

**RESULTS OF FOREST INSECT
AND DISEASE SURVEYS IN THE
CENTRAL REGION OF ONTARIO,
1993**

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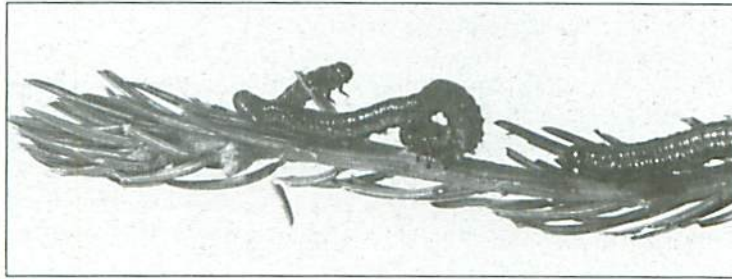
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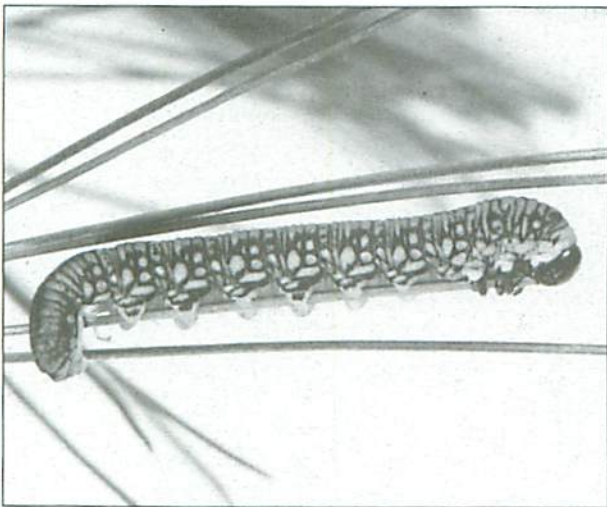
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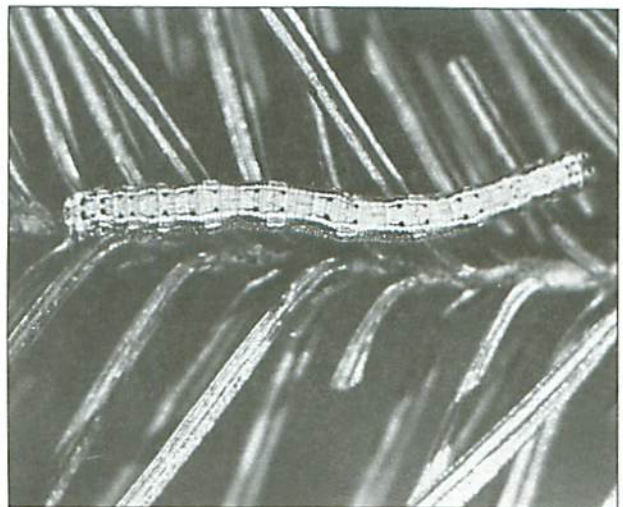
FRONTISPIECE



Larva of the yellowheaded spruce sawfly, *Pikonema alaskensis* (Roh.)



Larva of the introduced pine sawfly, *Diprion similis* (Htg.)



Larva of the hemlock looper, *Lambdina f. fuscicollis* (Gn.)

SURVEY HIGHLIGHTS

This report describes the more important insect, disease, and abiotic conditions encountered in 1993 during ground and aerial surveys in the Central Region of Ontario.

Two major hardwood defoliators, the forest tent caterpillar and the gypsy moth, continued to pose problems. Despite population collapses of the forest tent caterpillar in the Algonquin Park and Parry Sound districts the overall area of moderate-to-severe defoliation increased slightly to 85,463 ha. However, the area of medium-to-heavy infestation caused by gypsy moth decreased by over one-third to 6,645 ha. All of the damage was confined to the Sudbury District.

Population levels of two major conifer pests, the eastern spruce budworm and the jack pine budworm, increased from 1992 to 44,662 and 282,247 ha, respectively, of moderate-to-severe defoliation. Populations of both insects are forecast to increase. The pine false webworm continued to cause serious damage in red pine plantations in the Bancroft, Parry Sound, and Pembroke districts.

Surveys for Scleroderris canker were carried out again in 1993. The European race of the fungus was found in 33 red pine plantations. Two infected locations identified in the Bancroft District represent a significant extension in the geographic range of the disease.

Hardwood dieback and mortality affected some 33,500 ha and was still very visible; however, for the most part it appears to have stabilized.

Sixty-two sugar maple health plots, three oak plots, nine Acid Rain National Early Warning System (ARNEWS) plots, and eight North American Maple Project (NAMP) plots were reevaluated.

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

Major Insects or Diseases

capable of causing serious injury to or death of living trees or shrubs.

Minor Insects or Diseases

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

Other Forest Insects and 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 1993.

The valuable assistance and cooperation extended to the authors by Ontario Ministry of Natural Resources (OMNR) staff during the 1993 field season are gratefully acknowledged

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INSECTS

Major Insects

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

High populations of the pine false webworm continued to be a problem in a number of red pine (*Pinus resinosa* Ait.) plantations in the Bancroft, Parry Sound, and Pembroke districts. In those plantations where the pest has been present for a number of years there has been a noticeable impact on tree growth. Although the webworm prefers older foliage, high population numbers in some plantations caused up to 95% defoliation of the current growth on individual trees. Defoliation of current growth was high at some locations because successive years of heavy infestation has resulted in a reduction in overall growth. Shorter, current shoots are readily consumed by the pine false webworm when it runs out of the preferred older foliage. A total of ten red pine plantations, ranging in height from 0.9 to 7.0 m, were assessed in the three districts.

Trees averaging 2.9 m in height in two plantations in McMurrich Township, Parry Sound District, hosted the highest populations. The incidence of trees attacked in these plantations averaged 99% and corresponding defoliation of the previous year's growth averaged 66%. Current defoliation averaged 31% on 82% of the trees (Table 1). For the first time, two recently dead trees were encountered on one subplot in one of the plantations. Scleroderris canker disease (*Gremmeniella abietina* [Lagerb.] Morelet) may have contributed to the mortality of these trees, but several years of moderate-to-severe defoliation by the pine false webworm was considered to be the major factor contributing to their death.

The incidence of trees attacked at six locations in the Bancroft District in Carlow, Minden, Monteagle, Somerville, and Snowden townships ranged from 32 to 100%. Defoliation of the previous year's growth ranged from 19 to 83%. At four additional sites, up to 100% of the trees exhibited 2 to 26% current defoliation.

Current growth defoliation was encountered at one of two plantations surveyed in Horton Township, Pembroke District. Defoliation of the previous year's growth averaged 50% on the entire sample at this location. Current growth defoliation averaged 25% on 33% of the trees.

Elsewhere in the region, light foliar damage (<10%) was recorded in a 2-ha plantation of 1.2-m red pine in Airy Township, Algonquin Park District and on ornamental eastern white pine (*Pinus strobus* L.) and mugo pine (*Pinus mugo* Turra var. *mughus* Zenari) in the city of Sault Ste. Marie.

No control operations were carried out against the pine false webworm by the Ontario Ministry of Natural Resources in 1993.

Birch Skeletonizer, *Bucculatrix canadensisella* Cham.

In 1993 the areas infested by this late season pest of white birch (*Betula papyrifera* Marsh.) remained similar to those found in 1992. These included the south-central portion of the Parry Sound District, most of the Bancroft and Algonquin Park districts, the western and southern portions of the Pembroke District, the northern North Bay District, the northeastern Sudbury District, and the southern portions of the Temagami District (Fig. 1). Low populations were surveyed in the Sault Ste. Marie District.

Table 1. Damage caused by the pine false webworm at ten locations in the Central Region of Ontario in 1993. (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>Bancroft District</i>							
Carlow	2.4	1,800	5	0	32	0	21
Minden	2.7	2,700	3	49	100	5	48
Monteagle	1.6	2,250	5	8	94	5	36
Somerville	.9	2,500	3	0	33	0	19
Somerville	4.8	3,300	3	17	88	2	24
Snowden	7.0	3,000	4	100	100	26	83
<i>Parry Sound</i>							
McMurrich	2.7	2,500	18	78	99	21	65
McMurrich	3.0	2,600	30	85	100	40	68
<i>Pembroke District</i>							
Horton	0.9	2,700	20	33	100	25	50
Horton	2.7	2,000	15	0	37	0	17

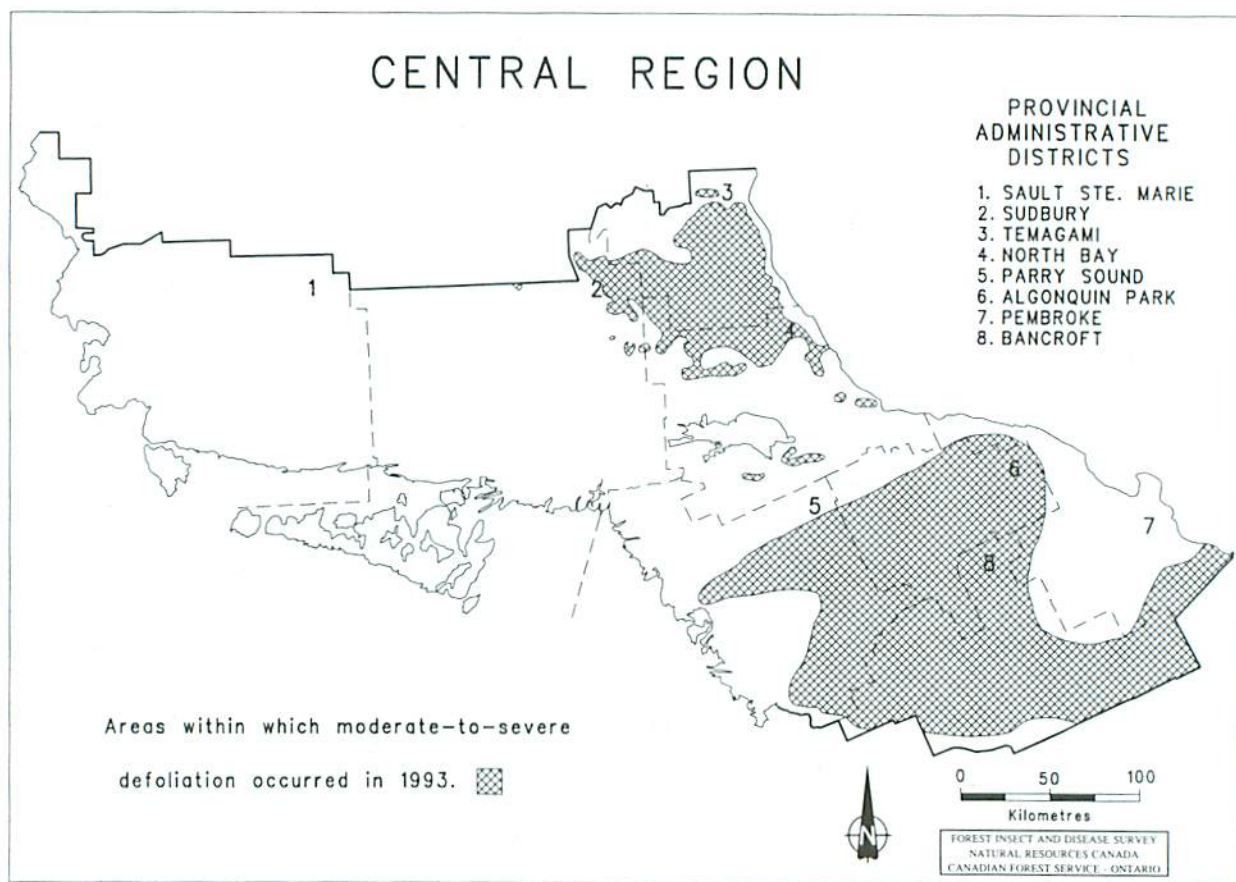


Figure 1. Birch skeletonizer, *Bucculatrix canadensisella* Cham.

Although the area infested in 1993 was similar in size to that of the previous year there was a general decrease in the intensity of damage. In 1992 defoliation up to 100% was common, but in 1993 foliar damage was mostly in the 50–70% range. Occasional stands experienced higher levels of damage.

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

Provincial Situation

The eastern spruce budworm outbreak in Ontario declined from 9,595,762 ha to 8,991,177 ha in 1993. This is the first time a decrease has been recorded in the overall size of the infestation in 5 years (Fig. 2). The largest area of decline, 440,403 ha, occurred in the Northeast Region while a smaller area of decrease, 178,147 ha, was recorded in the Northwest Region. Relatively small increases of 13,887 and 78 ha were recorded in the Central and Southern regions, respectively (Table 2).

Tree mortality resulting from successive years of defoliation was evident on the main hosts, balsam fir (*Abies balsamea* [L.] Mill.) and white spruce (*Picea glauca* [Moench] Voss), within a total area of 5,032,925 ha.

This represents an increase from the 3,943,442 ha reported in 1992.

Central Region

The spruce budworm is currently a problem in four districts of the region. The total area of moderate-to-severe defoliation in white spruce and balsam fir stands increased from 30,775 ha to 44,662 ha (Table 3 and Fig. 3).

In the Sault Ste. Marie District the infestation increased from 965 ha to 4,639 ha. Most of the infested area was within the boundaries of the city of Sault Ste. Marie, primarily to the north of the urban area, in the

Table 2. Gross area of moderate-to-severe defoliation caused by the eastern spruce budworm in Ontario in 1992 and 1993.

Region	Area of defoliation (ha)		Change (ha)
	1992	1993	
Northwest	7,473,883	7,295,736	–178,147
Northeast	2,091,080	1,650,677	–440,403
Central	30,775	44,662	+13,887
Southern	24	1	+78
Total	9,595,762	8,991,177	–604,585

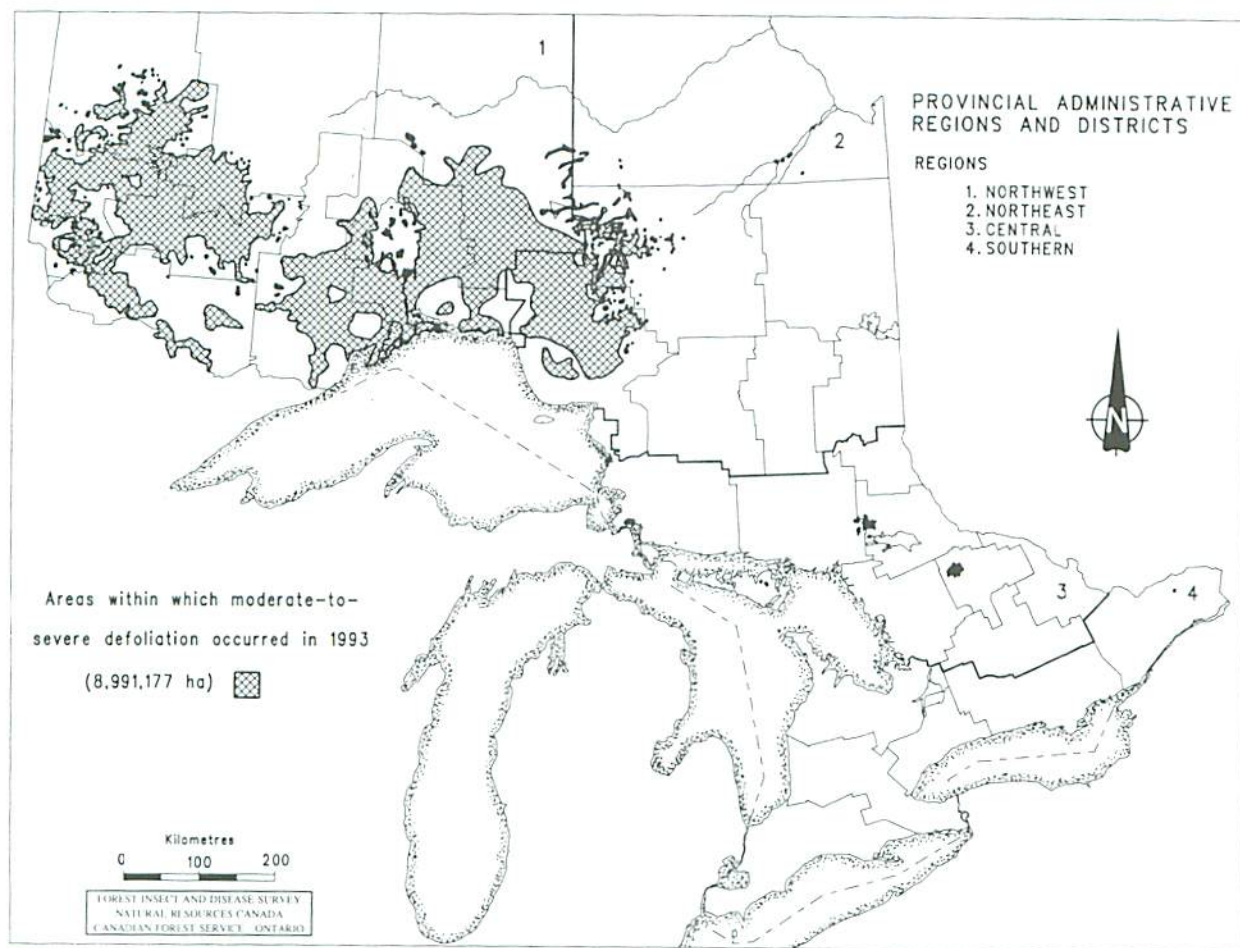


Figure 2. Eastern spruce budworm, *Choristoneura fumiferana* (Clem).

same region that was affected in 1992. However, damage intensified this year when several small outbreaks coalesced to form one main area of infestation. Outside of this larger area, there was one small pocket of severe damage in the east end of the city and small areas of moderate defoliation on the Garden River First Nation, Kirkwood Township and on St. Joseph Island.

The outbreak along the Sudbury–North Bay district boundary increased as numerous small pockets of infestation intensified and combined to form one main area of infestation with a few smaller areas on the periphery. The largest area of moderate-to-severe defoliation occurred in the eastern parts of Ratter and Dunnet town-

ships, Sudbury District and extended into portions of Kirkpatrick, Hugel, Crerar, and Caldwell townships, North Bay District. Smaller pockets of similar damage occurred in the surrounding area in MacPherson, Henry, and Badgerow townships, North Bay District and in Hagar, Appleby, and Casimir townships, Sudbury District. There were also small areas of moderate-to-severe defoliation reported in Bidwell and Allan townships on Manitoulin Island, Sudbury District. Elsewhere, low populations were noted in several areas of these two districts.

Infestation in the Algonquin Park District was centred mainly in the northwest part in Biggar and Osler townships. The area of moderate-to-severe defoliation in this area decreased by 6,495 ha from the high of 26,900 ha reported in 1992. The intensity of this infestation was also reduced in 1993 and the level of defoliation was noticeably lower. Whereas almost complete defoliation of balsam fir and white spruce was reported last year, foliar damage in 1993

Table 3. Gross area of moderate-to-severe defoliation by the eastern spruce budworm in the Central Region of Ontario from 1991 to 1993.

District	Area of defoliation (ha)			Change (ha)	
	1991	1992	1993	1992	1993
Algonquin Park	11,640	26,900	20,405	+15,260	–6,495
North Bay	10	1,545	10,468	+1,535	+8,923
Sault Ste. Marie	0	965	4,639	+965	+3,674
Sudbury	70	1,365	9,150	+1,295	+7,785
Total	11,720	30,775	44,662	+19,055	+13,887

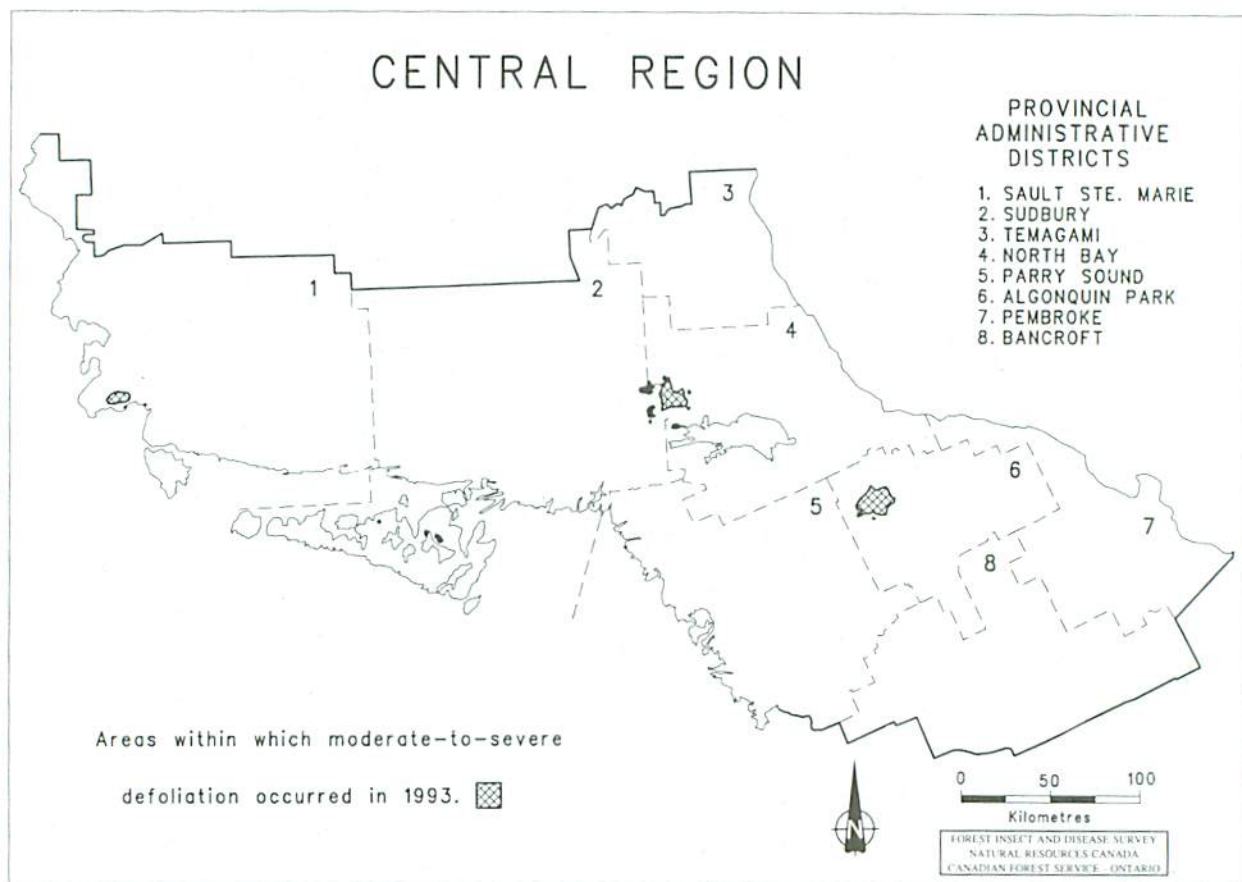


Figure 3. Eastern spruce budworm, *Choristoneura fumiferana* (Clem.).

was generally in the 50% range. Balsam fir tree and top mortality has increased and the affected area now totals 11,300 ha in Biggar and Wilkes townships. Mortality counts conducted in stands at Gibson and Loontail lakes, Biggar Township, revealed that 34 and 58%, respectively, of the balsam fir were dead.

To forecast 1994 budworm populations and expected damage, two methods were utilized. The conventional egg-mass sampling procedure was performed at many widely dispersed locations. Results indicate that infestations will probably recur in areas that are currently in-

festated but any expansion should be limited (Table 4). The newer and less refined method of forecasting involves the use of pheromone traps. These traps are designed to attract and capture male spruce budworm moths. A correlation can then be drawn between the number of moths caught and expected populations for the following year. This has not been done; however, a simple comparison of capture results at common locations in 1992 and 1993 is presented in Table 5. There were reduced numbers of moths trapped at 80% of the locations in 1993.

Table 4. Central Region – Eastern Spruce Budworm: summary of defoliation estimates and egg-mass counts in 1993 and infestation forecasts for 1994.

Location	Host ^a	Estimated % defoliation 1993	Number of egg-masses per 9.29 sq. m of foliage	Infestation forecasts for 1994 ^b	Accumulated damage ^c
<i>Algonquin Park District</i> (6 locations)					
Biggar Township – Gibson Lake	bF	56	72	M–S	4
– Loontail Lake	bF	80	141	M–S	4
Lister Township	bF	9	28	L–M	1
Osler Township	bF	42	281	S	1
Stratton Township	wS	3	0	N	0
White Township	bF	1	20	L–M	0
<i>Bancroft District</i> (3 locations)					
Cavendish Township	bF	0	0	N	0
Denbigh Township – Slate Falls Road	bF	2	0	N	0
Hindon Township	bF	0	0	N	0
<i>North Bay District</i> (11 locations)					
Crerar Township	bF	57	277	S	1
Henry Township ^d	bF	43	51	M–S	0
	wS	25	125	M–S	0
	bS	0	55	M	0
	bF	63	8	M–S	1
Hugel Township	bF	0	0	N	0
Jocko Township	bF	0	0	N	0
Kirkpatrick Township	bF	34	96	M–S	0
MacBeth Township	bF	0	0	N	0
McWilliams Township	bF	0	17	L–M	0
Sisk Township	bF	0	0	N	0
South Himsforth Township	bF	1	0	N	0
<i>Parry Sound District</i> (6 locations)					
Bethune Township	bF	1	0	N	0
Laurier Township	bF	0	0	N	0
McMurrich Township	bF	0	0	N	0
Mowat Township	bF	0	15	L–M	0
Ridout Township	bF	0	0	N	0
Spence Township	bF	0	0	N	0
<i>Pembroke District</i> (1 sample)					
Alice Township	bF	2	0	N	0
<i>Sault Ste. Marie District</i> (24 locations)					
Asselin Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Aweres Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Galbraith Township	bF	0	7	L	0
Gaudette Township	bF	0	0	N	0
Herrick Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Jollineau Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Kincaid Township	bF	0	0	N	0
Kirkwood Township – Nursery area	wS	59	71	M–S	1
LaRonde Township ^d	bF	1	0	N	0
	wS	0	0	N	0
Nicholas Township	bF	0	0	N	0
Parkinson Township	bF	0	0	N	0

(cont'd)

Table 4. Central Region – Eastern Spruce Budworm: summary of defoliation estimates and egg-mass counts in 1993 and infestation forecasts for 1994. (concl.)

Location	Host ^a	Estimated % defoliation 1993	Number of egg-masses per 9.29 sq. m of foliage	Infestation forecasts for 1994 ^b	Accumulated damage ^c
<i>Sault Ste. Marie District (24 locations) (concl.)</i>					
Peever Township ^d	bF	0	0	N	0
	wS	1	0	N	0
Shields Township ^d	bF	0	0	N	0
	wS	0	0	N	0
Spragge Township	bF	0	0	N	0
Tarbutt Additional Township	bF	0	0	N	0
Tarentorus Township	bF	95	81	M-S	3
Villeneuve Township	bF	0	0	N	0
<i>Sudbury District (24 locations)</i>					
Antrim Township					
– Halfway Provincial Park	wS	1	0	N	0
Baldwin Township	bF	1	0	N	0
Bidwell Township	bF	12	0	N	0
Boon Township ^d	bF	1	0	N	0
Cascaden Township	bF	0	0	N	0
Denison Township	wS	21	28	L-M	0
Dunnet Township	bF	37	156	M-S	0
Foster Township ^d	bF	1	0	N	0
	wS	1	0	N	0
Fraleck Township	bF	0	0	N	0
Hart Township ^d	bF	0	0	N	0
	wS	1	0	N	0
	bS	1	0	N	0
Mongowin Township	bF	1	0	N	0
Nairn Township ^d	bF	0	0	N	0
	wS	2	14	L	0
Ratter Township	wS	60	1205	S	2
Robinson Township	wS	12	0	N	0
Rowat Township	bF	0	0	N	0
Salter Township ^d	bF	1	0	N	0
	wS	2	8	L	0
Venturi Township	bF	1	0	N	0
Waldie Township	bF	0	0	N	0
Weeks Township ^d	bF	0	0	N	0
<i>Temagami District (6 location)</i>					
Barr Township	bF	0	8	L	0
Brewster Township	bF	0	0	N	0
Gillies Limit Township	wS	0	0	N	0
Olive Township	bF	0	0	N	0
Strathcona Township ^d	bF	0	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 Accumulated damage: 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% of stand dead; 7 = 50 to 70 % of stand dead; 8 = >70% of 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.

Table 5. Results of eastern spruce budworm pheromone trapping in eight districts of the Central Region of Ontario from 1991 to 1993.

Location (Township)	Number of adults trapped		
	1991	1992	1993
<i>Algonquin Park District</i>			
Stratton	633	643	482
White	622	962 ^a	501
<i>Bancroft District</i>			
Denbigh	—	193	53
Hindon	140	340	67
<i>North Bay District</i>			
Jocko	—	66	96
Macbeth	—	567	400
Sisk	—	161	71
<i>Parry Sound District</i>			
Bethune	530	1,169	251
Spence	221	414	117
<i>Pembroke District</i>			
Alice	782	2,447	619
<i>Sault Ste. Marie District</i>			
Asselin ^b	—	117	147
Aweres ^b	—	520	710
Gaudette	—	263	219
Jollineau ^b	204	281	180
Kincaid	—	181	155
Kirkwood	915	4,738	162
Laronde ^b	—	635	412
Nicholas	—	397	250
Peever ^b	—	175 ^c	302
Tarbutt	—	175	532
Villeneuve	—	156	154
<i>Sudbury District</i>			
Antrim	—	811	547
Baldwin	—	184	74
Cascaden	405	292	607
Cleland	—	124	74
Drury	—	293	221
Fracleck	—	271	255
Gerow	—	143	99
Gervais	—	294	39 ^a
Hugel	—	7,073 ^c	3,027
Venturi	—	490	376
<i>Temagami District</i>			
Barr	—	222	35
Brewster	—	55	57
Gillies Limit	—	82 ^a	79
Strathcona ^b	30	71	35

^a Two traps missing.

^b Eastern spruce budworm NFP plot.

^c One trap missing.

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

Provincial Situation

In 1993, the area of moderate-to-severe defoliation in Ontario totaled 282,247 ha, an increase of 123,543 ha from the 158,704 ha mapped in 1992. All of the defoliation this year was confined to the Central Region in the following districts: Algonquin Park, North Bay, Parry Sound, Pembroke, Sault Ste. Marie, Sudbury, and Temagami (Fig. 4). The 1992 infestations, which totaled 693 ha in the Red Lake District, Northwest Region and 533 ha in the Tweed District, Southern Region, collapsed in 1993.

Central Region

The area of moderate-to-severe defoliation of jack pine (*Pinus banksiana* Lamb.) increased substantially in the Sudbury District from 60,349 to 165,840 ha in 1993 (Table 6). Most of the areas defoliated in 1992 in the Espanola area and the southeastern portion of the Sudbury District were again defoliated in 1993. The new medium-to-heavy infestations occurred primarily in the northern and western portions of the district. New defoliated areas were recorded north and southeast of Lake Wanapitei, between the towns of Capreol, Cartier, and Chelmsford; southwest of Cartier in Hart, Ermatinger, and Totten townships; and along the Wakonassin and aux Sables Rivers and included much of Rowat, Solski, Moses, Weeks, Bigelow, Monestime, Olinyk, Prescott, Teasdale, Strain, and Mandamin townships. Defoliation was also noted as far north as Athlone Township. Extremely heavy damage occurred north of Lake Wanapitei in Aylmer and Rathbun townships where severe backfeeding on older foliage was observed.

In the Parry Sound District high budworm populations were recorded for the fourth consecutive year and moderate-to-severe defoliation was noted in much of the same area that was infested in 1992. The largest single body of medium-to-heavy infestation extended north of the Pointe au Baril area and along the Georgian Bay coast to Cox and Delamere townships in the Sudbury District. Generally, the infestation was contained west of Highway 69 but extended east into Blair and Brown townships. Smaller pockets of damage were observed in Mowat, Blair, Brown, Wilson, McKenzie, East Burpee, and Shawanaga townships.

A new infestation totaling 1,095 ha was recorded in Sagard Township, north of Elliot Lake, in the Sault Ste. Marie District. Another new infestation, covering 50 ha, was found in Armagh Township, south of Wawigama Lake in the Temagami District. In Armagh Township the damage was very heavy and the majority of the trees sustained 75 to 95% current defoliation.

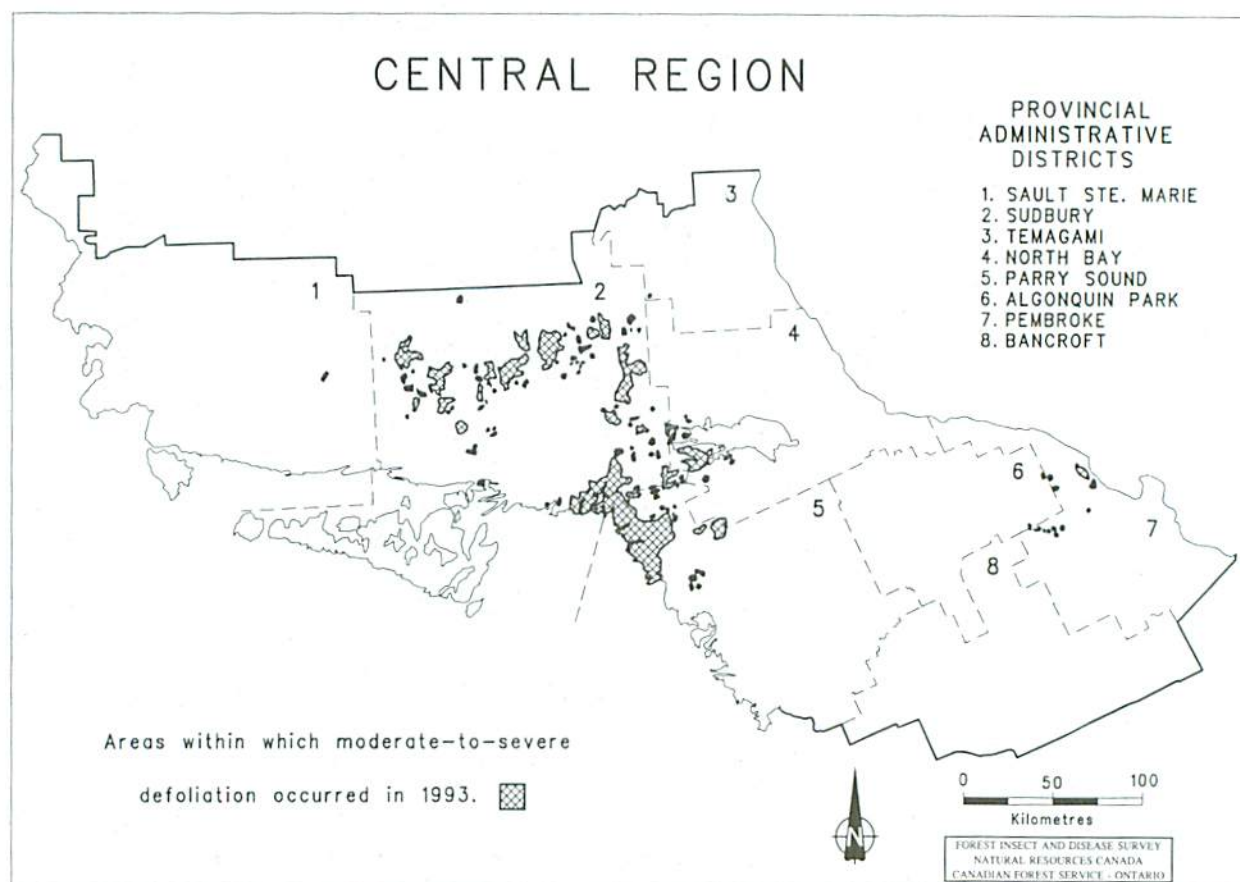


Figure 4. Jack pine budworm, *Choristoneura p. pinus* Free.

Table 6. Gross area of moderate-to-severe defoliation by the jack pine budworm in the Central Region of Ontario, 1991-1993.

District	Area of Moderate-to-severe defoliation (ha)		
	1991	1992	1993
Algonquin Park	0	465	380
Bancroft	20	30	0
North Bay	290	16,379	19,035
Parry Sound	51,276	77,551	91,645
Pembroke	0	2,704	4,202
Sault Ste. Marie	0	0	1,095
Sudbury	9,518	60,349	165,840
Temagami	0	0	50
Total	61,104	157,478	282,247

In the North Bay, Pembroke, and Algonquin Park districts most of the area defoliated in 1992 was again defoliated in 1993. The largest pocket of moderate-to-severe defoliation in the North Bay District 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 in Macpherson, Kirkpatrick, and Caldwell townships. Relatively small infestations occurred in Petawawa, Wylie, McKay, Alice, Fraser, Richards, and Burns townships in the Pembroke District and in Guthrie and Stratton townships in the Algonquin Park District.

Damage to eastern white pine, growing in close 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, 4- to 16-m trees sustained current defoliation ranging between 60 and 100%.

High population levels of the jack pine budworm were present in parts of the Parry Sound District for the fourth consecutive year. Much of this currently infested area had also been subjected to five consecutive years of moderate-to-severe defoliation by the jack pine budworm from 1982 to 1986. Some areas, therefore, 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 the additional stress of below-

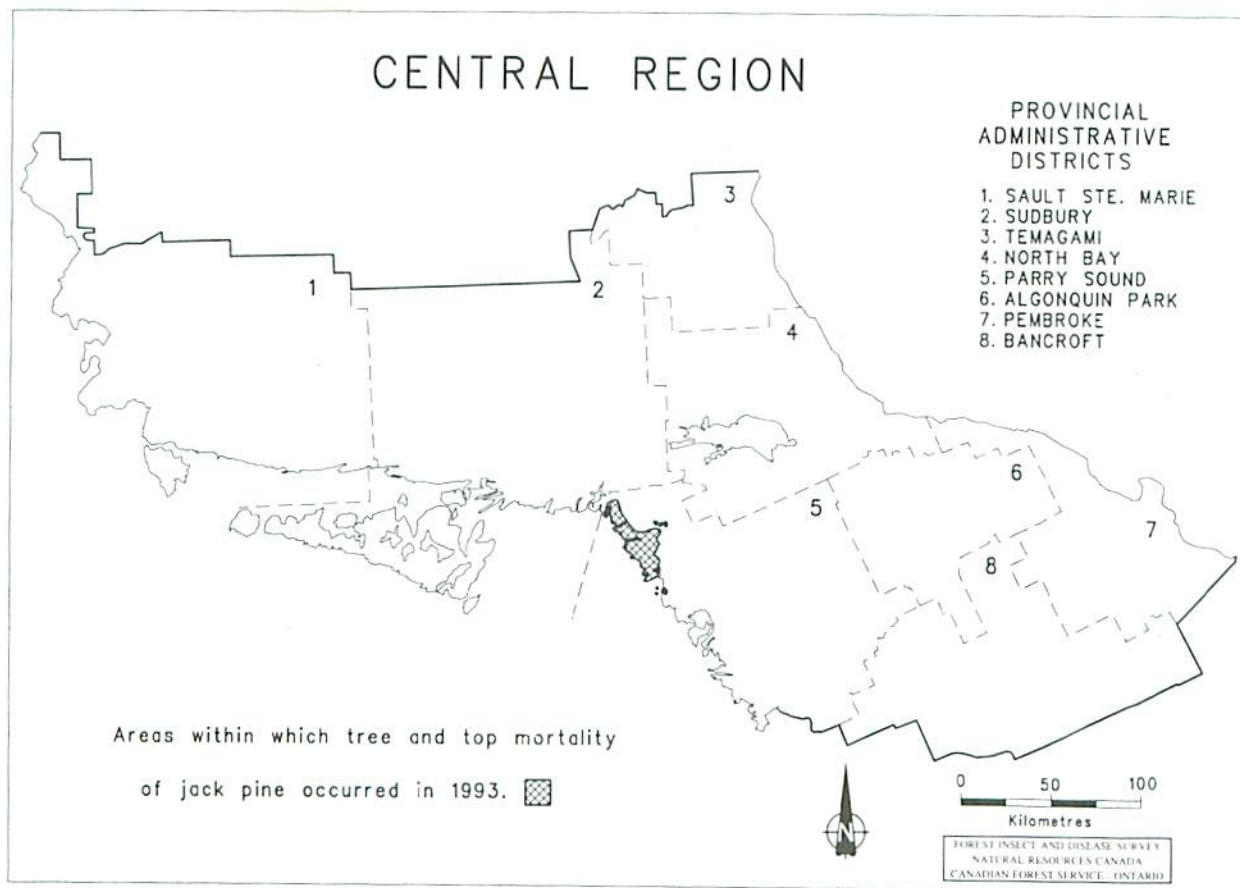


Figure 5. Jack pine budworm, *Choristoneura p. pinus* Free.

normal precipitation for a number of years. The result has been a large area (50,937 ha) of jack pine mortality (Fig. 5). A single large body of dead and moribund jack pine was mapped north of Point au Baril, along the Georgian Bay coast to the Pickerel River area along the Parry Sound-Sudbury district boundary. At one point it extends east as far as the CNR tracks in Wallbridge Township, Parry Sound District. Smaller, separate pockets of dead jack pine were recorded in Shawanaga, Mowat, Wallbridge, Blair, and Brown townships. Four 100-tree mortality plots were tallied in 1993; one in each of Brown and Harrison townships and two in Wallbridge Township. In the Brown Township plot, 27% mortality and 15% bare tops (heavy crown defoliation) were recorded. Assessment at Harrison Township disclosed 26% mortality and 40% bare tops. At one location in Wallbridge Township there was 38% mortality and 19% dead tops. At the other location 29% of the trees were dead and another 13% had bare tops.

Egg-mass sampling to forecast 1994 population levels was carried out at 134 locations in the region (Table 7). In the Sudbury District, moderate or heavy infestation levels are forecast for 67% of the 55 mature or overmature sample sites. The area of moderate-to-severe defoliation is expected to increase in the district, particularly to the north. Elsewhere in the region little change is expected. In Parry Sound, 9 of 12 sample points are predicted to have medium-to-heavy population levels although the average number of egg-masses per sample indicates that the intensity of the defoliation should again decrease. In the Sault Ste. Marie, Temagami, and North Bay districts those areas infested in 1993 are likely to be reinfested in 1994. Some possible expansion of the outbreak may also occur. In the Pembroke and Algonquin Park districts egg-mass counts indicate a likely decrease in the area infested in 1994. However, in White Township, Algonquin Park District, population levels appear to be increasing. No egg masses were observed at two sample points in the Bancroft District.

Table 7. Jack pine budworm in the Central Region of Ontario: defoliation estimates and egg-mass counts in 1993 and infestation forecasts for 1994 on jack pine.

Location	Estimated % defoliation (1993)	Total number of egg masses on six 61-cm branch tips	Infestation forecast for 1993 ^a
<i>Algonquin Park District</i>			
Fitzgerald Township	0	0	N
Guthrie Township	36	3	M
Stratton Township	61	0	N
White Township	34	12	H
<i>Bancroft District</i>			
Chandos Township	0	0	N
Methuen Township	0	0	N
<i>North Bay District</i>			
Latchford Township – stand 168 ^b	30	9	H
McNish Township	5	0	N
Merrick Township	0	0	N
<i>Parry Sound District</i>			
Blair Township	11	1	L
Brown Township	72	9	H
Carling Township – Hwy 69	4	1	L
Carling Township – Snug Harbour	9	4	M
Harrison Township – Hwy 529A	68	29	H
Harrison Township – I.R. 17A	29	22	H
Harrison Township – S. of Point eau Baril	7	2	L
Henvey Township	18	8	H
Mowat Township – Pickerel River	36	3	M
Mowat Township – 10 km east of Still River	33	16	H
Wallbridge Township – Harris Lake Road	78	34	H
Wallbridge Township – Magnetawan River	48	20	H
<i>Pembroke District</i>			
Burns Township	4	0	N
Clara Township	4	0	N
Fraser Township	42	5	M
Head Township	4	0	N
Maria Township	4	0	N
Petawawa Township	36	0	N
Richards Township	18	3	M
Richards Township – Brønnechere	43	19	H
Wylie Township – Frontier Lake	36	4	M
Wylie Township – PNFI – Ex 255	8	0	N
Wylie Township – PNFI – Ex 431	11	2	L
Wylie Township – Sturgeon Lake	11	0	N
<i>Sault Ste. Marie District</i>			
Bouck Township – stand 198 ^b	0	1	L
Gaunt Township – stand 118	1	0	N
Lane Township – stand 40 ^{bc}	0	0	N
Lane Township – stand 64 ^b	0	0	N
Laughren Township – stand 135 ^b	0	0	N
Martel Township – stand 56 ^b	0	0	N
Martel Township – stand 170	0	0	N
Martel Township – stand 178 ^{bc}	0	0	N
Nicholas Township	1	0	N

(cont'd)

Table 7. Jack pine budworm in the Central Region of Ontario: defoliation estimates and egg-mass counts in 1993 and infestation forecasts for 1994 on jack pine.

Location	Estimated % defoliation (1993)	Total number of egg masses on six 61-cm branch tips	Infestation forecast for 1993 ^a
<i>Sault Ste. Marie District (concl.)</i>			
Poulin Township – stand 93 ^b	0	0	N
Rioux Township – stand 31 ^b	0	1	L
Sagard Township – stand 3 ^b	0	0	N
Sagard Township – stand 113 ^b	32	11	H
Sagard Township – stand 132	85	26	H
Sagard Township – stand 136 ^{bc}	4	4	M
Vance Township – stand 130 ^{bc}	0	0	N
Villeneuve Township – stand 200 ^b	0	0	N
Villeneuve Township – stand 218 ^{bc}	0	1	L
Wardle Township	0	0	N
Wardle Township – stand 99 ^{bc}	0	0	N
Wells Township – stand 69 ^b	30	0	N
Winkler Township – stand 95 ^{bc}	0	1	L
Winkler Township – stand 180 ^b	0	0	N
<i>Sudbury District</i>			
Allen Township – stand 82 ^b	15	22	H
Antrim Township – stand 235 ^b	21	4	M
Avis Township – stand 62	0	0	N
Aylmer Township – stand 143 ^b	92	3	M
Bigelow Township – stand 175	8	10	H
Bigwood Township – Murdock River	14	2	L
Bigwood Township – west	11	0	N
Birch Island	7	2	L
Cartier Township – stand 236 ^b	70	13	H
Cartier Township – stand 367 ^b	50	17	H
Cleland Township	73	1	L
Cox Township	50	26	H
Dunbar Township – stand 227 ^{bc}	4	1	L
Dunlop Township – stand 6	15	0	N
Dunlop Township – stand 13 ^{bc}	5	3	M
Durban Township – stand 72 ^{bc}	4	0	N
Ermatinger Township – stand 50 ^b	70	11	H
Ermatinger Township – stand 70 ^b	13	6	H
Foucault Township – stand 103 ^b	12	0	N
Gervais Township – stand 28	4	0	N
Great La Cloche Island	9	2	L
Haddo Township	39	7	H
Hamner Township	46	3	M
Hart Township	52	4	M
Hart Township – stand 73 ^{bc}	2	1	L
Hart Township – stand 137 ^{bc}	0	0	N
Hart Township – stand 139 ^b	50	20	H
Hotte Township	6	0	N
Hutton Township – stand 402 ^b	26	3	M
Lefebvre Township – stand 234 ^{bc}	8	2	L
Leinster Township – stand 297 ^b	59	34	H
Lumsden Township	12	1	L
Mandamin Township – km 39.2	81	11	H

(cont'd)

Table 7. Jack pine budworm in the Central Region of Ontario: defoliation estimates and egg-mass counts in 1993 and infestation forecasts for 1994 on jack pine. (concl.)

Location	Estimated % defoliation (1993)	Total number of egg masses on six 61-cm branch tips	Infestation forecast for 1993 ^a
<i>Sudbury District (concl.)</i>			
Mandamin Township – km 46.5	55	20	H
Merritt Township – Block 3	7	2	L
Merritt Township – Block 4	8	2	L
Merritt Township – Block 5	7	5	M
Merritt Township – Queensway Road west	38	4	M
Moncrieff Township – stand 144 ^{bc}	15	1	L
Moncrieff Township – stand 429 ^{bc}	8	1	L
Moncrieff Township – stand 441 ^b	5	0	N
Monestime Township – stand 210 ^b	27	19	H
Moses Township – stand 22 ^{bc}	10	1	L
Moses Township – stand 120 ^b	58	21	H
Moses Township – stand 260 ^{bc}	65	24	H
Munster Township – stand 66 ^{bc}	0	0	N
Munster Township – stand 107 ^b	35	3	M
Nairn Township – stand 28	66	4	M
Nairn Township – stand 125	59	1	L
Olinyk Township – stand 90 ^b	24	1	L
Olinyk Township – stand 290 ^b	44	12	H
Prescott Township – stand 73	79	37	H
Prescott Township – stand 148 ^b	79	43	H
Prescott Township – stand 333	52	13	H
Rathbun Township – stand 129 ^b	64	9	H
Rhodes Township – stand 139 ^b	4	3	M
Rhodes Township – stand 247 ^b	3	3	M
Rowat Township – stand 47 ^b	18	8	H
Rowat Township – stand 316 ^b	23	7	H
Scadding Township – stand 20 ^b	48	10	H
Scadding Township – stand 33 ^b	52	11	H
Scadding Township – stand 71 ^{bc}	35	6	H
Scollard Township – stand 50 ^b	66	10	H
Solski Township – stand 36 ^{bc}	0	0	N
Street Township – stand 60 ^{bc}	14	1	L
Teasdale Township – stand 94 ^b	67	13	H
Teasdale Township – stand 185 ^b	38	5	M
Ulster Township – east	8	1	L
Ulster Township – stand 308 ^b	4	1	L
Weeks Township – stand 271 ^{bc}	26	11	H
<i>Temagami District</i>			
Armagh Township	74	9	H
Coleman Township – family test E. ^c	2	1	L
Coleman Township – family test W. ^c	0	0	N
Coleman Township – seed orchard ^c	0	1	L
Firstbrook Township – family test ^c	0	0	N
Firstbrook Township – seed orchard ^c	0	0	N
Firstbrook Township – stand test ^c	0	0	N
Gillies Limit Township	0	0	N

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

^b NFP plot.

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

Eastern Pine Shoot Borer, *Eucosma gloriola* Heinr.

Juvenile pine trees are the most susceptible to attack by the eastern pine shoot borer. The insect causes damage to the new shoots and is most adverse when the leader is attacked.

Surveys conducted in 1993 indicate that, for the most part, damage was much reduced from that reported in 1992. At eight jack pine locations in the Sault Ste. Marie and Sudbury districts, where surveys were carried out in both years, the average number of damaged leaders declined from 15.4 to 5.5%. Evaluations were conducted in plantations in five districts in 1993 (Table 8).

Fall Webworm, *Hyphantria cunea* (Drury)

In 1993, areas of moderate foliar damage caused by this late season pest were confined to the eastern Pem-

broke District. In Clara, Head, Maria, and Rolph townships of the Pembroke District damage was observed in small pockets (< 1 ha) of semimature and mature trees. Defoliation of affected trees averaged 35%. Black ash (*Fraxinus nigra* Marsh.) was the favoured host but cherry (*Prunus* spp. L.), white elm (*Ulmus americana* L.), and white birch were also attacked. Similar damage to hedgerow white elm was observed in McNab Township, Pembroke District.

Light damage was found in Digby, Harry, Laxton, and Somerville townships, Bancroft District. In most cases damage to single trees averaged 30%. Light damage was also scattered throughout the North Bay, Parry Sound, and Sudbury districts.

Table 8. Damage caused by the eastern pine shoot borer at 22 locations in the Central Region of Ontario in 1993. (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>North Bay District</i>					
Merrick – family test	jP	4.1	2,300	4	0
<i>Parry Sound District</i>					
Ryde	ewP	1.6	3,100	2	2.7
Ryde	ewP	2.3	4,100	1	2.0
<i>Sault Ste. Marie District</i>					
Cuthbertson – family test	jP	2.1	2,500	4	4.7
Hurlburt	jP	1.5	2,500	15	2.0
Hynes	jP	1.2	3,500	10	3.0
Hynes	rP	0.8	2,800	10	0
Kirkwood – family test	jP	4.5	2,500	2	3.0
Lamming	jP	3.1	3,000	12	2.0
Landriault	jP	2.2	2,500	20	10.0
Lane – family test	jP	3.3	2,500	10	11.7
LaVerendyre	jP	1.3	3,600	5	7.3
McNie	jP	2.4	3,000	5	7.0
Smilsky – family test	jP	3.4	2,500	4	0.7
<i>Sudbury District</i>					
Hallam – seed orchard	jP	5.5	2,400	6	4.0
Lumsden – seed orchard	jP	4.2	2,200	4	3.0
Olinyk – family test	jP	1.5	2,400	4	2.7
Street – family test	jP	3.1	2,400	4	4.0
Venturi	jP	2.5	2,400	25	13.3
<i>Temagami District</i>					
Firstbrook – family test	jP	1.7	2,500	12	0.7
Firstbrook – stand test	jP	2.2	2,500	5	1.3
Milne	jP	2.4	4,000	100	0.7

^a ewP = eastern white, jP = jack pine, rP = red pine.

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

Aerial surveys for this late season pest (see frontispiece) revealed 1,260 ha of moderate-to-severe defoliation in the Sudbury District. The majority of the damage occurred on the southern and eastern portions of Manitoulin Island. A single island in Beaverstone Bay, east of Killarney, also sustained heavy damage. In most cases the infested stands 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.

The heaviest damage occurred in the James Bay area on the Wikwemikong First Nation. Within the area of infestation, 5- to 10-ha pockets sustained extremely high levels of defoliation. Balsam fir was the preferred host and trees up to 15 m in height sustained complete defoliation. Damage to the cedar was also heavy and groups of trees experienced total defoliation. However, overall damage was not as extensive as that on balsam fir. Moderate-to-severe defoliation was also recorded on some overstory eastern white pine. Poplar (*Populus* spp.) in the area sustained severe damage but usually only on sites where the balsam fir and cedar were already heavily defoliated. Elsewhere on the reserve damage was recorded north of Nadeau Point and along the Manitowaning Bay shore south of Rabbit Island.

Although the population level of hemlock looper has decreased, the area infested in Campbell Township in 1992 sustained high levels of damage again in 1993. Six additional pockets, ranging in area from 6 to 130 ha, were observed between Marsh Lake and Dean's Bay in Mills and Campbell townships. Relatively small infested areas were also observed northeast of Lorne Lake in Burpee Township, north of Mud Lake in Mills Township, and south of Squirrel Town in Assiginack Township. Most of the damage in these areas was confined to understorey balsam fir and eastern white cedar; however, some trees sustained total defoliation.

High looper populations were also observed on Lang Island in Beaverstone Bay. Surrounding islands, however, sustained negligible amounts of damage. The heaviest damage occurred to eastern white cedar where 75% of the understorey and individual trees up to 15 m in height were denuded of foliage. Severe defoliation (up to 100% on individual trees) was observed on understorey white spruce and black spruce (*Picea mariana* [Mill] BSP). Overstory eastern white pine sustained moderate and, in some cases, severe defoliation. Red maple (*Acer rubrum* L.) and white birch sustained light-to-moderate levels of defoliation in areas where the cedar and spruce were heavily damaged. Ground juniper (*Juniperus* sp.) was also heavily defoliated over most of the island.

Early season surveys revealed mortality to balsam fir regeneration caused by heavy defoliation in 1992. At

one location in Campbell Township, 20% mortality occurred to understorey trees over a 1-ha area.

Extremely heavy moth flights were observed in the James Bay area on the Wiwemikong Indian Reserve and on Lang Island in Beaverstone Bay. These indicate high population levels of the pest will likely recur in 1994. Moths were also observed in uninfested areas in Bidwell Township and in the Bell Lake area in Killarney Provincial Park.

Gypsy Moth, *Lymantria dispar* (L.)

Provincial Situation

A total of 9,784 ha of moderate-to-severe defoliation was recorded in the province in 1993. This represents a substantial 24,676 ha decrease from the previous year. Population increases in the Sudbury District, Central Region and the Aylmer District, Southern Region were offset by major population collapses elsewhere (Fig. 6).

Central Region

A widespread population collapse occurred throughout the Algonquin Park, Bancroft, Parry Sound, and Pembroke districts (Table 9). For the first time in many years there was no moderate-to-severe defoliation in these districts. However, low numbers of larvae were observed throughout many of the areas that were heavily infested in previous years.

Although the total area of moderate-to-severe defoliation increased in the Sudbury District, there were some population collapses in the Killarney Provincial Park area and on Manitoulin Island (Fig. 7). These were offset by an increase of defoliated areas on rocky ridges south and east of the city of Sudbury. The largest concentration of medium-to-heavy infestation occurred in Dryden, Neelon, Dill, Secord, and Broder townships. Numerous, smaller pockets were observed in Cleland, Tilton, Eden, Waters, Graham, Nairn, and Foster townships and in Whitefish Lake Indian Reserve 6 and Whitefish River Indian Reserve 4 where much of the damage occurred on open-growing trees on shallow sites. Small red oak (*Quercus rubra* L.) and white birch sustained the majority of the defoliation although heavy damage was also recorded on red pine and trembling aspen (*Populus tremuloides* Michx.). Dead and diseased larvae infected by the nuclear polyhedrosis virus were found throughout those areas infested by large numbers of gypsy moths.

In the Sault Ste Marie District, high egg-mass populations were observed in 1992 in Long and Striker townships in the Blind River area. These appear to have succumbed to low winter temperatures, however, as no eggs could be found that had hatched in 1993. Later surveys in this area failed to detect any larvae or defoliation that could be attributed to gypsy moth.

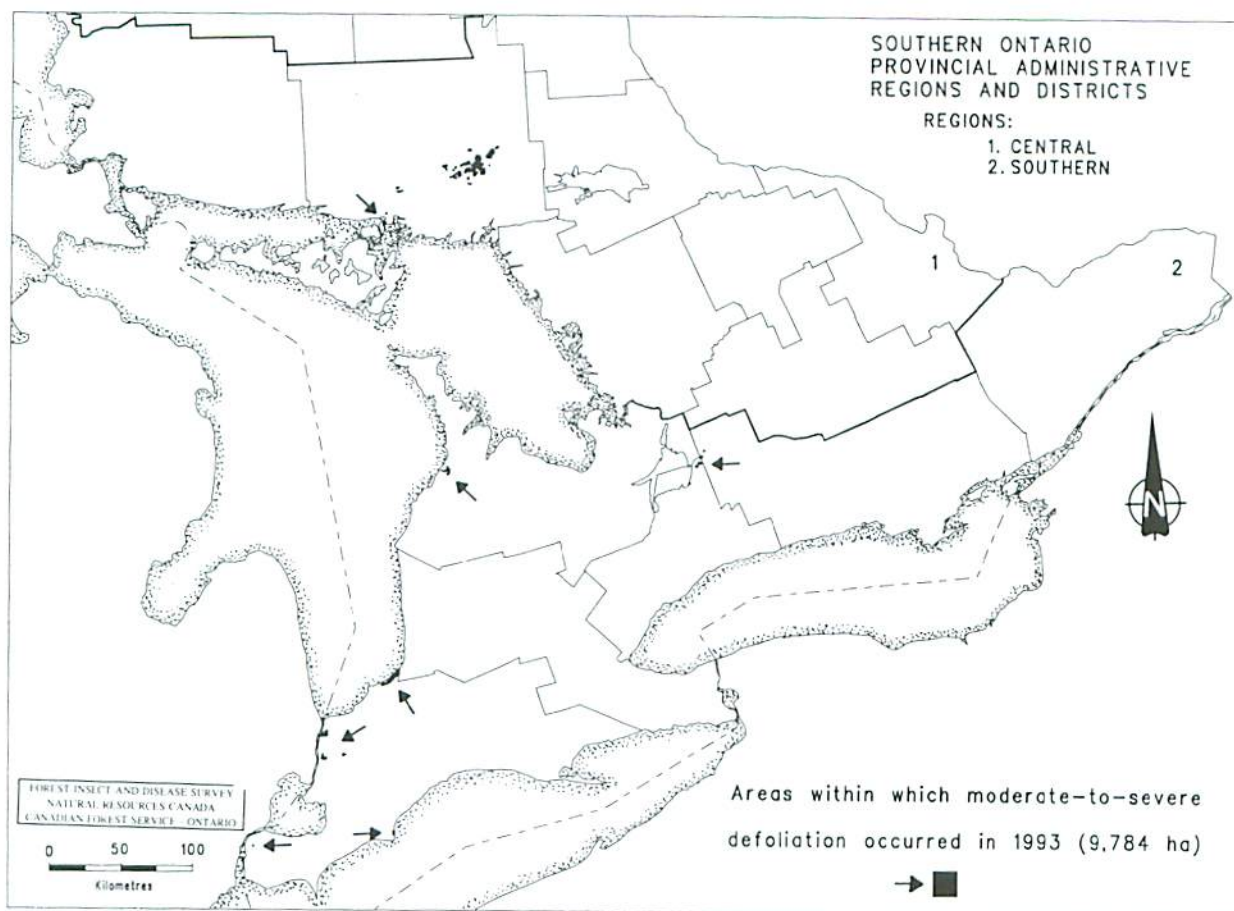


Figure 6. Gypsy moth, *Lymantria dispar* (L.).

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 10). Male moths were trapped at all but two locations. Both of these exceptions were in Lake Superior Provincial Park in the Sault Ste. Marie District.

Table 9. Gross area of moderate-to-severe defoliation caused by the gypsy moth from 1991 to 1993 in the Central Region of Ontario.

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

Forest Tent Caterpillar, *Malacosoma disstria* Hbn.

Provincial Situation

The forest tent caterpillar caused a provincewide total of 655,256 ha of moderate-to-severe defoliation in 1993 (Fig. 8), a significant decrease from the 1992 total of 16,051,424 ha. This was the result of a total population collapse in the Northwest Region and a large decrease in the area of medium-to-heavy infestation in the Northeast Region. Slight increases in the area of moderate-to-severe defoliation were recorded in the Central and Southern regions.

Aerial surveys revealed the following total areas of moderate-to-severe defoliation: 532,907 ha in the Northeast Region, 85,463 ha in the Central Region, and 36,886 ha in the Southern Region.

Central Region

The area of medium-to-heavy infestation in the Central Region increased slightly from 78,677 ha in 1992 to 85,463 ha in 1993 (Table 11 and Fig. 9). Population collapses in the Algonquin Park and

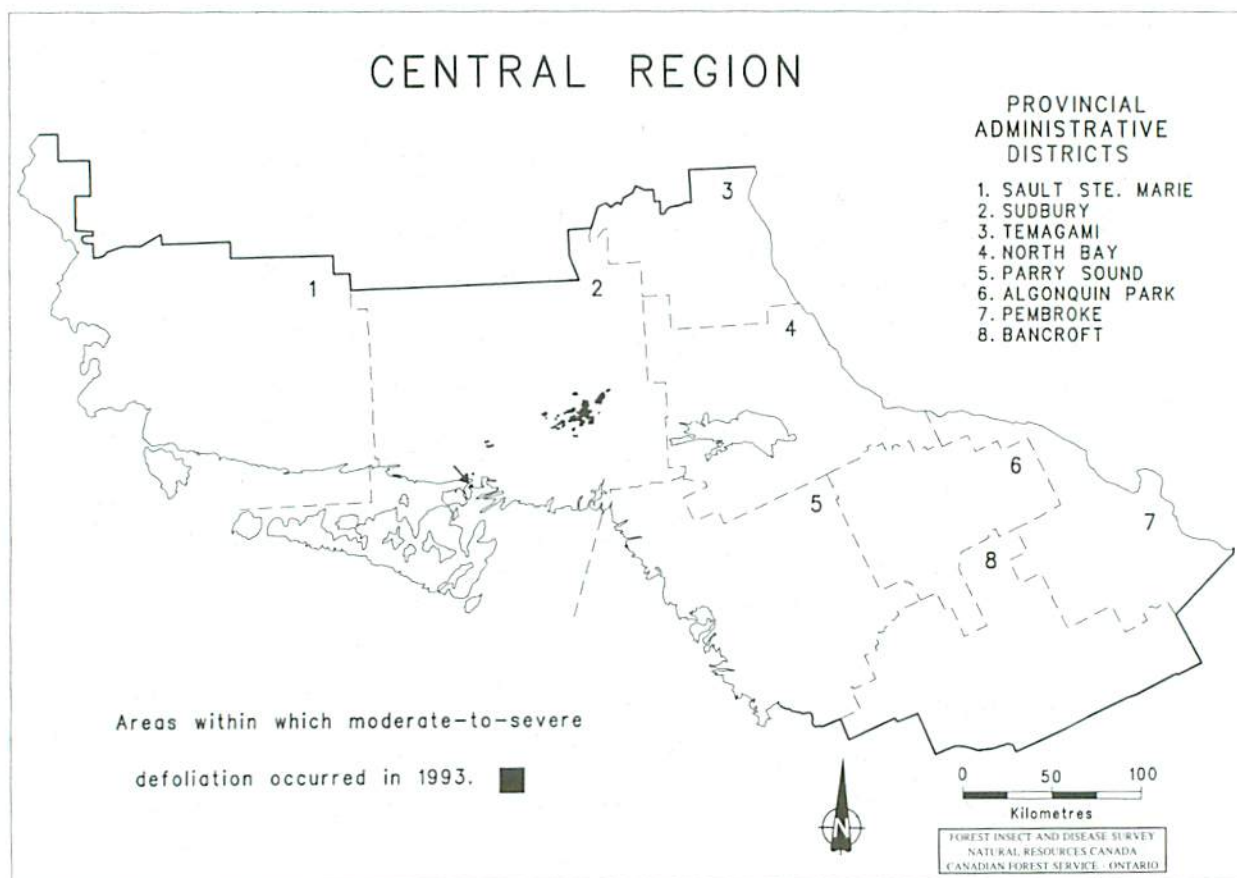


Figure 7, Gypsy moth, *Lymantria dispar* (L.).

Parry Sound districts were offset by increased areas of defoliation in the North Bay, Sudbury, and Bancroft districts. Aspen and oak were the preferred host species but a number of other hardwoods, including white birch and sugar maple (*Acer saccharum* Marsh.), experienced moderate-to-severe defoliation.

The area of moderate-to-severe defoliation in the Sudbury and North Bay districts increased by 10,925 ha to 53,835 ha in 1993. The largest single body of damage occurred along the North Bay-Sudbury districts border and occupied most of Casimir and Dunnet townships, Sudbury District and Kirkpatrick and Macpherson townships, North Bay District. It also extended into Jennings, Appleby, and Cherriman townships, Sudbury District and Loudon, Caldwell, and Hugel townships, North Bay District. Smaller pockets of medium-to-heavy infestation were noted in Gibbons, Crerar, Henry, Janes, Dana, Pardo, and McNish townships, North Bay District and Loughrin, Hagar, Hendrie, Burwash, Cleland, Dryden, Street, Falconbridge, MacLennan, Garson, Blezard, McKim, Neelon, Dill, Graham, and Denison townships, Sudbury District.

Increased areas of moderate-to-severe defoliation were also recorded in the Bancroft District where the area of damage increased by 3,349 ha to 31,628 ha in

1993. Infestation was confined to the southwestern part of the district and the majority of damage occurred in three distinct areas, two of which extended into the Tweed District of the Southern Region. One of these areas occurred in Grimsthorpe and Anglesea townships, the other occupied parts of Barrie, Clarendon, and Palmerston townships. A third body of damage was recorded in Methuen Township. Smaller, satellite infestations were also found in association with the larger bodies of defoliation.

In 1994 the area of moderate-to-severe defoliation is expected to be reduced. Although defoliation of this level is predicted in a number of areas presently infested, the current forecast method tends to overestimate damage in an aging infestation. This is due to increased levels of insect parasitism and the widespread presence of viral, fungal, and microsporidian diseases. Taking both the presence of these factors and the results of the egg-band survey into account, population declines will probably occur in the areas currently infested. Population decreases are expected at some locations and reduced areas of moderate-to-severe defoliation are likely to persist in the North Bay, Sudbury, and Bancroft districts (Table 12).

Table 10. Results of gypsy moth pheromone trapping in the Central Region of Ontario in 1992 and 1993.

Location	Number of traps		Number of males captured	
	1992	1993	1992	1993
<i>North Bay District</i>				
Antoine Provincial Park	1	1	19	6
Lake Nipissing Scenic Lookout	1	2	19	37
Martin River Provincial Park	2	2	34	25
Restoule Provincial Park	1	2	19	23
Samuel de Champlain Provincial Park	1	2	18	21
<i>Sault Ste. Marie District</i>				
Agawa Bay Campground	2	2	1	3
Crescent Lake Campground	2	1	0	0
Mississagi Provincial Park	2	2	21	14
Pancake Bay Provincial Park	2	2	11	3
Rabbit Blanket Lake Campground	2	2	0	0
<i>Sudbury District</i>				
Bidwell Township, Red Lodge	2	2	66	28
Chutes Provincial Park	2	2	53	34
Fairbanks Provincial Park	1	2	16	26
Gordon Township, Gordons Lodge	2	2	55	29
Halfway Lake Provincial Park	1	1	4	4
Killarney Provincial Park	2	2	45	28
South Baymouth Ferry Dock	1	2	19	66
South Baymouth Trailer Park	1	2	19	55
Windy Lake Provincial Park	2	2	26	24
<i>Temagami District</i>				
Finlayson Point Provincial Park	6	2	43	6

Table 11. Gross area of moderate-to-severe defoliation by the forest caterpillar in 1992 and 1993 in the Central Region of Ontario.

District	Defoliation (ha)		Change(ha)
	1992	1993	
Algonquin Park	3,555	0	-3,555
Bancroft	28,279	31,628	+3,349
North Bay	9,445	19,025	+9,580
Parry Sound	3,933	0	-3,993
Sudbury	33,465	34,810	+1,345
Total	78,677	85,463	+6,726

Balsam Fir Sawfly, *Neodiprion abietis* complex

Surveys revealed that light-to-medium populations of this pest continued in 1993. Upper crown defoliation as high as 20% was recorded in the following townships in the southwestern Bancroft District: Anstruther,

Chandos, Cavendish, Dysart, Galway, Harcourt, Minden, Harvey, Laxton, Lutterworth, Methuen, Minden, Snowdon, and Somerville. A survey conducted in Somerville Township disclosed that 93% of the 13-m trees were damaged and defoliation averaged 15%. Similar damage was also observed in six townships in the central Parry Sound District and in the southeast Pembroke District. A survey conducted in Wilberforce Township, Pembroke District, showed 84% of the 8-m balsam fir trees averaged 19% defoliation. This was indicative of damage in this area.

This insect was also common in the North Bay and Sudbury districts in 1993. Heaviest damage occurred in Crerar Township, North Bay District and in the Ratter and Dunnet townships, Sudbury District. At these locations 75% of the semimature balsam fir averaged 20% defoliation. Areas damaged ranged from 5 to 20 hectares.

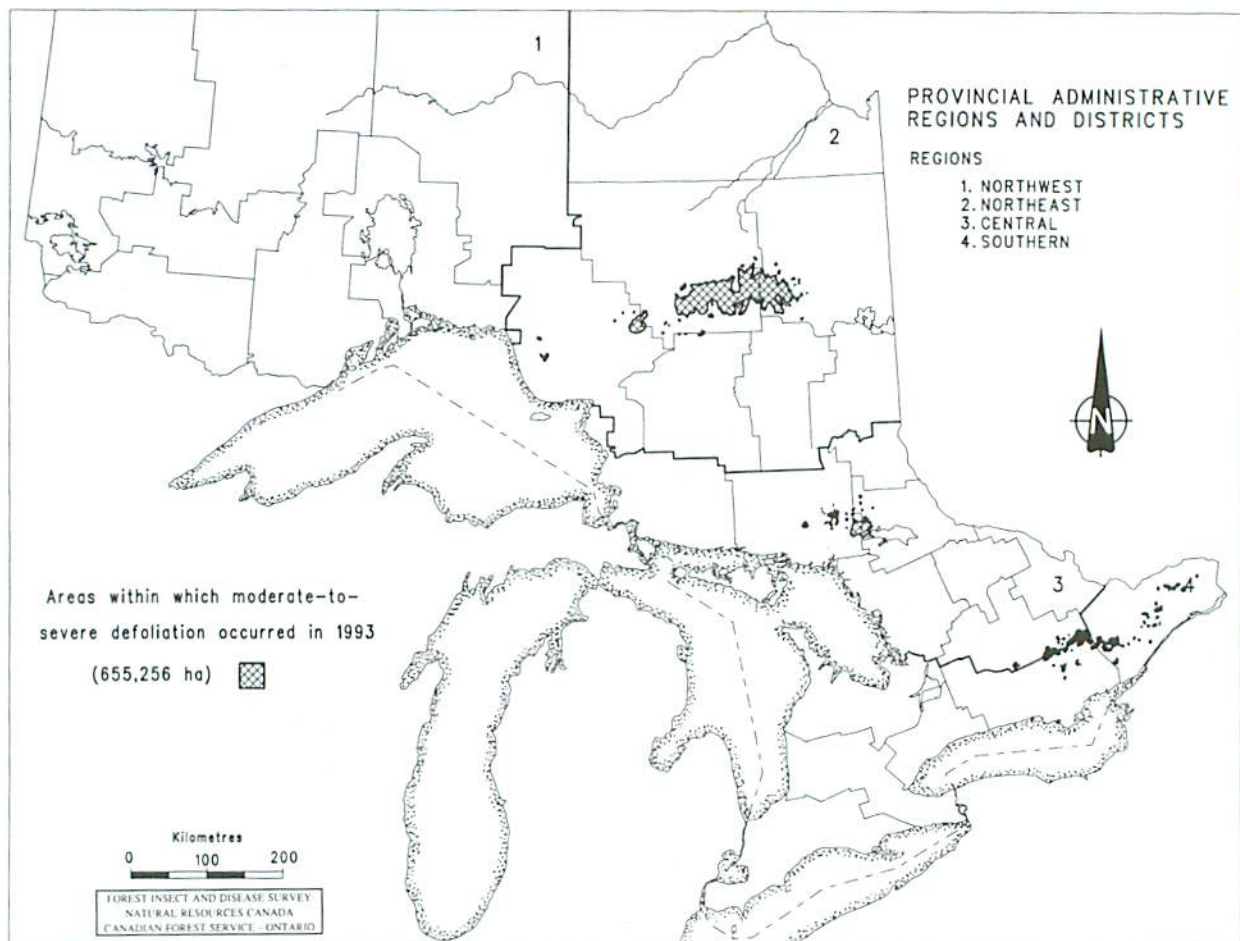


Figure 8. Forest tent caterpillar, *Malacosoma disstria* Hbn.

Redheaded Pine Sawfly, *Neodiprion lecontei* (Fitch)

In 1993 there was a decline in the population and damage caused by this pest of red pine plantations in parts of the Central Region. After several years of heavy damage in the southwestern portion of the Sudbury District, populations collapsed to trace levels. However, they seem to be increasing in the eastern North Bay District. For example, 15% of the 1.7-m trees in a 0.5-ha plantation in Cameron Township were attacked and averaged 50% defoliation. In Paxton Township, Parry Sound District, 28% of the 0.9-m trees in a 10-ha plantation averaged 18% defoliation and 2.7% recent mortality. In Snowdon Township, Bancroft District, a 0.5-ha plantation of 5-m trees had up to 90% defoliation. Low levels of damage were also surveyed in the Algonquin Park and Sault Ste. Marie districts.

High populations found in two plantations in 1992 prompted control measures this year with *Lecontivirus*. Control treatment in Somerville Township, Bancroft District, reduced the incidence of this pest by more than one-half (29% in 1992 vs. 12% in 1993) and reduced defoliation from 25% in 1992 to 8% in 1993. Control measures carried out in Paxton Township, Parry Sound

District, reduced defoliation from 29% in 1992 to 18% this year.

European Fruit Lecanium, *Parthenolecanium corni* (Bouché)

This pest was reported at damage-causing levels in the region for the first time in 1992. High populations were again present in a number of hardwood stands although not all the areas infested the previous year were reinfested in 1993. Sugar maple, black cherry (*Prunus serotina* Ehrh.), and ironwood (*Ostrya virginiana* [Mill.] K. Koch) appear to be preferred hosts. Understorey regeneration (<5 m in height) in a number of medium-to-heavily infested stands exhibited visible signs of damage in the form of branch and tree mortality.

Low numbers of scales were observed in most hardwood stands that contained sugar maple. High populations of the scale were noted in stands having a significant sugar maple component in the Bancroft District, in Eyre, Havelock, Harburn, Minden, and Ridout townships. Observations in a woodlot in Minden Township disclosed 10 to 60% recent branch mortality of 2- to 5-m sugar maple as well as light mortality (<1%) of 2- to

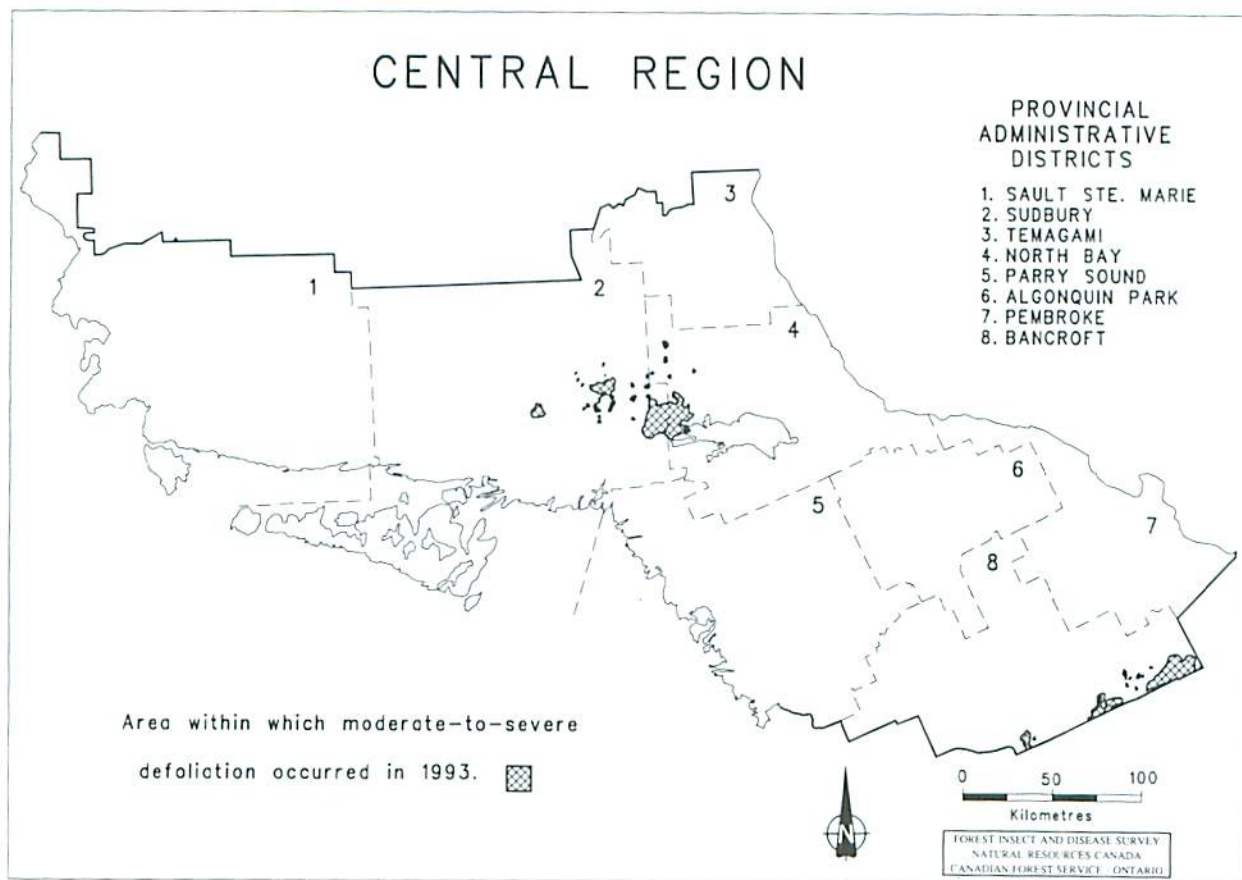


Figure 9. Forest tent caterpillar, *Malacosoma disstria* Hbn.

4-m understorey sugar maple. At the woodlot location in Ridout Township, the scale was responsible for 20 to 30% branch mortality of 2- to 3-m sugar maple and ironwood and light tree mortality (<1%) of 1- to 3-m sugar maple. Similar damage levels were reported for the second consecutive year in a woodlot in Machar Township, Parry Sound District. Affected sugar maple ranged from 1.5 to 5 m in height and recent branch mortality was as high as 60%. High scale populations were also encountered on understorey sugar maple in Airy and Sproule townships, Algonquin Park District and understorey mountain maple (*Acer spicatum* Lam.) in Sisk Township, North Bay District.

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

The yellowheaded spruce sawfly (see frontispiece) was again encountered throughout the region. Typically, damaged trees were fringe and open-growing roadside or ornamental spruce in the 1- to 5-m height range. All species of spruce (*Picea* spp.) were affected.

In the northern districts of North Bay, Temagami, Sault Ste. Marie, and Sudbury, low sawfly populations prevailed in most areas but moderate-to-severe damage occurred at sporadic locations. The heaviest damage was reported in Caldwell Township, North Bay District, where 70% of the white spruce in a 1-ha area suffered 80% defoliation. Damage was common in urban areas such as Sault Ste. Marie where 5-m blue spruce (*Picea pungens* Engelm.) were 25% defoliated at two locations.

The sawfly was more common in the southern part of the region and white spruce was the most commonly attacked host. Surveys revealed that 80% defoliation was often encountered, particularly in the Parry Sound and Bancroft districts. Specific assessments in Mowat and Perry townships, Parry Sound District, showed average defoliation rates of 25 and 30%, respectively, on 100% of the 1.5-m trees at both locations. In the Bancroft District, 72% of the 1.9-m trees in Denbigh Township sustained 44% defoliation and 48% of the trees under 3 m in height in the town of Bancroft had 17% foliar damage.

At Carson Lake Provincial Park, Pembroke District, there was an incidence of 72% with accompanying defoliation of 40%. In the town of Pembroke 64% of the trees averaged 21% damage.

Table 12. Forest tent caterpillar egg-band counts on trembling aspen and red oak at 16 locations in the Central Region of Ontario in 1993 and infestation forecasts for 1994.

Location (Township)	Host ^a	Average DBH of sample tree (cm)	Average number of egg bands per tree	Infestation forecasts for 1993 ^b
<i>Bancroft District</i>				
Abinger	rO	10.0	2	M
Anglesea	tA	12.2	2	M
Clarendon	rO	9.7	9	S
Methuen	tA	12.0	0	N
Methuen	rO	14.0	10	S
Palmerston	rO	12.7	13	S
<i>North Bay District</i>				
Hugel	tA	10.3	0	N
MacPherson	tA	12.6	31	S
Pardo	tA	10.7	<1	T
<i>Sudbury District</i>				
Bleazard	tA	11.6	7	S
Cherriman	tA	13.1	<1	T
Cleland	tA	13.4	11	S
Dunnet	tA	12.5	39	S
Falconbridge	tA	9.6	<1	T
Graham	tA	12.9	4	L
Hagar	tA	14.3	3	L

^a rO = red oak, tA = trembling aspen.

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

White Pine Weevil, *Pissodes strobi* (Peck)

The white pine weevil is a perennial problem of conifer plantations in the Central Region. In 1993, damage assessments were conducted at 36 locations in seven districts of the region. The average proportion of attacked leaders was 6.4%; very similar to that of 1992 when the average was 7.3% at 38 locations. Results of 1993 data are listed in Table 13.

Spruce Bud Moth, *Zeiraphera canadensis* Mut. & Free

This insect caused moderate, and in some cases severe, damage to individual and small groups of trees at numerous points in the southern portion of the Sudbury and Sault Ste. Marie districts. Typically, only a few trees were affected but the defoliation on these was quite high. In the Sudbury District the heaviest damage occurred in Shedden, Victoria, and Salter townships where defoliation averaged 70%. Moderate levels of defoliation (30 to

60%) were also recorded in May, Shespeare, Merritt, Hallam, Nairn, Assiginack, Tehkummah, Carnarvon, Mills, and Burpee townships. In the Sault Ste. Marie District this insect caused moderate levels of damage in the city of Sault Ste. Marie; on the Garden River First Nation lands; and in the townships of Lewis, Spragge, Cobden, Thompson, Gladstone, Thessalon, Kirkwood, Wells, St. Joseph, and Hilton.

Elsewhere in the region damage was recorded in the North Bay and Bancroft districts. Moderate levels of defoliation to small groups of trees occurred in Scholes and French townships in the North Bay District. In Monmouth Township, Bancroft District, defoliation of 3-m open-growing trees averaged 10% in a 5-ha field.

Minor Insects

Poplar Flea Beetle, *Altica populi* Brown

During most years, this mid-season pest of balsam poplar (*Populus balsamifera* L.) is commonly found at low population levels. In 1993, however, favorable conditions allowed it to reach high population levels and cause moderate-to-severe damage in the southern portion of the Central Region. Damage covered the entire area of the following districts: Algonquin Park, Bancroft, Parry Sound, and Pembroke. Similar foliar damage was also observed in the southern North Bay District, south and east of Lake Nipissing. In the affected areas, high numbers of beetles skeletonized 100% of the leaves and caused foliar browning and, in some cases, premature leaf drop.

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

The low numbers of introduced pine sawfly (see frontispiece) recorded in the Parry Sound District in 1992 increased to outbreak status in 1993. Extremely high populations of this pest and associated moderate-to-severe defoliation of eastern white pine were recorded at two separate areas along the Georgian Bay coast in the Parry Sound District. The largest concentration of moderate-to-severe defoliation was mapped in the Sand Bay–Dillon Bay–Franklin Island–Snug Harbour areas. Open-growing, shoreline eastern white pine on the mainland in the Sand Bay and Dillon Bay areas were severely affected. As well, exposed host trees on some 20 islands, including Franklin Island, were severely defoliated. The second area of moderate-to-severe damage was confined to over 50 islands in the Cameron Island–Fryingpan

Table 13. Damage caused by the white pine weevil at 36 locations in the Central Region of Ontario in 1993. (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)	Trees affected (%)
<i>Bancroft District</i>					
Mayo	ewP	1.8	2,200	4	4.0
<i>North Bay District</i>					
Cameron	ewP	1.4	2,000	10	6.0
Gurd	rS	2.4	2,000	2	2.0
Gurd – seed orchard	ewP	6.5	1,000	3	6.0
Mattawa – seed orchard	ewP	1.5	700	5	0
Merrick – family test	jP	4.1	2,300	4	0
Olinyk – family test	jP	1.5	2,400	4	2.0
Olrig	ewP	2.3	2,100	1	16.0
Pardo	ewP	2.4	1,900	10	11.0
<i>Parry Sound District</i>					
Armour	ewP	2.9	1,875	3	2.9
Cardwell	ewP	3.9	2,800	5	22.0
Ryde	ewP	1.1	3,100	2	0.7
Ryde	ewP	2.3	4,100	1	6.0
Stisted	ewP	1.6	2,800	2	2.7
<i>Pembroke District</i>					
Clara	ewP	0.9	1,000	50	3.3
Lyndoch	ewP	1.9	2,000	3	4.7
<i>Sault Ste. Marie District</i>					
Cuthbertson – family test	jP	2.1	2,500	4	14.7
Hurlburt	jP	1.5	2,500	15	10.7
Hynes	jP	1.2	3,500	10	6.0
Hynes	rP	0.8	2,800	10	1.0
Kirkwood – family test	jP	4.5	2,500	2	4.0
Lamming	jP	3.1	3,000	12	9.3
Landriault	jP	2.2	2,500	20	3.0
Lane – family test	jP	3.3	2,500	10	2.8
LaVerendyre	jP	1.3	3,600	5	10.7
McNie	jP	2.4	3,000	5	13.0
Smilsky – family test	jP	3.4	2,500	4	16.0
<i>Sudbury District</i>					
Hallam – seed orchard	ewP	1.2	1,000	2	2.0
Hallam – seed orchard	jP	5.5	2,400	6	6.0
Lumsden – seed orchard	jP	4.2	2,200	4	15.0
Street – family test	jP	3.1	2,400	4	11.0
Venturi	jP	2.5	2,400	25	12.0
<i>Temagami District</i>					
Milne	jP	2.4	4,000	100	0.7
Milne	rP	2.9	2,500	10	0.7
Firstbrook – family test	jP	1.7	2,500	12	1.3
Firstbrook – stand test	jP	2.2	2,500	5	1.3

^a ewP = eastern white pine, jP = jack pine, rP = red pine, rS = red spruce.

Island–Wreck Island–Peacock Island areas and formed a 25 kilometre stretch along the Georgian Bay coast.

The insect demonstrated a preference for the upper crowns of exposed trees ranging in height from 9 to 16 m. Shoreline and open-growing eastern white pine experienced complete defoliation of the previous year's growth and 90% defoliation of the current foliage. A large part of the moderate-to-severe damage occurred to the open-growing and often scattered host trees on the smaller islands. On the mainland, as well as on Franklin Island, shoreline trees experienced severe defoliation. Eastern white pine growing in the interior or inland suffered only light damage. The sawfly was also observed feeding on the current foliage of jack pine, but defoliation was <10%.

White Pine Needle Midge, *Resseliella pinifoliae* (Felt)

This needle midge was encountered throughout the region in stands of planted and naturally occurring eastern white pine. All age classes were affected but younger trees sustained the heaviest damage. The pest feeds inside the needle sheath and causes it to droop and eventually fall off. If populations are high enough shoot mortality may result.

Surveys conducted in 1993 disclosed a wide range of damage in the region. Defoliation averaged 75% in a

number of stands averaging 7 m in height in Alice and Fraser townships, Pembroke District and Canisbay Township, Algonquin Park District. Similar defoliation levels were also noted in a 0.5-ha area of 1.5-m trees in Antrim Township, Sudbury District.

As well, high populations were encountered at a number of locations in the Bancroft and Parry Sound districts. A survey of 200, 5-m roadside eastern white pine in Laxton Township, Bancroft District, disclosed the entire sample was infested with current shoot attack averaging 60%. Associated current defoliation was as high as 30% but averaged 12%. A similar damage assessment carried out in a 3-ha plantation in Armour Township, Parry Sound District, revealed 89% of the 3-m host were affected. Current defoliation averaged 9% but individual tree damage of up to 40% was observed.

The needle midge was also observed in the Sault Ste. Marie District in the Thessalon Tree Nursery where it caused 12% shoot damage to 63% of the 1.5-m seed orchard trees. However, associated current defoliation was <5%.

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>Acordulecera</i> sp. A sawfly	rO	Defoliation of 10% occurred on semimature trees in Bon Echo Provincial Park, Bancroft District and in Jones Township, Pembroke District.
<i>Agrilus anxious</i> Gory Bronze birch borer	wB	High populations were found along ridge tops around the city of Sudbury.
<i>Altica ambiens</i> LeC. Roadside alder flea beetle	Al	Complete defoliation occurred on trees in Stratton Township, Algonquin Park District.
<i>Aphrophora cribrata</i> (Wlk.) Pine spittlebug	ScP	Half of the 2.1-m trees averaged 2 spittle masses in a 0.5-ha area in Allan Township, Sudbury District.
<i>Archips cerasivorana</i> (Fitch) Uglynest caterpillar	Cherry	Low populations were encountered in Horton Township, Pembroke District; in Faraday Township, Bancroft District; and in Carnarvon Township, Sudbury District.
<i>Cameraria aceriella</i> (Clem.) Maple leafblotch miner	sM	Foliar damage to mature roadside trees ranged from 5–10% in Somerville Township, Bancroft District.
<i>Contarinia baeri</i> (Prell) European pine needle midge	ScP	Up to 50% needle loss occurred on 4-m trees in Cobden Township, Sault Ste. Marie District.

(cont'd)

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

Insect	Host(s) ^a	Remarks
<i>Caliroa fasciata</i> (Nort.) Oakslug sawfly	rO	This pest caused 30% foliar damage on 7-m trees, Garden River First Nation, Sault Ste. Marie District.
<i>Corythylus punctatissimus</i> (Zimm.) Pitted ambrosia beetle	sM	Regeneration mortality of 20% occurred in Chisholm Township, North Bay District. Mortality of less than 5% occurred in some stands in the Sault Ste. Marie and Parry Sound districts.
<i>Acleris</i> (= <i>Croesia</i>) <i>semipurpurana</i> (Kft.) Oak leaf shredder	rO	Foliar damage in the 5–10% range occurred in Jones, Richards, and Radcliffe townships, Pembroke District; in Effingham Township, Bancroft District; and in Long and Striker townships, Sault Ste. Marie District.
<i>Dryocampa rubicunda</i> (F.) Greenstriped mapleworm	rM	Defoliation averaged 60% in Broder Township, North Bay District. Moderate damage also occurred in the Sudbury city area.
<i>Gonioctena americana</i> (Schaeff.) American aspen beetle	tA	This insect caused 65% defoliation to 2-m regeneration in Mayo Township, Bancroft District.
<i>Hydria prunivorata</i> (Fgn.) Cherry scallophshell moth	pCh	Defoliation averaged 5% on 3-m trees in Somerville Township, Bancroft District.
<i>Malacosoma americana</i> (F.) Eastern tent caterpillar	pCh	Populations of the eastern tent caterpillar declined, but notable defoliation of 50% was reported in Nipissing Township, North Bay District.
<i>Neodiprion nanulus nanulus</i> Schedl Red pine sawfly	rP	In Haddo Township, Sudbury District, 30% of 1.2-m trees averaged 45% defoliation.
<i>Neodiprion sertifer</i> (Geoff.) European pine sawfly	ScP	Defoliation averaged 30% on 80% of 2-m trees, Allan Township, Sudbury District. The sawfly was common elsewhere on Manitoulin Island.
<i>Neodiprion swainei</i> Midd. Swaine jack pine sawfly	jP	Heavy damage recurred on Island #127 in Lake Temagami, Temagami District.
<i>Neodiprion virginiana</i> complex Redheaded jack pine sawfly	jP	Defoliation averaged 60% on 15-m open-grown trees in Cardiff Township, Bancroft District.
<i>Periclista albicollis</i> (Nort.) Oak sawfly	rO	Defoliation averaged 10% in Nipissing Township, North Bay District.
<i>Petrova albicapitana</i> (Bsk.) Northern pitch twig moth	jP	Low levels of this pest were common in the Temagami, North Bay, and Sudbury districts. In Firstbrook Township, Temagami District, 11% of the 2-m trees were affected.
<i>Phytocoptella abnormis</i> (Gar.) Linden gall mite	Ba	Heavy galling occurred to 80% of the foliage on 2-m regeneration, Bangor Township, Bancroft District.

(cont'd)

Table 14. Other forest insects. (concl.)

Insect	Host(s) ^a	Remarks
<i>Pissodes nemorensis</i> Germ. (= <i>approximatus</i>) Hopk. Northern pine weevil	rP	Mortality of 60% occurred on 1.4-m trees in Tehkummah Township, Sudbury District.
<i>Pristiphora geniculata</i> (Htg.) Mountain-ash sawfly	aMo	In the Sault Ste. Marie, Sudbury, and Temagami districts foliar damage in the range of 20–50% was common.
<i>Rhyacionia adana</i> Heinr. Pine tip moth	jP	This insect affected 27% of 2-m trees in Firstbrook Township, Temagami District.
<i>Scolioneura betuleti</i> Klug Birch edgeminer	wB	Foliar damage averaged 90% on 15-m trees in Cardiff Township, Bancroft District. The first occurrences of this pest were recorded in the Sudbury District and in the city of Sault Ste. Marie.
<i>Sparganothis acerivorana</i> MacK. Maple leafroller	sM	Up to 5% foliar damage was reported in numerous maple stands in the Bancroft District.
<i>Symmerista canicosta</i> Franc. Redhumped oakworm	rO	Low numbers of this pest caused up to 5% defoliation of 10-m trees in Methuen and Anglesea townships, Bancroft District.
<i>Xyela minor</i> Nort. Pine flower sawfly	ewP	Extremely high numbers of this sawfly were noted on 7-m trees in Horton Township, Pembroke District.

^a Al = alder, aMo = mountain ash, Ba = basswood, ewP = eastern white pine, jP = jack pine, pCh = pin cherry, rM = red maple, rO = red oak, rP = red pine, ScP = Scots pine, sM = sugar maple, tA = trembling aspen, wB = white birch.

TREE DISEASES

Major Diseases

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

Surveys conducted throughout the region in 1993 indicated that this root rot disease was common at damaging levels. A total of 30 conifer plantations tested positive for the fungus (Table 15). The greatest incidence of the disease occurred on eastern white pine in seed orchards at the Thessalon Nursery, Sault Ste. Marie District and in Hallam Township, Sudbury District. Recent mortality at these locations was 6 and 4%, respectively.

Ink Spot of Aspen, *Ciborinia whetzellii* (Seaver) Seaver

The heaviest damage in 1993 occurred in a 15-ha stand of trembling aspen in Salter Township, Sudbury District, where 90% of the trees sustained an average of 40% foliar damage. In Waldie Township, Sudbury Dis-

trict, 30% foliar damage was observed on 90% of the 8-m trees in a 2-ha stand. In the Sault Ste. Marie District, several small pockets up to 0.5 ha in size in a 25-ha stand in Villeneuve Township sustained 70% defoliation. In a 1-ha stand in Curtis Township foliar damage averaged 20%.

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

With the exception of the northern portion of the North Bay District (Table 16) low levels of damage resulting from this early season pest of white pine were observed in the Central Region. The heaviest damage occurred in a 2-ha plantation of 2.6-m-high trees in Olig Township, North Bay District, where 22% of the trees were affected, 20% severely. One plantation in the Bancroft District at Monteagle Township also had heavy damage. At this location 40% of the 2.4-m trees in a 3-ha plantation were severely affected and exhibited 8% recent mortality. Elsewhere in the region low levels of damage were recorded.

Table 15. Damage caused by *Armillaria* root rot at 30 locations in the Central Region of Ontario in 1993. (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>					
Mayo	rP	2.3	1,700	3	1.3
Snowdon	rP	2.6	2,300	5	<1
Wicklow	rP	1.6	2,200	10	2.7
Harburn	rP	3.8	2,800	13	<1
Somerville	rP	1.4	1,900	7	<1
<i>North Bay District</i>					
Cameron	ewP	1.4	2,000	10	0.7
Cameron	rP	1.7	2,000	4	3.0
Mattawa – seed orchard	ewP	1.5	700	5	2.0
<i>Parry Sound District</i>					
Ballantyne	rP	1.7	1,500	15	1.3
Humphrey	rP	3.8	3,000	2	0.7
McMurrich	rP	2.0	1,800	30	<1
McMurrich	rP	1.3	1,500	8	<1
McMurrich	rP	1.5	2,200	8	<1
Paxton	rP	0.9	2,300	10	1.3
Ryerson	rP	2.1	3,200	5	0.7
Ryerson	rP	2.1	3,000	10	<1
Ryerson	rP	2.3	3,000	8	0.7
<i>Pembroke District</i>					
Clara	ewP	0.6	2,000	50	2.0
<i>Sault Ste. Marie District</i>					
Cuthbertson – family test	bS	0.9	2,500	4	2.7
Cuthbertson – family test	jP	2.1	2,500	4	1.3
Harvot – family test	bS	0.8	2,500	2	1.3
Hynes	rP	0.8	2,800	10	1.0
Kirkwood – seed orchard	ewP	1.5	2,000	1	6.0
Landriault	jP	2.2	2,500	20	1.0
LaVerendyre	jP	1.3	3,600	5	2.0
McNie	jP	2.4	3,000	5	1.0
<i>Sudbury District</i>					
Hallam – seed orchard	ewP	1.2	1,000	2	4.0
Venturi	jP	2.5	2,400	25	0.7
<i>Temagami District</i>					
Firstbrook – family test	jP	1.7	2,500	12	0.7
Gillies Limit – family test	bS	0.8	2,350	10	1.3

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

Table 16. Damage caused by white pine blister rust in plantations of eastern white pine in the Central Region of Ontario in 1993.

Location (Township)	Average height of trees (m)	Estimated area affected (ha)	Estimated trees per ha	Trees affected (%)	Trees severely affected (%)
<i>Bancroft District</i>					
Monteagle	3.0	3	1,500	40.0	40.0
<i>North Bay District</i>					
Antoine	1.7	5	2,000	9.3	8.0
Cameron	0.9	6	1,400	4.0	3.0
Eddy	1.2	5	2,400	9.3	8.0
Gurd	5.5	3	1,000	2.0	0
Mattawan	1.1	5	700	0	0
Mattawan	1.1	1	2,000	3.0	2.0
Olrig	2.6	2	2,000	22.0	20.0
Pardo	1.2	6	2,400	2.0	1.0
Phelps	0.9	5	1,400	6.0	4.0
Sisk	2.8	4	2,000	2.0	2.0
<i>Parry Sound District</i>					
Joly	2.5	10	3,000	2.0	1.3
Monck	1.9	1	3,500	1.3	1.3
Monck	3.2	1	1,700	1.3	0
Ryde	1.0	2	3,100	6.7	4.7
Ryde	1.6	1	4,100	3.3	3.3
<i>Sudbury District</i>					
Allan	4.0	3	1,400	3.0	1.0
<i>Temagami District</i>					
S. Lorrain	1.9	2	1,000	2.0	0.7

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

This 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 at the Kirkwood Township jack pine family test site in the Sault Ste. Marie District. At this location the incidence of infection was 18%; of these, 3% were main stem infections.

**Black Canker of Willow, *Glomerella cingulata*
(Stoneman) Spauld & H.S. Schrenk and Willow
Scab, *Venturia saliciperda* J. Nuesch**

Unusually heavy infections of these two diseases occurred in 1993 on willow (*Salix* spp.) trees in the area from Sault Ste. Marie to Sudbury. Infection was apparent on trees of all sizes but was more prevalent on open-grown ornamental, roadside, and fringe trees. Damage varied but was often very severe with up to 100% of the

foliage affected. Typically, only a small portion of the upper crown of larger trees was unaffected. Some varieties of willow were much more susceptible to infection than were others.

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

A total of 163 red pine plantations and three jack pine plantations, ranging in height from 0.5 to 4.2 m, were surveyed in 1993 to determine the presence and distribution of the North American race, and the more virulent European race, of the *Scleroderris* canker fungus. Serological testing confirmed the presence of the European race at 33 red pine plantations, more than double the number found the previous year (Table 18). It was also discovered for the first time in Armour, Chaffey, Ryde, Stisted, and Watt townships, Parry Sound District and Galway and Somerville townships, Bancroft District. The two locations in Somerville and Galway townships

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

Location (Township)	Tree species ^a	Average height of trees (m)	Estimated stand area (ha)	Trees affected (%)	Stem infections (%)
<i>North Bay</i>					
East Mills	ScP	1.7	2	2	<1
<i>Sault Ste. Marie</i>					
Hynes	jP	1.2	10	0	0
Kirkwood – family test	jP	4.5	2	18	3
Lane	jP	2.9	5	12	3
LaVerendrye	jP	1.3	5	0	0
<i>Sudbury</i>					
Dunbar	jP	1.6	8	2	<1
Lumsden – seed orchard	jP	2.8	5	0	0
Mandamin – family test	jP	2.1	4	5	2
Munster	jP	1.8	15	1	0
Munster – family test	jP	1.1	5	1.3	<1
Street – family test	jP	2.5	5	0	0
<i>Temagami</i>					
Firstbrook	jP	1.7	12	1.3	0

^a jP = jack pine, ScP = Scots pine.

represent significant extensions because they are far removed from the areas where the disease has traditionally been found (Fig. 10). As well, the European race of the fungus was recovered from a number of townships with a previous history of the disease: McMurrich, Ryerson, Macaulay, Perry, Stephenson, and Strong townships, Parry Sound District and Mayo Township, Bancroft District.

The incidence of trees affected by the European race ranged as high as 36.7% and associated recent tree mortality (dying in the past year), when detected on survey plots, was < 1%. Recent tree mortality, however, was observed off the survey plots at 15 locations. In some areas, the results of the current year's surveys showed a significant increase in the rate of infection. A comparison of red pine plantations in McMurrich and Ryerson townships, Parry Sound District, where the disease was confirmed in 1992 and 1993, disclosed increased infection at 12 of the 19 sites examined.

The North American race was recovered at 26 locations; 9 of these also hosted the European race of the fungus. At those locations where only the native race was found, the incidence of infection ranged from <1% to a high of 84% in a red pine plantation in Villeneuve Township, Sault Ste. Marie District. This plantation was also

the only location associated with the North American race where recent tree mortality (2.7%) was detected on the survey plots. All surveys for any presence of the disease were negative in the Algonquin Park, Pembroke, and Sudbury districts.

Minor Diseases

Tar Spot Needle Cast, *Davisomyces ampla* (Davis) Darter

This needle cast of jack pine is 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 the damage becomes less evident. Younger trees are usually more susceptible to this disease.

Tar spot needle cast was recorded at 11 locations in five districts in the Southern Region in 1993. The highest incidence (60%) occurred at the Mandamin family test, Sudbury District. The most severe foliar damage (30%) was observed at family test sites in Merrick Township, North Bay District and in Munster Township, Sudbury District (Table 19).

Table 18. Results of a special survey for Scleroderris canker in the Central Region of Ontario in 1993. (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 affected (%)	Trees dead ^b (%)
<i>Bancroft District</i>						
Galway	rP	2.3	1,700	4	<1	0 ^c
Harburn	rP	1.0	2,800	10	<1	0
Mayo	rP	1.7	2,000	5	2.7	0 ^d
Somerville	rP	1.0	2,500	3	2.0	0.7 ^c
<i>North Bay District</i>						
Olrig	rP	2.1	2,400	4	1.3	0
Olrig	rP	2.1	2,400	10	28.7	0
<i>Parry Sound District</i>						
Armour	rP	3.0	3,000	40	<1	0 ^c
Chaffey	rP	3.0	3,000	4	<1	0 ^c
Macaulay	rP	2.9	3,000	1	1.3	0 ^c
Monck	rP	2.2	2,500	2	<1	0
McMurrich	rP	2.7	2,500	18	4.0	0 ^{d*}
McMurrich	rP	2.3	2,800	5	12.7	0 ^{c*}
McMurrich	rP	2.5	1,800	9	12.0	0 ^{c*}
McMurrich	rP	3.0	2,600	30	8.0	0 ^{c*}
McMurrich	rP	1.5	2,500	14	1.3	0 ^c
McMurrich	rP	3.9	3,000	13	0.7	0 ^c
McMurrich	rP	2.0	1,800	30	9.3	0 ^{c*}
McMurrich	rP	3.5	1,400	11	5.3	0 ^c
McMurrich	rP	1.3	1,500	8	4.7	0 ^{c*}
McMurrich	rP	0.9	2,000	10	2.0	0 ^{c*}
McMurrich	rP	2.5	2,300	4	9.3	0 ^{d*}
McMurrich	rP	1.5	2,200	8	3.3	0.7 ^d
McMurrich	rP	2.5	3,000	11	0.7	0 ^{c*}
McMurrich	rP	1.3	2,800	3	26.7	0.7
Perry	rP	2.3	2,900	10	<1	0 ^{c*}
Ryde	rP	2.1	2,900	7	<1	0 ^c
Ryde	rP	4.2	2,800	6	15.3	0 ^{d*}
Ryerson	rP	3.8	2,000	12	0.7	0 ^d
Ryerson	rP	2.1	3,200	5	<1	0 ^c
Ryerson	rP	2.1	3,000	10	<1	0 ^c
Ryerson	rP	3.6	2,800	4	1.3	0 ^d
Ryerson	rP	3.6	3,000	15	2.0	0 ^{d*}
Ryerson	rP	2.3	3,000	8	<1	0 ^c
Stephenson	rP	2.6	2,200	5	5.3	0 ^{c*}
Stisted	rP	1.3	2,900	6	0.7	0 ^{d*}
Stisted	rP	3.3	2,500	5	1.3	0 ^c
Strong	rP	3.0	2,500	3	36.7	0 ^{c*}
Watt	rP	2.6	3,200	10	<1	0 ^c
<i>Sault Ste. Marie District</i>						
Hynes	jP	1.2	3,500	10	<1	0
Hynes	rP	0.8	2,800	10	<1	0
Jocelyn	rP	1.6	2,000	1	2	0
Kirkwood	rP	3.1	2,500	0.5	90	0
LaVerendrye	jP	1.3	3,600	5	<1	0
Martel	rP	3.5	3,000	8	18	0

(cont'd)

Table 18. Results of a special survey for *Scleroderris* canker in the Central Region of Ontario in 1993. (Counts are based on an examination of 150 randomly selected trees at each location.) (concl.)

Location (Township)	Tree species ^a	Average height of trees (m)	Estimated trees per hectare	Total area affected (ha)	Trees affected (%)	Trees dead ^b (%)
<i>Sault Ste. Marie District (concl.)</i>						
Parkinson	rP	1.6	3,000	10	4	0
Timbrell	rP	2.5	3,500	12	5	0
Veil	rP	2.3	2,800	12	<1	0
Villeneuve	rP	2.2	3,000	13	84	2.7
Wardle	rP	2.5	1,200	0.5	12	0
Wells	rP	3.5	1,500	0.5	1	0
<i>Temagami District</i>						
Firstbrook	jP	1.7	2,500	12	0.7	0

^a jP = jack pine, rP = red pine.

^b Unless otherwise noted, only the North American race was found.

^c Both the North American and European races were found.

^d Only the European race was found.

* Recent tree mortality was observed off survey plots.

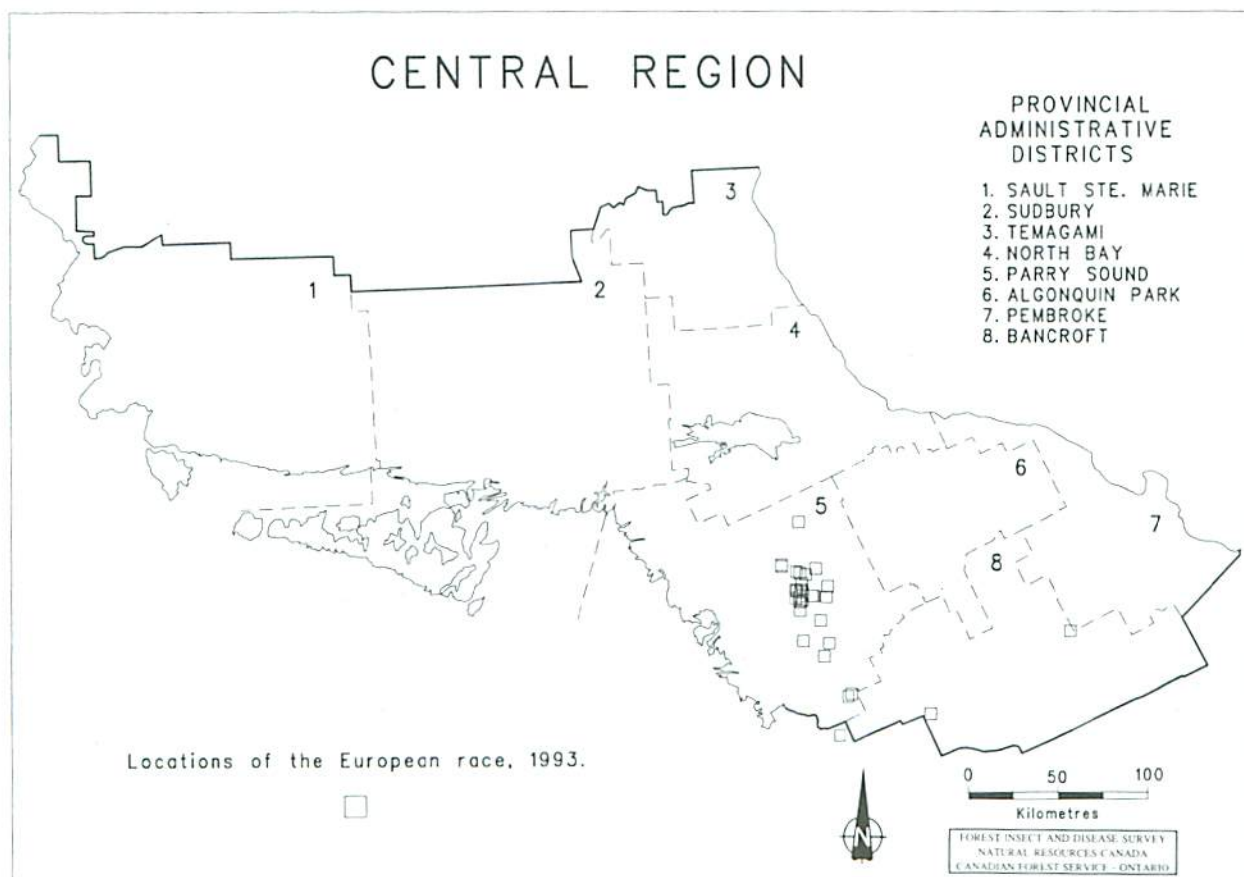


Figure 10. *Scleroderris canker*, *Gremmeniella abietina* (Lagerb.) M. Morelet.

Table 19. Damage to jack pine caused by tar spot needle cast in five districts in the Central Region of Ontario in 1993.

Location (Township)	Area affected (ha)	Average tree height (m)	Estimated trees per ha	Trees affected (%)	Foliar damage (%)
<i>Algonquin Park District</i>					
Edgar	5	3.0	1600	40	20
<i>North Bay District</i>					
Merrick – family test	5	4.0	2,400	35	30
<i>Sault Ste. Marie District</i>					
Kirkwood – family test	2	4.5	2,500	24	25
Lane – family test	10	3.3	2,500	20	25
<i>Sudbury District</i>					
Dunbar	8	1.6	2,200	10	10
Lumsden – seed orchard	5	2.8	2,500	15	15
Mandamin – family test	4	2.1	1,800	60	15
Munster – family test	5	1.1	2,000	10	30
Sisk – family test	5	1.2	2,500	25	15
Street – family test	5	2.5	2,400	15	20
<i>Temagami District</i>					
Firstbrook – family test	12	1.7	2,500	8	2
Firstbrook – seed orchard	8	2.0	2,500	30	6
Firstbrook – seed orchard	5	2.2	2,500	25	5

Other Forest Diseases

Various other diseases were encountered during the course of regular surveys. Information on these is provided in Table 20.

ABIOTIC DAMAGE

Dieback/Decline

Decline continued to be apparent to some degree in all hardwood stands in the region, with trembling aspen, largetooth aspen (*Populus grandidentata* Michx.), white birch, and oak the most visible indicators of past stresses such as drought and insect defoliation. The most extensive areas of damage occurred over the past few years in the Bancroft, Parry Sound, and Sudbury districts (Fig. 11). The hardwood damage situation seems to have stabilized somewhat in 1993 with no new large areas of dieback or tree mortality recorded. The decline process may still be occurring but certainly not at the accelerated rate of the past couple of years. This is reflected in analysis of the region's 25-tree maple plots as well as oak and white birch dieback and/or mortality plots established in the Bancroft and Parry Sound districts. Little change was observed in the condition of the 25-tree maple health plots (see Maple Health section). Dieback and mortality

in established oak and white birch plots slowed or stabilized somewhat (Table 21).

Numerous areas of moderate-to-severe oak dieback and mortality, totaling 8,400 ha, were found in the Parry Sound District. The majority of the damage, certainly the sites with the highest incidence, occurred in areas of open-growing oak on shallow soils. Affected areas were virtually a copy of the previous year with the largest part of the damage occurring in the southern part of the district in Baxter, Wood, Muskoka, Morrison, and Ryde townships. Widely scattered pockets were also noted northward through the district in Gibson, Conger, Humphrey, Foley, Christie, McDougall, Carling, Shawanaga, Harrison, and Burton townships.

A comparison of 1992 and 1993 results at a 100-tree red oak mortality plot in Carling Township showed a 1% increase in mortality, from 91 to 92%. Mortality stabilized as well in a 50-tree red oak plot in Ryde Township. In 1992, mortality tripled over the previous year while in 1993 it increased to 54% from the 48% recorded in 1992. Cumulative dieback of the remaining live trees at this location was relatively unchanged. Large areas of damaged white birch were again noted in the same areas in the northern part of the district. Mortality increased by 7% to 58% in a recount of a 100-tree white birch mortality plot in Mowat Township. All seven of the recently

Table 20. Other forest diseases.

Disease	Host(s) ^a	Remarks
<i>Chrysomyxa ledi</i> (Alb. & Schwein.) de Barry var. <i>ledi</i> Spruce needle rust	bS	Surveys found 70% of the 6-m trees affected with low levels of damage in Halfway Lake Provincial Park, Sudbury District.
<i>Coleosporium asterum</i> (Dietel) Syd & P. Syd Pine needle rust	jP	Foliar damage averaged 1.3% on 9.3% of the 2-m trees in a 8-ha plantation, Firstbrook Township, Temagami District. In the Lumsden Township seed orchard, Sudbury District, 10% of the jack pine averaged 5% foliar damage.
<i>Cronartium comptoniae</i> Arthur Sweetfern blister rust		An incidence rate of 13% stem infections occurred on semimature trees in Rioux Township, Sault Ste. Marie District.
<i>Discula campestris</i> (Pass) Arx Anthracnose	sM	Moderate-to-severe foliar infections of this leaf disease were noted throughout the Bancroft and Parry Sound districts on fringe and open growing trees.
<i>Guignardia aesculi</i> (Peck.) & Stewart Leaf blotch	hChe	Heavy damage was observed in the town of Gore Bay, Sudbury District, where 25% of the ornamental trees sustained 80% foliar damage.
<i>Heterobasidium annosum</i> (Fr.) Bref. Fomes root rot	rP	All tree disc samples set out to trap spores of this pathogen at the Petawawa National Forest Institute, Pembroke District, were negative in 1993.
<i>Mycosphaerella populi</i> (Auersw.) J. Schröt. Septoria leaf spot	bPo	Moderate levels of damage caused premature leaf discoloration and drop in the North Bay, Sault Ste. Marie, and Sudbury districts. Heaviest damage occurred in Drury Township, Sudbury District, where 80% of the foliage was affected on 90% of the trees.
<i>Septoria betulae</i> Pass. Leaf spot	wB	Widespread moderate infections were observed in the Sault Ste. Marie District and the northern North Bay and Sudbury districts, with up to 60% foliar damage in some areas.
<i>Sirococcus conigenus</i> (DC.) P.F. Cannon Shoot blight	jP	Shoot damage averaged 24% on 70% of the 2-m regeneration at Agawa Bay in Lake Superior Provincial Park, Sault Ste. Marie District.
	rP	Assessment disclosed 80% of the regeneration averaged 10% shoot damage in Winkler Township, Sault Ste. Marie District.
<i>Taphrina caerulescens</i> (Desm. & Mont.) Tul. Leaf blister rust	rO	This foliage disease, commonly observed in the city of North Bay, affected up to 75% of the foliage on the open-growing urban trees.
<i>Uredinopsis</i> sp. Needle rust	bF	Foliar damage averaged 3% on 90% of the 1.5-m understorey trees over a 2-ha area in Foster Township, Sudbury District.
<i>Venturia macularis</i> (Fr.) E. Müller & v. Arx Shoot blight of aspen	tA	Moderate infection levels were observed across the Sudbury and North Bay districts with the heaviest damage observed in a 1-ha area of Venturi Township, North Bay District, where 20% of the trees sustained an average of 15% shoot damage.

^a bF = balsam fir, bPo = balsam poplar, bS = black spruce, hChe = horse chestnut, jP = jack pine, rO = red oak, rP = red pine, sM = sugar maple, tA = trembling aspen, wB = white birch.

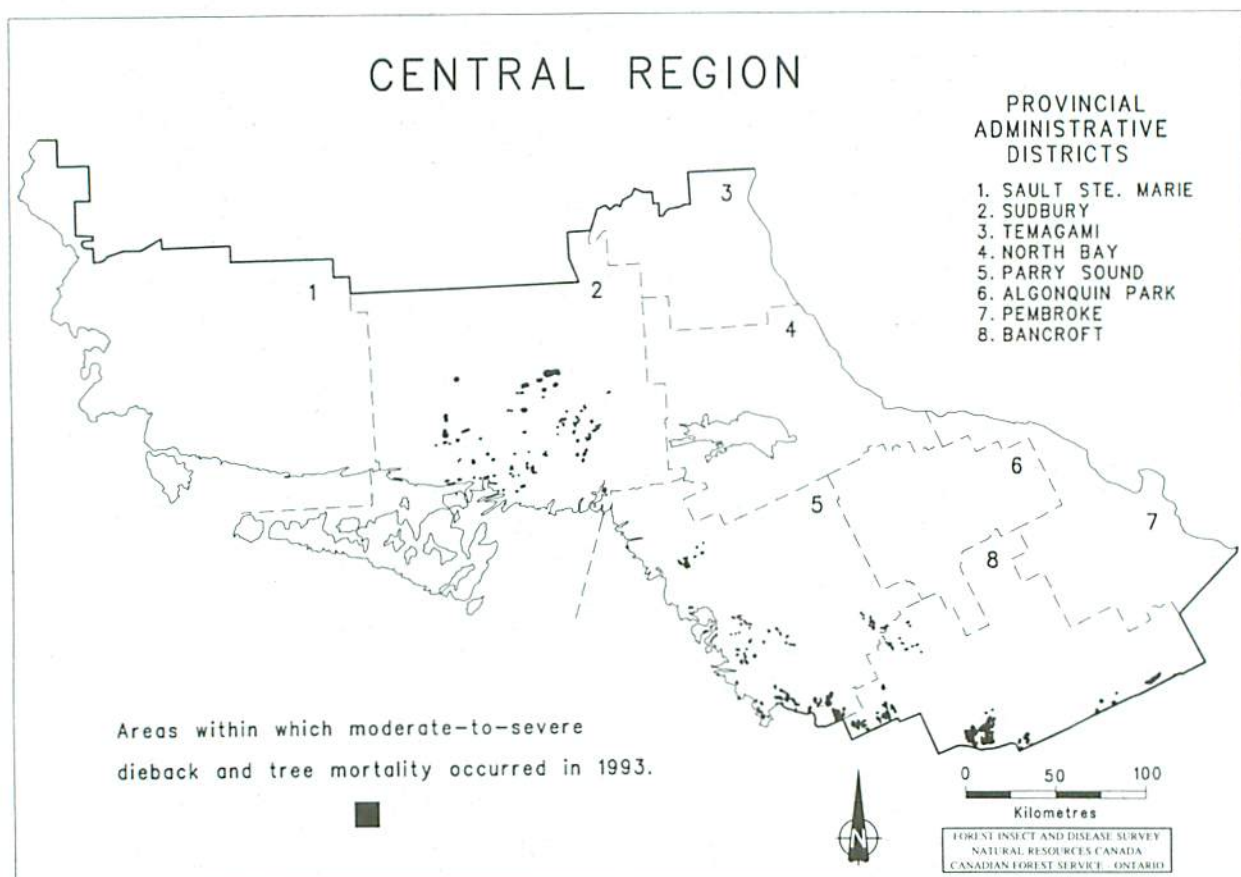


Figure 11. Hardwood damage.

dead trees were attacked by the bronze borer (*Agrilus anxius* Gory) and Armillaria root rot [*Armillaria ostoyae* (Romagn.) Herink].

The situation in the Bancroft District was similar to that of the previous year with 15,100 ha of damaged oak mapped. The majority of this was in the southern part of the district. Affected areas occurred west through Lutterworth, Anson, Digby, Longford, and Dalton townships into the Parry Sound District. Extensive areas were also delineated eastward through Harvey, Cavendish, Anstruther, Burleigh, Methuen, Grimsthorpe, Anglesea, Barrie, and Clarendon townships. Pockets of oak dieback were again mapped around the Highway 35 corridor north of Carnarvon to the Lake-of-Bays area in Stanhope, Franklin, Hindon, Ridout, and Sherborne townships. Visits to a number of oak plots determined little significant change from the previous year. Mortality and/or cumulative dieback have remained relatively unchanged for the last three years at plots in Harvey Township and for the last two years at plots in Lutterworth, Methuen, and Stanhope townships. This suggests that the decline process may have leveled off. A slight mortality increase of 4% was recorded for 1993 at plots in Hindon and Clarendon townships.

Areas of aspen, oak, and white birch damage have been apparent for the past few years in the Sudbury District; some 10,000 ha were delineated in 1993. As well, small pockets of oak and white birch mortality were mapped over a large area in the district. The affected area extended from Burwash Township in the east to the La Cloche mountain chain in the south, then west to Gough Township, and north to Lake Wanapitei. As well, areas of trembling aspen dieback were delineated in the Sudbury District.

Winter Drying

Winter drying is caused by unusually warm weather in late winter and early spring. Moisture lost from needle tissues cannot be replaced from the frozen soil by the root systems. This results in needle browning and possible needle mortality.

Moderate browning of the older foliage of red pine trees, ranging in height from 1 to 5 m, was observed in many plantations examined during the spring of 1993 across the Pembroke and North Bay districts. An evaluation conducted in a 1-ha plantation in the Pembroke Township, Pembroke District, revealed that 75% of the 1.4-m red pine exhibited 30% foliar damage. The

Table 21. Forest health data for 1993 from 10 plots in the Central Region. (Counts are based on the examination of 25 to 100 trees at each location.)

Location (Township)	Tree species ^a	height (m)	Average Number of trees	Year	Cumulative dieback (%)	Mortality (%)
<i>Bancroft District</i>						
Clarendon	rO	15	50	1992		66
				1993		70
Harvey	rO,wO	15	25	1990	40	0
				1991	28	36
				1992	32	36
				1993	26	36
Harvey	rO,wO	15	50	1990		84
				1991		90
				1992		90
				1993		90
Hindon	rO	18	50	1992	34	36
				1993	31	40
Lutterworth	rO	11	50	1992		90
				1993		90
Methuen	rO,wO	10	50	1992		60
				1993		60
Stanhope	rO	19	50	1992	23	8
				1993	25	8
<i>Parry Sound District</i>						
Carling	rO	10	100	1992		91
				1993		92
Mowat	wB	12	100	1992		51
				1993		58
Ryde	rO	6	50	1991	55	16
				1992	53	48
				1993	60	54

^a rO = red oak, wB = white birch, wO = white oak.

heaviest damage in the North Bay District occurred in a 2-ha, 2.0-m red pine plantation in Bonfield Township where 60% of the trees sustained 35% foliar damage. Elsewhere in the region, this condition was reported at trace levels at scattered locations.

FOREST HEALTH

Acid Rain National Early Warning System (ARNEWS)

The ARNEWS plots in the Central Region, part of a national network that has been established across the country, are monitored annually for signs or symptoms of acid rain damage as well as for any other damaging agents such as insects and disease.

In 1993, two new plots were added to complement the nine already established within the region. One new

plot was added in an immature red oak stand near Tunnel Lake in Gould Township, Sault Ste. Marie District. The other plot added was a semimature white birch stand along the Wanapeitei River, Aylmer Township, Sudbury District.

There were very few changes to report this year. Only trace levels of insects were found on the plots and the dieback condition reported in previous years has now stabilized and no new mortality is occurring.

Maple Health

Since 1987, 55 sugar maple plots have been established in woodlot stands within the Central Region to study the condition of sugar maple (Fig. 12). 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 road-

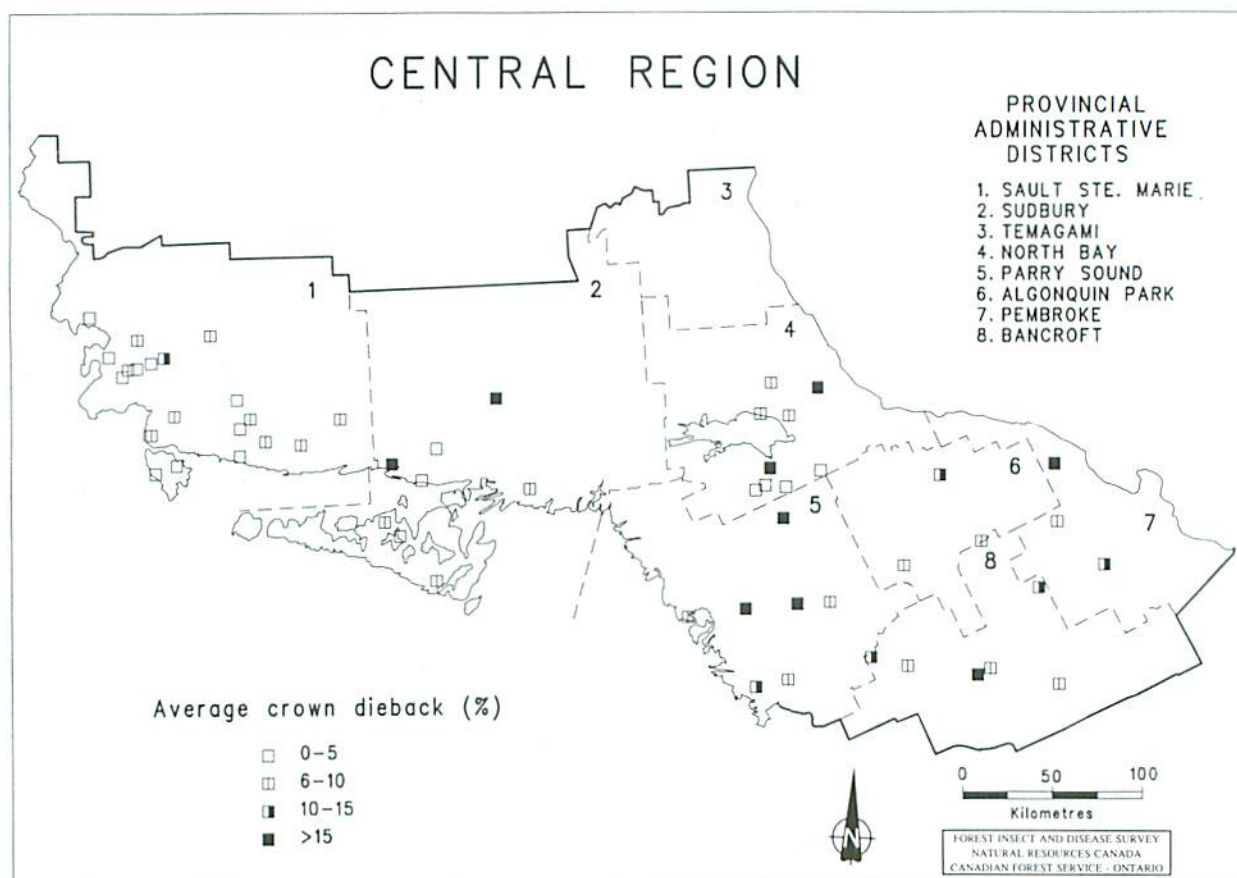


Figure 12. Sugar maple health plots.

ways and trees planted as ornamentals in urban centres, usually as boulevard or park trees. Four roadside plots and three urban plots have now been established. All of these plots include 25 semimature or mature maple trees. The current crown condition of each tree was rated with a dieback classification that evaluated total dieback in five categories: 0 = 0–5%, 2 = 21–40%, 3 = 41–60%, 4 = >60%, and 5 = dead tree.

In 1993, 7.8% of the woodlot trees improved (moved into a lower dieback class), 11.1% declined, 0.3% died, and 80.8% remained in the same dieback class as in 1992 (Table 22). Figure 13 shows that although more trees declined than improved in 1992 and 1993, the majority of the trees remained static. Also, between 1990 and 1991, there was a much greater percentage of improved trees. Figure 14 and Appendix 1 indicate that in the last several years the majority of

trees surveyed had less than 20% cumulative dieback. In 1993, this trend continued with 93.9% having up to 20% dieback.

Some of the other variables recorded at the 55 plots in the woodlot stands are shown in Figure 15. No insect, disease, or abiotic pests/problems were observed on

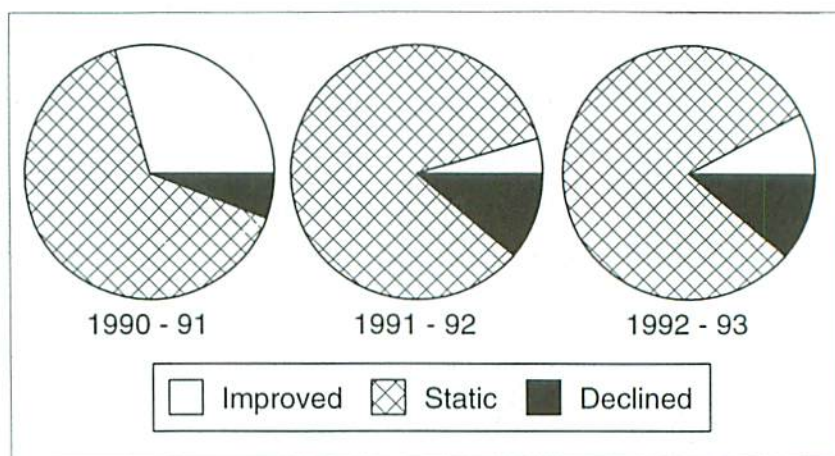


Figure 13. Summary of the sugar maple dieback trends in woodlot plots in the Central Region of Ontario from 1991 to 1993.

Table 22. Yearly trend for maple health in 55 woodlot, 3 urban, and 4 roadside plots in the Central Region of Ontario from 1987 to 1993. (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
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
Roadside	1989-90	0.0	46.7	53.3	0	0
	1990-91	34.7	65.3	0.0	0	0
	1991-92	4.0	85.0	11.0	0	0
	1992-93	3.0	69.0	28.0	0	0

45.6% of the trees surveyed. Injuries to the main stem, including open or closed wounds, seams, and frost cracks were found on 51.7% of the trees. Stem decay, including the presence of fungal fruiting bodies, occurred on 8.9% of the trees. Damage characteristic of the sugar maple borer (*Glycobius speciosus* [Say]) was noted on 8% of the trees. Current or old tapping wounds were observed on 6.2% of the trees while 1.6% displayed eutypella cankers. Damage by the forest tent caterpillar

occurred on 1.7% of the trees but the gypsy moth was not recorded on any of the plots. Defoliation in all cases was less than 20%.

In the three urban plots, 80.0% of the trees had 20% or less total dieback. Some 89% of the roadside trees had this same level of damage (Appendix 2). Other problems were recorded in the seven plots. Stem damage in the form of seams, frost cracks, etc. was found on the majority of the trees. Six trees were damaged by the sugar maple borer and 16.7% were infested with carpenter ants (*Camponotus* sp.).

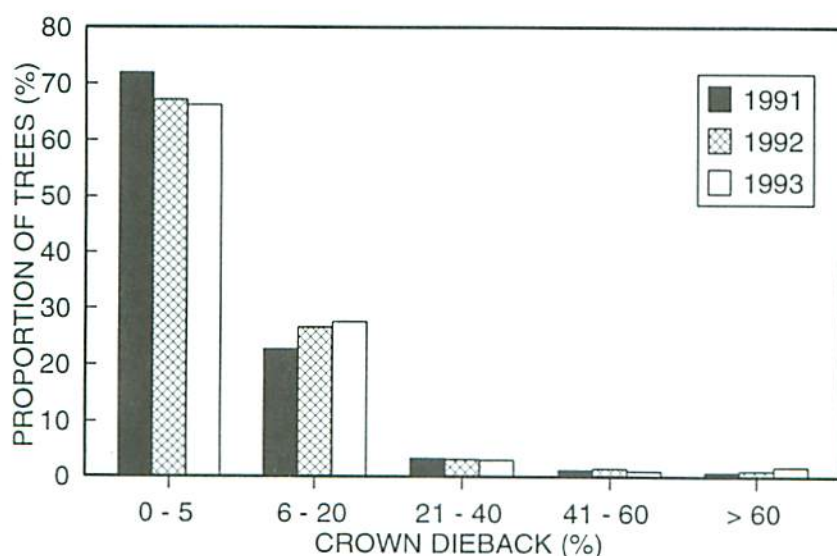


Figure 14. Summary of the sugar maple dieback in woodlot plots in the Central Region of Ontario 1991 to 1993.

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 1993,

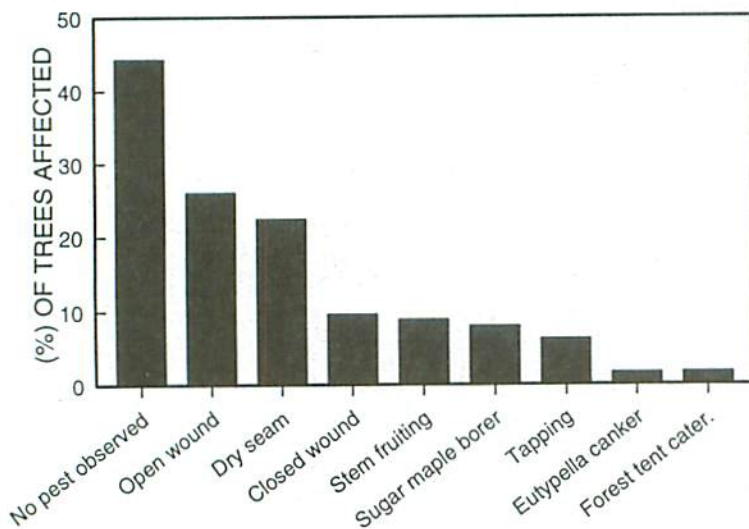


Figure 15. Summary of pests found in sugar maple woodlot plots in the Central Region in 1993.

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.

There are 106 NAMP plots in the northeastern United States and 84 in Canada; 24 of the Canadian plots are situated in Ontario. Plots are located in each acid deposition zone with one in an active sugar bush and one in an undisturbed stand. In the Central Region, two plots are established in each of the Bancroft, North Bay, Parry Sound, and Sault Ste. Marie districts.

Although sugar maple was the primary species studied, all of the trees in each plot were surveyed and the following data was recorded: diameter at breast height (DBH), vigor (five ratings), crown condition, tapping status (sugar maple), bole quality including bole defects and their location, crown dieback, foliar transparency and discoloration, dwarfed foliage, and levels of any defoliation. In 1993, DBH was remeasured for the first time since plot establishment.

Results of assessments conducted during the past 6 years are provided in Table 23. Tree condition was similar in 1993 when compared with 1992. There were two new dead trees in 1993; one in Cardiff Township, Bancroft District and the other in Ridout Township, Parry Sound District. There was no significant insect or disease damage encountered in 1993. Overall, the trees

on these plots are healthy and the majority (88%) have less than 15% cumulative damage.

Oak Health

In 1977, three survey plots were established in red oak stands to monitor crown decline of this tree species. Plots consist of 100 trees and are assessed each year. Two plots are located in the Pembroke District; one in Alice Township and the other in Wylie Township. The third plot in the region is located in Macaulay Township, Parry Sound District.

Compared with 1992, there was a slight improvement in tree condition in two plots in 1993 (Table 24). In the Wylie Township plot current crown condition was similar to that of the previous year. In Alice Township, crown condition was also similar but showed

an additional 3% mortality. In the Macaulay Township plot there was a significant improvement. In 1992, 66% of the trees had less than 20% dieback; in 1993, this increased to 81% having less than 20% dieback. No insect or disease damage was noted in any of the plots during 1993.

SPECIAL SURVEYS

Light Trap

As in previous years, operation of a light trap was conducted at the Forest Insect and Disease Survey field headquarters at the Petawawa National Forestry Institute (PNFI). This light trap, set up on 9 June and continued until 3 August, was used to monitor spruce budworm moths during their flight period as well as populations of other major insects. In 1993, four spruce budworm adults were caught, a decrease from 29 moths captured in 1992. Jack pine budworm decreased by 50% from 133 moths in 1992 to 66 this year. There was also a slight decline in forest tent caterpillar moths, from 130 in 1992 to 118 in 1993.

Thessalon Tree Nursery

During 1993, routine visits were made to the Thessalon Tree Nursery by FIDS personnel to monitor for insects and/or diseases. However, no major insects or diseases caused unacceptable damage levels to crop trees. Pests that occurred at low incidence levels include the darksided cutworm, *Euxoa messoria* (Harris) on

Tab Sugar maple crown conditions recorded in eight North American Maple Project (NAMP) established in 1988 in the Central Region of Ontario.

Location (Township)	Average DBH (cm)	Year	Number of trees examined	Total percentage of dead crown											Trees dead	Trees blown down or cut
				0	1-5	6-15	16-25	26-35	36-45	46-55	56-65	66-75	76-85	>86		
Number of trees																
Bancroft District																
Bangor ^a	37.1	1988	53	0	13	27	11	2	0	0	0	0	0	0	0	0
		1989	50	0	18	25	6	1	0	0	0	0	0	0	0	3
		1990	49	0	27	16	3	2	0	1	0	0	0	0	0	4
		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
Cardiff ^b	20.2	1993	47	0	23	15	7	0	1	0	1	0	0	0	2	4
		1988	94	1	54	24	11	2	1	0	0	0	0	1	0	0
		1989	92	0	28	50	12	2	0	0	0	0	0	0	2	0
		1990	90	0	38	35	4	6	2	1	3	1	0	0	4	0
		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
North Bay District																
Nipissing ^b	19.6	1988	113	56	39	13	3	1	1	0	0	0	0	0	0	0
		1989	113	20	69	16	6	2	0	0	0	0	0	0	0	0
		1990	113	0	102	7	2	1	1	0	0	0	0	0	0	0
		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
Patterson ^a	19.6	1993	112	0	87	18	3	2	0	1	0	0	1	0	1	0
		1988	65	23	29	7	5	0	0	0	1	0	0	0	0	0
		1989	65	22	23	16	3	0	0	0	0	1	0	0	0	0
		1990	64	0	62	2	0	0	0	0	0	0	0	0	1	0
		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
Parry Sound District																
Franklin ^a		1988	44	0	32	8	3	1	0	0	0	0	0	0	0	0
		1989	44	0	29	12	1	1	1	0	0	0	0	0	0	0
		1990	42	0	25	14	0	2	1	0	0	0	0	0	2	0
		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
Ridout ^b	25.4	1993	41	0	26	10	4	1	0	0	0	0	0	0	3	0
		1988	61	0	36	15	5	2	1	0	0	0	2	0	0	0
		1989	59	0	42	10	4	3	0	0	0	0	0	0	2	0
		1990	56	0	34	19	2	0	1	0	0	0	0	0	5	0
		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
Sault Ste. Marie District																
Tarentorus ^b	24.4	1988	84	8	57	16	2	1	0	0	0	0	0	0	0	0
		1989	82	3	31	27	19	0	0	1	0	0	0	0	0	2
		1990	81	0	63	11	6	1	0	0	0	0	0	0	1	2
		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
Wishart ^a	27.6	1993	80	7	67	4	2	0	0	0	0	0	0	0	2	2
		1988	74	27	21	10	11	4	0	0	0	1	0	0	0	0
		1989	72	19	31	14	4	3	0	0	1	0	0	0	1	1
		1990	72	0	49	12	5	5	0	0	1	0	0	0	1	1
		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

^a Undisturbed woodlot.

^b Trees currently tapped for maple syrup.

Table 24. Oak health at three locations in the Central Region of Ontario from 1989 to 1992. (Data are based on an 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	
			Number of trees						
<i>Parry Sound District</i>									
Macaulay	35	1989	2	54	29	4	0	11	0
		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
<i>Pembroke District</i>									
Alice	18	1989	0	25	53	7	6	5	4
		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
Wylie	25	1989	0	11	65	15	0	9	0
		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

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

1+0 red pine; the white pine aphid, *Cinara strobi* (Fitch) on potted white pine; and frost damage, which totally defoliated but caused no lasting effect to a white ash compartment.

Pests that affected fringe trees in the area surrounding the nursery included: Scleroderris canker, which caused light infections to several 4-m red pine trees; trace numbers of yellowheaded spruce sawfly on black spruce seed orchard trees; trace numbers of the jack pine sawfly, *Neodiprion pratti paradoxicus* Ross, on jack pine; and very low numbers of the introduced pine sawfly on white pine seed orchard trees. These white pine trees were also affected by the white pine weevil, Armillaria root rot, and the white pine needle midge. Armillaria caused 6% recent mortality and the needle midge affected new shoots on 63% of the trees. Leaders affected by the weevil were clipped to reduce the insect population and minimize damage.

Pear Thrips, *Taeniothrips inconsequens* (Uzel)

Pear thrips, an insect found on many plants, is most common on fruit trees. However, it has become a serious pest of forest trees, mainly sugar maple, in several American states. A special survey, conducted in 1989 to

determine the status of this pest in Ontario, determined that the insect was present at generally low population levels in most of the range of sugar maple. In 1993 a follow-up survey was conducted with Agriculture Canada to assist with a climate matching study and to determine the status of pear thrips where it was scarce or absent in the 1989 survey. In the Central Region, pear thrips were found at nine of the 29 areas examined in 1993 (Fig 16).

The adult thrips emerge from the soil in the early spring to feed and reproduce. Eggs are laid mainly along veins and petioles. Feeding damage consists of fallen green leaves, dwarfed foliage, and chlorotic and tattered or wilted leaves. Outbreaks can result in growth loss, crown dieback, and top-kill. After feeding, the thrips larvae enter the soil where they complete their development. In 1990 pear thrips damage, combined with frost damage, was observed in Chaffey, Watt, and Oakley townships of the Parry Sound District. Damage levels were low with the exception of the 15-m sugar maple stand in Oakley township where 60% of the foliage was blackened and wrinkled. In 1993, no evidence of feeding damage was observed at the sample points.

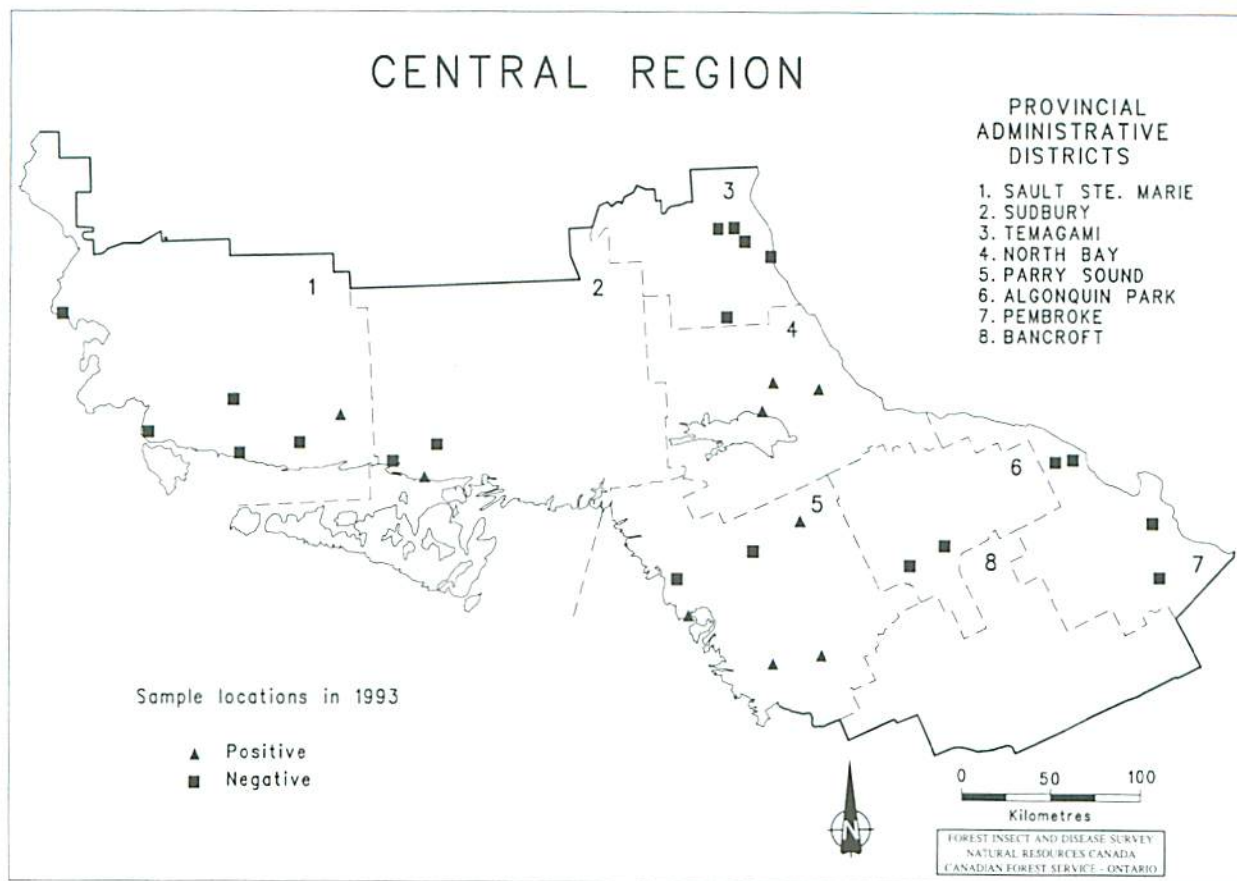


Figure 16. Pear thrips, *Taeniothrips inconsequens* (Uzel).

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 four-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 the NFP. These include studies of eastern spruce budworm, jack pine budworm, and Scleroderris canker.

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. Egg-mass samples were taken at all of the plots and pheromone traps were

deployed at some of the plots (Tables 4 and 5). A total of 18 plots were laid out in the Central Region in 1993. One plot is located in each of the North Bay and Temagami districts; however, most of the plots are in the Sault Ste. Marie and Sudbury districts. These have ten and six plots, respectively.

Management Guidelines for Jack Pine Budworm NFP Project No. 4033

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. Egg-mass (Table 7) and second instar (over-wintering) larvae samples were taken at all plots. In 1992, 27 impact plots were established in the Sudbury District and nine were created in the eastern portion of the Sault Ste.

Marie District. New plots established in 1993 included 17 in the Sudbury District, 9 in the Sault Ste. Marie District, and 1 in the North Bay District.

Impact Assessment of Scleroderris Canker in Ontario NFP Project No. 4034

The objective of this project is to obtain better information on the distribution and damage caused by the European and North American races of *Scleroderris* canker on red pine plantations in Ontario. Results of the 1993 survey are found in the *Tree Disease* section of this report.

Climatic Data

Environmental factors such as temperature and precipitation play an important role in the development of insects and diseases and in tree growth in the forest. Certain weather conditions can predispose the forest to damage and can be the cause of marked fluctuations in insect problems or in the incidence of disease. Adverse weather conditions can cause abiotic damage from factors such as frost, winter drying, breakage due to heavy winds, 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 25.

Table 25. Summary of mean temperatures and total precipitation at five locations in the Central Region of Ontario in 1993.

		Mean temperature (C°)		Deviation from normal (°C)	Total precipitation (mm)		Deviation from normal (mm)
Location	Month	Normal	Actual		Normal	Actual	
<i>North Bay District</i>							
North Bay Airport	January	-13.0	-10.9	+2.1	63.5	62.8	-0.7
	February	-11.3	-14.5	-3.2	56.2	13.4	-42.8
	March	-5.3	-4.4	+0.9	61.1	24.7	-36.4
	April	+3.2	+3.9	+0.7	62.3	58.8	-3.5
	May	+10.6	+10.6	0	69.3	113.4	+44.1
	June	+15.7	+15.4	-1.3	85.1	64.6	-20.5
	July	+18.3	+19.9	+1.6	102.4	38.0	-64.4
	August	+17.0	+19.4	+2.4	98.7	93.2	-5.5
	September	+12.2	+10.2	-2.0	115.9	103.4	-12.5
	October	+6.4	+3.8	-2.6	87.7	130.3	+42.6
	November	-1.0	-2.9	-1.9	86.6	69.4	-17.2
	December	-9.7	-8.0	+1.7	75.4	39.8	-35.6
<i>Parry Sound District</i>							
Muskoka Airport	January	-10.4	-7.8	+2.6	85.9	134.1	+48.2
	February	-9.4	-13.2	-3.8	62.4	25.3	-37.1
	March	-3.8	-5.1	-1.3	66.3	39.8	-26.5
	April	+4.5	+5.2	+0.7	73.3	101.4	+28.1
	May	+10.9	+10.9	0	77.8	97.9	+20.1
	June	+15.9	+15.6	-0.3	81.9	100.2	+18.3

(cont'd)

Table 25. Summary of mean temperatures and total precipitation at five locations in the Central Region of Ontario in 1993.

Location	Month	Mean temperature (C°)		Deviation from normal (°C)	Total precipitation (mm)		Deviation from normal (mm)
		Normal	Actual		Normal	Actual	
Parry Sound District (concl.)							
Muskoka	July	+18.3	+19.3	+1.0	77.5	131.9	+54.4
Airport	August	+17.4	+18.4	+1.0	89.0	120.3	+31.3
	September	+13.2	+11.1	-2.1	102.4	143.2	+40.8
	October	+7.5	+5.8	-1.7	93.9	122.6	+28.7
	November	-1.1	+0.3	+1.4	101.0	112.9	+11.9
	December	-7.1	-6.1	+1.0	97.8	57.5	-40.3
Pembroke District							
Petawawa	January	-12.8	-12.0	+0.8	46.7	80.9	+34.2
Weather	February	-11.2	-16.3	-5.1	51.0	23.8	-27.2
	March	-4.6	-4.7	-0.1	50.5	25.5	-25.0
	April	+4.2	+4.5	+0.3	59.6	59.9	+0.3
	May	+11.5	+11.6	+0.1	60.0	77.8	+17.8
	June	+16.3	+15.9	-0.3	87.5	76.6	+33.7
	July	+18.7	+20.4	+1.7	84.5	29.2	-55.3
	August	+17.6	+19.0	+1.4	79.8	99.7	+19.9
	September	+12.6	+10.4	-2.2	83.1	120.2	+37.1
	October	+7.1	+4.7	-2.4	66.7	100.1	+33.4
	November	-0.1	-1.6	-1.5	65.8	53.3	-12.5
	December	-9.7	-8.2	+1.5	64.8	22.4	-42.4
Sault Ste. Marie District							
Sault Ste.	January	-10.1	-8.9	+1.2	74.0	51.5	-22.5
Marie Airport	February	-10.0	-12.5	-2.5	68.0	5.8	-62.2
	March	-5.1	-4.2	+0.9	60.4	12.3	-48.1
	April	+3.3	+2.5	-0.8	65.2	102.9	+37.7
	May	+9.8	+8.7	-1.1	70.8	121.9	+51.1
	June	+14.3	+13.4	-0.9	83.1	91.8	+8.7
	July	+17.8	+17.7	-0.1	65.6	96.9	+31.3
	August	+17.0	+18.1	+1.1	85.3	64.2	-21.1
	September	+12.9	+10.4	-2.5	95.2	91.3	-3.9
	October	+7.4	+5.1	-2.3	83.2	116.4	+33.2
	November	+0.7	-1.2	-1.9	85.7	61.9	-23.8
	December	-6.7	-5.7	+1.0	79.6	57.2	-22.4
Sudbury District							
Sudbury	January	-13.7	-11.8	+1.9	57.5	55.2	-2.3
Airport	February	-12.5	-14.9	-2.4	47.0	12.0	-35.0
	March	-6.0	-5.1	+0.9	55.2	23.0	-32.2
	April	+2.7	+2.9	+0.2	61.1	92.2	+31.1
	May	+10.5	+10.4	-0.1	67.1	127.6	+60.5
	June	+16.0	+15.3	-0.7	82.8	40.6	-42.2
	July	+18.7	+20.0	+1.3	83.1	55.2	-27.9
	August	+17.3	+19.4	+2.1	82.9	73.2	-9.7
	September	+12.2	+10.2	-2.0	106.5	79.1	-27.4
	October	+6.3	+3.5	-2.8	74.6	96.4	+21.8
	November	-1.2	-3.7	-2.5	77.8	72.0	-5.8
	December	-10.2	-8.7	+1.5	65.8	51.7	-14.1

Appendix 1. Maple health data from 1988 to 1993 on 55 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	
			Number of trees						
<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
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
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	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
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
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

(cont'd)

Appendix 1. Maple health data from 1988 to 1993 on 55 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	
			Number of trees						
<i>Bancroft District (concl.)</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
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
<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
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
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
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
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

(cont'd)

Appendix 1. Maple health data from 1988 to 1993 on 55 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	
Number of trees									
<i>North Bay District (concl.)</i>									
Nipissing	20.6	1989	17	9	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
Pringle	22.5	1989	19	6	0	0	0	0	0
		1990	18	7	0	0	0	0	0
		1991	24	0	1	0	0	0	0
		1992	24	0	1	0	0	0	0
		1993	22	3	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	25	0	0	0	0	0	0
		1992	23	2	0	0	0	0	0
		1993	24	1	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
<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
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
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

(cont'd)

Appendix 1. Maple health data from 1988 to 1993 on 55 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	
			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
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
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
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
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	0	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
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

(cont'd)

Appendix 1. Maple health data from 1988 to 1993 on 55 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	
			Number of trees						
<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	0	1
		1993	19	5	0	0	0	0	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
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
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
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
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
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

(cont'd)

Appendix 1. Maple health data from 1988 to 1993 on 55 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	
			Number of trees						
<i>Sault Ste. Marie District (cont'd)</i>									
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
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
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
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
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	2
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
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

(cont'd)

Appendix 1. Maple health data from 1988 to 1993 on 55 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	
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
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
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
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
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
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
<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

(cont'd)

Appendix 1. Maple health data from 1988 to 1993 on 55 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	
			Number of trees						
<i>Sudbury District (concl.)</i>									
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
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
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
Spanish River Indian Reserve	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
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
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
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

^aDieback classes: 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 1993 from three urban and four 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
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
<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
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
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
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
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

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