RESULTS OF FOREST INSECT AND DISEASE SURVEYS IN THE CENTRAL REGION OF ONTARIO 1991

Forest Districts:
Huronia, Lindsay, Cambridge, Maple and Niagara

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SURVEY HIGHLIGHTS

This report presents data collected by the Forest Insect and Disease Survey (FIDS) in 1991 on various insects, diseases, and abiotic damage in the Ontario Ministry of Natural Resources' (OMNR) Central Region of Ontario. In addition, information is also included on the various forest health plots currently being studied and on surveys done in the two OMNR forest tree nurseries in the region.

The most noteworthy insect present in 1991 was the gypsy moth. Population levels increased throughout the region, especially in Huronia District. General population increases were also recorded for the pine false webworm, birch skeletonizer, spruce budworm, satin moth, fall webworm, eastern tent caterpillar and white pine weevil. The forest tent caterpillar infestation all but collapsed and reductions in damage by cedar leafminers and the larch casebearer were observed in 1991.

Dutch elm disease and tip blight were the only major forest diseases causing noticeable damage in 1991. However, leaf scorch damage on hardwoods, particularly sugar maple, was very common, as was localized, drought-related hardwood mortality. No major changes were recorded in any of the forest health plots; if anything, some improvement in tree condition was noted.

Insect and diseases described in this report fall into three categories, on the basis of their importance:

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. (No minor insects or diseases were reported in Central Region in 1991.)

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 populations or for other reasons, did not cause serious damage this year.

The cooperation and assistance provided by OMNR and other government agencies and individuals are gratefully acknowledged.

If further information is required about pest conditions in Central Region, please contact W.D. Biggs or write to the Chief, Forest Insect and Disease Survey Unit, Forestry Canada, Ontario Region, P.O. Box 490, Sault Ste. Marie, Ontario, P6A 5M7.

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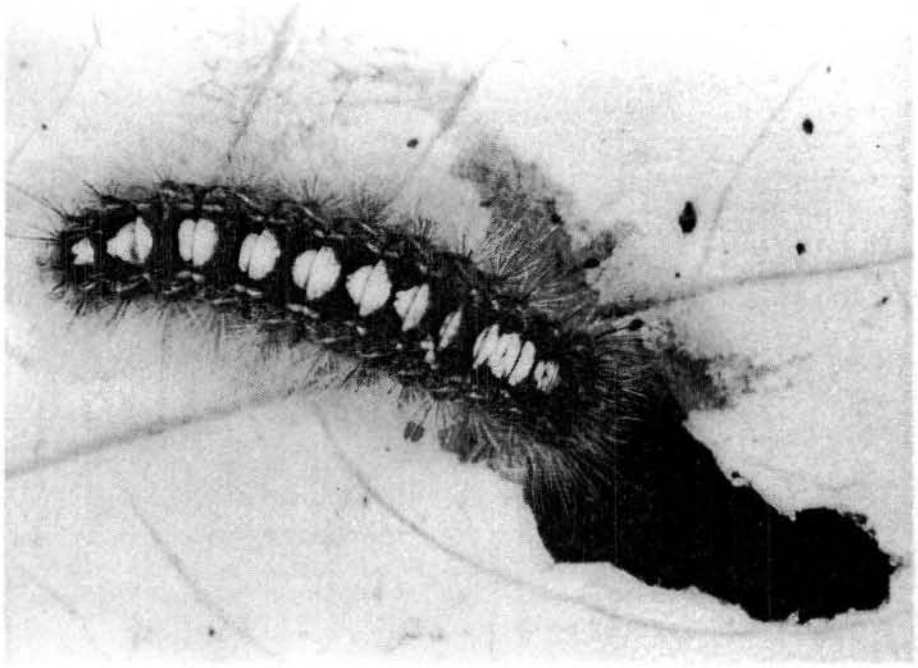
Frontispiece



Larva of the satin moth (*Leucoma salicis [L.]*).

Severe defoliation of Carolina poplar (*Populus* X *canadensis* Moench)
by larvae of the satin moth.

TABLE of CONTENTS

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TABLE of CONTENTS (concl.)

INSECTS

Major Insects

Pine False Webworm,
Acantholyda erythrocephala (L.)

Population levels of this pine insect increased in 1991 in two districts within Central Region. The heaviest damage was found in a 2-ha red pine (*Pinus resinosa* Ait.) plantation in Essa Township in Huronia District, where approximately 40% of the 1.5-m trees had average defoliation levels of 50%, with about 10% of these completely stripped of their foliage. In a 0.5-ha portion of a 2.7-ha red pine plantation in Oro Township, Huronia District, average defoliation levels were also 50%. Damage levels were high in a 5-ha mixed red pine and eastern white pine (*P. strobus* L.) plantation in Cavan Township, Lindsay District. Almost 100% of the 2-m eastern white pine had 39% of their old foliage removed and 65% of the trees had 14% defoliation of new growth. Defoliation of old growth averaged 40% on 95% of the 2-m red pine, with 57% of the trees having 13% of the new growth removed. Low insect population levels were observed in the eastern white pine tree seed orchards at Midhurst and Glencairn in Huronia District.

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

The amount of damage to eastern white cedar (*Thuja occidentalis* L.) decreased slightly in Maple District and increased slightly in Lindsay District. Once again, the highest concentration of leafminer damage was observed in the southeastern corner of Maple District. Eastern white cedar stands exhibited 50 to 70% brown foliage in the eastern parts of Uxbridge and Pickering townships (Fig. 1). Compared with last year, some reduction in population levels and the area affected were noted in 1991 in this area of Maple District. Low damage levels were found in four townships in Lindsay District. Foliar browning averaging 20% was observed in stands ranging in height from 6 to 7 m in Belmont, Cavan, Eldon and Clarke townships in Lindsay District. Elsewhere in the region, population levels were very low and there was no noticeable damage.

Birch Skeletonizer,
Bucculatrix canadensisella Cham.

Population levels increased in 1991 in three districts of Central Region; the most recent noteworthy damage before this was in 1984. This late-season insect pest skeletonizes white birch (*Betula papyrifera* Marsh.) leaves about the time fall coloration starts; damaged leaves turn brown rather than the yellow color associated with this time of year.

Foliar browning of 80 to 100% was common on scattered clumps of white birch less than 1 ha in size in Nottawasaga, Sunnidale, Vespra, Essa and Tosorontio townships in Huronia District. In Cambridge District, 10- and 4-ha areas in Puslinch Township had scattered white birch with foliar browning levels of 80 to 100%, and 2 ha of similar damage was also observed in Beverly Township. Moderate-to-severe damage was found in Otonabee Township in Lindsay District.

Eastern Spruce Budworm,
Choristoneura fumiferana (Clem.)

Province-wide, an increase of 2,282,520 ha in the area of moderate-to-severe defoliation was mapped. The infestations were mainly located in the Northwestern and North Central regions, along with smaller infestations in the Northern, Northeastern and Algonquin regions. The total area infested in Ontario in 1991 was 9,065,781 ha. The gross area of budworm-killed balsam fir (*Abies balsamea* [L.] Mill.) covered an area of 3,736,379 ha in the Northwestern and North Central regions. This represents an increase of some 638,190 ha over the area affected in 1990 in these regions.

In Central Region, populations remained at much the same level as in 1990, with a few new white spruce (*Picea glauca* [Moench] Voss) plantations found with light-to-moderate current defoliation (Fig. 2). Defoliation levels averaged 80% on 19-m white spruce in a 7-ha plantation in Adjala Township, Huronia District, and damage levels ranged from 10 to 80% in a nearby tree seed

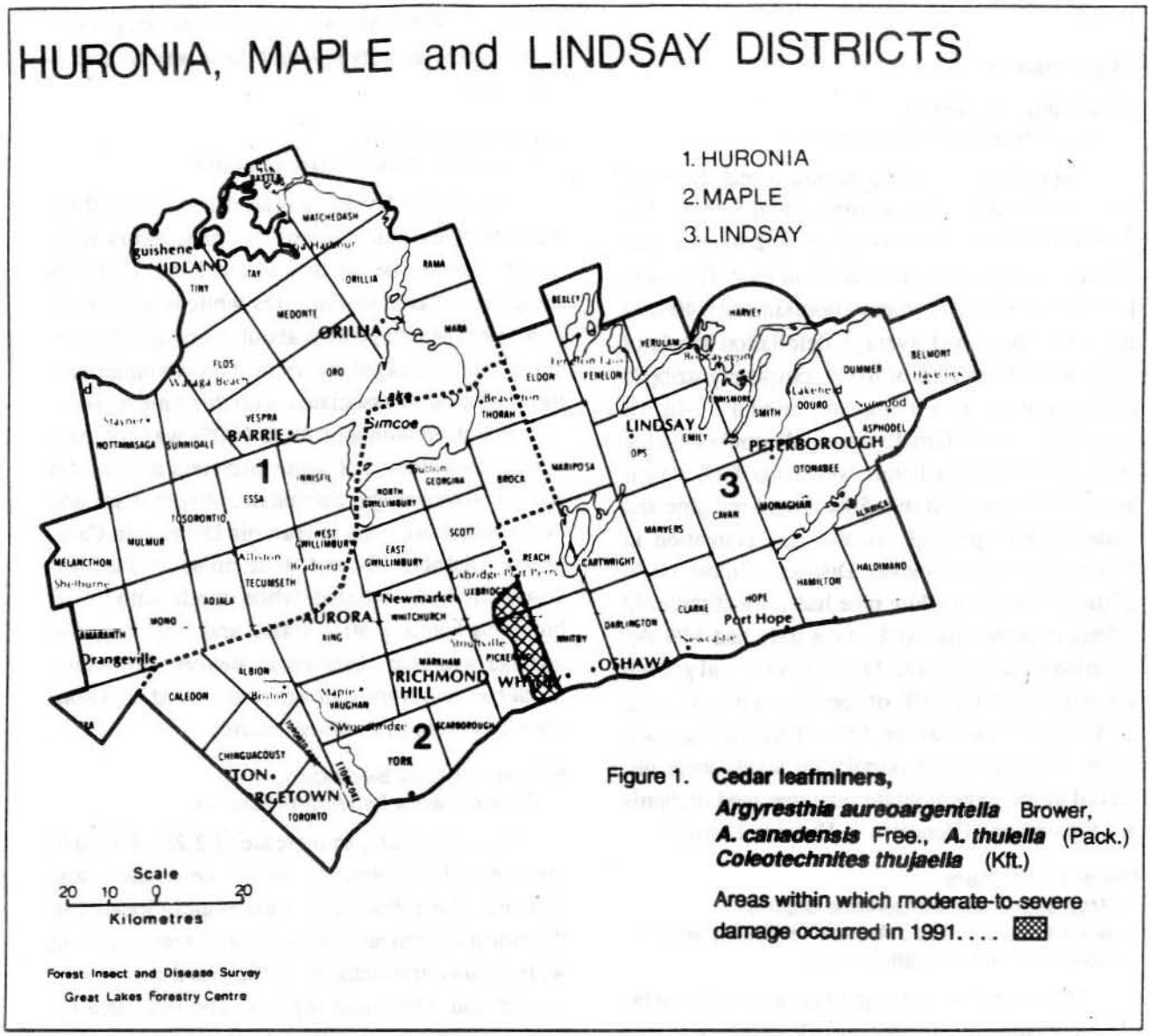

Figure 1. **Cedar leafminers,**
Argyresthia aureoargentella Brower,
A. canadensis Free., ***A. thuiella*** (Pack.)
Coleotechnites thujaella (Kft.)

Areas within which moderate-to-severe damage occurred in 1991. . . .

production area of 10-m trees. Current defoliation levels were higher this year in the white spruce plantations in the Main Tract in Uxbridge Township, Maple District. Two separate plantations totaling about 4 ha had current defoliation levels of from 75 to 100% on 15-m trees. Population levels remained unchanged in Tiny Township, Huronia District, where defoliation levels averaged 40% on 18-m trees over a 2-ha area. Larval population levels remained high on the 9-m white spruce in the seed production area at the Orono Forest Tree Nursery in Clarke Township, Lindsay District. Defoliation of new growth averaged 50% on 10-m white spruce over about 7-ha in the Hodson Tract in West Gwillimbury Township, Huronia District. Lower population levels were present at two white spruce plantations in Cambridge District. Current defoliation levels of 25% were found in an 8-ha plantation in the Cumnock Tract in Nichol Township and in a 5-ha area in the Boyd Tract in West Luther Township (Fig. 2).

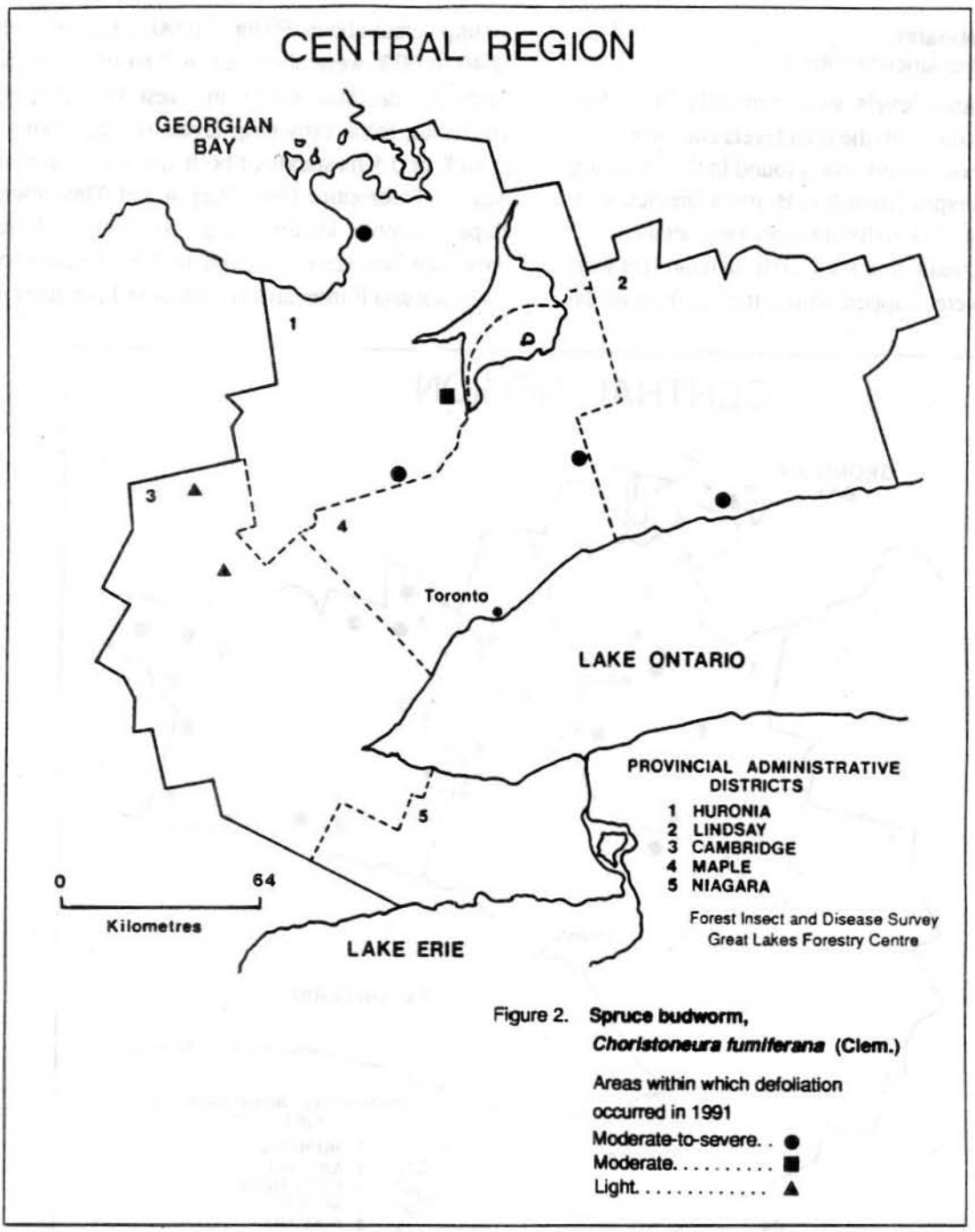

Figure 2. **Spruce budworm, *Choristoneura fumiferana* (Clem.)**

Areas within which defoliation occurred in 1991

Moderate-to-severe. . ●
Moderate. . . . . ■
Light. . . . . ▲

An egg-mass survey was carried out during late July at five locations in the region. The results indicate that population levels will remain high with the exception of the sites sampled in Lindsay District. Severe and moderate-to-severe infestations are forecast for 1992 at the two sites already infested in Adjala Township in Huronia District and in Uxbridge Township, Maple District. No eggs were collected from the sample in Clarke Township and a light infestation is forecast for a new sample point in Bexley Township, Lindsay District.

Larch Casebearer,
Coleophora laricella (Hbn.)

Population levels were generally lower this year, in contrast with the high levels encountered in 1990. The population levels found in the Minesing Swamp in Vespra Township, Huronia District, were an exception. Six individual pockets, totaling 467 ha, of brick-red tamarack (*Larix laricina* [Du Roi] K. Koch) were mapped within the confines of the swamp versus about 100 ha in 1990. Damage levels of 40 to 60% were observed in 7 ha of European larch (*L. decidua* Mill.) in West Gwillimbury Township; foliar browning levels ranged from 40 to 80% in 0.5-ha stands of both species of larch in Adjala, Tosorontio, Flos, Vespra and Tiny townships, Huronia District (Fig. 3). Similar foliar browning was also observed in 0.5-ha stands of tamarack and European larch on 6- to 12-m trees in

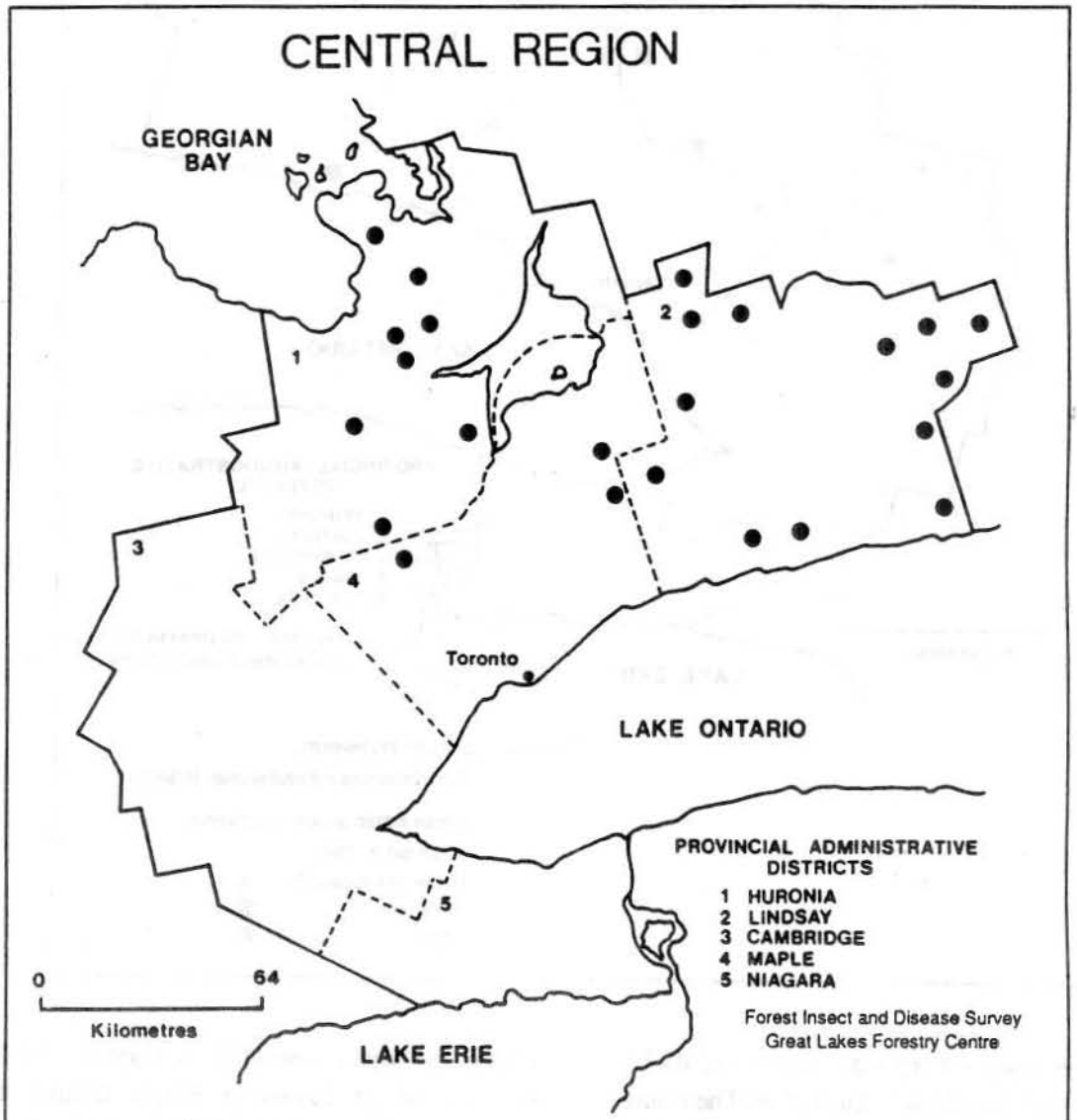

Figure 3. **Larch casebearer**
***Coleophora laricella* (Hbn.)**
Areas within which moderate-to-severe foliar damage occurred in 1991. . . ●

Scott, Uxbridge and Albion townships, Maple District. Foliar damage ranging from 30 to 80% was found affecting tamarack ranging in height from 12 to 18 m in Bexley, Fenelon, Verulam, Mariposa, Reach, Hope, Asphodel, Douro, Dummer and Belmont townships in Lindsay District. On European larch, foliar browning averaged 50% in a 2-ha plantation of 4-m trees in Alnwick Township and 30% damage in 10-ha of 18-m trees in Haldimand Township, Lindsay District. Lower population levels were common at many other points across the remainder of the region.

Oak Leaf Shredder,
Croesia semipurpurana (Kft.)

Surveys carried out in the population study plots in the Huronia, Maple and Niagara districts determined that oak leaf shredder populations remained at endemic levels and egg sampling indicates this will continue to be the case in 1992 (Table 1). Gypsy moth was present at many of the study plots and the damage it caused could not be separated from that of the oak leaf shredder on red oak (*Quercus rubra* L.). A large number of male moths was captured in the pheromone traps at two sites in Niagara District (Table 1), but it appears that this did not result in a correspondingly large number of eggs.

Table 1. Results of oak leaf shredder pheromone trapping, defoliation estimates and egg counts in 1991, and defoliation forecasts for 1992 in the Central Region of Ontario.

Location	Plot #	Total number of adults captured[a]		Average number per trap		Total number of adults captured[b]		Pheromone concentration 1991	Leaves attacked 1991	Foliar damage 1991	Total number of eggs		Defoliation forecast for
		1990	1991	1990	1991	1990	1991	(%)	(%)	(%)	1990	1991	1992
Huronia District													
Awenda Prov. Park	4[c]	0	0	0.0	0.0	–	–	0.003	–[d]	–[d]	0	0	Nil
	5	0	0	0.0	0.0	–	–	0.003	–[d]	–[d]	0	0	Nil
Dufferin County Forest	3	0	0	0.0	0.0	–	–	0.003	5	1	0	0	Nil
	9	0	0	0.0	0.0	–	–	0.003	10	2	0	0	Nil
	10	366	34	73.2	6.8	19	6	0.03	0	0	0	0	Nil
	12	0	0	0.0	0.0	–	–	0.003	0	0	0	0	Nil
	95	57	16	11.4	3.2	362	29	0.03	5	2	0	0	Nil
	Check 3	593	90	118.6	18.0	101	76	0.03	40	10	2	0	Nil
Hendrie	1	10	0	2.0	0.0	–	–	0.003	0	0	2	1	Light
Midhurst	1	0	0	0.0	0.0	5	2	0.03	0	0	0	0	Nil
Orr Lake	Danials	51	0	10.2	0.0	33	9	0.03	3	1	1	0	Nil
Wildman Tract	4	0	0	0.0	0.0	–	–	0.003	–[d]	–[d]	0	0	Nil
	7	45	23	9.0	4.6	2	9	0.03	–[d]	–[d]	0	1	Light
Maple District													
Uxbridge Twp	1	0	0	0.0	0.0	–	–	0.003	–[d]	–[d]	0	0	Nil
	2	29	14	5.8	2.8	28	15	0.03	–[d]	–[d]	0	0	Nil
Niagara District													
Cayuga Twp	1	17	254	3.4	50.8	–	–	0.003	–[d]	–[d]	3	1	Light
Thorold	6	136	853	27.2	170.6	–	–	0.003	–[d]	–[d]	75	2	Light
Pelham	7	812	937	162.4	187.4	98	805	0.03	–[d]	–[d]	4	4	Light
West Lincoln Twp	2	607	846	121.4	169.2	219	670	0.03	–[d]	–[d]	283	2	Light

[a] in five sticky traps
[b] in two Multipher traps
[c] sprayed with *Bacillus thuringiensis* in 1991 against gypsy moth
[d] area defoliated by gypsy moth

Fall Webworm,
Hyphantria cunea (Drury)

Population levels of this late-summer defoliator increased noticeably in Huronia District, with little change observed in the other districts in the region. The largest insect populations were found on lowlying wet sites hosting white ash and black ash (*Fraxinus americana* L. and *F. nigra* Marsh.) and white elm (*Ulmus americana* L.). Approximately 20 12-m trees were covered by tents, resulting in 100% defoliation at two 0.5-ha sites in Vespra Township, Huronia District. Numerous trees were also covered with larval tents in a small pocket in Medonte Township, Huronia District. Scattered 10-m white ash were 100% defoliated in Nottawasaga Township, and approximately 25 trees had five to eight tents on them, with some 6-m trees completely covered in Tosorontio Township, Huronia District. Small pockets with three to five tents per tree on scattered ash and elm were observed in Sunnidale, Mono, Adjala, Oro and Vespra townships in Huronia District, and in Wellesley and Puslinch townships in Cambridge District. Small numbers of caterpillars were observed in Lindsay District; scattered 5- and 10-m black ash had one to two tents on them in Cavan Township. Up to six webs were found on 15-m ash in Hamilton and Clarke townships, Lindsay District. Webmasses were a common site on scattered trees at many points in Niagara District.

Satin Moth,
Leucoma salicis (L.)

This insect was collected for the first time in Huronia District in 1990 and it was present again this year, but at higher levels. Approximately 200 open-growing 20-m Carolina poplar (*Populus X canadensis* Moench) were 100% defoliated throughout the western built-up area of Canadian Forces Base (CFB) Borden in Huronia District (see Frontispiece). In addition, 11 clumps of from 3 to 50 trees growing near the airport and along the Lisle Road were stripped of their foliage. Defoliation levels ranging from 50 to 70% were found on an additional 70 "urban" Carolina poplar on CFB Borden. Once again, defoliation levels of 80% were present on the clump of European white poplar (*P. alba* L.) where this insect was first found in 1990 in Tosorontio Township, Huronia District. In Essa Township, Huronia District, damage was found at two sites. High larval population levels resulted in 100% defoliation of 17 European white poplar at one site and similar damage levels to five trees at another.

Gypsy Moth,
Lymantria dispar (L.)

There were some very large increases in the amount of defoliation caused by this insect in 1991 in Central Region. The gross area of moderate-to-severe defoliation in 1991 was 129,453 ha, an increase of slightly over 100,000 ha from the 28,624 ha of 1990 (Table 2).

Huronia District had the largest increase in the area infested; an additional 63,357 ha were mapped in 1991 (Table 2). The greatest increases occurred in the northern portion of the district, where moderate-to-severe defoliation of mainly red oak and trembling aspen (*P. tremuloides* Michx.) covered most of Baxter and Matchedash town-

Table 2. Gross area of moderate-to-severe defoliation by the gypsy moth in the Central Region of Ontario from 1987 to 1991.

	Area of moderate-to-severe defoliation (ha)					Change from
District	1987	1988	1989	1990	1991	1990 to 1991
Cambridge	0	0	0	3,323	15,432	+12,109
Huronia	0	0	0	2,418	65,775	+63,357
Lindsay	888	861	4,071	1,118	11,418	+10,300
Maple	0	0	370	2,291	6,110	+3,819
Niagara	0	28	2,177	19,474	30,718	+11,244
	888	889	6,618	28,624	129,453	+100,829

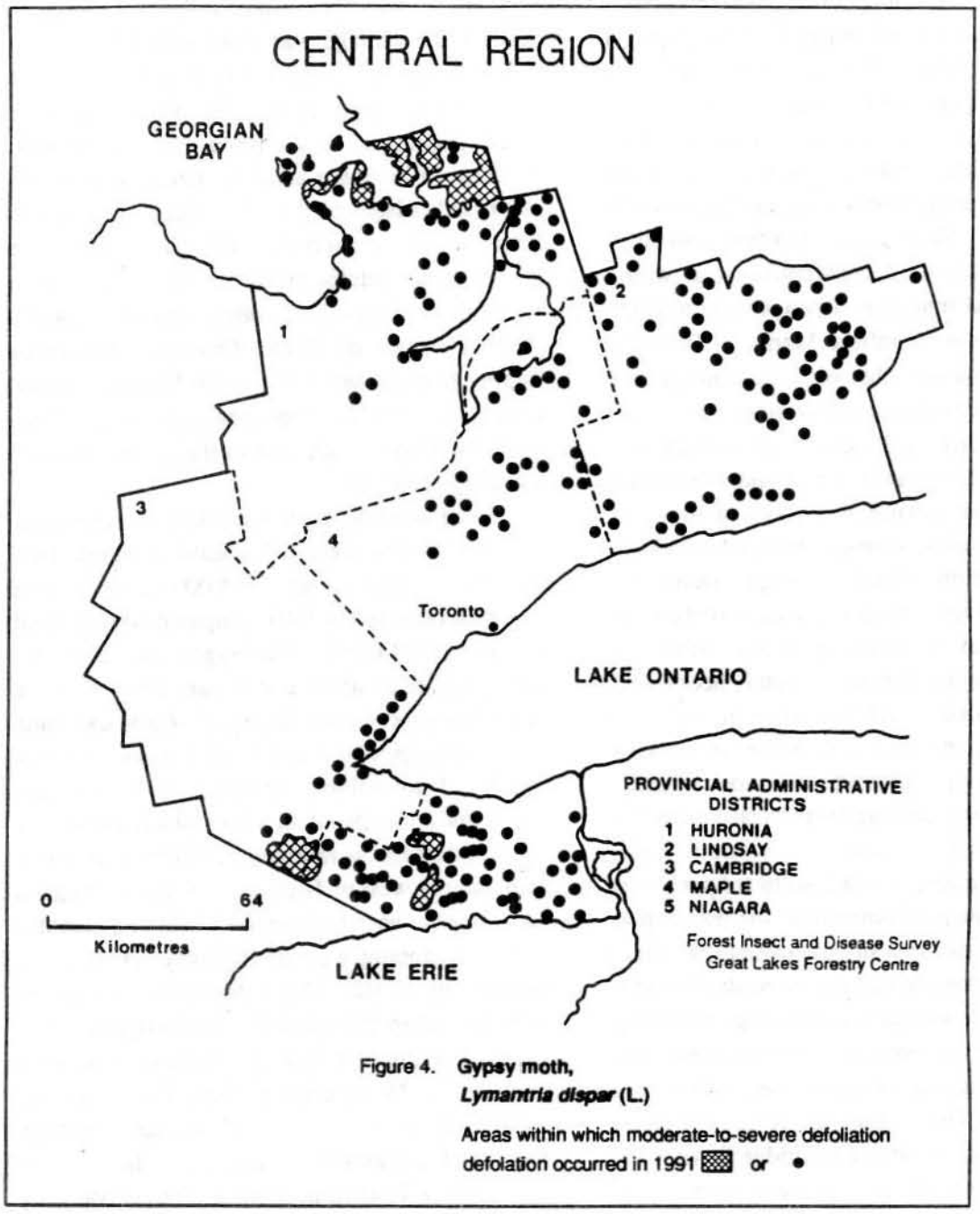

Figure 4. **Gypsy moth, *Lymantria dispar* (L.)**

Areas within which moderate-to-severe defoliation defolation occurred in 1991 ▩ or •

ships. Large pockets of damage were mapped over much of Tiny Township, including Christian, Beckwith, Hope, Giant's Tomb and Beausoleil islands, and in parts of Tay, Medonte, Orillia and Rama townships (Fig. 4). Smaller pockets of defoliation were observed in the northern end of Mara Township; in the northwestern corner of Oro Township; just southeast of Wasaga Beach; in and around the city of Barrie in Vespra, Innisfil and Essa townships; and at the southern end of CFB Borden, Huronia District. Lower population levels that caused no noticeable defoliation were present at many other points in Huronia District.

Niagara District had the next largest total area of infestation, with 30,718 ha, although this did not represent the second-largest increase since 1990

(Table 2). High population levels have been present in the central and eastern portions of this district in the past, and in 1991 there was more of a shift to the western part of the district (Fig. 4). Several small pockets of moderate-to-severe defoliation to mainly red oak and white oak (*Q. alba* L.) were mapped in Oneida, Seneca, North Cayuga, Canborough, Gainsborough, Caistor and Moulton townships (Fig. 4). For the third consecutive year, willow (*Salix* spp.) and trembling aspen were completely defoliated in the Wainfleet Marsh in Wainfleet Township; however, this year the damage was confined to the northern and western parts of the marsh. Numerous small pockets of damage were observed east of Welland in Crowland, Willoughby and Cumberstone townships. Pockets of moderate-to-severe defoliation were also mapped in Pelham, Grimsby, Clinton, South Cayuga, Dunn and Niagara townships. Levels of nuclear polyhedrosis virus appear to be building in the population throughout Niagara District. Ground checks at 20 locations revealed a high incidence of late-instar larval mortality and smaller than normal pupae.

In Cambridge District, the most dramatic increase in the area damaged was located on the Six Nations Indian Reservation in Tuscarora Township. A great number of small, scattered pockets of damage were mapped throughout the reservation, comprising a gross area slightly over 14,000 ha in size. A few pockets of damage were also found to the north of the reservation in Onondaga Township. This infestation is responsible for the more than 12,000 ha increase in the area of defoliation since 1990 (Table 2). Once again, the remainder of the heavy defoliation found in Cambridge District was in oak stands from the Ancaster area northeast to Oakville, with pockets of damage both north and south of Highway 5 (Fig. 4). The largest of these were located in East and West Flamborough townships, south of Waterdown and in the Dundas area, respectively. Small numbers of larvae were seen at many other points in Cambridge District.

There was a marked increase in the area defoliated by the gypsy moth in Lindsay District in 1991. A gross area of 11,418 ha was mapped this year, compared with 1,118 ha in 1990 (Table 2). In general, the damage was more widespread across the district in 1991, whereas most of it was located in the northeastern third of the district last year. Many pockets of moderate-to-severe defoliation occurred in lowlying areas in stands of trembling aspen and balsam poplar (*P. balsamifera* L.). The largest pockets, averaging 235 ha in size, were located near Peterborough in North Monaghan, Asphodel and Smith townships, and in the northwestern corner of Eldon Township. Numerous smaller pockets were mapped in Verulam, Emily, Ennismore, Harvey, Otonabee, Douro and Dummer townships in addition to the aforementioned townships (Fig. 4).

Increased populations resulted in more tracts of moderate-to-severe defoliation in Maple District. An increase of almost 4,000 ha in the area damaged occurred in 1991 compared with the total for last year (Table 2). The biggest increases were noted near the southern end of Lake Simcoe, where moderate-to-severe defoliation of poplar and white birch was mapped in North Gwillimbury, Georgina and Brock townships, including all of Georgina Island and a tiny patch on Snake Island. Other new areas of damage were found in Whitchurch Township, mainly west of Highway 48, and in Vaughan Township between highways 400 and 11 and southeast of Kleinburg west of Highway 400 (Fig. 4). Expansions in the 1990 infestation occurred in King Township, particularly west of Highway 400; north of Richmond Hill in Markham Township; just west of Newmarket in King Township; and throughout the eastern half of Uxbridge Township. New small pockets were mapped at the southern end of Brock Township, along the district boundary in Pickering Township, and in the northwestern corner of Uxbridge Township. Gypsy moth also defoliated individual trees in the urban area of Holland Landing and was present in conjunction with the forest tent caterpillar (*Malacosoma disstria* Hbn.) in Thorah Township near the district boundary. Lower population levels were common at many other points in Maple District.

The burlap and pheromone trapping program in provincial parks is no longer being used for the purpose of detection. In a select group of parks in three districts, trapping was carried out with the focus now on developing a sampling system to forecast damage levels (Table 3). Burlap trapping of larvae remained virtually unchanged; however, for pheromone trapping, a different type of pheromone trap and a low-release-rate lure are now in use. This particular trap and lure combination has been in use now for the past 2 years. As can be seen in Table 3, moth catches were much higher in 1991 at most of the parks. Numbers of larvae were also higher at five of the seven sites, and a big reduction in the number of eggs was noted at Six Mile Lake Provincial Park in Huronia District (Table 3).

Large numbers of an insect parasite were observed on gypsy moth egg masses at Bronte Creek Provincial Park in Cambridge District. The parasite was a tiny wasp called *Ooencyrtus kuvanae* (Howard), which breeds in the upper layers of individual eggs, usually parasitizing about one-third of the mass.

Eastern Tent Caterpillar,
Malacosoma americanum (F.)

Population levels rebounded somewhat in 1991 after experiencing a downward trend for the past 2 years. Large numbers of larvae were observed along Highway 69 in Huronia District, and numerous choke cherry (*Prunus virginiana* L.) were stripped of their leaves. Similar occurrences were found in Tay, Orillia, Medonte and Tiny townships in Huronia District. In Lindsay District, observations made in Haldimand, Hamilton and Scugog townships disclosed one tent each on one or two choke cherry, resulting in 20 to 40% defoliation. Similar population levels were seen at other points in Lindsay District.

Forest Tent Caterpillar,
Malacosoma disstria Hbn.

Population levels decreased again this year in Central Region, with the exception of Lindsay District, where a minor resurgence occurred in 1991 (Table 4). However, the damage in Lindsay District was confined to a cluster of pockets in the northwestern corner of Eldon Township, with moderate defoliation levels averaging 30% (Fig. 5). In addition to the forest tent caterpillar, there was also a large number of gypsy moth caterpillars feeding at these same sites.

In Maple District, one 462-ha pocket of moderate-to-severe defoliation and three other tiny ones resulted in a total infestation of 551 ha in the northern end of Thorah Township (Fig. 5). Larvae

Table 3. The results of gypsy moth burlap and pheromone trapping and egg counts from line searches at selected provincial parks in the Central Region of Ontario in 1991.

	Burlap traps					Pheromone traps					
	Total number of larvae caught in 10 burlap traps		Average number of larvae per observation		Average defoliation level (%)	Number of traps	Total number of moths caught		Average number per trap		Egg count
Location	1990	1991	1990	1991	1991	1991	1990	1991	1990	1991	1991
Cambridge District											
Bronte Creek	568	7,537	142	1,884	30	3	521	2,208	174	736	16
Huronia District											
Awenda[a]	105	258	26	65	0	3	449	1,398	150	466	82
Bass Lake	345	2,372	86	593	20	3	346	2,635	115	878	58
Six Mile Lake[a]	591	1,037	148	259	90	3	1,401	2,505	467	835	26
Springwater	1,563	1,216	391	304	0	3	385	1,430	128	477	0
Wasaga Beach	151	1,362	38	341	10	3	575	1,740	192	580	9
Lindsay District											
Serpent Mounds	6,377	5,479	1,594	1,370	20	1	413	72	138	72	15

[a] sprayed with *B.t.* in 1991

Table 4. Gross area of moderate-to-severe defoliation by the forest tent caterpillar in the Central Region of Ontario from 1987 to 1991.

District	Area of moderate-to-severe defoliation (ha)					Change from
	1987	1988	1989	1990	1991	1990 to 1991
Huronia	7,723	104,240	124,513	29,166	285	-28,881
Lindsay	5,198	47,752	132,578	350	1,236	+886
Maple	0	0	2,130	1,335	551	-784
	12,921	151,992	259,221	30,851	2,112	-28,779

were observed in poplar stands to the south of Lake Simcoe, but the gypsy moth was present in higher numbers and was mapped as such.

The forest tent caterpillar infestation in Huronia District collapsed in 1991. Only 285 ha of moderate-to-severe defoliation were confirmed as having been caused by this insect. This took the form of a single pocket of damage in the south-eastern corner of Mara Township (Fig. 5). Although forest tent caterpillar larvae were still

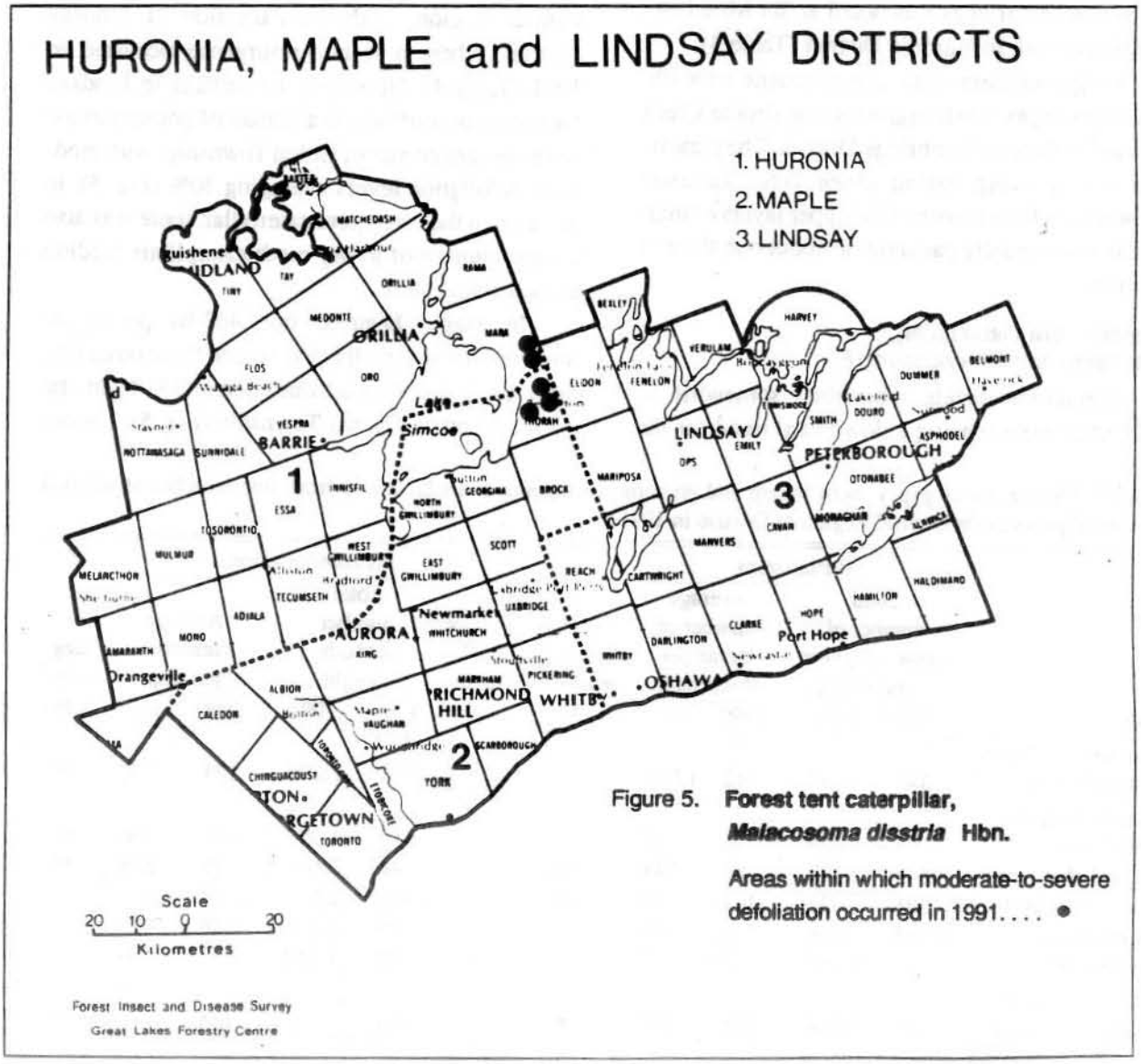

Figure 5. **Forest tent caterpillar, *Malacosoma disstria* Hbn.**

Areas within which moderate-to-severe defoliation occurred in 1991. . . . ●

present across the northern portion of the district, the gypsy moth was once again the dominant defoliator.

White Pine Weevil,
Pissodes strobi (Peck)

Although only a limited number of formal surveys were carried out in 1991, it appears from some general observations and from information supplied by contacts that population levels increased in 1991. In Lindsay District, pest evaluations were carried out in two eastern white pine plantations. In Cavan Township, 7% of the 2-m trees were attacked in a 5-ha plantation, and 1% of the 2-m trees had leader damage in a 3-ha plantation in Eldon Township. Damage levels of 2% were observed on about 550 eastern white pine in the tree seed orchard at the Midhurst Forest Tree Nursery in Huronia District. Trees averaging 2 m in height had 1% of their leaders damaged in a 1.5-ha plantation in Nichol Township and in a 0.5-ha plantation in Puslinch Township in Cambridge District. One plantation was checked in each of Louth and South Cayuga townships, Niagara District; however, weevil damage was not found.

Table 5. Other forest insects.

Insect	Host(s)	Remarks
Altica carinata Germ. Elm flea beetle	wE	High population levels resulted in sporadic 50 to 95% foliar browning through Grimsby, Louth, Niagara, Cayuga and Seneca townships in Niagara District.
Corthylus punctatissimus (Zimm.) Pitted ambrosia beetle	sM	A 30% mortality level in 0.7-m regeneration was present in a 280-m^2 patch within a semimature stand in Adjala Township, Huronia District. Additional pockets of damage in the 5–10% range were also present in the same stand. Regeneration mortality ranging from 20 to 40% was found in a couple of small patches at Bass Lake Provincial Park in Huronia District. Lower damage levels were common in many other sugar maple (*Acer saccharum* Marsh.) woodlots in the region.
Cryptococcus fagisuga Linding. Beech scale	Be	Large numbers of insects were found on mature hosts at Mark S. Burnham Provincial Park in Otonabee Township, Lindsay District. Varying insect population levels were recorded in North Cayuga, Louth, Stamford, and Pelham townships, Niagara District.
Datana integerrima G. & R. Walnut caterpillar	bWa	Defoliation of 40 to 100% occurred on occasional trees in Niagara District.
Diprion similis (Htg.) Introduced pine sawfly	ewP	Surveys disclosed that 23% of the 2-m trees had defoliation levels of < 10% in a 3-ha plantation in Eldon Township, Lindsay District. Trace numbers of larvae were found in a seed orchard in South Cayuga Township, Niagara District.
Eucosma gloriola Heinr. Eastern pine shoot borer	ewP	In Lindsay District, 47% of the 2-m trees were affected in a 5-ha plantation in Cavan Township and 5% of the 2-m trees were damaged in a 3-ha plantation in Eldon Township.
Fenusa dohrnii (Tisch.) European alder leafminer	European alder	This pest was responsible for an average of four mines per leaf on 30% of the foliage of trees at the Orono Forest Tree Nursery, Lindsay District.
Fenusa pusilla (Lep.) Birch leafminer	wB	Foliar browning levels in the 80–100% range were observed on individual ornamentals in the towns of Barrie, Angus, Tottenham, Creemore and Stayner, Huronia District; in Palgrave and Holland

(cont'd)

Table 5. Other forest insects (concl.).

Insect	Host(s)	Remarks
		Landing, Maple District; and in the city of Cambridge, Cambridge District. Foliar browning averaging 75% was observed on scattered trees in various towns in Niagara District.
Fenusa ulmi Sund. Elm leafminer	wE	High population levels resulted in 90% foliar damage on scattered 4- to 6-m trees in Nassagaweya Township, Cambridge District, and in Whitchurch Township, Maple District.
Heterocampa guttivitta (Wlk.) Saddled prominent	sM	Trace populations were found in Oro Township, Huronia District, resulting in 5% defoliation of scattered 2-m understory regeneration.
Lepidosaphes ulmi (L.) Oystershell scale	Be	A large population was observed in a 0.2-ha area at Bass Lake Provincial Park in Huronia District causing 10% branch-tip mortality on 15-m trees.
Mordwilkoja vagabunda (Walsh) Poplar vagabond aphid	ltA	Six 12-m trees had heavy leafcurl damage near the Lisle Road at CFB Borden, Huronia District.
Neodiprion abietis complex Balsam fir sawfly	bF	Defoliation levels of 10 to 15% were observed in 2-ha pockets of 10- to 15-m trees in Harvey, Verulam, Emily, South Monaghan, Smith and Alnwick townships, Lindsay District. Defoliation levels of up to 50% were found on the occasional tree <10 m in height.
Neodiprion n. nanulus Schedl. Red pine sawfly	rP	Light (<5%) defoliation was recorded in plantations ranging in height from 1 to 6 m in Clarke Township, Lindsay District.
Neodiprion pratti banksianae Roh. Jack pine sawfly	jP	A large population on about two dozen 3-m roadside trees in Georgina Township, Maple District, resulted in 80% defoliation.
Neodiprion sertifer (Geoff.) European pine sawfly	rP, scP	A survey in an 8-ha red pine plantation of 2-m trees in Belmont Township, Lindsay District, disclosed that <1% of the trees were affected, causing 5% defoliation. Trace populations were found in two 0.5-ha red pine plantations in Orillia and Medonte townships, Huronia District. Scattered 2-m roadside Scots pine (*P. sylvestris* L.) were stripped of their foliage at various points in Uxbridge Township, Maple District, and in Essa Township, Huronia District.
Paraleucoptera albella (Cham.) Cottonwood leafminer	bPo	Foliar browning levels of 95% were observed in a 0.1-ha stand of 15-m trees in Mono Township, Huronia District. Much lower damage levels were common in other scattered pockets in the region.
Pikonema alaskensis (Roh.) Yellowheaded spruce sawfly	wS	Defoliation averaged 14% on 68% of the 2-m trees in a 3-ha plantation in Eldon Township, Lindsay District. Some individual trees were 90% defoliated and 1% tree mortality was also recorded. Damage levels of 15% were seen on ornamentals in Fenelon Township, Lindsay District.
Plagiodera versicolora (Laich.) Imported willow leaf beetle	W	A population explosion in 1991 resulted in heavy damage to the willows, mostly black willow (*Salix nigra* Marsh.), found growing in low areas often along a waterway. Foliar browning levels ranging from 70 to 100% were common at numerous areas throughout the region.
Podapion gallicola Riley Pine gall weevil	rP	Low levels (10–20%) of branch mortality on 14- to 18-m trees were common in many plantations in Simcoe County, Huronia District.

TREE DISEASES

Major Diseases

Scleroderris Canker,
Gremmeniella abietina (Lagerb.) Morelet

The long-standing formal regionwide survey for the European race of this fungus was changed in 1991. Plantation examinations were restricted to the northern portion of Huronia District and to Lindsay District. Five Scots pine Christmas tree plantations ranging in height from 1.0 to 1.4 m were checked in Tiny Township as was a 0.8-m red pine plantation in Orillia Township, Huronia District. Scleroderris canker was not found in any of these stands. In Lindsay District, five red pine plantations were surveyed, two in Clarke Township and one each in Haldimand, Hamilton and Belmont townships. Neither the North American nor the European race of this fungus was found in the region in 1991.

Dutch Elm Disease,
Ophiostoma ulmi (Buisman) Nannf.

This once common wilt disease of shade trees is again becoming prevalent across Central Region on white elm regeneration ranging in height from 6 to 12 m. In Huronia District, three separate sites were observed in Oro Township and from three to six trees were dead within small scattered clumps of white elm. A dozen 10-m trees had more than 50% crown dieback in Vespra Township and along a fencerow of 12-m trees one was dead and five trees had more than 50% dieback in Sunnidale Township. Scattered dead and dying trees were found between Angus and Brentwood in Sunnidale Township and between Angus and Barrie in Vespra Township. Six trees were killed by the fungus in the village of Duntroon in Nottawasaga Township, Huronia District.

In Maple District, numerous pockets of dead and dying trees were observed in Whitchurch and Markham townships, particularly adjacent to Highway 404. Four dead trees were found within a small clump of elm growing along the Bloomington Road in Whitchurch Township, Maple District.

A mortality rate of 50% was recorded in a clump of about twenty 12-m trees at one location in Beverly Township, Cambridge District. Within a group of ten 12-m trees in Wellesley Township in Cambridge District, approximately 20% were dead.

An evaluation in Louth Township, Niagara District, revealed that 68% of the 11-m elm were dead and 27% had heavy crown dieback over about a 1-ha area. Other infection centers were present elsewhere in the region.

Tip Blight,
Sphaeropsis sapinea (Fr.) Dyko & B. Sutton

The fungus that causes tip blight infects all pines native to Ontario, but major damage seems to occur only on plantings of exotics, particularly Scots pine and Austrian pine (*P. nigra* Arnold). Heavy shoot, whole-branch and whole-tree mortality in Scots pine plantations and Austrian pine shelterbelts has destroyed the aesthetic and sheltering values of these trees at many points across the region.

Numerous clusters of 10-m Austrian pine planted adjacent to Highway 400 between Barrie and Toronto in Huronia and Maple districts sustained an average of 30% branch mortality, with the occasional tree having up to 80% dieback. Average branch mortality levels of 30 to 40% were present in an 8-ha Scots pine plantation in Beverly Township, Cambridge District, with 1% of the 12-m trees dead as a result of repeated heavy infection. In the same township, a 3-ha plantation of 10-m trees also had 1% tree mortality and average branch dieback of 40%. Similar infection centers were located in many other Scots pine plantations in older age classes in the Huronia and Maple districts. Branch mortality ranged from 20 to 65% on roadside plantings of Austrian pine in Niagara District. Tip blight also played havoc with ornamental Austrian pine in many urban centers across the region.

Table 6. Other forest diseases.

Organism	Host(s)	Remarks
Arceuthobium pusillum Peck Eastern dwarf mistletoe	wS	A pocket consisting of four dead trees and six heavily infected 16-m trees was again present near the Angus gate at CFB Borden in Huronia District.
Asteroma caryae (Peck) B. Sutton Leaf spot of hickory	Hi	Foliar damage levels ranging from 80 to 100% were found in some woodlots in Niagara District.
Aureobasidium apocryptum (Ell. & Ev.) Hermanides–Nijhof Anthracnose	sM, nM	Approximately 80% of the open-growing trees sustained 100% foliar damage at scattered locations in Niagara District.
Cronartium ribicola J.C. Fischer White pine blister rust	ewP	On average, 4% of the 2-m trees were affected in a 5-ha plantation in Cavan Township, Lindsay District, with 3% of the trees having stem cankers.
Cryptodiaporthe populea (Sacc.) Butin Poplar canker	LPo	A row of 120 dead and dying 10-m trees was present in West Gwillimbury Township, Huronia District. Other heavy infections were observed elsewhere in the region.
Endocronartium harknessii (J.P. Moore) Y. Hirats. Western gall rust	scP	Approximately 10% of the 1.4-m Christmas trees were affected in a 0.5-ha plantation in Tiny Township, Huronia District.
Guignardia aesculi (Peck) V.B. Stewart Leaf blotch	hChe	Ornamental trees planted in urban areas had foliar browning levels as high as 100% at many scattered sites across the region.
Mycosphaerella populicola G.E. Thompson Septoria leaf spot	bPo	Foliar infections levels ranging from 10 to 30% were present on 2-m trees at CFB Borden, Huronia District.

ABIOTIC DAMAGE

Leaf Scorch

Leaf scorch is a condition that develops as a yellowing or browning of tissue between the veins or along the leaf margins or as browning and withering of entire leaves. It may be caused by internal physiological disturbances in response to low temperatures, excess water, drought or poor soil. Frequently, scorch develops in July and August when the roots are unable to furnish sufficient water to compensate for the moisture lost from the leaves during prolonged dry periods. Drying winds and high temperatures will increase the amount and severity of scorch. Open-growing, exposed trees will also be more susceptible to damage.

Scorch damage was much more prevalent across Central Region in 1991. In Niagara District, foliar damage near 95% was recorded in a 0.5-ha area of mature red maple (*A. rubrum* L.) in Willoughby Township, and on 85% of the ornamental sugar maple and little-leaf linden (*Tilia cordata* Mill.) along the Niagara Parkway in Bertie Township, foliar browning levels ranged between 75 and 100%. In the remainder of the region, the damage was confined to roadside sugar maple. Scorch damage ranging from 50 to 80% was observed on 100% of the sugar maple found between Angus and Highway 26 in Sunnidale Township, and about 30 roadside trees had average damage levels of 30% in Tosorontio Township, Huronia District. Foliar browning averaging 50% was observed on a row of 30 trees in Chinguacousy Township in Maple Dis-

trict. High damage levels were seen at various points in Lindsay District and at other points in the region.

Drought

The combination of poor sites, past defoliation by the forest tent caterpillar and the current gypsy moth infestation, and drought-like weather conditions off and on for the past 5 years has resulted in sufficient stress to cause the death of scattered red oak across the northern reaches of the Huronia and Lindsay districts. Trembling aspen and white birch have been affected too, but to a lesser extent. The areas most affected were those along the edge of the Canadian Shield in Baxter, Matchedash and Rama townships, Huronia District, and in Bexley and Fenelon townships, Lindsay District. A study plot in a 25-m red oak stand in Bexley Township disclosed a 51% mortality level in 1991 compared with 38% found the previous year.

FOREST HEALTH

Maple Health

The woodlot, urban and rural plots in this ongoing study were visited again to assess total crown dieback levels and observe any pests present. This year, in a departure from previous practice, the crown dieback was not separated into current and cumulative catagories; only the total level of dieback was recorded.

In the 10 woodlot plots, there were some minor changes in dieback levels. Slight increases in the numbers of trees that progressed to a higher level of dieback were recorded in the two plots in Niagara District, and a new dead tree was found in the plot in Adjala Township, Huronia District (Table 7). At all other plots, average tree condition either improved slightly or stayed the same compared with 1990. There were no insect or disease problems observed in any of the woodlot plots.

There are a total of 15 urban and rural plots in the region, eight rural and seven in towns. Because of the greater range of stress factors experienced by these trees, they are in much poorer condition than the woodlot trees. In general, there was an improvement in most of the plots in 1991 (Table 8). The bulk of the trees still remained in the 0–20% dieback range. There were no pest problems; however, two of the urban plots had low levels (30%) of leaf scorch damage. The usual holes and wounds typical of trees growing in this type of environment were present, and some of the urban trees had been pruned since the last visit.

North American Maple Project

Once again, the six sugar maple plots established in the region were checked. Levels of de-

Table 7. Maple health at woodlot locations in the Central Region of Ontario from 1987 to 1991 (25 sugar maple examined at each location).

Location (Twp)	Average height (m)	Average DBH (cm)	Year	Total dieback class[a] 0	1	2	3	4	5	Trees blown down or cut
				← Number of trees →						
Cambridge District										
Nassagaweya	27	31.5	1987	25	0	0	0	0	0	0
			1988	25	0	0	0	0	0	0
			1989	25	0	0	0	0	0	0
			1990	24	1	0	0	0	0	0
			1991	25	0	0	0	0	0	0
Trafalgar	35	43.6	1987	25	0	0	0	0	0	0
			1988	25	0	0	0	0	0	0
			1989	23	2	0	0	0	0	0
			1990	23	2	0	0	0	0	0
			1991	25	0	0	0	0	0	0

(cont'd)

Table 7. Maple health at woodlot locations in the Central Region of Ontario from 1987 to 1991 (25 sugar maple examined at each location) (concl.).

Location (Twp)	Average height (m)	Average DBH (cm)	Year	Total dieback class[a] 0	1	2	3	4	5	Trees blown down or cut
				← Number of trees →						
Huronia District										
Adjala	21	33.0	1987	25	0	0	0	0	0	0
			1988	24	1	0	0	0	0	0
			1989	23	2	0	0	0	0	0
			1990	23	2	0	0	0	0	0
			1991	23	1	0	0	0	1	0
Flos	27	33.4	1987	25	0	0	0	0	0	0
			1988	25	0	0	0	0	0	0
			1989	25	0	0	0	0	0	0
			1990	25	0	0	0	0	0	0
			1991	25	0	0	0	0	0	0
Medonte	30	38.0	1987	25	0	0	0	0	0	0
			1988	25	0	0	0	0	0	0
			1989	21	4	0	0	0	0	0
			1990	17	7	1	0	0	0	0
			1991	17	7	1	0	0	0	0
Oro	23	26.5	1987	25	0	0	0	0	0	0
			1988	25	0	0	0	0	0	0
			1989	24	1	0	0	0	0	0
			1990	23	2	0	0	0	0	0
			1991	24	1	0	0	0	0	0
Maple District										
Albion	29	39.7	1987	25	0	0	0	0	0	0
			1988	25	0	0	0	0	0	0
			1989	24	1	0	0	0	0	0
			1990	24	1	0	0	0	0	0
			1991	25	0	0	0	0	0	0
Whitchurch	21	35.5	1987	25	0	0	0	0	0	0
			1988	25	0	0	0	0	0	0
			1989	25	0	0	0	0	0	0
			1990	25	0	0	0	0	0	0
			1991	25	0	0	0	0	0	0
Niagara District										
Oneida	27	40.4	1987	25	0	0	0	0	0	0
			1988	24	1	0	0	0	0	0
			1989	19	1	3	1	0	0	1
			1990	20	4	0	0	0	0	1
			1991	20	3	1	0	0	0	1
South Cayuga	21	21.2	1987	25	0	0	0	0	0	0
			1988	25	0	0	0	0	0	0
			1989	24	1	0	0	0	0	0
			1990	24	1	0	0	0	0	0
			1991	22	2	1	0	0	0	0

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

Table 8. Maple health at urban and rural locations in the Central Region of Ontario from 1989 to 1991 (25 maple trees examined at each location).

Location[a]	Average height (m)	Average DBH (cm)	Year	Total dieback class[b] 0	1	2	3	4	5	Trees blown down or cut
				← Number of trees →						
Cambridge District										
Guelph (U)	18	70.5	1990	13	11	1	0	0	0	0
			1991	10	14	1	0	0	0	0
Oakville (U)	20	82.5	1989	13	10	2	0	0	0	0
			1990	14	10	1	0	0	0	0
			1991	12	11	1	0	0	0	1
Huronia District										
Mono Twp (R)	18	54.0	1989	1	9	5	7	2	1	0
			1990	1	10	4	4	4	2	0
			1991	6	5	4	3	5	2	0
Orillia (U)	21	66.1	1989	7	11	4	3	0	0	0
			1990	7	12	4	1	1	0	0
			1991	10	12	1	2	0	0	0
Oro Twp (R)	19	66.9	1989	12	11	2	0	0	0	0
			1990	9	14	2	0	0	0	0
			1991	16	9	0	0	0	0	0
West Gwillimbury Twp (R)	15	69.9	1989	8	7	4	5	1	0	0
			1990	8	7	4	4	2	0	0
			1991	9	7	7	0	2	0	0
Lindsay District										
Clarke Twp (R)	15	72.9	1989	9	7	6	1	2	0	0
			1990	7	10	5	1	0	1	1
			1991	6	16	1	0	0	1	1
Cobourg (U)	18	68.5	1989	10	10	3	1	1	0	0
			1990	9	10	3	2	1	0	0
			1991	11	9	3	2	0	0	0
Fenelon Twp (R)	14	57.3	1989	12	7	5	1	0	0	0
			1990	5	14	3	3	0	0	0
			1991	5	14	4	2	0	0	0
Hamilton Twp (R)	18	71.1	1989	9	6	9	1	0	0	0
			1990	6	11	4	1	0	0	3
			1991	5	16	1	0	0	0	3
Little Britain (U)	21	67.6	1989	10	9	6	0	0	0	0
			1990	9	10	2	1	0	0	3
			1991	8	12	1	0	1	0	3
Ops Twp (R)	13	61.1	1989	2	8	10	4	1	0	0
			1990	1	10	8	2	0	0	4
			1991	0	16	4	0	1	0	4
Peterborough (U)	19	51.1	1989	12	13	0	0	0	0	0
			1990	14	11	0	0	0	0	0
			1991	17	8	0	0	0	0	0
Maple District										
Chinguacousy Twp (R)	18	70.9	1990	6	8	5	5	0	0	0
			1991	6	8	5	1	4	0	1
Richmond Hill (U)	15	57.9	1990	19	3	1	2	0	0	0
			1991	16	5	0	1	0	0	3

[a] U = urban, R = rural (roadside)

[b] 0 = 0–5%, 1 = 6–20%, 2 = 21–40%, 3 = 41–60%, 4 = >60%, 5 = dead tree

cline increased in three of the plots; the plot in Belmont Township, Lindsay District, had the most noteworthy change. This stand had one new dead tree, and more trees in the 6–15% range of dieback (Table 9) compared with last year. The three plots in Huronia District showed some sign of improvement, with more trees shifting to the lower dieback ranges or having no dieback at all, as occurred in Adjala Township. There were no significant pests found in any of the plots. A trace level of defoliation by the gypsy moth was observed in Belmont Township, Lindsay District, and an occasional tree was infected by Eutypella canker (*Eutypella parasitica* R.W. Davidson & R.C. Lorenz) in two plots.

Oak Health

With the exception of a low level of increased mortality in three of the plots, all plots showed varying levels of improvement (Table 10). Most of this tree mortality was the result of Armillaria root rot (*Armillaria* spp.) infections. Four trees had died since last year's visit in the plot in Tiny Township at Awenda Provincial Park, Huronia District. The majority of the trees have reverted to dieback levels in the 0–20% range, with fewer trees found in the 21–40% range, particularly in the Mulmur and Clarke Township plots in Huronia and Lindsay districts, respectively (Table 10). The breakdown between current and cumulative dieback has also been dropped in the red oak plots and now only the total level of crown dieback is recorded.

Insect activity was very noticeable in two of the stands examined. High gypsy moth population levels resulted in average defoliation of 75% and 68% in the Farlain Lake plot, Huronia District, and in the Uxbridge Township plot, Maple District, respectively. Both the gypsy moth and the oak leaf shredder were present in sufficient numbers to cause an average defoliation level of 10% in the plot in Clarke Township, Lindsay District. No other pest damage was observed in any of the study plots.

Acid Rain National Early Warning System (ARNEWS)

Acid rain is more than just precipitation with below-average pH: it has become the popular term for all forms of airborne pollution such as wet or dry deposition of pollutants, gaseous pollutants, etc. In 1984 and 1985, two plots were established in Central Region, one in a sugar maple stand in Oro Township, Huronia District, and the other in an eastern white pine plantation in Erin Township, Cambridge District. The purpose of these plots is to monitor changes in the condition of these forest trees. The presence of and changes in biotic and abiotic factors or symptoms not attributable to pollution are also monitored. No damage was observed that could be linked with pollution, and there was no insect or disease damage present on either the sugar maple or the eastern white pine in these study plots in 1991.

SPECIAL SURVEYS

Forest Tree Nursery Report

The two OMNR forest tree nurseries responsible for supplying most of the planting stock for south-central Ontario are located at Midhurst in Huronia District and at Orono in Lindsay District. This section summarizes the status of pests encountered by FIDS Rangers during visits to these nurseries in 1991.

At the Midhurst Forest Tree Nursery, the heaviest disease damage encountered in 1991 was in compartment C6, where a 5% mortality level caused by the root rot *Cylindrocladium scoparium* Morgan was recorded in the 1+2 red pine. A low infection level of poplar leaf spot (*Marssonina tremulae* [Lib.] Kleb.) in compartment D4 resulted in foliar browning on lower leaves of hybrid poplar stools. About 5% shoot damage caused by a late frost was present on hybrid poplar in compartments C21 and D4. Thrips damage was found affecting 1+0 eastern white pine in the parts of compartments K3 and A6 that had not been sprayed with the insecticide Cymbush® 250 EC (cypermethrin). The unsprayed seedlings were shorter and had wounds on the main stem that caused a loss of apical dominance. Approximately 40 to 50% of the unsprayed seedlings in compartment K3 were damaged, with 20% damaged in compartment A6. Thrips were found in the sample, but only identifi-

Table 9. Crown condition of sugar maple at six North American Maple Project plots in the Central Region of Ontario from 1988 to 1991.

Location (Twp)	Average DBH (cm)	Year	Number of trees[c]	Total dead crown (%) Number of trees 0	1–5	6–15	16–25	26–35	36–45	46–55	56–65	66–75	76–85	86–95	96–100	Trees dead	Trees blown down or cut
Cambridge District																	
Nassagaweya[a]	30.0	1988	49	26	19	3	0	1	0	0	0	0	0	0	0	0	0
		1989	49	10	34	4	1	0	0	0	0	0	0	0	0	0	0
		1990	49	0	39	9	1	0	0	0	0	0	0	0	0	0	0
		1991	49	0	39	7	2	0	0	0	0	0	0	0	0	1	0
Huronia District																	
Adjala[a]	30.4	1988	65	24	37	4	0	0	0	0	0	0	0	0	0	0	0
		1989	65	2	49	8	4	1	0	0	0	0	0	1	0	0	0
		1990	65	0	43	14	5	0	0	0	0	0	0	1	0	2	0
		1991	65	12	41	5	3	0	0	0	0	0	0	1	0	3	0
Orillia[b]	36.7	1988	53	25	24	3	1	0	0	0	0	0	0	0	0	0	0
		1989	53	16	29	7	1	0	0	0	0	0	0	0	0	0	0
		1990	53	0	47	3	2	1	0	0	0	0	0	0	0	0	0
		1991	53	5	43	4	1	0	0	0	0	0	0	0	0	0	0
Oro[a]	23.5	1988	80	50	27	3	0	0	0	0	0	0	0	0	0	0	0
		1989	66	14	49	3	0	0	0	0	0	0	0	0	0	0	14
		1990	66	1	53	11	1	0	0	0	0	0	0	0	0	0	14
		1991	66	5	58	0	1	0	0	0	0	0	0	0	0	2	14
Lindsay District																	
Belmont[b]	26.6	1988	55	0	43	9	2	0	0	0	0	0	0	1	0	0	0
		1989	55	0	38	10	6	0	0	0	0	0	0	1	0	0	0
		1990	55	0	46	7	1	0	0	0	0	0	0	1	0	0	0
		1991	54	0	34	15	4	0	0	0	0	0	0	0	0	1	1
Maple District																	
Vaughan[b]	30.8	1988	47	33	8	5	0	0	0	0	0	0	0	0	0	0	0
		1989	47	23	19	4	0	0	0	0	1	0	0	0	0	0	0
		1990	47	1	44	1	0	0	1	0	0	0	0	0	0	0	0
		1991	45	4	36	5	0	0	0	0	0	0	0	0	0	0	2

[a] undisturbed woodlot
[b] trees currently tapped for maple syrup
[c] sugar maple only

Table 10. Oak health at five locations in the Central Region of Ontario from 1984 to 1991 (100 red oak examined at each location).

Location	Average[a] height (m)	Average[a] DBH (cm)	Year	Total dieback class[b] 0	1	2	3	4	5	Trees blown down or cut
				← Number of trees →						
Huronia District										
Tiny Twp	21.9	25.9	1984	6	56	9	4	1	9	15
Awenda Prov. Park			1985	4	62	9	0	1	9	15
			1986	31	41	2	1	0	10	15
			1987	41	29	4	0	0	11	15
			1988	30	37	7	0	0	11	15
			1989	8	49	13	4	0	11	15
			1990	7	48	11	7	1	11	15
			1991	7	57	4	1	1	15	15
Tiny Twp	22.0	26.0	1984	0	31	25	6	5	33	0
Farlain Lake			1985	0	49	12	3	1	34	1
			1986	28	25	7	1	0	33	6
			1987	36	22	2	1	0	33	6
			1988	23	32	5	1	0	33	6
			1989	25	27	8	1	0	33	6
			1990	3	36	17	3	1	34	6
			1991	3	42	9	1	3	36	6
Mulmur Twp	21.0	28.2	1984	1	52	33	6	0	4	4
			1985	0	71	19	2	0	4	4
			1986	55	35	2	0	0	4	4
			1987	64	22	3	0	1	6	4
			1988	52	33	3	0	1	7	4
			1989	39	34	12	2	0	9	4
			1990	25	48	10	3	1	9	4
			1991	35	45	5	1	0	10	4
Maple District										
Uxbridge Twp	21.2	26.1	1984	0	40	27	6	3	24	0
			1985	0	53	17	4	1	25	0
			1986	0	62	12	1	0	25	0
			1987	4	46	24	0	0	26	0
			1988	3	33	19	1	0	26	0
			1989	7	47	17	2	0	27	0
			1990	10	44	14	1	0	31	0
			1991	13	47	9	0	0	31	0
Lindsay District										
Clarke Twp	20.6	22.9	1984	37	39	10	2	2	10	0
			1985	21	45	19	2	2	11	0
			1986	28	38	16	5	2	11	0
			1987	37	42	6	2	1	12	0
			1988	23	54	7	1	2	13	0
			1989	28	48	7	1	2	14	0
			1990	15	62	5	1	0	17	0
			1991	0	80	3	0	0	17	0

[a] from 1977 measurements

[b] 0 = 0–5%, 1 = 6–20%, 2 = 21–40%, 3 = 41–60%, 4 = >60%, 5 = dead tree

cation as far as the family (Thripidae) was made. Lab staff at Forestry Canada, Ontario Region, confirmed that the damage to the seedlings was typical of that caused by thrips, i.e., brown feeding scars with curled needles.

The eastern white cedar windbreaks at the Orono Forest Tree Nursery had average damage levels of 20 to 30% caused by cedar leafminers and larch casebearer populations caused 60% defoliation on the 16-m European larch windbreaks beside compartment S41. Feeding by the gypsy moth caused average defoliation levels of 10 to 15% on the red oak in compartments T91 and T92 and occurred to a lesser extent on the European alder (*Alnus incana* [L.] Moench) in compartment S50. Small numbers of the red pine sawfly were observed on the 6-m red pine in compartment S10. A combination of two root rots, *Cylindrocladium* sp. and *Fusarium* sp., was responsible for 1% mortality of European larch in compartment T52. Tip blight caused up to 90% shoot and branch mortality on 6-m Scots pine found growing in an area of the nursery not under cultivation. Cold temperatures resulted in frost heaving and caused 15% mortality of white spruce in compartment T82.

Climatic Data

Abiotic damage is most commonly caused by extremes in weather; examples include frosts or low precipitation levels that cause drought stress. Climate also has an important effect on the development of insect and disease problems. Table 11 lists the mean monthly temperatures and total precipitation for 1991 at two locations in Central Region, as recorded by the Atmospheric Environment Service. Deviations from the 30-year average values are also reported. Climate can vary greatly from district to district, and these data represent information from only two stations.

Table 11. A summary of temperatures and precipitation for 1991 at two locations in the Central Region of Ontario, and deviations from the 30-year norms.

Location	Month	Mean temperature (°C)		Deviation from normal (°C)	Total precipitation (mm)		Deviation from normal (mm)
		Normal	Actual		Normal	Actual	
Peterborough	Jan.	–9.3	–8.7	+0.6	44.1	52.2	+8.1
Airport	Feb.	–8.5	–5.0	+3.5	48.9	24.0	–24.9
	March	–2.5	0.2	+2.7	62.9	105.6	+42.7
	April	6.0	7.7	+1.7	71.8	114.2	+42.2
	May	12.1	14.8	+2.7	57.1	78.0	+20.9
	June	16.8	17.8	+1.0	60.4	18.8	–41.6
	July	19.2	19.7	+0.5	77.9	30.0	–47.9
	Aug.	18.1	19.3	+1.2	74.2	36.6	–37.6
	Sept.	14.0	12.6	–1.4	72.9	77.0	+4.1
	Oct.	7.9	8.6	+0.7	59.9	72.0	+12.1
	Nov.	2.1	0.7	–1.4	69.4	48.0	–21.4
	Dec.	–6.0	–6.0	0.0	74.3	71.0	–3.3
Lester B.	Jan.	–6.7	–5.7	+1.0	50.4	33.6	–16.8
Pearson	Feb.	–6.1	–2.4	+3.7	46.0	23.5	–22.5
International	March	–1.0	1.7	+2.7	61.1	98.1	+37.0
Airport	April	6.2	8.7	+2.5	70.0	115.4	+45.4
	May	12.3	16.3	+4.0	66.0	83.6	+17.6
	June	17.7	20.0	+2.3	67.1	24.4	–42.7
	July	20.6	21.7	+1.1	71.4	91.0	+19.6
	Aug.	19.7	21.1	+1.4	76.8	91.4	+14.6
	Sept.	15.5	14.9	–0.6	63.5	52.1	–11.4
	Oct.	9.3	10.4	+1.1	61.8	46.3	–15.5
	Nov.	3.3	2.5	–0.8	62.7	56.3	–6.4
	Dec.	–3.5	–2.4	+1.1	64.7	44.7	–20.0