern pine shoot borer attacks juvenile pine (*Pinus* spp.) trees. While all pine species may be attacked, damage in 1994 was confined to red pine and jack pine. Most of the damage was noted on red pine, particularly in the Sault Ste. Marie, Bancroft, and Parry Sound districts. Although any terminal branch may be affected, the insect causes the most serious damage when it attacks the leader. For that reason, surveys often concentrate on leader damage.

The highest damage in 1994 occurred in Firstbrook Township, Temagami District. Here, the stand test and the family test sites had 21.3 and 20% of the leaders affected, respectively. Other areas of relatively high damage occurred in May Township and at the Lumsden Township seed orchard, Sudbury District. Leader damage at these sites was 19 and 16% respectively. Many other areas showed a positive incidence of this pest, but the number of affected leaders did not exceed 5% (Table 9).

It should be noted that the shoot borer was not present in all of the plantations examined. It was much more commonly

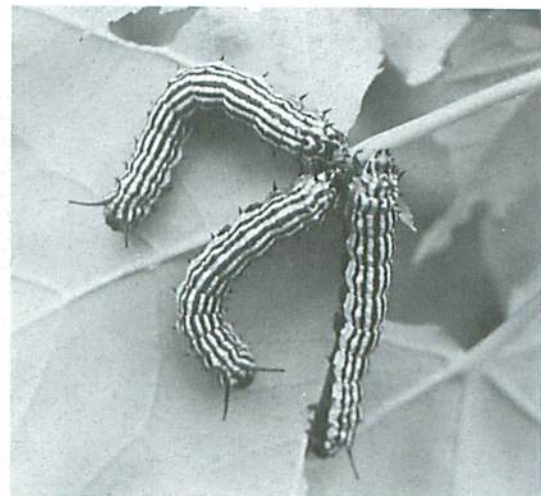


Figure 10. Larvae of the greenstippled maplemoormoth, *Dryocampa r. rubicurda*.

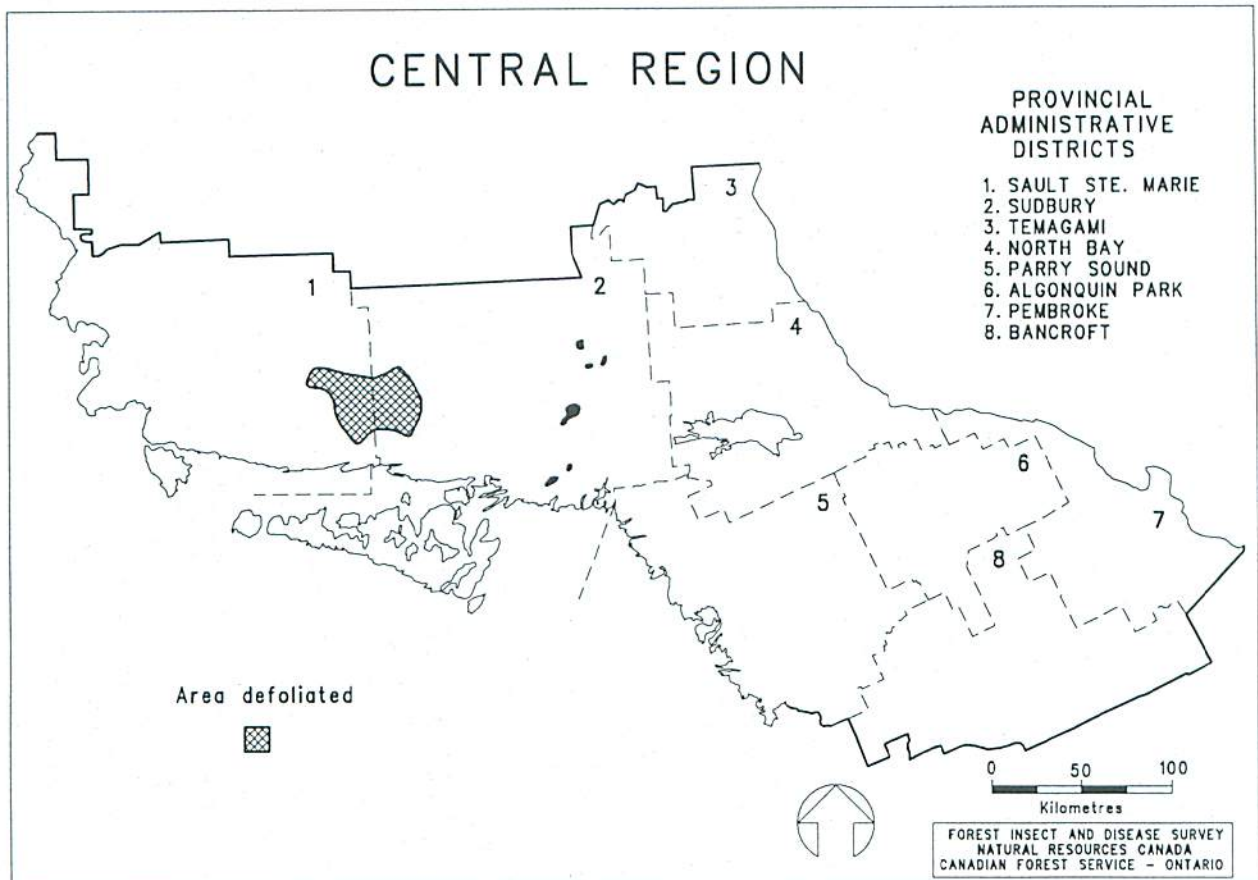


Figure 11. Areas within which moderate to severe defoliation was caused by the greenstriped mapleworm (*Dryocampa r. rubicunda* [F.]) in 1994.

encountered in the northern districts as compared to the southern districts. For example, in the Sault Ste. Marie District, the pest was present in nine of 12 plantations; in the Bancroft and Parry Sound districts it was recorded in only four of 40 plantations.

Fall Webworm, *Hyphantria cunea* (Drury)

Small, localized infestations of the fall webworm occurred in several areas of the region in 1994. Moderate defoliation was recorded on immature white elm (*Ulmus americana* L.) and on both mature and immature black ash (*Fraxinus nigra* Marsh.) in the southeastern portion of the Pembroke District in Westmeath, Ross, Horton, McNab, and Wilberforce townships. The heaviest damage was recorded on black ash in Wilberforce Township. Here, 60% tree defoliation was common.

Elsewhere in the region, small pockets of ash (*Fraxinus* spp.), elm (*Ulmus* spp.), birch (*Betula* spp.), cherry (*Prunus* spp.), aspen (*Populus* spp.), and alder (*Alnus* spp.) experienced damage on up to 50% of the current foliage. Damage in Algonquin Park was reported along the Achray Road and in the North Bay District along Highway 64

between the towns of Martin River and Field. Similar damage was also recorded in Somerville and Laxton townships, Bancroft District and in Day, Thompson, Parkinson, and Gladstone townships, Sault Ste. Marie District.

Hemlock Looper, *Lambdina f. fiscellaria* (Gn.)

In 1994, within the province of Ontario, hemlock looper (Fig. 12) damage was detected in the Central and Southern regions. Aerial surveys revealed the following areas of moderate to severe defoliation: 560 and 312 ha in the Sudbury and Bancroft districts, respectively, in the Central Region (Fig. 13) and 149, 26, and 3.5 ha in the Kemptville, Tweed, and Maple districts, respectively, in the Southern Region.

Within the Sudbury District, the area of moderate to severe defoliation decreased by 700 ha from the 1,260 ha that was aerial surveyed in 1993. The majority of the damage in 1994 occurred on Wikwemikong First Nations land. Small pockets of damage, with moderate levels of defoliation, occurred in Bidwell Township and on Lang Island in Beaverstone Bay, east of Killarney. In most

Table 9. Damage caused by the eastern pine shoot borer at 26 locations in the Central Region of Ontario in 1994. (Counts are based on an examination of 150 randomly selected trees at each location.)

Location (Township)	Tree species ^a	Average height of trees (m)	Estimated trees per ha	Estimated area affected (ha)	Leaders affected (%)
<i>Bancroft District</i>					
Sommerville	rP	1.2	2,500	4	0.7
Sommerville	rP	2.1	2,000	6	1.3
<i>North Bay District</i>					
Merrick – family test	jP	5.0	1,800	5	2.0
Sisk – stand test	jP	2.9	2,000	1.5	8.0
Stewart – family test	jP	5.5	2,200	5	1.3
<i>Parry Sound District</i>					
Sinclair	rP	1.2	3,775	1	1.3
<i>Sault Ste. Marie District</i>					
Cuthbertson – family test	jP	2.5	2,500	4	2.7
Hurlburt	jP	1.8	2,500	15	2.7
Hynes	jP	2.3	3,300	10	1.3
Hynes	rP	1.5	3,100	8	0.7
Kirkwood – stand test	jP	2.0	2,000	1	2.0
Jocelyn	rP	2.9	1,600	4	3.3
Lane – family test	jP	3.5	2,500	10	2.7
Parkinson	rP	1.5	2,000	4	0.7
Parkinson	rP	0.9	2,000	2	1.7
<i>Sudbury District</i>					
Hallam – seed orchard	jP	4.5	2,400	5	16.0
Lumsden – seed orchard	jP	3.5	2,000	5	4.0
Mandamin – family test	jP	2.0	1,400	4	5.0
May	jP	1.8	1,200	3	19.0
Munster – family test	jP	1.0	1,600	3	4.7
Olinyk – family test	jP	1.3	2,000	4	5.0
Street – family test	jP	3.5	1,800	4	2.7
<i>Temagami District</i>					
Coleman	jP	3.6	4,100	15	4.7
Coleman	jP	3.8	3,100	5	3.3
Firstbrook – family test	jP	2.0	2,500	12	20.0
Firstbrook – stand test	jP	2.1	2,500	5	21.3

^arP = red pine, jP = jack pine.

cases, the stands infested were located on shallow soils and were comprised mainly of balsam fir and eastern white cedar (*Thuja occidentalis* L.) with a few overstory eastern white pine.

On Manitoulin Island, a total population collapse was observed in the Providence Bay area, which was infested in 1992 and 1993. A similar collapse was also recorded in the James Bay area on the Wikwemikong First Nations land. It was here that the heaviest damage was observed in

1993. Although high, early instar populations were observed during initial surveys, heavy larval mortality resulted in trace levels of late instar larvae and pupae. A tree-mortality count in the James Bay area revealed that the severe damage of 1993 resulted in the death of 60% of the 15-m balsam fir. Mortality to eastern white cedar also occurred, but salvage operations had been conducted over the winter so estimates of the extent of damage were unavailable. Much of the area northeast of the town of



Figure 12. Damage to conifer trees caused by the hemlock looper, *Lambdina f. fiscellaria* (Gn.).

Wikwemikong, which was infested in 1993, was less affected in 1994. Only two, relatively small pockets of damage were recorded. Four new areas of damage were observed on the northwestern portion of the First Nations land between Rabbit Island and Bold Point. A new infestation was also observed northwest of Manitou Lake in Bidwell Township. In these areas, balsam fir 1 to 16 m in height sustained up to 100% defoliation. Defoliation to eastern white cedar ranged between 20 and 60%. In areas with high populations of hemlock looper, low levels of defoliation were observed on white spruce (*Picea glauca* [Moench] Voss), trembling aspen, and willow (*Salix* spp.). The infested area in Bidwell Township was also defoliated by eastern spruce budworm earlier in the season.

The looper population on Lang Island in Beaverstone Bay, Sudbury District, also decreased substantially. However, moderate levels of defoliation were recorded in 1994. Surrounding islands in this area sustained negligible amounts of damage. The 1993 defoliation resulted in 90 to 100% mortality to the balsam fir, eastern white cedar, white spruce, and black spruce (*Picea mariana* [Mill.] B.S.P.) on the island. Several of the mature eastern white pine also died over the past year; however, pine bark beetles appear to be the main cause of this mortality.

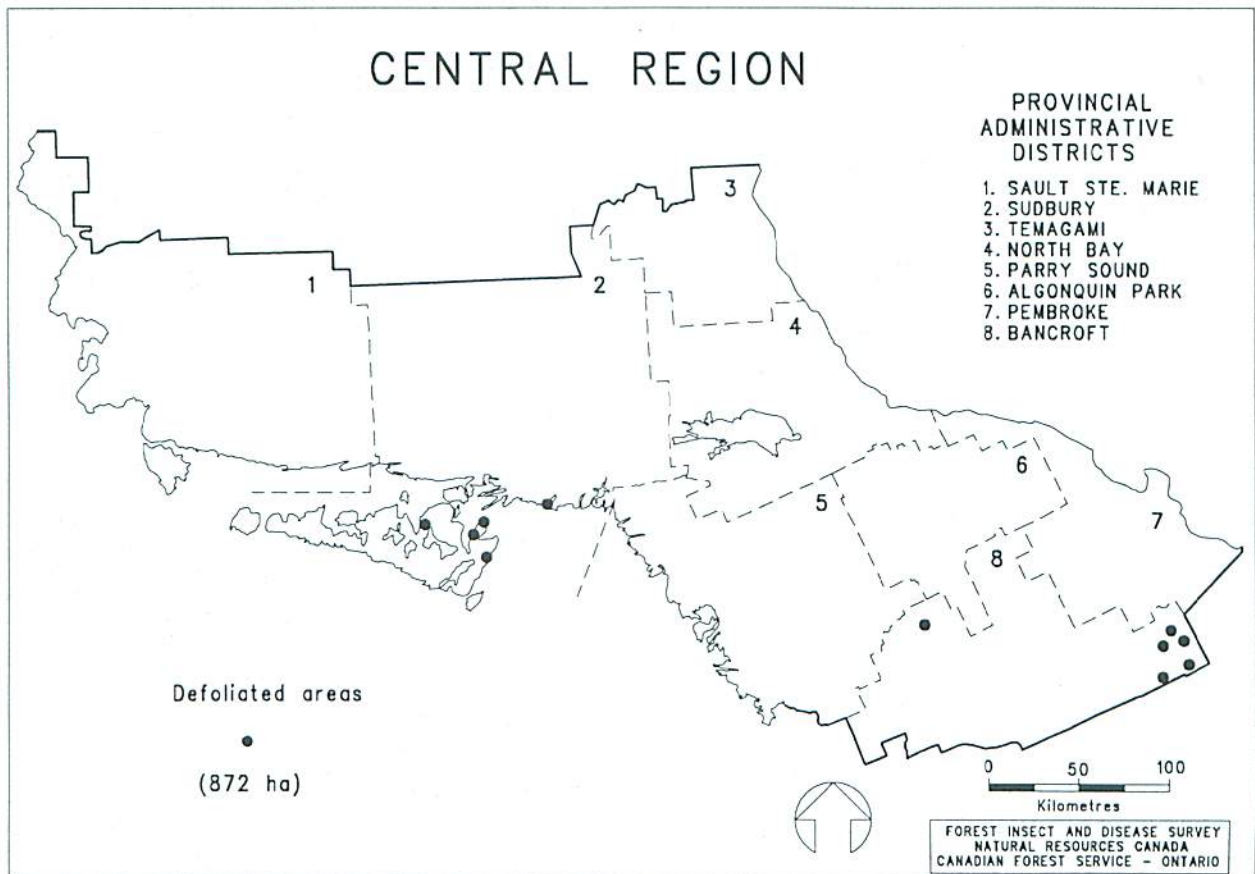


Figure 13. Points where moderate to severe defoliation was caused by the hemlock looper (*Lambdina f. fiscellaria* [Gn.]) in 1994.

In the Bancroft District, damage by hemlock looper was recorded for the first time since 1980 and defoliation occurred over numerous small areas, 2 to 75 ha in size, in the southeast portion of the district. The majority of the damage occurred on eastern hemlock (*Tsuga canadensis* [L.] Carr) and eastern white pine up to 15 m in height growing along lakeshores or on islands. Defoliation ranged from 60 to 90%, although some eastern hemlock were totally defoliated. In Palmerston Township, three small infestations occurred in the Crotch Lake area and another small site was observed along the south shore of Sunday Lake. A small area was affected on the north shore of Big Gull Lake in Clarendon Township. There were three single pockets of damage in southeast Miller Township; one on an island in Big Lake, one on an island on Grindstone Lake, and one on the west shore of Mosque Lake. In Canonto Township, two small areas of damage were observed north of Palmerston Lake and single infestations occurred on the northeast shore of Roundcamp Lake and on the southeast shore of Quinn Lake. Finally, a 2-ha island in Lake Kenisis, Havelock Township, was heavily infested with this pest.

Gypsy Moth, *Lymantria dispar* (L.)

Provincial Situation

Gypsy moth populations declined for the third consecutive year in 1994. A total of 5,645 ha of moderate to severe defoliation was recorded in the province. This represents a 4,139-ha decrease from the previous year. Again, the majority of defoliation (5,543 ha) occurred in the Sudbury District, Central Region. In the Southern Region, population collapses occurred in all of the districts. However, the Aylmer District recorded 102 ha of damage.

Central Region

Moderate to severe defoliation was recorded in the Sudbury District for the second consecutive year (Table 10). Elsewhere in the region low numbers of larvae, observed

in Long Township, Sault Ste. Marie District and in Carling Township, Parry Sound District, caused trace amounts of damage.

In the Sudbury District the area of aerially mapped damage decreased. However, many of the same areas infested in 1993 were damaged again in 1994, and there was an expansion of smaller pockets in the Espanola area and northeast of Sudbury (Fig. 14). The reduction in the area affected was caused by a decrease in the size of the pockets. The majority of the damage occurred in the Sudbury area and was contained within the townships of McKim, Garson, Neelon, Dryden, Graham, Waters, Broder, Dill, Eden, and Tilton. Elsewhere in the Sudbury District, smaller pockets of damage were observed in Hallam, Merritt, Nairn, Foster, Lorne, Truman, Louise, Dieppe, and Roosevelt townships. The infestation in Roosevelt Township was along the northern border of the Killarney Provincial Park.

Most of the defoliation occurred on red oak (*Quercus rubra* L.) and white birch growing on barren and rocky ridge tops. Many of these trees sustained up to 100% defoliation. Trembling aspen and red pine growing in the area also sustained 30 to 60% defoliation, and some Manitoba maple (*Acer negundo* L.) were defoliated within the city of Sudbury. Surveys early in the season revealed that 100% of the egg masses laid above the snowline where killed because of the extreme cold temperatures recorded during the winter of 1993-94. The combination of winterkill and commonly occurring natural pathogens (mainly nuclear polyhedrosis virus) may have contributed to a decline in the extent of damage noted in many areas south of Sudbury in 1994.

Pheromone traps were deployed at 20 locations, mainly in campgrounds, to determine the presence and distribution of the gypsy moth in the northern part of the region. The districts of North Bay, Sault Ste. Marie, Sudbury, and Temagami were included in the study (Table 11). Male moths were trapped at all but two locations. Both of these exceptions were in the Lake Superior Provincial Park, Sault Ste. Marie District.

Table 10. Gross area of moderate to severe defoliation caused by the gypsy moth from 1991 to 1994 in the Central Region of Ontario.

District	Area of moderate to severe defoliation (ha)			
	1991	1992	1993	1994
Algonquin Park	915	591	0	0
Bancroft	61,840	13,205	0	0
Parry Sound	148,412	1,513	0	0
Pembroke	16,554	2,301	0	0
Sudbury	441	3,502	6,645	5,543
Total	228,162	21,112	6,645	5,543

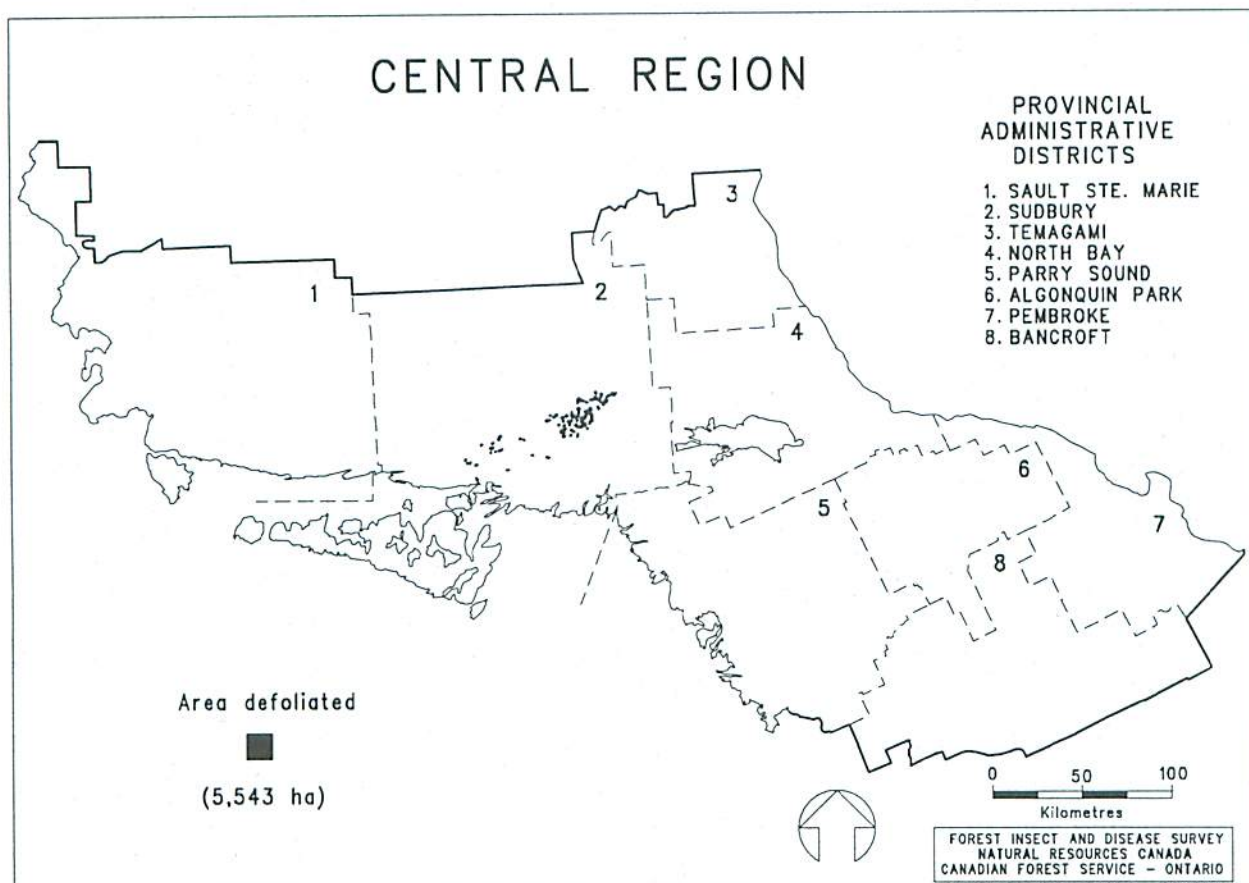


Figure 14. Areas of moderate to severe defoliation caused by the gypsy moth (*Lymantria dispar* [L.]) in 1994.

Balsam fir sawfly, *Neodiprion abietis* complex

Compared with 1993, there was an overall decrease in the level of damage from balsam fir sawfly in the region in 1994. The number of areas where defoliation was recorded was down markedly, although a few areas of infestation persisted. Although this insect feeds on both balsam fir and spruces (*Picea* spp.), all the damage recorded in 1994 was on balsam fir.

In the North Bay District, the most notable area of defoliation (average 30%) occurred on 10-m trees in Springer Township. Lighter damage was evident in Hugel, Chisholm, and Hagar townships, Sudbury District. In the Bancroft District, small pockets of moderate defoliation (up to 60%) on individual trees occurred in Glamorgan, Monmouth, Cardiff, and Palmerston townships. Typical damage was recorded in Palmerston Township, where 60% of the trees averaged 22% defoliation. Notable areas of damage occurred in McNabb, Horton, and Bagot townships, Pembroke District. The heaviest damage occurred in McNabb Township, where 100% of the 7-m trees averaged 40% defoliation.

Redheaded Pine Sawfly, *Neodiprion lecontei* (Fitch)

Populations of the redheaded pine sawfly were variable in the region in 1994 and both increases and decreases were recorded. For example, in Somerville Township, Bancroft District, where control measures were undertaken in 1993 with Lecontivirus, larval numbers were greatly reduced and subsequent defoliation was very light. Areas of increased populations were noted in the Sault Ste. Marie District, in the Espanola area of the Sudbury District, and in the eastern part of the North Bay District.

The heaviest damage occurred in Carling Township, Parry Sound District, where 80% of the 3.5-m red pine suffered an average of 20% defoliation and 40% accumulated mortality. In Bouck Township, Sault Ste. Marie District, 10.6% of the 0.7-m red pine sustained 70% foliar damage and 5% current mortality. A total of 18 locations was evaluated for this insect in 1994 (Table 12).

Table 11. Results of gypsy moth pheromone trapping in the Central Region of Ontario in 1993 and 1994.

Location	Number of traps		Number of male moths captured	
	1993	1994	1993	1994
<i>North Bay District</i>				
Antoine Provincial Park	1	2	6	22
Lake Nipissing Scenic Lookout	2	1	37	8
Martin River Provincial Park	2	2	25	22
Restoule Provincial Park	2	2	23	21
Samuel de Champlain Provincial Park	2	2	21	19
<i>Sault Ste. Marie District</i>				
Agawa Bay Campground	9	9	3	1
Crescent Lake Campground	1	1	0	0
Mississagi Provincial Park	2	2	14	3
Pancake Bay Provincial Park	2	2	3	3
Rabbit Blanket Lake Campground	2	2	0	0
<i>Sudbury District</i>				
Bidwell Township, Red Lodge	2	2	28	28
Chutes Provincial Park	2	1	34	19
Fairbanks Provincial Park	2	1	26	13
Gordon Township, Gordons Lodge	2	2	29	29
Halfway Lake Provincial Park	1	2	4	5
Killarney Provincial Park	2	1	28	13
South Baymouth Ferry Dock	2	2	66	1
South Baymouth Trailer Park	2	2	55	7
Windy Lake Provincial Park	2	2	24	13
<i>Temagami District</i>				
Finlayson Point Provincial Park	6	2	6	15

Yellowheaded Spruce Sawfly, *Pikonema alaskensis* (Roh.)

The yellowheaded spruce sawfly recurred at damaging levels throughout the region. This insect causes sporadic damage, which can be very severe in some instances. In almost all cases, defoliation occurred on open-grown or roadside trees. It was only in rare situations that plantations were infested to any degree. Almost all encounters of the pest in 1994 were on white spruce, the main host in the area. Other spruces, including ornamental varieties, were affected in some urban areas.

In the northern districts of Sault Ste. Marie, Sudbury, North Bay, and Temagami, trees along major roadways were affected at intermittent locations. Typical damage occurred in Best, Strathcona, Askin, Coleman, and Law townships, Temagami District, where trees up to 3 m in height averaged 90% defoliation; in Thompson Township, Sault Ste. Marie District, where 20% of the 3-m windbreak

trees averaged 50% foliar damage; and along Highway 637 in the Sudbury District, where 2-m trees were up to 90% defoliated. The heaviest area of damage occurred in Commanda Township, North Bay District. Here, 7-m trees suffered up to 80% defoliation.

There were more concentrated areas of damage in the southern part of the region. Extensive defoliation occurred to roadside trees in the eastern part of the Parry Sound and Bancroft districts. Here, on trees up to 3 m in height, defoliation ranged up to 90%. At evaluated sites in the Bancroft District, defoliation averaged 27 and 42%, respectively, on over 70% of the 0.7-m trees in Wicklow Township and on the 1.4-m trees in Denbigh Township. Tree mortality of 8% was also recorded at this latter location. Foliar damage of 56% was observed on 28% of the 1.3-m trees in Sproule Township, Algonquin Park District. This was typical of damage along the Highway 60 corridor within the park. The highest damage in the

Table 12. Damage caused to red pine by the redheaded pine sawfly at 18 locations in the Central Region of Ontario in 1994.

Location (Township)	Estimated stand area (ha)	Average height (m)	Trees affected (%)	Average defoliation (%)
<i>Algonquin Park District</i>				
Peck	1	1.2	10.0	14
<i>Bancroft District</i>				
Somerville	12	2.1	2.0	2
Monmouth	2	2.1	3.3	5
Methuen	5	4.0	3.0	2
<i>North Bay District</i>				
Cameron	5	1.7	5.0	10
Cameron	4	1.8	5.0	20
Cameron	8	1.5	4.0	20
French	10	2.1	2.6	15
Odrig	4	3.5	2.0	20
<i>Parry Sound District</i>				
Carling	1	3.5	80.0	20
<i>Pembroke District</i>				
Maria	3	1.7	2.7	12
<i>Sault Ste. Marie District</i>				
Bouck	4	0.7	10.6	70
Bridgeland	8	0.9	1.3	15
Parkinson	4	1.5	5.3	12
Patton	1	1.2	3.0	30
<i>Sudbury District</i>				
Drury	2	3.0	2.0	10
Hallam	2	2.5	4.0	10
Shakespeare	1	2.5	4.0	10

Pembroke District occurred at the Carson Lake Provincial Park. Here, 28% of the 1.7-m trees sustained 45% defoliation.

White Pine Weevil, *Pissodes strobi* (Peck)

White pine weevil, considered a serious pest of spruces and pines, kills the leader and top part of the main stem and causes main stem deformity. Thus, it reduces the commercial and aesthetic value of a tree. Trees up to 10 metres in height are attacked. Above this height, trees are generally less likely to be attacked.

Surveys for this pest were conducted in 30 plantations in 1994. These revealed an incidence of attack that ranged from 0 to 21% in the region (Table 13). In general, damage levels in most areas remained static or declined slightly compared to 1993. Over the past 3 years there has been a

decline in damage of approximately 33%. The average proportion of attacked leaders was 7.3% in 1992, 6.4% in 1993, and 4.9% in 1994. The highest incidence of leader damage occurred in a 3-ha plantation of 1.8-m jack pine in May Township, Sudbury District. Elsewhere in the region, the majority of plantations surveyed had less than 10% of the trees affected.

Red Pine Needle Midge, *Thecodiplosis piniresinosae* Kearby

The red pine needle midge caused considerable damage on host trees in the Sault Ste. Marie District in 1994. For the most part the heaviest and most widespread damage occurred in the large diameter red pine stands in Kirkwood Township. This infestation extended into parts of the adjacent townships of Bridgeland, Rose, and Lefroy. Here, foliar damage to the current years needles averaged 50%, but ranged as high as 90%. Other areas of damage, which were generally somewhat lighter (25–50% defoliation), occurred in the nearby townships of Aberdeen, Plummer, Plummer Additional, Galbraith, Haughton, and Parkinson. Other notable areas of 25–50% damage occurred at the east end of Garden River First Nation land, in Van-

Koughnet Township, in Gapp Township, and north of Aubrey Falls in Martel and Root townships (Fig. 15). Aerial mapping was conducted to delineate areas of moderate and severe damage on 30 September. The gross area affected was 2,972 ha. Lighter damage was noted in numerous other stands of red pine as far east as Proctor Township. The only infested area not in the Sault Ste. Marie District was in Carling Township, Parry Sound District, where a 2-ha stand of 4-m red pine trees was moderately damaged.

The midge feeds at the base of needles throughout the summer, but the damage does not appear until mid-September when the foliage turns yellow and then brown. By the time the foliage has discolored, the needle is severed at the base and is easily dislodged. Damage is usually heavier on exposed portions of the tree crown and

Table 13. Damage caused by the white pine weevil at 30 locations in the Central Region of Ontario in 1994. (Counts are based on an examination of 150 randomly selected trees per location.)

Location (Township)	Tree species ^a	Average height of trees (m)	Estimated trees per ha	Estimated area affected (ha)	Trees affected (%)
<i>Bancroft District</i>					
Mayo	ewP	1.9	2,200	4	6.0
<i>North Bay District</i>					
Gurd	ewP	5.5	1,000	3	14.0
Mattawan	ewP	0.9	800	5	3.0
Merick	jP	5.0	1,800	5	0.7
Sisk	jP	2.9	2,000	2	5.3
Stewart	jP	5.5	2,200	5	0
<i>Pembroke District</i>					
Clara	ewP	1.2	2,250	50	1.7
Clara	jP	1.9	2,500	12	2.7
<i>Sault Ste. Marie District</i>					
Curtis	bS	1.0	2,500	10	2.7
Cuthbertson	bS	1.2	2,500	4	4.7
Cuthbertson	jP	2.5	2,500	4	12.0
Hurlbert	jP	1.8	2,500	15	8.0
Hynes	rP	1.5	3,100	8	1.3
Hynes	jP	2.3	3,300	10	6.7
Lane	jP	3.5	2,500	10	2.7
Nicholas	jP	1.2	2,300	7	0.7
Parkinson	wS	0.8	600	4	2.0
Sturgeon	jP	2.7	2,600	10	12.0
<i>Sudbury District</i>					
Hallam	jP	4.5	2,400	5	2.0
Lumsden	jP	3.5	2,000	5	6.0
Mandamin	jP	2.0	1,400	4	7.0
May	jP	1.8	1,200	3	21.0
Munster	jP	1.0	1,600	3	3.3
Olinyk	jP	1.3	2,000	4	1.3
Robinson	jP	3.5	1,800	4	2.0
Street	jP	3.5	1,800	4	4.6
<i>Temagami District</i>					
Firstbrook	jP	2.0	3,300	5	4.7
Gilles Limit	bS	1.0	2,500	7	0.7
Coleman	jP	3.6	2,500	15	6.7
Coleman	jP	3.8	3,100	5	2.7

^a bS = black spruce, ewP = eastern white pine, jP = jack pine, wS = white spruce.

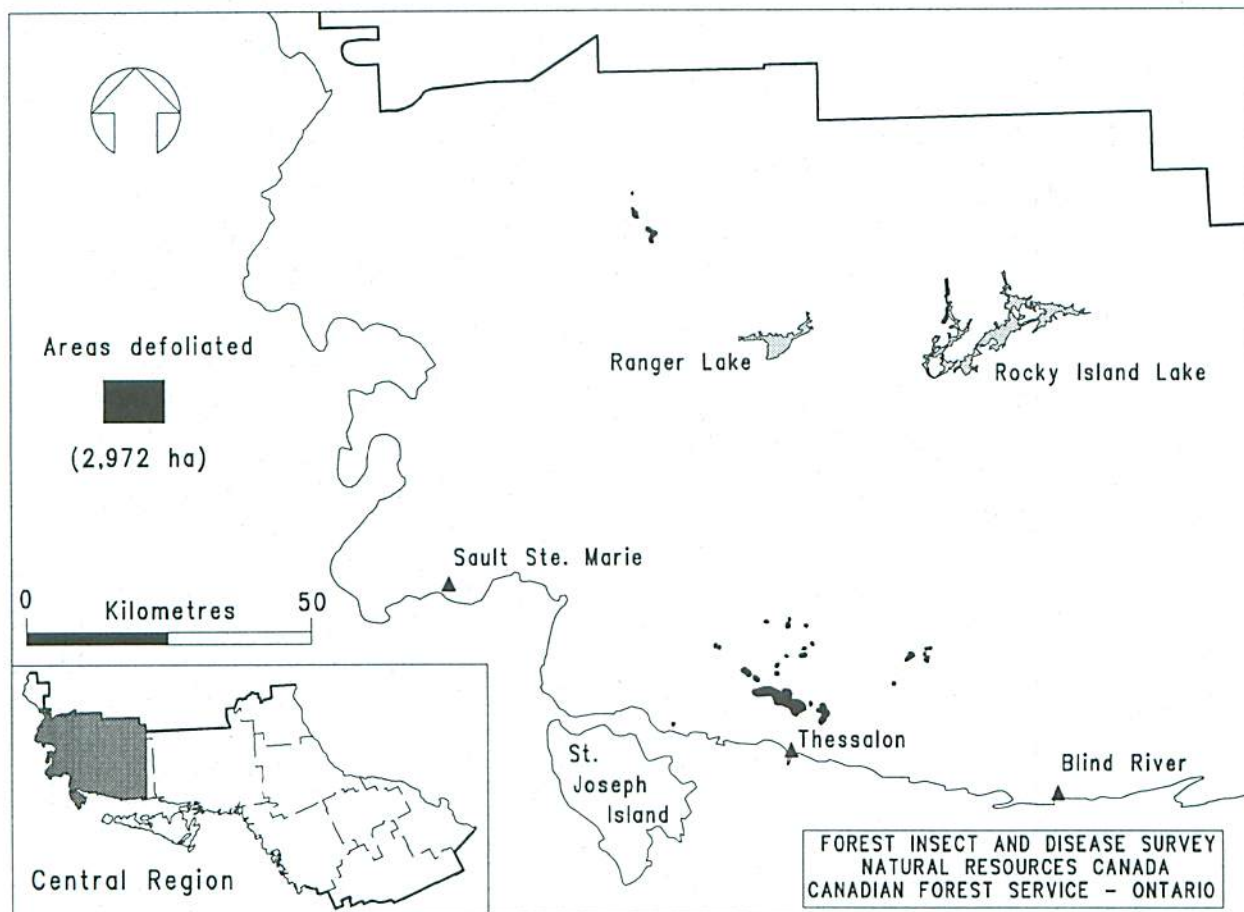


Figure 15. Areas of moderate to severe defoliation caused by the red pine needle midge (*Thecodiplosis piniresinosae* Kerby) in the Sault Ste. Marie District, Central Region, in 1994. Insert shows area within Central Region displayed in the map.

fringe trees are often more heavily affected than trees within a stand. Needle loss in excess of 75% often results in terminal shoot and lateral shoot mortality.¹

Outbreaks of the midge have occurred in North America since 1932 and infestations usually have a duration of 2–4 years. However, the insect has not been recorded as a serious problem in the region since 1976–78. At that time, many of the same areas of the Sault Ste. Marie District were infested as were infected this year.

Minor Insects

Oak Leaf Shredder, *Acleris semipurpurana* (Kft.)

There was a considerable increase in the occurrence of oak leaf shredder in the Sault Ste. Marie District in 1994.

In most areas of red oak in the district there was at least some level of damage due to larval feeding. The heaviest damage occurred in the Hiawatha Park area at the north end of the city of Sault Ste. Marie. Here, defoliation on fringe trees ranged from 20–80%, but averaged 30%. Damage averaged 15% in an area of mature red oak in Wells Township, but some individual trees were more heavily defoliated. Other areas, where defoliation ranged as high as 10%, occurred in Fisher, Gladstone, Patton, and Thessalon townships and at other locations in the city of Sault Ste. Marie. A number of other insects sometimes fed in conjunction with the oak leaf shredder. The most notable were the hickory leafroller, *Pseudexentera cressoniana* (Clem.); the obliquebanded leafroller, *Choristoneura rosaceana* (Harr.); and the linden looper, *Erannis tiliaria* (Harr.).

¹ Kearby W.H.; Benjamin, D.M. 1964. The biology and ecology of the red-pine needle midge and its role in fall browning of red pine foliage. *Can. Ent.* 96:1313–1322.

Poplar Flea Beetle, *Altica populi* Brown

The area of moderate to severe damage reported last year in the southern portion of the Central Region further intensified in 1994. By mid-July, pockets of entire trees appeared orange in color and by early August premature leaf drop occurred throughout the range of balsam poplar (*Populus balsamifera* L.) in much of the Algonquin Park, Bancroft, Pembroke, and Parry Sound districts. Similar damage levels were recorded in the southern portion of the North Bay District, south and east of Lake Nipissing; and at one location in Broder Township, Sudbury District.

In most instances, mature forest stands and young regeneration received damage at the 80–100% level. At one location in Minden Township, Bancroft District, a total of 15 larvae were recorded on a single leaf.

Early Aspen Leafcurler, *Pseudexentera oregonana* (Wlsm.)

Low levels of damage caused by the early aspen leafcurler were commonly observed throughout much of the North Bay District and the eastern portion of the Sudbury District. This pest did, however, cause moderate levels of damage east of Lake Nipissing in Lockhart, Mulock, French, Widdifield, Phelps, Orlig, Mattawan, Ferris, Bonfield, Calvin, Himsworth, Chisholm, and Boulter townships. Another pocket of damage located northwest of Lake Nipissing included Crerar, Hugel, Gibbons, Badgerow, Caldwell, Bastedo, Field, Springer, Fell, and Grant townships, North Bay District and Hagar and Ratter townships, Sudbury District. In most cases

damage was confined to small areas (1 to 20 ha in size) within the delineated townships. Defoliation ranged from 30 to 70%. Although the majority of the damage was caused by the early aspen leafcurler, in most of the infested areas other leafrollers and tiers were present. These included the aspen twoleaf tier, *Enargia decolor* (Wlk.); the darkheaded aspen leafroller, *Anacampsis innocuella* (Zell.); paleheaded aspen leafroller, *Anacampsis niveopulvella* (Cham.); and in the pocket northwest of Lake Nipissing, the large aspen tortrix.

Redhumped Oakworm, *Symmerista canicosta* Franc.

Population levels of the redhumped oakworm increased in selected areas of the region in 1994. In the Bancroft District, a 25-ha area of moderate (20 to 80%) defoliation was recorded on open-grown white oak (*Quercus alba* L.) and red oak up to 10 m in height in the area of the Gold and Mississauga lakes in Cavendish Township.

More moderate defoliation (20 to 40%) was common over areas up to 5 ha in size in Burleigh, Harvey, Anglesea, and Anstruther townships, Bancroft District. Low oakworm populations were also recorded in the Dillon area of Carling Township, Parry Sound District and in Esten and Lewis townships, Sault Ste. Marie District.

Other Forest Insects

A number of other pests were encountered during the course of regular surveys. Information on these pests is provided in Table 14.

Table 14. Other forest insects.

Insect	Host(s) ^a	Remarks
<i>Acleris variana</i> (Fern.) Eastern blackheaded budworm	He	Defoliation of 40% was recorded on 80% of the 20-m trees over a 0.5-ha area in the Restoule Provincial Park, North Bay District.
<i>Agrilus anxius</i> Gory Bronze birch borer	wB	In Mowat Township, Parry Sound District, 64% of the recently dead trees had evidence of attack by this borer.
<i>Altica ambiens</i> Alder flea beetle	Al	Lakeside shrubs in the Cache Lake area in Canisbay Township, Algonquin Park District, averaged 75% defoliation.
<i>Ancylis fuscociliana</i> (Clem.) Elm leaffolder	rO	Light, 10–20% defoliation levels were recorded on individual trees in Prince and Hilton townships, Sault Ste. Marie District; in Carling Township, Parry Sound District; and in Hindon Township, Bancroft District.
<i>Anisota virginiana</i> (Drury) Pinstriped oakworm	wB	Low oakworm numbers were common on shoreline trees along Lake Temagami in Strathcona Township, Temagami District.

(cont'd)

Table 14. Other forest insects. (cont'd)

Insect	Host(s) ^a	Remarks
<i>Aphrophora cribrata</i> (Wlk.) Pine spittlebug	pine	Low spittlebug population levels were commonly recorded across the Sudbury District. In Gordon Township on Manitoulin Island, 90% of the 2.5-m Scots pine trees averaged five insects per tree over a 0.5-ha area.
<i>Archips cerasivorana</i> (Fitch) Uglynest caterpillar	cherry	Heaviest damage was recorded on Manitoulin Island and along the north shore of Lake Huron, both in the Sudbury District, and on St. Joseph's Island in the Sault Ste. Marie District. At these locations defoliation averaged 50% over large areas while the remainder of the region received sporadic, localized, heavy, single-tree damage.
<i>Archips fervidana</i> (Clem.) Oak webworm	rO	Foliar damage of up to 10% was recorded on individual trees in Maria Township, Pembroke District and Carling Township, Parry Sound District.
<i>Arge pectoralis</i> (Leach) Birch sawfly	wB	Heavy individual tree defoliation was recorded on 2- to 3-m regeneration in Monmouth and Methuen townships, Bancroft District and in Carling Township, Parry Sound District.
<i>Cameraria aceriella</i> (Clem.) Maple leafblotch miner	rM	Light defoliation was recorded on 3- to 6-m trees in Carling and Mowat townships, Parry Sound District and in Hindon and Cardiff townships, Bancroft District.
<i>Caulocampus acericaulis</i> (MacG.) Maple petiole borer	sM	Foliar damage of 10% was common on understory trees in Victoria and Allan townships, Sudbury District and occasionally in the city of Sault Ste. Marie, Sault Ste. Marie District.
<i>Cinara strobi</i> (Fitch) White pine aphid	ewP	High aphid populations were recorded on 5% of the 0.9-m trees over a 5-ha seed orchard in Mattawan Township, North Bay District.
<i>Coleophora laricella</i> (Hbn.) Larch casebearer	tL	Defoliation of 30% was recorded on all available 12-m host trees over a 3-ha area of larch-cedar in McNab Township, Pembroke District.
<i>Conophthorus resinosae</i> Hopk. Red pine cone beetle	jP	Leader damage of 2% was recorded on 3.5-m trees in the Lane Township test area, Sault Ste. Marie District.
<i>Contarinia baeri</i> (Prell) European pine needle midge	rP	Low levels of damage were recorded in a 25-ha plantation of 2-m trees in Nightingale Township, Algonquin Park District and over a 1-ha plantation of 1.4-m trees in Campbell Township, Sudbury District.
<i>Hylobius warreni</i> Wood Warren's root collar weevil	rP	Mortality of 2% was recorded over a 0.5-ha area of 2.1-m trees in Sisk Township, North Bay District.
<i>Isochnus</i> (= <i>Rhynchaenus</i>) <i>rufipes</i> (LeC.) Willow flea weevil	W	Foliar damage of 70–100% was recorded on ornamental shrubs in the city of Sudbury, Sudbury District. Sporadic, heavy damage was recorded in small pockets throughout much of the Sudbury and North Bay districts.
<i>Malacosoma americanum</i> (F.) Eastern tent caterpillar	cherry	Moderate populations of this pest were recorded on roadside cherry trees in Machar and Strong townships, Parry Sound District.

(cont'd)

Table 14. Other forest insects. (cont'd)

Insect	Host(s) ^a	Remarks
<i>Malacosoma californicum pluviale</i> (Dyar) Northern tent caterpillar	wB	Defoliation, averaging 20%, was recorded on several 2.5-m trees in MacLennan Township, Sudbury District.
<i>Malacosoma disstria</i> Hbn. Forest tent caterpillar	deciduous	A complete collapse of forest tent caterpillar populations was recorded across the region in 1994. Individual larvae were recorded in many of the areas that had previous heavy defoliation.
<i>Messa Nana</i> (Klug) Early birch leaf edgeminer	wB	Light defoliation was recorded in the Pembroke, Bancroft, and Parry Sound districts and approximately 10% of the trees around Ramsey Lake in the town of Sudbury, Sudbury District, were damaged.
<i>Neodiprion nanulus nanulus</i> Schedl Red pine sawfly	jP	Low sawfly population levels persisted on 2- to 6-m trees in McKim Township, Sudbury District.
<i>Neodiprion pratti banksianae</i> Roh. Jack pine sawfly	jP	Defoliation of 60% was recorded on 4-m fringe trees in Merritt Township, Sudbury District.
<i>Neodiprion pratti paradoxicus</i> Ross Jack pine sawfly	jP	Moderate defoliation was recorded over a 20-ha area of naturally grown 7-m trees in Hagarty Township, and a 2-ha plantation of 8-m trees in Horton Township, both in the Pembroke District. Similar defoliation occurred over a 25-ha area of open-grown 5- to 6-m trees in the Kasshabog Lake area in Methuen Township, Bancroft District.
<i>Neodiprion sertifer</i> (Geoff.) European pine sawfly	scP, muP	Low sawfly population levels were recorded on Scots pine on Manitoulin Island, Sudbury District and on ornamental mugho pine in the city of Sault Ste. Marie, Sault Ste. Marie District. The heaviest damage recorded (20%) was on 2-m Scots pine over a 0.5-ha area in Gordon Township on Manitoulin Island, Sudbury District.
<i>Neodiprion swainei</i> Midd. Swaine jack pine sawfly	jP	Defoliation up to 60% was recorded on 5- to 10-m trees on Island 127 in Lake Temagami, Temagami District. Light defoliation was also recorded on open-grown 3-m trees in Carling Township, Parry Sound District.
<i>Neodiprion virginiana</i> complex Redheaded jack pine sawfly	jP	Light defoliation was recorded on open-grown 3- to 7-m trees in Carling Township, Parry Sound District.
<i>Nymphalis antiopa</i> (L.) Spiny elm caterpillar	tA, W	Moderate defoliation was recorded on 4-m open-grown trees in Galway, Chandos, and Methuen townships, Bancroft District and on 7-m ornamentals within the city of North Bay, North Bay District.
<i>Orthotomicus caelatus</i> (Eich.) Bark beetle	ewP	Mortality levels of 3% were recorded on 0.9-m trees over a 5-ha seed orchard in Mattawan Township, North Bay District.
<i>Petrova albicapitana</i> (Bsk.) Northern pitch twig moth	jP	In the family test site in Munster Township, Sudbury District, 2% of the 1-m trees were affected over a 3-ha area.

(cont'd)

Table 14. Other forest insects. (concl.)

Insect	Host(s) ^a	Remarks
<i>Phyllobius oblongus</i> (L.) European snout beetle	sM	Regeneration was defoliated up to 25% in stands in Dennis, Jocelyn, and Gladstone townships, Sault Ste. Marie District.
<i>Pineus pinifoliae</i> (Fitch) Pine leaf adelgid	ewP, bS	Varying degrees of damage were recorded on 25% of the seedlings examined in Hynes Township, Sault Ste. Marie District. High populations were recorded on 60% of the 11-m trees over a 1-ha area in Drury Township, Sudbury District.
<i>Pissodes nemorensis</i> Germ. Northern pine weevil	ewP, rP	Mortality was recorded on 4% of the 0.9-m trees over a 5-ha white pine seed orchard in Mattawan Township and on 2% of the 0.5-m red pine trees over a 0.5-ha area in Wilson Township in the North Bay District.
<i>Resseliella pinifoliae</i> (Felt) White pine needle midge	ewP	Foliar damage of 40% was observed over a 0.5-ha area of 2.5-m trees in the Halfway Provincial Park, Sudbury District. Trace levels of damage were recorded on 5.5-m trees in the seed orchard in Gurd Township, North Bay District and in the breeding orchard at the Kirkwood Nursery, Sault Ste. Marie District.
<i>Sparganothis acerivorana</i> Mack. Maple leafroller	sM	Moderate defoliation of 20 to 30% was recorded over a 0.5-ha mature maple stand in Dysart Township and in the maple health plot located in Minden Township. Both areas are in the Bancroft District.
<i>Tetralopha applastella</i> (Hlst.) Aspen webworm	tA	Defoliation of 20 to 30% was recorded in the general area of the acid rain plot in Mowat Township, Parry Sound District.
<i>Toumeyella parvicornis</i> (Ckll.) Pine tortoise scale		High population levels of this pest were observed on 4% of the 1.5-m trees over a 1-ha area in Burpee Township, Sudbury District.
<i>Zeiraphera canadensis</i> Mut. & Free. Spruce bud moth	wS	This insect occurred at reduced levels across the southern portion of the Sudbury and North Bay districts. In Gordon Township, Sudbury District, the heaviest damage was to 20% of the current shoots on 60% of the trees.

^a Al = alder, bS = black spruce, ewP = eastern white pine, He = eastern hemlock, jP = jack pine, muP = mugho pine, rO = red oak, rM = red maple, rP = red pine, scP = Scots pine, sM = sugar maple, tA = trembling aspen, tL = tamarack, W = willow, wB = white birch, wE = white elm.

TREE DISEASES

Major Diseases

Armillaria Root Rot, *Armillaria ostoyae* (Romagn.) Herink

Evaluations conducted across the region revealed that 16% of spruce and pine plantations were affected by *Armillaria* root rot. In 22 affected plantations, host trees averaged 1.6 m in height; the average infection level was

2.2% (Table 15). The heaviest mortality (4%) caused by this organism was in a 4-ha plantation of 1.2-m black spruce trees in the Cuthbertson Township family test, Sault Ste. Marie District.

In Monmouth Township, Bancroft District, a pocket of 20 red pine trees, averaging 10 m in height, was killed by this organism. The area affected was 0.5 ha of a larger, 10-ha plantation and trees died over at least a 3-year period. Adjacent trees exhibited symptoms of root rot but are still alive.

Table 15. Damage caused by *Armillaria* root rot at 22 locations in the Central Region of Ontario in 1994. (Counts are based on an examination of 150 randomly selected trees at each location.)

Location (Township)	Tree species ^a	Average height of trees (m)	Estimated trees per ha	Estimated area affected (ha)	Current mortality (%)
<i>Bancroft District</i>					
Harburn	rP	2.1	1,750	4.0	0.7
Wicklow	rP	1.8	2,200	10.0	2.7
<i>North Bay District</i>					
Cameron	rP	1.5	1,200	8.0	2.0
<i>Parry Sound District</i>					
Ballantyne	rP	2.7	1,250	4.0	0.3
McMurrich	rP	1.8	1,250	3.6	1.4
<i>Pembroke District</i>					
Clara	ewP	1.4	2,250	50.0	1.3
Clara	jP	1.5	2,500	10.0	1.3
Clara	rP	1.9	2,500	10.0	2.7
<i>Sault Ste. Marie District</i>					
Bridgeland	rP	0.9	3,200	8.0	2.7
Curtis	bs	1.0	2,500	10.0	1.3
Cuthbertson	bs	1.2	2,500	4.0	4.0
Cuthbertson	jP	2.5	2,500	4.0	2.0
Hynes	rP	1.5	3,100	8.0	1.3
Hynes	jP	2.3	3,300	10.0	0.7
Kirkwood	ewP	1.6	2,000	2.0	2.0
Nicholas	jP	1.2	2,300	7.0	0.7
Parkinson	wS	0.8	800	4.0	1.3
<i>Sudbury District</i>					
Merritt	jP	0.4	2,300	6.0	0.7
<i>Temagami District</i>					
Askin	ewP	0.5	2,170	3.0	0.7
Coleman	jP	3.8	2,500	15.0	1.1
Firstbrook	jP	2.0	3,300	5.0	1.3
Firstbrook	jP	2.1	2,500	14.0	0.1

^a bs = black spruce, ewP = eastern white pine, jP = jack pine, rP = red pine, wS = white spruce.

White Pine Blister Rust, *Cronartium ribicola* J.C. Fisch.

White pine blister rust continues to be a serious problem, primarily in the North Bay, Temagami, and Bancroft districts (Table 16).

Evaluations conducted at 22 plantations across the region revealed that 73% of those examined were infected by this organism. Affected plantations averaged 2.4 m in height and experienced infection levels of 8.2%. However, 80% of the damaged trees showed severe, main-stem infections.

The most severe damage was recorded in a 3-ha plantation of 0.5-m trees in Askin Township, Temagami District. At this site, 30% of the trees have severe, main-stem infections and have experienced heavy rodent feeding. This combination has resulted in 19% tree mortality within the plantation.

Throughout the remainder of the region blister rust, although present, was not detected at serious damage levels in young white pine plantations.

Western Gall Rust, *Endocronartium harknessii* (J.P. Moore) Y. Hirats.

Western gall rust, a pine branch and stem disease, was commonly observed at low incidence levels in the Sault Ste. Marie, Sudbury, North Bay, and Temagami districts (Table 17). The heaviest damage occurred in the Olinyk Township jack pine family test area in the Sudbury District. Here, an incidence level of 19.3% occurred on the 1.3-m trees. In the Bancroft District a single observation of damage was recorded in Somerville Township. At this location 10% of the 4.5-m Scots pine and mugho pine over a 0.5-ha area were affected with stem infections.

Table 16. Damage caused by white pine blister rust in plantations of eastern white pine in the Central Region of Ontario in 1994.

Location (Township)	Average height of trees (m)	Estimated area affected (ha)	Estimated trees per ha	Trees affected (%)	Trees severely affected (%)	Recent mortality (%)
<i>Bancroft District</i>						
Mayo	1.8	5.0	1,250	11.6	7.6	0
Mayo	2.0	5.0	1,500	10.7	10.7	1.3
Monteagle	2.1	8.0	750	12.0	12.0	2
Snowdon	3.0	10.0	600	1.3	0	0
<i>North Bay District</i>						
Cameron	1.2	4.0	1,200	2.0	1.0	0
Gurd (seed orchard)	5.5	2.5	1,000	5.3	2.7	0
Mattawan	2.0	1.0	1,400	6.0	4.0	0
Mattawan (seed orchard)	0.9	5.0	800	0.7	0.7	0
Olrig	2.1	1.5	1,200	29.3	24.0	0
Pardo	2.5	10.0	1,200	5.0	3.0	0
<i>Parry Sound District</i>						
Monk	2.1	1.0	2,500	2.0	0.7	0
<i>Pembroke District</i>						
Lyndoch	1.6	6.0	2,200	4.7	4.7	0
<i>Sudbury District</i>						
Burpee	4.0	3.0	1,600	1.0	1.0	0
Gordon	3.3	3.0	1,800	5.3	2.7	0
Hallam	4.5	1.0	1,400	5.0	1.0	0
<i>Temagami District</i>						
Askin	0.5	3.0	2,170	30.0	30.0	19.3

Table 17. Damage caused by western gall rust in plantations of jack pine in the Central Region of Ontario in 1993.

Location (Township)	Species ^a	Average height of trees (m)	Estimated stand area (ha)	Trees affected (%)	Stem infections (%)
<i>Bancroft</i>					
Somerville	scP,mP	4.5	0.5	10	10
<i>North Bay</i>					
Merrick – family test	jP	5.0	5	2	0
<i>Sault Ste. Marie</i>					
Hynes	jP	1.9	12	2	0
Landriault	jP	2.0	10	7.3	1.3
<i>Sudbury</i>					
Durban – seed orchard	jP	3.3	6	10	2
Hallam - seed orchard	jP	4.0	4	0	0
Lumsden – seed orchard	jP	3.5	5	0.7	0
Mandamin – family test	jP	2.0	4	10	2
Munster – family test	jP	1.0	3	5	2
Olinyk – family test	jP	1.3	4	19.3	4
Street – family test	jP	3.5	4	0	0
<i>Temagami</i>					
Coleman – seed orchard	jP	3.6	15	2.7	0
Coleman – family test	jP	3.8	5	2.7	1.3
Firstbrook – family test	jP	2.0	5	2.0	0
Firstbrook – seed orchard	jP	2.1	14	0.7	0

^a jP = jack pine, mP = mugo pine, scP = Scots pine.

Scleroderris Canker, *Gremmeniella abietina* (Lagerb.) M. Morelet

A total of 115 red pine and two jack pine plantations were evaluated across the region in 1994 in an effort to establish the distribution and impact of the European race, and the less virulent North American race, of the Scleroderris canker fungus (Fig. 16). Plantations examined ranged from 0.6 to 5 m in height and up to 30 ha in size. Overall, 48% of the plantations exhibited damage due to this fungus (Table 18).

European Race

The European race of the Scleroderris canker was again confined to the Parry Sound and Bancroft districts. Throughout the areas of damage, infection levels remained much the same as in 1993 except in McMurrich Township, Parry Sound District. Infection levels here, in many instances, doubled from the previous year (Table 19).

A total of 39 collections of this race of Scleroderris canker was identified from pine plantations in 1994. As in 1993, the heaviest damage was recorded in McMurrich Township. Here, 92% of the 2-m trees in a 20-ha plantation were damaged. This resulted in a current mortality

rate of 4%. Also in this township, in the north half of Lot 21, Concession I, large, 10-m red pine and Scots pine were moderately affected. Flagging and whole-branch mortality appeared worse on the red pine host and by fall some trees had lost 50% of their branches.

The only area of new infection in 1994 was in Minden Township, Bancroft District, where 2% of the 1-m trees received light flagging over an area of 3.5-ha.

North American Race

Of the total of 23 plantations that received damage by this race of Scleroderris canker, only three samples were collected outside the area of occurrence of the European race. At these locations, two in the Sault Ste. Marie District and one in the North Bay District, trees averaged 3.3 m in height and showed infection levels of 15%.

Within the Parry Sound District, the North American race occurred 95% of the time within the same stands as the European race. Damage levels caused by either organism are impossible to separate. In the single plantation in McMurrich Township, where only the North American race occurred, 3.6% of the 1.8-m trees were affected over an area of 2.5 ha.

Table 18. Positive results of a special survey for Scleroderris canker in the Central Region of Ontario in 1994. (Counts are based on an examination of 150 randomly selected trees at each location.)

Location (Township)	Tree species ^a	Average height of trees (m)	Estimated trees per hectare	Total area affected (ha)	Trees		Race(s) involved ^b
					Affected (%)	Dead (%)	
<i>Bancroft District</i>							
Mayo	rP	1.9	1,500	5.0	2.7	-	E
Mayo	rP	2.7	1,500	3.0	1.3	-	E
Minden	rP	1.0	2,450	3.5	2.0	-	E
<i>North Bay District</i>							
Olrig	rP	2.5	1,200	10.0	20.0	0	N
<i>Parry Sound District</i>							
Chaffey	rP	4.4	2,500	4.0	0.2	0	E N
Macaulay	rP	4.0	2,800	3.0	2.2	0	E
McMurrich	rP	3.6	2,250	2.0	1.0	0	E N
McMurrich	rP	1.8	1,250	2.5	3.6	0	N
McMurrich	rP	1.0	1,000	3.0	50.0	7.3	E N
McMurrich	rP	4.8	1,200	11.0	1.6	0	E N
McMurrich	rP	1.5	1,250	8.0	3.6	0	E N
McMurrich	rP	1.4	1,500	10.0	0.2	0	E N
McMurrich	rP	1.4	2,375	18.0	0.4	0	E N
McMurrich	rP	2.9	2,800	5.0	42.2	0	E N
McMurrich	rP	3.5	2,250	4.0	18.0	0	E N
McMurrich	rP	2.4	1,800	15.0	24.7	0	E
McMurrich	rP	2.6	1,800	20.0	12.7	0	E N
McMurrich	rP	3.4	2,000	30.0	10.0	0	E
McMurrich	rP	2.0	2,500	14.0	0.2	0	E
McMurrich	rP	5.0	2,500	13.0	0.4	0	E N
McMurrich	rP	3.0	2,000	9.0	36.0	0	E
McMurrich	rP	3.4	2,000	8.0	0.6	0	E N
McMurrich	rP	2.0	2,000	20.0	92.0	4.0	E
Perry	rP	3.2	2,900	10.0	0.2	0	E
Ryde	rP	5.2	2,250	6.0	1.4	0	E
Ryde	rP	2.3	2,500	8.0	0.7	0	E
Ryerson	rP	2.7	2,000	10.0	0.2	0	E
Ryerson	rP	4.2	2,000	4.0	0.4	0	E N
Ryerson	rP	2.8	2,500	5.0	0.4	0	E N
Ryerson	rP	2.7	2,500	8.0	0.2	0	E N
Ryerson	rP	4.5	2,000	12.0	0.2	0	E N
Ryerson	rP	4.0	2,500	15.0	0.6	0	E N
Stisted	rP	1.6	2,350	6.0	3.2	0	E N
Stisted	rP	4.5	2,500	5.0	0.6	0	E
Strong	rP	3.5	2,000	3.0	36.0	0	E N
<i>Sault Ste. Marie District</i>							
Haughton	rP	2.6	800	12.0	20.0	0	N
Kirkwood – (at Nursery)	rP	4.3	1,700	5.0	6.0	0	N

^a rP = red pine.

^b E = European race, N = North American race.

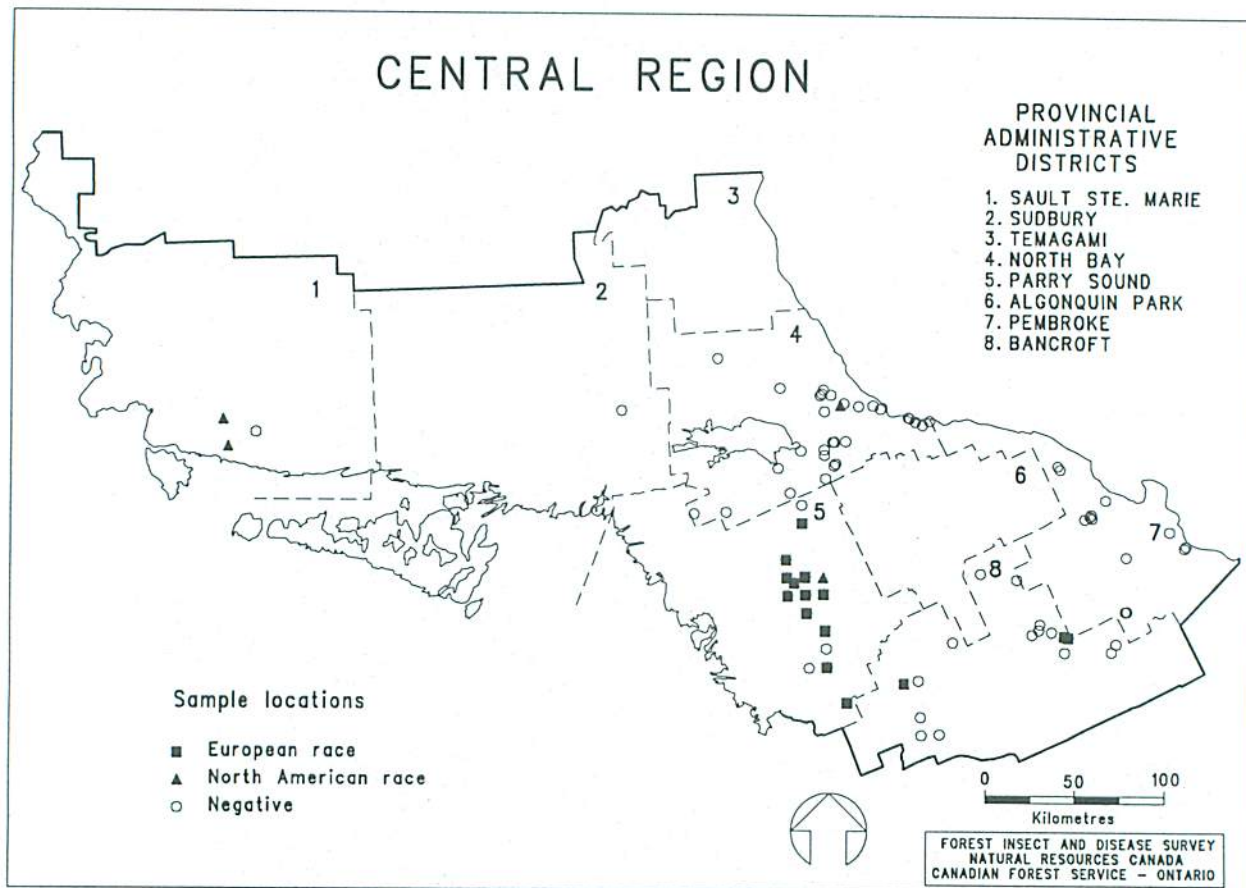


Figure 16. Sample locations for the *Scleroderris canker*, *Gremmeniella abietina* (Lagerb.) M. Morelet, in 1994.

Table 19. A comparison of incidence levels of the European race of *Gremmeniella abietina* in two townships in the Parry Sound District.

Township	Woodland improvement agreement numbers	% Incidence		
		1992	1993	1994
Ryerson	147	1.3	<1.0	0.2
Ryerson	153	2.0	2.0	0.6
Ryerson	93	2.0	1.3	0.4
Ryerson	167	<1.0	<1.0	0.2
Ryerson	174	<1.0	<1.0	0.4
Ryerson	73	<1.0	<1.0	0.2
McMurrich	138	2.7	0.7	0.2
McMurrich	163	1.3	3.3	3.6
McMurrich	92	1.3	9.3	18.0
McMurrich	173	6.7	26.7	50.0
McMurrich	178	3.3	4.7	3.6
McMurrich	70	<1.0	5.3	1.6
McMurrich	139-140	0.7	9.3	12.7
McMurrich	135-137	0.7	9.3	24.7
McMurrich	149	<1.0	1.3	0.2
McMurrich	108	<1.0	8.0	10.0
McMurrich	131	2.7	2.0	36.0
McMurrich	175	8.0	12.7	42.0
McMurrich	158	0.7	4.0	0.2
McMurrich	168	<1.0	2.0	0.4
Average incidence level		(2.02)	(5.80)	(10.26)

Minor Diseases

Tar Spot Needle Cast, *Davisomyces amplus* (Davis) Darker

This needle cast of jack pine is first noticeable in the spring when it infects the foliage of the previous year and causes the needles to discolor, desiccate, and shed prematurely. Once new growth is complete for the year, damage becomes less evident. Younger trees are usually more susceptible to this disease.

Tar spot needle cast was noted at 12 locations in the Central Region in 1994 (Table 20) and damage levels remained similar to those observed in 1993. The highest incidence (60%) occurred in Mandamin Township, Sudbury District. The most severe foliar damage (75%) was found in White Township, Algonquin Park District.

Other Forest Diseases

Various other diseases were encountered during the course of regular surveys. Information on these is provided in Table 21.

ABIOTIC DAMAGE

Browning of Eastern White Pine

An unusual condition was first noted on eastern white pine in early June of 1994 in both the Sault Ste. Marie and Parry Sound districts. Symptoms of this condition included a yellowish-brown coloring of the extreme tips of the current year's foliage followed by a desiccated appearance. Tips died later, but the needle base remained alive and green. The condition appeared physiological, since no primary insect or disease pests were found from any of the samples examined. This condition closely resembles semimature-tissue needle blight but, in some instances, also looks like ozone damage.

In the Sault Ste. Marie District, the condition was observed from the city of Sault Ste. Marie east into the Blind River area. It affected occasional trees or small groups of trees and caused various levels of damage. In the Parry Sound District, discoloration was most evident on open-grown white pine along shorelines in the Parry Sound area and around the Lake of Bays and Muskoka lakes area. In the Parry Sound District, damage was recorded over entire stands of trees or sporadically on individual groups of trees. In some instances, as much as 60% of the current foliage was affected.

Table 20. Damage to jack pine caused by tar spot needle cast in four districts in the Central Region of Ontario in 1994.

Location (Township)	Area affected (ha)	Average tree height (m)	Estimated trees per ha	Trees affected (%)	Foliar damage (%)
<i>Algonquin Park District</i>					
White	10	7.0	1,000	50	75
<i>North Bay District</i>					
Merrick	5	5.0	1,800	20	20
<i>Sault Ste. Marie District</i>					
Landriault	10	2.0	2,500	4	17
Villeneuve	12	4.0	2,400	8	40
<i>Sudbury District</i>					
Hallam	4	4.0	2,400	5	15
Lumsden	5	3.5	2,000	10	10
Mandamin	4	2.0	1,400	60	20
Munster	3	1.0	1,600	10	10
Olinyk	4	1.3	2,000	20	15
Street	4	3.5	1,800	5	5
<i>Temagami District</i>					
Coleman	15	3.6	4,100	37	20
Coleman	5	3.8	3,100	14	20
Firstbrook	12	2.0	2,500	31	10
Firstbrook	5	2.1	2,500	14	15

Table 21. Other forest diseases.

Disease	Host(s) ^a	Remarks
<i>Chrysomyxa ledi</i> (Alb. & Schwein.) de Barry var. <i>ledi</i> Spruce needle rust	bS	Incidence levels of 20%, with 5 to 25% foliar damage, were recorded in a 2-ha stand of 7-m trees in Antrim Township, Sudbury District.
<i>Chrysomyxa pirolata</i> G. Winter Spruce cone rust	bS	Damage levels of 2% were recorded on 10-m trees in Curtis Township, Sault Ste. Marie District.
<i>Coleosporium asterum</i> (Dietel) Syd. & P. Syd. Pine needle rust	jP	Foliar damage of 20% occurred on 4% of the 1.9-m trees in Hynes Township, Sault Ste. Marie District.
<i>Cronartium comptoniae</i> Arthur Sweetfern blister rust	jP	Damage in a 4-ha area in Moncrieff Township, Sudbury District, showed 5% active fruiting on 8-m trees.
<i>Lirula nervata</i> (Darker) Darker Needle cast	bF	Incidence levels of 100% were observed on regeneration in Maria Township, Pembroke District. Foliar damage averaged 20%. In Finlayson Township, Algonquin Park District, 75% of the regeneration had 35% foliar damage.
Flood damage	various	High water levels caused flood damage to trees growing along streams. Damage was particularly noticeable in the Haliburton Highlands area of the Bancroft District and in adjacent areas of the Parry Sound District.
Mouse damage	ewP	Severe stem damage was observed on 21% of the 0.8-m white pine in Curtis Township, Sault Ste. Marie District.
<i>Mycosphaerella populicola</i> G.E. Thomps. Septoria leaf spot	bPo	Moderate levels of damage were commonly observed across the Sudbury and North Bay districts. The heaviest damage occurred in Drury Township, Sudbury District, where a 1-ha stand of 10-m trees sustained an average of 80% foliar damage to 95% of the trees.
<i>Ophiostomi ulmi</i> (Buisman) Nannf. Dutch elm disease	wE	Damage in Neelon and Hanmer townships, on Wikemikon First Nations land, and in East Mills Township was limited to 20 to 40% dieback. No new mortality was observed.
<i>Septoria betulae</i> Pass. Leaf spot	wB	Leaf spot was observed sporadically throughout the Algonquin Park and Pembroke districts. In Stratton Township, Algonquin Park District, 100% of the 7-m trees averaged 20% foliar damage.
<i>Venturia macularis</i> (Fr.:Fr.) E. Mull. & Arx Shoot blight of aspen	tA	Variable damage levels were observed on young trees across the entire Central Region. The heaviest damage was assessed in Methuen Township, Bancroft District, where approximately 40% of the 2.5-m trees had 20% of the shoots affected.

^a bF = balsam fir, bPo = balsam poplar, bS = black spruce, ewP = eastern white pine, jP = jack pine, tA = trembling aspen, wB = white birch, wE = white elm.

Dieback

To some degree all hardwood stands across the region exhibit damage in the form of whole-tree or top mortality. Damage in 1994, totaling 8,389 ha, was recorded only in the Parry Sound and Bancroft districts. In the Parry Sound District, the areas of damage coalesced along the shore of Georgian Bay and adjacent to large bodies of water in Gibson, Carling, Christie, Foley, Conger, Freeman, Baxter, Wood, Morrison, Muskoka, Stephenson, Watt, and Cardwell townships. Similarly, in the Bancroft District, damaged areas coalesced throughout Anstruther, Cavendish, Somerville, Lutterworth, Digby, Dalton, and Langford townships.

This condition has been ongoing since 1990 when below-normal precipitation over the 3 years previous combined with heavy forest tent caterpillar infestations and resulted in 16,000 ha of hardwood dieback. Further damage was placed on the stressed trees when heavy populations of gypsy moth moved into the southern portion of the region in 1991.

Damage over the past 4 years has been recorded primarily on trembling aspen, large-tooth aspen (*Populus grandidentata* Michx.), white birch, and oak growing in

more exposed, shallow soil, ridge tops, and shorelines throughout much of the Bancroft, Pembroke, Algonquin Park, Parry Sound, North Bay, and Sudbury districts (Fig. 17).

Ground checks conducted in the area of this year's damage, and the general health of the forest (*see* the Maple Health and Oak Health sections), would lead one to believe that the current forest dieback situation has indeed stabilized.

Frost Damage

Late spring frosts were responsible for foliar damage in several areas of the region in 1994. Low levels of damage were reported on balsam fir growing in frost pockets and in low-lying areas across the North Bay District and in the northern portion of the Sudbury District. The heaviest damage observed was in Chisholm Township, North Bay District, where 20% of the 5-m trees averaged 10% shoot kill. In the Sault Ste. Marie District, 100% of the 2-m white spruce was 30% defoliated in Curtis Township and 50% of the 2-m breeding orchard trees had 20% shoot damage.

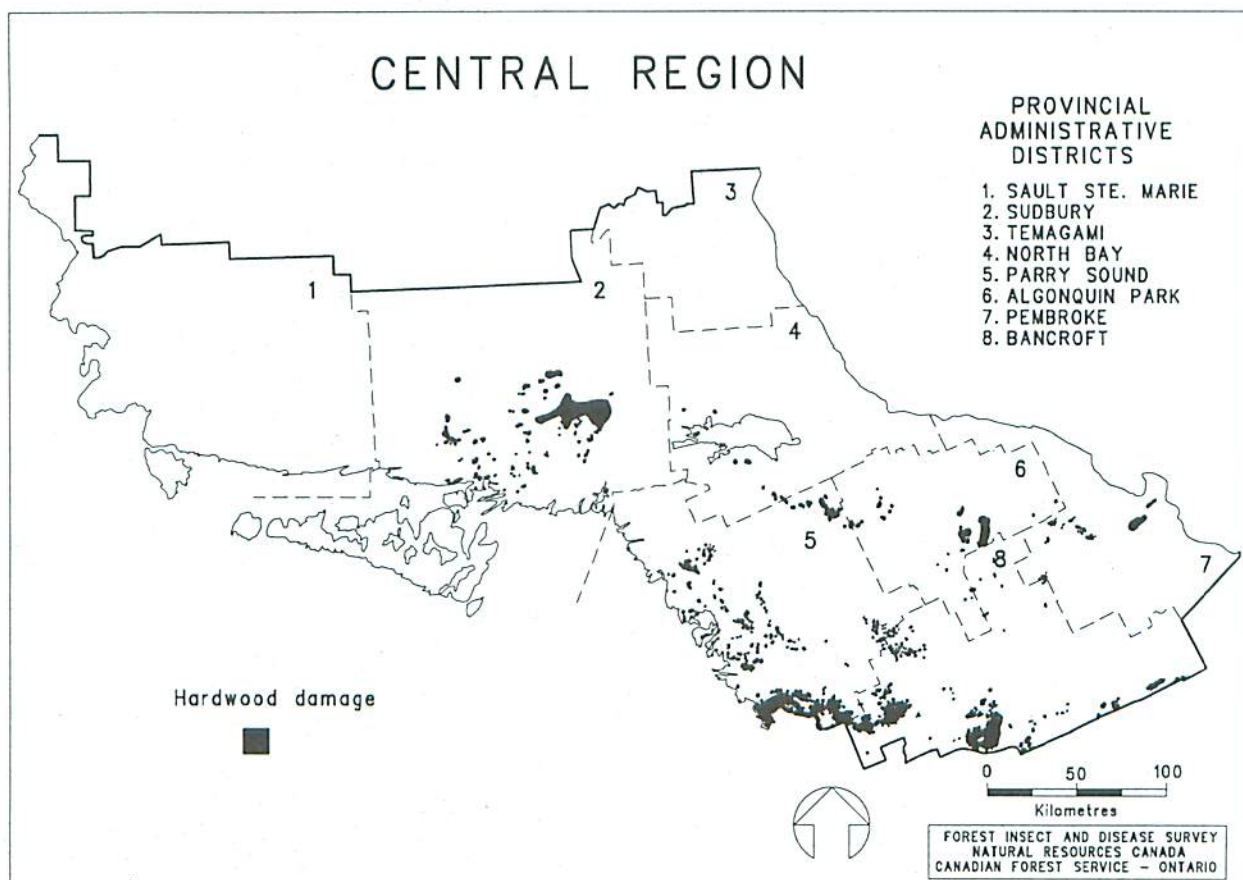


Figure 17. Areas within which moderate to severe dieback and tree mortality occurred from 1990 to 1994.

Heavier damage was reported on balsam fir in the Parry Sound District and in the western half of the Bancroft District. Here, damage levels of 90–100% occurred on the 1- to 4-m trees in low-lying areas. Also in the Bancroft District, light foliar damage (up to 5%) occurred to black ash and walnut trees in the town of Minden, and 5% of the tamarack (*Larix laricina* [DuRoi] K. Koch) and white pine averaged 35% foliar damage in a stand in Snowdon Township.

Winter Drying

Winter drying is caused by unusually warm weather in late winter and early spring. Moisture that is lost from needle tissue cannot be replaced from the frozen soil by the root systems. This results in needle browning and possible needle mortality. Trees in exposed areas usually suffer more because wind can accentuate the problem.

In 1994, winter drying was more widespread and evident than in the past. Light to moderate damage was found throughout much of the region (Table 22). The most severe damage in 1994 was recorded in Wicklow Township, Bancroft District, where 100% of the 1.3-m red pine were affected. Foliar damage averaged 38%.

Winterkill

The unusually prolonged cold weather during January and February of 1994 damaged many hardwood trees in the Sault Ste. Marie, Sudbury, and North Bay districts. This became apparent in the spring when trees did not flush or only partially leafed out. In most situations the younger, more succulent growth of 1993 was killed. This resulted in stunted branches and adventitious growth. Damage was most severe at the outer extremities of the plant and decreased toward the main stem. In other cases, tufts of foliage survived in the tree crowns or trees had enough energy to accomplish bud flush, but soon after the foliage drooped and dieback occurred. In extreme situations, trees were killed.

Ornamentals, many of them far north of their natural range, in both urban or rural areas were the most seriously damaged. Affected trees included Lombardy poplar (*Populus nigra* var. *italica* Muenchh.), honey locust (*Gleditsia triacanthos* L.), English walnut (*Juglans regia* L.), and various species of apples (*Malus* spp.), cherries, willows, and mulberries (*Morus* spp.). Lesser damage occurred on ashes and butternut (*Juglans cinerea* L.). Exposed red oak growing on rocky sites in the Sudbury area sustained dieback in the 10 to 20% range. Many varieties of shrubs and hedges also suffered heavy damage. Some of these were killed to the ground, but later sprouting indicated that the roots had been protected by snow cover.

FOREST HEALTH

Acid Rain National Early Warning System (ARNEWS)

ARNEWS plots in the Central Region are part of a national network that has been established across Canada. The plots are monitored annually for symptoms of acid rain damage as well as for the presence of other damaging agents, such as insects and disease. Information is also collected on branch and crown condition. There are a total of 11 plots in the region; two plots in each of the Sault Ste. Marie, Sudbury, Parry Sound, and Pembroke districts and single plots in the Bancroft, Algonquin Park, and North Bay districts. The plots cover a range of different stand types and acid deposition zones (Table 23 and Fig. 18).

Few insects or diseases were reported from the plots in 1994. Current defoliation, caused mostly by oak leaf shredder, ranged from 6–15% at the plot in Gould Township, Sault Ste. Marie District. Five recently dead red oak were also recorded in this plot. All appeared to be infected with Armillaria root rot. At the plot in Sproule Township, Algonquin Park District, low levels of oak webworm were responsible for 5–10% defoliation to red oak. Moderate defoliation (20–30%) by the aspen webworm was recorded in the general area of the plot in Mowat Township, Parry Sound District.

Because most of the plots are located in hardwood stands, an assessment was made of the collective crown conditions of all deciduous trees on all of the plots in the region. Figure 19 shows that for the most part crown dieback was less than 25%.

Maple Health

Since 1987, 56 sugar maple plots have been established in woodlot stands within the Central Region to study the condition of sugar maple (Fig. 20). In 1989, the project was expanded to include two other growing conditions within which maple trees are commonly found in southern Ontario; trees growing adjacent to rural roadways and trees planted as ornamentals in urban centres. Often, the latter occur as boulevard or park trees. Five roadside plots and three urban plots have now been established. All of these include 25 semimature or mature maple trees. The current crown condition of each tree was rated using a classification system that evaluated total dieback in five categories: 0 = 0–5%, 1 = 6–20%, 2 = 21–40%, 3 = 41–60%, 4 = >60%, and 5 = dead tree.

In 1994, 9.3% of the woodlot trees improved (moved into a lower dieback class), 8.4% declined, 2.3% died or were cut, and 80.0% remained in the same dieback class as in 1993 (Table 24). Figure 21 shows that between 1991 and 1994 the majority of the trees remained static, and that

Table 22. Results of surveys for winter drying in the Central Region in 1994.

Location (Township)	Tree species ^a	Estimated stand area (ha)	Average height (m)	Number of trees per ha	Trees affected (%)	Foliage affected (%)
<i>Bancroft District</i>						
Galway	rP	4	2.0	1,700	7.3	5.5
McMurrich	rP	1	1.5	1,500	20.7	6.5
Minden	rP	4	1.0	2,450	17.3	2.9
Monteagle	rP	10	1.7	2,200	90.0	32.0
Ryde	rP	8	2.3	2,500	26.0	18.8
Ryde	rP	6	5.2	2,250	30.7	13.3
Snowdon	ewP	10	3.0	600	28.0	0.7
Snowdon	rP	5	2.0	2,400	44.7	17.2
Sommerville	rP	30	4.5	2,500	100.0	30.0
Sommerville	rP	3	1.1	2,450	45.0	10.0
Wicklow	rP	6	1.3	2,000	100.0	38.0
<i>North Bay District</i>						
Afton	ewP	2	1.2	1,800	90.0	30.0
Bonfield	rP	2	2.5	1,500	60.0	15.0
Chisholm	rP	3	1.5	1,700	20.0	10.0
East Mills	sP	2	1.7	1,000	10.0	15.0
Gurd	rS	2	3.5	1,600	64.0	15.0
Gurd	scP	2	5.0	1,800	70.0	20.0
Gurd	piP	2	3.0	2,100	50.0	30.0
Mattawan	ewP	5	0.9	800	65.0	30.0
Olrig	rP	5	2.5	2,000	85.0	15.0
<i>Parry Sound District</i>						
Laurier	rP	4	2.2	2,000	14.0	12.5
Monck	ewP	1	2.1	2,500	42.0	31.4
Monck	rP	3	3.3	2,000	61.3	18.5
Monck	rP	2	3.3	2,000	15.3	20.0
Strong	rP	3	3.5	2,000	85.3	26.5
<i>Sault Ste. Marie District</i>						
Curtis	ewP	5	0.8	2,700	25.0	23.0
Hynes	rP	8	0.9	3,100	10.0	15.0
Kirkwood	ewP	1	1.5	2,500	50.0	20.0
Lewis	rP	5	2.2	3,300	13.0	20.0
Parkinson	rP	2	0.6	2,000	7.0	16.0
Parkinson	rP	8	1.5	3,500	45.0	26.0
Thessalon	wS	4	1.3	3,000	66.0	40.0
Viel	rP	14	2.3	3,000	4.0	30.0
Wells	rp	16	0.6	2,600	23.0	15.0
<i>Sudbury District</i>						
Hallam	ewP	2	0.9	800	64.0	30.0
Olinyk	jP	4	1.3	2,000	10.0	15.0

^a ewP = eastern white pine, jP = jack pine, piP = pitch pine, rP = red pine, rS = red spruce, scP = Scots pine, wS = white spruce.

Table 23. Listing of ARNEWS plots, their stand type, and maturity in the Central Region.

Location (Township)	Stand type	Maturity
<i>Algonquin Park District</i>		
Sproule	red oak	semimature
<i>Bancroft District</i>		
Sherbourne	white pine, sugar maple	mature
<i>North Bay District</i>		
Calvin	white birch, large-tooth aspen	overmature
<i>Parry Sound District</i>		
Mowat	trembling aspen, red maple, white birch	mature, two-aged
Ridout	sugar maple	mature
<i>Pembroke District</i>		
Wylie	Norway spruce	semimature
Wylie	white spruce	semimature
<i>Sault Ste. Marie District</i>		
Gould	red oak	semimature
Wishart	sugar maple	mature
<i>Sudbury District</i>		
Aylmer	white birch	mature
Hyman	mixed hardwood	semimature

roughly the same percentage improved as declined. However, between 1990 and 1991, the percentage of improved trees was much greater as compared to declined trees. Figure 22 and the table in Appendix 1 indicate that in the last several years the majority of trees surveyed had less than 20% cumulative dieback. In 1994, this trend continued; 92.2% had up to 20% dieback.

Some of the other variables recorded at the 56 plots in the woodlot stands are shown in Figure 23. No insect, disease, or abiotic pests/problems were observed on 46.2% of the trees surveyed. Injuries to the main stem, including open or closed wounds, seams, and frost cracks, were found on 64.1% of the trees. Stem decay, including the presence of fungal fruiting bodies, occurred on 8.3% of the trees. Damage characteristic of the sugar maple borer (*Glycobius speciosus* [Say]) was noted on 9.3% of the trees. Current or old tapping wounds were observed on 3.7% of the trees and 1.7% displayed eutypella cankers. Damage by the forest tent caterpillar occurred on 0.1% of the trees, but the gypsy moth was not recorded on any of the plots. Defoliation in all cases was at trace levels.

In the three urban plots, 71.7% of the trees had 20% or less total dieback. Some 81.9% of the roadside trees showed this same level of damage (Appendix 2). Other problems were recorded in all eight plots. Stem damage in the form of seams, frost cracks, etc. was found on the majority of the trees. Thirteen trees were damaged by the sugar maple borer and 8.7% were infested with carpenter ants (*Camponotus* sp.).

North American Maple Project (NAMP)

This cooperative project, initiated by the United States Forest Service and the Canadian Forest Service to study the health of sugar maple, has the following objectives:

1. to determine the rate of change in sugar maple tree condition ratings from 1988 to the present;
2. to determine if the rate of change in sugar maple tree condition ratings differed between: (a) various levels of pollution, measured as wet deposition, (b) sugar bush and undisturbed forest, and (c) various levels of initial stand conditions; and

3. to determine the possible causes

of sugar maple decline and the geographical relationship between the causes and extent of decline.

In all, 106 NAMP plots were established in the northeastern United States. There are another 84 plots in Canada. The 24 plots in Ontario were paired in each deposition zone; one was positioned in an undisturbed site and one in an active sugar maple bush. There are eight plots in the Central Region, two in each of the Bancroft, North Bay, Parry Sound, and Sault Ste. Marie districts (Fig. 18).

Although sugar maple is the primary species of interest, all trees in each plot were examined and the following quantitative and qualitative data were recorded: diameter at breast height (DBH), vigor, crown condition, tapping status of sugar maple, bole quality, location of bole defects, type of bole defects, percentage of crown dieback, foliar transparency, and defoliation. This information was obtained by a minimum of two trained observers.

Table 25 compares the results of assessments from 1991 to 1994. In most cases it appears that the health of examined trees has remained constant. Generally, the health of these trees is good and 89% have less than 15%

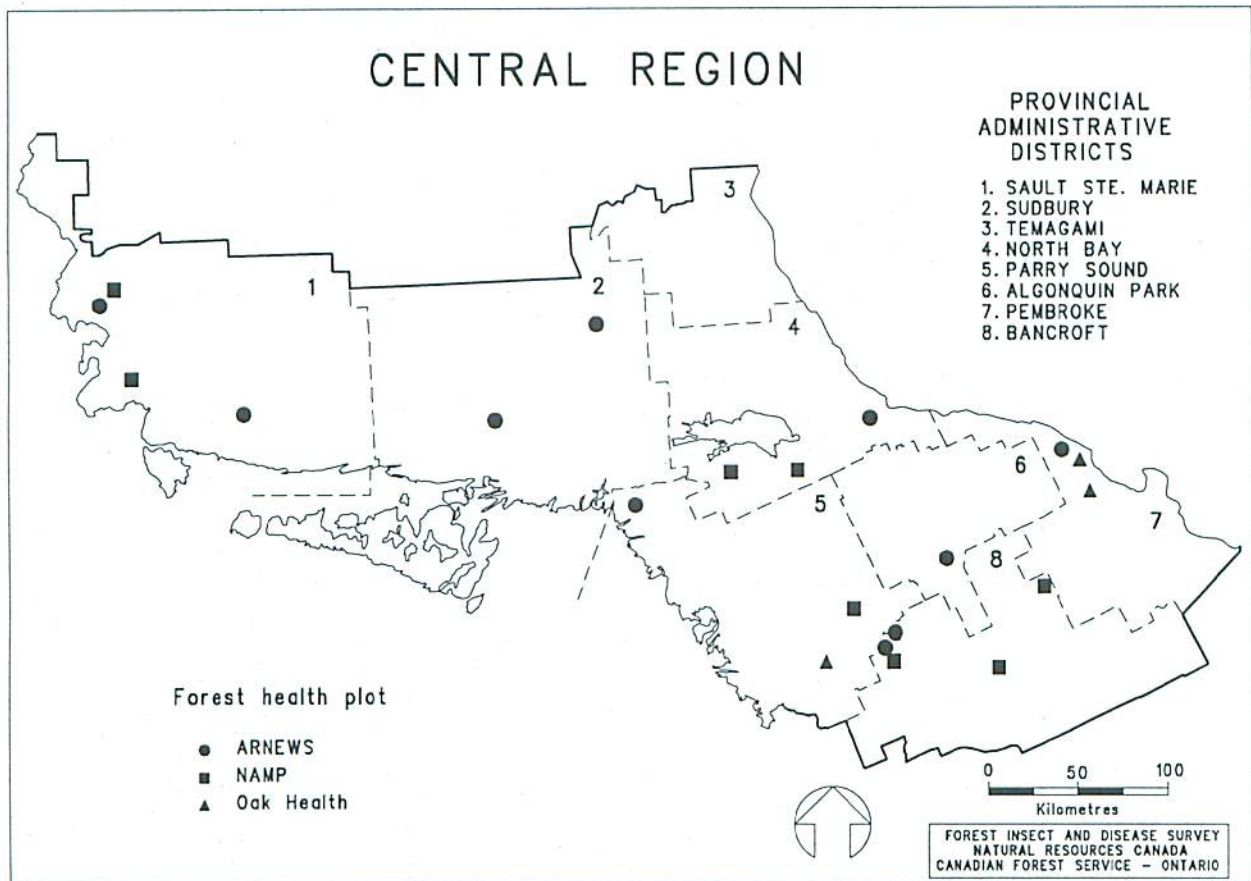


Figure 18. Location of forest health plots in the Central Region in 1994.

dieback. In 1994 one tree died in Cardiff Township, Bancroft District. Since plot establishment, 24 trees (4%) have died. This is an annual average of three trees. Nine trees (1.5%) have either been cut or have blown down.

No significant insect, disease, or abiotic pests were observed in any of the plots in 1994.

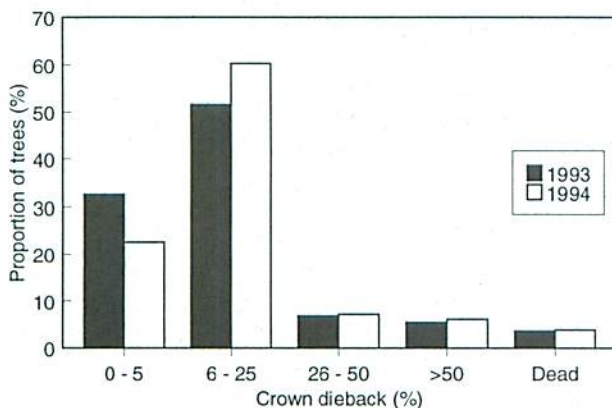


Figure 19. Summary of the crown dieback in hardwood ARNEWS plots in the Central Region in 1993 and 1994.

Oak Health

In 1977, three survey plots were established in red oak stands to monitor crown conditions of this tree species. These 100-tree plots are assessed annually to monitor any changes in the health of this species. One plot is located in Macaulay Township, Parry Sound District. The other two are located in the Pembroke District; one in Alice Township and the other in Wylie Township (Fig. 18).

In 1994, the trend of slight improvement in the health of the surveyed trees continued (Table 26). In the Alice Township plot, 57% of the trees were in the first two classes and had less than 20% dieback as compared to 49% dieback in 1993. In the Wylie Township plot, 69% were in the first two categories in 1994 versus 61% the previous year. Tree conditions in the Macaulay Township plot remained similar to those in 1993. This continues a trend of improvement in oak health that began in 1992.

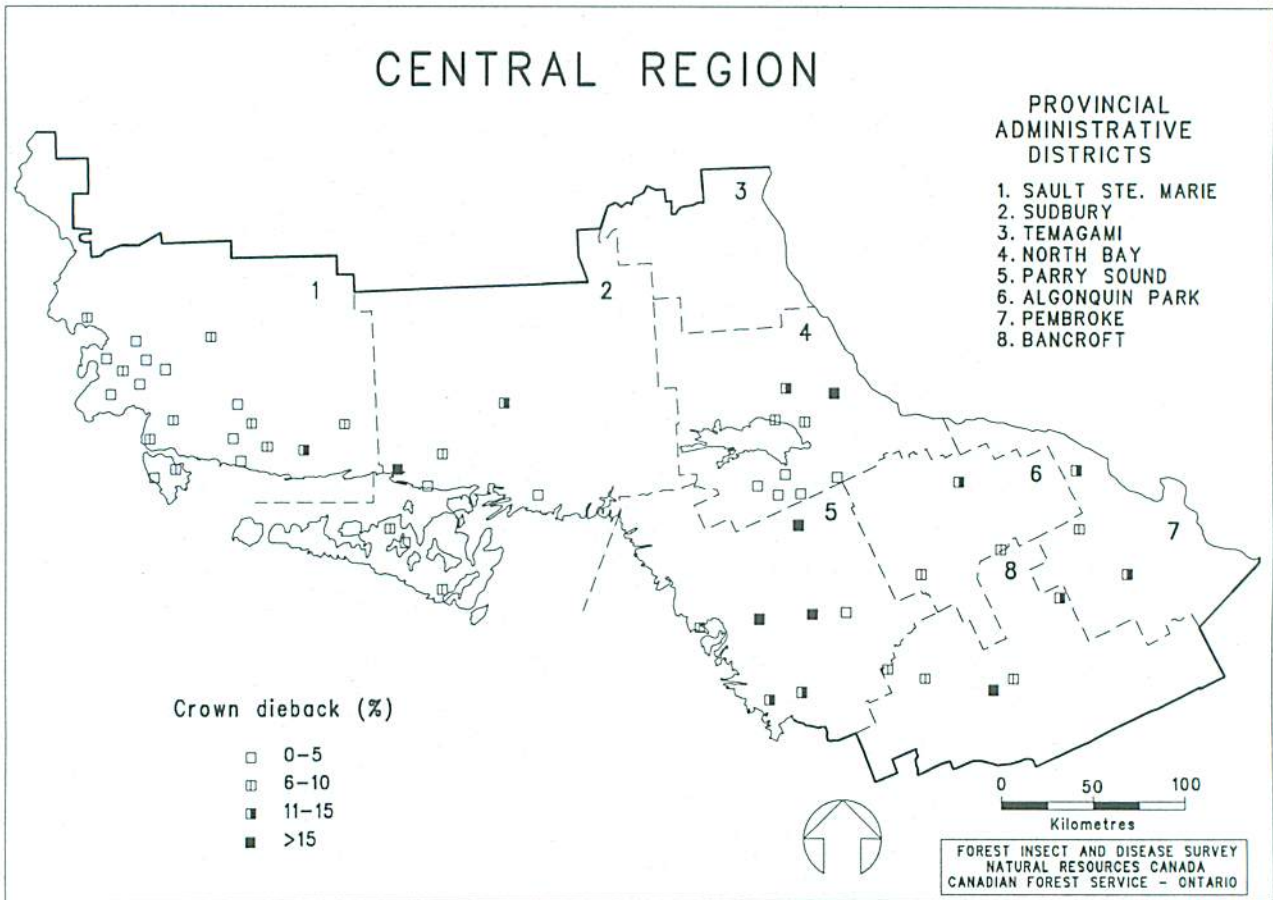


Figure 20. Average crown dieback in sugar maple health plots in the Central Region in 1994.

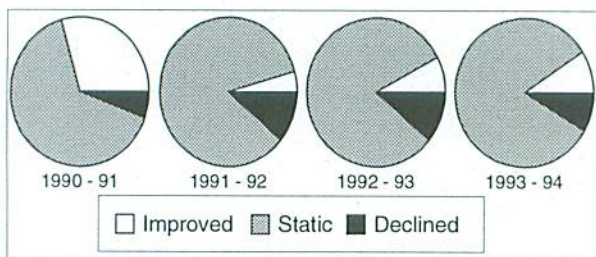


Figure 21. Summary of the sugar maple dieback trends in woodlot plots in the Central Region of Ontario from 1990 to 1994.

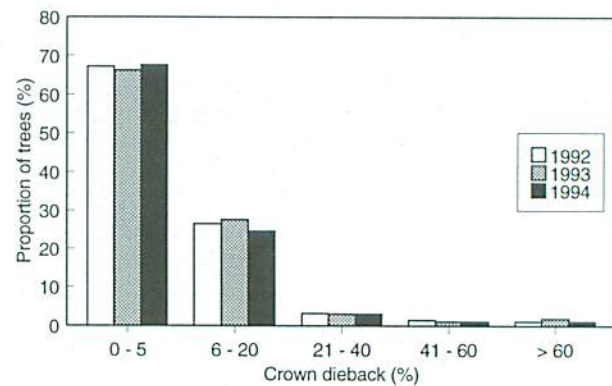


Figure 22. Summary of the sugar maple dieback in woodlot plots in the Central Region of Ontario, 1992 to 1994.

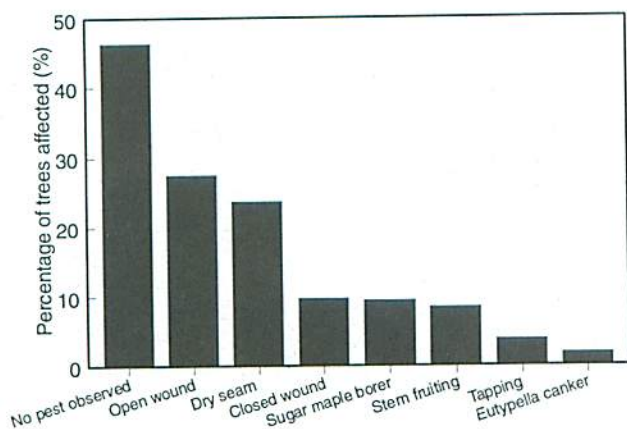


Figure 23. Summary of pests found in sugar maple woodlot plots in the Central Region of Ontario in 1994.

Table 24. Yearly trend for maple health in 56 woodlot, 3 urban, and 5 roadside plots in the Central Region of Ontario from 1987 to 1994. (Counts are based on an examination of 25 sugar maple trees at each location.)

Plot type	Years	Tree condition (% of trees)			Current dead trees (%)	Downed or missing trees (%)
		Improved	Static	Declined		
Woodlot	1987-88	3.8	83.6	12.6	0	0
	1988-89	20.1	66.2	13.6	0.4	0.1
	1989-90	8.0	83.6	8.4	0.9	0
	1990-91	29.5	64.8	5.7	0.6	0
	1991-92	4.4	83.9	11.1	0.7	0
	1992-93	7.8	80.8	11.1	0.3	0
	1993-94	9.3	80.0	8.4	2.3	0
Urban	1989-90	0.0	80.0	20.0	0	0
	1990-91	21.3	50.7	9.3	0	18.7
	1991-92	6.6	70.5	21.3	0	1.6
	1992-93	3.3	78.4	18.3	0	0
	1993-94	6.7	61.7	30.0	1.7	0
Roadside	1989-90	2.0	55.0	43.0	0	0
	1990-91	40.0	60.0	0.0	0	0
	1991-92	3.2	84.8	12.0	0	0
	1992-93	2.4	68.8	28.0	0.8	0
	1993-94	9.7	78.2	12.1	0	0

Table 25. Sugar maple crown conditions recorded in eight North American Maple Project (NAMP) plots from 1991 to 1994 in the Central Region of Ontario.

Location (Township)	Average DBH (cm)	Year	Number of trees examined	Total percentage of dead crown											Trees down dead	Trees blown or cut
				0	1-5	6-15	16-25	26-35	36-45	46-55	56-65	66-75	76-85	>86		
<i>Bancroft District</i>																
Cardiff ^a	20.2	1991	89	0	35	30	10	5	2	2	2	3	0	0	5	0
		1992	89	0	34	29	13	5	1	2	2	2	1	0	5	0
		1993	88	0	40	24	7	7	2	0	3	5	0	0	6	0
		1994	88	0	48	17	17	4	0	2	0	0	0	0	7	0
Bangor ^b	37.1	1991	49	0	26	16	5	0	1	0	0	1	0	0	0	4
		1992	47	0	7	32	6	1	0	1	0	0	0	0	2	4
		1993	47	0	23	15	7	0	1	0	1	0	0	0	2	4
		1994	46	0	18	13	12	1	1	1	0	0	0	0	2	5
<i>North Bay District</i>																
Nipissing ^a	19.6	1991	112	0	101	7	1	2	1	0	0	0	0	0	1	0
		1992	112	0	85	21	4	0	1	0	0	0	0	1	1	0
		1993	112	0	87	18	3	2	0	1	0	0	1	0	1	0
		1994	112	0	83	19	4	1	0	4	0	1	0	0	1	0
Patterson ^b	19.6	1991	64	0	61	1	1	1	0	0	0	0	0	0	1	0
		1992	64	0	58	3	3	0	0	0	0	0	0	0	1	0
		1993	64	0	54	9	0	0	1	0	0	0	0	0	1	0
		1994	64	0	56	4	4	0	0	0	0	0	0	0	1	0
<i>Parry Sound District</i>																
Franklin ^b	32.3	1991	41	0	21	13	1	4	1	1	0	0	0	0	3	0
		1992	41	0	23	10	4	2	0	1	1	0	0	0	3	0
		1993	41	0	26	10	4	1	0	0	0	0	0	0	3	0
		1994	41	0	35	6	0	0	0	0	0	0	0	0	3	0
Ridout ^a	25.4	1991	56	0	33	19	3	0	0	0	1	0	0	0	5	0
		1992	56	0	33	19	2	0	1	1	0	0	0	0	5	0
		1993	56	0	36	14	5	0	0	1	0	0	0	0	6	0
		1994	56	0	48	5	3	0	0	0	0	0	0	0	6	0
<i>Sault Ste. Marie District</i>																
Tarentorus ^a	24.4	1991	81	0	71	10	0	0	0	0	0	0	0	0	1	2
		1992	80	0	58	19	3	0	0	0	0	0	0	0	2	2
		1993	80	7	67	4	2	0	0	0	0	0	0	0	2	2
		1994	80	0	63	17	0	0	0	0	0	0	0	0	2	2
Wishart ^b	27.6	1991	71	0	53	7	6	4	0	0	1	0	0	0	2	1
		1992	70	3	49	8	2	5	3	0	0	0	0	0	2	2
		1993	70	0	42	17	4	4	3	0	0	0	0	0	2	2
		1994	69	0	45	16	0	4	2	2	0	0	0	0	2	2

^a Trees currently tapped for maple syrup.

^b Undisturbed woodlot.

Table 26. Oak health at three locations in the Central Region of Ontario from 1990 to 1994. (Data are based on the examination of 100 host trees at each location.)

Location (Township)	Average DBH (cm)	Year	Cumulative dieback class ^a					Trees blown down or cut	
			0	1	2	3	4		5
<i>Parry Sound District</i>									
Macaulay	35	1990	2	52	33	1	1	11	0
		1991	1	72	15	0	0	12	0
		1992	1	66	18	3	0	12	0
		1993	0	81	5	1	1	12	0
		1994	4	76	7	0	1	12	0
<i>Pembroke District</i>									
Alice	18	1990	0	25	51	4	5	11	4
		1991	2	58	14	3	5	14	4
		1992	1	47	22	1	6	19	4
		1993	1	48	18	1	4	21	7
		1994	3	54	10	1	3	22	7
Wylie	25	1990	0	23	59	7	1	10	0
		1991	1	76	9	1	1	12	0
		1992	0	66	18	1	1	14	0
		1993	0	61	21	3	1	14	0
		1994	3	66	14	2	1	14	0

^aDieback classification: 0 = 0–5%, 1 = 6–20%, 2 = 21–40%, 3 = 41–60%, 4 = >60%, 5 = dead tree.

SPECIAL SURVEYS

Northern Ontario Development Agreement (NODA) Northern Forestry Program (NFP)

The Canada–Ontario Northern Ontario Development Agreement (NODA) was signed in November 1991. Under this agreement, the Northern Forestry Program (NFP) provides \$50 million over a 4-year period for economic development in forestry in northern Ontario.

The NFP is delivered by the OMNR and the Canadian Forest Service, and focuses on obtaining information for better tools and ultimately better decisions in the management of Ontario's forests for economic, social, and environmental prosperity. Objectives include the development of programs of applied research and technology transfer in support of sustainable forestry in Ontario.

Several FIDS projects, supplemental to normal activities, are funded by NODA. These include studies of the eastern spruce budworm and the jack pine budworm.

Development of an Eastern Spruce Budworm Hazard Rating System for the Forests of Northern Ontario NFP Project No. 4210

Study objectives of the NFP eastern spruce budworm project focus on development of a hazard rating system to

assist forest managers in assessing the susceptibility and vulnerability of forests in northern Ontario to eastern spruce budworm attack. This will include the following activities:

1. developing an eastern spruce budworm susceptibility map for northern Ontario,
2. developing an eastern spruce budworm vulnerability map and predictive vulnerability models, and
3. developing a process for the production of an annual eastern spruce budworm hazard report.

Plots for this study were located by FIDS survey technicians in consultation with OMNR and forest industry staff and were established using three stand variables: balsam fir/white spruce composition, balsam fir age, and site class. The height, diameter, and age of the trees were measured at each plot. Every individual host tree was examined for the amount of current years' defoliation and general tree health. Egg-mass samples were taken at all of the plots and pheromone traps were deployed at some (Tables 5 and 8). A total of 18 plots were laid out in the Central Region in 1993 and 28 plots were added in 1994 (Fig. 20). The total number of plots now located in each district is as follows: Algonquin Park, 6; Bancroft, 1; North Bay, 7; Parry Sound, 7; Pembroke, 2; Sault Ste. Marie, 11; Sudbury, 10; and Temagami, 2.

The study objective of the NFP jack pine budworm project is to develop guidelines for the management of jack pine budworm in northern Ontario. These guidelines will in turn provide accurate predictions of growth loss, top kill, tree mortality, decay, and defect and will allow forest managers to make sound management decisions on protection, harvest, salvage, and regeneration activities.

Plots for this study were once again located by FIDS survey technicians in consultation with OMNR and forest industry staff and were established using two variables, age and site class. Various parameters, such as tree height, diameter, and age, were measured at each plot. In 1994, all plots were visited twice and each tree was examined for the amount of male flowering, current years' defoliation, and level of tree health. Egg-mass (Table 8) and second instar (overwintering) larvae samples were also taken at all the plots. In 1992 and 1993, a total of 63 impact plots were established in the Central Region (Fig. 24); 1, 18, and 44 plots in the North Bay, Sault Ste. Marie, and Sudbury districts, respectively.

Kirkwood Nursery Report

Several visits were made to the Kirkwood Forest Station during the 1994 field season to check for and monitor forest insects and diseases, but recorded damage to tree seedlings was minimal. The shoot blight, *Kabatina thujae* R. Schneid. & Arx, was identified from two small patches of dead or dying eastern white cedar seedlings. This was believed to be a secondary fungal growth as the condition did not spread. A dozen, 1 1/2-year-old red pine seedlings averaged 80% defoliation from a colony of redheaded pine sawfly. A single, speckled green fruitworm (*Orthosia hibisci* [Gn.] larva) was collected from a jack pine seedling. There were also low numbers of pine spittlebug on the jack pine seedlings. Potted white pine and white spruce suffered some light winter drying damage. The pine were also lightly infested with pine leaf adelgid.

There were a number of problems identified at the white pine breeding orchard on the nursery property. Winter drying caused 20% foliar damage to 50% of the 1.6-m trees; the white pine needle midge caused 30% defoliation to 5% of the trees; the introduced pine sawfly was found on 16% of the trees and created an average of 5% defoliation; white pine weevil was successfully

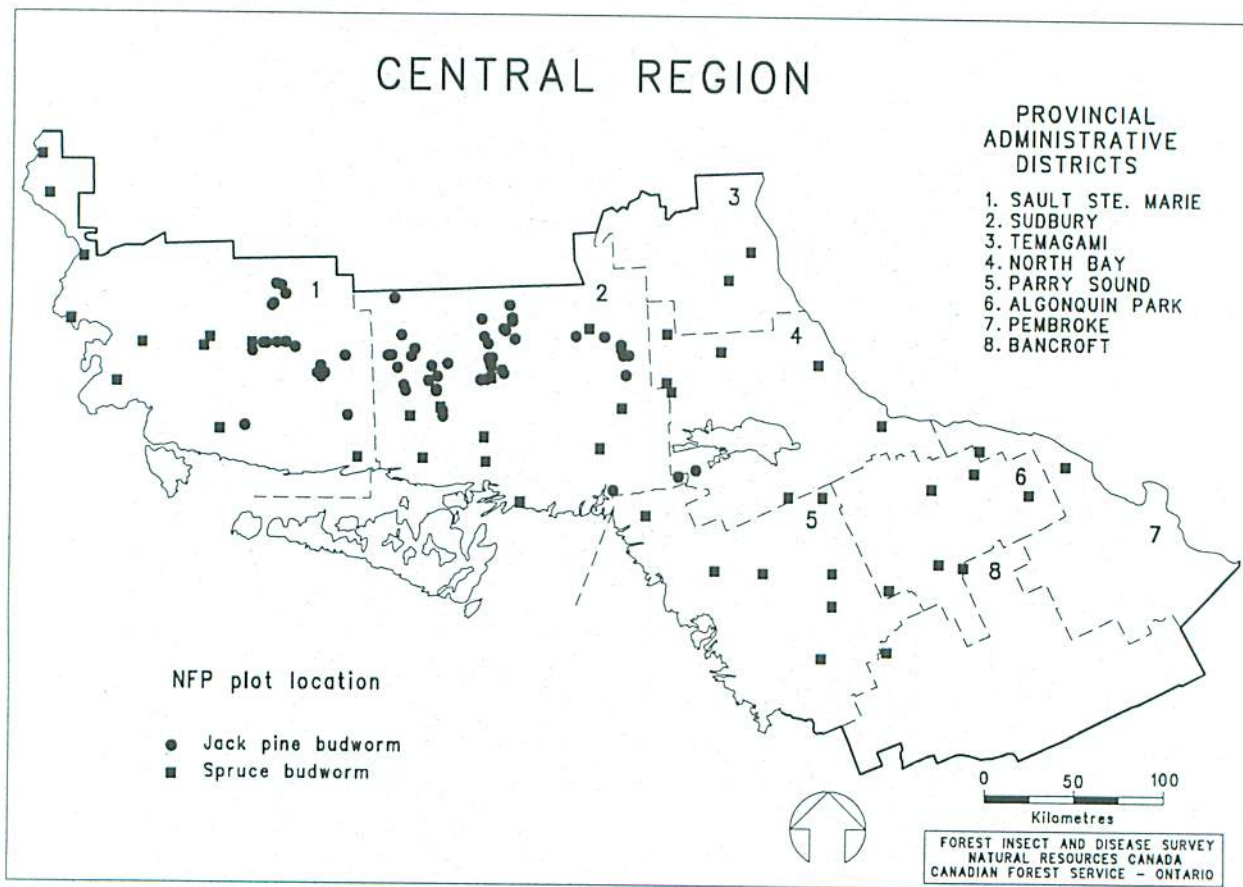


Figure 24. Location of NFP plots in the Central Region of Ontario in 1994.

sanitized while still in the larval stage; the white pine aphid (*Cinara strobi* [Fitch]) caused an abundance of sooty mold on a few edge trees; and *Armillaria* root rot infected 2% of the trees.

Leader damage due to white pine weevil and eastern pine shoot borer was 3% and 2%, respectively, in an experimental 2-m jack pine planting. The shoot borer infested a total of 8% of the trees.

The yellowheaded spruce sawfly was found at low levels on breeding orchard and young windbreak trees. Both white spruce and black spruce were affected. Typical damage on 0.7-m black spruce trees averaged 5% defoliation on 5% of the trees. There was 20% shoot kill from frost damage on 50% of the white spruce breeding orchard trees.

The North American race of *Scleroderris* canker was identified from 4.3-m red pine in the area surrounding the nursery. The current infections were very light and affected only 6% of the trees. The red pine needle midge infested the current years' foliage on large diameter red pine in the area. Average defoliation was approximately 35%. Neither of these problems had any effect on seedlings.

Climatic Data

Environmental factors, such as temperature and precipitation, play an important role in the development of insects and diseases and on tree growth. Certain weather can predispose the forest to damage and can be the cause of marked fluctuations in insect problems or the incidence of disease. Adverse weather conditions can cause abiotic damage (frost, winter drying, storm damage, and drought) and can also be a contributing agent to forest decline. Weather data for five locations across the Central Region are recorded in Table 27.

During the winter of 1994, extremely low temperatures were recorded in January and February across the Central Region. These cold temperatures were contributing factors to several damaging agents. For example, winter drying and winterkill were both accentuated in 1994. Insect populations, particularly that of the gypsy moth, also declined because of the cold temperatures. In the Sudbury District, 100% of the gypsy moth egg masses surveyed above the snowline were killed.

Normal temperature and precipitation levels are based on results of data from the Atmospheric Environment Service, Environment Canada, from 1961 to 1990.

Table 27. Summary of mean temperature and total precipitation at five locations in the Central Region of Ontario in 1994.

Location	Month	Mean temperature (C°)		Deviation from normal (C°)	Total precipitation (mm)		Deviation from normal (mm)
		Normal	Actual		Normal	Actual	
North Bay Airport	January	-13.0	-20.7	-7.7	60.6	66.4	+5.8
	February	-11.3	-13.8	-2.5	52.1	54.7	+2.6
	March	-5.0	-4.2	+0.8	63.5	20.4	-43.1
	April	+3.2	+2.8	-0.4	66.7	44.9	-21.8
	May	+10.7	+10.3	-0.4	80.0	119.5	+39.5
	June	+15.5	+17.2	+1.7	91.6	116.6	+25.0
	July	+18.5	+19.0	+0.5	96.6	126.0	+29.4
	August	+17.0	+15.6	-1.4	101.9	141.8	+39.9
	September	+12.1	+13.4	+1.3	108.9	97.2	-11.7
	October	+6.2	+8.0	+1.8	89.3	84.4	+4.7
	November	-1.1	+1.1	+2.2	87.4	94.4	+7.0
	December	-9.6	-4.9	+4.7	75.4	30.6	-44.8
Muskoka Airport	January	-10.5	-17.0	-6.5	88.2	84.8	-3.4
	February	-9.6	-12.2	-2.6	63.1	30.0	-33.1
	March	-3.6	-3.6	0	69.5	22.6	-46.9
	April	+4.4	+5.0	+0.6	72.8	59.0	-13.8
	May	+11.1	+10.0	-1.1	84.8	149.3	+64.5
	June	+15.7	+16.5	+0.8	85.2	79.9	-5.3
	July	+18.5	+18.9	+0.4	76.6	140.5	+63.9

(cont'd)

Table 27. Summary of mean temperature and total precipitation at five locations in the Central Region of Ontario in 1994. (concl.)

Location	Month	Mean temperature (C°)		Deviation from normal (C°)	Total precipitation (mm)		Deviation from normal (mm)
		Normal	Actual		Normal	Actual	
Muskoka Airport (cont'd)	August	+17.3	+16.6	-0.7	91.5	101.5	+10.0
	September	+13.1	+13.6	+0.5	108.7	88.9	-19.8
	October	+7.2	+8.2	+1.0	96.5	79.2	-17.3
	November	-0.9	+2.9	+3.8	110.6	136.4	+25.
	December	-6.9	-3.7	+3.2	106.5	58.6	-47.9
Petawawa Airport	January	-12.9	-21.6	-8.7	49.2	53.4	+4.2
	February	-10.9	-14.7	-3.8	47.0	27.8	-19.2
	March	-4.1	-4.2	-0.1	61.3	23.9	-37.4
	April	+4.4	+4.0	-0.4	61.8	45.8	-16.0
	May	+11.9	+10.0	-1.9	69.8	82.0	+12.2
	June	+16.2	+16.7	+0.5	86.8	140.7	+53.9
	July	+19.2	+19.4	+0.2	74.2	143.9	+69.7
	August	+17.7	+16.3	-1.4	76.1	84.7	+8.6
	September	+12.7	+12.6	-0.1	78.8	52.6	-26.2
	October	+6.4	+7.1	+0.7	72.1	41.7	-30.4
	November	-0.3	+1.7	+1.4	66.9	72.6	+5.7
	December	-9.6	-6.4	+3.2	69.8	45.0	-24.8
Sault Ste. Marie Airport	January	-10.4	-17.7	-7.3	74.4	56.2	-18.2
	February	-10.5	-14.3	-3.8	50.7	23.1	-27.6
	March	-4.6	-4.4	+0.2	60.4	37.0	-23.4
	April	+3.3	+2.1	-1.2	65.2	64.6	-0.6
	May	+9.8	+9.0	-0.8	70.8	84.3	+13.5
	June	+14.3	+15.2	+0.9	83.1	62.0	-21.1
	July	+17.8	+17.2	-0.6	65.6	86.0	+20.4
	August	+17.0	+15.9	-1.1	85.3	117.3	+32.0
	September	+12.9	+13.9	+1.0	95.2	54.1	-41.1
	October	+7.4	+9.1	+1.7	83.2	70.8	-12.4
	November	+0.8	+2.1	+1.3	90.3	80.4	-9.9
	December	-6.6	-1.1	+5.5	81.9	10.9	-71.0
Sudbury Airport	January	-13.5	-21.9	-8.4	60.3	59.3	-1.0
	February	-11.9	-14.9	-3.0	48.6	40.0	-8.6
	March	-5.6	-4.9	+0.7	61.4	38.2	-23.2
	April	+3.0	+2.5	-0.5	63.2	35.2	-28.0
	May	+10.8	+10.0	-0.8	71.1	103.0	+31.9
	June	+15.8	+17.2	+1.4	84.1	111.0	+26.9
	July	+19.1	+18.6	-0.5	71.3	144.6	+73.3
	August	+17.4	+15.8	-1.6	87.3	138.0	+50.7
	September	+12.3	+13.5	+1.2	103.0	64.2	-38.8
	October	+6.1	+7.7	+1.6	76.0	71.7	-4.3
	November	-1.3	+0.6	+1.9	79.3	75.2	-4.1
	December	-9.9	-4.7	+5.2	66.2	30.4	-35.8

Appendix 1. Maple health data from 1988 to 1994 on 56 woodlot plots established in the Central Region of Ontario. (Counts are based on examination of 25 sugar maple trees at each location.)

Location (Township)	Average DBH (cm)	Year	Cumulative dieback class ^a						Cumulative number of cut/ windfall trees
			0	1	2	3	4	5	
<i>Algonquin Park District</i>									
Deacon	32.5	1988	0	3	16	6	0	0	0
		1989	0	16	8	1	0	0	0
		1990	0	13	12	0	0	0	0
		1991	11	14	0	0	0	0	0
		1992	7	18	0	0	0	0	0
		1993	8	15	2	0	0	0	0
		1994	9	16	0	0	0	0	0
Peck	36.3	1988	0	5	16	4	0	0	0
		1989	0	13	11	1	0	0	0
		1990	0	20	3	0	1	1	0
		1991	18	5	0	0	1	1	0
		1992	18	5	0	0	0	2	0
		1993	17	5	1	0	0	2	0
		1994	9	13	1	0	0	2	0
Murchison	41.0	1988	0	9	16	0	0	0	0
		1989	0	21	4	0	0	0	0
		1990	0	23	2	0	0	0	0
		1991	24	1	0	0	0	0	0
		1992	14	11	0	0	0	0	0
		1993	11	14	0	0	0	0	0
		1994	9	16	0	0	0	0	0
<i>Bancroft District</i>									
Bangor	44.9	1988	0	6	13	6	0	0	0
		1989	0	16	6	1	1	0	1
		1990	0	17	5	1	0	1	1
		1991	13	9	0	1	0	1	1
		1992	12	10	0	1	0	1	1
		1993	7	13	2	1	0	1	1
		1994	2	18	2	1	0	1	1
Cardiff	32.3	1988	0	3	15	7	0	0	0
		1989	1	18	4	1	0	1	0
		1990	1	21	1	1	0	1	0
		1991	22	1	0	0	1	1	0
		1992	14	8	1	0	0	2	0
		1993	11	12	0	0	0	2	0
		1994	17	6	0	0	0	2	0
Hindon	35.9	1988	7	17	1	0	0	0	0
		1989	11	12	2	0	0	0	0
		1990	9	11	5	0	0	0	0
		1991	11	10	4	0	0	0	0
		1992	9	12	3	1	0	0	0
		1993	12	10	2	1	0	0	0
		1994	16	8	0	1	0	0	0

(cont'd)

Appendix 1. Maple health data from 1988 to 1994 on 56 woodlot plots established in the Central Region of Ontario. (Counts are based on examination of 25 sugar maple trees at each location.) (cont'd)

Location (Township)	Average DBH (cm)	Year	Cumulative dieback class ^a					Cumulative number of cut/ windfall trees		
			0	1	2	3	4		5	
			Number of trees							
<i>Bancroft District (cont'd)</i>										
Limerick	31.8	1988	0	6	16	3	0	0	0	
		1989	0	19	6	0	0	0	0	
		1990	0	21	4	0	0	0	0	
		1991	20	5	0	0	0	0	0	
		1992	20	5	0	0	0	0	0	
		1993	12	13	0	0	0	0	0	
		1994	0	0	0	0	0	0	0	25
Minden	35.9	1988	5	15	4	1	0	0	0	
		1989	8	16	1	0	0	0	0	
		1990	11	13	1	0	0	0	0	
		1991	14	11	0	0	0	0	0	
		1992	10	14	1	0	0	0	0	
		1993	13	11	0	0	0	0	0	1
		1994	15	8	1	0	0	0	0	1
Monmouth	30.4	1988	9	12	4	0	0	0	0	
		1989	7	12	3	2	0	1	0	
		1990	4	13	3	2	0	3	0	
		1991	2	17	2	0	0	4	0	
		1992	1	18	1	1	0	4	0	
		1993	2	17	0	1	1	4	0	
		1994	10	9	0	0	0	0	6	0
<i>North Bay District</i>										
Blyth	18.4	1988	14	5	4	2	0	0	0	
		1989	15	7	2	0	1	0	0	
		1990	10	11	2	0	1	1	0	
		1991	14	8	1	0	0	2	0	
		1992	14	6	2	1	0	2	0	
		1993	14	7	0	2	0	2	0	
		1994	15	6	0	1	1	2	0	
Chisholm	23.7	1989	25	0	0	0	0	0	0	
		1990	24	1	0	0	0	0	0	
		1991	24	1	0	0	0	0	0	
		1992	24	1	0	0	0	0	0	
		1993	25	0	0	0	0	0	0	
		1994	25	0	0	0	0	0	0	
Commanda	22.8	1989	18	7	0	0	0	0	0	
		1990	16	9	0	0	0	0	0	
		1991	24	1	0	0	0	0	0	
		1992	23	2	0	0	0	0	0	
		1993	23	0	0	0	0	2	0	
		1994	18	4	0	0	0	0	3	0

(cont'd)

Appendix 1. Maple health data from 1988 to 1994 on 56 woodlot plots established in the Central Region of Ontario. (Counts are based on examination of 25 sugar maple trees at each location.) (cont'd)

Location (Township)	Average DBH (cm)	Year	Cumulative dieback class ^a					Cumulative number of cut/ windfall trees	
			0	1	2	3	4		5
			Number of trees						
<i>North Bay District (concl.)</i>									
French	16.3	1988	13	6	5	1	0	0	0
		1989	12	8	3	2	0	0	0
		1990	11	10	1	3	0	0	0
		1991	13	9	1	2	0	0	0
		1992	12	7	2	2	1	1	0
		1993	11	8	2	1	1	2	0
		1994	12	6	2	1	1	3	0
Nipissing	22.0	1988	21	4	0	0	0	0	0
		1989	11	12	1	0	1	0	0
		1990	11	10	2	1	1	0	0
		1991	18	4	1	0	0	2	0
		1992	17	4	1	0	1	2	0
		1993	17	2	1	0	0	5	0
		1994	19	1	0	0	0	5	0
Nipissing	20.6	1989	17	8	0	0	0	0	0
		1990	16	9	0	0	0	0	0
		1991	24	1	0	0	0	0	0
		1992	23	2	0	0	0	0	0
		1993	24	1	0	0	0	0	0
		1994	23	1	1	0	0	0	0
Pringle	22.5	1989	19	6	0	0	0	0	0
		1990	18	7	0	0	0	0	0
		1991	25	0	0	0	0	0	0
		1992	23	2	0	0	0	0	0
		1993	22	3	0	0	0	0	0
		1994	24	1	0	0	0	0	0
Pringle	22.3	1988	16	9	0	0	0	0	0
		1989	14	10	0	1	0	0	0
		1990	14	10	0	1	0	0	0
		1991	24	0	1	0	0	0	0
		1992	24	0	1	0	0	0	0
		1993	24	1	0	0	0	0	0
		1994	25	0	0	0	0	0	0
Widdifield	31.1	1989	7	14	4	0	0	0	0
		1990	7	13	5	0	0	0	0
		1991	17	7	1	0	0	0	0
		1992	15	7	3	0	0	0	0
		1993	15	7	3	0	0	0	0
		1994	16	6	3	0	0	0	0

(cont'd)

Appendix 1. Maple health data from 1988 to 1994 on 56 woodlot plots established in the Central Region of Ontario. (Counts are based on examination of 25 sugar maple trees at each location.) (cont'd)

Location (Township)	Average DBH (cm)	Year	Cumulative dieback class ^a					Cumulative number of cut/ windfall trees	
			0	1	2	3	4		5
			Number of trees						
<i>Parry Sound District</i>									
Carling	30.6	1988	24	1	0	0	0	0	0
		1989	21	4	0	0	0	0	0
		1990	20	4	1	0	0	0	0
		1991	21	3	1	0	0	0	0
		1992	16	7	1	0	0	1	0
		1993	16	7	1	0	0	1	0
		1994	16	7	1	0	0	1	0
Chaffey	31.6	1988	11	12	1	0	1	0	0
		1989	16	6	1	0	1	1	0
		1990	11	11	0	0	1	2	0
		1991	15	7	0	0	0	3	0
		1992	9	7	0	0	0	3	6
		1993	9	7	0	0	0	3	6
		1994	15	1	0	0	0	3	6
Christie	31.7	1988	2	16	6	1	0	0	0
		1989	1	13	11	0	0	0	0
		1990	1	19	5	0	0	0	0
		1991	3	17	4	1	0	0	0
		1992	2	17	3	2	1	0	0
		1993	2	17	2	2	1	1	0
		1994	4	16	0	2	2	1	0
Gibson	27.1	1988	16	8	1	0	0	0	0
		1989	18	6	1	0	0	0	0
		1990	18	6	1	0	0	0	0
		1991	12	13	0	0	0	0	0
		1992	8	17	0	0	0	0	0
		1993	6	19	0	0	0	0	0
		1994	7	17	1	0	0	0	0
Machar	34.4	1988	9	13	3	0	0	0	0
		1989	3	17	5	0	0	0	0
		1990	0	18	5	1	0	1	0
		1991	5	15	3	1	0	1	0
		1992	1	17	3	3	0	1	0
		1993	1	15	5	2	1	1	0
		1994	2	16	5	1	0	1	0
Stisted	29.9	1988	2	12	9	2	0	0	0
		1989	1	16	6	1	1	0	0
		1990	0	16	8	1	0	0	0
		1991	3	19	1	2	0	0	0
		1992	2	18	3	0	2	0	0
		1993	5	17	1	0	2	0	0
		1994	8	12	1	1	2	1	0

(cont'd)

Appendix 1. Maple health data from 1988 to 1994 on 56 woodlot plots established in the Central Region of Ontario. (Counts are based on examination of 25 sugar maple trees at each location.) (cont'd)

Location (Township)	Average DBH (cm)	Year	Cumulative dieback class ^a						Cumulative number of cut/ windfall trees
			0	1	2	3	4	5	
			Number of trees						
<i>Parry Sound District (concl.)</i>									
Wood	31.3	1988	14	8	3	0	0	0	0
		1989	15	8	0	0	1	1	0
		1990	16	7	0	0	1	1	0
		1991	14	9	0	0	0	2	0
		1992	15	8	0	0	0	2	0
		1993	13	10	0	0	0	2	0
		1994	14	8	0	0	0	3	0
<i>Pembroke District</i>									
Richards	40.5	1988	0	7	17	1	0	0	0
		1989	0	16	9	0	0	0	0
		1990	0	20	5	0	0	0	0
		1991	17	8	0	0	0	0	0
		1992	21	4	0	0	0	0	0
		1993	14	11	0	0	0	0	0
		1994	17	8	0	0	0	0	0
Sebastopol	40.2	1988	0	15	9	1	0	0	0
		1989	0	23	1	1	0	0	0
		1990	0	21	3	1	0	0	0
		1991	20	4	1	0	0	0	0
		1992	12	12	1	0	0	0	0
		1993	8	15	2	0	0	0	0
		1994	8	15	2	0	0	0	0
Wylie	37.0	1988	0	4	14	7	0	0	0
		1989	0	15	7	3	0	0	0
		1990	0	17	6	2	0	0	0
		1991	17	5	1	1	0	1	0
		1992	13	9	1	1	0	1	0
		1993	12	10	0	0	1	2	0
		1994	7	14	1	0	1	2	0
<i>Sault Ste. Marie District</i>									
Aweres	27.3	1988	12	12	1	0	0	0	0
		1989	9	16	0	0	0	0	0
		1990	11	14	0	0	0	0	0
		1991	15	10	0	0	0	0	0
		1992	14	10	0	0	0	1	0
		1993	19	5	0	0	0	1	0
		1994	17	6	0	0	0	1	1
Casson	23.2	1988	24	1	0	0	0	0	0
		1989	22	2	1	0	0	0	0
		1990	24	0	1	0	0	0	0
		1991	25	0	0	0	0	0	0
		1992	25	0	0	0	0	0	0
		1993	24	1	0	0	0	0	0
		1994	24	1	0	0	0	0	0

(cont'd)

Appendix 1. Maple health data from 1988 to 1994 on 56 woodlot plots established in the Central Region of Ontario. (Counts are based on examination of 25 sugar maple trees at each location.) (cont'd)

Location (Township)	Average DBH (cm)	Year	Cumulative dieback class ^a						Cumulative number of cut/ windfall trees
			0	1	2	3	4	5	
			Number of trees						
<i>Sault Ste. Marie District (cont'd)</i>									
Deroche	18.4	1988	17	7	1	0	0	0	0
		1989	21	3	1	0	0	0	0
		1990	24	1	0	0	0	0	0
		1991	19	6	0	0	0	0	0
		1992	18	7	0	0	0	0	0
		1993	20	5	0	0	0	0	0
		1994	21	4	0	0	0	0	0
Fenwick	23.1	1988	22	3	0	0	0	0	0
		1989	13	10	2	0	0	0	0
		1990	21	3	1	0	0	0	0
		1991	19	5	0	0	1	0	0
		1992	18	6	0	0	0	1	0
		1993	24	0	0	0	0	1	0
		1994	19	0	0	0	0	1	5
Gladstone	30.6	1988	21	3	1	0	0	0	0
		1989	23	2	0	0	0	0	0
		1990	24	1	0	0	0	0	0
		1991	22	1	1	1	0	0	0
		1992	20	3	1	1	0	0	0
		1993	19	4	1	0	0	1	0
		1994	19	3	2	0	0	1	0
Gould	24.9	1988	18	7	0	0	0	0	0
		1989	18	7	0	0	0	0	0
		1990	21	4	0	0	0	0	0
		1991	25	0	0	0	0	0	0
		1992	24	1	0	0	0	0	0
		1993	22	2	0	0	1	0	0
		1994	21	3	0	0	0	1	0
Gunterman	23.2	1988	22	2	1	0	0	0	0
		1989	23	1	1	0	0	0	0
		1990	23	2	0	0	0	0	0
		1991	21	3	1	0	0	0	0
		1992	19	5	0	1	0	0	0
		1993	19	5	0	1	0	0	0
		1994	20	4	0	0	1	0	0
Hilton	23.0	1988	19	6	0	0	0	0	0
		1989	22	3	0	0	0	0	0
		1990	24	1	0	0	0	0	0
		1991	23	2	0	0	0	0	0
		1992	22	3	0	0	0	0	0
		1993	25	0	0	0	0	0	0
		1994	24	0	0	1	0	0	0

(cont'd)

Appendix 1. Maple health data from 1988 to 1994 on 56 woodlot plots established in the Central Region of Ontario. (Counts are based on examination of 25 sugar maple trees at each location.) (cont'd)

Location (Township)	Average DBH (cm)	Year	Cumulative dieback class ^a					Cumulative number of cut/ windfall trees	
			0	1	2	3	4		5
			Number of trees						
<i>Sault Ste. Marie District (cont'd)</i>									
Hodgins	24.5	1988	15	6	2	2	0	0	0
		1989	13	8	3	1	0	0	0
		1990	18	5	1	0	0	1	0
		1991	20	3	1	0	0	1	0
		1992	22	2	0	0	0	1	0
		1993	21	3	0	0	0	1	0
		1994	22	1	1	0	0	1	0
Jocelyn	33.5	1988	22	2	1	0	0	0	0
		1989	22	3	0	0	0	0	0
		1990	17	8	0	0	0	0	0
		1991	18	7	0	0	0	0	0
		1992	20	5	0	0	0	0	0
		1993	23	1	0	0	0	0	1
		1994	21	3	0	0	0	0	1
Jollineau	25.8	1988	13	10	1	1	0	0	0
		1989	13	7	4	1	0	0	0
		1990	13	9	2	1	0	0	0
		1991	16	7	1	1	0	0	0
		1992	17	7	0	0	0	1	0
		1993	15	8	1	0	0	1	0
		1994	19	4	1	0	0	1	0
Laird	23.9	1988	14	5	5	1	0	0	0
		1989	16	9	0	0	0	0	0
		1990	14	10	0	1	0	0	0
		1991	20	4	1	0	0	0	0
		1992	12	10	0	1	0	0	2
		1993	17	4	0	0	1	0	3
		1994	15	6	0	0	0	1	3
Meredith	35.0	1988	13	5	5	1	0	1	0
		1989	14	7	3	0	0	1	0
		1990	16	6	2	0	0	1	0
		1991	13	8	3	0	0	1	0
		1992	15	6	3	0	0	1	0
		1993	13	8	3	0	0	1	0
		1994	17	4	3	0	0	1	0
Palmer	32.0	1988	17	7	1	0	0	0	0
		1989	20	5	0	0	0	0	0
		1990	20	5	0	0	0	0	0
		1991	19	6	0	0	0	0	0
		1992	20	5	0	0	0	0	0
		1993	22	3	0	0	0	0	0
		1994	20	3	1	1	0	0	0

(cont'd)

Appendix 1. Maple health data from 1988 to 1994 on 56 woodlot plots established in the Central Region of Ontario. (Counts are based on examination of 25 sugar maple trees at each location.) (cont'd)

Location (Township)	Average DBH (cm)	Year	Cumulative dieback class ^a					Cumulative number of cut/ windfall trees	
			0	1	2	3	4		5
			Number of trees						
<i>Sault Ste. Marie District (concl.)</i>									
Scarfe	18.4	1988	24	1	0	0	0	0	0
		1989	22	3	0	0	0	0	0
		1990	23	2	0	0	0	0	0
		1991	20	3	2	0	0	0	0
		1992	19	5	1	0	0	0	0
		1993	19	6	0	0	0	0	0
		1994	18	4	1	1	1	0	0
Shield	26.0	1988	15	6	3	1	0	0	0
		1989	20	5	0	0	0	0	0
		1990	19	5	0	0	0	1	0
		1991	23	1	0	0	0	1	0
		1992	23	1	0	0	0	1	0
		1993	21	2	0	0	0	2	0
		1994	22	1	0	0	0	2	0
Thessalon	22.0	1988	22	3	0	0	0	0	0
		1989	22	3	0	0	0	0	0
		1990	23	2	0	0	0	0	0
		1991	25	0	0	0	0	0	0
		1992	25	0	0	0	0	0	0
		1993	23	1	0	0	0	0	1
		1994	22	2	0	0	0	0	1
VanKoughnet	20.8	1988	21	4	0	0	0	0	0
		1989	23	1	0	0	0	1	0
		1990	23	0	1	0	0	1	0
		1991	20	2	1	1	0	1	0
		1992	20	2	1	0	1	1	0
		1993	20	3	0	1	0	1	0
		1994	21	2	0	1	0	1	0
Wells	24.5	1988	22	2	1	0	0	0	0
		1989	20	4	1	0	0	0	0
		1990	22	3	0	0	0	0	0
		1991	25	0	0	0	0	0	0
		1992	25	0	0	0	0	0	0
		1993	23	2	0	0	0	0	0
		1994	23	1	0	1	0	0	0
Whitman	26.5	1988	16	7	1	1	0	0	0
		1989	14	9	0	2	0	0	0
		1990	18	5	0	1	0	1	0
		1991	20	2	1	1	0	1	0
		1992	21	2	0	0	1	1	0
		1993	19	3	0	0	0	3	0
		1994	19	3	0	0	0	3	0

(cont'd)

Appendix 1. Maple health data from 1988 to 1994 on 56 woodlot plots established in the Central Region of Ontario. (Counts are based on examination of 25 sugar maple trees at each location.) (cont'd)

Location (Township)	Average DBH (cm)	Year	Cumulative dieback class ^a					Cumulative number of cut/ windfall trees	
			0	1	2	3	4		5
			Number of trees						
<i>Sudbury District</i>									
Allan	28.0	1989	8	12	4	1	0	0	0
		1990	6	13	5	1	0	0	0
		1991	13	9	4	0	0	0	0
		1992	16	6	1	0	0	0	2
		1993	16	6	1	0	0	0	2
		1994	17	4	2	0	0	0	2
Billings	18.5	1988	22	3	0	0	0	0	0
		1989	16	8	1	0	0	0	0
		1990	16	8	1	0	0	0	0
		1991	24	1	0	0	0	0	0
		1992	24	1	0	0	0	0	0
		1993	23	2	0	0	0	0	0
1994	25	0	0	0	0	0	0		
Gough	23.3	1988	21	4	0	0	0	0	0
		1989	8	15	2	0	0	0	0
		1990	6	17	2	0	0	0	0
		1991	17	8	0	0	0	0	0
		1992	20	5	0	0	0	0	0
		1993	21	4	0	0	0	0	0
1994	16	8	1	0	0	0	0		
Killarney	21.0	1988	23	1	0	1	0	0	0
		1989	18	6	1	0	0	0	0
		1990	16	8	1	0	0	0	0
		1991	23	2	0	0	0	0	0
		1992	22	2	0	0	0	1	0
		1993	21	2	0	0	0	2	0
1994	20	3	0	0	0	2	0		
Spanish River First Nation	21.4	1988	23	2	0	0	0	0	0
		1989	20	5	0	0	0	0	0
		1990	21	4	0	0	0	0	0
		1991	25	0	0	0	0	0	0
		1992	25	0	0	0	0	0	0
		1993	24	1	0	0	0	0	0
1994	25	0	0	0	0	0	0		
Tehkummah	28.6	1989	13	10	1	1	0	0	0
		1990	12	11	1	1	0	0	0
		1991	14	9	1	0	0	1	0
		1992	17	6	1	0	0	1	0
		1993	16	6	2	0	0	1	0
1994	17	5	1	1	0	1	0		

(cont'd)

Appendix 1. Maple health data from 1988 to 1994 on 56 woodlot plots established in the Central Region of Ontario. (Counts are based on examination of 25 sugar maple trees at each location.) (concl.)

Location (Township)	Average DBH (cm)	Year	Cumulative dieback class ^a					Cumulative number of cut/ windfall trees	
			0	1	2	3	4		5
			Number of trees						
<i>Sudbury District (concl.)</i>									
Trill	16.9	1988	22	3	0	0	0	0	0
		1989	12	8	3	0	0	1	0
		1990	10	10	4	0	0	1	0
		1991	17	4	1	2	0	1	0
		1992	15	7	1	1	0	1	0
		1993	11	7	4	2	0	1	0
		1994	12	11	1	0	0	1	0
Victoria	33.3	1989	3	12	8	2	0	0	0
		1990	3	11	9	1	0	1	0
		1991	5	11	7	1	0	1	0
		1992	5	11	5	3	0	1	0
		1993	4	13	5	0	1	2	0
		1994	6	10	5	1	1	2	0

^a 0 = 0–5%, 1 = 6–20%, 2 = 21–40%, 3 = 41–60%, 4 = >60%, 5 = dead tree.

Appendix 2. Maple health data from 1989 to 1994 from three urban and five roadside plots established in the Central Region of Ontario. (Counts are based on examination of 25 sugar maple trees at each location.)

Location (Township)	Plot type	Average DBH (cm)	Year	Cumulative dieback class ^a					Cumulative number of cut/ windfall trees	
				0	1	2	3	4		5
				Number of trees						
<i>Bancroft District</i>										
Carlow	rural	60.7	1991	19	3	3	0	0	0	0
			1992	16	6	3	0	0	0	0
			1993	14	6	4	1	0	0	0
			1994	11	10	3	1	0	0	0
Dungannon	rural	67.7	1989	23	2	0	0	0	0	0
			1990	16	9	0	0	0	0	0
			1991	19	6	0	0	0	0	0
			1992	19	6	0	0	0	0	0
			1993	16	9	0	0	0	0	0
			1994	15	10	0	0	0	0	0
Somerville	rural	49.4	1989	7	16	2	0	0	0	0
			1990	7	15	3	0	0	0	0
			1991	18	7	0	0	0	0	0
			1992	14	11	0	0	0	0	0
			1993	7	17	0	0	0	0	1
			1994	14	10	0	0	0	0	1
<i>Pembroke District</i>										
Arnprior	urban	54.8	1990	12	9	4	0	0	0	0
			1991	11	8	2	1	1	0	2
			1992	6	13	3	1	0	0	2
			1993	5	12	3	3	0	0	2
			1994	2	10	10	0	1	0	2
Pembroke	urban	63.2	1989	21	2	1	1	0	0	0
			1990	16	7	1	1	0	0	0
			1991	11	1	1	0	0	0	12
			1992	12	0	1	0	0	0	12
			1993	12	1	0	0	0	0	12
			1994	10	3	0	0	0	0	12
Renfrew	urban	62.4	1990	8	16	1	0	0	0	0
			1991	19	5	1	0	0	0	0
			1992	13	9	2	0	0	0	1
			1993	11	7	5	0	1	0	1
			1994	6	12	5	0	0	0	2
Ross	rural	67.1	1989	21	4	0	0	0	0	0
			1990	9	14	2	0	0	0	0
			1991	17	8	0	0	0	0	0
			1992	15	10	0	0	0	0	0
			1993	12	11	2	0	0	0	0
			1994	7	17	1	0	0	0	0
Westmeath	rural	58.3	1989	20	5	0	0	0	0	0
			1990	5	15	4	1	0	0	0
			1991	14	11	0	0	0	0	0
			1992	15	10	0	0	0	0	0
			1993	4	17	4	0	0	0	0
			1994	2	18	5	0	0	0	0

^a 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = >60%, 5 = dead tree.