

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

*Forest Districts: Aylmer, Cambridge,
Midhurst, Maple, Tweed, and Kemptville*

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SURVEY HIGHLIGHTS

This report describes the most significant biotic and abiotic conditions detected and evaluated by the Forest Insect and Disease Survey (FIDS) Unit of the Canadian Forest Service in the Ontario Ministry of Natural Resources' (OMNR) Southern Region of Ontario in 1994.

There was a major decline in the area of moderate to severe defoliation caused by the gypsy moth. Some 48 ha of moderate defoliation occurred at the Pinery Provincial Park in the Aylmer District and an experimental aerial spray was conducted across 210 ha. Population and defoliation levels of the eastern spruce budworm continue to increase in white spruce plantations in the central and eastern portions of the region. In 1994, approximately 690 ha of moderate to severe defoliation were recorded. For the second consecutive year, the area of moderate to severe defoliation caused by the hemlock looper continued to increase and spread in the eastern portion of the region. In 1994, some 150 ha of severe defoliation were aerially sketched mapped in the Kemptville District and 23 ha were recorded in the Tweed District. At most locations additional areas of light defoliation surrounded the pockets of severe damage.

The pine false webworm continued to be a serious problem in semimature red pine and eastern white pine throughout 375 ha in the Midhurst District and 90 ha in the Tweed District. In the Midhurst District, approximately 25 ha of semimature red pine were clear-cut. This area was in an obvious state of decline as a result of 2 years of severe defoliation by the webworm.

There was a complete collapse of the forest tent caterpillar population in the eastern portion of the region. Over 36,885 ha of moderate to severe defoliation had occurred here in 1993. A major decline in the population levels of the satin moth was also recorded across the region. For the second consecutive year a successful aerial control operation against the satin moth was conducted throughout the residential areas at Canadian Forces Base (CFB) Borden in the Midhurst District.

The redheaded pine sawfly caused severe defoliation to 90 ha of juvenile red pine on the First Nations Lands at Christian Island in the Midhurst District. A control operation, using the biological insecticide *Lecontvirus*, is scheduled for 1995. Following a year of declining populations, the balsam fir sawfly increased in the central and eastern portion of the region. Low levels of cedar leafminers were commonly encountered at numerous sites throughout the entire region.

Pockets of whole tree mortality, caused by *armillaria* root rot, were detected in semimature pine plantations in Northumberland, Simcoe, Ganaraska, and Durham county forests. Surveys have indicated that the butternut canker disease, very common and widely distributed throughout the region, is having a serious impact on host trees.

A marked decline in the incidence of and damage level caused by *diplodia* tip blight was recorded in the central portion of the region. Surveys conducted in pine plantings for *Scleroderris* canker yielded negative results. However, poplar leaf diseases and Dutch elm disease were commonly encountered.

Annual evaluation of the fifty-five 25-tree sugar maple health plots revealed that the majority of trees were healthy; only 12% had sustained >20% dieback. Similar results were recorded in the 16 sugar maple plots in the North American Maple Project (NAMP). Annual assessment of the 760 trees in this project revealed that 98% were healthy, with <25% average crown dieback. For the second consecutive year, an overall improvement in crown vigor was recorded throughout the ten permanent 100-tree oak plots in the region. Evaluation in 1994 revealed that 88% of the trees were healthy, with <20% average crown dieback. No evidence of acid rain damage was detected in the annual assessment of the eight Acid Rain National Early Warning System (ARNEWS) plots that target four specific tree species in the region. The results of routine surveys conducted in the three OMNR Forest Tree Nurseries in the region are also presented.

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

Major Insects/Diseases

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

Minor Insects/Diseases

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

Other Forest Insects/Diseases (Tables)

These tables provide information on two types of pest:

- (1) those that are of minor importance and have not been known to cause serious damage to forest trees, and
- (2) those that are capable of causing serious damage but, because of low population levels or for other reasons, did not cause serious damage in 1994.

The authors would like to express their appreciation to personnel of the various OMNR district and area offices and tree nurseries, and to various private individuals for their excellent cooperation during the 1994 field season.

Ed Czerwinski was transferred from the region in the fall of 1994. He would like to extend special thanks to all the OMNR staff in the eastern portion of the region for the excellent cooperation he received during the last 3 years.

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FRONTISPIECE



Severe defoliation of mature eastern hemlock (*Tsuga canadensis* [L.] Carr.) caused by the hemlock looper (*Lambdina f. fuscicollis* [Gn.]) in the Kemptville District.

TABLE of CONTENTS

INSECTS

Major Insects

Pine False Webworm, <i>Acantholyda erythrocephala</i> (Cambridge, Midhurst, Kemptville, and Tweed districts)	1
Arborvitae Leafminer, <i>Argyresthia thuiella</i> (All districts)	2
Birch Skeletonizer, <i>Bucculatrix canadensisella</i> (Kemptville, Maple, Midhurst, and Tweed districts)	2
Large Aspen Tortrix, <i>Choristoneura conflictana</i> (Kemptville and Maple districts)	3
Eastern Spruce Budworm, <i>Choristoneura fumiferana</i> (All districts)	3
Larch Casebearer, <i>Coleophora laricella</i> (All districts)	7
Introduced Pine Sawfly, <i>Diprion similis</i> (Cambridge, Midhurst, and Tweed districts)	7
Hemlock Looper, <i>Lambdina f. fiscellaria</i> (Kemptville, Maple, and Tweed districts)	7
Satin Moth, <i>Leucoma salicis</i> (Maple and Midhurst districts)	9
Gypsy Moth, <i>Lymantria dispar</i> (All districts)	9
Forest Tent Caterpillar, <i>Malacosoma disstria</i> (Kemptville and Tweed districts)	10
Balsam Fir Sawfly, <i>Neodiprion abietis</i> (Kemptville and Tweed districts)	11
Redheaded Pine Sawfly, <i>Neodiprion lecontei</i> (Kemptville, Midhurst, and Tweed districts)	11
White Pine Weevil, <i>Pissodes strobi</i> (All districts)	12

Minor Insects

Maple Trumpet Skeletonizer, <i>Epinotia aceriella</i> (Cambridge, Maple, Midhurst, and Tweed districts)	12
Eastern Pine Shoot Borer, <i>Eucosma gloriola</i> (Kemptville, Midhurst, and Tweed districts)	13
Fall Webworm, <i>Hyphantria cunea</i> (Aylmer, Cambridge, Kemptville, and Tweed districts)	14
Other Forest Insects (All districts)	14

TREE DISEASES

Major Diseases

Armillaria Root Rot, <i>Armillaria ostoyae</i> (Kemptville, Maple, Midhurst, and Tweed districts)	18
Scleroderris Canker, <i>Gremmeniella abietina</i> (Kemptville, Maple, Midhurst, and Tweed districts)	18

(cont'd)

TABLE of CONTENTS (concl.)

Major Diseases (cont'd)

Dutch Elm Disease, <i>Ophiostoma ulmi</i> (All districts)	19
Butternut Canker, <i>Sirococcus clavigignenti-juglandacearum</i> (All districts)	20
Diplodia Tip Blight, <i>Sphaeropsis sapinea</i> (Aylmer, Cambridge, Maple, and Midhurst districts)	21

Minor Diseases

Leaf Spot, various (All districts)	22
Pine Needle Rust, <i>Coleosporium asterum</i> (Kemptonville and Tweed districts)	22
White Pine Blister Rust, <i>Cronartium ribicola</i> (Cambridge, Kemptonville, and Midhurst districts)	23
Other Forest Diseases (All districts)	23

ABIOTIC CONDITIONS

Frost Damage (All districts)	25
Animal Damage (Aylmer, Cambridge, and Kemptonville districts)	26

FOREST HEALTH

Ash Dieback (Kemptonville, Maple, Midhurst, and Tweed districts)	26
Maple Health (All districts)	27
North American Maple Project (All districts)	32
Oak Health (All districts)	34
Acid Rain National Early Warning System (All districts)	36

SPECIAL SURVEYS

Pine Shoot Beetle, <i>Tomicus piniperda</i> (Aylmer, Cambridge, and Midhurst districts)	36
Forest Tree Nursery Reports (Aylmer, Kemptonville, and Maple districts)	36
Climatic Data (Aylmer, Cambridge, Kemptonville, Maple, and Tweed districts)	39

INSECTS

Major Insects

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

The pine false webworm continued to cause severe defoliation in pine plantations across the region. For the second consecutive year, severe defoliation occurred in 40- to 50-year-old red pine (*Pinus resinosa* Ait.) and eastern white pine (*P. strobus* L.) in the Midhurst and Tweed districts.

In Oro Township in the Midhurst District, moderate to severe defoliation, aerially sketched mapped across 34 plantations, totaled 375 ha. This was a slight increase from the 287 ha reported in 1993. (Fig. 1). At several locations throughout this area the larvae consumed 100% of the old foliage and >50% of the current foliage on semimature red pine and eastern white pine. This level of damage was detected on everything from single, open-grown, 18-m eastern white pine to all of the 14-m-tall trees in a 50-ha red pine plantation. This area of infestation appears to be expanding, as was evidenced by heavy

defoliation detected along the extreme outside edges of several adjacent plantations (Fig. 2).

In an attempt to control the spread of this pest in Oro Township, staff from the Ontario Ministry of Natural Resources (OMNR) Midhurst District Office clear-cut approximately 25 ha in the most heavily infested area. This formed the centre of the damaged area in 1993; thus, the 18-m red pine here had sustained 2 consecutive years of severe defoliation. As such, the OMNR was concerned that the trees could not withstand this level of damage and would start to deteriorate and die. Therefore, the trees were harvested before this occurred. The cut was completed during late October and early November. This harvesting schedule was suggested so that the tops would still be green in the spring when the adult webworms emerge from the soil. It is hoped that they will lay their eggs on the foliage of the dead tops and not disperse to adjacent stands. Then, as spring advances, the tops will dry out and the larvae should starve to death.

The area of moderate to severe defoliation in Hope Township, Tweed District, was scattered across a total of six plantations and increased in size from 73 ha in 1993 to

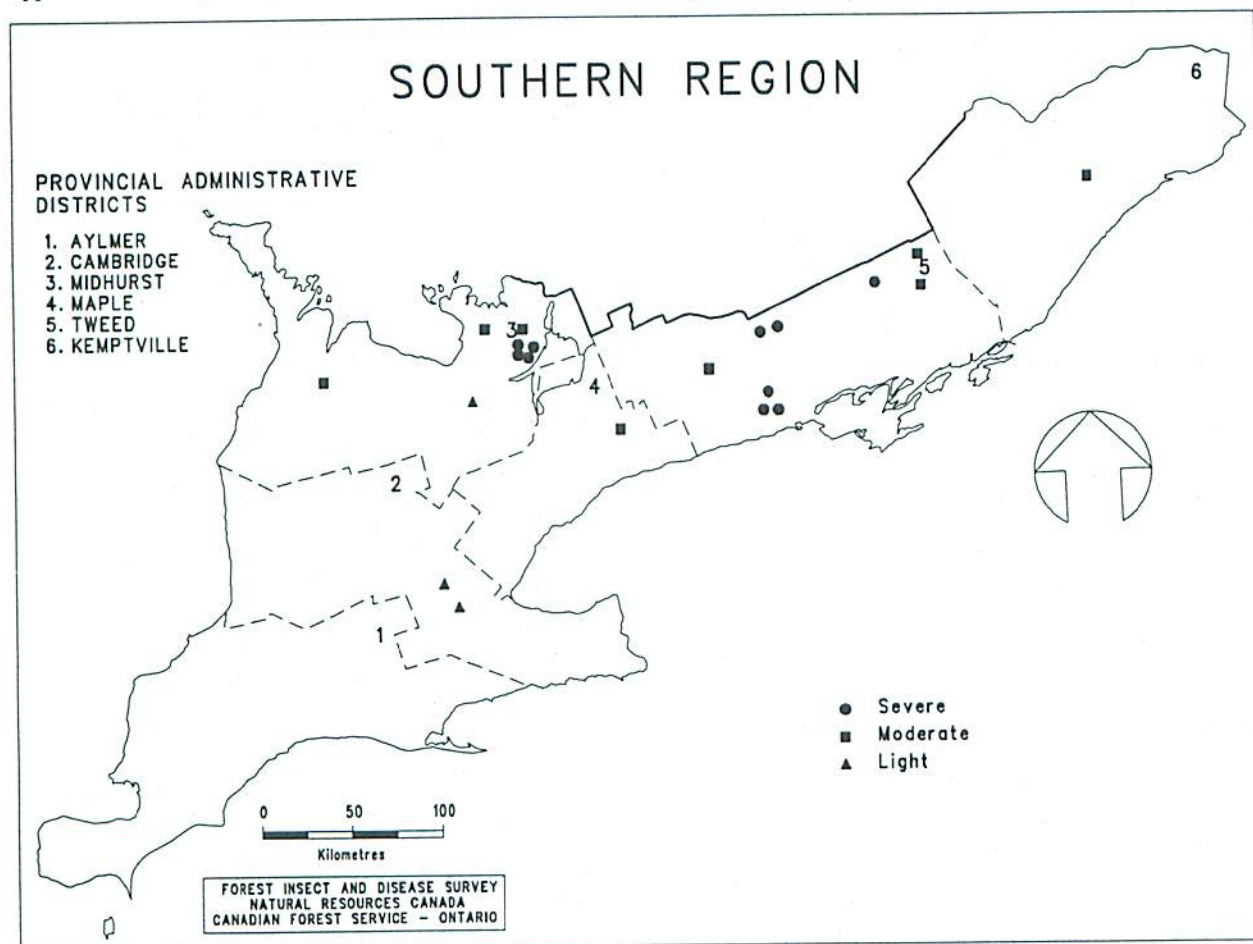


Figure 1. Areas where damage caused by the pine false webworm, *Acantholyda erythrocephala* (L.), occurred in 1994.

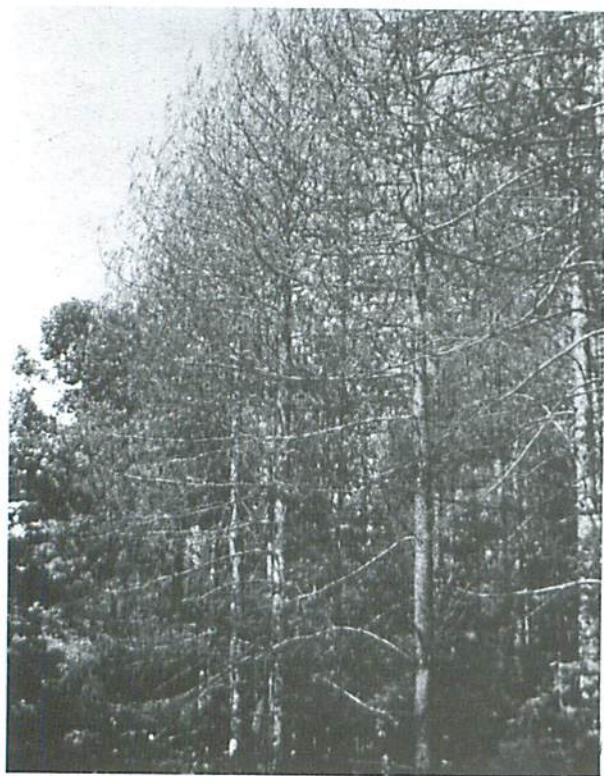


Figure 2. Severe defoliation of semimature red pine (*Pinus resinosa* Ait.) caused by the pine false webworm (*Acantholyda erythrocephala* [L.]).

90 ha in 1994. In the most heavily damaged sites, 100% of the old foliage and 50% of the current foliage on the 8- to 13-m-tall red pine had been consumed. Once again, the pest appears to be spreading as the outside edges of adjacent plantations of 15-m eastern white pine and red pine were heavily infested.

A standard 150-tree evaluation conducted in a 25-ha red pine plantation in Cavan Township, Tweed District, revealed that 100% of the 4-m red pine were severely defoliated. It was determined that an average of 94% of the old foliage and 20% of the current foliage had been consumed. The complete results of areas surveyed are presented in Table 1.

Moderate to severe defoliation occurred along the outside edges of one 10-m and one 6-m red pine plantation in the southern portion of Uxbridge Township in the Maple District. Comparable damage was also detected on 6-m-tall red pine at two locations in the western portion of Dummer Township, Tweed District. Aerial surveys revealed that a pocket of damage in young red pine plantations in the northwest corner of Dummer Township and the northeast corner of Belmont Township has increased in size from 35 ha in 1993 to approximately 55 ha in 1994. Moderate to severe defoliation was also reported in a 5-ha, 4-m-tall red pine plantation in Kaladar Township in the

Tweed District, and in several 3-m-tall Scots pine plantations in Oxford-on-Rideau Township in the Kemptville District.

Light to moderate defoliation was detected on 25-m-tall, open-grown, mature eastern white pine in the northwest corner of Oso Township in the Tweed District. Light defoliation was recorded in a 5-ha, 2.3-m-tall red pine plantation at the Canadian Forces Base (CFB) Borden in Tosorontio Township, Midhurst District.

Arborvitae Leafminers, *Argyresthia thuiella* (Pack.), *Coleotechnites thujaella* (Kft.)

Populations of arborvitae leafminers varied considerably across the region in 1994. The most severe damage occurred west of the city of Kingston in Kingston Township, Tweed District, where foliar damage averaged 80% throughout several hundred hectares. This level of defoliation was typical in smaller pockets of 2–20 ha in Bathurst, Dalhousie, Drummond, Montague, North Gower, and Nepean townships in the Kemptville District.

Foliar browning in the 60–70% range was common on ornamental trees and small stands along creek banks in the eastern portion of the Aylmer District. This was especially true closer to Lake Erie and included some of the eastern white cedar (*Thuja occidentalis* L.) windbreaks at the OMNR St. Williams Forest Tree Nursery in Charlotteville Township. Moderate damage levels of 50% were fairly typical in Erin Township, Cambridge District, but light defoliation was more common in the remainder of the district.

Moderate to severe defoliation of 40–80% was scattered throughout the south end of Harvey Township and the adjacent northern portion of Ennismore Township in the Tweed District. Small pockets of moderate damage (40–50%) were observed in North and South Elmsley townships, Kemptville District.

Light damage was detected on the mature cedar windbreaks at the OMNR G. Howard Ferguson Forest Tree Nursery, and commonly at numerous locations across the remainder of the region.

Birch Skeletonizer, *Bucculatrix canadensisella* Cham.

For the third consecutive year populations of the birch skeletonizer were recorded across the region. In 1994, defoliation of white birch (*Betula papyrifera* Marsh.) and yellow birch (*B. alleghaniensis* Britton) was noted at much reduced levels from those recorded over the previous 2 years.

Sporadic clumps of trees sustained moderate to severe foliar browning within the area; however, trace to light defoliation (5–10%) prevailed across most of the region. Damage extended from the Orangeville/Collingwood area,

Table 1. Summary of damaged caused by the pine false webworm in 14 pine plantations in the Southern Region of Ontario in 1994. (Counts are based on the examination of 150 randomly selected trees at each location.)

Ontario in 1994. (Counts are based on the examination of 100 trees)							
Location (Township)	Tree species ^a	Average height of trees (m)	Estimated number of trees per ha	Total area affected (ha)	Trees infested (%)	Average defoliation	
						Old (%)	Current (%)
<i>Cambridge District</i>							
Beverly	rP	5.0	4,000	0.5	5	10	0
Puslinch	scP	1.8	2,300	1.0	1	5	0
<i>Midhurst District</i>							
Oro	rP	18.0	1,250	20.0	100	92	68
Oro	rP	14.0	1,200	2.0	80	100	91
Oro - SPA ^b	rP	15.0	800	2.5	100	67	7
Oro	ewP	17.0	1,700	20.0	100	28	5
Oro	rP	5.0	2,400	5.0	100	47	17
Sullivan	ewP	2.0	1,900	3.0	87	30	0
<i>Tweed District</i>							
Cavan	rP	4.0	2,200	25.0	100	94	20
Hinchbrooke	rP	3.8	2,000	2.0	99	49	1
Hope	rP	13.0	2,000	10.0	100	100	50
Hope	rP	8.0	2,200	20.0	100	95	20
Oso	rP	6.6	2,000	1.0	100	34	0
Belmont	rP	15.0	2,500	15.0	100	80	1

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

^b SPA = seed production area.

eastward across the Midhurst District and the northern portion of the Maple District, and throughout most of the Tweed District. Similar damage levels were recorded across the central portion of the Kemptville District and in areas along the St. Lawrence River east of Brockville to Cardinal.

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

Populations of the large aspen tortrix decreased significantly in 1994. However, moderate to severe defoliation did occur in scattered areas throughout the Kemptville and Maple districts.

Aerial and ground surveys revealed an 86% reduction in the area of moderate to severe defoliation. In 1994 three pockets, totaling 38.5 ha, were aerially sketch mapped. This compared to 284 ha in 1993. The largest area infested with moderate to severe defoliation (75–100%) totaled 20 ha and occurred on 19-m trembling aspen (*Populus tremuloides* Michx.) just west of Leitrem, in Gloucester Township, Kemptville District. A second area in Gloucester Township, totaling 17.5 ha, was delineated near Johnston Corners.

In the Maple District, approximately 1 ha of 8-m-tall trembling aspen was severely defoliated east of Beaverton in Thorah Township.

Other insects, found in association with the large aspen tortrix, contributed to the overall levels of defoliation at these sites. Included were the leafroller, *Acleris nigrolinea* (Rob.); the white triangle leafroller, *Clepsis persicana* (Fitch); and the speckled green fruitworm, *Orthosia hibisci* (Gn.).

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

Provincial Situation

There was a noticeable decline in the area of moderate to severe defoliation in 1994. A total of 4,266,656 ha were mapped compared with 8,991,177 ha in 1993. Most of this decline occurred east of Lake Nipigon in the Nipigon and Geraldton districts in the Northwest Region. Significant declines were recorded also in the Dryden, Kenora, Red Lake, Sioux Lookout, and Thunder Bay districts. An increase was reported in the Fort Frances District. In the Northeast Region, drastic declines were recorded in the Hearst and Wawa districts (Fig. 3).

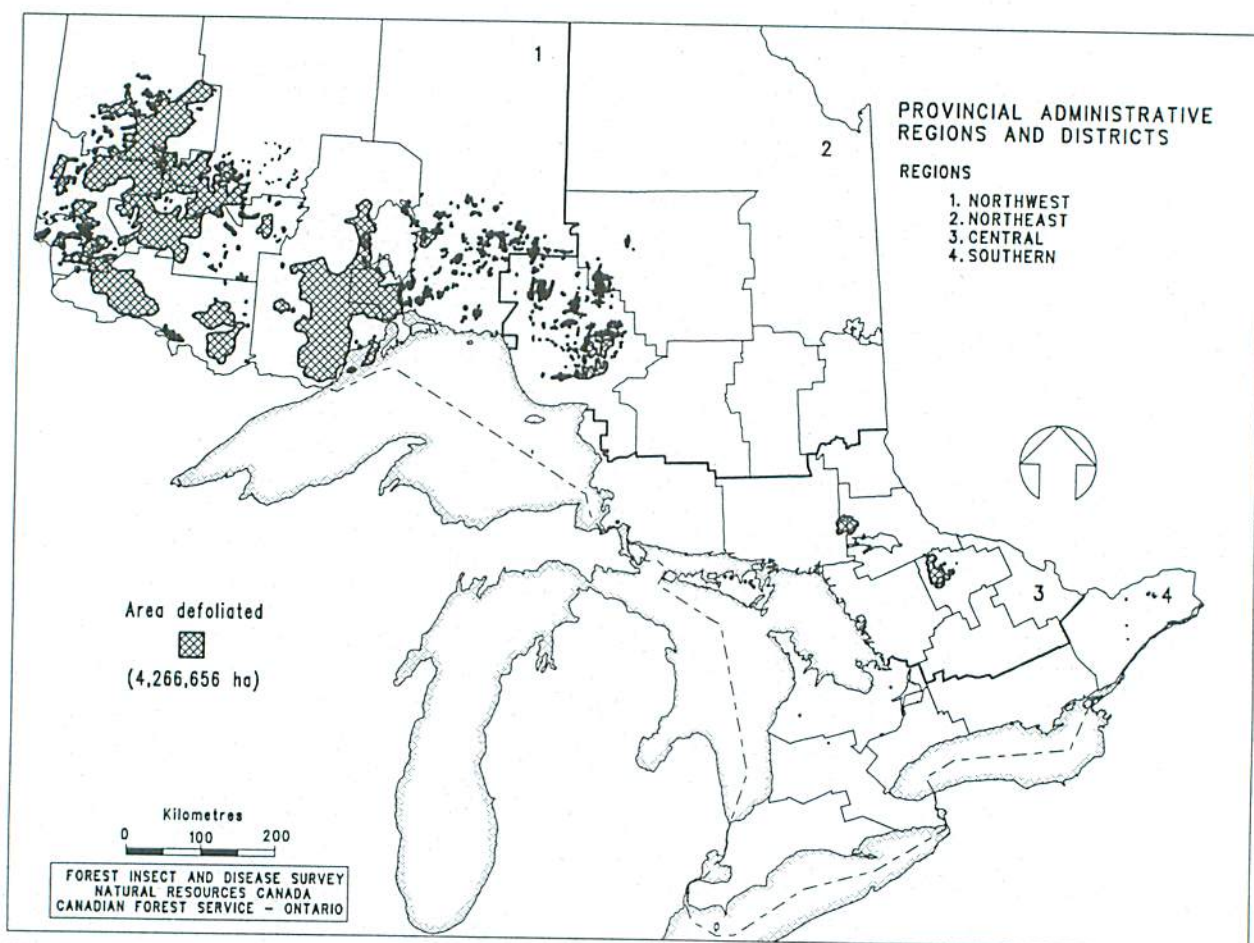


Figure 3. Areas of moderate to severe defoliation caused by the eastern spruce budworm, *Choristoneura fumiferana* (Clem.), in 1994.

There was a slight increase in the area of moderate to severe defoliation in the Central Region. Damage was mapped along the Sudbury–North Bay district boundary and in the northwest corner of the Algonquin Park District.

The total area of eastern spruce budworm induced, whole-tree mortality continues to increase across the province. In 1994, a total of 7,783,336 ha of mortality were detected. This compared to 5,032,925 ha recorded in 1993. The largest increase, some 2,693,043 ha, occurred in the Northwest Region. Increases were also recorded in the Wawa District of the Northeast Region (53,086 ha) and in the Algonquin Park District of the Central Region (4,282 ha).

Southern Region

Eastern spruce budworm population levels continued to increase in white spruce (*Picea glauca* [Moench] Voss) plantations across the Southern Region. In 1994 some 687 ha had sustained moderate to severe defoliation. Various levels of defoliation have now been recorded for 4 consecutive years from several locations in the region. The actual damage level has increased annually at most of these sites (Fig. 4).

For the fourth consecutive year, severe defoliation (>75%) occurred at three locations. These were in a 7-ha, 12-m-tall white spruce plantation and a 5-ha, 10-m-tall white spruce seed production area in the southern end of Adjala Township, Midhurst District and in a 2-ha, 16-m-tall white spruce plantation in Uxbridge Township, Maple District. At this latter site, small pockets of recently dead trees were detected throughout the plantation. Examination of several of these trees revealed that they had been in a severe state of decline as a result of extensive budworm defoliation and had finally been killed by *Armillaria* root rot (*Armillaria ostoyae* [Romagn.] Herink).

Severe defoliation was reported for the third consecutive year from a 5-ha, 12-m-tall white spruce plantation in Oro Township in the Midhurst District. Similar damage levels were scattered across several compartments in Clarence and Cambridge townships in the La Rose Forest, Kemptville District. The total area infested increased from 80 ha in 1993 to 300 ha in 1994 (Fig. 5).

Moderate to severe defoliation was detected throughout 75 ha of white spruce in the National Capitol Commission Green Belt area in Gloucester Township and in two 17-m-tall plantations at the OMNR G. Howard Ferguson

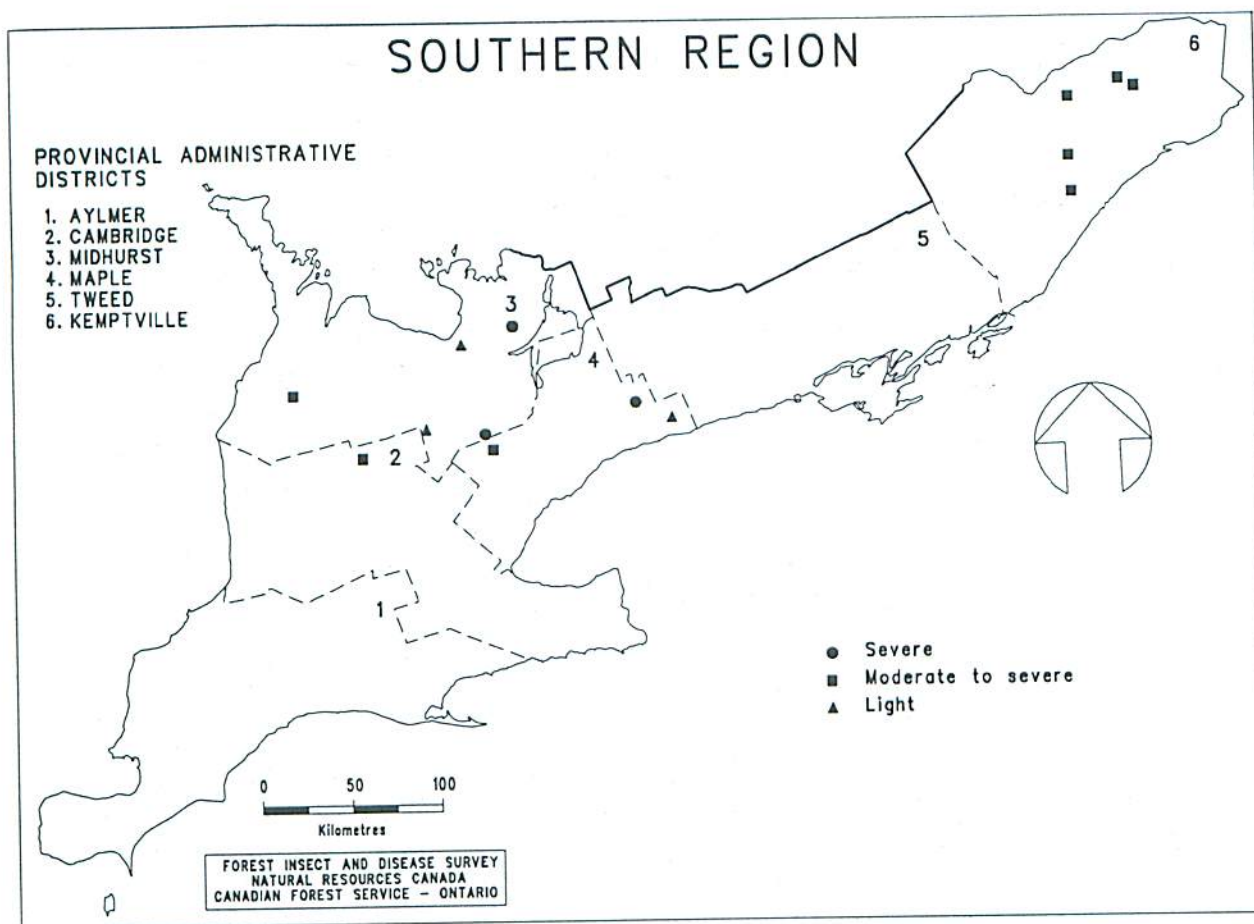


Figure 4. Areas where damage caused by the eastern spruce budworm, *Choristoneura fumiferana* (Clem.), occurred in 1994.

Forest Tree Nursery in the Kemptville District. At the nursery, the total area infested increased from 2 ha in 1993 to 15 ha in 1994. A similar level of damage was detected for the second consecutive year throughout the 80-ha County Forest in Brant Township in the western portion of the Midhurst District.

Three new areas of moderate to severe defoliation were detected. The first was in a 15-ha, 19.5-m-tall white spruce and Norway spruce (*Picea abies* [L.] Karst.) plantation in the Limerick County Forest in Oxford-on-Rideau and Edwardsburgh townships in the Kemptville District. The second area was a 15-ha plantation of 17-m-tall white spruce in Albion Township in the Maple District. The last was in a 9-ha, 16-m-tall white spruce plantation in the Smaele Tract in Minto Township, Cambridge District.

Light to moderate defoliation occurred on white spruce scattered throughout the County Forest in Amaranth Township, Midhurst District. This large forested area covers two complete lots and consists of blocks of white spruce, eastern white pine, and European larch (*Larix decidua* Mill.). Similar defoliation levels were recorded in the 5-ha, 10-m-tall white spruce seed production area at



Figure 5. Mature larvae and severe defoliation of balsam fir (*Abies balsamea* [L.] Mill.) caused by the eastern spruce budworm (*Choristoneura fumiferana* [Clem.]).

the OMNR Orono Forest Tree Nursery in Clarke Township in the Maple District.

Trace population levels were detected on 6-m-tall white spruce in a 15-ha plantation in Sunnidale Township, Midhurst District.

A total of 17 areas were sampled in the region for the purpose of forecasting possible defoliation levels for

1995. Nine of these areas are forecasting severe defoliation next season. Two other sites are likely to sustain moderate to severe damage and one area should have a moderate level of defoliation. A complete list of areas sampled, together with forecasts for 1995, is presented in Table 2.

Table 2. Summary of eastern spruce budworm defoliation estimates and egg-mass counts in the Southern Region of Ontario in 1994 and infestation forecasts for 1995.

Location (Township)	Host ^a	Estimated % defoliation 1994	Number of egg masses per 9.29m ² of foliage	Infestation forecasts for 1995 ^b	Accumulated damage ^c
<i>Aylmer District</i>					
Charlottenville (Turkey Point)	wS	1	0	N	0
South Walsingham (OMNR Tree Nursery)	wS	0	0	N	0
<i>Cambridge District</i>					
Minto	wS	62	324	S	1
<i>Kemptville District</i>					
Clarence (La Rose Forest)	wS	99	639	S	2
Fitzroy	wS	16	62	M	1
Gloucester	wS	81	776	S	1
Lavant (Robertson Lake)	bF	0	0	N	0
Oxford-on-Rideau (Limerick)	wS	71	260	S	1
(OMNR Tree Nursery)	wS	34	387	S	1
<i>Maple District</i>					
Clarke (OMNR Tree Nursery)	wS	10	227	M-S	1
Uxbridge	wS	59	267	S	4
<i>Midhurst District</i>					
Adjala (Seed Production Area)	wS	94	1381	S	4
Brant	wS	47	83	M-S	2
Lindsay	wS	1	0	N	0
Oro	wS	51	578	S	4
St. Edmunds	wS	0	0	N	0
<i>Tweed District</i>					
Bexley (Balsam Lake Provincial Park)	wS	4	255	S	1

^a bF = balsam fir, 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 to 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 grey 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 70% of stand dead, no significant defoliation for several years.

Three spruce budworm multipher pheromone traps, baited with Biolure, were deployed at five separate locations across the region. In the Kemptville District the traps were set in a balsam fir (*Abies balsamea* [L.] Mill.) stand in Lavant Township. Trapping results there averaged 31 male moths per trap; a slight decline from the average of 40 male moths in 1993. In the Midhurst District the traps were set at two locations along the Bruce Peninsula. The first was in a white spruce plantation in Lindsay Township. The average number of male moths trapped at this site was 25. This number was virtually unchanged from the average of 27 last season. The second site was a spruce-fir stand in St. Edmunds Township. Here, an average of 72 male moths were caught; down from a high of 114 in 1993. Two areas were trapped in the Aylmer District. The first was a windbreak at the OMNR St. Williams Forest Tree Nursery in South Walsingham Township. An average of 179 male moths were captured here; a marked decline from the average of 275 caught in 1993. The second site consisted of a small planted area of white spruce at the Turkey Point Provincial Park in Charlotteville Township. This area averaged 139 male moths per trap.

Larch Casebearer, *Coleophora laricella* (Hbn.)

Aerial and ground surveys disclosed that foliar damage by the larch casebearer was widespread in the Maple, Midhurst, Cambridge, and Aylmer districts. For the second consecutive year, a decline occurred in populations in the Kemptville and Tweed districts.

Moderate to severe defoliation occurred throughout the region on tamarack (*Larix laricina* [Du Roi] K. Koch) and European larch, but this was confined to small pockets. Generally these measured 3 ha or less in size. The highest damage levels occurred at the OMNR Orono Forest Tree Nursery and in Uxbridge Township, Maple District. Here, windbreak trees sustained an average of 90% defoliation. In Osgoode Township, Kemptville District, 12.5-m roadside tamarack trees suffered an average of 80% foliar damage. In a 3-ha plantation of mature European larch and eastern white pine at the Waterford Conservation Area in Townsend Township, Aylmer District, the larch averaged 60% defoliation. At the Mountsberg Reservoir in Puslinch Township, Cambridge District, 1 ha of mature European larch averaged 70% foliar damage. Much of this was confined to the upper two-thirds of the crown. For the second consecutive year, moderate defoliation (35%) was recorded on 15-m Japanese larch (*Larix leptolepis* [Sieb. & Zucc.] Gord.) at the managed tree seed production area in Marlborough Township, Kemptville District. Elsewhere, light defoliation was common across the region.

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

There was no change in the low population levels of introduced pine sawfly that were recorded in 1993 in the western half of the region. In the Midhurst District, standard 150-tree evaluations revealed that trace populations could readily be detected in eastern white pine plantations. Surveys carried out at the seed orchard in Tosorontio Township disclosed that 79% of the 4.9-m-tall trees and 61% of the 1.8-m-tall trees averaged two to four larvae per tree. However, these caused less than 1% defoliation. Similar surveys conducted in two plantations in Euphrasia Township detected much lower population levels. Less than 4% of the 1.8-m-tall trees harbored only one or two larvae each. Trace numbers of larvae, causing <1% defoliation, were also detected in a 1-ha, 2.1-m-tall Scots pine (*P. sylvestris* L.) plantation in North Marysburg Township in the Tweed District.

The only exception to these trace population levels occurred for the past 2 years in a 10-ha, 2.2-m-tall eastern white pine plantation in South Cayuga Township, Cambridge District. In 1993 this sawfly caused an average of 50% total defoliation across the plantation. In response, staff from the OMNR Cambridge District Office hand-sprayed the entire plantation on 22 June in an attempt to control the population of sawflies. A single application of Sevin XLR Plus was applied at a rate of 2.4 liters per 1,000 liters of water. Standard evaluations conducted in late August revealed a noticeable reduction in larvae population levels and total defoliation declined to 10%.

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

During 1994, regional populations of the hemlock looper increased for the second consecutive year. Aerial reconnaissance and ground surveys disclosed moderate to severe defoliation had occurred in primarily the same locations as in 1993. However, the area ravaged by the hemlock looper expanded westward to encompass some 178.5 ha. This compared to 70 ha in 1993. Eastern hemlock (*Tsuga canadensis* [L.] Carr), eastern white pine, and eastern white cedar were most heavily infested, although damage was also recorded on trembling aspen (*see* the Frontispiece).

The largest infestation in the region totaled 47.4 ha and was comprised of six small pockets of severe defoliation (75–100%) on eastern hemlock. The infestation was situated on the east side of Charleston Lake, east of Frog Cove, in Front of Escott and Front of Yonge townships, Kemptville District. In the Fitzsimmons Mountain area of Front of Leeds and Lansdowne Township, Kemptville District, the infested area expanded almost threefold. Moderate to severe defoliation of eastern hemlock and eastern white pine increased from 8 ha in 1993 to 22.5 ha

in 1994. An additional 23.5 ha of light damage extended from Landons Bay to Highway 401.

Other areas reinfested included eastern hemlock stands on the northeast side of Temperance Lake in Rear of Yonge and Escott Township in the Kemptville District. This area increased in size from 6.75 ha in 1993 to 8.5 ha in 1994. The small, 4-ha infestation recorded in 1993 on the north side of Highway 401, south of the town of Lyn in Elizabeth Township, Kemptville District, increased to 6.2 ha. Again, moderate to severe defoliation of eastern hemlock occurred at Higley Lake in Rear of Leeds and Lansdowne Township in the Kemptville District, but the total area infested declined to 14.5 ha from the 31 ha recorded in 1993 (Fig. 6).

New pockets of infestation were recorded on the south shore of Bass Lake in Rear of Leeds and Lansdowne Township in the Kemptville District. Eastern hemlock and eastern white pine growing on the rugged terrain sustained moderate to severe defoliation throughout some 22.5 ha and light damage was recorded in an adjacent 8.5-ha area. An additional 26 ha of eastern hemlock were moderately to severely defoliated along Willys Brook on the south shore of South Lake in Front of Leeds and Lansdowne

Township in the Kemptville District. Three small areas of severe defoliation, totaling 3.5 ha, and surrounded by an additional 3.5 ha of light defoliation, were noted on the island in South Lake.

In the Tweed District, new pockets of defoliation were recorded in Kingston, Ernestown, and Haldimand townships. Two stands of eastern white cedar, 15 ha and 3 ha in size, sustained moderate to severe defoliation on the north side of Highway 401, east of the town of Odessa in Kingston Township. A 5-ha pocket of light defoliation was delineated adjacent to these sites along Highway 401 in Ernestown Township. In Haldimand Township, a 6-ha hillside area of 20-m-tall eastern hemlock and 12-m-tall eastern white cedar sustained 90% defoliation. Adjacent to this area, the surrounding eastern white cedar sustained 10–30% defoliation. Further west, two small areas of severe defoliation were delineated along Highway 401 in Clarke Township, Maple District. The largest area consisted of an isolated 2-ha clump of 12-m-tall eastern white cedar that had sustained 95% defoliation. The second area, totaling 1.5-ha, consisted of 14-m-tall eastern white cedar and was surrounded by a narrow band of light to moderate defoliation (20–50%).

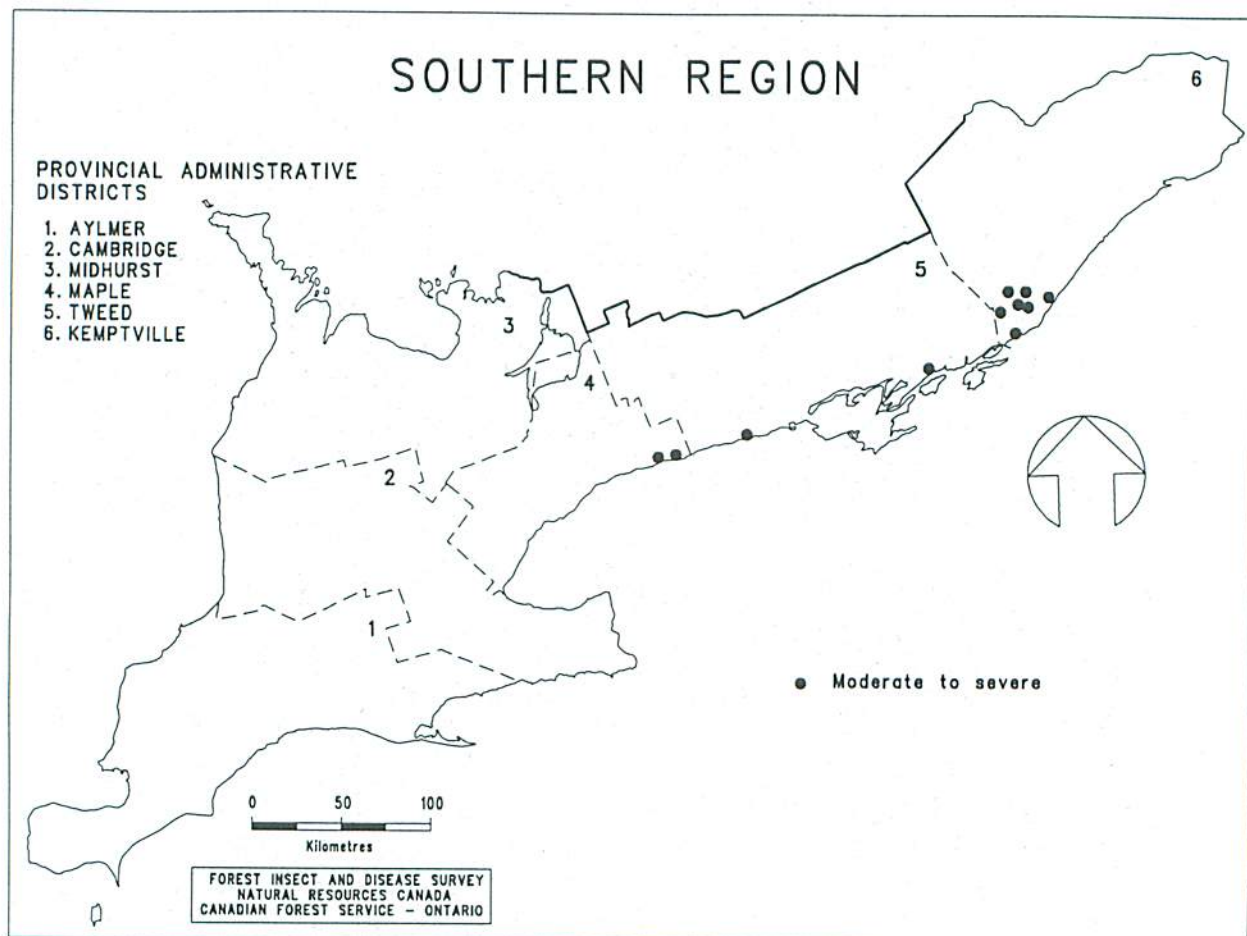


Figure 6. Areas where moderate to severe defoliation caused by the hemlock looper, *Lambdina f. fiscellaria* (Gn.), occurred in 1994.

During 1994, mortality plots were established in accessible and representative areas to measure the impact of severe defoliation by the hemlock looper on mature eastern hemlock. In a severely defoliated stand south of the town of Lyn, in Elizabeth Township, Kemptville District, surveys disclosed 48% whole-tree mortality. An additional 26% of the trees sustained >90% total defoliation. Surveys of an infestation on the south shore of Higley Lake, in Rear of Leeds and Lansdowne Township, indicated that whole-tree mortality may be as high as 80% in 1995. However, at the time of the assessment, the cambium layer had not dried sufficiently to determine whether the trees were dead. Additional assessment work will be required in 1995 to determine the full impact of this current hemlock looper infestation.

Satin Moth, *Leucoma salicis* (L.)

There was a major decline in population levels of satin moth throughout the region. The only populations detected were scattered throughout the Barrie area of the Midhurst District.

For the second consecutive year an aerial control program was conducted throughout the residential area of CFB Borden in an effort to control severe defoliation of boulevard Carolina poplar (*Populus X canadensis* Moench). Two single applications of the biological insecticide *Bacillus thuringiensis* var. *karstaki* (B.t.), Foray 48B, were applied 7 days apart, by rotary-wing aircraft, at a rate of 50 BIU/4.0 liters per hectare. The first application was applied on the morning of 3 June. Surveys conducted in late June revealed that this operation had been extremely effective; no evidence of satin moth larvae could be detected in the sprayed areas.

Severe defoliation (>75%) was detected on six 17-m-tall roadside Carolina poplar along Highway 27, just north of the city of Barrie and on four 15-m-tall trees along a concession road in Oro Township, Midhurst District. Several 20-m-tall Carolina poplar growing along Highway 401, in the city of Oshawa, Maple District, were also severely defoliated.

Gypsy Moth, *Lymantria dispar* (L.)

The only significant population of gypsy moth in the region in 1994 occurred in the western portion of the Aylmer District. This represents the second consecutive year that a major reduction has been recorded in the total area infested, which has declined from 3,139 ha in 1993 to 102 ha in 1994 (Fig. 7). This marked decline was also seen provincially; 5,645 ha of moderate to severe defoliation in 1994 compared to 9,784 ha in 1993 (Table 3).

In the Aylmer District the largest area of infestation occurred in the Pinery Provincial Park in Bosanquet Township. Six separate pockets of moderate defoliation,

totaling 48 ha, were aerially sketch mapped. Five of the six sites occurred between the Ausable River and Lake Huron. The last pocket was detected along the west side of Highway 21. High mortality levels of overwintering egg masses were noted throughout the park during early spring surveys. Light defoliation (5–25%) was mapped across 269 ha within the park. White oak (*Quercus alba* L.) and red oak (*Q. rubra* L.) were the primary hosts.

South of the city of Sarnia, three small areas of moderate to severe defoliation, totaling 13 ha, were detected in Moore Township. Two of these were located in the same woodlot along Highway 40; the third was southeast of the town of Courtright in Mosa Township.

Four areas of moderate defoliation, totaling 41 ha in size, were detected southeast of the town of Bothwell in the southwest corner of Mosa Township. The majority of the damage occurred along the fringes of the four forest stands. This location has high potential for damage because of the large component of oak species in the contiguous forest stands of the area.

Gypsy moth populations collapsed at the Rondeau Provincial Park, on the Sarnia First Nations Lands, at St. Clair College in the city of Windsor, and to a certain extent at the Pinery Provincial Park in the Aylmer District. This collapse also occurred in the Arran Lake–Southampton area of the Midhurst District and in Madoc and Sheffield townships in the Tweed District. The severe weather conditions experienced during the winter of 1993–1994 may have contributed to overwintering larval mortality. In addition, during the summer of 1994 evidence of natural control agents of gypsy moth were detected at four of the infested areas. Egg and larval parasitism was recorded at both the Pinery and Rondeau provincial parks. In a woodlot south of Sarnia, larvae were killed by the fungal agent *Entomophaga maimaiga*. In Mosa township, a nuclear polyhedral virus killed many of the larvae.

During 1994, an experimental aerial spray operation was conducted at the Pinery Provincial Park, Aylmer District. This was a cooperative project involving the Forest Pest Management Institute (FPMI), OMNR, Atmospheric Environment Services (AES), and Novo Nordisk Bioindustrials Inc. Ten 10-ha plots were treated with Disparvirus, a nuclear polyhedrosis virus (NPV) produced at FPMI. The dosage of virus was a double application of 5×10^{11} polyhedral inclusion bodies (PIB)/ha (total 10^{12} PIB/ha). The application rate for five of these plots was 5.0 L/ha; it was 2.5 L/ha for the remaining five plots. The virus was suspended in Carrier 244, which was supplied by Novo. As a positive control, a 110-ha block was treated with a single application of the bacterium *Bacillus thuringiensis* (Foray 48B), at 4.0 L/ha, giving a dosage of 50 BIU/ha. A preliminary analysis of results indicated that all treatments gave excellent reduction in egg-mass numbers and significant foliage protection compared to untreated check plots.

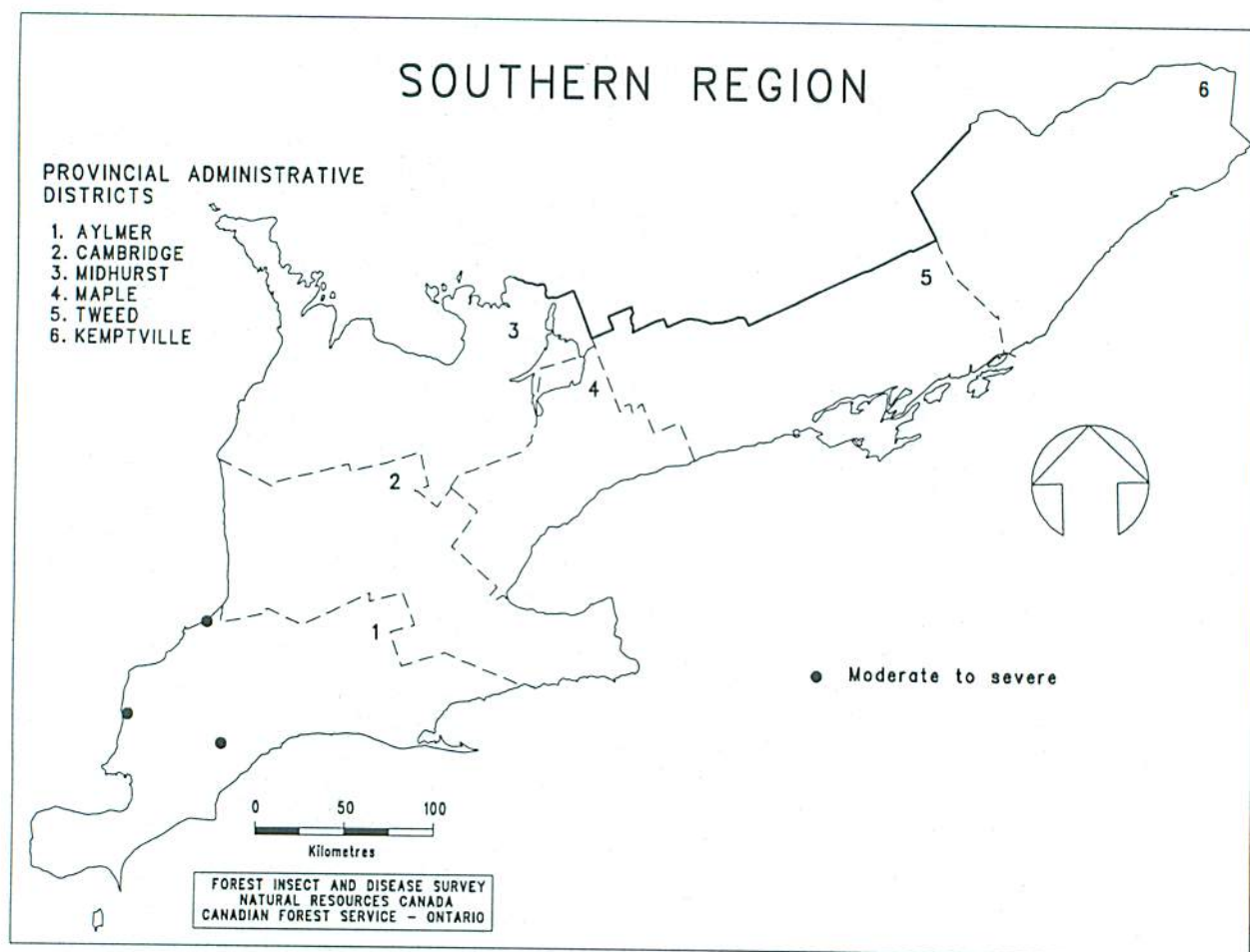


Figure 7. Areas where gypsy moth, *Lymantria dispar* (L.), caused defoliation in 1994.

Extensive aerial and ground surveys conducted throughout the treated and untreated areas of the park during June and July of 1994 revealed a marked reduction in gypsy moth populations and hardwood defoliation. Egg-mass surveys conducted in the controlled areas by FPMI staff in October indicated significant reductions from 1993 in the number of egg masses per hectare.

Table 3. Total area of moderate to severe defoliation caused by the gypsy moth in the Southern Region of Ontario and the yearly change in total area infested, by district, for 1993 and 1994.

District	Total area of moderate to severe defoliation (ha)		Change from 1993 to 1994 (ha)
	1993	1994	
Aylmer	2,357	102	-2,255
Cambridge	0	0	0
Kemptville	0	0	0
Maple	304	0	-304
Midhurst	349	0	-349
Tweed	129	0	-129
Total	3,139	102	-3,037

Forest Tent Caterpillar, *Malacosoma disstria* Hbn.

The current outbreak of forest tent caterpillar peaked in 1991 with a provincewide total of 18,870,508 ha of moderate to severe defoliation recorded. Populations have declined steadily since then and in 1994 a total of 166,060 ha of moderate to severe defoliation was recorded. All the damage this year occurred in the Cochrane and Hearst districts, where a sizeable infestation straddled the district boundaries.

In the Southern Region, the current outbreak peaked in 1989, slightly ahead of the provincewide infestation. Similarly, it has decreased steadily since that time, and in 1994 only trace populations could be found. These caused <5% defoliation in an 80-ha sugar maple (*Acer saccharum* Marsh.) -red oak stand in Glenelg Township, Midhurst District. Low insect populations were also detected at the east end of Christie Lake in a trembling aspen stand and on mature red oak near Little Silver Lake. Both lakes are located in South Sherbrooke Township, Kemptville District.

Balsam Fir Sawfly, *Neodiprion abietis* complex

Following a single year of decline, defoliation caused by the balsam fir sawfly increased across the eastern half of the region. Where damage occurred, often a single tree or a small group of four or five trees in a stand were infested. Typically, only the top one-third of the crown was defoliated at most sites (Fig. 8).

The largest area of continuous damage, averaging 75% defoliation, occurred in a 10-ha stand of 15-m-tall balsam fir near Lake Eloida in Rear of Yonge and Escott Township, Kemptville District. Similar defoliation levels were detected in a 7-ha stand along the South Kemptville Creek in Elizabethtown Township, and in a 5-ha woodlot along Highway 43 in Oxford-on-Rideau Township in the Kemptville District. Moderate to severe defoliation was detected on single trees within balsam fir stands in the south end of Verulam and Emily townships in the Tweed District.

Light to moderate defoliation (5–25%) levels were commonly detected throughout the remainder of the infested areas. Similarly, damage occurred on single trees in small stands of balsam fir. A noticeable decline

was detected in Fenelon, Verulam, Ennismore, and Harvey townships in the Tweed District.

Redheaded Pine Sawfly, *Neodiprion lecontei* (Fitch)

Extremely high populations of the redheaded pine sawfly caused severe defoliation to juvenile red pine plantations at the First Nations Lands on Christian Island in the Midhurst District.

Surveys in a 36-ha, 7-year-old red pine plantation revealed that 80% of the trees had sustained 100% defoliation of both old and new foliage. Half of the remaining trees had sustained 60% defoliation, primarily of the old foliage. Sawfly population levels were so high that once complete defoliation had occurred, larvae were observed migrating across the ground to noninfested trees. This severe level of defoliation usually results in whole-tree mortality, and it is expected that all of the trees on some 30 ha of this plantation will die. The first two rows of a nearby 5-ha, 30-year-old red pine plantation also sustained 80% defoliation.

In a 40-ha, 5-year-old red pine plantation, 30% of the trees sustained 100% defoliation. Again, both old and new

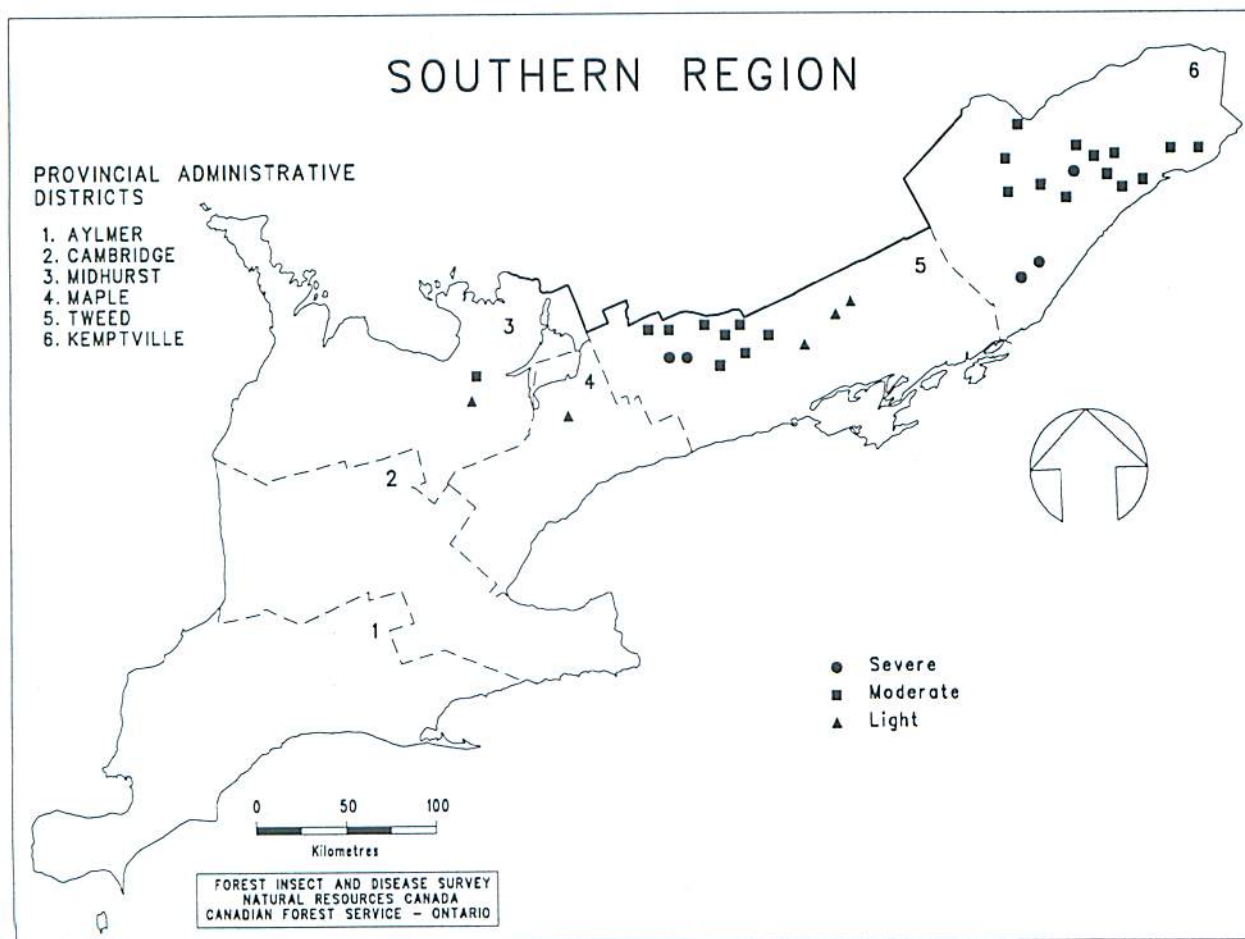


Figure 8. Areas where damage caused by balsam fir sawfly, *Neodiprion abietis* complex, occurred in 1994.

foliage were damaged. An additional 20% of the trees averaged 30% defoliation. In an adjacent 15-ha plantation, 60% of the 12-year-old trees experienced 100% defoliation; the remaining 40% averaged 30% defoliation. Completely defoliated trees in these plantations are likely to die.

A general survey conducted across accessible portions of Christian Island revealed varying levels of redheaded pine sawfly populations. Colonies and/or damage were observed on red pine, eastern white pine, and Scots pine.

Elsewhere, high sawfly populations caused complete defoliation of several 1-m-tall red pine trees in Kitley Township, on two 3-m-tall red pine along the Rideau River in Montague Township, and on four 4.9-m-tall red pine in North Gower Township, Kemptville District. Low insect numbers were detected on 7-m-tall red pine growing along County Road 4 in Dummer Township in the Tweed District. Here, they caused <10% defoliation.

White Pine Weevil, *Pissodes strobi* (Peck)

Surveys conducted across the region for white pine weevil showed that the incidence level of leader attack varied from 0 to 45% (Table 4). Twenty-nine plantations were evaluated; of these, ten revealed negative results

(Fig. 9). The most severe leader damage occurred in Charlotteville Township, Aylmer District, where 45% of the 5.2-m-tall eastern white pine were infested in a 3-ha plantation. In a 2-ha area in Front of Yonge Township in the Kemptville District, 43.3% of the 4.2-m trees were infested. In the northern portion of the region, the highest incidence of leader attack, 14%, was to 1.8-m-tall trees in Medonte Township, Midhurst District.

In Lanark Township, Kemptville District, 22% of the 3.5-m Norway spruce were damaged in a 1-ha plantation. Variable-aged white spruce, black spruce (*Picea mariana* [Mill.] B.S.P.), and blue spruce (*Picea pungens* Engelm.) had an average of 20% leader attack in a 2-ha plantation in Charlotteville Township, Aylmer District.

MINOR INSECTS

Maple Trumpet Skeletonizer, *Epinotia aceriella* (Clem.)

Incidence of the maple trumpet skeletonizer was widespread across the region in 1994, but in most instances defoliation was only at a trace to light level.

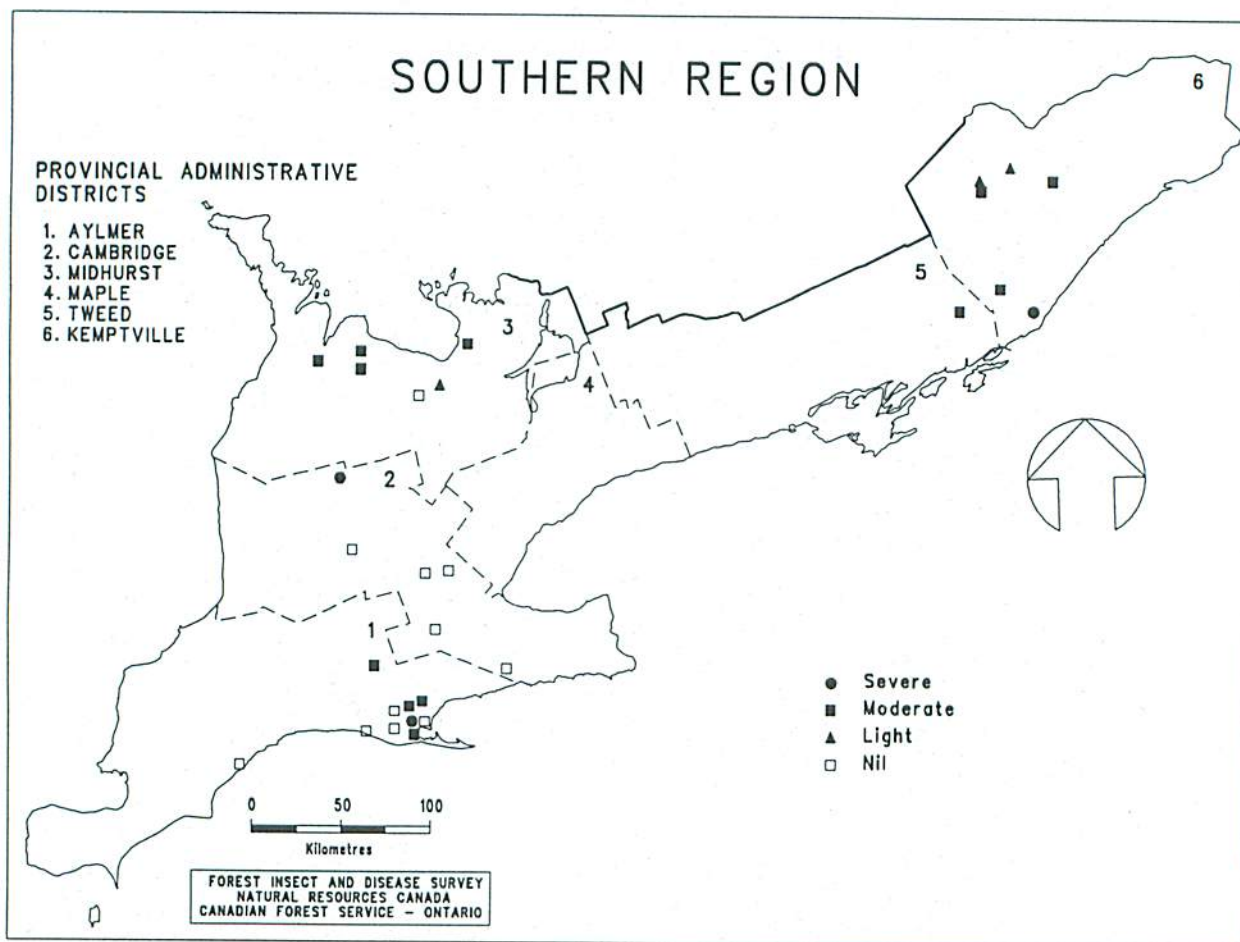


Figure 9. Areas where damage caused by the white pine weevil, *Pissodes strobi* (Peck.), occurred in 1994.

Table 4 . Damage caused by the white pine weevil at 29 locations in the Southern Region of Ontario in 1994. (Counts are based on an examination of 150 randomly selected trees at each location.)

Location (Township)	Tree species ^a	Average height of trees (m)	Estimated number of trees per ha	Total area affected (ha)	Leaders attacked (%)
<i>Aylmer District</i>					
Charlotteville	scP	1.9	4,000	5	0
Charlotteville	scP	2.5	2,500	2	0
Charlotteville	scP	2.4	2,000	3	0
Charlotteville	ewP	3.2	2,500	2	11
Charlotteville	ewP	5.2	3,500	3	45
Charlotteville	ewP	2.0	1,800	1	20
Charlotteville	wS	2.0	2,500	2	20
Dunwich	ewP	4.2	3,000	1	0
Houghton	ewP	3.9	2,500	2	0
North Norwich	ewP	5.1	3,500	1	20
<i>Cambridge District</i>					
Brantford	scP	2.2	2,500	4	0
Puslinch	scP	1.8	2,300	1	0
Puslinch	scP	2.5	2,200	2	0
Minto	ewP	3.4	2,000	2	25
Mornington	ewP	4.8	3,000	1	0
South Cayuga	ewP	3.3	2,700	4	0
<i>Kemptville District</i>					
Bastard	ewP	3.7	2,990	2	20
Front of Yonge	ewP	4.2	2,990	2	43
Lanark	nS	3.5	2,850	1	22
Lanark seed orchard	ewP	1.8	1,300	20	1
Oxford-on-Rideau	bIS	3.4	2,000	1	7
Ramsay	ewP	1.6	2,750	1	2
<i>Midhurst District</i>					
Euphrasia	ewP	1.7	2,200	10	12
Euphrasia	ewP	1.8	2,300	7	8
Medonte	ewP	1.8	1,000	15	14
Sullivan	ewP	2.3	1,900	3	17
Tosorontio	ewP	1.8	800	5	2
Tosorontio	ewP	4.9	800	5	0
<i>Tweed District</i>					
Bedford	ewP	3.1	2,500	1	15

^a bIS = blue spruce, ewP = eastern white pine, nS = norway spruce, scP = Scots pine, wS = white spruce.

The most severe damage levels recorded were in the Presquile Provincial Park in Brighton Township, Tweed District, where 95% of the foliage in a 5-ha stand of 24-m-tall sugar maple trees was skeletonized. Lower damage levels, in the 5–30% range, were observed in the North American Maple Project plots in Hallowell and Belmont Townships, also in the Tweed District. Juvenile sugar maples sustained 10% foliar damage in East Wawanosh Township in the Cambridge District.

Elsewhere, this pest was detected at trace to low levels in virtually every maple stand surveyed in the Maple, Midhurst, and western portion of the Tweed districts.

Eastern Pine Shoot Borer, *Eucosma gloriola* Heinr.

Surveys for the eastern pine shoot borer, conducted in conjunction with other pine pest evaluations, revealed that the population remains at a low level across the region.

Damaged leaders averaged <5% in three 3- to 15-ha Scots pine plantations, which ranged in height from 1.8 to 5.0 m, in Tiny and Essa townships, and in a 5-ha eastern white pine plantation in Tosorontio Township in the Midhurst District. In Bedford Township, Tweed District, an evaluation disclosed that 9.3% of the 3.1-m-tall eastern white pine were infested, but only 2% had damaged terminals. High shoot borer populations recurred in a 2-ha eastern white pine plantation of 7-m trees in Oxford-on-Rideau Township in the Kemptville District. An evaluation here disclosed that 80% of the trees were infested. However, no leader damage was detected. Thirteen other plantations, primarily in the southwestern portion of the region, were examined for the presence of this pest. All produced negative results.

Fall Webworm, *Hyphantria cunea* (Drury)

The highest populations and damage levels caused by the fall webworm were in the western portion of the Aylmer District. The greatest populations encountered in the past 3 years were in Point Pelee National Park. Black walnut (*Juglans nigra* L.) and willow (*Salix* sp.) were the

host species most severely infested. A number of large willow trees were completely covered with the typical webs and defoliation levels ranged from 10 to 95%. In a marshy area by the Lake St. Clair shoreline in Dover Township, 100% of the willows were infested. These trees had an average defoliation of 10%. Similar population levels were detected at Turkey Point in Charlotteville Township, Aylmer District and at Decew Falls in Thorold Township, Cambridge District. Black walnut and cherry (*Prunus* sp.) were the main host species at these two locations.

Elsewhere, single webmasses were commonly encountered on black ash (*Fraxinus nigra* Marsh.) and white elm (*Ulmus americana* L.) trees throughout the Aylmer District, the southern portion of the Cambridge District, and in the southwest corner of Keppel Township, Midhurst District.

Other Forest Insects

A number of other pests were encountered during the course of regular surveys. Information on these is provided in Table 5.

Table 5. Other forest insects.

Insects	Host(s) ^a	Remarks
<i>Acleris</i> (= <i>Croesia</i>) <i>semipurparana</i> (Kft.) Oak leaf shredder	rO	Trace foliar damage of 2–5% was detected along Highway 36 in Harvey Township, Tweed District.
<i>Acleris</i> <i>variana</i> (Fern.) Eastern blackheaded budworm	ewP	A survey of a 20-ha plantation of 3-year-old trees revealed that 15% had sustained <5% defoliation.
<i>Acrobasis</i> <i>caryivorella</i> Rag. Shoot borer-and-tier	Bu	This insect infested <1% of the shoots in Ernestown Township, Tweed District.
<i>Acrobasis</i> <i>demotella</i> Grt. Walnut shoot moth	Bu	In Lancaster Township, Kemptville District, this insect infested <2% of the buds on 12-m trees.
<i>Agonopterix</i> <i>robiniella</i> (Pack.) Micro moth	bL	Foliar damage of 80% occurred in a 0.1-ha area in Camden East Township, Tweed District.
<i>Altica</i> <i>populi</i> Brown Poplar flea beetle	bPo	In host stands throughout the eastern portion of the region, 80–100% foliar bronzing was common.
<i>Anelaphus</i> (= <i>elaphidionoides</i>) sp. Twig pruner	rO wO bO	Populations of this insect in the Aylmer District were definitely more prevalent in 1994 than in 1993. It was common in many locations where the oak component was high. Damage was particularly noticeable in the Pinery Provincial Park. Many trees exhibited the brown flagging characteristic of damaged twigs and branches. In addition, many pruned twigs and branches were noticed on the forest floor.

(cont'd)

Table 5. Other forest insects (cont'd).

Insects	Host(s) ^a	Remarks
<i>Anisota finlaysoni</i> Riotte Shorthorned oakworm	bO	Several dozen open-growing, 21-m trees had defoliation ranging from 20–100% in Kingston Township, Tweed District. Complete defoliation occurred on four trees on Concession 1 and throughout a 1.6-ha area on Corn Island in the St. Lawrence River, Front of Leeds and Lansdowne Township, Kemptville District.
<i>Aphrophora cribrata</i> (Wlk.) Pine spittlebug	ewP jP scP	An evaluation in Montague Township, Kemptville District, disclosed that 65% of the trees were infested. Elsewhere, very high spittlebug populations were detected at numerous locations across the eastern portion of the Midhurst District and the western end of the Tweed District. Populations declined considerably in the Aylmer and Cambridge districts.
<i>Archips cerasivorana</i> (Fitch) Uglynest caterpillar	pCh cCh	Extremely high caterpillar populations were found across the eastern half of the Midhurst District and the western half of the Maple District. At Canadian Forces Base Borden, every scrub pin cherry or choke cherry was completely webbed. Roadside locations with 25% foliar damage were common in the eastern portion of the region.
<i>Brachys aerosus</i> Melsh. (= <i>rufescens</i> N. & W.) Leafmining beetle	bPo	An average of 10% foliar damage was recorded on 100% of the trees in a small stand in Eramosa Township, Cambridge District.
<i>Caulocampys acericaulis</i> (MacG.) Maple petiole borer	sM	This insect was observed on 100% of the trees in the Hofstetter Lake plot in Wilmot Township, Cambridge District. Damage levels were low at only 2%.
<i>Choristoneura p. pinus</i> Free. Jack pine budworm	scP	An evaluation disclosed that 3.3% of the 1.8-m trees were infested. Trace foliar damage of 1% was recorded in a 2-ha plantation in Oxford-on-Rideau Township, Kemptville District.
<i>Conophthorus piniperda</i> (Schw.) White pine cone beetle	ewP	Beetle populations increased and caused 10% shoot mortality on 22-m trees at several sites in South Crosby Township, Kemptville District. In South Cayuga Township, Cambridge District, an evaluation revealed that 2.3% of the 3.3-m trees were infested.
<i>Corthylus punctatissimus</i> (Zimm.) Pitted ambrosia beetle	sM	Sugar maple regeneration sustained 20–30% mortality in a stand in Adjala Township, Midhurst District. In the same district, 1% mortality was common in sugar maple stands in Sullivan and Derby Townships. Low levels of mortality occurred on seedlings <1 m tall in two stands in Rear of Yonge and Escott and Belmont townships, Kemptville and Tweed districts, respectively.
<i>Datana integerrima</i> G. & R. Walnut caterpillar	bHi bWa	High caterpillar populations caused 80% defoliation on several trees in a woodlot in Osnabruck Township, Kemptville District. This also typified observations on black walnut at scattered locations across the eastern portion of the region.

(cont'd)

Table 5. Other forest insects (cont'd).

Insects	Host(s) ^a	Remarks
<i>Datana ministra</i> (Dury) Yellownecked caterpillar	Ba	An average of 10% foliar damage was observed on six 6-m trees in a 3-ha hybrid poplar/basswood plantation in Oro Township, Midhurst District.
<i>Dendroctonus simplex</i> LeC. Eastern larch beetle	tL	This pest caused whole-tree mortality in three pockets of 15–40 trees each in the La Rose Forest, Clarence Township, Kemptville District and near Harrowsmith in Portland Township, Tweed District.
<i>Dendroctonus valens</i> LeC. Red turpentine beetle	rP	In Charlotteville Township, Aylmer District, a pocket of 15–20 dead, semimature trees and some apparently healthy ones nearby, were infested with this beetle. The beetles probably moved into area following initial root rot infection and were contributing to the decline of the living trees.
<i>Egira dolosa</i> (Grt.) Lined black aspen caterpillar	tA	Moderate defoliation levels, averaging 30%, were found in some 20–30 ha in a small stand in Georgina Township, Maple District. Similar damage levels were recorded at a number of sites at Canadian Forces Base Borden in Essa Township, Midhurst District.
<i>Epinotia solandriana</i> (L.) Birch-aspen leafroller	tA	In Edwardsburgh Township, Kemptville District, 15-m fringe trees in a 1-ha area sustained 40% foliar damage. This type of damage was typical at three other sites in the district.
<i>Eriophyes</i> sp. A mite	Be	An average of 15% foliar damage was observed, mostly on lower foliage, in a woodlot in Clinton Township, Cambridge District. This mite was also common on beech in the south-western portion of the region.
<i>Fenusa ulmi</i> Sund. Elm leafminer	sE	Average defoliation due to leafminer was 50%, but some of the larger elm had 70–80% foliar damage in a natural forest area in Williams Township, Aylmer District. This insect was also common at a number of other locations in the same district and caused moderate defoliation.
<i>Gnophothrips</i> sp. Thrips	scP	This insect was found on roadside and plantation trees throughout the eastern portion of the region. One evaluation disclosed that 66% of the 1.8-m trees were infested and foliar damage averaged 44% in a 1-ha plantation in Oxford-on-Rideau Township, Kemptville District. Similar damage was observed on open-growing trees in a number of townships in the Tweed District.
<i>Hylobius pales</i> (Hbst.) Pales weevil	scP	Adult weevil feeding resulted in 20% branch mortality on 80% of the 3.4-m trees at a Christmas tree operation in Sidney Township, Tweed District.
<i>Ips grandicollis</i> (Eich.) Southern pine engraver	rP	This beetle was noted as a secondary pest in ten dead, semi-mature trees at the edge of a woodlot in Brantford Township, Aylmer District.

(cont'd)

Table 5. Other forest insects (cont'd).

Insects	Host(s) ^a	Remarks
<i>Sochnus rufipes</i> (LeC.) Willow flea weevil	W	In the Guelph Lake Conservation Area in Cambridge District, a small stand of willow was 100% affected. Foliar damage averaged 10%.
<i>Malacosoma americanum</i> (F.) Eastern tent caterpillar	pCH cCH	Scattered individual trees across the Aylmer District had defoliation ranging from 10–90%. Defoliation levels of 60–70% were detected in Brant Township, Midhurst District. Otherwise, caterpillar populations declined.
<i>Messa nana</i> (Klug) Early birch leaf edgeminer	wB gB	Several 13.9-m white birch trees had an average of 80% foliar browning in the Presquile Provincial Park in Brighton Township, Tweed District. In Gloucester Township, Kemptville District, damage levels of 2% were recorded on 1.5-m grey birch. A small stand of mature white birch had 5% foliar damage in conjunction with another leafminer in the Luther Marsh area in Cambridge District.
<i>Oligonychus ununguis</i> (Jac.) Spruce spider mite	jP wS erC bS	Mite populations were widespread across the eastern portion of the region in 1994. An evaluation disclosed 100% older foliage browning in a 5-ha jack pine plantation in Richmond Township, Tweed District. Less severe damage was encountered on white spruce across the Tweed and Kemptville districts. In the Aylmer District, 5–10% damage levels were observed on eastern red Charlotteville Township, a mixed plantation of 10-m white spruce and black spruce sustained an average of 5% foliar browning.
<i>Paraleucoptera albella</i> (Cham.) Cottonwood leafminer	hybrid poplar	One ha of 14-m trees was 100% infested and averaged 30% foliar browning in Erin Township, Cambridge District.
<i>Phratora p. purpurea</i> Brown Aspen skeletonizer	tA	This pest skeletonized 10% of the trembling aspen foliage throughout Asphodel Township, Tweed District.
<i>Pikonema alaskensis</i> (Roh.) Yellowheaded spruce sawfly	wS	An evaluation in Ramsay Township, Kemptville District, disclosed that 83.3% of the 4.7-m trees were infested. Average foliar damage was 27.7%. Defoliation on individual trees, however, ranged from 1–100%.
<i>Podapion gallicola</i> Riley Pine gall weevil	rP	Heavy weevil damage caused whole-branch mortality along plantation edges in Haldimand Township, Tweed District and along the Dieppe Road in Essa Township, Midhurst District.
<i>Profenusa thomsoni</i> (Konow) Ambermarked birch leafminer	wB	A small stand of mature trees in the Luther Marsh area in West Luther Township, Cambridge District, were totally infested with leafminer. Recorded foliar damage was 5%.
<i>Psilocorsis reflexella</i> Clem. Flat leaf-tier	deciduous	This leaf-tier was commonly found across the region and caused damage levels of 5–10%.
<i>Resseliella pinifoliae</i> (Felt) White pine needle midge	ewP	For the second consecutive year, moderate to severe defoliation of the current year's foliage was encountered across the eastern portion of the region. Infested trees ranged in height from 3–10 metres.

(cont'd)

Table 5. Other forest insects (concl.).

Insects	Host(s) ^a	Remark
<i>Rhyacionia granti</i> Miller Red jack pine shoot borer	jP	Twig and shoot mortality averaged 5% on 70% of the 3.8-m trees in a 5-ha plantation in Richmond Township, Tweed District.
<i>Taeniothrips inconsequens</i> Pear thrips	sM	Eight trees, averaging 20% defoliation, were observed along the Niagara Escarpment in Clinton Township, Cambridge District.
<i>Tremex columba</i> (L.) Pigeon tremex	Be	High populations of this wood boring wasp were attacked weakened host trees along the beach road in the Presquile Provincial Park, Brighton Township, Tweed District.

^a Ba = basswood, Be = beech, bHi = bitternut hickory, bL = black locust, bO = bur oak, bPo = balsam poplar, bS = black spruce, Bu = butternut, bWa = black walnut, cCh = choke cherry, erC = eastern red cedar, ewP = eastern white pine, gB = grey birch, jP = jack pine, pCh = pin cherry, rO = red oak, rP = red pine, scP = scots pine, sM = sugar maple, tA = trembling aspen, tL = tamarack, slE = slippery elm, W = willow, wB = white birch, wO = white oak, wS = white spruce.

TREE DISEASES

Major Diseases

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

Pockets of dead and dying trees were detected in a number of natural hardwood stands and conifer plantations across the region. All of the damage evaluated in the pine plantations has been present for a number of years. However, this disease annually kills additional surrounding trees, thereby continually enlarging the area of damage.

Two areas of damage were sampled in red pine plantations in the Northumberland County Forest in Haldimand Township, Tweed District. In a 3-ha, 50-year-old plantation, a single large area of 46 dead trees was detected. Eighteen surrounding trees were also severely affected by this root rot. At the second location, a 4-ha, 40-year-old plantation, 12 dead trees were detected. Surrounding trees at this site did not appear to be affected by the root rot (Fig. 10).

Routine surveys of red pine plantations in the Midhurst District revealed three plantations with pockets of dead trees. In a 25-ha, 30-year-old plantation in Vespra Township, two areas, consisting of seven and four dead trees, respectively, were detected. Nine dead trees were detected in a 20-ha, 35-year-old plantation in the same township. Several surrounding trees showed obvious symptoms of early infection by this root rot. Two pockets of dead trees were also detected in a 20-ha, 40-year-old plantation in Oro Township. The first site consisted of 28 dead trees, surrounded by several declining ones. The second area contained six dead trees. In a 35-ha, 45-year-old plantation

in Sunnidale Township, two areas of dead trees were observed. These contained 11 and six dead trees, respectively (Fig. 11).

Scattered, single, whole-tree mortality caused by *Armillaria* root rot was also detected throughout a 15-ha white spruce plantation in Uxbridge Township, Maple District. This plantation has been moderately to severely defoliated by the eastern spruce budworm for 5 years.

This root rot was also collected from trees that had recently died in the 100-tree red oak plots in the Ganaraska County Forest in Clarke Township, and at Joe's Lake in Lavant Township, Kemptville District. Recently killed oaks were sampled at five locations in the Aylmer District; one from each of the 100-tree oak plots at the Pinery Provincial Park, Bosanquet Township; at the St. Williams Crown Forest, South Walsingham Township; and at the Turkey Point Provincial Park, Charlotteville Township. The remaining two collections were made in privately owned woodlots in Charlotteville Township. The rot was collected also on recently killed sugar maple at the 25-tree sugar maple plot in Malahide Township, Aylmer District and from two dead white ash (*Fraxinus americana* L.) trees on the North American Maple Project (NAMP) plot in Hallowel Township, Tweed District.

Additional evaluations in 48 pine plantations produced negative results. These plantations ranged in size from 0.5 ha to 30 ha and tree height varied from 0.4 m to 18 m.

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

In 1994, surveys were conducted in 29 pine plantations in the Southern Region to detect the presence of the North American or European race of *Scleroderris* canker. Four

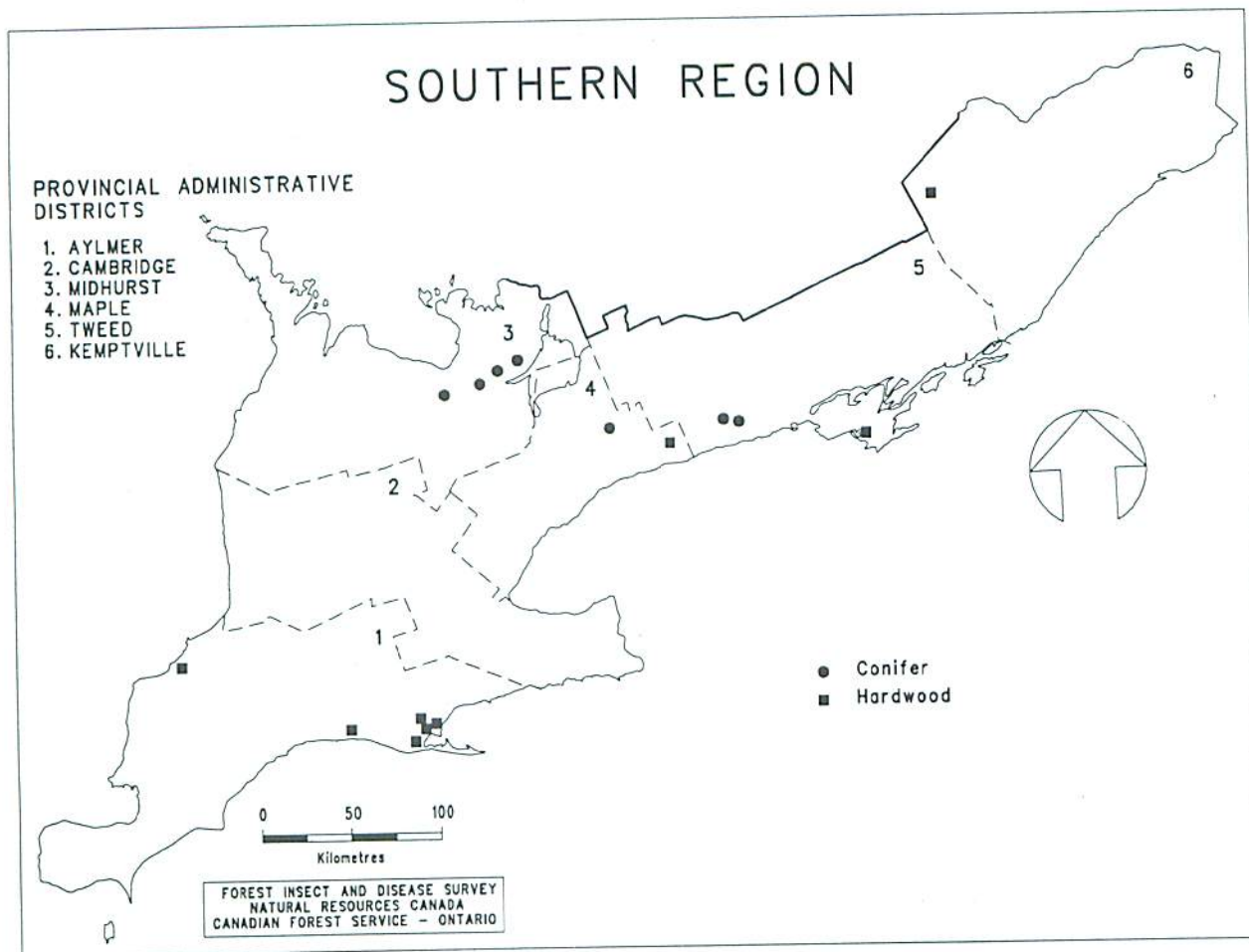


Figure 10. Locations where damage caused by *Armillaria* root rot, *Armillaria ostoyae* (Romagn.), occurred in 1994.



Figure 11. A pocket of whole-tree mortality caused by *Armillaria* root rot (*Armillaria ostoyae* [Romagn.] Herink) in a semimature red pine (*Pinus resinosa* Ait.) plantation.

Scots pine, one Austrian pine, and 24 red pine plantations, ranging in height from 0.7–18.0 m, were checked in the Kemptville, Maple, Midhurst, and Tweed districts (Fig. 12). No evidence of the disease was detected.

Dutch Elm Disease, *Ophiostoma ulmi* (Buisman) Nannf.

Dutch elm disease was widespread across the entire region in 1994, as has been the case for the past few years. Ongoing mortality or recently infected elm trees were easily observed in small pockets or as individuals along roadsides, fencelines, farm fields, or in wet sites.

The highest incidence of damage was recorded in Thorah Township, Maple District. Here, 25 of 30 trees were killed in one clump along County Road 15 near Beaverton. A high incidence rate was also recorded throughout the Stayner–Collingwood area of the Midhurst District.

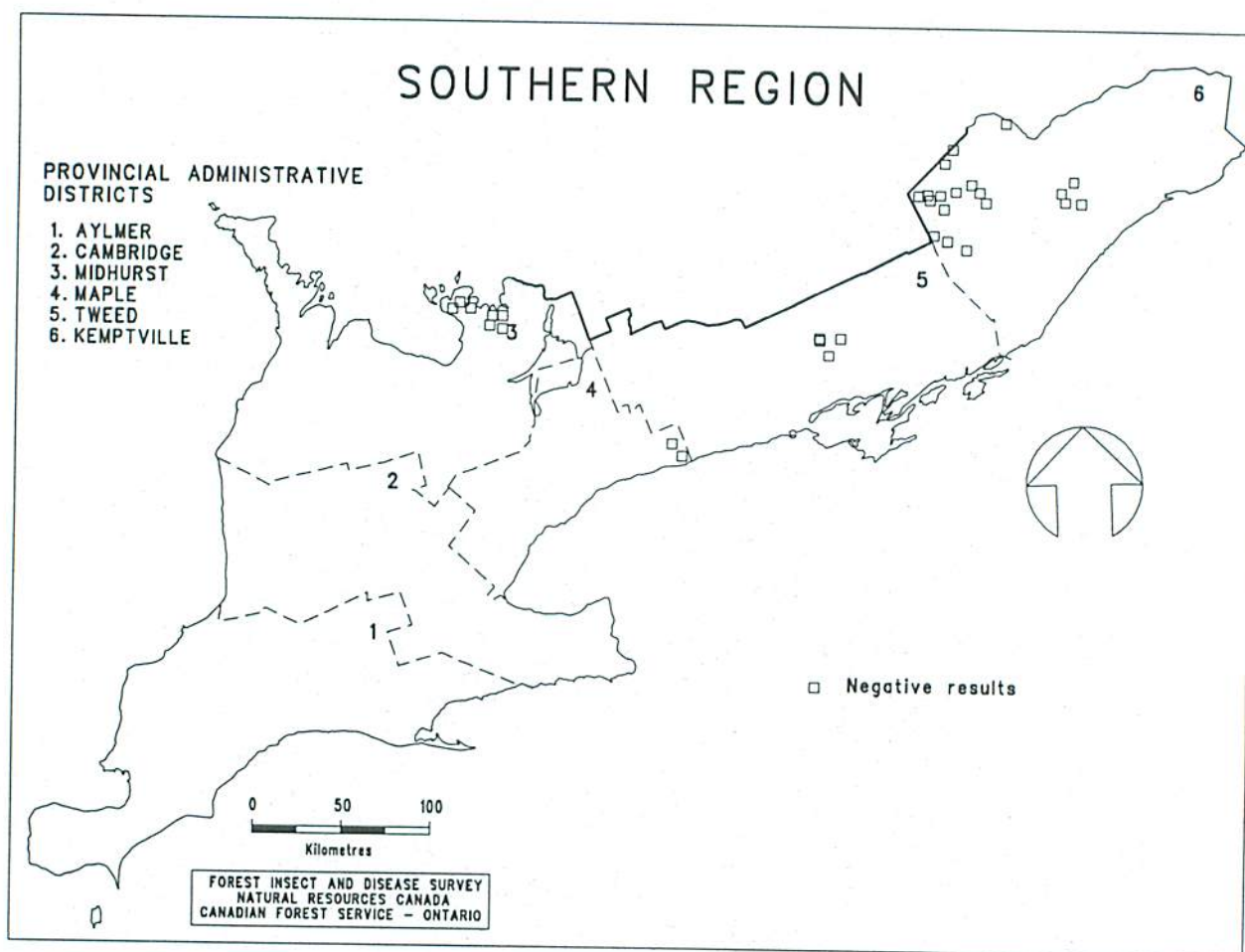


Figure 12. Locations where surveys for the *Scleroderris* canker, *Gremmeniella abietina* (Largerb.) M. Morelet, were conducted in 1994.

Butternut Canker, *Sirococcus clavignenti-juglandacearum* V.M.G. Nair, Kostichka & Kuntz

For the fourth consecutive year, surveys were conducted in the region to determine the presence, distribution, and damage level caused by the butternut canker.

Butternut (*Juglans cinera* L.) is not a tree species commonly found in the region. A shade intolerant species, it must be open to direct sunlight to thrive. It generally grows on deep, rich soils in the central and southwestern portion of the region, but is also found on the drier, exposed, rocky soil sites in the eastern portion of the region on the Frontenac Axis and the Smith Falls Limestone Plain. The most abundant distribution of butternut is found in the Rideau Lakes area of the Kemptville District.

In 1994, typical signs of the butternut canker were collected at 20 of 23 locations examined (Fig. 13). At each location from 1–20 trees were checked. Table 6 summarizes the results of a survey that quantified branch mortality. Branch mortality caused by this disease is generally first observed in the lower crown. It then progresses upward into the entire crown. Adventitious sucker growth, which

develops on or near the base of an infected tree, is often quickly infected (Fig. 14).

The disease seems to be prevalent wherever the host occurs in the region. In 1994, new distribution records were noted in the far eastern townships of Clarence, Caledonia, and Lancaster in the Kemptville District; in Scugog Township in the Maple District; in Arthur and Erin townships in the Cambridge District; and in Mosa Township in the Aylmer District. In addition, the disease was also collected for the first time in South Burgess, Bastard, Edwardsburgh, Front of Yonge and Rear of Leeds, and Lansdowne townships, Kemptville District and in Oso Township, Tweed District. These areas are adjacent to previously known infested sites.

The most severe damage was recorded in Erin Township, Cambridge District, where two of the three 15-m trees examined had 95% branch mortality. Elsewhere, branch mortality was from 10–90% on trees ranging from 7.5–18.9 m in height. Most trees exhibiting branch cankers also hosted large stem cankers that had not developed callus tissue, but infection was evident from the symptomatic sooty bark patches.

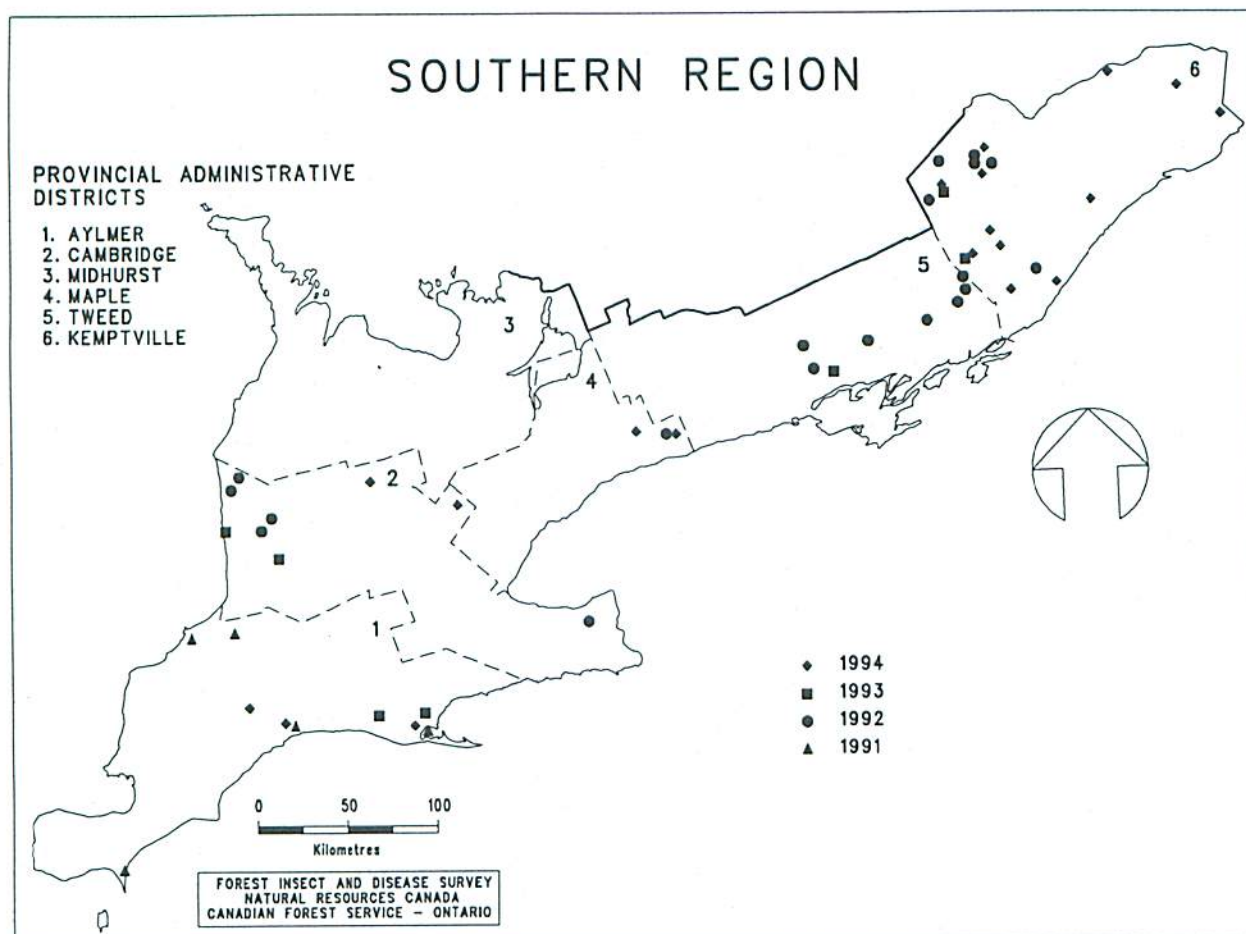


Figure 13. Locations where collections of the butternut canker, *Sirococcus clavigignenti-juglandacearum* Nair, Kostichla & Kuntz., were collected from 1991–1994.



Figure 14. Crown dieback in a semimature butternut (*Juglans cinerea* L.) caused by butternut canker, (*Sirococcus clavigignenti-juglandacearum* V.M.G. Nair, Kostichka & Kuntz).

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

There was a major decline in the incidence of diplodia tip blight in the region, except in the southwestern portion. Damage in the Aylmer and Cambridge districts was widespread, most particularly on Scots and Austrian pine (*P. nigra* Arnold). Severe branch and shoot mortality was observed along major highway corridors, such as Highway 401, where stresses of pollution from traffic and proximity to heavy use of salt have been contributing factors in the onset of the disease.

The heaviest cumulative damage recorded was in Brantford Township, Cambridge District, where 90–100% of the trees in a 3-ha, 40-year-old Scots pine plantation were affected. Severe foliar damage, averaging 75%, has resulted in 30% whole-tree mortality.

At the Valens Reservoir in Beverly Township in the Cambridge District, 50% of the 10-m, open-grown Scots pine were affected. These averaged 20% foliar damage. In the same general area, this disease killed several trees in a small pocket of 15-m red pine and caused shoot and branch mortality, ranging up to 70%, on several additional

Table 6. Summary of branch mortality caused by butternut canker at 20 locations in the Southern Region of Ontario in 1994.

Location (Township)	Number of trees examined	Average height (m)	Branch mortality (%)
<i>Aylmer District</i>			
Dunwich	1	8.0	0
Mosa	1	12.0	40
South Walsingham	2	14.0	90
<i>Cambridge District</i>			
Arthur	20	13.0	0
Erin	3	15.0	95
<i>Kemptville District</i>			
Bastard	2	10.0	0
Caledonia	5	9.6	10
Clarence	5	14.0	20
Darling	3	14.0	20
Edwardsburgh	6	12.5	50
Front of Yonge	1	9.0	20
Lancaster	12	18.9	20–80
North Crosby	3	16.0	40
Ramsay	1	12.8	80
Ramsay	4	18.5	65
Rear of Leeds & Lansdowne	4	7.5	30
South Burgess	9	14.6	85
<i>Maple District</i>			
Clarke	3	13.0	60
Scugog	1	8.0	70
<i>Tweed District</i>			
Oso	4	9.5	10

trees. Heavy damage was aerially detected in this township in a 16-ha area of 13-m-tall Scots pine at the Rockton Game Farm. In the St. Williams Crown Forest in South Walsingham Township, Aylmer District, 50 fringe Austrian pine sustained 5–10% shoot and branch mortality. In a 0.5-ha plantation of 6-m Scots pine, damage to shoots and branches averaged 30%. Along Highway 3, a few kilometres east of the town of Aylmer, 100% of the trees were affected in a 300-m Scots pine shelterbelt. Foliar damage averaged 30%.

Low damage levels were observed on Austrian pine and Scots pine in the Midhurst District along Highway 400, south of the city of Barrie; along Highway 50 in Adjala Township; and along County Road 11 in Oro Township. Similar foliar damage was detected on ornamental Austrian pine at the OMNR Orono Forest Nursery in the Maple District.

Minor Diseases

Leaf Spot, *Drepanopeziza populorum* (Desm.) Höhn., *D. salicis* (Tul. & C. Tul.) Höhn., *D. tremulae* Rimpau, *Gnomonia caryae* F.A. Wolf, *G. leptostyla* (Fr.:Fr.) Ces. & De Not., *Mycosphaerella effigurata* (Schwein.) House, *M. fraxinicola* (Schwein.) House, and *M. populicola* G.E. Thomps.

For the second consecutive year leaf spot diseases were abundant and affected a number of different deciduous tree species in the region. Balsam poplar (*Populus balsamifera* L.) stands in the northern portion of the Cambridge District were the most severely affected. Assessment of a 1-ha stand in East Luther Township disclosed that *Mycosphaerella populicola* caused 80% foliar damage on 100% of the host trees. Similar damage levels were detected in a small balsam poplar stand in Howick Township. Leaf infections caused by *Mycosphaerella effigurata* were widespread and an average of 80% foliar damage was recorded on white ash in the Tweed and Kemptville districts. *Mycosphaerella fraxinicola* caused an average of 40% foliar damage to several 16-m-tall white ash in Front of Leeds and Lansdowne Township in the Kemptville District.

Shagbark hickory (*Carya ovata* [Mill.] K. Koch), growing along roadsides in South Cayuga Township in the Cambridge District, sustained 40% foliar damage caused by *Gnomonia caryae*. Leaf infections of *Gnomonia leptostyla* ranged from 40–80% and caused premature leaf drop on butternut throughout the host range in the eastern portion of the Tweed and Kemptville districts. They also caused an average of 20% foliar damage on 100% of the trees in a black walnut plantation in Harwich Township in the Aylmer District. In Hay Township, Cambridge District, a small pocket of young trembling aspen averaged 20% foliar damage from *Drepanopeziza tremulae*, and a clump of ten 8-m-tall European white poplar (*P. alba* L.) had sustained 10% foliar damage in Haldimand Township in the Tweed District. *D. salicis* caused 30% foliar damage on 100% of the trees in a small stand of willows in Guelph Township, Cambridge District. Defoliation averaged 25% on 20% of the 9-m-tall hybrid poplar in a 3-ha plantation in Oro Township in the Midhurst District. Approximately 80% of the 7-m-tall trembling aspen sustained 75% defoliation caused by *D. populorum* in a 0.5-ha area at CFB Borden in Tosorontio Township, Midhurst District.

Pine Needle Rust, *Coleosporium asterum* (Dietel) Syd. & P. Syd.

This needle rust was detected in three red pine plantations in the Kemptville District. The heaviest damage occurred in a 1.5-ha, 1.4-m-tall plantation in North Sherbrooke Township. A standard 150-tree evaluation

revealed an average of 52% foliar damage on 83% of the trees. In a 3-ha plantation in Pakenham Township, 11% of the 2.4-m trees averaged 17% foliar damage, and in Darling Township in a 3-ha plantation, 2% of the 3.3-m trees sustained 25% foliar damage.

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

In 1994, a special survey was conducted to collect the actual fruiting structures of this particular stem rust. In general, the incidence level of white pine blister rust is very low across most of the region. During the survey only

one location was found with a high incidence rate. In a 2.5-ha eastern white pine plantation in Fitzroy Township in the Kemptville District, 17% of the 3.3-m-tall trees were severely infected. Elsewhere, at the seven additional sites that were evaluated as part of this special survey, incidence levels averaged from 2 to 5%. Three sites were evaluated in the Cambridge District and two in each of the Kemptville and Midhurst districts.

Other Forest Diseases

Various other diseases were encountered during the course of regular surveys. Information on these is provided in Table 7.

Table 7. Other forest diseases.

Organism	Host(s) ^a	Remarks
<i>Apiognomonia venata</i> (Sacc. & Speg.) Höhn. Anthracnose	Sy	Twig and branch mortality rates of 30% were recorded on 20, planted, 10-m host trees in the St. Williams Crown Forest in South Walsingham Township, Aylmer District.
<i>Apiognomonia errabunda</i> (Roberge) Höhn. Anthracnose	Ash	Approximately 80% defoliation occurred on 10 white ash trees in Darlington Township, Maple District and 95% of the leaves were affected on red ash in Kinloss and Huron townships, Midhurst District. Low damage levels were recorded on green ash in a plantation and on blue beech in the Rondeau Provincial Park, both in Harwick Township, Aylmer District.
<i>Apiognomonia tiliae</i> (Rehm) Höhn. Anthracnose	Ba	Trace infection levels were detected on 8-m-tall trees in a 3-ha plantation in Oro Township, Midhurst District.
<i>Auerobasidium apocryptum</i> (Ellis & Everth.) Herm.-Nijh. Anthracnose	sM	Foliar damage averaged 40% on 25 trees in a plot in Chinguacousy Township, Maple District.
<i>Chrysomyxa ledi</i> (Alb. & Schwein.) de Bary var. <i>ledi</i> Spruce needle rust	bIS	Severe infection occurred on a single 6.7-m-tall ornamental tree in Cumberland Township, Kemptville District.
<i>Cryphonectria parasitica</i> (Murrill) M.E. Barr Chestnut blight	aCh	A single 10-m ornamental tree was severely cankered by infections of this pathogen in Thurlow Township, Tweed District.
<i>Cyclaneusma minus</i> (Butin) DiCosmo, Peredo & Minter Naemacyclus needle cast	scP	In Charlotteville Township, Aylmer District, damage ranged from 5-10% in a 1-ha area of 2-m-tall Christmas trees.
<i>Endocronartium harknessii</i> (J.P. Moore) Y. Hirats. Western gall rust	scP scP	This gall rust was commonly encountered on host trees in Christmas tree plantations and naturally occurring stands occurring stands throughout the region. The most severe damage was recorded in a 7-ha plantation in Tiny Township, Midhurst District. An evaluation revealed 13% of the 2-m-tall trees were affected. Of these, 5% had more serious stem infections.
<i>Eutypella parasitica</i> R.W. Davidson & R.C. Lorenz Eutypella canker	sM	This canker was observed at low infection levels throughout the range of sugar maple in the region.

(cont'd)

Table 7. Other forest diseases (cont'd).

Organism	Host(s) ^a	Remarks
<i>Glomerella cingulata</i> (Stoneman) Spauld. & H. Schrenk Black canker of willow	alDo	Heavy canker infection caused 60% defoliation and 25% twig mortality at one site in Ramsay Township, Kemptville District.
<i>Guignardia aesculi</i> (Peck) V.B. Stewart Horse-chestnut leaf blotch	hCh	A single 16-m tree sustained 15% foliar damage in the Town of Coburg, Tweed District.
<i>Gymnosporangium clavipes</i> (Cooke & Peck) Cooke & Peck Quince rust	Haw	Host trees 4 to 6.5 m tall suffered 80% twig and branch mortality from Brockville, north through Smith Falls and east to Burrits Rapids. This included Elizabethtown, Kitley, Montague, and Wolford townships, Kemptville District.
<i>Gymnosporangium juniperi-virginianae</i> Schwein. Cedar-apple rust	cJ	Low infection levels were recorded at one site in Townsend Township, Aylmer District.
<i>Heterobasidion annosum</i> (Fr.:Fr.) Bref. Fomes root rot	rP	Infections of this disease caused the 0.2-ha pocket of mortality in 22-m-tall trees in La Rose Forest, Clarence Township, Kemptville District.
<i>Inonotus tomentosus</i> (Fr.:Fr.) S. Teng Tomentosus Root Rot	wS	A 0.1-ha pocket of dead and dying 14-m-tall trees were recorded along Concession 18 in Stephen Township, Cambridge District.
<i>Lophodermium</i> sp. Needle cast	rP	Foliar damage ranged from 40–80% on 65–100% of the trees of various heights (1.8–14 m) in plantations throughout the eastern portion of the region. Severe needle cast infections were aerially observed in large pockets (5 ha) in the La Rose Forest, and damage areas totaled over 25 ha in Clarence and Cambridge townships, Kemptville District.
<i>Linospora tetraspora</i> G.E. Thomps. Linospora leaf	bPo	Infections of this leaf blight caused 80% foliar browning and premature leaf drop in host stands 0.1–1.0 ha in size throughout the Tweed and Kemptville districts.
<i>Melampsorella caryophyllacearum</i> J. Scröt. Fir broom rust	bF	Broom structure was found on a single tree in Tosorontio Township, Midhurst District.
<i>Mycosphaerella pini</i> Rostr. Red band needle blight	auP	The most severe needle blight foliar damage (50–85%) was recorded on 3,000 ornamental 3-m-tall trees at a tree farm in Goulborne Township, Kemptville District. A second site sustained 50% foliar damage on 80% of the 7-m-tall trees in a 1-ha plantation in Osgoode Township, Kemptville District.
<i>Mycosphaerella populorum</i> G.E. Thomps. Septoria canker	Po	This leaf disease affected 100% of the 12-m-tall trees in a 5-ha stand in Wainfleet Township, Cambridge District and resulted in a current mortality rate of 20%. In South Cayuga Township, in the Cambridge District, 92% of the 7-m-tall trees were affected in a 2-ha area. The current mortality rate at this site was 10%.
<i>Nectria</i> sp. Canker	Be	Host trees, 18 m tall, were found to be in a state of decline in a 0.5-ha area in the Presquile Provincial Park along the Lake Ontario shoreline, Brighton Township, Tweed District.

(cont'd)

Table 7. Other forest diseases (concl.).

Organism	Host(s) ^a	Remarks
<i>Phaeocryptopus gaeumannii</i> (T. Rohde) Petr. Swiss needle cast	dF	In a Christmas tree plantation 75% of the 3.2-m-tall trees had sustained 82.5% foliar damage in Oxford-on-Rideau Township, Kemptville District.
<i>Phomopsis arnoldiae</i> B. Sutton Russian olive canker	rOl	Branch mortality averaged 60% on several 4.5-m-tall trees in a private planting in Edwardsburgh Township, Kemptville District. This typified observations of affected trees in the region.
<i>Rhizophaera kalkhoffii</i> Bubák Needle blight	wS dF wF	One 12.9-m-tall white spruce tree sustained 60% foliar damage in Finch Township, Kemptville District. In Essa Township, Midhurst District, thirty 3.7-m-tall white fir had 75% foliar damage. This disease was also collected from several 1.3-m-tall Douglas fir Christmas trees in Manvers Township, Tweed District.
<i>Venturia macularis</i> (Fr.:Fr.) E. Müll. & Arx Shoot blight	tA	A low level of shoot blight damage was detected on 2-m-tall roadside regeneration in Oro Township, Midhurst District.

^a aCh = american chestnut, alDo = alternate dogwood, auP = Austrian pine, Ba = Basswood, Be = beech, bF = balsam fir, blS = blue spruce, bPo = balsam poplar, cJ = common juniper, dF = Douglas fir, Haw = hawthorn, hCh = horse chestnut, Po = poplar, rOl = russian olive, rP = red pine, scP = Scots pine, sM = sugar maple, Sy = sycamore, tA = trembling aspen, wF = white fir, wS = white spruce.

ABIOTIC CONDITIONS

Frost Damage

Freezing temperatures on 13 and 14 May and again on 26 and 27 May caused widespread damage to hardwood and conifer foliage in the region.

Overall, damage to white spruce, blue spruce, and Norway spruce in plantations and balsam fir in natural stands was concentrated south of the Bruce Peninsula from Kinkardine, west to Midland, and south to the Simcoe/Brantford area. Damage to open-growing hardwoods was recorded at various levels across the entire region, but became increasingly more severe east of Ottawa. Here, entire stands of maple and ash were defoliated.

The most severe frost damage occurred in plantations in Essa Township, Midhurst District, where 100% of the 0.6-m-tall trees in a 5-ha white spruce plantation had 95% of the new shoots killed. Observations in several plantations and natural stands in the Midhurst, Cambridge, and Aylmer districts (summarized in Table 8) disclosed incidence levels of 10 to 100%. New shoot mortality ranged from 18 to 95% (Fig. 15).

Frost damage on hardwoods generally killed only a portion of the leaf and was not usually severe enough to cause leaf drop. The browning and subsequent shrivelling of foliage was confined primarily to the lower and westerly exposed portion of the crown. Only in the most severe cases did all of the foliage of affected trees become damaged.



Figure 15. Current shoot mortality on young white spruce (*Picea glauca* [Moench] Voss) caused by heavy, late spring frost.

Table 8. Summary of damage caused by late spring frost at seven locations in the Southern Region of Ontario.

Location (Township)	Tree species ^a	Average height of trees (m)	Estimated trees per ha	Estimated area of (ha)	Trees affected (%)	Foliar damage (%)
<i>Aylmer District</i>						
Charlotteville	bF	1.0	1,280	0.2	100	30
<i>Cambridge District</i>						
East Wawanosh	wS	4.0	2,990	1	100	18
Turnberry	wS	2.0	2,990	1	50	85
<i>Midhurst District</i>						
Essa	wS	0.6	1,000	5	100	95
Flos	wS	0.5	2,300	15	10	75
Huron	wS	1.1	2,200	10	88	90
Medonte	wS	7.5	2,250	10	20	75

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

The heaviest frost damage in the Cambridge District occurred on roadside sugar maples in Brantford, Pelham, and Saltfleet townships and north of the town of Simcoe in Burford Township, Aylmer District. Foliar damage ranged from 40–60%. Hardwood foliar damage, primarily to sugar maples, was detected from the Walkerton–Markdale area south of Owen Sound in the Midhurst District, east through the Richmond Hill area to the west end of Rice Lake in the Tweed District. Damage across the area varied from foliar discoloration to complete leaf drop. White ash, and to a lesser extent, white oak, were similarly affected. Occasional, open-grown sugar maple trees, 17-m-tall, sustained foliar damage in the 40–55% range in the eastern portion of the Tweed District. Damage became increasingly prevalent east of Ottawa in the Kemptville District. Observations in a 20-ha stand of sugar maple disclosed 50–65% foliar damage in Russell Township in the Kemptville District. Similar symptoms were apparent on Manitoba maple (*A. negundo* L.), silver maple (*A. saccharinum* L.), and white ash throughout the same area.

Foliar frost damage measuring 5% was recorded on white spruce seedlings in Compartment C1 at the St. Williams Provincial Tree Nursery in South Walsingham Township, Aylmer District.

Animal Damage

As a result of harsh winter conditions, which included heavy snow cover during the winter of 1993–1994, rodent damage was commonly encountered in pine plantations in the Southern Region. When the snow cover is deep and rodent populations are high, heavy feeding by mice on the bark at the base of young trees results in girdling, and often death, of the entire tree.

The most severe damage during 1994 occurred in Woodhouse Township in the Aylmer District. Here, 85% of the 1.8-m-tall Scots pine in a 0.5-ha plantation were severely damaged. Mortality was estimated at 10% at the time of the assessment, although the majority of the trees were expected to eventually die as a result of the basal injury. In a 1-m-tall, 2-ha eastern white pine plantation in West Garafraxa Township in the Cambridge District, 45% of the trees were damaged. It was determined that the majority of the damaged trees at this location would die from the feeding activity. An evaluation in a 10-ha eastern white pine plantation in Augusta Township, Kemptville District, disclosed that 25% of the 1.6-m trees had also been killed. Similar damage levels occurred in a 0.2-ha plantation of 2.6-m-tall eastern white pine in Matilda Township in the Kemptville District. At the Luther Marsh in West Luther Township, Cambridge District, a standard 150-tree evaluation conducted in a 5-ha eastern white pine plantation revealed that 10% of the 1.5-m trees were dead. At the OMNR Orono Forest Tree Nursery, 25,000 eastern white pine seedlings were killed by feeding mice. At CFB Borden, in the Midhurst District, porcupine (*Erethizon dorsatum* Linnaeus) feeding was common on 5- to 10-m Scots pine. This resulted in the entire top of the trees being killed.

FOREST HEALTH

Ash Dieback

Dieback of white ash, and to a lesser extent green ash (*F. pennsylvanica* var. *subintegerrima* [Vahl.] Fern.), was evident at numerous locations throughout the region. In early June, the foliage on portions of apparently healthy trees would turn yellow and fall. Affected branches would

then die back. Often this resulted in an average of 30 to 60% total crown dieback. This condition was most frequently encountered on young, vigorously growing, fenceline trees; however, it was also recorded on mature trees in mixed hardwood stands. The only pathogens recovered from the affected branches were *Durandiella fraxini* (Schwein.:Fr.) Seaver and *Dothiorella fraxinicola* Ell. & Everh. Both can be mildly parasitic organisms that have often been associated with ash dieback. However, a very high incidence of various anthracnose leaf diseases have been recorded on white ash across the western portion of the region since 1992. Heavy infections of anthracnose leaf diseases often result in the death of entire branches, and in some cases of the entire tree. Therefore, the ash dieback may be the result of these infections.

The dieback was first observed on fenceline and roadside trees in Keppel and Amabel townships in the west end of the Midhurst District. Young white ash having 20 to 30% crown dieback were commonly detected throughout these townships. The condition was later observed in Derby Township, where young, 9-m-tall white ash commonly averaged 20% crown dieback. Along a section of County Road 9 in Albion Township, Maple District, 40% of the 20-year-old planted white ash showed a severe state of decline. The dieback started at one end of the row and the first 19 trees averaged 40 to 60% damage. The next three trees averaged 80% damage and the following two trees were dead. The remainder of the trees appeared to be unaffected.

One complete hedgerow of 30-year-old white ash growing between two of the compartments at the Glencairn eastern white pine seed orchard in Tosorontio Township, Midhurst District, averaged 60% crown dieback. In Darlington Township in the Maple District, five young white ash in a shelterbelt averaged 50% crown dieback. Along the Pine Grove Road in Storrington Township, Tweed District, branch mortality rates ranging from 10 to 100% were detected on 12.5-m-tall green ash. In the Kemptville District, crown dieback levels of 20 to 60% were detected on five mature white ash growing along Regional Road 38 in South Burgess Township. An average of 40% dieback was recorded on 14-m trees along Regional Road 9 in South Crosby Township.

Maple Health

Annual assessment of the sugar maple health plots, consisting of 26 woodlot, 14 urban, and 15 roadside plots, was completed across the region. The individual crowns of 25 trees on each plot were rated for percentage of total branch dieback and for any pest conditions that might affect overall vigor. The majority of the sugar maple trees were found to be very healthy. Complete results of the crown evaluations conducted in 1993 and 1994 for the three plot types are presented in Tables 9, 10, and 11.

Evaluation of the woodlot plots revealed that 92% of the trees were considered to be very healthy, with <5% crown dieback; a further 6.9% were considered healthy, with <20% dieback. An additional 1.1% of the trees sustained 21–60% crown dieback. Only a single tree, on the plot in Brighton Township in the Tweed District, was rated with >60% dieback. No current whole-tree mortality was reported on any of the plots.

Assessment of the urban plots disclosed that 71.6% of the trees were very healthy and had <5% crown dieback. This figure increased considerably, to 92.5%, when those trees with <20% crown dieback were included. The remaining 6.5% of the living trees had moderate levels (21–60%) of crown dieback. No trees were found to have >61% crown dieback. Severely declining trees in an urban setting are often cut down and removed for safety reasons. If the 31 trees in this category had not been removed throughout the 6 years of the study, the percentage of trees considered healthy would obviously be less than 92.5%. In 1994 three trees were removed.

Roadside plots have annually shown the highest level of dieback. This is expected, in part, due to the harsh environment within which the trees are growing. The 1994 survey revealed that only 45.9% could be considered very healthy, having <5% crown dieback. The number increased to 78.7% when added to the percentage of trees considered to be healthy (<20% crown dieback). A total of 13.9% had moderate levels (21–60%) of crown dieback and 4.1% were in a severe state of decline (>61% crown dieback). Only one tree, on the plot in Chinguacousy Township in the Maple District, had died since the last assessment. Ten trees, on various plots, had been cut down. As is the case with the urban plots, often it is the most severely deteriorated trees that are removed and this impacts on the overall impression of the health of the plots.

Table 12 summarizes yearly trends in the crown condition of trees on the three different plot types. This table shows that the overall health of the woodlot plots continues to improve, as has been the case since 1990–1991. For the first time since then, however, both the urban and roadside plots show a slight decrease in overall vigor. Still, the percentage of unchanged or static trees has remained very similar on these plots since 1992–1993 (from 78 to 79% for the urban trees and 73 to 74% for roadside trees). Therefore, these plots are still considered to be healthy.

The average defoliation level was very low across the three plot types. It averaged 5.6% for the roadside plots, 0.8% for the woodlot plots, and only 0.1% for the urban plots. The highest defoliation levels for the roadside plots occurred on the plot in Mono Township, Midhurst District (16.8%) and on the plot in Chinguacousy Township, Maple District (12.8%). At both locations the damage was caused by late spring frost. Early spring, open-defoliating

Table 9. Summary of data collected at 26 woodlot maple health plots in the Southern Region of Ontario for 1993 and 1994. (Counts are based on the examination of 25 sugar maple trees at each location.)

Location (Township)	Average		Year	Cumulative dieback class						Cumulative number of cut/windfall trees ^b
	Height (m)	DBH (cm)		Number of trees ^a						
				0	1	2	3	4	5	
<i>Aylmer District</i>										
Houghton	24	33.3	1993	24	1	0	0	0	0	0
			1994	25	0	0	0	0	0	0
Malahide	22	35.3	1993	24	1	0	0	0	0	0
			1994	25	0	0	0	0	0	0
North Norwich	21	31.0	1993	25	0	0	0	0	0	0
			1994	25	0	0	0	0	0	0
Plympton	22	29.3	1993	21	1	0	0	0	3	0
			1994	21	1	0	0	0	3	0
Warwick	27	31.3	1993	22	0	0	0	0	2	1
			1994	22	0	0	0	0	2	1
<i>Cambridge District</i>										
Morris	21	29.5	1993	25	0	0	0	0	0	0
			1994	25	0	0	0	0	0	0
Onieda	27	40.4	1993	22	2	0	0	0	0	1
			1994	22	2	0	0	0	0	1
South Cayuga	21	21.2	1993	23	2	0	0	0	0	0
			1994	23	2	0	0	0	0	0
<i>Kemptville District</i>										
Lavant	22	37.6	1993	16	8	0	0	0	0	1
			1994	20	4	0	0	0	0	1
Nepean	20	37.1	1993	18	6	0	0	0	1	0
			1994	20	4	0	0	0	1	0
Oxford	24	35.6	1993	20	4	1	0	0	0	0
			1994	21	4	0	0	0	0	0
Pakenham	25	50.5	1993	8	12	4	0	0	1	0
			1994	14	7	3	0	0	1	0
Rear of Leeds and Lansdowne	28	66.4	1993	14	2	0	0	0	4	5
			1994	15	1	0	0	0	4	5
<i>Maple District</i>										
Albion	29	39.7	1993	25	0	0	0	0	0	0
			1994	25	0	0	0	0	0	0
Trafalgar	35	43.6	1993	25	0	0	0	0	0	0
			1994	24	1	0	0	0	0	0
Whitchurch	21	35.5	1993	25	0	0	0	0	0	0
			1994	25	0	0	0	0	0	0

(cont'd)

Table 9. Summary of data collected at 26 woodlot maple health plots in the Southern Region of Ontario for 1993 and 1994. (Counts are based on the examination of 25 sugar maple trees at each location.) (concl.)

Location (Township)	Average		Year	Cumulative dieback class						Cumulative number of cut/windfall trees ^b
	Height (m)	DBH (cm)		Number of trees ^a						
				0	1	2	3	4	5	
<i>Midhurst District</i>										
Derby	24	31.6	1993	24	1	0	0	0	0	0
			1994	23	2	0	0	0	0	0
Flos	27	33.4	1993	25	0	0	0	0	0	0
			1994	25	0	0	0	0	0	0
Keppel Concession I	20	27.0	1993	24	1	0	0	0	0	0
			1994	24	1	0	0	0	0	0
Keppel Concession XIII	16	23.0	1993	24	0	0	0	0	0	1
			1994	24	0	0	0	0	0	1
Keppel Concession XXI Lot 22	24	32.1	1993	23	1	0	0	0	0	1
			1994	23	0	1	0	0	0	1
Keppel Concession XXI Lot 40	22	38.3	1993	25	0	0	0	0	0	0
			1994	25	0	0	0	0	0	0
Medonte	30	38.0	1993	15	10	0	0	0	0	0
			1994	17	8	0	0	0	0	0
Sullivan	26	42.2	1993	23	1	0	0	0	1	0
			1994	23	1	0	0	0	1	0
<i>Tweed District</i>										
Brighton, Staff	23	53.9	1993	19	4	1	0	0	1	0
			1994	21	2	1	0	0	1	0
Brighton, Camp	24	45.2	1993	13	6	0	2	0	0	4
			1994	16	3	0	1	1	0	4
Totals			1993	553	62	6	2	0	1	4
%			1993	88.1	9.9	1.0	0.3	0.0	0.2	0.6
Totals			1994	573	43	5	1	1	0	0
%			1994	92.0	6.9	0.8	0.2	0.2	0.0	0.0

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

^b Since plot establishment.

insects caused trace levels of damage on the woodlot plots, and late season defoliators caused trace damage on the urban plots.

During the course of the survey, any fruiting of decay fungi that was observed on the main stem of the plot trees was collected for identification. Armillaria root rot was found on the base of the main stem on a single tree on the woodlot plot in Malahide Township in the Aylmer District. The mossy maze conk (*Cerrena unicolor* [Bull.:Fr.] Murrill) was collected on a single woodlot plot tree in Flos Township in the Midhurst District. Eutypella canker

(*Eutypella parasitica* R.W. Davidson & R.C. Lorenz) was collected on single trees at the woodlot plot in Keppel Township, Midhurst District and at the urban plot in the town of Cobourg in the Tweed District. Artist's conk (*Ganoderma applanatum* [Pers.] Pat) was recorded on an urban plot tree in the city of Richmond Hill in the Maple District and on a roadside plot tree in Mono Township, Midhurst District. The mossy maple conk (*Oxyporus populinus* [Schumacher.:Fr.] Donk) was collected on woodlot plot trees in Medonte Township, Midhurst District and in Oneida Township, Cambridge District. The fruiting

Table 10. Summary of data collected at 14 urban maple health plots in the Southern Region of Ontario for 1993 and 1994. (Counts are based on the examination of 25 sugar maple trees at each location.)

Location (Township)	Average		Year	Cumulative dieback class						Cumulative number of cut/windfall trees ^b
	Height (m)	DBH (cm)		Number of trees ^a						
				0	1	2	3	4	5	
<i>Aylmer District</i>										
Strathroy	24	82.5	1993	21	2	0	0	0	0	2
			1994	22	1	0	0	0	0	2
Woodstock	23	63.4	1993	17	3	2	0	0	1	2
			1994	16	2	1	3	0	1	2
<i>Cambridge District</i>										
Blyth	23	74.3	1993	12	8	0	0	0	0	5
			1994	12	7	1	0	0	0	5
Guelph	18	70.5	1993	20	5	0	0	0	0	0
			1994	21	3	1	0	0	0	0
<i>Kemptville District</i>										
Brockville	23	64.0	1993	17	6	0	1	0	0	1
			1994	18	2	4	0	0	0	1
Gananoque	24	59.0	1993	17	3	2	1	0	0	2
			1994	18	4	1	1	0	0	2
<i>Maple District</i>										
Oakville	20	82.5	1993	15	7	1	0	0	0	2
			1994	12	11	0	0	0	0	2
Richmond Hill	15	57.9	1993	21	0	1	0	0	0	3
			1994	18	4	0	0	0	0	3
<i>Midhurst District</i>										
Orillia	21	66.1	1993	15	6	1	0	0	0	3
			1994	15	5	1	0	0	0	4
Owen Sound	26	91.0	1993	23	2	0	0	0	0	0
			1994	22	3	0	0	0	0	0
<i>Tweed District</i>										
Campbellford	21	68.0	1993	6	7	5	0	1	0	6
			1994	7	7	3	0	1	0	7
Cobourg	18	68.5	1993	10	9	3	1	0	1	1
			1994	15	6	2	0	0	1	1
Kingston	23	53.0	1993	13	10	1	0	0	0	1
			1994	11	9	3	0	0	0	1
Peterborough	19	51.1	1993	23	2	0	0	0	0	0
			1994	22	3	0	0	0	0	0
Totals			1993	230	70	16	3	1	1	4
%			1993	70.8	21.5	4.9	0.9	0.3	0.3	1.2
Totals			1994	229	67	17	4	0	0	3
%			1994	71.6	20.9	5.3	1.2	0.0	0.0	0.9

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

^b Since plot establishment.

Table 11. Summary of data collected at 15 roadside maple health plots in the Southern Region of Ontario for 1993 and 1994. (Counts are based on the examination of 25 sugar maple trees at each location.)

Location (Township)	Average		Year	Cumulative dieback class						Cumulative number of cut/windfall trees ^b
	Height (m)	DBH (cm)		Number of trees ^a						
				0	1	2	3	4	5	
<i>Aylmer District</i>										
Bayham	20	85.9	1993	23	2	0	0	0	0	0
			1994	25	0	0	0	0	0	0
Windham	23	81.9	1993	17	7	1	0	0	0	0
			1994	14	10	0	1	0	0	0
<i>Cambridge District</i>										
Goderich	19	72.4	1993	5	3	5	1	1	0	10
			1994	5	3	3	1	0	0	13
North Easthope	18	69.2	1993	4	4	6	2	5	1	3
			1994	6	2	1	6	2	1	7
<i>Kemptville District</i>										
Edwardsburgh	21	47.0	1993	17	4	3	0	0	0	1
			1994	18	5	0	0	0	0	2
North Elmsley	22	68.0	1993	17	3	0	1	0	0	4
			1994	17	3	0	0	0	0	5
<i>Maple District</i>										
Chinguacousy	18	70.9	1993	10	6	2	1	5	0	1
			1994	8	6	2	3	4	1	1
Clarke	15	72.9	1993	7	8	6	2	0	1	1
			1994	8	6	8	1	0	1	1
<i>Midhurst District</i>										
Mono	18	54.0	1993	7	4	3	3	2	2	4
			1994	5	6	2	3	3	2	4
Sullivan	20	84.4	1993	12	11	1	0	0	1	0
			1994	11	10	2	0	0	1	1
West Gwillimbury	15	69.9	1993	10	10	3	0	2	0	0
			1994	7	12	4	0	2	0	0
<i>Tweed District</i>										
Fenelon	14	57.3	1993	6	13	4	0	0	1	1
			1994	6	13	3	1	0	1	1
Hallowell	26	59.0	1993	12	11	1	0	0	0	1
			1994	11	10	3	0	0	0	1
Hillier	19	67.0	1993	6	9	2	1	2	0	5
			1994	4	13	0	0	3	0	5
Loughborough	22	70.0	1993	11	10	4	0	0	0	0
			1994	10	12	3	0	0	0	0
Totals			1993	164	105	41	11	17	1	11
%			1993	46.9	30.0	11.7	3.1	4.9	0.3	3.1
Totals			1994	155	111	31	16	14	1	10
%			1994	45.9	32.8	9.2	4.7	4.1	0.3	3.0

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

^b Since plot establishment.

Table 12. Summary of the yearly trend in maple health at 26 woodlot, 14 urban, and 15 roadside plots in the Southern Region of Ontario from 1987 to 1993. (Counts based on the examination of 25 sugar maple trees are in each location.)

Plot Type	Years	Number of trees	Yearly trend % of trees			Cut/windfall trees (%)
			Improved	Static	Declined ^a	
Woodlot ^b	1987–1988	500	1.6	91.0	7.2	0.2
	1988–1989	548	2.2	83.2	13.9	0.7
	1989–1990	543	3.3	89.0	7.7	0.0
	1990–1991	613	11.6	82.0	5.7	0.6
	1991–1992	631	14.1	80.2	5.5	0.2
	1992–1993	628	5.4	91.9	2.1	0.6
	1993–1994	623	5.5	92.5	2.1	0.0
Urban	1989–1990	274	8.0	73.4	15.7	2.9
	1990–1991	341	15.8	72.1	9.9	2.0
	1991–1992	334	23.6	62.6	11.1	2.7
	1992–1993	325	14.5	78.1	6.1	1.2
	1993–1994	319	8.8	79.6	10.7	0.9
Roadside	1989–1990	299	7.4	71.9	19.4	1.3
	1990–1991	365	18.9	64.4	13.7	3.0
	1991–1992	353	23.5	64.0	11.6	0.8
	1992–1993	350	12.0	73.4	11.4	3.1
	1993–1994	338	8.0	74.3	14.8	2.9

^a Declined category includes current mortality.

^b Excludes the four plots established in Keppel Township, Midhurst District.

of an *Agaricales* species was collected on a roadside plot in Clarke Township, Maple District. An *Irpex* species was recorded on an urban plot in the city of Orillia in the Midhurst District.

North American Maple Project (NAMP)

In 1988 a major project was established, involving four Canadian provinces and seven American states, to annually monitor the crown conditions of sugar maple trees and to determine any possible causes of decline. To this effect, 16 plots (totaling 778 trees) were set up across the Southern Region of Ontario.

All of the stands within which the plots are located are actively managed. Half are annually tapped for the production of maple syrup; the remainder are in untapped woodlots. Different management techniques exist throughout the plots and impact upon the data. In a woodlot that is managed for maple syrup production, trees with high levels of dieback are generally removed, whereas in a woodlot managed for sawlogs, the healthy, dominant trees are removed. Therefore, woodlots managed for maple syrup production may appear healthier than those under other management techniques.

During 1994, a total of 384 trees were evaluated in the eight nontapped sugar maple woodlots. The overall condition of the majority of the trees was very healthy, with virtually no statistical change from 1993. The percentage of trees considered to be very healthy, with <5% dieback, was 89.6%. This compared with 91.2% in 1993. There was a slight increase (9.1%) in 1994 in the percentage of trees considered to be healthy (6–25% dieback) compared to 6.9% recorded in 1993. In the more severe categories of decline (>46%) there was virtually no change from the extreme low of 0.3% reported in 1993. Two new dead trees were recorded in 1994. A noticeable improvement was evident in Adjala Township, Midhurst District, where 94.9% of the trees evaluated showed <5% dieback. This compared to 80.6% in 1993. The largest increase in dieback occurred in the plot in Hallowell Township in the Tweed District, where 26.7% of the trees were recorded in the 6–25% category in 1994. This increased from 10% of the trees in 1993 (Table 13).

In the eight tapped woodlots, a total of 371 trees were evaluated and, as in the nontapped plots, the majority of the trees were considered very healthy (<5% dieback). However, there was a decrease in the percentage of trees recorded in this class. In 1993, 90.4% of the trees were in this category and 7.2% were in the healthy class (6–25%).

Table 13. Summary of crown conditions of sugar maples at eight North American Maple Project plots not tapped for maple syrup production in the Southern Region of Ontario for 1993 and 1994.

Location (Township)	DBH (cm)	Year	Number of trees examined	Dieback classes Number of trees					Annual number of dead trees	Annual number of cut trees
				0-5	6-25	26-45	46-65	>65		
<i>Aylmer District</i>										
Blandford	29.6	1993	42	41	1	0	0	0	0	0
		1994	42	38	4	0	0	0	0	0
Warwick	26.5	1993	42	39	3	0	0	0	0	0
		1994	42	39	3	0	0	0	0	0
<i>Cambridge District</i>										
West Wawanosh	29.9	1993	37	36	0	0	0	1	0	0
		1994	37	34	2	0	0	1	0	0
<i>Kemptville District</i>										
Rear of Yonge and Escott	19.1	1993	62	56	6	0	0	0	0	0
		1994	62	54	7	0	0	0	1	0
<i>Maple District</i>										
Nassagaweya	30.0	1993	48	42	5	0	0	0	0	1
		1994	47	43	4	0	0	0	0	0
<i>Midhurst District</i>										
Adjala	30.4	1993	62	50	7	2	0	1	0	2
		1994	60	56	1	1	1	0	1	0
Oro	23.5	1993	64	62	2	0	0	0	0	0
		1994	64	58	6	0	0	0	0	0
<i>Tweed District</i>										
Hallowell	33.0	1993	30	27	3	0	0	0	0	0
		1994	30	22	8	0	0	0	0	0
Total %		1993 1993	387 100	353 91.2	27 6.9	2 0.5	0 0.0	2 0.5	0 0.0	3 0.8
Total %		1994 1994	384 100	344 89.6	35 9.1	1 0.3	1 0.3	1 0.3	2 0.5	0 0.0

In 1994, 85.7% of the trees had showed <5% dieback; 12.4% were in the 6-25% dieback class. There was virtually no change in the more severe categories, with only 0.6% of the trees having >46% dieback (Table 14). Only a single new dead tree was recorded this year.

Two plots showed slight decreases in the percentage of trees that were considered very healthy. In Orillia Township, Midhurst District, evaluation revealed that the percentage of trees in the 0-5% dieback category dropped to 81.5% compared with 90.9% in 1993. In Belmont Township in the Tweed District, 69.2% of the trees were considered very healthy in 1994. This figure compared to 84.6% in 1993. However, the percentages of trees at these two locations that were considered healthy, or in the 6-25% dieback category, were 100% and 96.2%, respectively. Therefore, the overall vigor rating of these two plots was still very good.

Trace levels of defoliation caused by various pests were recorded at ten of the 16 plots. The maple trumpet skeletonizer was by far the most common pest encountered. Open defoliators, leaf rollers, leafminers, and skeletonizers were also observed on many of the plots. The highest level of defoliation was recorded in Hallowell Township in the Tweed District. Here, maple trumpet skeletonizer caused an average of 15% foliar damage. Hail damage caused 5% foliar damage on plot trees in Townsend Township in the Aylmer District. The maple webworm was detected at low levels in Rear of Young and Escott Township in the Kemptville District. Incidental damage levels caused by wood boring insects and sapsuckers was recorded on single trees at four of the plots. Seed production was virtually nil across all of the plots.

During evaluation, a number of disease fruiting structures were recorded on the main stems of the trees.

Table 14. Summary of crown conditions of sugar maples at eight North American Maple Project plots currently tapped for maple syrup production in the Southern Region of Ontario for 1993 and 1994.

Location (Township)	DBH (cm)	Year	Number of trees examined	Dieback classes Number of trees					Annual number of dead trees	Annual number of cut trees
				0-5	6-25	26-45	46-65	>65		
<i>Aylmer District</i>										
Bayham	73.5	1993	40	36	3	1	0	0	0	0
		1994	40	35	4	1	0	0	0	0
Townsend	41.1	1993	31	22	3	1	2	1	2	0
		1994	29	23	4	0	0	1	1	0
<i>Cambridge District</i>										
Goderich	32.3	1993	60	56	4	0	0	0	0	0
		1994	60	55	5	0	0	0	0	0
<i>Kemptville District</i>										
South Burgess	38.4	1993	42	38	4	0	0	0	0	0
		1994	42	36	5	1	0	0	0	0
<i>Maple District</i>										
Vaughan	30.8	1993	56	56	0	0	0	0	0	0
		1994	56	55	1	0	0	0	0	0
<i>Midhurst District</i>										
Orillia	36.7	1993	55	50	4	1	0	0	0	1
		1994	54	44	10	0	0	0	0	0
Saugeen	30.8	1993	38	36	1	1	0	0	0	0
		1994	38	34	3	1	0	0	0	0
<i>Tweed District</i>										
Belmont	26.6	1993	52	44	8	0	0	0	0	0
		1994	52	36	14	0	0	0	2	0
Total %		1993	374	338	27	3	2	1	2	1
		1993	100	90.4	7.2	0.8	0.5	0.3	0.5	0.3
Total %		1994	371	318	46	3	0	1	1	2
		1994	100	85.7	12.4	0.8	0.0	0.3	0.3	0.5

Artist's conk (*Ganoderma applanatum* [Pers.] Pat.) affected two declining trees in Townsend Township in the Aylmer District. The mossy maple conk (*Oxyporus populinus* [Schumacher:Fr.] Donk) contributed to the overall deterioration of a single tree at the plot in Belmont Township, Tweed District and on single trees at the plots in Oro and Orillia townships in the Midhurst District.

Oak Health

Ten permanent oak plots in the region are monitored annually to determine the current level of crown conditions, foliar pest damage, stem defects, and abiotic damage. Each plot consists of 100 mature or semimature oak trees. The overall assessment for 1994 indicated that the majority of the trees, 88.4%, were healthy and had <20% crown

dieback. Only 5.8% were considered to have moderate levels of dieback and just 1.4% sustained >61% crown dieback. The current, annual whole-tree mortality rate averaged only 1.4% across the entire study area. In most circumstances, the trees that died in 1994 had been in a severe state of deterioration since 1992. Complete results of the annual crown conditions in 1993 and 1994 are presented in Table 15.

Table 16 summarizes the yearly trend in crown conditions for the trees on the ten oak health plots. Overall, a continual improvement in crown conditions on the plots was noted. This steady improvement has been evident in the majority of the plots since 1990-1991.

Trace to light levels of defoliation, caused by gypsy moth, were detected on five of the plots; in Clarke and

Table 15. Summary of data collected at ten oak health plots in the Southern Region of Ontario in 1993 and 1994. (Counts are based on an examination of 100 oak trees at each location since 1977.)

Location (Township)	Average height (m)	DBH (cm)	Year	Dieback classes Number of trees ^a						Cumulative number of dead/cut trees ^b
				0	1	2	3	4	5	
<i>Aylmer District</i>										
Bosanquet	16.6	29.0	1993	28	39	5	2	10	0	16
			1994	50	25	2	0	2	5	21
Charlotteville	20.1	32.0	1993	35	52	3	0	2	1	8
			1994	57	33	0	0	1	1	9
South Walsingham	17.0	22.0	1993	62	14	1	0	0	3	23
			1994	62	15	0	0	0	0	23
<i>Kemptville District</i>										
Lavant - Flower Station	13.6	20.6	1993	2	44	21	2	2	4	29
			1994	3	54	8	3	1	2	31
Lavant - Joe Lake	12.5	25.5	1993	0	49	26	4	3	1	18
			1994	1	56	18	4	3	0	18
<i>Maple District</i>										
Clarke	20.6	24.5	1993	66	15	0	1	0	1	18
			1994	62	19	0	1	0	0	18
Uxbridge	21.5	26.2	1993	33	30	3	1	1	0	32
			1994	32	16	2	0	1	0	49
<i>Midhurst District</i>										
Mulmur	21.0	28.8	1993	59	21	3	0	0	1	16
			1994	58	22	2	0	0	1	17
Tiny - Awenda Provincial Park	22.1	28.5	1993	54	10	1	2	0	1	33
			1994	55	10	0	1	1	0	33
Tiny - Farlain Lake	22.0	26.0	1993	43	8	2	0	3	1	44
			1994	42	8	2	1	1	2	46
Total			1993	382	282	65	12	21	12	237
%			1993	49.3	36.4	8.4	1.5	2.7	1.5	23.7
Total			1994	422	258	34	10	10	11	265
%			1994	55.4	33.9	4.5	1.3	1.3	1.4	26.5

^a 0 = 0–5%, 1 = 6–20%, 2 = 21–40%, 3 = 41–60%, 4 = 61–100%, 5 = dead tree.

^b Cumulative total from 1977 (based on the original 100 trees per plot).

Uxbridge townships in the Maple District and in Bosanquet, Charlottenville, and South Walsingham townships in the Aylmer District. The average defoliation level ranged from a low of 1.0% in South Walsingham Township to a high of 14.2% in Bosanquet Township. Stem decay and stem-boring insects were recorded on 0.4 and 0.1% of the trees, respectively. Trace damage levels, caused by the oak twig pruner, were recorded on several trees in the Bosanquet Township plot. Signs of *Armillaria* root rot

(mycelial fans) were detected at the bases of the 11 trees that had died since the 1993 assessment.

Two common stem decays, artist's conk and mossy maple conk, were collected on two separate trees at the Flower Station plot in Lavant Township, Kemptville District. False tinder fungus (*Phellinus igniarius* [L.:Fr.] Quél.) was collected from a single tree at the South Walsingham Township plot in the Aylmer District.

Table 16. Summary of the yearly trend in oak health at ten oak plots in the Southern Region of Ontario from 1984 to 1994. (Counts are based on the examination of 100 oak trees at each location.)

Years	Yearly trend (% of trees)			Number of newly dead or cut trees per year
	Improved	Static	Declined ^a	
1984-1985	25.9	67.4	6.6	1
1985-1986	37.3	56.8	5.6	3
1986-1987	18.9	73.2	7.9	0
1987-1988	10.8	74.2	15.1	0
1988-1989	10.0	58.6	31.4	0
1989-1990	8.8	64.5	26.7	0
1990-1991	23.8	61.0	15.2	1
1991-1992	19.4	59.4	21.3	0
1992-1993	32.0	59.5	8.4	1
1993-1994	14.3	76.9	6.6	17

^a Declined category includes current mortality.

Acid Rain National Early Warning System (ARNEWS)

Eight ARNEWS plots are evaluated annually across the region. These are part of a nationwide program that monitors the possible effects of airborne pollutants on forest trees. The evaluation process also includes all biotic and abiotic conditions.

Sugar maple stands are monitored in Howard Township, Aylmer District; West Wawanosh Township, Cambridge District; Rear of Yonge and Escott Township, Kemptville District; and in Oro Township, Midhurst District. Eastern white pine plantations are monitored in Erin Township, Cambridge District and in Hungerford Township, Tweed District. A white spruce plantation in Gloucester Township, Kemptville District and a mixed red oak and black oak (*Q. velutina* Lam.) stand in South Walsingham Township, Aylmer District are also monitored.

To date, no visible damage caused by airborne pollutants has been recorded on any of the plot trees. Pest damage varies annually and the following is a summary of the most significant pest damage encountered in 1994.

The eastern spruce budworm continued to cause moderate to severe defoliation on 100% of the plot trees in the Gloucester Township plot. Populations are forecasted to recur at the same intensity in 1995, and add to the overall decline of this plot. In the Oro, West Wawanosh, and Howard township plots, the maple trumpet skeletonizer was recorded on 100% of the trees at a trace damage level. The maple webworm was recorded on all of the trees at the Rear of Yonge and Escott Township plot and gipsy moth

was detected at trace incidence levels on several of the trees in the oak plot in South Walsingham Township.

SPECIAL SURVEYS

Pine Shoot Beetle, *Tomicus piniperda* (L.)

In 1994, 42 pine plantations in the Southern Region were examined for the presence of pine shoot beetle (Fig. 16). Positive identification of adult beetles was confirmed from four of these locations.

Examination of several rows of 11-m-tall Scots pine in Mono Township, Midhurst District, in Dufferin County, detected adult beetles in a recently dead standing tree. In Wellington County, adult beetles were collected at two new sites in Puslinch Township, Cambridge District. At the first of these sites, <1% shoot mortality was recorded on 7.3% of the 2.5-m-tall Scots pine trees in a 2-ha plantation. In the second area, 2% of the 1.8-m-tall Scots pine in a 1-ha plantation showed minimal shoot mortality. This insect had been detected in the township in 1993. A positive collection of adult beetles was also made in a 0.2-ha area of scattered 2.5-m-tall Scots pine in South Cayuga Township, Aylmer District, in the Haldimand-Norfolk Regional Municipality.

In 1993, the Animal and Plant Health Directorate, Plant Protection Division, Agriculture Canada, declared the regional municipalities of Haldimand-Norfolk, Niagara, and Hamilton-Wentworth and the counties of Waterloo and Wellington, as being infested with the pine shoot beetle. In 1994 Dufferin, Brant, and Oxford counties were added to this list. Agriculture Canada has placed a restriction on the movement of pine material, with bark still attached, out of these areas.

Forest Tree Nursery Reports

There are three OMNR nurseries in the Southern Region: the St. Williams Forest Tree Nursery in the Aylmer District, the Orono Forest Tree Nursery in the Maple District, and the G. Howard Ferguson Forest Tree Nursery in the Kemptville District. The following is a summary of pest data collected at these locations during the 1994 field season.

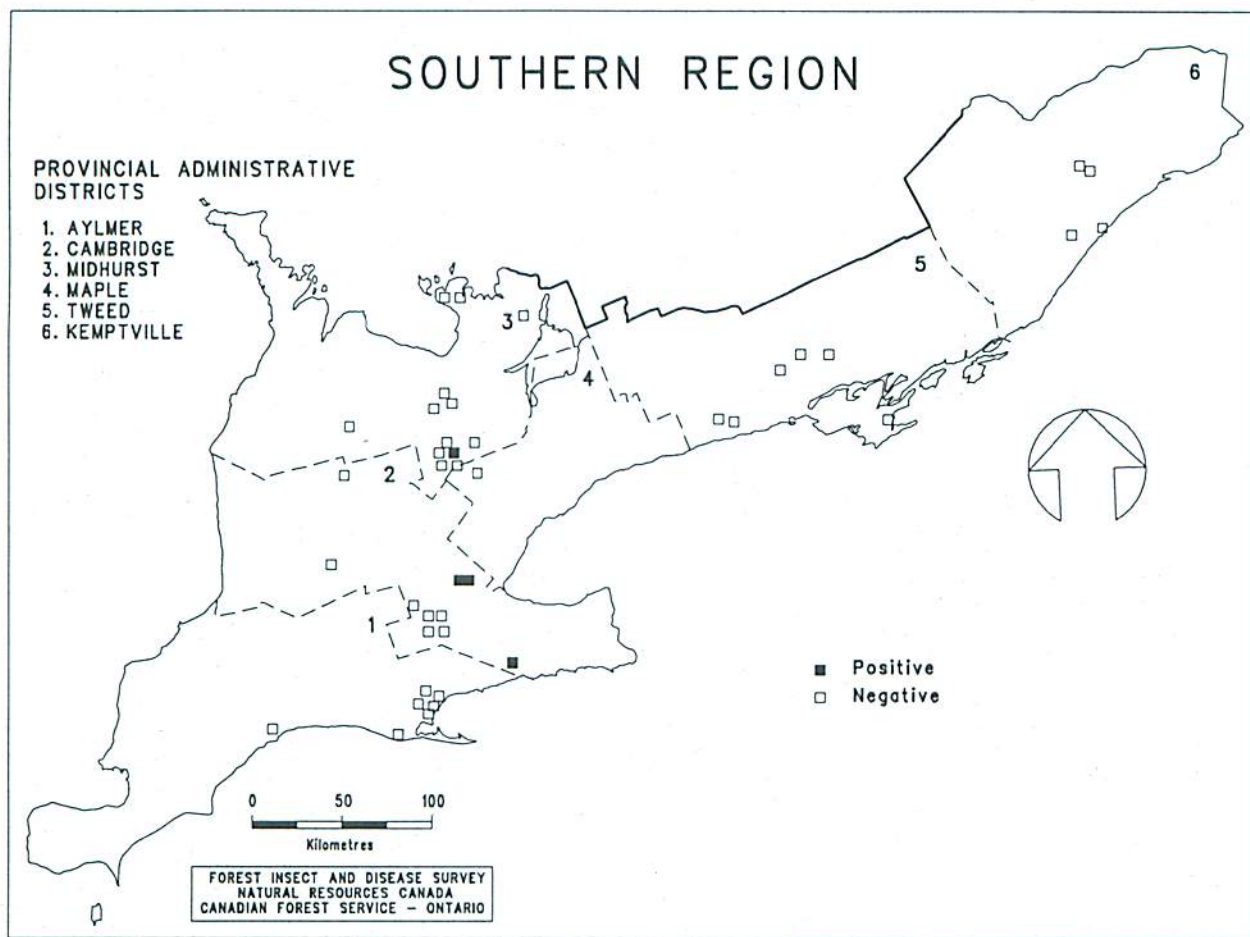


Figure 16. Locations surveyed for the spine shoot beetle, *Tomicus piniperda* (L.), in 1994.

St. Williams Forest Tree Nursery

Five routine inspections were carried out at this nursery in 1994. The worst insect problem encountered was caused by the strawberry root weevil (*Otiorhynchus ovatus* [L.]). As a result of late fall and early spring larval feeding, 3-0 white spruce in Compartment A15 suffered 25% mortality and/or damage. An average of 10% damage was caused by the same pest on 2-0 white spruce in Compartment A11. This insect was collected periodically throughout the summer. Two applications of Sevin and a single application of Orthene were applied during the season in an effort to control weevil populations. A number of oak and maple compartments were infested with a leaf hopper (*Cicadellidae* spp.). This caused a stippling effect on many leaves. More importantly, one flush of young leaves on the oak seedlings was virtually eliminated by the curling and desiccating damage typical of this insect. To control this pest two applications of Ambush, applied at a rate of 25 ml/ha, and a single application of Orthene, applied at a rate of 1.4 kg/ha, were used. Cedar leaf miners caused varying degrees of damage to windbreaks throughout the nursery. Some of these were still green;

others had browning foliage ranging from 10–75%. The larch casebearer caused an average of 10% foliar damage on 15-m-tall European larch windbreak trees.

Heavy infections of a leaf spot (*Tubakia dryina* [Sacc.] B. Sutton) affected all of the oak compartments. Along with abiotic and leaf hopper damage, this made for a poor year for the oak seedlings. Another leaf spot (*Mycosphaerella effigurata* [Schwein.] House) caused an average of 20% foliar damage on 80% of the white ash seedlings in a portion of Compartment B7. Desiccated foliage caused by winter drying was noted on 50% of the 3-0 red pine seedlings in Compartment A17. *Fusarium* root rot, *Fusarium* spp., was isolated from patches of old dead and discolored seedlings on 3-0 white pine in Compartment A12. By late summer, in Compartments C3 and C6, many of the 2-0 white pine had begun to turn chlorotic. Samples collected showed total root mortality in some cases and heavy fruiting by *Fusarium* spp. This pathogen was also isolated from 2-0 eastern white cedar seedlings in Compartments E4, E5, and C8, but at minor incidence levels. In all cases, this root rot was probably present as a secondary fungus following other problems. Juniper blight (*Kabatina thujae* R. Schneid & Arx) was sampled from

four 4-year-old cedar in Compartment F10, and from younger seedlings in Compartments D1, D8, and C8. In all cases, damage was minor. Extensive mortality and root decay to a small patch of 3-0 white pine seedlings in Compartment A12 was detected, but the only pathogen isolated was a secondary one, *Cylindrocarpon* sp. A root rot (*Cylindrocladium scoparium* Morgan), a grey mould (*Botrytis cinerea* Pers.:Fr.), and a seedling blight (*Phoma* sp.) were isolated from cedar and white pine seedlings, but all were considered of secondary importance.

Orono Forest Tree Nursery

Five routine inspections and one unscheduled visit were completed at this nursery during the 1994 season. In early spring, it became evident that some 10,000 eastern white pine seedlings in one of the cold frames had been killed during the winter as a result of mice feeding on the main stems. Severe defoliation (>75%) caused by the larch casebearer occurred on semimature European larch windbreak trees along Compartments S41 and S50. The eastern spruce budworm caused low to moderate levels of defoliation throughout the 7-ha, 12-m-tall white spruce seed orchard. Examination of an egg-mass sample taken from this stand indicates that severe defoliation is likely to occur in 1995.

In late August it was determined that approximately one hundred 2-year-old, grafted and potted eastern white pine stock had been killed in one of the cold frames by the northern pine weevil (*Pissodes nemorensis* Germ. [= *approximatus* Hopk.]). Trace populations of the spruce spider mite (*Oligonychus ununguis* [Jac.]) were detected in two red pine compartments. These were treated with a single application of the insecticide Orthene. Moderate to severe defoliation occurred on highbush cranberry (*Viburnum trilobum* Marsh.) in Compartment S34. This was caused by the cranberry leaf beetle (*Pyrrhalta viburni* [Paykull]). Low population levels of the woolly alder aphid (*Prociphilus tessellatus* [Fitch]) were detected on 10% of the European alder (*Alnus incana* [L.] Moench) in Compartment S50.

Approximately 60% of the crowns of three 13-m-tall butternut trees growing along the edge of the hardwood stand north of Compartment T74 were killed by butternut canker disease (*Sirococcus clavigigenti-juglandacearum* V.M.G. Nair, Kostichka & Kuntz). The anthracnose leaf disease, *Apiognomonia errabunda* (Roberge) Höhn., was detected on 80% of the foliage on 5% of the 1.5-m white ash trees and on 90% of the foliage on three 1.0-m red oak trees in Compartment S42. Approximately 30% of the 2.0-m-tall hybrid poplar trees in Compartment T22 sustained an average of 5% foliar damage due to another leaf

disease (*Marssonina tremuloides* [Lib.] Kleb.). Balsam poplar windbreaks growing along the main road into the white spruce seed orchard sustained an average of 75% foliar damage. This was caused by the leaf blight *Linospora tetraspora* G.E. Thomps. Dipodia tip blight caused 2% foliar damage to a single tree in the Christmas Tree Growers Associations' clonal Scots pine orchard. A special survey was conducted in the red pine seed orchard, in an adjacent red pine plantation, and in all of the pine compartments for any evidence of Scleroderris canker (*Gremmeniella abietina* [Lagerb.] Morelet). However, no damage was detected.

G. Howard Ferguson Forest Tree Nursery

During 1994, five inspections were completed at the G. Howard Ferguson Forest Tree Nursery. Damage caused by the eastern spruce budworm increased in the forested areas on the nursery tract. For the second consecutive year, moderate to severe defoliation was delineated in 2 ha of 17-m-tall white spruce in Compartments 72 and 73. This infestation has expanded to now include a total of 15 ha. An egg-mass sample, used to forecast possible defoliation levels for 1995, indicated that severe damage is likely to recur in 1995.

Throughout the nursery, cedar leafminer populations caused light to moderate foliar damage (5–25%) to eastern white cedar windbreaks. Fall webworm caused 10% defoliation on sporadic, 6-m-tall white birch and shagbark hickory (*Carya ovata* [Mill.] K. Koch). Norway spruce and white spruce windbreaks, 15 m in height, sustained 80% damage to old foliage due to feeding by the spruce spider mite. The 7-m-tall eastern white pine in Tree Improvement Area No. 4 were once again infested with several pests. For the second consecutive year, the introduced pine sawfly was found at trace levels and the white pine needle midge, *Resseliella pinifoliae* (Felt), caused an average of 15% defoliation on 40% of the trees. The eye-spotted bud moth (*Spilonota ocellana* [D. & S.]) webbed needles together in the shoot tips of 1% of the seedlings in Compartment 9.

Evaluation disclosed that 1.3% of the 3.4-m blue spruce windbreak trees had single branch infections caused by Cytospora canker (*Leucostoma kunzei* [Fr.:Fr.] Munk). One windbreak tree suffered 80% defoliation due to infections by needle blight (*Rhizosphaera kalkhoffii* Bubák). An anthracnose disease, *A. errabunda* (Roberge) Höhn, was responsible for <5% foliar damage on red oak seedlings in Compartment 36 and 25% defoliation to 20% of the bur oak (*Quercus macrocarpa* Michx.) seedlings in Compartment 9. For the second consecutive year, Downy mildew (*Plasmopara viburni* Peck) caused 100% foliar damage and premature leaf drop to all of the highbush cranberry seedlings in Compartment 2.

Climatic Data

The FIDS Unit maintains daily and monthly averages of weather conditions for numerous locations throughout the province. This is done because seasonal variations and sudden and extreme changes in normal weather patterns have a direct effect on the occurrence of both biotic and abiotic conditions. The data is also compiled to permit

accurate prediction of the emergence of overwintering larvae of some of the major forest pests. Table 17 summarizes the weather data for 1994 provided by Atmospheric Environment Service weather offices in the Southern Region of Ontario. The "normals" quoted were taken directly from the Canadian Climate Normals for Ontario from 1951 to 1980.

Table 17. A summary of temperatures and precipitation in 1994 at seven locations in the Southern Region of Ontario, and deviations from the 30-year norm.

Location	Month	Mean temperature (C°)		Deviation from normal (C°)	Total precipitation (mm)		Deviation from normal (mm)
		Normal	Actual		Normal	Actual	
Peterborough Airport	January	-9.3	-15.9	-6.6	44.1	42.8	-2.9
	February	-8.5	-11.7	-3.2	48.9	24.2	-50.5
	March	-2.5	-2.2	+0.3	62.9	50.2	-20.2
	April	6.0	6.1	+0.1	71.8	103.2	+17.5
	May	12.1	11.0	-1.1	57.1	105.2	+84.2
	June	16.8	18.0	+1.2	60.4	17.6	-70.9
	July	19.2	19.8	+0.6	77.9	87.8	+12.7
	August	18.1	17.1	-1.1	74.2	45.8	-60.2
	September	14.0	13.9	-0.1	72.9	55.4	+5.7
	October	7.9	7.5	-0.4	59.9	23.2	-60.1
	November	2.1	3.5	+1.4	69.4	83.8	+20.7
	December	-6.0	-2.8	+3.1	74.3	52.0	-30.0
Lester B. Pearson International Airport	January	-6.7	-12.4	-6.1	50.4	61.0	+23.0
	February	-6.1	-8.2	-2.0	46.0	20.2	-56.0
	March	-1.0	-0.9	+0.1	61.1	49.2	-19.4
	April	6.2	7.2	+1.2	70.0	96.0	+37.0
	May	12.3	11.8	-0.5	66.0	78.8	+19.4
	June	17.7	19.1	+1.4	67.1	54.4	-18.9
	July	20.6	21.5	+1.1	71.4	83.0	+16.2
	August	19.7	18.7	-1.0	76.8	59.8	-22.1
	September	15.5	15.9	+2.3	63.5	51.4	-19.1
	October	9.3	9.9	+0.6	61.8	27.4	-55.6
	November	3.3	5.4	+2.1	62.7	84.9	+35.4
	December	-3.5	-0.2	+3.3	64.7	51.4	-20.5
London	January	-6.6	-11.4	-4.8	75.2	84.5	+12.4
	February	-6.1	-8.7	-2.6	60.5	36.3	-40.0
	March	-0.9	-1.3	-0.4	75.1	60.4	-19.6
	April	6.4	7.2	+0.8	81.2	86.1	+6.0
	May	12.4	10.9	+1.5	66.9	105.4	+57.5
	June	17.9	18.6	+0.7	73.6	120.8	+64.1
	July	20.3	20.6	+0.3	72.4	90.6	+25.1
	August	19.5	18.1	-1.4	80.3	70.2	-12.6
	September	15.4	13.2	-2.2	78.6	135.8	+72.8
	October	9.4	10.1	+0.7	73.4	48.6	-33.8
	November	3.1	5.3	+2.2	84.7	73.2	-13.6
	December	-3.5	-0.2	+3.3	87.5	59.7	-31.8

(cont'd)

Table 17. A summary of temperatures and precipitation in 1994 at seven locations in the Southern Region of Ontario, and deviations from the 30-year norm. (concl.)

Location	Month	Mean temperature (C°)		Deviation from normal (C°)	Total precipitation (mm)		Deviation from normal (mm)
		Normal	Actual		Normal	Actual	
Delhi	January	-6.0	-10.5	-4.5	68.8	86.4	+25.6
	February	-5.4	-7.9	-2.5	56.8	46.4	-18.3
	March	-0.3	-0.8	-0.5	84.4	74.4	-11.8
	April	6.7	7.6	+0.9	93.6	91.5	-5.5
	May	12.8	11.6	-1.2	73.7	84.1	+14.1
	June	17.0	19.5	+2.5	75.0	121.0	+61.3
	July	20.7	21.4	+0.7	76.6	172.2	+124.8
	August	19.8	19.1	-0.7	96.3	89.1	-7.5
	September	15.9	16.1	+0.2	88.4	57.9	-34.5
	October	9.9	10.1	+0.2	90.3	59.2	-34.4
	November	3.7	6.1	+2.4	101.4	93.0	-8.3
	December	-2.9	-0.1	+2.8	116.2	77.7	-33.1
Blyth	January	-7.9	-13.4	-5.6	105.8	212.5	+100.9
	February	-8.2	-10.6	-2.4	67.2	43.5	-35.3
	March	-2.8	-3.0	-0.2	62.7	61.0	-2.7
	April	5.1	6.5	+1.4	71.9	96.0	+33.5
	May	11.8	10.8	-1.0	73.7	102.0	+38.4
	June	17.0	18.2	+1.2	75.0	76.5	+2.0
	July	19.7	20.6	+0.9	76.6	99.0	+29.2
	August	18.8	17.1	-1.7	96.3	86.5	-10.2
	September	15.1	15.4	+0.3	88.4	101.0	+14.3
	October	8.7	10.7	+0.3	90.3	55.0	-39.1
	November	2.5	4.6	+2.1	101.4	100.1	-1.3
	December	-4.3	-0.5	+3.8	116.2	67.5	-58.1
Ottawa International Airport	January	-7.6	-18.0	-10.4	61.0	67.6	+10.8
	February	-9.5	-11.8	-2.3	60.3	55.8	-7.5
	March	-3.0	-2.6	+0.4	67.5	62.6	-7.2
	April	5.6	5.5	-0.1	69.1	84.9	+22.9
	May	12.8	12.2	-0.6	67.5	71.4	+5.7
	June	18.0	19.2	+1.2	73.4	165.4	+125.3
	July	20.6	21.4	+0.8	85.9	114.6	+33.4
	August	19.2	18.2	-1.0	88.4	120.4	+36.2
	September	14.3	14.8	+0.5	79.3	56.0	-29.4
	October	8.1	9.1	+1.0	68.1	15.4	-77.4
	November	1.2	3.6	+2.4	86.1	88.1	+2.3
	December	-7.7	-4.5	+3.2	82.9	37.0	-55.4
Trenton	January	-7.6	-14.2	-6.8	68.9	67.8	-1.6
	February	-6.5	-9.8	-3.3	57.0	29.5	-48.2
	March	-1.0	-1.3	-0.3	72.0	57.0	-20.8
	April	6.4	6.3	-0.1	76.1	91.5	+20.2
	May	12.5	11.4	-1.1	73.0	84.8	+16.2
	June	17.8	18.5	+0.8	63.7	78.1	+22.6
	July	20.6	21.0	+0.4	60.9	48.0	-21.2
	August	19.7	18.0	-1.7	71.9	81.2	+12.9
	September	15.3	15.6	+0.3	72.8	49.2	-32.4
	October	9.2	9.2	0.0	70.1	31.8	-54.6
	November	3.2	4.7	+1.5	86.1	111.0	+28.9
	December	-4.5	-1.7	+2.7	82.9	58.6	-29.3