

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

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SURVEY HIGHLIGHTS

This report describes the most significant biotic and abiotic conditions that were detected and evaluated in 1993 during extensive aerial and ground surveys conducted in the Ontario Ministry of Natural Resources' (OMNR) Southern Region of Ontario.

The total area of moderate-to-severe defoliation caused by the gypsy moth continued to decline across the region. In 1993 3,139 ha were infested, compared with 13,350 ha last year. The majority of damage, some 1,263 ha, occurred in the Aylmer District. The largest area of current decline occurred in the Tweed District. The total area defoliated by the forest tent caterpillar increased slightly across the eastern portion of the region, encompassing 36,886 ha this year, compared with 35,520 ha in 1992. The eastern spruce budworm caused severe defoliation in several white spruce plantations and there was a complete collapse of the pocket of jack pine budworm that occurred in the Tweed District last season.

The pine false webworm caused severe defoliation to semimature red pine and eastern white pine across 287 ha in the Midhurst District and 73 ha in the Tweed District. This introduced pest was first reported in Ontario in 1961; however, this is the first time that severe defoliation has been recorded on this age class of trees. During 1993 the pine shoot beetle, an introduced pest of major concern to Christmas tree growers, was also collected in Ontario for the first time. It was identified during a special survey at three separate locations in the Cambridge District.

The hemlock looper caused severe defoliation across 70 ha in the Kemptville District, virtually consuming all foliage on infested mature hemlock trees. The larch casebearer was widespread and caused high levels of defoliation across the region. Population levels of various types of pine sawflies remained high at numerous locations. As well, the birch skeletonizer was widespread throughout the eastern half of the region. Low-to-moderate numbers of cedar leafminers were commonly detected throughout the entire region.

Diplodia tip blight caused branch and whole tree mortality in Scots pine and red pine plantings at several locations throughout the central portion of the region. Hardwood leaf diseases were very common across the entire region and foliar damage levels often exceeded 75%. Dutch elm disease was frequently encountered on roadside and fence row trees and armillaria root rot was detected in several pockets of dead and dying pine and in areas of hardwood decline in the Tweed District. Butternut canker was confirmed at seven new locations within the region; however, a survey of 26 pine plantations for evidence of the European race of Scleroderris canker produced negative results.

In the central portion of the Tweed District the total area of hardwood decline, including branch and whole-tree mortality, increased in 1993 to 5,607 ha from 3,880 ha last year. Drought damage was evident in the Kingston area of the Tweed District and frost damage was recorded, primarily on white ash, from the Owen Sound area of the Midhurst District southeastward to the Rice Lake area of the Maple District.

Annual evaluation of the fifty-five 25-tree sugar maple health plots revealed that the majority of the trees were very healthy, with 84% of the trees sustaining <20% dieback. Similar results were recorded in the 16 sugar maple plots that are part of the international North American Maple Project (NAMP). Approximately 98% of the 761 trees evaluated in this project exhibited <25% crown dieback. A noticeable recovery was evident throughout the ten 100-tree oak plots in the region, with 32% of the trees actually showing crown improvement over last season. No evidence of acid rain damage was recorded on the four targeted tree species on the eight Acid Rain National Early Warning System (ARNEWS) plots that are annually evaluated in the region. Results of routine surveys conducted in the three OMNR Forest Tree Nurseries in the region are also presented in this report.

(cont'd)

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 this year.

The authors would like to express their appreciation to personnel of the various OMNR district and area offices and tree nurseries, the Natural Resource Officer at Canadian Forces Base Borden, and to various private individuals for their excellent cooperation during the 1993 field season.

*R.J. Sajan
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FRONTISPIECE



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



Damage to the current growth on Scots pine (*Pinus sylvestris* L.) caused by the pine shoot beetle (*Tomicus piniperda* [L.]).



Typical damage to white elm (*Ulmus americana* L.) caused by Dutch elm disease (*Ophiostoma ulmi* [Buisman] Nannf.).



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

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INSECTS

Major Insects

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

This introduced pest was first detected in the Simcoe area of southern Ontario in 1961. Historically, it has been considered to feed primarily on the old foliage of immature pine, generally <6 m in height. During 1993 however, for the first time in the province, approximately 400 ha of semimature red pine (*Pinus resinosa* Ait.) and eastern white pine (*P. strobus* L.) were severely defoliated at two locations in the Southern Region.

Scattered across some 16 separate plantations in the northeast corner of Oro Township, Midhurst District, a total of 287 ha (247 ha of red pine and 40 ha of eastern white pine) sustained moderate-to-severe levels of defoliation (Fig. 1). The infested stands varied in size from 6 to 59 ha and were 45 to 55 years old. The heaviest damage occurred in a 59-ha, 20-m red pine plantation northeast of the Edgar Adult Education Centre. A standard 150-tree evaluation completed in the 55-year-old red pine plantation revealed that the webworm larvae had consumed an average of 81% of the old foliage and 54%

of the current foliage per tree. The survey also detected a 1.3% current whole tree mortality rate that was heavily infested with the pine engraver beetle (*Ips pini* [Say]). Additional evaluations and ground surveys conducted in other areas of the infestation revealed lower levels of defoliation, with damage to old foliage ranging from 32 to 75% and damage to current foliage ranging from 1 to 30%. In all cases some level of damage was detected on the current foliage throughout the infested area.

The second area of infestation on this older age class of pine was detected in the Ganaraska County Forest, west of Rice Lake, in Hope Township, Tweed District. One of the currently infested stands in this area may have been severely defoliated in 1992; however, neither the damage nor the pest was confirmed until this season. A total of 73.2 ha were aerially sketch mapped across four sites. The largest pocket of damage, covering 59 ha, was located north of the hamlet of Elizabethville. It encompassed the northern portion of a 30-year-old red pine plantation and extended west across a fire guard road into a 20-year-old red pine plantation. The heaviest damage occurred on the 30-year-old trees, where ground surveys estimated old foliar damage levels of 80% and current foliage damage rates of 30% per tree. In the

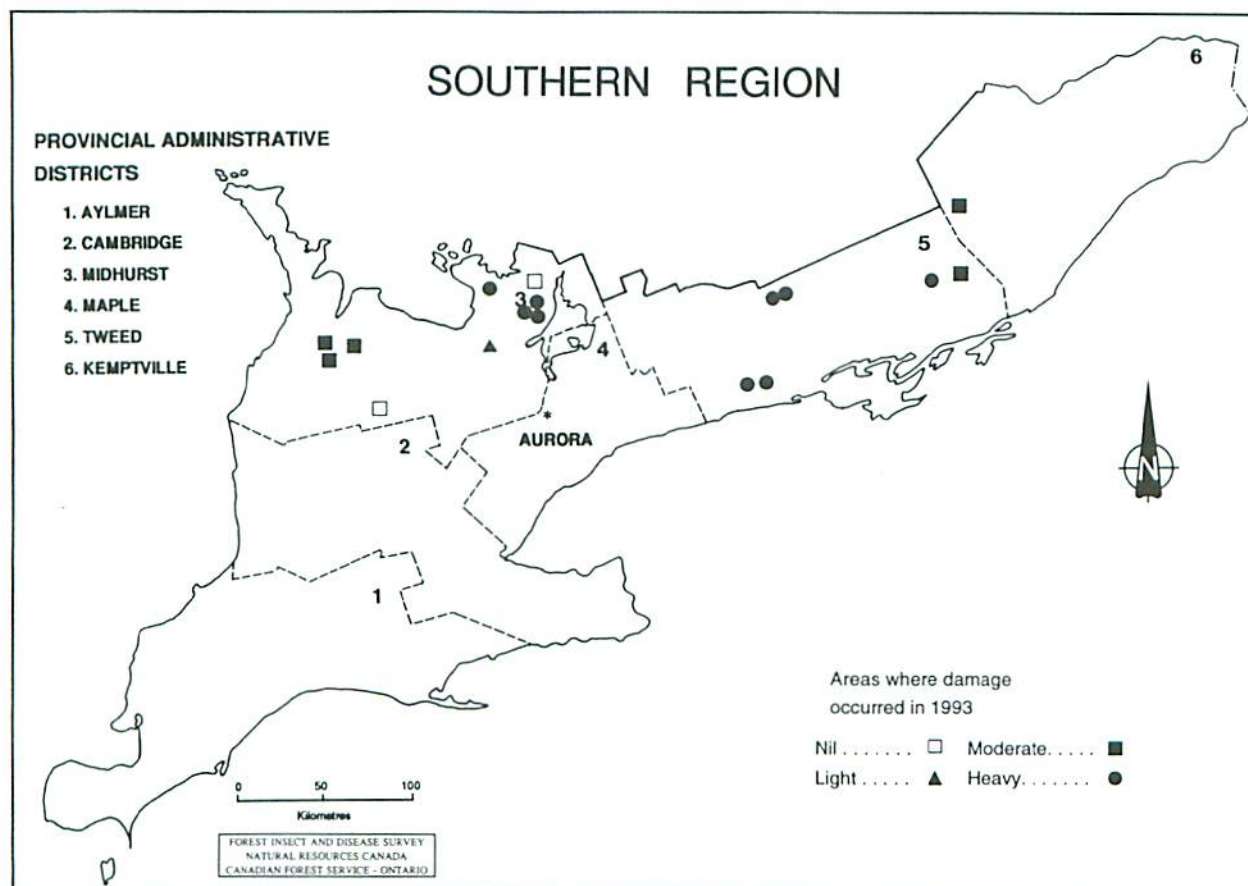


Figure 1. Pine false webworm, *Acantholyda erythrocephala* (L.).

20-year-old plantation damage, averaging 30 to 40%, was confined exclusively to the older foliage. No current, whole-tree mortality was detected in this area. The remainder of the damage occurred 4 km to the east and consisted of three smaller areas, ranging in size from 1.7 to 6.7 ha and from 20 to 45 years of age.

An additional area of damage was aerially detected north of the town of Havelock, on the Belmont and Dummer township line in the Tweed District. Two pockets of moderate-to-severe defoliation, 10 and 25 ha in size, were detected in 20- to 25-year-old red pine. Ground surveys were not conducted in these two plantations; however, OMNR personnel from the Tweed District Office confirmed that the 15-m trees in the Belmont Township plantation had sustained high levels of defoliation caused by this webworm.

Trace damage levels were detected on several 40-year-old trees along the edge of Stand Number 77, south of the main north gate at Canadian Forces Base Borden, in Tosorontio Township, Midhurst District.

High incidence rates of pine false webworm were also detected in immature stands at several locations across the region. Incidence levels of 100% were recorded in plantations of 5.5-m red pine and 2.4-m eastern white pine in Sullivan Township, Midhurst District; however, the defoliation levels averaged only 10 and 30%, respectively. Also in this district, in Tiny

Township, a Christmas tree plantation of 1.7-m Scots pine (*P. sylvestris* L.) sustained a similar incidence rate and averaged 40% foliar damage. In Hinchinbrooke Township, Tweed District, 85% of the 2.9-m red pine in a 2-ha plantation sustained an average of 80% defoliation. The complete results of 14 locations surveyed are presented in Table 1.

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

Populations of arborvitae leafminers varied considerably across the region in 1993. The most severe damage was encountered in Cambridge Township, Kemptville District, where 75% defoliation occurred throughout a 5-ha area of eastern white cedar (*Thuja occidentalis* L.). Moderate foliar damage was noted at several locations in the Tweed District. Foliar damage, averaging 40 – 50%, was recorded in a 20-ha area of Loughborough Township and 45% foliar damage occurred in a 5-ha area in Seymour Township. In Bathurst Township, Kemptville District, foliar browning was recorded at the 25 – 40% level. Similar damage levels were recorded in the western portion of the region. The heaviest foliar damage was recorded at 50 and 40% in natural stands along creek banks in Wilmot and Yarmouth townships in the Cambridge and Aylmer districts, respectively. Foliar damage averaged 30% in a 3-ha area in Colborne Township,

Table 1. Summary of damage caused by the pine false webworm in 14 pine plantations in the Southern Region of Ontario in 1993. (Counts are based on the 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)	Trees infested (%)	Average defoliation (%)
<i>Kemptville District</i>						
Dalhousie	rP	5.0	2,900	5	79	48
<i>Midhurst District</i>						
Egermont	wP	5.0	2,400	10	0	0
Holland	wP	1.7	2,200	5	95	60
Medonte	wP	2.3	800	20	0	0
Oro	rP	23.0	1,250	40	100	81
Oro	rP	14.0	750	3	100	32
Sullivan	wP	2.4	2,100	7	100	30
Sullivan	rP	5.5	1,000	7	100	10
Tiny	scP	1.7	3,000	5	100	40
<i>Tweed District</i>						
Belmont	rP	15.0	2,500	25	100	75
Bedford	rP	2.1	2,200	5	86	37
Hinchinbrooke	rP	2.9	2,700	2	85	80
Hope	rP	12.0	1,200	40	100	80
Hope	rP	8.0	2,000	20	100	30

^a rP = red pine, scP = Scots pine, wP = white pine.

Cambridge District and eastern white cedar growing in Pinafore Park in the city of St. Thomas, Aylmer District, sustained 50% defoliation.

Light defoliation (5–20%) was recorded in wind-breaks at the provincial tree nurseries in St. Williams, Charlotteville Township, Aylmer District and in Kemptville, Oxford-on-Rideau Township, Kemptville District. This level of defoliation was commonly encountered throughout the eastern portion of the region.

Trace populations were recorded on shelterbelt trees at the Orono Forest Station, Maple District; Glencairn Seed Orchard, Tosorontio Township, Midhurst District; and on roadside cedar in Eldon Township, Tweed District.

Birch Skeletonizer, *Bucculatrix canadensisella* Cham.

High populations of this late-season defoliator of white birch (*Betula papyrifera* Marsh.) and grey birch (*B. populifolia* Marsh.) caused moderate-to-severe foliar browning for the second consecutive year in the eastern portion of the region. Scattered pockets of defoliation, totaling some 1,876,500 ha (Fig. 2), were delineated through numerous ground and aerial checks across the

eastern portion of the Tweed District and most of the Kemptville District. White birch stands, ranging in area from small clumps to 25 ha, sustained moderate-to-severe defoliation. Damage extended from the Rice Lake area in Asphodel and Manvers townships, Tweed District, eastward to the central portion of Kemptville District. This infestation is part of a much larger one which extends northward into the Bancroft District of the Central Region. Foliar damage was considered to be at slightly reduced levels compared with those reported in 1992.

Foliar browning, ranging from 10 to 80%, was recorded throughout most of the stands infested; however, damage was quite variable. One tree may have sustained 75% defoliation while adjacent trees showed only 10–20% foliar damage. In the northeastern portion and southern section of the Kemptville District, especially along the St. Lawrence River, grey birch was more severely infested. Here foliar damage levels of 80% were commonly detected.

Elsewhere, trace-to-light damage was evident on scattered individual trees or small clumps, extending westward from the area described above to the eastern portion of the Midhurst and Maple districts.

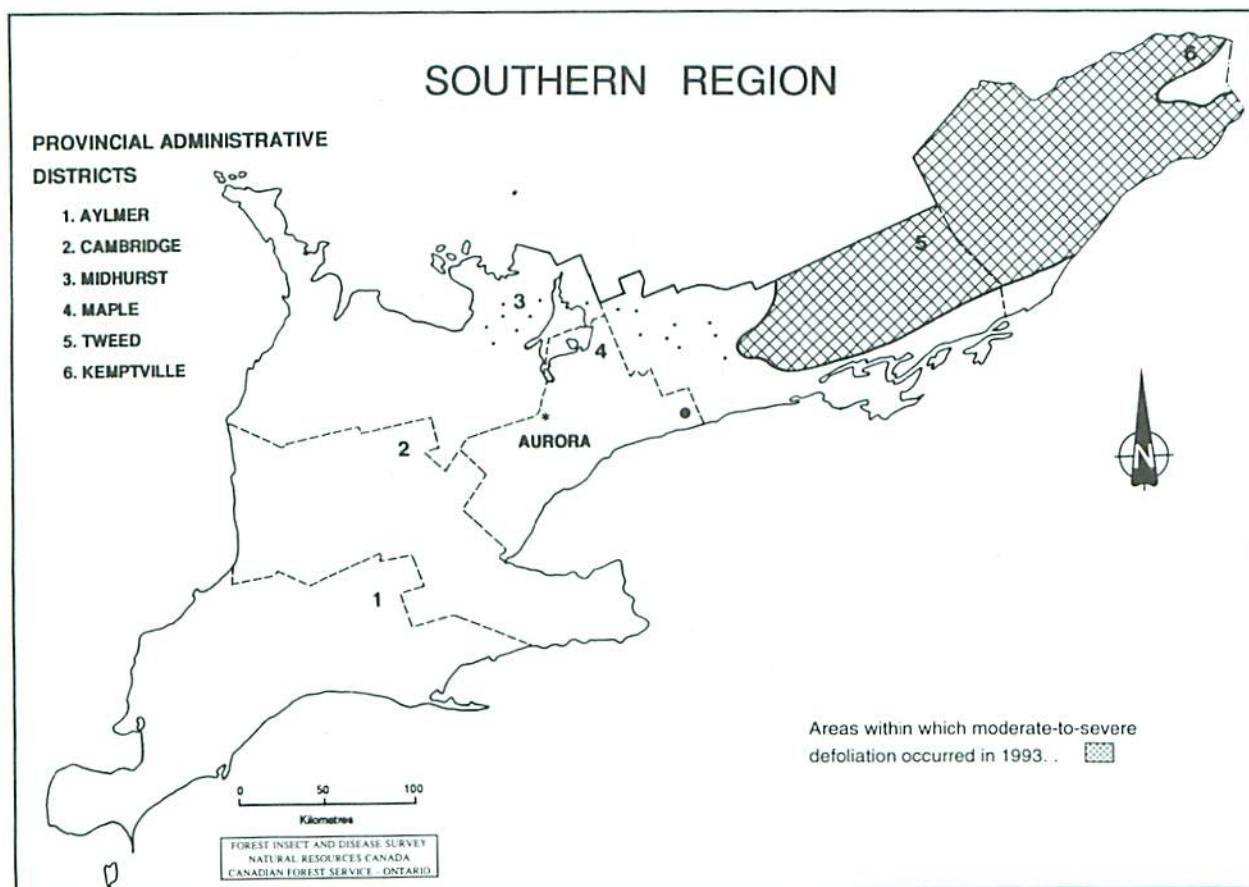


Figure 2. Birch skeletonizer, *Bucculatrix canadensisella* (Cham.).

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

This early defoliator of trembling aspen (*Populus tremuloides* Michx.) was observed causing moderate-to-severe defoliation in three separate areas this year, two in Midhurst District and one in Kemptville District.

Four separate pockets of foliar damage were recorded in and around the City of Ottawa in Gloucester Township, Kemptville District. Defoliation levels of 50–75%, totaling 15 ha, occurred along the Airport Parkway in Ottawa. The largest area of defoliation was east of Highway 31, along Davidson Road, where 150 ha of 18-m trembling aspen sustained 75–100% foliar damage. A 15-ha pocket in close proximity to this area sustained similar damage levels on the same host, as did a 100-ha area to the southwest of these two sites.

The largest pocket of defoliation in the Midhurst District occurred east of the hamlet of Baxter, in Essa Township, where trembling aspen in a 10-ha area averaged 80% defoliation. Balsam poplar (*Populus balsamifera* L.) sustained light damage levels of 10–20%. Two concessions north, 5 ha of trembling aspen averaged

60% defoliation. In the northern portion of Tiny Township two small pockets, each 2 ha in size, averaged 85% foliar damage on the same host species.

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

Provincial Situation

The total area within which moderate-to-severe defoliation of spruce–fir occurred declined to approximately 8,991,177 ha in 1993; down 604,585 ha from the 9,595,762 ha reported in 1992. This is the first decline in the overall area infested in the past 5 years. The largest area of decline, some 440,400 ha, occurred in the Hearst and Wawa districts in the Northeast Region. Declines totaling some 178,000 ha were also recorded in the Red Lake, Kenora, Fort Frances, and Thunder Bay districts in the Northwest Region. However, increases in the total area infested were recorded in other districts within these two regions as well as in the Central and Southern regions (Fig. 3).

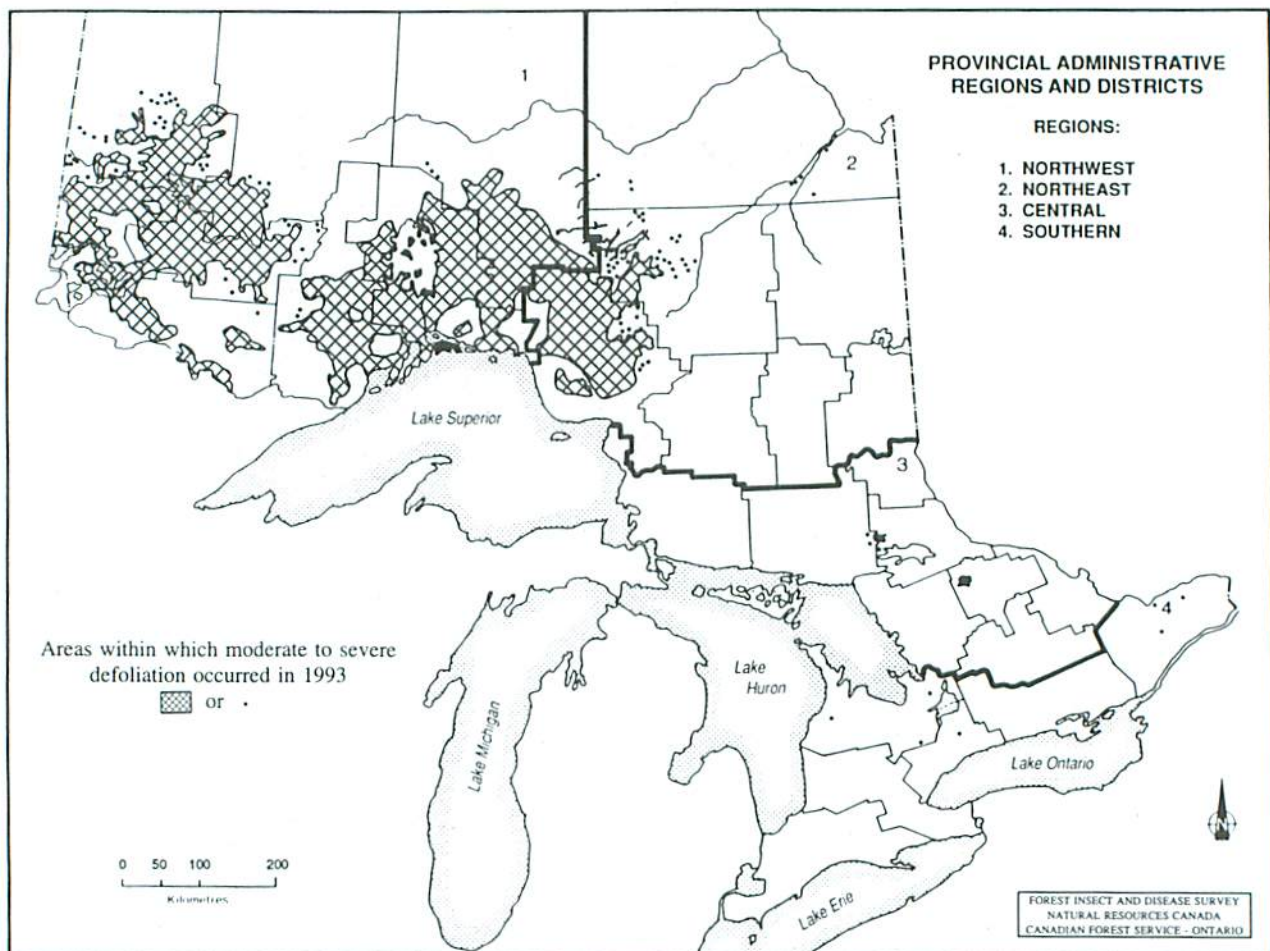


Figure 3. Eastern spruce budworm, *Choristoneura fumiferana* (Clem.).

The Ontario Ministry of Natural Resources in Nipigon District, Northwest Region, aerially sprayed four white spruce (*Picea glauca* [Moench] Voss) plantations totaling 291 ha. The treatment consisted of a single application of the biological insecticide *Bacillus thuringiensis* (B.t.) Foray 48B at 30 BIU/ha (neat) applied by rotary winged aircraft.

Southern Region

For a third consecutive year severe defoliation (>75%) occurred in a 7-ha, 12-m-tall white spruce plantation and in a 5-ha, 10-m white spruce seed production area in the south end of Adjala Township. For the second consecutive year heavy foliage damage was recorded in a 5-ha, 12-m white spruce plantation in Oro Township, Midhurst District. Similar defoliation levels were detected scattered across several spruce compartments, encompassing some 80 ha, in the La Rose Forest, Clarence Township, Kemptville District (Fig. 4).

Moderate-to-severe defoliation (>25%) was encountered for the fourth consecutive year in a 2-ha, 15-m-tall white spruce plantation in Uxbridge Township, Maple District. This level of damage was also recorded in a 2-ha, 15-m white spruce plantation at the

G. Howard Ferguson Forest Tree Nursery in Oxford-on-Rideau Township and in a 5-ha, 16-m white spruce plantation in Gloucester Township, Kemptville District. Similar levels of damage were detected this season in an 80-ha mixed plantation of 12-m white spruce, eastern white pine, and European Larch (*Larix decidua* Mill.) in Brant Township, Midhurst District. Light defoliation (<25%) was recorded in a 5-ha, 14-m-tall white spruce plantation in the Smaele Tract, Minto Township, Cambridge District.

Sixteen areas were sampled in the region for the purpose of forecasting possible defoliation levels for 1994. The data collected from ten of these locations predict moderate-to-severe defoliation for next season. All of these are in white spruce plantations that were heavily defoliated this season. A complete list of areas sampled, together with forecasts for 1994, is presented in Table 2.

Three spruce budworm multipher pheromone traps, baited with Biolure, were deployed at each of five separate locations across the region. In the Aylmer District the traps were set in a white spruce stand at the OMNR Tree Nursery at St. Williams. These averaged 275 male moths per trap; an increase of 50 moths per trap from 1992. In the Cambridge District the traps were deployed for the

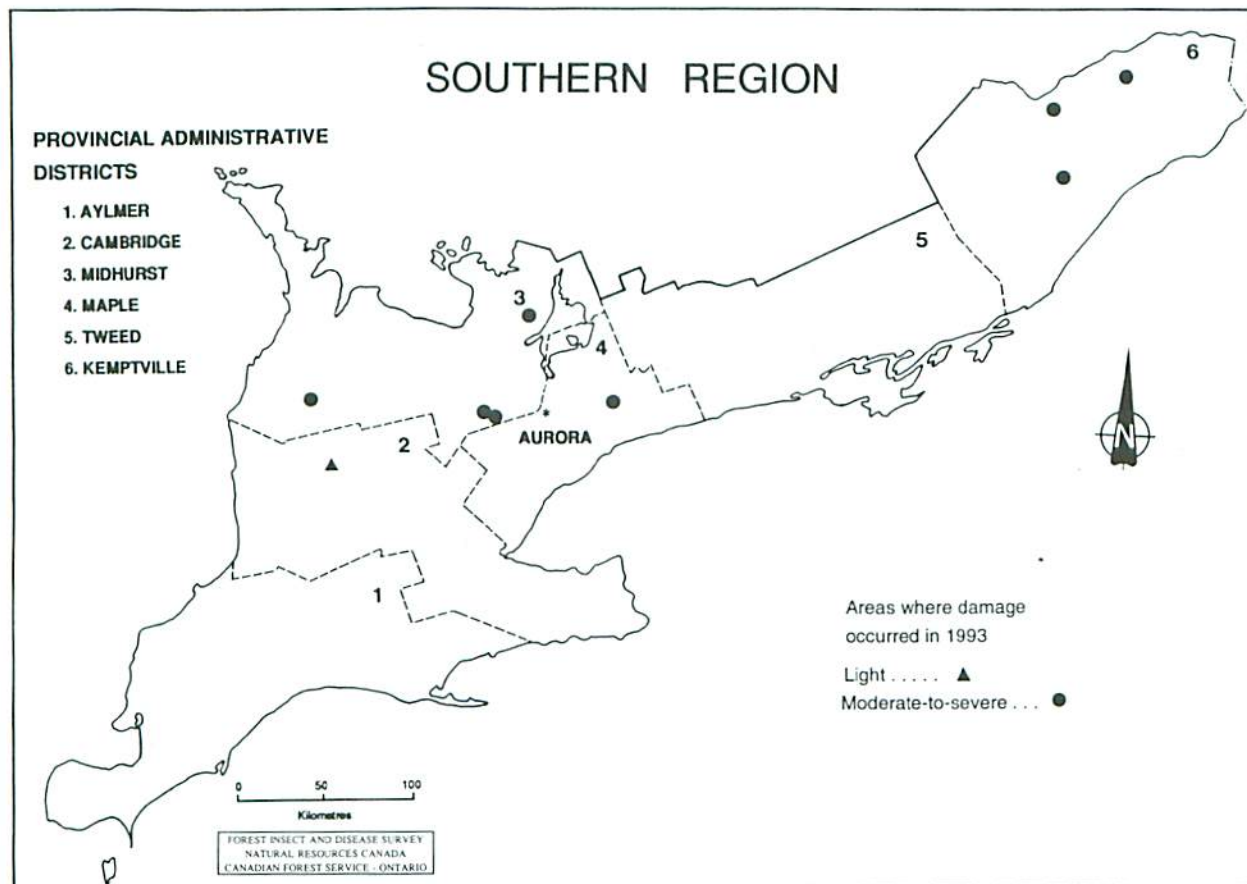


Figure 4. Eastern spruce budworm, *Choristoneura fumiferana* (Clem.).

Table 2. Summary of eastern spruce budworm defoliation estimates and egg-mass counts in the Southern Region of Ontario in 1993 and infestation forecasts for 1994.

Location (Township)	Host ^a	Estimated % defoliation 1993	Number of egg-masses per 9.29 m ² of foliage	Infestation forecasts for 1994 ^b	Accumulated damage ^c
<i>Aylmer District</i>					
Charlotteville (Turkey Point)	wS	1	0	N	0
South Walsingham (OMNR Tree Nursery)	wS	1	0	N	0
<i>Cambridge District</i>					
Minto	wS	22	619	S	0
<i>Kemptville District</i>					
Clarence (La Rose Forest)	wS	93	1034	S	1
Gloucester	wS	28	660	S	1
Lavant (Robertson Lake)	bF	2	8	L	0
Oxford	wS	75	778	S	1
<i>Maple District</i>					
Clarke (Orono Seed Orchard)	wS	3	102	M-S	2
Uxbridge	wS	44	235	M-S	2
<i>Midhurst District</i>					
Adjala (Seed Production Area)	wS	58	305	S	3
Brant - area 1	wS	59	177	M-S	2
Brant - area 2	wS	40	91	M-S	2
Lindsay	wS	0	0	N	0
Oro	wS	89	1083	S	3
St. Edmunds	wS	0	0	N	0
<i>Tweed District</i>					
Bexley (Balsam Lake Provincial Park)	wS	0	36	L-M	0

^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.

first time in a white spruce plantation in Minto Township. Only two of the three traps were recovered; with an average of 500 moths per trap. In the Midhurst District the traps were set at two locations along the Bruce Peninsula. The first site was in a white spruce plantation in Lindsay Township. This area averaged 27 male moths per trap; an increase of 11 moths per trap from 1992. The second location, a spruce-fir stand in St. Edmunds Township, averaged 114 moths per trap; an increase of 68 moths per trap this season. The fifth location was in a spruce-fir stand in Lavant Township, Kemptville District. It averaged 40 moths per trap; a decline of 55 moths per trap from last season.

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

Aerial surveys in 1992 disclosed an infestation of 533 ha of 6.5-m-tall, open-growing jack pine (*Pinus banksiana* Lamb.) along rocky ridges in Sheffield Township, Tweed District. However, populations collapsed and no evidence of defoliation was detected anywhere in the region in 1993.

Larch Casebearer, *Coleophora laricella* (Hbn.)

Aerial and ground surveys disclosed that foliar damage by this early season pest was widespread in the Maple, Midhurst, Cambridge, and Aylmer districts, but

not as prevalent as last year in the Kemptville and Tweed districts. Moderate-to-severe defoliation occurred throughout the region on tamarack (*Larix laricina* [Du Roi] K. Koch) stands ranging in size from 0.4 to 81 ha. The largest area affected was an 81-ha bog near Nicholas Creek in Marlborough Township, Kemptville District. Here 100% of the 17-m trees sustained 80–100% foliar damage. Smaller pockets with similar damage levels were observed at other locations in the central portion of Kemptville District.

At the Orono Forest Station in Maple District, a 20-m-tall windbreak sustained 95% foliar damage. In Uxbridge Township, Maple District, a 2.5-ha plantation of 12-m eastern white pine and tamarack sustained an average of 75% defoliation. A 5-ha, 17-m tamarack plantation in Clarke Township suffered 40% defoliation. This type of damage was typical at a number of other locations in the Midhurst and Tweed districts.

At the Waterford Conservation Area in Townsend Township, Aylmer District, mature European larch in a 4-ha plantation mixed with eastern white pine sustained an average of 80% defoliation. A mature stand of tamarack sustained 70% foliar damage in Minto Township, Cambridge District, and Japanese larch (*Larix leptolepis* [Sieb. & Zucc.] Gord.) sustained 25–60% foliar damage at a managed tree seed production area in Marlborough Township, Kemptville District. Elsewhere, light damage was observed at numerous locations throughout the region.

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

Moderate levels of defoliation, caused by this introduced sawfly, were detected in a 10-ha, 8-year-old eastern white pine plantation in South Cayuga Township, Cambridge District. The 1.7-m trees sustained an average of 50% defoliation as a result of two generations of larval feeding. Generally there are two generations per year; with the majority of the damage being caused by the second generation. Routine surveys revealed that 100% of the mature eastern white pine, 26 m tall, growing along the rocky shoreline of Charleston Lake, in Rear of Yonge and Escott Township, Kemptville District, had sustained defoliation levels of 10–20%. In the same district, at the G. Howard Ferguson Forest Tree Nursery, in Oxford Township, similar defoliation levels were recorded on 4.5-m eastern white pine trees in Tree Improvement Area No. 4.

A standard 150-tree evaluation was conducted in two compartments of eastern white pine, 2 and 4 ha in size, at the Glencairn Seed Orchard in Tosorontio Township, Midhurst District. The survey revealed defoliation levels across the orchard of less than 1% on 94% of the 3.7-m trees and on 91% of the 2.0-m trees.

Eastern Pine Shoot Borer, *Eucosma gloriola* Heinr.

Surveys for the eastern pine shoot borer revealed that the incidence level remained constant this season in the Maple and Midhurst districts but increased in the Kemptville and Tweed districts. Nine standard 150-tree evaluations were completed at various locations across the region. The heaviest damage occurred in Oxford Township, Kemptville District, where 76% of the 4.5-m trees in a 1-ha plantation of eastern white pine sustained multiple shoot damage (Table 3). Multiple lateral shoot damage was very common in the region but leader damage was recorded at <2% at all locations surveyed.

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

A sudden increase in populations and damage levels caused by this defoliator was recorded in the Kemptville District during 1993. This is the first infestation of this pest in the region since 1950–51 when light defoliation was recorded on Hill Island, along the St. Lawrence River in Front of Leeds and Lansdowne Township, Kemptville District.

High population levels of hemlock looper occurred at five separate sites, totaling 70 ha, near Charleston Lake in Rear of Leeds & Lansdowne Township, Kemptville District (Fig. 5). The largest area of infestation was comprised of three stands of mature eastern hemlock (*Tsuga canadensis* [L.] Carr.) totaling 31 ha and surrounding Higley Lake, west of Charleston Lake. A 20-ha pocket of 16.5-m hemlock trees was delineated on the east side of Charleston Lake in Front of Yonge and Front of Escott townships. South of these occurrences, an 8-ha area of eastern hemlock was also severely defoliated (100%) on Fitzsimmons Mountain near the town of Lansdowne in Front of Leeds & Lansdowne Township. A 7-ha pocket of damage was also mapped on the northeast shore of Temperance Lake in Rear of Yonge and Escott Township. Finally, a 4-ha pocket of moderate-to-severe defoliation (50–100%) was surveyed along Highway 401, south of the village of Lyn in Elizabethtown Township. Complete defoliation of current and old foliage occurred on numerous trees throughout the infested areas. This could result in various levels of branch and whole-tree mortality in 1994.

Satin Moth, *Leucoma salicis* (L.)

For the fourth consecutive year this introduced pest has caused severe hardwood defoliation at various locations across the region. The largest area of infestation occurred at Canadian Forces Base (CFB) Borden, Midhurst District. This was the third consecutive year that mature Carolina poplar (*Populus X canadensis* Moench) growing along the residential streets and main thoroughfares were heavily infested.

Table 3. Damage caused by the eastern pine shoot borer at 9 locations in the Southern Region of Ontario in 1993. (Counts are based on an examination of 150 randomly selected eastern white pine at each location.)

District (location)	Average height of trees (m)	Estimated number of trees per ha	Estimated area of stand (ha)	Trees infested (%)
<i>Kemptville</i>				
Yonge & Escott	2.8	2700	15	27
Bastard	3.2	1000	4	22
Oxford	4.5	2700	1	76
<i>Maple</i>				
Clarke ^a	2.0	1000	4	14
<i>Midhurst</i>				
Holland	1.7	2200	5	1
Tosorontio	4.0	1200	3	6
Tosorontio ^a	3.5	1200	3	8
<i>Tweed</i>				
Bedford	2.5	1200	2	22
Hungerford	2.2	2200	5	12

^a Scots pine was surveyed at this location.

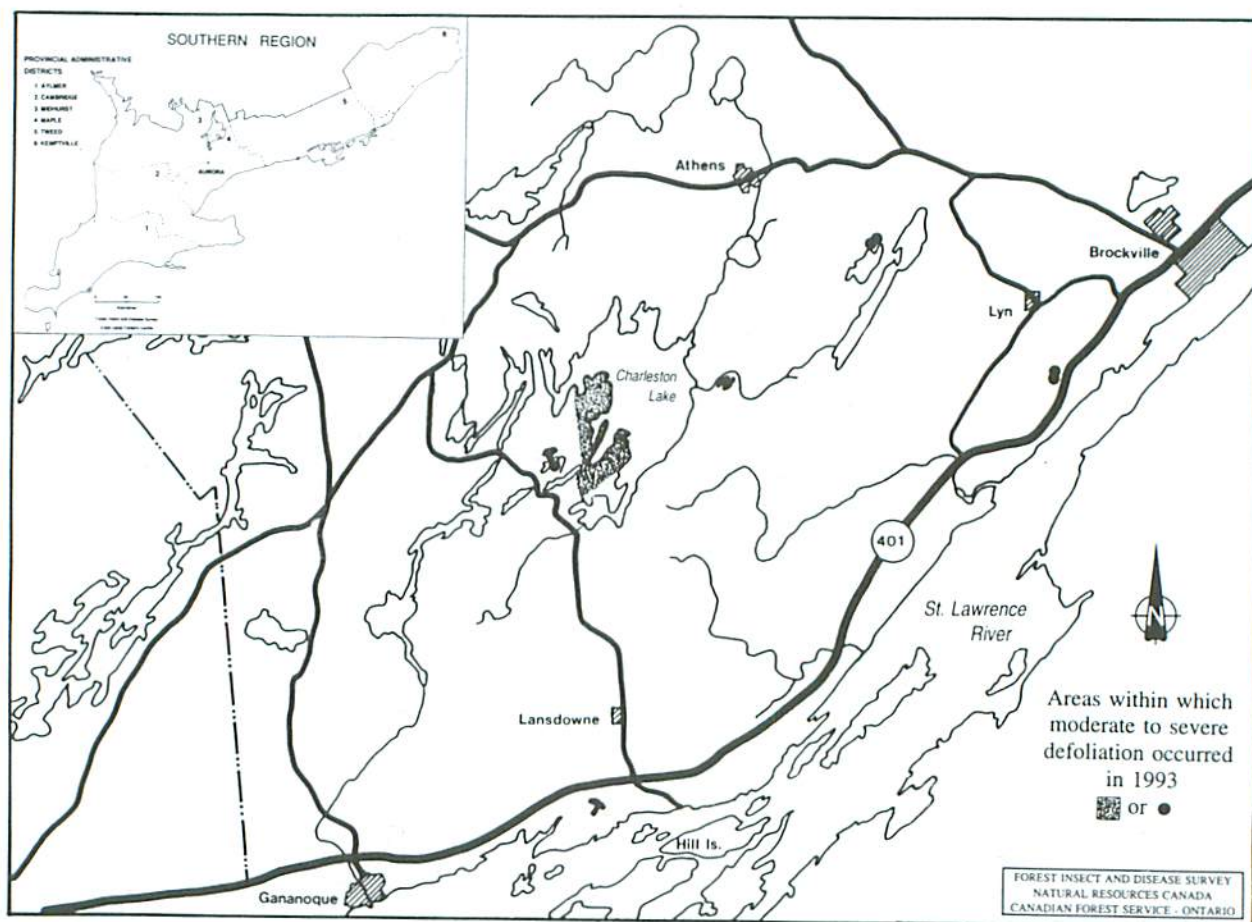


Figure 5. Hemlock looper, *Lambdina fiscellaria lugubrosa* (Hulst.).

Surveys conducted at this site in the fall of 1992, and in the spring of 1993, indicated an extremely high population of larvae on the boulevard poplars and ornamental trembling aspen, balsam poplar, and willows (*Salix* spp.). These high numbers indicated that severe defoliation would likely occur across the base. Therefore, a special permit was obtained from Agriculture Canada to aerially spray the infested area with the biological insecticide *Bacillus thuringiensis* var. *kurstaki* (B.t.), Foray 48B. The spray operation consisted of two single applications of B.t., applied by a rotary-winged aircraft at a rate of 50 BIU/4.0 liters per ha, on a 10-day interval. The first application was applied on the morning of 27 May and the second on the evening of 3 June. An isolated but heavily infested 2-ha stand of trembling aspen, located southeast of the main airfield, was used as a control block and was not aerially sprayed.

Postspray surveys conducted in mid and late June revealed that this operation had been extremely effective; no evidence of satin moth larvae could be detected in the areas sprayed. Total defoliation across the sprayed areas averaged 10–20%, whereas in the control block, virtually 100% defoliation had occurred.

Whole tree mortality and severe crown dieback, often exceeding 50%, was recorded across CFB Borden in the Carolina poplars. It was not determined if the three years of severe defoliation caused by the satin moth had resulted in this crown deterioration or if other factors, such as drought, had been responsible. Dead and severely declining trees, with >75% crown dieback, were cut down and removed from the boulevards.

Elsewhere, a slight decline was evident in the number of areas infested by this pest, especially throughout the eastern portion of the region. However, severe defoliation levels (75–100%) were still detected in the areas where populations did exist. In the Tweed District damage was widely scattered on European white poplar (*Populus alba* L.) clones or on single, ornamental trees. Throughout Hungerford Township, scattered pockets of semimature Carolina poplar sustained defoliation levels of 100% and a defoliation level of 75% was recorded on a clump of 21-m-tall European white poplar. A single, 22-m-tall Carolina poplar sustained 100% defoliation for the second consecutive year along Highway 401 in Tyendinaga Township. In Goulbourn Township, Kemptville District, ornamental European white poplar, averaging 18 m in height, sustained 80% foliar damage.

Gypsy Moth, *Lymantria dispar* (L.)

For the second consecutive year there was a marked decrease in the total area of moderate-to-severe defoliation caused by this introduced pest. Extensive aerial and ground surveys disclosed that the numerous pockets of defoliation observed in 1992 had declined to only a few areas in 1993. Moderate-to-severe defoliation decreased from 13,348 ha last year to 3,139 ha this season (Fig. 6). The largest decrease occurred in the Tweed District, where some 7,978 ha were heavily defoliated in 1992, compared with only 129 ha in 1993 (Table 4). This marked decline was also seen province-wide; 9,784 ha of moderate-to-severe defoliation reported this year compared with 34,460 ha in 1992.

Within the region, only the Aylmer District showed an increase in the area defoliated by gypsy moth. This district accounted for 2,357 ha of the regional total. The largest area of moderate-to-severe defoliation, 1,263 ha, occurred in the Pinery Provincial Park along the shores of Lake Huron. A steady increase in the number of new egg masses detected annually in the park has finally resulted in this large pocket of foliar damage. Primarily red oak (*Quercus rubra* L.) and white oak (*Quercus alba* L.) were infested in the park and the areas immediately adjacent. Moderate-to-severe defoliation also occurred on many of the scattered juvenile, understory eastern white pine that are scattered throughout this oak stand. The number of new egg masses observed in the park during the fall of 1993 indicate that high larval populations and severe defoliation will probably occur in 1994. Three additional separate pockets of moderate-to-severe oak defoliation, totaling 55 ha, occurred immediately southwest of the park in the Port Franks area.

The second largest area of moderate-to-severe defoliation occurred in the Sarnia area where a total of 713 ha of red oak, white oak, and scrub willow sustained

Table 4. Total area of moderate-to-severe defoliation caused by the gypsy moth in the Southern Region of Ontario and the change in total area infested, by district, for 1992 and 1993.

District	Total area of moderate-to-severe defoliation (ha)		Change from 1992 to 1993 (ha)
	1992	1993	
Aylmer	123	2,357	+2,234
Cambridge	225	0	–225
Kemptville	0	0	0
Maple	3,986	304	–3,682
Midhurst	1,036	349	–687
Tweed	7,978	129	–7,849
Total	13,348	3,139	–10,209

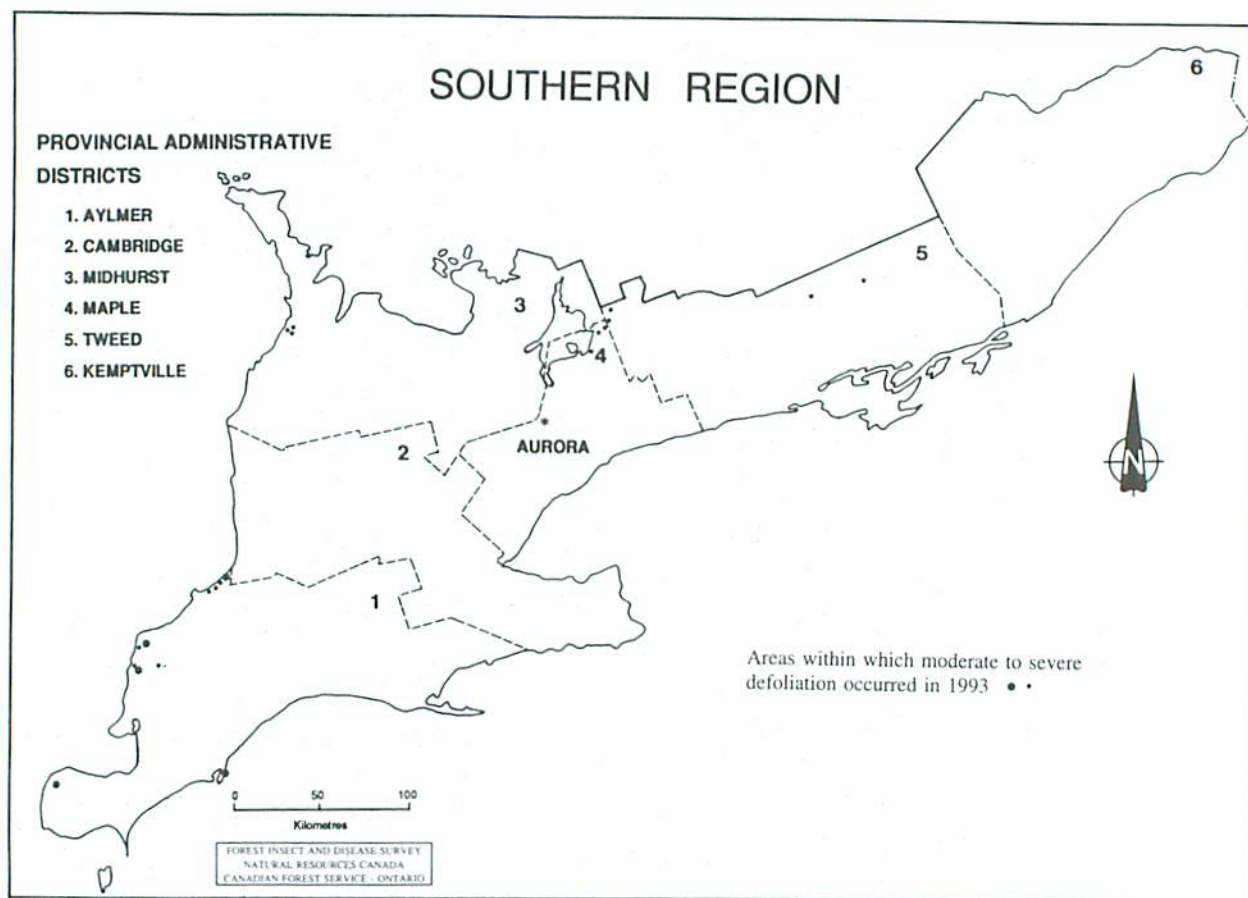


Figure 6. Gypsy moth, *Lymantria dispar* (L.).

damage on the Sarnia Indian Reserve and adjoining properties to the west and north. A few kilometres south, along Highway 40 in Moore Township, two additional woodlots were infested. The first area consisted of 35 ha of white oak and the second included 238 ha of mixed red, white, and bur (*Quercus macrocarpa* Michx.) oaks. Southeast of the town of Bridgen in Moore Township, two woodlots were also infested. These were approximately 40 ha and 2 ha in size, respectively, and consisted of mixed oak species. A small 3-ha stand of white oak, near St. Clair College in the City of Windsor, was infested again this year. The ongoing infestation in Rondeau Provincial Park in Harwich Township declined considerably from 76 ha in 1992 to 4 ha this year. Several scattered individual red oak and willow trees growing along the lake shore were also heavily infested.

In the Midhurst District four pockets of moderate-to-severe defoliation, totaling 247 ha, occurred in trembling aspen and balsam poplar stands on the Saugeen Indian Reserve near the town of Southhampton. Two additional areas of defoliation occurred in poplar stands south of the reserve, near Arran Lake.

Three pockets of similar defoliation levels, totaling 304 ha, occurred on the east side of Lake Simcoe in the

Maple District. One pocket was located in Brock Township near the town of Port Bolster and the other two were in Thorah Township, just north of the town of Beaverton. Trembling aspen and balsam poplar were the primary hosts throughout these areas. Adjacent to these pockets two small areas of infestation on trembling aspen and balsam poplar, totaling 129 ha, occurred on the east side of Canal Lake in Eldon Township, Tweed District. Further east in the Tweed District the only foliar damage observed was on red oak in 1- and 5-ha areas in Madoc and Sheffield townships, respectively.

For the second consecutive year an aerial spray operation was conducted at Canadian Forces Base Borden, Midhurst District, to control gypsy moth on both forested and urban areas. A single application of B.t. (Foray 48B) was applied at a rate of 50 BIU/4.0 liters per ha, using rotary-winged aircraft, on the morning of 27 May and again on the evening of 3 June. The treatment was applied east of the main airfield, to a single 9.1-ha block, comprised primarily of trembling aspen and balsam poplar and to Carolina poplar growing along the majority of the residential streets. This operation appears to have been very effective as postspray ground surveys failed to detect any larval populations in the controlled areas.

Forest Tent Caterpillar, *Malacosoma disstria* Hbn.

In 1993 the total area of defoliation caused by this pest increased in the Southern Region while for the province as a whole it decreased dramatically. Extensive aerial and ground surveys disclosed a reduction of 96% in the provincial total, from 16,051,424 ha in 1992 to 655,256 ha in 1993. In the Southern Region, infestations increased by approximately 4% from 35,520 ha last year to 36,886 ha this year (Table 5).

Table 5. Total area of moderate-to-severe defoliation caused by the forest tent caterpillar in the Southern Region of Ontario in 1991, 1992, and 1993.

District	Gross area of moderate-to-severe defoliation (ha)			Change (%)
	1991	1992	1993	
Kemptville	49,122	7,905	22,473	+284
Maple	551	0	0	0
Midhurst	26,441	1,020	0	-100
Tweed	229,547	26,595	14,413	-46

The majority of the increase in the Southern Region occurred in the Kemptville District. A total of 22,473 ha of trembling aspen, growing in small scattered stands, were defoliated in 1993 compared with 7,905 ha in 1992. Aerial reconnaissance disclosed a multitude of pockets of moderate-to-severe defoliation extending from the town of Westport in North Crosby Township eastward through the Rideau Lakes area into North Burgess Township. Sizeable areas of infestation were also mapped in the Marlborough, Oxford-on-Rideau, and Mountain townships. Further east additional pockets, with defoliation averaging 75–100%, were delineated along the Highway 417 corridor in the Russell, Cambridge, Roxborough, and Caledonia townships (Fig. 7).

In the Tweed District the total area infested declined by 46%; from 26,595 ha in 1992 to 14,413 ha in 1993. Populations remained high enough to cause moderate-to-severe defoliation in red oak stands growing on shallow rocky sites. Surveys disclosed defoliation at the 60–100% level throughout the Otter Creek and Mellon Lake areas in Hungerford and Sheffield townships and northward into the Bancroft District of the Central Region. Trembling aspen sustained 50–100% defoliation in large pockets through

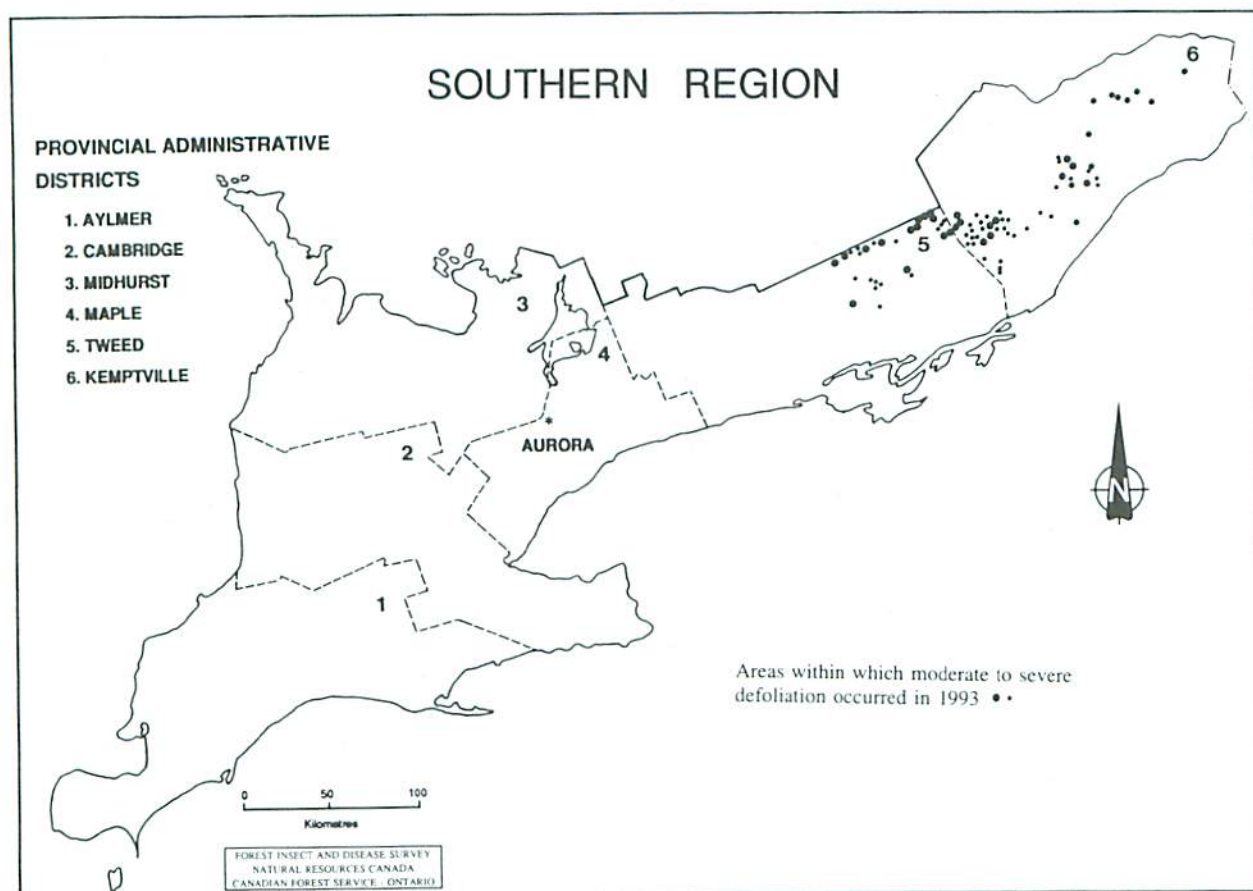


Figure 7. Forest tent caterpillar, *Malacosoma disstria* (Hbn.).

the Claredon Station area in Olden and Oso townships, Tweed District. Elsewhere low numbers of larvae, causing trace levels of defoliation, were found on red oak in the Copeland Forest, Medonte Township, Midhurst District and in Hope Township, Tweed District.

Quantitative egg-band counts were conducted at seven locations in the region in 1993 for the purpose of predicting defoliation levels for 1994 (Fig. 8). This data indicates that forest tent caterpillar populations may recur throughout the area infested in 1993 at approximately the same level of intensity (Table 6). Moderate-to-severe defoliation may persist in trembling aspen stands through Elzevir and Kaladar townships, in red oak stands in Sheffield Township, and near Claredon Station in Oso Township, Tweed District. Pockets of trembling aspen may sustain moderate-to-severe defoliation from Christie Lake, Sherbrooke Township, through the Rideau Lakes area and to the east through the Winchester Bog in Mountain Town-

ship as far as St. Bernardin in Caledonia Township, Kemptville District.

However, because of a combination of factors, decreases in infestation intensity may actually occur in 1994. The procedures used to forecast populations, i.e., egg-band counts, tend to overestimate defoliation in an aging infestation. Parasitism; overwintering mortality; the presence of smaller and poorly formed egg-bands;

Table 6. Forest tent caterpillar egg-band samples collected in two districts of the Southern Region of Ontario in 1993, with infestation forecasts for 1994.

District (Township)	Host ^a	Average DBH of trees (cm)	Average number of egg bands per tree	Infestation forecast for 1994
<i>Kemptville</i>				
Caledonia	tA	15.3	13	severe
Cambridge	tA	15.4	32	severe
Mountain	tA	14.5	53	severe
North Burgess	tA	8.8	9	severe
Oxford	tA	10.2	13	severe
South Sherbrooke	tA	17.3	36	severe
<i>Tweed</i>				
Elzevir	tA	13.9	25	severe

^a tA = trembling aspen.

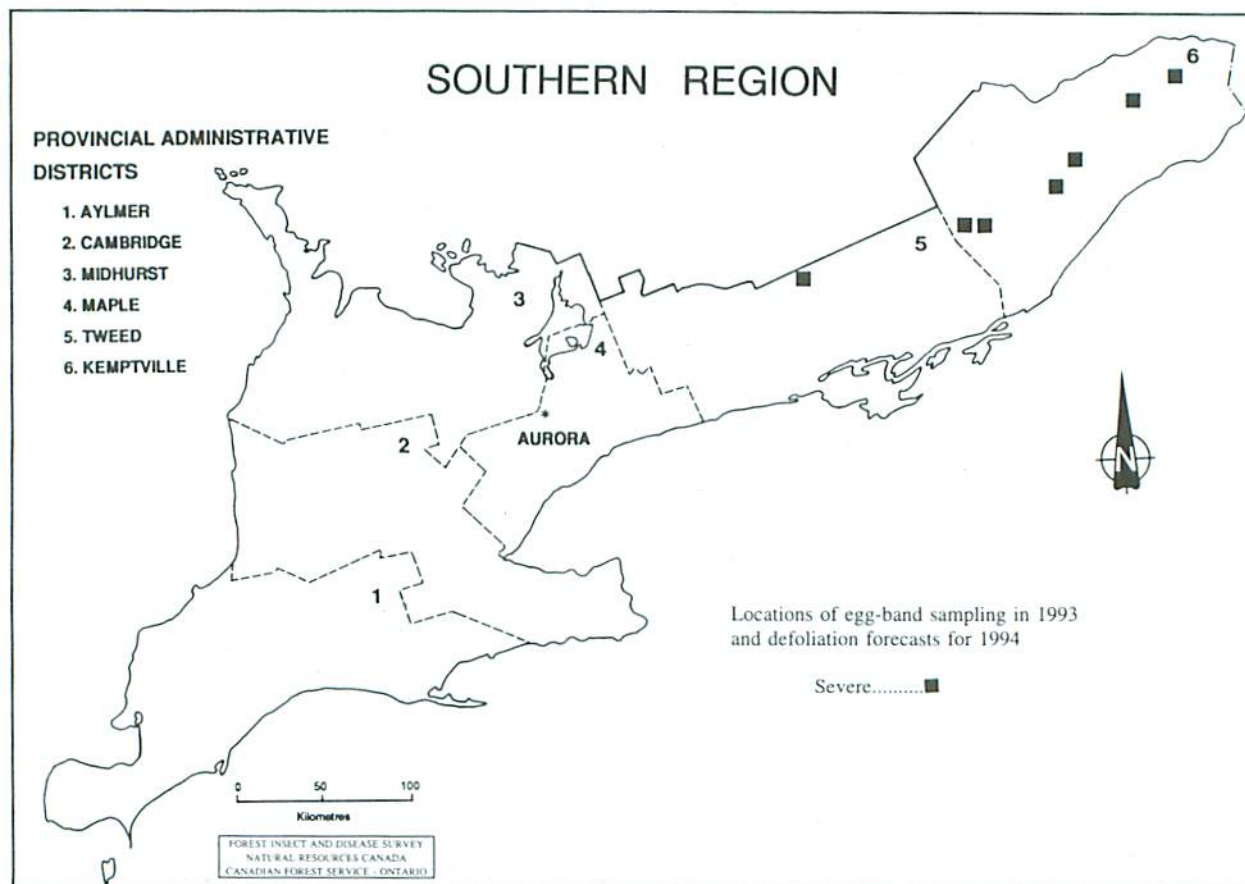


Figure 8. Forest tent caterpillar, *Malacosoma disstria* (Hbn.).

and the widespread presence of viral, fungal, and microsporidian diseases may all contribute to a decline. All of these factors, presently occurring across the entire infested area in the region, could cause populations to collapse.

Balsam Fir Sawfly, *Neodiprion abietis* complex

There was a noticeable decline in populations of this spring pest in the Tweed and Kemptville districts in 1993. Surveys showed that scattered individual trees and/or small stands were infested throughout the Kemptville District and the northwestern portion of the Tweed District for the second consecutive year.

The largest area infested was a 65-ha stand of balsam fir in Pakenham Township, Kemptville District, where 84% of the 18-m trees sustained an average of 60% foliar damage. Similar damage levels in this district were noted in stands in Oxford and West Carleton townships. Light defoliation of 5–10% was noted in East Hawkesbury and Bathurst townships.

In the northwestern portion of the Tweed District, infested trees generally averaged 10–20% defoliation. Usually damage was confined to the mid and upper crown of the trees. The heaviest defoliation was noted in Verulam Township where scattered trees sustained >75% foliar damage.

Redheaded Pine Sawfly, *Neodiprion lecontei* (Fitch)

Low levels of this sawfly were recorded in the region in 1993. The heaviest defoliation levels occurred in a 5-ha red pine plantation of 2.7-m trees in Huntingdon Township, Tweed District. An evaluation of 150 trees at this site disclosed that 2.7% were infested and average defoliation was 18.7%. Lower populations of this pest were recorded this year in a 5-ha plantation of 1.5-m red pine trees in Bedford Township, Tweed District. In 1992, 41.3% of the trees at this location sustained 28.7% defoliation. This year only 0.7% of the 1.9-m trees sustained 10% defoliation.

A low level of damage was recorded in a 1-ha plantation in Ennismore Township, Tweed District, where 4% of the 1.3-m trees harboured a single colony per tree that caused an average of 10% defoliation.

Jack Pine Sawfly, *Neodiprion pratti paradoxicus* Ross

For the second consecutive year this sawfly caused severe defoliation to jack pine plantations and to open-grown trees at numerous locations in the Kemptville and Tweed districts. Once again, the largest area infested, approximately 533 ha, occurred in Sheffield and Kennebec townships, Tweed District. A standard 150-tree evaluation conducted in a portion of this open-

grown pine stand revealed that 100% of the 3.2-m trees were infested and had an average defoliation of 58%. Numerous trees throughout the area surveyed had sustained complete defoliation. Similar results were recorded in a 0.4-ha plantation in Kenyon Township, Kemptville District. Assessment there revealed that 100% of the 6-m trees sustained an average of 60% foliar damage.

Moderate defoliation levels, averaging 36%, occurred on 98% of the 5.3-m trees in a 10-ha plantation in Lanark Township, Kemptville District. General surveys of a roadside planting in the same township revealed that 98% of the 17.5-m trees sustained damage levels ranging from 5 to 100%.

Low levels of defoliation, averaging 20%, were detected on 94% of the 2.9-m trees in a 4.0-ha plantation in Bastard Township and on 83% of the 3.7-m trees in a 5.0-ha plantation in Finch Township, Kemptville District. Elsewhere in these two districts, various levels of damage occurred in numerous plantations at widely scattered locations.

European Pine Sawfly, *Neodiprion sertifer* (Geoff.)

For the second consecutive year this Scots pine pest was widely distributed across the region and caused varying levels of damage. The highest population and defoliation levels occurred in the south central portion of the Tweed District and southeastern corner of the Maple District (Fig. 9).

In a 2-ha Scots pine plantation in North Marysburgh Township, Tweed District, 94% of the 2-m trees averaged 52% defoliation. Several trees at this location were completely denuded of both old and new foliage. At the OMNR Orono Forest Tree Nursery in Clarke Township, Maple District, the Ontario Christmas Tree Growers Association have developed and maintain a clonal Scots pine orchard. A standard 150-tree evaluation was conducted across this 7-ha planting. Results revealed 90% of the 2-m trees sustained an average of 60% defoliation. This defoliation estimate was made before the larvae had completed their entire feeding and, with some trees harbouring as many as 12 colonies per tree, the final defoliation level would have been very severe. Therefore, the association decided to control the population in the clonal orchard. Subsequently a single application of the insecticide *Carbaryl* was aerially applied. Elsewhere in the region trace-to-light (1–24%) defoliation was detected. The complete list of locations sampled and the results of the surveys are presented in Table 7.

White Pine Weevil, *Pissodes strobi* (Peck)

Surveys for this conifer pest, conducted in 26 plantations across the region, revealed an incidence of attack

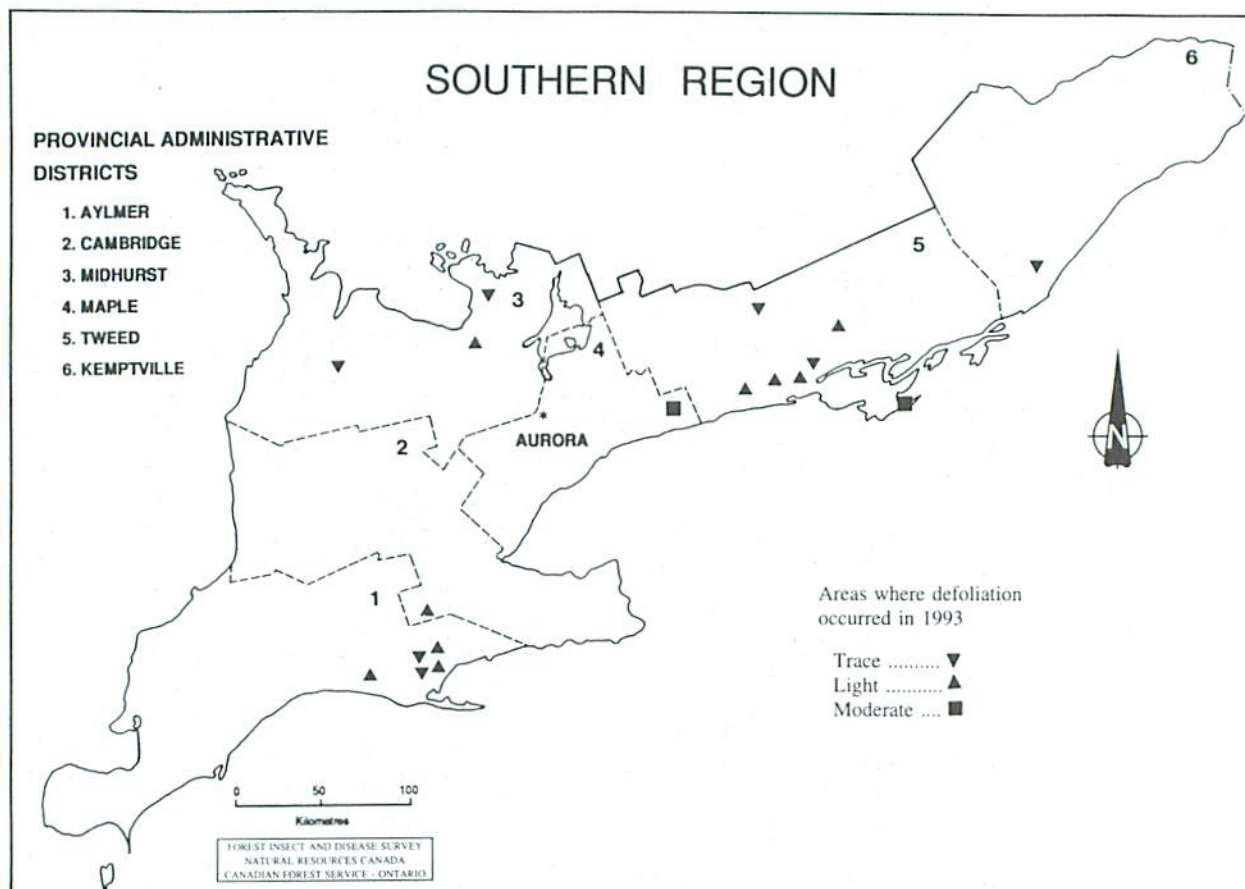


Figure 9. European pine sawfly, *Neodiprion sertifer* (Geoff.).

that ranged from 0–60% (Table 8). The highest incidence of leader damage occurred in a 3-ha eastern white pine plantation in Charlotteville Township, Aylmer District where 60% of the 4.6-m trees were affected. In a 3-ha plantation in Ramsay Township, Kemptville District, a standard 150-tree evaluation determined that 33% of the leaders were infested on 4.8-m eastern white pine. A similar survey revealed that 23% of the leaders were attacked in a 2-ha, 3-m-tall eastern white pine plantation in Minto Township, Cambridge District (Fig. 10). Elsewhere in the region surveys have determined that the overall incidence of leader damage by this pest is at a very low level.

MINOR INSECTS

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

This late season pest of sugar maple was commonly encountered at numerous locations throughout the region. Damage levels in most instances were <5% and generally confined to the lower branches or to young trees.

The heaviest damage detected, averaging 75%, occurred on several 12-m-tall sugar maple trees along a concession road in the south end of Clarke Township, Maple District. Foliar damage levels ranging from 5 to 60% were detected on the lower branches of 18-m trees in the Sandbanks area of Hallowell Township, Tweed District. Damage levels from 5 to 20% were recorded in the Schomberg area of King Township, Maple District.

Fall Webworm, *Hyphantria cunea* (Drury)

This late summer-defoliator was frequently identified on various hardwoods throughout the region. Black ash (*Fraxinus nigra* Marsh.), white elm (*Ulmus americana* L.), black walnut (*Juglans nigra* L.), and willow were most affected. The most severe foliar damage, varying from 50 to 85%, occurred on black ash near Rideau Ferry in North Elmsley Township, Kemptville District. In the Maple and Tweed districts, black ash growing in low, wet sites often had two or three large webmasses per tree. The highest populations were observed in the Palgrave area of Albion Township; the Port Perry area of Scugog and Cartwright townships, Maple District; and in Douro, Ennismere, and Dummer townships, Tweed

Table 7. Summary of damage caused by the European pine sawfly at 18 locations in the Southern Region of Ontario in 1993. (Counts are based on the examination of 150 randomly selected trees at each location.)

District (Township)	Tree species ^a	Average height of trees (m)	Estimated number of trees per ha	Total area affected	Trees infested (%)	Average % defoliation per tree
<i>Aylmer</i>						
Blenheim	scP	2.5	2,900	3	73	8
Charlotteville	scP	1.7	3,800	5	31	5
Charlotteville	scP	2.4	3,200	3	19	2
Charlotteville	scP	1.4	4,000	5	11	2
Malahide	scP	2.1	4,900	12	15	5
Middleton	scP	2.2	1,500	2	69	12
<i>Kemptville</i>						
Rear of Yonge & Escott	scP	2.2	1,620	7	17	2
<i>Maple</i>						
Clarke	scP	2.0	800	7	90	60
<i>Midhurst</i>						
Sullivan	scP	3.5	2,100	2	1	2
Sunnidale	scP	3.1	2,500	3	30	10
Tiny	scP	2.0	300	1	1	2
<i>Tweed</i>						
Brighton	scP	2.2	2,990	1	18	3
Cramahe	scP	4.3	2,200	4	35	20
Dummer	rP	3.3	2,200	3	1	2
Haldimand	rP	3.9	2,250	2	2	5
Hope	scP	3.5	1,000	10	45	
Huntingdon	rP	1.3	2,500	10	1	5
North Marysburgh	scP	2.0	1,950	2	94	52

^a rP = red pine, scP = Scots pine.

District. Various hardwoods in the Turkey Point area in Charlotteville Township, Aylmer District, averaged 10% defoliation. In Rondeau Provincial Park and in Point Pelee National Park, black walnut was the species most affected, averaging 15% foliar damage. In a marshy area along the shore of Lake St. Clair in Dover Township, Aylmer District, 100% of the willow trees averaged 10% defoliation.

Pine Engraver Beetle, *Ips pini* (Say)

Extremely high populations of this bark beetle were detected in a pocket of declining eastern white pine at the Canadian Forces Base Borden, Torosontio Township, Midhurst District. Armillaria root rot (*Armillaria ostoyae* [Romagn.] Herink) was found to have recently killed a pocket of eight, 17-m trees and this pocket was surrounded by several low vigor, declining trees. Examination of the dead and dying white pine determined that the population of beetles had originally been established on the root rot affected trees and was now spreading outward, thus increasing the actual size of the pocket of damage. Similar conditions were detected in a

roadside planting of 17-m red pine in North Walsingham Township, Aylmer District, where high populations of the beetle were found on 39 recently dead or declining trees.

Populations of this beetle were recorded virtually anywhere that recently dead or dying pine were encountered across the region (see additional information on this pest under *Tree Diseases – Armillaria root rot*).

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

Infestations of this serious defoliator of white spruce occurred in several locations in the eastern portion of the region. However, most of the damage was confined to roadside and open-growing trees. Evaluation in a 2-ha plantation in Bastard Township, Kemptville District, revealed that 100% of the current foliage and 65% of the old foliage was consumed on 18% of the 1.9-m trees. Elsewhere in the region roadside trees at scattered locations suffered severe defoliation (>75%) to current foliage. For example, new foliage on seven 2-m-tall roadside white spruce in Verulam Township, Tweed

Table 8. Damage caused by the white pine weevil at 26 locations in the Southern Region of Ontario in 1993. (Counts are based on an examination of 150 randomly selected trees at each location.)

Location (Township)	Tree species ^a	Average height of trees (m)	Estimated trees per ha	Estimated area of (ha)	Leaders attacked (%)
<i>Aylmer District</i>					
Charlotteville	ewP	2.6	2500	2	7
Charlotteville	ewP	1.5	1100	2	0
Charlotteville	ewP	4.6	3500	3	60
Charlotteville	ewP	3.8	3000	1	8
N. Walsingham	ewP	2.2	2600	1	0
W. Oxford	ewP	6.5	3000	3	0
<i>Cambridge District</i>					
Colborne	ewP	4.5	2000	1	5
Minto	ewP	3.0	2000	2	23
S. Cayuga	ewP	2.4	2700	4	0
<i>Kemptville District</i>					
Bastard	ewP	3.2	1000	1	12
Lanark	ewP	1.2	1200	7	1
Lanark	nS	4.8	2850	1	17
N. Elmsley	ewP	3.0	2400	4	0
Oxford	ewP	4.5	2700	1	0
Ramsay	ewP	4.8	2900	3	33
Yonge & Escott	ewP	2.8	2700	15	0
<i>Maple District</i>					
Clarke	ewP	3.0	2000	5	0
<i>Midhurst District</i>					
Egremont	ewP	5.0	2400	10	2
Holland	ewP	1.7	2200	5	1
Medonte	ewP	2.3	800	20	8
Sullivan	ewP	2.4	1900	7	1
Tosorontio	ewP	3.5	1500	2	6
Tosorontio	ewP	3.7	1800	2	0
Tosorontio	ewP	2.0	1800	4	0
<i>Tweed District</i>					
Bedford	ewP	2.5	1200	2	11
Hungerford	ewP	2.1	2200	5	19

^a ewP = eastern white pine, nS = Norway spruce.

District, was severely damaged. Light defoliation (20%) to previous year's growth was also recorded at this site.

Pear Thrips, *Taeniothrips inconsequens* (Uzel)

In 1989, a special survey by the Forest Insect and Disease Survey Unit was conducted across the region for this pest. Due to this survey, pear thrips in Ontario was generally considered to occur throughout the range of its primary host, i.e., sugar maple (*Acer saccharum*

Marsh.). A special survey was completed during 1993 to assist with a climate matching survey conducted by Agriculture Canada. The survey concentrated on areas where pear thrips was scarce or absent in 1989. Expanding foliage and flowers were collected in mid May from the upper crowns of sugar maple at 18 widely scattered locations. Ten of these locations have since been confirmed positive for this pest by the insect identification section of Agriculture Canada in Ottawa.

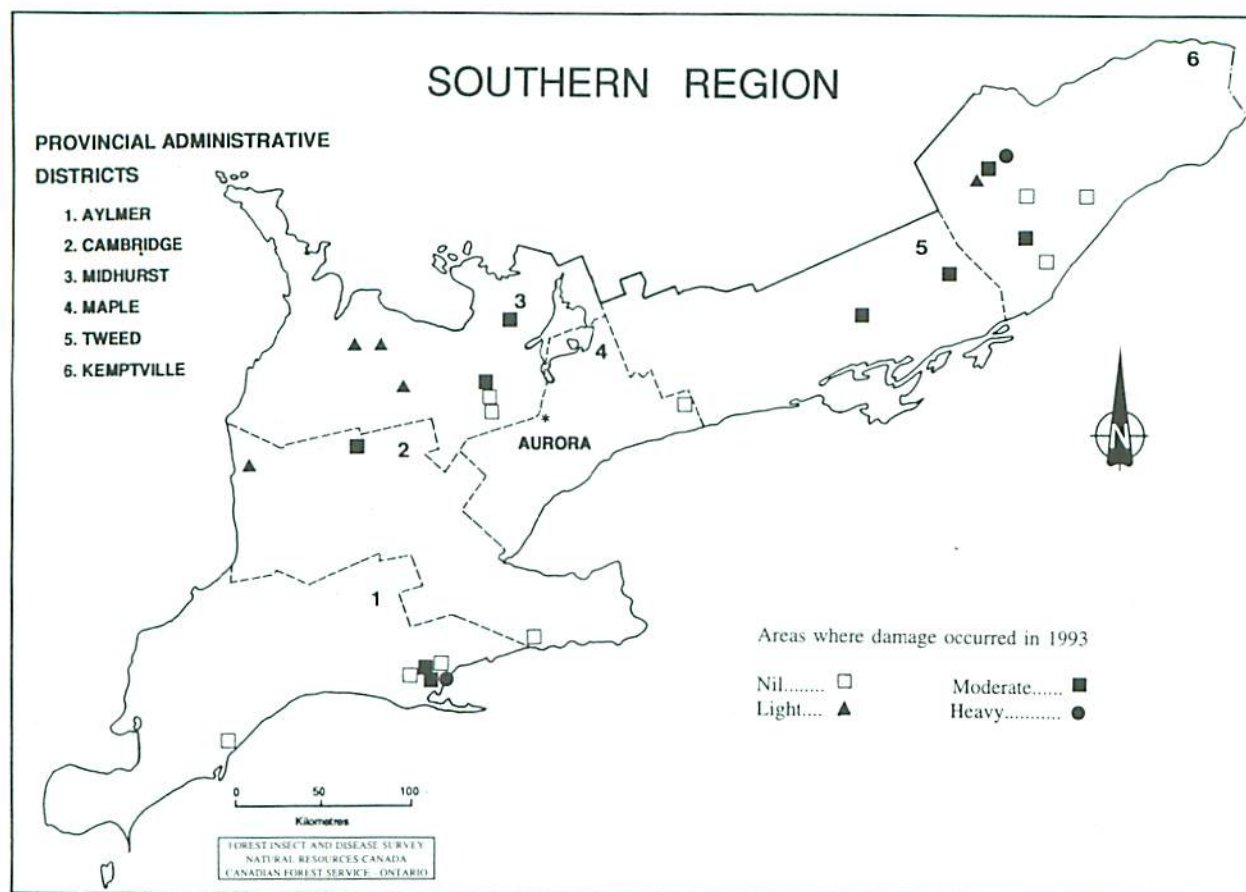


Figure 10. White pine weevil, *Pissodes strobi* (Peck.).

General surveys in 1993 detected pear thrips' damage to sugar maple trees at two widely separated sites in the region. The most severe damage occurred in maple stands along a 4.5-km stretch of the Niagara Escarpment within the City of St. Catharines, Grantham Township, Cambridge District. Foliar damage averaged 35% and occurred mainly on the lower branches of infested trees. In the eastern portion of the region, populations of the pear thrips appear to be continuing to build. High populations caused 30% defoliation on 22-m-tall sugar maple

trees in a 2.5-ha stand in Hallowell Township, Tweed District. At this location in 1991, only 2% of the regeneration (<5 m tall) had sustained severe foliar damage.

Other Forest Insects

A number of other pests were encountered during the course of regular surveys. Information on these is provided in Table 9.

Table 9. Other forest insects.

Insects	Host(s) ^a	Remarks
<i>Acericecis ocellaris</i> (O.S.) Ocellate gall midge	sM	Foliar damage of <5% was recorded in stands examined in the Aylmer, Cambridge, Kemptville, and Tweed districts.
<i>Adelges lariciatus</i> (Patch) Spruce gall adelgid	EuL	High populations were observed on 9.6-m trees at several locations in Front of Yonge and Osgoode townships, Kemptville District.

(cont'd)

Table 9. Other forest insects (cont'd).

Insects	Host(s) ^a	Remarks
<i>Alsophila pometaria</i> (Harr.) Fall cankerworm	sM, siM	A virtual collapse occurred this year in the infestations that were recorded in woodlots in Burford and Caradoc townships, Aylmer District, in 1991 and 1992. Low numbers caused <10% defoliation in these areas this year.
<i>Altica populi</i> Brown Poplar flea beetle	bPo	High populations caused 75–100% foliar browning to host trees throughout the central portion of the Tweed District.
<i>Aphrophora cribrata</i> (Wlk.) Pine spittlebug	ewP, scP	Low populations were commonly found on host trees in Somerville Township, Tweed District and were frequently encountered in plantations in the southwestern portion of the region.
<i>Bucculatrix ainliella</i> Murt. Oak skeletonizer	rO	This insect caused 5–10% skeletonizing in the lower crowns of many stands throughout the Midhurst, Maple, and Tweed districts.
<i>Corthylus punctatissimus</i> (Zimm.) Pitted ambrosia beetle	sM	Less than 2% of the 1-m-tall understory regeneration was recorded killed in maple stands in the Kemptville and Midhurst districts.
<i>Datana integerrima</i> G. & R. Walnut caterpillar	bWa	Defoliation averaged 60% on several trees in Point Pelee National Park, Mersea Township, Aylmer District and 10% in a 0.1-ha area of 17.5-m trees in Pittsburgh Township, Tweed District.
<i>Datana ministra</i> (Drury) Yellownecked caterpillar	Ba	Trace populations were detected on a single 10-m tree and caused 30% defoliation in Laxton Township, Tweed District.
<i>Epinotia nanana</i> (Treit.) European spruce needleminer	nS	Populations declined in a 10-ha plantation of mature trees to cause only 15% needle mining in Houghton Township, Aylmer District.
<i>Fenusa ulmi</i> Sund. Elm leafminer	wE	Foliar damage reached 80% on a single tree in Puslinch Township, Cambridge District.
<i>Isochnus rufipes</i> (LeC.) Willow flea weevil	W	This insect caused 80–100% foliar browning and premature leaf drop throughout the eastern portion of the region on open-growing ornamentals and in pure stands. The most severe damage was noted along the St. Lawrence River from Prescott to Lancaster, Kemptville District. Similar damage was recorded at one location in East Zorra Township, Aylmer District.
<i>Malacosoma americanum</i> (F.) Eastern tent caterpillar	cCh, bCh	This insect was very common in the Midhurst District, but only recorded at scattered locations in the Tweed and Aylmer districts. It caused 30–75% defoliation on roadside shrubs.
<i>Neodiprion nanulus nanulus</i> Schedl Red pine sawfly	rP	Evaluation in a 12-ha plantation of 2.7-m trees disclosed 56% were infested and sustained 12.5% defoliation. Similar damage was observed in an adjacent 20-ha plantation of 7-m trees in Dalhousie Township, Kemptville District.
<i>Oligonychus ununguis</i> (Jac.) Spruce spider mite	tL	Foliar damage ranged from 20 to 75% on 5-m trees in 2- to 5-ha plantations in Edwardsburgh Township, Kemptville District.

(cont'd)

Table 9. Other forest insects (concl.).

Insects	Host(s) ^a	Remarks
<i>Pantographa limata</i> (G. & R.) Basswood leafroller	Ba	Foliar damage was recorded at 5% on understory regeneration in one woodlot in Albion Township, Midhurst District.
<i>Paraclemensia acerifoliella</i> (Fitch) Maple leafcutter	sM	Trace populations were recorded in maple stands in Oro Township, Midhurst District and in Rear of Yonge and Escott Township, Kemptville District.
<i>Parthenolecanium corni</i> (Bouché) European fruit lecanium	wA	High populations caused the lower branches of a 15-m tree to wilt in Adjala Township, Midhurst District.
<i>Petrova albicapitana</i> (Bsk.) Northern pitch twig moth	jP	An assessment of 50, 3.7-m trees in a 5-ha plantation in Finch Township, Kemptville District, revealed 68% were infested with 1 to 3 nodules per stem.
<i>Pissodes nemorensis</i> Germ. Northern pine weevil	ewP	Approximately 0.7% of the 5-m trees were affected in a 10-ha plantation in Egremont Township, Midhurst District.
<i>Psilicorsis quercicella</i> Clem. Oak leaf-tier	rO, wO	Trace damage was located in oak stands in Turkey Point Provincial Park, Charlotteville Township and in South Walsingham Township, Aylmer District.
<i>Pyrhalta viburni</i> (Paykull) Cranberry leaf beetle	hbC	Severe defoliation was recorded in the Angus, Barrie, and Midhurst areas of the Midhurst District.
<i>Resseliella pinifoliae</i> White pine needle midge	ewP	Current defoliation ranged from 10–40% on roadside and open-growing 4.6-m trees in Dalhousie Township, Kemptville District.
<i>Saperda populnea moesta</i> LeC. Poplar gall borer	tA	Seven-metre-tall open-growing trees were heavily galled and sustained branch mortality as a result of attack from this borer at Balsam Lake Provincial Park, Bexley Township, Tweed District.
<i>Schizura concinna</i> (J.E.Smith) Redhumped caterpillar	Sumac	Low populations caused 10% defoliation in a 0.1-ha area in Elzevir Township, Tweed District.
<i>Symmerista canicosta</i> Franc. Redhumped oakworm	rO	Defoliation averaged 10% on trees previously damaged by other defoliators in Marmora and Olden townships, Tweed District.
<i>Symmerista leucitys</i> Franc. Orangehumped mapleworm	sM	A 5% level of defoliation was recorded on 18-m trees at one location in Rear of Yonge and Escott Township, Kemptville District.
<i>Sparganothis acerivorana</i> Mac. Maple leafroller	sM	Numerous leafrollers caused 5% foliar damage in one woodlot in Burford Township, Cambridge District.
<i>Tetralopha asperatella</i> (Clem.) Maple webworm	sM	This insect contributed to 5% defoliation in maple stands in Rear of Yonge and Escott and South Burgess townships, Kemptville District.
<i>Thripidae</i> spp.	Ba	Foliar damage was recorded at 25% on several 13-m trees in Clarence Township, Kemptville District.

^a Ba = basswood, bCh = black cherry, bPo = balsam poplar, bWa = black walnut, cCh = choke cherry, EuL = European larch, ewP = eastern white pine, hbC = high bush cranberry, jP = jack pine, nS = Norway spruce, rO = red oak, scP = Scots pine, siM = silver maple, sM = sugar maple, tL = tamarack, W = willow, wA = white ash, wE = white elm, wO = white oak.

TREE DISEASES

Major Diseases

Anthracnose, *Apiognomonia errabunda* (Roberge) Hohn., *A. veneta* (Sacc. & Speg.) Hohn., *Aureobasidium apocryptum* (Ellis & Everh.) Herm.-Nijh., *Diplodina acerina* (Pass.) B. Sutton, *Discula campestris* (Pass.) v. Arx, *Gnomonia caryae* Wolf var. *caryae*, *G. leptostyla* (Fr.: Fr.) Ces. & De Not. and *Gnomoniella fraxini* Redlin & Stack.

Several different anthracnose fungi infecting a variety of deciduous hosts were prevalent at many locations throughout the region. The most commonly encountered anthracnose was caused by *Apiognomonia errabunda*, which heavily infected white ash (*Fraxinus americana* L.) throughout Egremount, Tosorontio, and Medonte townships, Midhurst District and in Albion and Pickering townships, Maple District. Foliar damage levels often exceeded 70%. This disease was also responsible for severe foliar damage (75–100%) to open-growing bur oak (*Quercus macrocarpa* Michx.) from 9.5 to 20 m tall in Caledonia and East Hawkesbury townships and in many other scattered locations in the Kemptville District. Trace foliar damage caused by this anthracnose was recorded on sugar maple in the Argent Tract, Albion Township, Midhurst District.

Infection levels ranging from 10 to 40% on black walnut (*Juglans nigra* L.) and butternut (*J. cinerea* L.) were caused by *Gnomonia leptostyla* in Tosorontio Township, Midhurst District and in Manvers and Somerville townships, Tweed District. In Point Pelee National Park, Mersea Township, Aylmer District, several sycamore (*Platanus occidentalis* L.) trees were attacked by *A. veneta*, which caused twig and branch dieback. In Gosfield North Township, Aylmer District, an 8.1-ha plantation of young green ash (*Fraxinus pennsylvanica* var. *subintegerrima* [Vahl] Fern.) sustained 25% foliar damage caused by *Gnomoniella fraxini*. Several 15-m-tall ornamental sugar maple experienced 10% foliar damage as a result of infections of *Discula campestris* in Augusta Township, Kemptville District. The same disease, recorded on roadside trees in North Easthope Township, Cambridge District, caused foliar damage ranging from 1 to 40%.

Trace levels of foliar damage caused by *Aureobasidium apocryptum* were recorded on several sugar maple trees in a woodlot in Oro Township, Midhurst District. As well, trace damage levels of *Diplodina acerina* were detected in a 20-ha sugar maple stand in Lindsay Township, Midhurst District. Fringe and roadside shagbark hickory (*Carya ovata* [Mill.] K. Koch) in Esquesing Township, Maple District, suffered very low levels of infection of *Gnomonia caryae*.

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

Surveys were conducted at some 61 pine and 5 hardwood locations across the region for any evidence of damage caused by this root rot. Surveys were carried out in pockets of known damage at six of the pine locations and one of the hardwood sites. The remainder of the sites were chosen in conjunction with routine surveys and randomly located in red pine, eastern white pine, and Scots pine plantations and in oak and sugar maple stands. A total of 53 of the 61 pine areas surveyed produced negative results. All varied from 1 to 10 ha in area and from 1 to 5 m in height (Fig. 11).

Pockets of dead or dying trees were detected at four locations in semimature red pine plantations in the Midhurst District. Pockets of damage, comprised of approximately 50 trees, were detected in a 20-ha, 35-year-old plantation along County Road 22 and in a 40-ha, 45-year-old plantation along County Road 57 in Oro Township. Two smaller pockets, each with only four to six trees affected, were aerially detected along County Road 10 in a 20-ha, 40-year-old plantation on Canadian Forces Base Borden property in Tosorontio Township. In the Maple District, approximately 20 affected trees were detected in a 10-ha, 45-year-old red pine plantation in the Main Tract of Durham County Forest in Uxbridge Township. A smaller pocket, consisting of approximately 15 trees, was detected in a 20-ha, 30-year-old red pine plantation in the west end of the Gananaska County Forest in Clarke Township.

This disease was considered the final factor causing death to 54% of the red oak trees in a mortality plot established in 1992. The plot, located near Mellon Lake in Sheffield Township, Tweed District, is in an area that has been severely affected by years of drought and insect defoliation. Armillaria was responsible for a 4% increase in whole-tree mortality during 1993 at the red oak impact plot at Joe Lake in Lavant Township, Kemptville District. Similarly, it caused single tree mortality in sugar maple plots near the town of Athens in Rear of Yonge and Escott Township, Kemptville District and near Picton in Hallowell Township, Tweed District. Declining, overmature beech (*Fagus grandifolia* Ehrh.) at Rondeau Provincial Park in Harwich Township, Aylmer District, were also found to be heavily infected with this root rot.

Standard 150-tree evaluations revealed an infection rate of 1% in two juvenile eastern white pine plantations in the western portion of the Midhurst District. The first was in a 7-ha, 2.4-m-tall plantation in Sullivan Township; the second in a 10-ha, 5.0-m-tall plantation in Egremont Township.

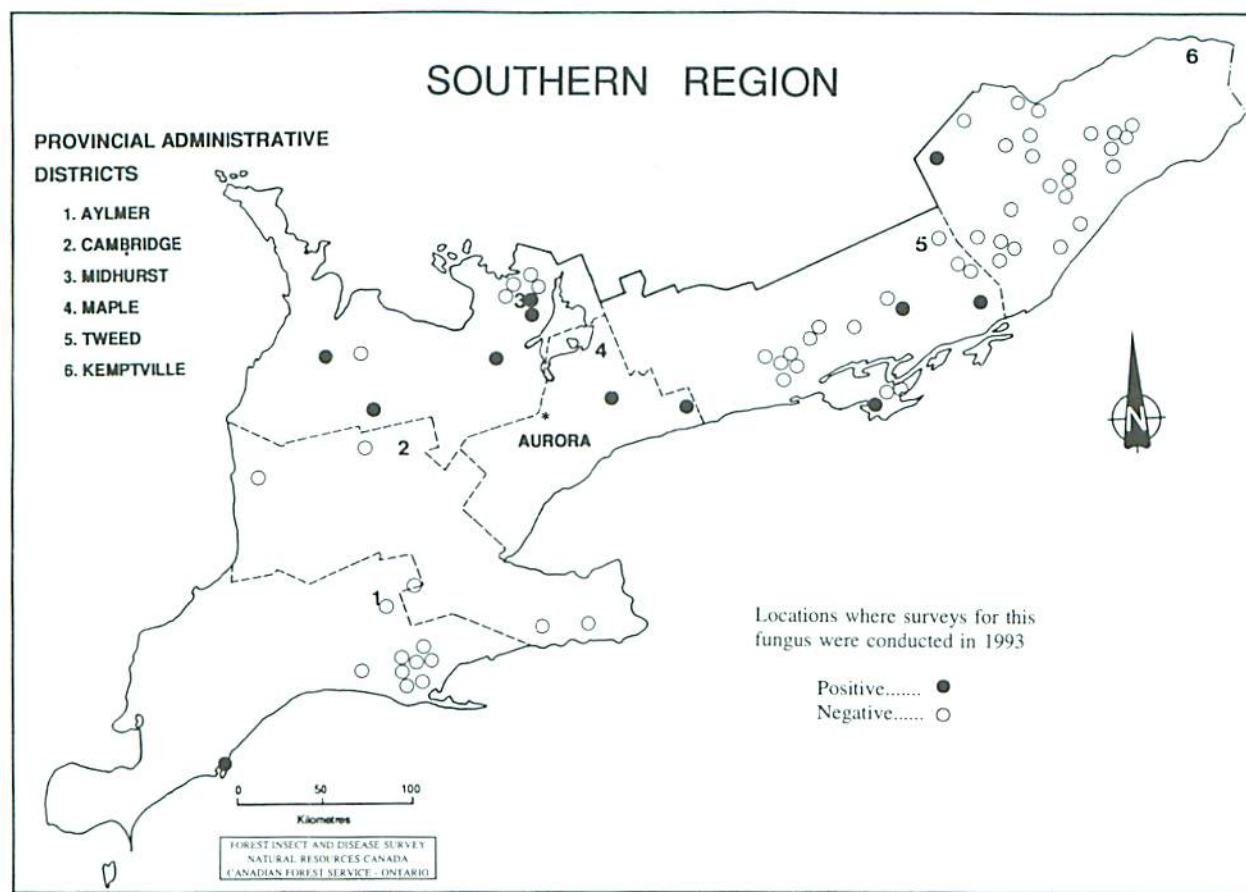


Figure 11. *Armillaria* root rot, *Armillaria* spp.

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

Twenty-six pine plantations were surveyed in the region for the presence of this disease but no evidence of either the North American or European races was detected. Four Scots pine and 22 red pine plantations, ranging in height from 0.8 to 9.0 metres, were surveyed in the Kemptville, Tweed, and northwest Midhurst districts (Fig. 12).

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

This wilt disease, which is capable of causing whole-tree mortality of elms (*Ulmus* sp.), once again appears to be widespread throughout the region. In particular juvenile elm growing along roadsides and fencelines, having reached 10 to 15 cm in diameter, become very susceptible to attack. Feeding bark beetles are the vectors of this fungus.

Pockets of dead and dying juvenile elms were noted at numerous locations. The highest incidence levels were observed along the east side of Lake Simcoe in the Midhurst District, the Niagara peninsula in the Cambridge

District, the western portion of the Aylmer District, and the western portion of the Kemptville District. Roadside assessments in these areas revealed recent whole-tree mortality ranging from 13 to 40%.

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

Surveys have been conducted for the last three years to determine the presence, distribution, and damage level of butternut canker in the region. The causal fungus may be a potentially serious threat to the future existence of butternut throughout its range in Ontario. Butternut is not a very abundant species and is usually found growing as a single tree or in small clumps in association with other hardwoods. In 1991, the fungus was identified for the first time in Ontario at five locations in the southwestern portion of the region.

In 1992, 22 additional positive locations were confirmed and, in 1993, six more sites were identified (Fig. 13). In the Cambridge District, two trees were affected with stem or branch cankers in a woodlot in Hibbert Township and three infected trees were confirmed in Goderich Township. In a woodlot in Charlotteville Township, Aylmer District, three trees were found

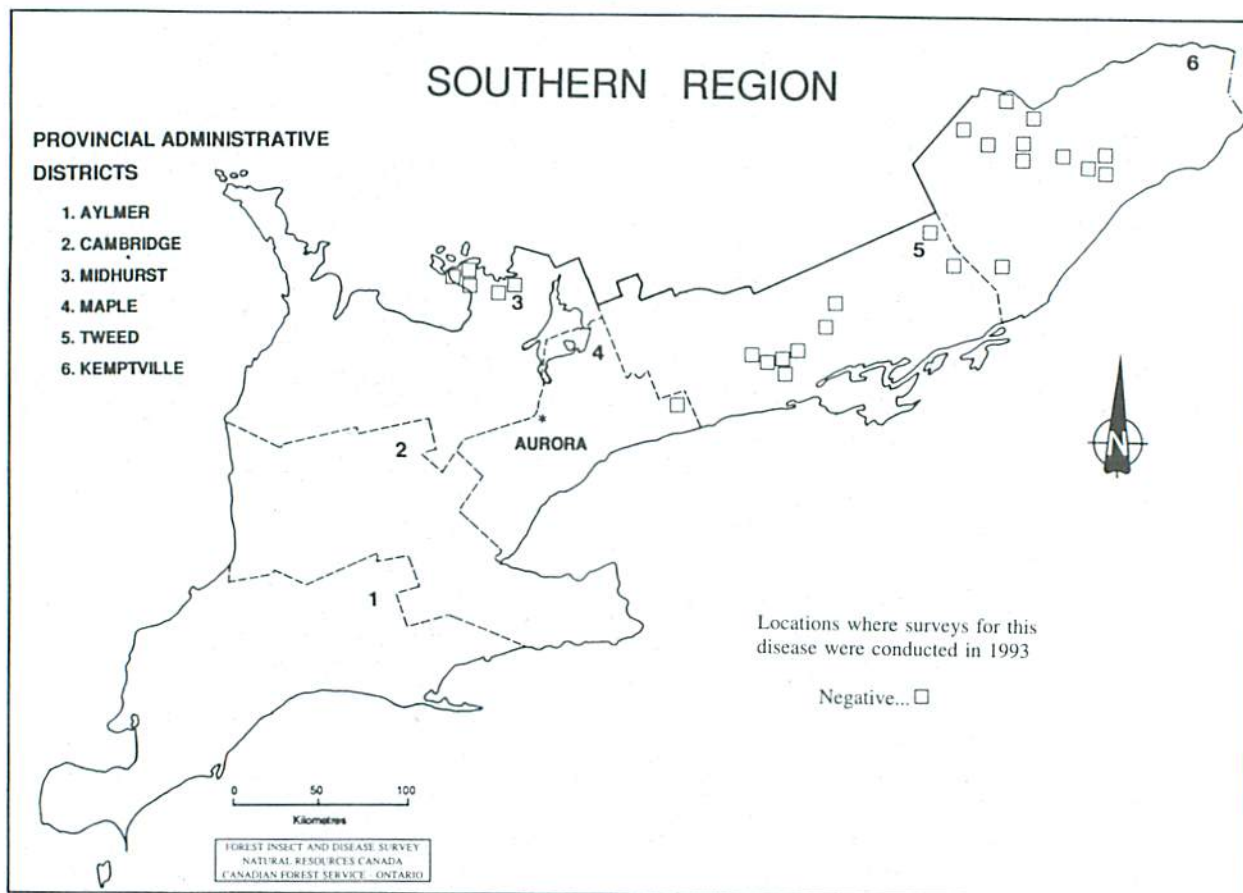


Figure 12. *Scleroderris canker*, *Gremmeniella abietina* (Lagerb.) Morelet.

to be infected. Branch mortality, ranging from 30 to 50%, was recorded at a single site in each of North Crosby and Lavant townships, Kemptville District and Tyendinaga Township, Tweed District.

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

Damage by this tip blight is widespread on a variety of coniferous host trees across the Southern Region. Infection rates and damage levels ranged from trace levels of foliar damage to whole-tree mortality. Stressed Scots pine, Austrian pine (*Pinus nigra* Arnold), and mugho pine (*P. mugo* Turra var. *mughus* Zenari) were the most commonly infected tree species. In some areas, however, healthy vigorously growing similar species of pine were also affected.

The highest infection rates and damage levels were encountered throughout the central portion of the region. In the Cambridge District, severe damage levels were detected at several locations. At the Apps Mills Conservation area, a 100% incidence rate was detected in a 2-ha planting of Scots pine, with a current whole-tree mortality rate of 5% and shoot and branch mortality

levels averaging 40%. An infection rate of 100% was detected in a 2-ha Scots pine plantation in Beverly Township. This resulted in 40–50% branch and shoot mortality and 10% whole-tree mortality. In Maryborough Township, one-half hectare of 7-m Scots pine sustained a current whole-tree mortality rate of 30% and along Highway 4 in Concession 9 of Morris Township, Austrian pine sustained foliar damage levels of 70%.

A number of Scots pine Christmas tree plantations in Essa and Tiny townships, Midhurst District, were found to be severely affected. Incidence levels exceeding 75%, with foliar and branch mortality levels often exceeding 30%, were commonly encountered. Due to this high level of damage the trees were considered not to be marketable and the landowners at two locations decided to cut and burn the infected 5- to 10-ha plantations. Surveys in a 2-ha Scots pine plantation in Adjala Township, Midhurst District, revealed that 17% of the 6-m trees were severely affected, averaging 40% foliar and branch mortality. Routine surveys at the Canadian Forces Base Borden in Tosorontio Township, detected heavy (>50%) foliar and branch mortality on several 40-year-old red pine along the edge of Stand Number 77, south of the

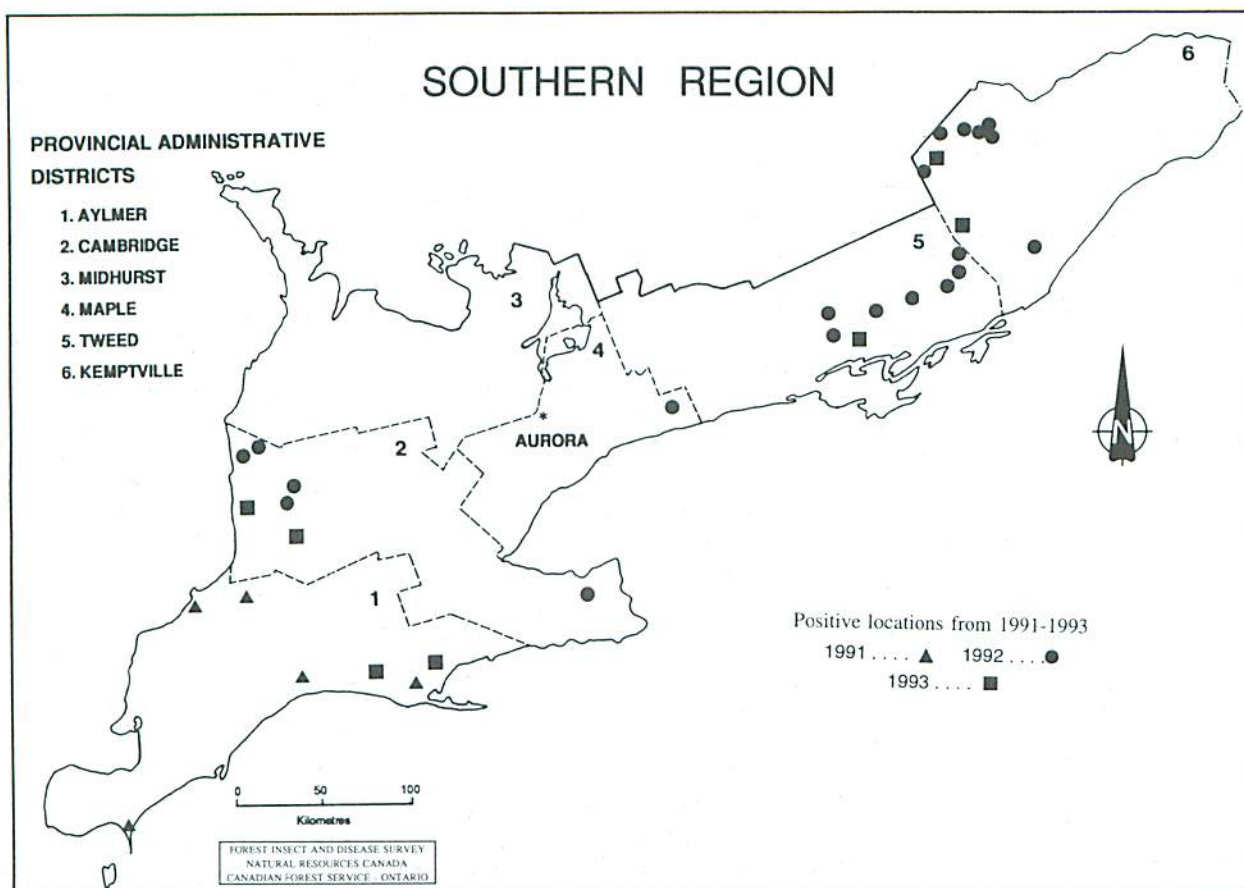


Figure 13. Butternut canker, *Sirococcus clavigenti-juglandacearum* Nair, Kostichka & Kuntz.

main north gate. In King Township, Maple District, a 3-ha Scots pine plantation was evaluated and found to have 50% of the 4.5-m trees affected. Foliar and branch mortality averaged 20%. Standard evaluations in a 3-ha Scots pine plantation in Dummer Township, Tweed District, revealed that 10% of the 6-m trees were affected, averaging 10% foliar damage. In Huntingdon Township, a 10-ha plantation of 12-m trees sustained 25% branch mortality. At a 3-ha Scots pine Christmas tree plantation in Charlotteville Township, Aylmer District, 15% of the trees sustained <5% foliar damage.

Elsewhere in the region roadside plantings, especially Austrian and mugho pine growing along major highway corridors, sustained varying levels of damage. These ranged from 5% foliar damage to whole-tree mortality.

Minor Diseases

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

This needle rust was recorded in only two of the 20 red pine plantations surveyed for this disease in the eastern portion of the region. As such, the incidence of this disease remains low.

In a 2-ha, 2.3-m-tall red pine plantation in Mountain Township, Kemptville District, 15% foliar damage was recorded on 100% of the trees and 10% foliar damage was recorded on 1.3% of the trees in a 0.4-ha, 2.4-m-tall red pine plantation in Huntingdon Township, Tweed District.

Gall Rusts, Eastern Gall Rust, *Cronartium quercum* (Berk.) Myiabe ex Shirafi f. sp. *banksianae* and Western Gall Rust, *Endocronartium harknessii* (J.P. Moore) Y. Hirats

Eastern gall rust was detected in three Scots pine Christmas tree plantations in Tiny Township, Midhurst District. The heaviest damage occurred in a 7-ha plantation where 30% of the trees were affected. Of these, 90% were considered to be severely affected, i.e., the infection was on the main stem. The other two plantations surveyed revealed 30 and 20% of the trees affected, with 50 and 70% of the infected trees severely affected, respectively.

The western gall rust was detected in Blenheim Township, Aylmer District, where a 3-ha Scots pine plantation had 17% of the 2.5-m trees affected. No trees

were detected with main stem infections; however, several trees with heavy branch mortality were considered severely affected. In Middleton Township, Aylmer District, a 2-ha Christmas tree plantation was found to have 9% of the 2.2-m trees affected, with numerous branch galls on the majority of the trees. In a 2-ha Scots pine plantation in Sullivan Township, Midhurst District, 1.3% of the trees were found with main stem cankers.

Leaf Spot, *Phyllosticta sphaeropsoides* Ellis & Everh., *Marssonina tremulae* (Lib.) Kleb., *Mycosphaerella populicola* G.E. Thomps., *Monostichella robergi* (Desm.) Hohn., *Septoria aceris* (Lib.) Berk. & Broome, and *Tubakia dryina* (Sacc.) B. Sutton.

Leaf spot diseases, affecting a variety of hardwood species, were very common across the central and western portions of the region. *Mycosphaerella populicola*, the most prevalent species detected, had an incident rate of 100% and caused moderate-to-severe levels of defoliation to balsam poplar throughout the central and eastern portion of the Midhurst District, the western end of the Tweed District, and the northwestern portion of the Cambridge District.

Marssonina tremulae was detected on large tooth aspen (*P. grandidentata* Michx.) and, wherever host trees occurred, caused 60 to 90% defoliation throughout Lindsay Township, Midhurst District. At St. Clair College, in the City of Windsor, foliar damage caused by *Septoria aceris* averaged 10% on 40 silver maple (*A. saccharinum* L.). In Rondeau Provincial Park, Harwich Township, Aylmer District, *Monostichella robergi* caused an average of 15% defoliation on several scattered blue beech (*Carpinus caroliniana* Walt.). *Tubakia dryina* caused 60% defoliation on red oak in the same park.

Other Forest Diseases

Various other diseases were encountered during the course of regular surveys. Information on these is provided in Table 10.

ABIOTIC DAMAGE

Drought Damage

Below normal precipitation was recorded at various locations in the eastern portion of the region during 1993. These drought conditions, evident by the wilting and yellowing of foliage and premature leaf drop, were observed at several locations, totaling some 548 ha.

The largest concentration of drought damage occurred just to the northeast of the city of Kingston, along Highway 401 in Pittsburgh Township, Tweed District. Red oak, red maple (*Acer rubrum* L.), white birch, basswood (*Tilia americana* L.), and white ash (*Fraxinus americana* L.) 4 m in height were equally affected. Foliar damage reached 100% on trees growing on the rocky outcrops and shallow-soil sites. Damage, delineated in pockets from 29 to 100 ha, totaled 358 ha.

Three areas of damage, totaling 155 ha, were recorded northeast of Stoco, near Otter Creek, in Hungerford Township, Tweed District, where similar damage levels were recorded in 1992 on hardwoods on the rock outcrops. Red oak, basswood, and red maple were severely affected in a 15-ha pocket in Hinchinbrooke Township, north of Fifth Depot Lake. Two additional sites of severe foliar damage, totaling 20 ha each, were recorded in Bedford and Portland townships, Tweed District.

Table 10. Other forest diseases.

Organism	Host(s) ^a	Remarks
<i>Ciborinia whetzellii</i> (Seaver) Seaver Ink spot of aspen	tA	A 1-ha area had 85% of the foliage affected on 18-m host trees in Oxford Rideau Township, Kemptville District.
<i>Cronartium ribicola</i> J.C. Fisch. White pine blister rust	ewP	A 4% infection rate occurred in a 10-ha plantation of 3.5-m trees in Sydenham Township, Midhurst District. All infections were on the main stem. A 5-ha plantation had 0.7% of the 2.1-m trees infected in Hungerford Township, Tweed District.
<i>Eutypella parasitica</i> R.W. Davidson & R.C. Lorenz Eutypella canker	sM	This disease was commonly observed throughout the eastern part of the work area at low levels. It was also recorded on 2 trees in a 10-ha stand in Copeland Forest, Medonte Township, Midhurst District and on a single tree in the sugar maple plot in the city of Richmond Hill, Maple District.
<i>Guignardia aesculih</i> (Peck) V.B. Stewart Leaf blotch	hChe	A single 15-m horse chestnut tree in the town of Cobourg, Tweed District, had 90% of the foliage affected.

(cont'd)

Table 10. Other forest diseases (concl.).

Organisms	Host(s) ^a	Remarks
<i>Gymnosporangium juniperi-virginianae</i> Schwein. Cedar-apple rust	erC	There were generally low levels of this disease; however, heavy infection to host trees occurred near Mallorytown in Front of Yonge Township, Kemptville District.
Herbicide damage	grAs	In Lot 8, Concession 4 in Harwich Township, Aylmer District, some of the 3.5-m green ash had severe leaf mortality and/or browning. Other trees had quite a number of curling leaves. All this damage was caused by drift from the herbicide 2-4-D.
<i>Hymenochaete tabacina</i> (Sowerby: F.R.) Lev. Stem decay	rO	Several recently dead trees were infected with this stem decay in a 1-ha red oak plantation in Copeland Forest, Medonte Township, Midhurst District.
<i>Hypoxyylon mammatum</i> (Wahlenb.) P. Karst. Hypoxyylon canker	tA bPo	A 10-ha area of 11-m trees had a 12% infection rate in Thorah Township, Maple District. More than 20% of the trembling aspen was infected in a 0.5-ha stand along the Lisle Road at Canadian Forces Base Borden, Midhurst District.
Leaf scorch	sM, rM	As the hotter weather progressed in July and August, this condition became more prevalent throughout the region. Foliar damage levels of <25% were common along with early leaf fall. Damage was confined almost exclusively to open-grown and ornamental maples.
<i>Lophodermium</i> sp. Needle cast	ewP	Scattered trees in a 6-m-tall plantation sustained 50–60% foliar damage in Bertie Township, Cambridge District.
<i>Marssonina juglandis</i> (Lib.) Magnus Hickory leaf spot	Bu	Six 8-m butternut trees growing along a laneway in Derby Township, Midhurst District, were heavily infected. Defoliation averaged 60%.
<i>Perennipora subacida</i> (Peck) Donk Spongy root rot	siM	This fungus was found to be infecting a number of silver maples that showed quite severe decline in a mixed maple-black walnut plantation at Parkhill Conservation Area in McGillvary Township, Aylmer District. Dieback on the silver maple was likely caused by its proximity to the the walnut toxin which allowed the spongy root rot to invade the stressed maples.
<i>Phellinus everhartii</i> (Ellis & Galloway) A. Ames White spongy rot	wO	One tree was affected in an oak plot in South Walsingham Township, Aylmer District.
Rodent damage	rP	An evaluation in 1.6-m red pine revealed 3.3% tree mortality in a 1-ha plantation in Bastard Township, Kemptville District.
<i>Venturia macularis</i> (Fr.) E. Mull. & Arx Shoot blight	tA	A 0.5-ha area was heavily infected with >60% of new shoots affected, especially on the natural regeneration, along the Lisle Road at Canadian Forces Base Borden in the Midhurst District.

^a bPo = balsam poplar, Bu = butternut, erC = eastern red cedar, ewP = eastern white pine, grAs = green ash, hChe = horse chestnut, rM = red maple, rO = red oak, rP = red pine, siM = silver maple, sM = sugar maple, tA = trembling aspen, wO = white oak.

Frost Damage

Below freezing temperatures were experienced at scattered locations across the western portion of the region in mid May. Varying levels of hardwood and conifer foliar damage resulted. Damage extended southeasterly from Owen Sound, Midhurst District; through the city of Barrie; across Lake Simcoe; and south easterly to Rice Lake, Tweed District. Pockets of light damage were also reported in the south central portion of the Aylmer District. The majority of damage occurred in low lying areas or on open-growing ornamental trees.

White ash sustained the highest level of damage throughout the affected area. In some instances >75% of the leaves were destroyed; however, at most locations only portions of the newly expanding leaves were affected and thus were not aborted. This resulted in the partial browning of the affected foliage later in the season and was often mistaken as a leaf disease, such as anthracnose. White ash seedlings in Compartment B8 at the St. Williams OMNR Tree Nursery in South Walsingham Township, Aylmer District, sustained 85% foliar damage (see *Forest Tree Nursery Report*).

Moderate levels of foliar and shoot damage, averaging 50%, were detected on 100% of the 0.6-m trees in a 2.5-ha Christmas tree plantation in Charlotteville Township, Aylmer District.

Trace levels (<5%) of foliar damage were also recorded at numerous locations on red oak, bur oak, balsam fir, and white spruce. A survey conducted in a 2.5-ha white spruce Christmas tree plantation in Charlotteville Township, Aylmer District, revealed that 100% of the 1.6-m trees sustained an average of 5% foliar damage. Similar levels were recorded on these species in Essa and Tiny townships, Midhurst District.

Wind Damage

Severe thunder storms, accompanied by high winds, occurred at many locations across the region in 1993. In their paths branches and limbs were broken and trees were snapped and uprooted.

One storm hit the town of Keswick, Maple District, and uprooted numerous ornamental trees in the area. The town of Angus and the city of Barrie, in Midhurst District, suffered three violent storms that brought down large branches and entire trees. Similar damage occurred in the Peterborough area, Tweed District. One storm tracked from the city of Hamilton, northeast across Toronto, through the Lake Simcoe area into the Kawartha Lakes region, and then northeastward into the Pembroke-Renfrew area. It caused severe damage to forested areas and ornamentals in its wake.

Winter Drying

Discoloration and dessication of older foliage was common on juvenile eastern white pine in the area north of Kitchener in the Cambridge District. Along Regional Road 15 in the Luther Marsh, 100% of the 1.2-m trees in a 5-ha plantation were affected with an average of 85% foliar damage. In West Garafraxa Township, 5-ha of 1-m trees were 60% affected, with an average of 35% foliar damage. In addition, this condition was common on conifers along highway corridors and on ornamental conifers across the entire region.

FOREST HEALTH

Dieback/Decline

A multitude of stress factors, including several years of drought, numerous years of insect damage (forest tent caterpillar and gypsy moth), bark beetle and wood boring insect activities, and infections from armillaria root rot have contributed to areas of forest decline, particularly in red oak and white oak stands growing on shallow-soil areas in the Tweed District.

Aerial reconnaissance in this district in 1992 disclosed numerous pockets of severe crown dieback and whole-tree mortality which totaled some 3,880 ha. The damage was concentrated in oak stands west of Sharbot Lake, north of Tamworth, and south of Big Gull Lake in Kaladar, Olden, Sheffield, and Hinchbrooke townships.

Surveys in 1993 showed a multitude of small new pockets in addition to the areas previously damaged. Aerial mapping disclosed that the largest of these areas was in Olden Township, east of Mink Lake, where 290 ha of oak mortality were delineated. The pockets of moderate-to-severe dieback and whole-tree mortality ranged in size from 4 to 290 ha and totaled 1,727 ha in 1993. Together with areas delineated in 1992, the total area of forest decline and whole-tree mortality now totals 5,607 ha in the Tweed District.

Reassessment of a 50-tree oak mortality plot in an area north of Mellon Lake, Sheffield Township, disclosed 54% mortality. This represented an increase of 8% over that recorded in 1992. The remaining 46% of the trees sustained an average of 47% branch dieback.

Maple Health

Annual assessment of 55 maple health plots was completed across the region in 1993. Trees on the 26 sugar maple woodlot, 14 urban, and 15 roadside plots are evaluated individually for total branch dieback within the crown. All pest conditions which affect the vigor of the trees are also recorded. Complete results of the annual crown evaluations in 1992 and 1993 for the three different plot types are presented in Tables 11, 12, and 13.

Table 11. Summary of data collected at 26 woodlot maple health plots in the Southern Region of Ontario for 1992 and 1993. (Counts are based on the examination of 25 sugar maple trees at each location.)

Location (Township)	Average		Year	Cumulative dieback class Number of trees ^a						Cumulative number of cut/windfall trees ^b
	Height (m)	DBH (cm)		0	1	2	3	4	5	
<i>Aylmer District</i>										
Houghton	24	33.3	1992	25	0	0	0	0	0	0
			1993	24	1	0	0	0	0	0
Malahide	22	35.3	1992	23	2	0	0	0	0	0
			1993	24	1	0	0	0	0	0
North Norwich	21	31.0	1992	25	0	0	0	0	0	0
			1993	25	0	0	0	0	0	0
Plympton	22	29.3	1992	20	2	0	0	0	3	0
			1993	21	1	0	0	0	3	0
Warwick	27	31.3	1992	22	0	0	0	0	2	1
			1993	22	0	0	0	0	2	1
<i>Cambridge District</i>										
Morris	21	29.5	1992	25	0	0	0	0	0	0
			1993	25	0	0	0	0	0	0
Onieda	27	40.4	1992	21	3	0	0	0	0	1
			1993	22	2	0	0	0	0	1
South Cayuga	21	21.2	1992	24	1	0	0	0	0	0
			1993	23	2	0	0	0	0	0
<i>Kemptville District</i>										
Lavant	22	37.6	1992	16	0	0	0	0	0	0
			1993	16	8	0	0	0	0	1
Nepean	20	37.1	1992	15	9	0	0	0	1	0
			1993	18	6	0	0	0	1	0
Oxford	24	35.6	1992	21	3	1	0	0	0	0
			1993	20	4	1	0	0	0	0
Pakenham	25	50.5	1992	7	13	4	0	0	1	0
			1993	8	12	4	0	0	1	0
Rear of Leeds and Lansdowne	28	66.4	1992	16	2	0	0	0	4	3
			1993	14	2	0	0	0	4	5
<i>Maple District</i>										
Albion	29	39.7	1992	24	1	0	0	0	0	0
			1993	25	0	0	0	0	0	0
Trafalgar	35	43.6	1992	25	0	0	0	0	0	0
			1993	25	0	0	0	0	0	0
Whitchurch	21	35.5	1992	25	0	0	0	0	0	0
			1993	25	0	0	0	0	0	0
<i>Midhurst District</i>										
Derby	24	31.6	1992	25	0	0	0	0	0	0
			1993	24	1	0	0	0	0	0
Flos	27	33.4	1992	24	1	0	0	0	0	0
			1993	25	0	0	0	0	0	0
Keppel Conc. I	20	27.0	1992	24	1	0	0	0	0	0
			1993	24	1	0	0	0	0	0
Keppel Conc. XII	16	23.0	1992	25	0	0	0	0	0	0
			1993	25	0	0	0	0	0	0

(cont'd)

Table 11. Summary of data collected at 26 woodlot maple health plots in the Southern Region of Ontario for 1992 and 1993. (Counts are based on the examination of 25 sugar maple trees at each location.) (concl.)

Location (Township)	Average		Year	Cumulative dieback class Number of trees ^a						Cumulative number of cut/windfall trees ^b
	Height (m)	DBH (cm)		0	1	2	3	4	5	
<i>Midhurst District (concl.)</i>										
Keppel Conc. XXI	24	32.1	1992	23	1	0	0	0	0	1
Lot 22			1993	23	1	0	0	0	0	1
Keppel Conc. XXI	22	38.3	1992	25	0	0	0	0	0	0
Lot 40			1993	25	0	0	0	0	0	0
Medonte	30	38.0	1992	11	13	1	0	0	0	0
			1993	15	10	0	0	0	0	0
Sullivan	26	42.2	1992	22	2	0	0	1	0	0
			1993	23	1	0	0	0	1	0
<i>Tweed District</i>										
Brighton, Camp	24	45.2	1992	11	8	0	1	1	0	4
			1993	13	6	0	2	0	0	4
Brighton, Staff	23	53.9	1992	14	8	1	0	1	1	0
			1993	19	4	1	0	0	1	0
Totals			1992	538	79	7	1	3	12	10
%			1992	82.8	12.1	1.1	0.2	0.5	1.8	1.5
Totals			1993	553	63	6	2	0	13	13
%			1993	85.1	9.7	0.9	0.3	0.0	2.0	2.0

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

^b Since plot establishment.

In 1993, 96% of the original 650 trees tallied in woodlot situations were alive. The remaining 4% were either cut or had died since plot establishment. Surveys disclosed 85.1% of the trees were very healthy, with <5% crown dieback; a further 9.7% of the trees were considered to be healthy, with only 6–20% crown dieback. The remaining 1.2% of the tree had sustained 21–60% crown dieback. There were no trees recorded in the severe category, >60% crown dieback, in the woodlot plots during 1993.

Assessments this year of the 14 sugar maple urban plots disclosed 91.2% of the 350 original trees were still alive. Crown dieback levels of <5% were recorded on 65.4% of the trees. In addition, 20.0% of the trees exhibited 6–20% dieback and 5.4% showed moderate dieback (21–60%). Dieback >60% was recorded on only 0.3% of the trees.

As exemplified by the results obtained on the 15 roadside plots, sugar maple growing in this environment experience the most harsh growing conditions in the region. Since plot establishment in 1987, 9.9% of the original 375 trees have either died (1.9%) or were cut down (8.0%). In 1993, only 43.7% of the remaining trees were considered to be healthy (6–20% crown dieback) while 13.8% of the trees showed moderate levels of die-

back (21–60%). The roadside plots had the highest percentage (4.5%) of trees in a severe dieback class (>60%). Severely declining trees are often removed by municipalities or townships. For example, 8% were cut in both roadside and urban plots. Only 2% of the trees in the woodlot plots were cut or windblown.

Table 14 summarizes yearly trends in crown condition of the trees in the three different plot types. Overall, the table indicates that crown conditions have improved annually on each of the different plot types, especially during the last three years. The percentage of trees remaining unchanged or static also increased each year. Urban plots showed the most significant change with 14.5% of the trees improving in crown condition. However, this figure may be misleading because trees with severe crown dieback are usually cut down and removed by the municipalities. In turn this makes the urban plots appear healthier than they actually are.

A review of the pests affecting maple trees on roadside plots in 1993 disclosed that the most significant was a leaf anthracnose. In Chinguacousy Township, Maple District, foliar damage ranged from 5 to 90% on 58.3% of the trees. In Clarke Township, Maple District, defoliation ranged from 1 to 60% on 78.3% of the roadside trees. Lighter foliar damage (1–40%), caused by

Table 12. Summary of data collected at 14 urban maple health plots in the Southern Region of Ontario in 1992 and 1993. (Counts are based on the examination of 25 sugar maple trees at each location.)

Location (Township)	Average		Year	Cumulative dieback class Number of trees ^a						Cumulative number of cut/windfall trees ^b
	Height (m)	DBH (cm)		0	1	2	3	4	5	
<i>Aylmer District</i>										
Strathroy	24	82.5	1992	21	3	0	0	0	0	1
			1993	21	2	0	0	0	0	2
Woodstock	23	63.4	1992	17	3	2	0	0	1	2
			1993	17	3	2	0	0	1	2
<i>Cambridge District</i>										
Blyth	23	74.3	1992	13	6	1	0	0	0	5
			1993	12	8	0	0	0	0	5
Guelph	18	70.5	1992	17	8	0	0	0	0	0
			1993	20	5	0	0	0	0	0
<i>Kemptville District</i>										
Brockville	23	64.0	1992	16	5	1	2	1	0	0
			1993	17	6	0	1	0	0	1
Gananoque	24	59.0	1992	16	4	3	0	0	0	2
			1993	17	3	2	1	0	0	2
<i>Maple District</i>										
Oakville	20	82.5	1992	17	5	1	0	0	0	2
			1993	14	7	1	0	0	0	3
Richmond Hill	15	57.9	1992	17	4	1	0	0	0	3
			1993	21	0	1	0	0	0	3
<i>Midhurst District</i>										
Orillia	21	66.1	1992	15	7	2	0	0	0	1
			1993	15	6	1	0	0	0	3
Owen Sound	26	91.0	1992	22	3	0	0	0	0	0
			1993	23	2	0	0	0	0	0
<i>Tweed District</i>										
Campbellford	21	68.0	1992	4	10	3	1	1	0	6
			1993	6	7	5	0	1	0	6
Cobourg	18	68.5	1992	6	15	2	1	0	0	1
			1993	10	9	3	1	0	1	1
Kingston	23	53.0	1992	12	9	3	0	0	0	1
			1993	13	10	1	0	0	0	1
Peterborough	19	51.1	1992	9	16	0	0	0	0	0
			1993	23	2	0	0	0	0	0
Totals			1992	152	121	44	12	21	1	18
%			1992	57.7	28	5.4	1.1	0.6	0.3	6.9
Totals			1993	164	105	41	11	17	2	29
%			1993	65.4	20	4.6	0.9	0.3	0.5	8.3

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

^b Since plot establishment.

anthracnose leaf diseases, was recorded at many locations in urban and woodlot plots. Light defoliation (<25%) was also widespread on 25.6% of the woodlot

trees. This was caused by a combination of late-season defoliators (e.g., maple trumpet skeletonizer, maple leaf-cutter, and leaf scorch). However, <1% defoliation was

Table 13. Summary of data collected at 15 roadside maple health plots in the Southern Region of Ontario in 1992 and 1993. (Counts are based on the examination of 25 sugar maple trees at each location.)

Location (Township)	Average		Year	Cumulative dieback class Number of trees ^a						Cumulative number of cut/windfall trees ^b
	Height (m)	DBH (cm)		0	1	2	3	4	5	
<i>Aylmer District</i>										
Bayham	20	85.9	1992	17	8	0	0	0	0	0
			1993	23	2	0	0	0	0	0
Windham	23	81.9	1992	17	6	2	0	0	0	0
			1993	17	7	1	0	0	0	0
<i>Cambridge District</i>										
Goderich	19	72.4	1992	6	4	4	2	2	2	5
			1993	5	3	5	1	1	2	8
North Easthope	18	69.2	1992	4	5	8	1	5	1	1
			1993	4	4	6	2	5	1	3
<i>Kemptville District</i>										
Edwardsburgh	21	47.0	1992	17	4	3	0	0	0	1
			1993	17	4	3	0	0	0	1
North Elmsley	22	68.0	1992	18	3	1	0	0	0	3
			1993	17	3	0	1	0	0	4
<i>Maple District</i>										
Chinguacousy	18	70.9	1992	8	8	2	3	3	0	1
			1993	10	6	2	1	5	0	1
Clarke	15	72.9	1992	5	16	2	0	0	1	1
			1993	7	8	6	2	0	1	1
<i>Midhurst District</i>										
Mono	18	54.0	1992	9	2	4	3	5	2	0
			1993	7	4	3	3	2	2	4
Sullivan	20	84.4	1992	13	10	1	0	0	0	1
			1993	12	11	1	0	0	0	1
West Gwillimbury	15	69.9	1992	12	9	2	0	2	0	0
			1993	10	10	3	0	2	0	0
<i>Tweed District</i>										
Fenelon	14	57.3	1992	2	17	3	1	1	0	1
			1993	6	13	4	0	0	1	1
Hallowell	26	59.0	1992	8	12	4	0	0	0	1
			1993	12	11	1	0	0	0	1
Hillier	19	67.0	1992	6	7	4	1	3	0	4
			1993	6	9	2	1	2	0	5
Loughborough	22	70.0	1992	10	10	4	1	0	0	0
			1993	11	10	4	0	0	0	0
Totals			1992	202	98	19	4	2	6	19
%			1992	40.5	32.3	11.7	3.2	5.6	1.6	5.1
Totals			1993	229	70	16	3	1	7	30
%			1993	43.7	28	10.9	2.9	4.5	1.9	8.0

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

^b Since plot establishment.

Table 14. Summary of the yearly trend in maple health at 22 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	538	13.2	79.7	6.3	0.7
	1991–1992	531	13.6	80.0	6.4	0.0
	1992–1993	529	6.2	90.7	2.5	0.6
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	77.8	6.1	1.5
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	354	23.5	63.8	11.6	1.1
	1992–1993	350	12.0	73.4	11.4	3.1

^a Declined category includes current mortality.

^b Excludes the 4 plots established in Keppel Township, Midhurst District.

recorded on most of the trees affected. As has been the case from the earliest surveys, trees in roadside plots sustained the majority of open wounds and scars. Approximately 16.9% of the trees were damaged. Urban and woodlot plots exhibited 13.1 and 6.6% tree damage, respectively. Hail damage was recorded on a single roadside plot in Hillier Township, Tweed District. Foliar damage at this site was rated from 2 to 75% on 50% of the trees.

North American Maple Project (NAMP)

Plots for the North American Maple Project were established across the region to annually monitor the crown condition of sugar maple trees and to determine possible causes of decline should it occur. This was the fifth year since plot establishment and, in addition to the customary crown measurements recorded throughout the 16 plots, the diameter of all trees in each plot was re-measured. Any intermediate tree that had reached a minimum DBH of 10 cm since the plots were established was added to the plot record. This ingrowth, together with the fact that trees have been cut and removed, accounts for the differences in the "Number of trees examined" category in Tables 15 and 16.

The 16 stands evaluated each year are actively managed and eight are currently being tapped for maple syrup production. In a woodlot that is managed for

maple syrup production, the older trees, with high levels of dieback, are generally removed. In a woodlot managed for sawlogs, the healthy, dominant trees are removed. These various management techniques exist throughout the plots and impact upon the data. Therefore, in maple syrup woodlots the stands may appear healthier than in unmanaged woodlots because trees with high levels of dieback are continually removed. The reverse is true in woodlots managed for sawlogs (Fig. 14).

During 1993 a total of 374 trees were evaluated across the eight tapped maple sugar woodlots. The overall condition of the trees was very healthy and there were signs of general improvement. It was determined that 90.4% of the crowns were rated at <5% dieback and only 0.8% had >46% dieback, compared with 84.2 and 0.9% respectively, in 1992. A definite improvement was recorded in the plots showing the highest levels of dieback in 1992. The first was in the Belmont Township plot, Tweed District, where 15.4% of the trees were recorded with 6–25% crown dieback, compared with 28.8% in 1992. The second was in Orillia Township, Midhurst District, where only 7.3% of the trees were rated with decline levels of 6–25% compared with 18.9% last year. The overall current mortality rate was only 0.5% and equated to two trees on the Townsend Township plot in Aylmer District. These two particular trees were recorded with severe dieback last season.

Table 15. Summary of crown conditions of sugar maples at eight North American Maple Project plots not tapped for maple syrup in the Southern Region for 1992 and 1993.

Location (Township)	DBH (cm)	Year	Number of trees examined	Percentage of dead crown 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	1992	42	41	1	0	0	0	0	0
		1993	42	41	1	0	0	0	0	0
Warwick	26.5	1992	47	37	5	0	0	0	0	5
		1993	42	39	3	0	0	0	0	0
<i>Cambridge District</i>										
West Wawanosh	29.9	1992	36	35	1	0	0	0	0	0
		1993	37	36	0	0	0	1	0	0
<i>Kemptville District</i>										
Rear of Yonge and Escott	19.1	1992	59	54	5	0	0	0	0	0
		1993	62	56	6	0	0	0	0	0
<i>Maple District</i>										
Nassagaweya	30.0	1992	48	42	5	0	0	1	0	0
		1993	48	42	5	0	0	0	0	1
<i>Midhurst District</i>										
Adjala	30.4	1992	62	38	20	1	1	1	1	0
		1993	62	50	7	2	0	1	0	2
Oro	23.5	1992	64	63	0	1	0	0	0	0
		1993	64	62	2	0	0	0	0	0
<i>Tweed District</i>										
Hallowell	33.0	1992	30	15	14	0	0	0	1	0
		1993	30	27	3	0	0	0	0	0
	Total	1992	388	325	51	2	1	2	2	5
	%	1992	100	83.7	13.1	0.5	0.3	0.5	0.5	1.3
	Total	1993	387	353	27	2	0	2	0	3
	%	1993	100	91.2	6.9	0.5	0.0	0.5	0.0	0.8

In the eight nontapped sugar maple woodlots a total of 387 trees were evaluated and, similar to the tapped woodlots, the overall condition of the trees was very healthy and showed signs of improvement from 1992. A total of 91.2% were considered very healthy (<5% dieback) and only 0.5% exhibited >46% crown damage. This compared with 83.7 and 0.8% respectively, in 1992. Improvement was also recorded in two plots showing severe dieback last season. At a plot in Hallowell Township, Tweed District, 10.0% of the trees were rated at the 6-26% dieback level this season compared with 46.7% in 1992. At the Adjala Township plot in the Midhurst District, 11.3% were recorded at this level compared with 32.2% last season. No current mortality was recorded throughout the eight plots. A complete summary of the data from the 16 individual plots is presented in Tables 15 and 16.

Trace levels of defoliation caused by various pests were recorded across all of the plots. Commonly en-

countered were open defoliators, leaf rollers, midges, skeletonizers, and an anthracnose leaf disease. At the Hallowell Township plot moderate-to-severe defoliation was recorded on several trees. This was caused by pear thrips and averaged 30% across the entire plot. As well, moderate defoliation levels were caused by the maple trumpet skeletonizer.

Severe storm damage also occurred throughout this plot and several large eastern white cedar were blown down. Logging damage, caused in 1992, was still evident in the crowns of the residual trees across the plot in Warwick Township, Aylmer District. Trace population levels of gypsy moth and forest tent caterpillar were recorded on the plot in Rear of Yonge and Escott Township in Kemptville District and trace levels of hail damage were detected across the plot in Adjala Township, Midhurst District. Virtually no seed crop was recorded throughout all of the 16 plots in the region.

Table 16. Summary of crown conditions of sugar maples at eight North American Maple Project plots currently tapped for maple syrup in the Southern Region for 1992 and 1993.

Location (Township)	DBH (cm)	Year	Number of trees examined	Percentage of dead crown					Annual number of dead trees	Annual number of cut trees
				Number of trees						
				0-5	6-25	26-45	46-65	>65		
<i>Aylmer District</i>										
Bayham	73.5	1992	39	35	3	1	0	0	0	0
		1993	40	36	3	1	0	0	0	0
Townsend	41.1	1992	32	23	3	2	1	2	0	1
		1993	31	22	3	1	2	1	2	0
<i>Cambridge District</i>										
Goderich	32.3	1992	60	56	2	1	0	0	1	0
		1993	60	56	4	0	0	0	0	0
<i>Kemptville District</i>										
South Burgess	38.4	1992	42	34	7	1	0	0	0	0
		1993	42	38	4	0	0	0	0	0
<i>Maple District</i>										
Vaughan	30.8	1992	44	41	3	0	0	0	0	0
		1993	56	56	0	0	0	0	0	0
<i>Midhurst District</i>										
Orillia	36.7	1992	53	42	10	1	0	0	0	0
		1993	55	50	4	0	0	0	0	1
Saugeen	30.8	1992	38	35	2	1	0	0	0	0
		1993	38	36	1	1	0	0	0	0
<i>Tweed District</i>										
Belmont	26.6	1992	52	37	15	0	0	0	0	0
		1993	52	44	8	0	0	0	0	0
<hr/>										
	Total	1992	360	303	45	7	1	2	1	1
	%	1992	100	84.2	12.5	1.9	0.3	0.6	0.3	0.3
	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

Oak Health

The ten oak health plots that were established across the region in 1977 are monitored annually to determine crown conditions, damage by foliar pests, stem defects, and abiotic damage. Each plot consists of 100 mature or semimature oak trees. Table 17 provides the cumulative crown conditions, per plot, for 1992-1993, as well as the number of windfall and cut trees. Overall, the percentage of trees that were considered very healthy increased this season. Some 49.3% showed virtually no dieback (0-5%) compared with 28.5% in the same category in 1992. This general state of improvement was also evident in the 6-20% category where the number of trees decreased from 49.3% in 1992 to 36.4% in 1993 (Fig. 14).

The proportion of trees showing a severe degree of crown dieback (>61%) decreased marginally this season from 2.8 to 2.7%. Annual mortality rates also decreased marginally from 2.0 to 1.6%. Three plots showed no current mortality.

Table 18 summarizes the changes in crown condition of all trees on an annual basis since 1984. Since inception of the plots, statistics show that 65.4% of the trees have remained in a static condition and a continued improvement in health was noted in 1992-1993. This trend dates from 1989-1990, when only 8.8% of the trees were in this category, compared to 32.0% this season.

The only major insect pest recorded this season was the gypsy moth. Six out of ten plots were affected but five of these exhibited only trace populations. Moderate-to-severe defoliation was recorded on the oaks in the plot located at Pinery Provincial Park in Bosanquet Township, Aylmer District. Armillaria root rot infected 2.7% of the trees at the plot at Flower Station in Lavant Township, Kemptville District. At the plot at Joe Lake in Lavant Township, 3.6% of the trees sustained sapsucker damage. All of the trees in the plot at Turkey Point Provincial Park in Charlotteville Township, Aylmer District, were affected at trace damage levels by the oak

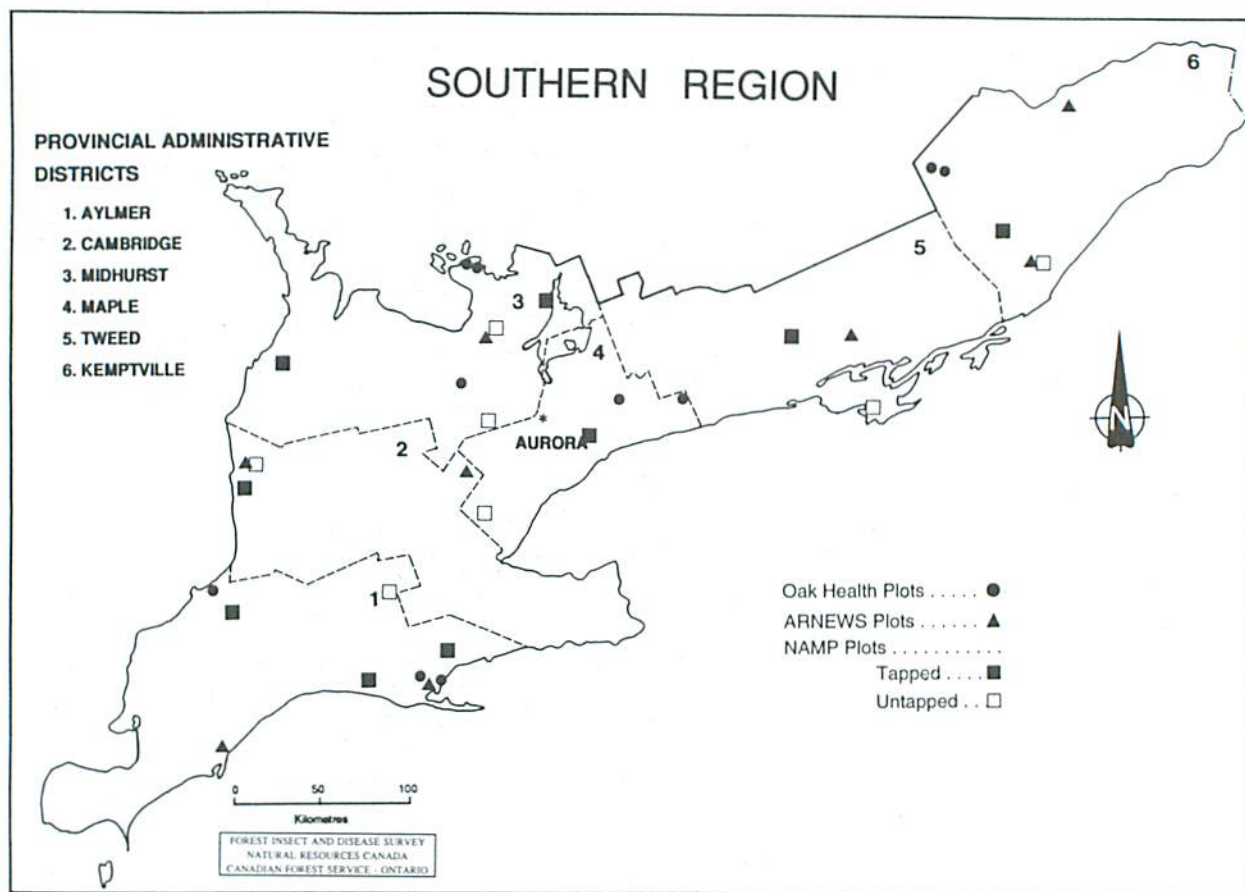


Figure 14. Hardwood monitor plots.

leaf-tier (*Psilicorsis quercicella* Clem.). In Mulmur Township, Midhurst District, an unidentified spring defoliator caused trace defoliation levels on 100% of the plot trees.

Acid Rain National Early Warning System (ARNEWS)

A total of eight ARNEWS plots, targeting four tree species, are evaluated annually across the region to monitor any possible effects of airborne pollutants on forest trees. Evaluation of trees on the plots also considers 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 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 (*Quercus 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 (Fig. 14).

All sugar maple ARNEWS plots are located in semi-mature sugar maple stands. A total of 63 of the original 68 dominant or codominant trees are still alive and were evaluated. This season it was determined that 65.1% (41) of the trees were very healthy, i.e., found to have no dead branches within the living crown but bare twigs were present on more than 6% of the crown. The remaining 34.9% (22) of the trees were recorded to have a low level of crown dieback i.e., dead branches and twigs were present in up to 15% of the living crown. Trace levels of defoliation (1–5%), caused by open defoliating insects and a leaf spot disease, were present on 100% of the plot trees. Carpenter ants (*Camponotus* sp.) inhabited the lower bowl of a single tree at the Howard and Oro township plots and the sugar maple borer (*Glycobius speciosus* [Say]) infested two trees at the Oro Township plot. No current whole-tree mortality or seed production was recorded on the plots.

The two eastern white pine ARNEWS plots are located in semimature plantations and a total of 89 of the original 93 trees are still alive. A normal, healthy pine retains a 4 year complement of foliage. This is comprised of the current years foliage and three internodes. In turn each internode maintains a minimum of 25% of its

Table 17. Summary of data collected at 10 oak health plots in the Southern Region of Ontario in 1992 to 1993. (Counts are based on an examination of 100 oak trees at each location since 1977.)

Location (Township)	Average Height (m)	DBH (cm)	Year	Cumulative dieback class Number of trees ^a						Cumulative number of cut/windfall trees ^b
				0	1	2	3	4	5	
<i>Midhurst District</i>										
Mulmur	21.0	28.8	1992	49	29	5	0	1	1	24
			1993	59	21	3	0	0	13	4
Tiny – Awenda Provincial Park	22.1	28.5	1992	20	39	6	2	1	17	15
			1993	54	10	1	2	0	18	15
Tiny – Farlain Lake	22.0	26.0	1992	32	19	1	2	3	39	4
			1993	43	8	2	0	3	40	4
<i>Maple District</i>										
Clarke	20.6	24.5	1992	15	64	3	1	0	17	0
			1993	66	15	0	1	0	17	1
Uxbridge	21.5	26.2	1992	20	45	2	0	1	32	0
			1993	33	30	3	1	1	32	0
<i>Aylmer District</i>										
Bosanquet	16.6	29.0	1992	38	29	6	5	6	16	0
			1993	28	39	5	2	10	16	0
Charlotteville	20.1	32.0	1992	14	52	23	3	1	7	0
			1993	36	52	3	0	2	7	0
South Walsingham	17.0	22.0	1992	35	37	4	2	2	20	0
			1993	62	14	1	0	0	23	0
<i>Kemptville District</i>										
Lavant – Flower Station	13.6	20.6	1992	2	45	21	4	3	25	0
			1993	2	44	21	2	2	29	0
Lavant – Joe Lake	12.5	25.5	1992	0	31	41	7	4	17	0
			1993	0	49	26	4	3	18	0

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

^b Cumulative total from 1977.

respective foliage. This year's evaluation revealed that 100% (89) of the trees retained less than 25% foliage on either the 1992 or 1991 internode. Therefore, under the terms of the ARNEWS program, the trees are considered to be in a light state of decline. No current defoliation was recorded at either site. White pine blister rust (*Cronartium ribicola* J.C. Fischer) was detected on the main stem of a single tree at the Hungerford Township plot and snow damage was reported in the Erin Township plot. No current whole-tree mortality or cone production was recorded on the plots.

The single white spruce ARNEWS plot is located in a semimature plantation and 60 of the original 69 trees are still alive. This season 96.7% (58) of the trees were considered healthy and showed <25% total defoliation. The remaining 3.3% (2)

Table 18. Summary of the yearly trend in tree health at 10 oak health plots from 1984 to 1993. (Counts are based on the examination of 100 oak trees at each location.)

Years	Yearly trend (% of trees)			Number of newly dead trees per year
	Improved	Static	Declined ^a	
1984–1985	25.9	67.4	6.6	4
1985–1986	37.3	56.8	5.6	10
1986–1987	18.9	73.2	7.9	6
1987–1988	10.8	74.2	15.1	3
1988–1989	10.0	58.6	31.4	12
1989–1990	8.8	64.5	26.7	17
1990–1991	23.8	61.0	15.2	20
1991–1992	19.4	59.4	21.3	16
1992–1993	32.0	59.5	8.4	12

^a Declined category includes current mortality.

were recorded to have >90% total defoliation. The eastern spruce budworm has been a serious pest problem on

this plot for the past 3 years and has been the primary cause of the defoliation. Current defoliation caused by this pest averaged 60% on the plot trees and ranged from 1 to 100%. This year's survey also detected two dead trees; however, the cause of mortality could not be determined because under the terms of the ARNEWS program destructive sampling is not permitted on the actual plot. No current cone production was reported on the plot.

The single oak plot, established in a semimature white oak and black oak stand in south Walsingham Township, Aylmer District, had all of the original 12 trees still alive. This year's evaluation revealed that 16.6% (2) of the trees were very healthy, i.e., found to have no dead branches within the living crown but bare twigs were present on more than 6% of the crown. Nine of the trees, 75.0%, were considered to have dead branches and bare twigs in up to 15% of the crown. The remaining 8.3% (1) of the trees were found to have dead branches and twigs present in up to 50% of the crown. Trace levels (1–5%) of current defoliation, caused by open defoliators such as gypsy moth, were recorded on 100% of the plot trees. Three trees were infected at a trace level with an anthracnose leaf disease. No current mortality or seed production was recorded on the plot.

SPECIAL SURVEYS

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

This European pine pest was first discovered in North America in 1992 on Scots pine trees in the state of Ohio. During the 1993 field season it was collected and positively identified from foliage samples collected in the Southern Region of Ontario.

This pest has one generation per year. It overwinters as an adult in shoots, under the bark at the base of a host tree, in fallen trees, or in the litter. In early spring the adults mate and lay eggs in horizontal galleries on felled or weakened trees. The larvae develop and tunnel under the bark to seek pupation sites. Adult beetles emerge a short time later, usually in June, through the outer bark. They then fly to the crown of living trees and bore into and feed upon the central portion of the expanding lateral shoots. In doing this they produce a characteristic cleanly excavated tunnel. Damaged shoots droop, turn reddish brown, and eventually drop to the ground. Each adult may destroy two to five lateral shoots per tree. Scots pine is the preferred host and therefore this pest is of major concern to Christmas tree growers, especially when quarantines are applied to infested areas. Adults will also readily feed on red pine and eastern white pine.

In the Southern Region of Ontario, 37 pine plantations were examined in 1993 for any evidence of adults causing lateral shoot damage (Fig. 15). Positive identi-

fication of adults and damage was confirmed from three locations on the Niagara Peninsula in the Cambridge District. Adults were recovered from the lateral shoots of 3- to 8-m Scots pine at Lot 7, Con. IV, in South Cayuga Township and from shoots in a 6-m eastern white pine plantation along Farm Road, at Beaver Creek in Bertie Township. A third site was located near the town of Rockton, Flamborough Township, in unevenaged Scots pine that was heavily infected with *Diplodia* tip blight.

During an information seminar/field trip, Agriculture Canada personnel also collected adults from a recently dead Scots pine along the Niagara Parkway, north of Niagara Falls. Agriculture Canada had successfully trapped adults at this particular site earlier in the season. Additional information may be obtained directly from Agriculture Canada in Ottawa.

Forest Tree Nursery Reports

There are three OMNR Forest Tree Nurseries in the Southern Region: the St. Williams nursery in the Aylmer District, the G. Howard Ferguson nursery in the Kemptville District, and the Orono nursery in the Maple District. The following is a summary of pest data collected at the three nurseries during the 1993 field season.

St. Williams Forest Tree Nursery

Four routine inspections and one unscheduled visit were completed this season at this nursery and no major pest problems were encountered. Cedar leafminers caused an average of 15% defoliation to a number of eastern white cedar hedgerows throughout the nursery. Frost caused approximately 85% foliar damage to rising 2–0 white ash across the southern half of Compartment B8 and a leaf spot (*Mycosphaerella effigurata* [Schw.] House) caused 35% foliar damage to rising 2–0 green ash in the northern half of this same compartment. A 5% whole-tree mortality rate and chlorotic, wilted trees were detected in the rising 2–0 eastern white pine trees across the eastern portion of Compartments B1 and C7. Two pathogens, *Fusarium* sp. and *Cylindrocarpum* sp., were isolated from the affected trees in the compartments. A mortality rate of 50% was detected in the rising 2–0 eastern white pine in the northern half of Compartment B9 and 25% of the eastern white pine in Compartment C7 failed to germinate. No primary pathogen was isolated from either of these compartments.

Orono Forest Tree Nursery

Five routine inspections and two unscheduled visits were completed at this nursery during 1993. European marsh crane fly larvae, also known as leatherjackets, (*Tipula paludosa* Meigen) caused 60% mortality in the rising 1–0 red pine in Compartment S01 and 5%

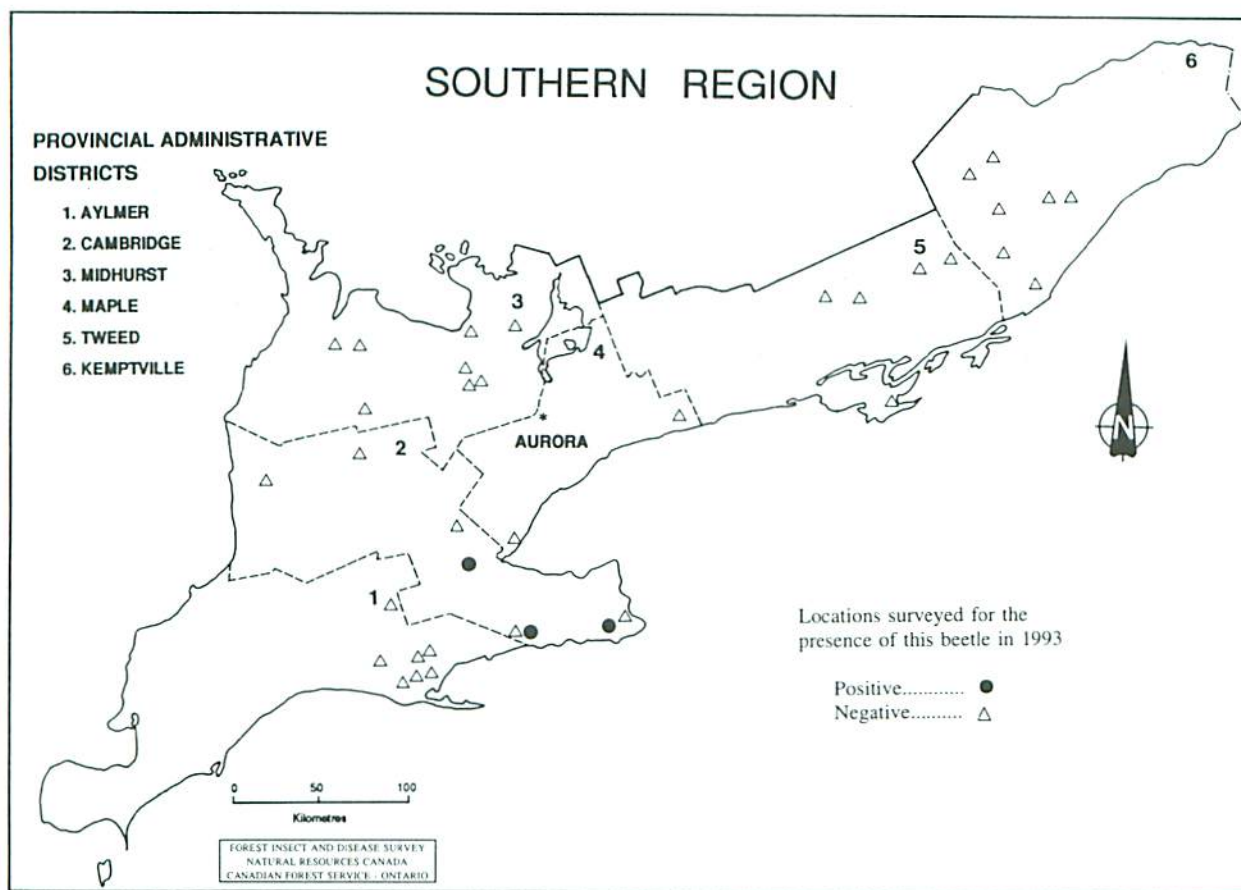


Figure 15. Pine shoot beetle, *Tomicus piniperda* (L.).

mortality in rising 1 – 0 red pine in Compartment S31. This is the first time that this species of insect larvae has been collected at the Orono Nursery and only the second time it has been collected at a provincial tree nursery. A survey of the Christmas Tree Growers Associations' clonal Scots pine orchard at the nursery revealed that 90% of the 2-m trees sustained an average of 60% defoliation caused by the European pine sawfly. A single, aerial application of the insecticide *Carbaryl* was applied by the association to control the population. Windbreak European larch growing along the edge of Compartments S41 and S50 sustained 95% defoliation by the larch casebearer. The eastern spruce budworm caused trace levels of defoliation across a 7-ha, 12-m-tall white spruce seed orchard. Trace populations of the white pine weevil were found affecting several potted, grafted 1-m eastern white pine in the cold frames. Trace populations of the spruce spider mite (*Oligonychus ununguis* [Jac.]) were detected, and treated with a single application of the insecticide *Orthene*, in three red pine compartments and on four 18-m windbreak larch trees at Compartment S5. Late summer surveys of European alder (*Alnus incana* [L.] Moench) in Compartment S50 revealed that 90% of the 8-m trees sustained 30% foliar

damage caused by the European alder leafminer (*Fenusa dohrnii* [Tisch.]) and <2% damage caused by the woolly alder sawfly (*Eriocampa ovata* [L.]). Cedar leafminers caused trace foliar damage levels throughout the nursery on eastern white cedar windbreaks and the privet leafminer (*Caloptilia fraxinella* [Ely]) caused an average of 5% defoliation on 10% of the 1.5-m white ash in Compartment S42. Severe defoliation, (>75%) caused by the cranberry leaf beetle, *Pyrrhalta viburni*, was detected on highbush cranberry (*Viburnum trilobum* Marsh.) in Compartment S34.

Fomes root rot (*Heterobasidion annosum* [Fr.] Bref.) was detected in a 1-ha, 50-year-old red pine plantation. A survey of the stand confirmed that 40% of the trees were either dead or dying as a result of this infestation. A leaf spot (*Marssonina tremulae* [Lib] Kleb.) detected in Compartment T22 caused 3% foliar damage on 75% of the 1.0-m hybrid poplar trees and downy mildew (*Plasmopara viburni* Peck) affected 75% of the foliage on 100% of the highbush cranberry in Compartment S34. Oak leaf-blisters (*Taphrina caerulescens* [Desm. & Mont.] Tul.) affected 10% of the foliage on 20% of the three-year-old red oak in Compartment S42.

G. Howard Ferguson Forest Tree Nursery

Five inspections were completed at this nursery during the 1993 season. Open-growing, 18-m-tall bur oak sustained 50–75% defoliation as a result of infection by a leaf anthracnose, *Apiognomonia errabunda* (Roberge) Hohn. A single 17-m-tall white oak sustained 10% foliar damage caused by a serpentine leafminer, *Stigmella saginella* (Clemens). Throughout the nursery, cedar leafminers caused light foliar damage (5–20%) to eastern white cedar windbreaks averaging 8 m in height. The eastern spruce budworm caused moderate-to-severe defoliation averaging 75% in Compartments 72 and 73. The damage was recorded throughout the 2-ha plantation of 15-m white spruce. An egg-mass sample, taken to help forecast possible defoliation levels for 1994, indicated that severe damage is likely in the plantation next year. The larch casebearer caused 80–100% foliar browning on several 12-m tamarack trees growing in forested areas on the nursery grounds.

The 4.5-m-tall eastern white pine in the 0.2-ha Tree Improvement Area #4 in the Kemptville Nursery were infested with several pests. The introduced pine sawfly infested 100% of the trees and caused 15% defoliation. One to eight laterals per tree were killed on 76% of the trees as a result of feeding by the eastern pine shoot borer and 10% defoliation was caused by the white pine needle midge, *Resseliella pinifoliae*.

The balsam twig aphid (*Mindarus abietinus* Koch) infested 40% of the 2+1 Norway spruce and white spruce in Compartments B6 and B14; however, no damage could be attributed to this infestation. *Cylindrocarpon* sp. root rot caused <1% seedling mortality to 1 1/2+1 1/2 Norway spruce in Compartment C15 and *Fusarium* sp. was responsible for <5% mortality to 1+1/2 eastern white pine in Compartment C7. A leaf spot, *Marsonina tremulae* (Lib) Kleb., caused foliar damage which ranged from 10 to 75% in poplar stool beds in Compartment C8 and 3+0 high bush cranberry in Compartment 2 were severely infected by a downy mildew (*Plasmopara viburni* Peck) which caused 100% foliar damage and premature leaf drop.

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 19 summarizes the weather data for 1993 provided by Atmospheric Environment Service weather offices in the Southern Region of Ontario. The "normals" quoted were taken directly from the 1950 to 1980 Canadian Climate Normals for Ontario.

Table 19. A summary of temperatures and precipitation in 1993 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	Jan.	-9.3			44.1		
	Feb.	-8.5			48.9		
	March	-2.5			62.9		
	April	6.0	5.8	-0.2	71.8	87.8	+22.3
	May	12.1	11.8	-0.3	57.1	55.5	-2.8
	June	16.8			60.4		
	July	19.2			77.9		
	Aug.	18.1			74.2		
	Sept.	14.0	11.7	-2.3	72.9	52.4	-28.1
	Oct.	7.9			59.9		
	Nov.	2.1			69.4		
	Dec.	-6.0			74.3		

(cont'd)

Table 19. A summary of temperatures and precipitation in 1993 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	
Lester B. Pearson International Airport	Jan.	-6.7	-4.0	+2.7	50.4	70.6	+40.0
	Feb.	-6.1	-8.4	-2.3	46.0	26.6	-42.2
	March	-1.0	-2.1	-1.1	61.1	31.0	-49.3
	April	6.2	6.6	+0.4	70.0	85.4	+22.0
	May	12.3	12.1	-0.2	66.0	51.6	-21.8
	June	17.7	17.1	-0.6	67.1	133.8	+99.4
	July	20.6	21.6	+2.0	71.4	87.4	+22.4
	Aug.	19.7	21.1	+1.4	76.8	39.9	-48.0
	Sept.	15.5	13.6	-1.9	63.5	59.2	-6.8
	Oct.	9.3			61.8		
	Nov.	3.3			62.7		
	Dec.	-3.5			64.7		
London	Jan.	-6.6			75.2		
	Feb.	-6.1			60.5		
	March	-0.9			75.1		
	April	6.4	6.4	0.0	81.2	114.3	+40.8
	May	12.4			66.9		
	June	17.9	17.4	-0.5	73.6	102.1	+38.7
	July	20.3	21.0	+0.7	72.4	91.0	+25.7
	Aug.	19.5	20.5	+1.0	80.3	42.4	+47.2
	Sept.	15.4	13.2	-2.2	78.6	135.8	+72.8
	Oct.	9.4			73.4		
	Nov.	3.1			84.7		
	Dec.	-3.5			87.5		
Delhi	Jan.	-6.0	-3.0	+3.0	68.8	123.9	+80.0
	Feb.	-5.4	-7.3	-1.9	56.8	41.5	-27.0
	March	-0.3	-1.7	-1.4	84.4	71.3	-15.5
	April	6.7	7.2	+0.5	93.6	96.9	+3.5
	May	12.8	12.9	+0.1	73.7	57.5	-22.0
	June	17.0			75.0		
	July	20.7			76.6		
	Aug.	19.8			96.3		
	Sept.	15.9			88.4		
	Oct.	9.9			90.3		
	Nov.	3.7			101.4		
	Dec.	-2.9			116.2		
Blyth	Jan.	-7.9	-4.8	+3.1	105.8	124.6	+17.8
	Feb.	-8.2	-9.8	-1.6	67.2	102.5	+52.5
	March	-2.8	-2.9	-0.1	62.7	23.5	-62.5
	April	5.1	5.8	+0.7	71.9	108.5	+50.9
	May	11.8	11.8	0.0	73.7	58.5	-20.6
	June	17.0			75.0		
	July	19.7			76.6		

(cont'd)

Table 19. A summary of temperatures and precipitation in 1993 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	
Blyth (cont'd)	Aug.	18.8			96.3		
	Sept.	15.1			88.4		
	Oct.	8.7			90.3		
	Nov.	2.5			101.4		
	Dec.	-4.3			116.2		
Ottawa	Jan.	-7.6	-9.2	-1.6	61.0	109.0	+78.7
Intntl. Airport	Feb.	-9.5	-13.6	-4.1	60.3	60.5	+0.3
	March	-3.0	-3.6	-0.6	67.5	86.5	+28.0
	April	5.6	5.6	0.0	69.1	144.1	+108.5
	May	12.8	13.3	+0.5	67.5	60.2	+10.8
	June	18.0	17.4	-0.6	73.4	101.4	+38.0
	July	20.6	21.8	+2.4	85.9	65.6	-20.3
	Aug.	19.2	21.0	+1.8	88.4	50.4	-38.0
	Sept.	14.3	13.3	-1.0	79.3	91.6	+12.3
	Oct.	8.1	6.1	-2.0	68.1	101.2	+48.6
	Nov.	1.2			86.1		
	Dec.	-7.7			82.9		
Trenton	Jan.	-7.6	-5.8	+1.8	68.9	99.9	+45.0
	Feb.	-6.5	-10.6	-4.1	57.0	51.5	-9.6
	March	-1.0	-2.9	-1.9	72.0	47.2	-34.4
	April	6.4	5.9	-0.5	76.1	86.4	+13.5
	May	12.5	12.1	-0.4	73.0	51.0	-30.1
	June	17.8	16.9	-0.9	63.7	100.8	+58.2
	July	20.6	21.2	+1.6	60.9	43.2	-29.0
	Aug.	19.7	20.5	+0.8	71.9	47.8	-33.5
	Sept.	15.3	13.4	-1.9	72.8	96.6	+32.7
	Oct.	9.2			70.1		
	Nov.	3.2			86.1		
	Dec.	-4.5			82.9		