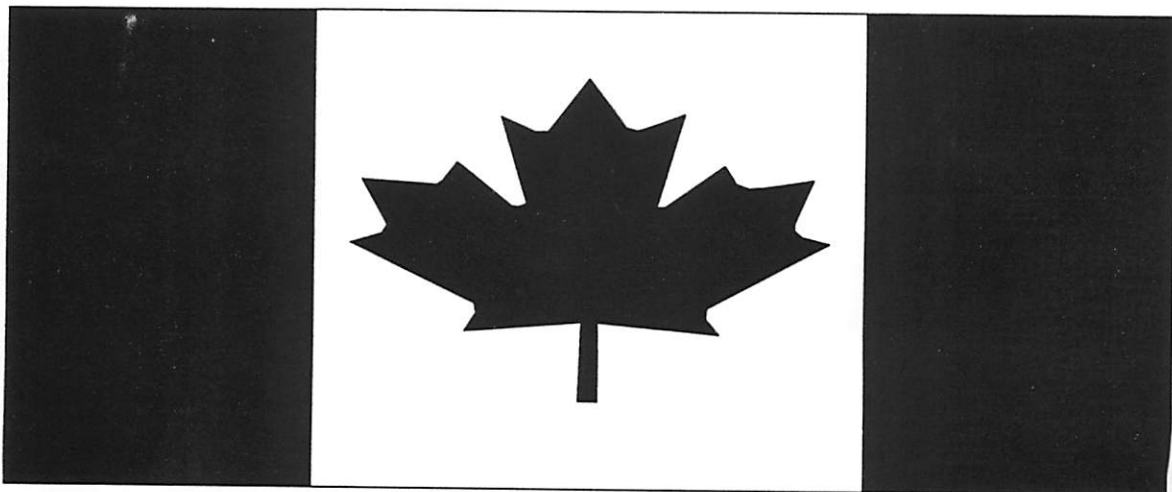


**RESULTS OF FOREST HEALTH MONITORING
IN THE SOUTHCENTRAL REGION OF
ONTARIO IN 1998**

FOREST DISTRICTS: *Aurora, Aylmer, Bancroft, Cambridge,
Kemptville, Midhurst, Parry Sound,
Pembroke and Peterborough*

*H.D. Lawrence¹, B.E. Smith¹
W.A. Ingram² and E. Czerwinski²*

**Natural Resources Canada¹
Canadian Forest Service
Great Lakes Forestry Centre
and
Ontario Ministry of Natural Resources²
Forest Management Branch**



OVERVIEW

The following report deals with the forest health conditions in the Southcentral Region of Ontario, as defined by the Ontario Ministry of Natural Resources (OMNR) geographical boundaries, for 1998. This report is divided into three sections which are 1) major forest disturbances, 2) quarantine pests and 3) forest health monitoring. The Forest Health Monitoring Unit (FHMU) of the Canadian Forest Service (CFS), Natural Resources Canada has taken the lead role in procuring information for this report.

Forest health information is obtained primarily through the monitoring of a variety of established plots. These plots include the international North American Maple Project plot network; the national Acid Rain National Early Warning System plot system; and a mixture of regional plots that include 12 oak health plots, 5 spruce/fir health plots and a number of 25 tree sugar maple plots.

Exotic pests are monitored under a Memorandum of Understanding (MOU) with the Canadian Food Inspection Agency (CFIA). Trapping and surveys were conducted for such quarantine pests as gypsy moth, pine shoot beetle and a recently introduced Asian long-horned beetle.

A recent agreement between OMNR and the CFS provides for six contract OMNR Field Technicians to work in partnership with the six Forest Health Officers of the FHMU for 6 months of the year centering around the summer field season. This co-operative work on the state of the health of Ontario's forest through the monitoring of forest health plots, surveys for forest disturbances and exotic pest investigations has resulted in an enhanced forest health report.

In the Southcentral Region the CFS personnel were Douglas Lawrence based in Angus and Barry Smith working out of Minden. The OMNR staff included Wayne Ingram stationed at Kemptonville and Ed Czerwinski out of Guelph.

The authors acknowledge the support and assistance of personnel in forest industry, the CFIA and others in the CFS and OMNR without whose efforts and contributions this joint report would not be possible.

Important coniferous pests encountered include pine false webworm, spruce budworm, larch casebearer and balsam fir sawfly. Deciduous pests include oak leaf shredder and fall cankerworm. Abiotic conditions in the form of drought, ice storm, scorch and wind had noticeable impact at various locations in southern Ontario. There are two quarantine pests that are becoming a concern to forest managers and land owners. An Asian long-horned beetle adult was found at a warehouse this summer and pine shoot beetle not only spread further but caused unprecedented shoot damage. ARNEWS and oak health plots showed some improvement in overall tree crown condition but the amount of crown damage of sugar maple in the NAMP health plots increased.

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MAJOR FOREST DISTURBANCES

INSECTS

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

The pine false webworm remained an important pest of red pine (*Pinus resinosa* Ait.) and eastern white pine (*Pinus strobus* L.) in the Southcentral Region in 1998. However, area and intensity of damage was down considerably throughout the two large infested areas reported over the last several years. Nonetheless the insect was more commonly observed at low levels through all districts except Aylmer and Cambridge.

The main area of impact for the past few years has been around Craighurst in Midhurst District. In this area moderate-to-severe defoliation of planted red pine and natural eastern white pine occurred over 2 265 ha in 1998 compared to 6 730 ha in 1997 (Fig. 1). Within this area heavy defoliation of mostly red pine was observed in 12 pockets, totalling 188 ha, in Oro Township; 2 ha in Medonte Township; two pockets totalling 19 ha in Vespra Township and two plantations of 7 and 2 ha in Flos Township. The remainder of the area was generally moderate damage to mainly scattered eastern white pine.

Elsewhere in the Midhurst District significant damage recurred in a 5 ha red and eastern white pine plantation in Mono Township. A 3 ha plantation of mature white pine was defoliated in a Simcoe County Forest in Tecumseth Township as well as young white pine in Holland Township and semi-mature white pine in Bentinck and Sullivan townships. It was common to encounter low populations west of Highway 400 over to Highway 10.

The other large area of concern has been the Ganaraska Region Agreement Forest along the Peterborough and Aurora district boundaries. In this area in 1998 defoliation of planted red pine and overstory eastern white pine decreased from 2 025 ha to 683 ha. About one third of this was considered to be heavily defoliated with the rest moderately affected. However, red pine severely defoliated over the past couple of years in Hope and Clarke townships exhibited decline and mortality. East of this large area in Hope Township 2 ha of red pine were also heavily infested.

Varying levels of attack occurred at numerous other stands ranging from 1 to 15 ha throughout the Region. These include plantations in Abinger and Dungannon townships, Bancroft District; in Croft, McMurrich and Stisted townships in Parry Sound District; at two locations in both Alice and Ross townships and at one location each in North Algona, Raglan and Stafford townships, Pembroke District; and in a plantation in Huntley Township in Kemptville District.

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

For the fourth consecutive year the area defoliated by the oak leaf shredder increased in southwestern Ontario reaching 2 078 ha in 1998 compared to 525 ha in 1997. This defoliation of red oak (*Quercus rubra* L.) occurred in four districts. Aylmer District appears to be the heaviest hit with three woodlots in Moore Township and one in Ekfrid Township (Fig. 2) totalling 804 ha being moderate-to-severely defoliated by this leaf shredder.

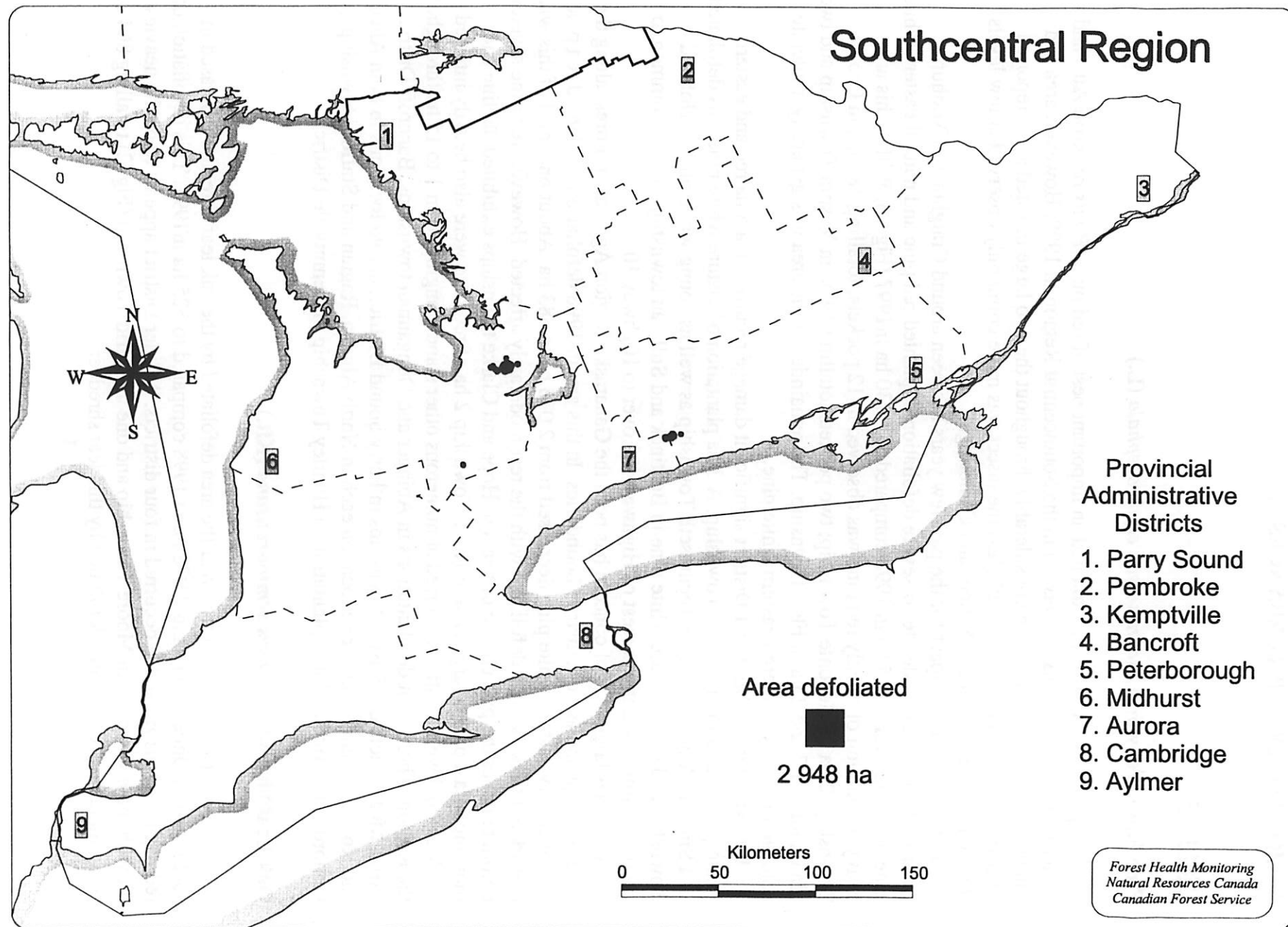


Figure 1. Areas of moderate to severe defoliation caused by the pine false webworm (*Acantholyda erythrocephala* [L.]) in 1998.

In the Midhurst District eight small scattered pockets of defoliation totalling 630 ha were aerially mapped. Two pockets were observed on Christian Island, two pockets in Awenda Provincial Park, one small pocket north of Penetanguishene, a larger pocket of red oak completely defoliated northwest of Midland and a pocket in Vespra Township north of Midhurst District office. The largest pocket detected was along Road 18 adjacent to Dufferin County forest, Mulmur Township. Although the insect occurred in the same general area as 1997, all these pockets were in different stands.

In the Parry Sound District a 52 ha stand of red oak was defoliated in Georgian Bay Islands National Park, Beausoleil Island.

A 592 ha area of mature red oak suffered severe defoliation north of Cayuga in Seneca Township in Cambridge District. Feeding by gypsy moth (*Lymantria dispar* [L.]) larvae also occurred throughout this area resulted in complete defoliation of red oak with variable defoliation on other host trees.

Fall Cankerworm, *Alsophila pometaria* (Harris)

Records and literature indicate the fall cankerworm periodically reaches epidemic proportions feeding on a variety of hosts including basswood (*Tilia americana* L.), maple (*Acer* spp.), elm (*Ulmus* spp.) and oak. In 1998 defoliation was observed in Midhurst, Aurora, Aylmer and Cambridge districts. In the past five years in southern Ontario this deciduous defoliator has only been detected once and only at a low level. In 1997 defoliation of sugar maple (*Acer saccharum* Marsh.) was noted throughout areas where this insect appeared this year. However because of staff reduced and a late start to field surveys, this insect was not collected last year.

In the Midhurst District moderate defoliation of sugar maple woodlots was noted in the townships of Amaranth, East Garafraxa, Melancthon, Mono and Mulmur.

Light defoliation was common through the southwest corner of Aurora District adjacent to areas affected in Midhurst District. Sugar maple and oak trees in Hilton Falls Conservation area in Nassagaweya Township were the only stands observed with heavy defoliation in this district.

In the Cambridge District much of Manitoba maple (*Acer negundo* L.) through the Cootes Paradise area of Dundas suffered complete defoliation.

In Aylmer District Manitoba maple growing along the Thames River between Chatham and Thamesville sustained moderate-to-severe defoliation. Elsewhere in the district basswood in a small woodlot in Orford Township were severely defoliated.

Hickory Twig Pruner, *Anelaphus parallelus* (Newm.)

A new infestation was recorded this year in the eastern half of the Southcentral Region. This borer is a common pest of roadside and ornamental oak trees in southern Ontario and although there may be considerable loss of twigs in some years, injury does not usually persist. The heaviest damage, ranging from 5 to 10 percent severed branches, was observed in the Lavant, Flower Station and Clyde Forks areas in the Kemptville District and around the Kawartha Lakes, south to Rice Lake then east to Belleville in the Peterborough District. The presence of pruned twigs resulted in queries from numerous concerned land owners in the Kasshabog Lake area in

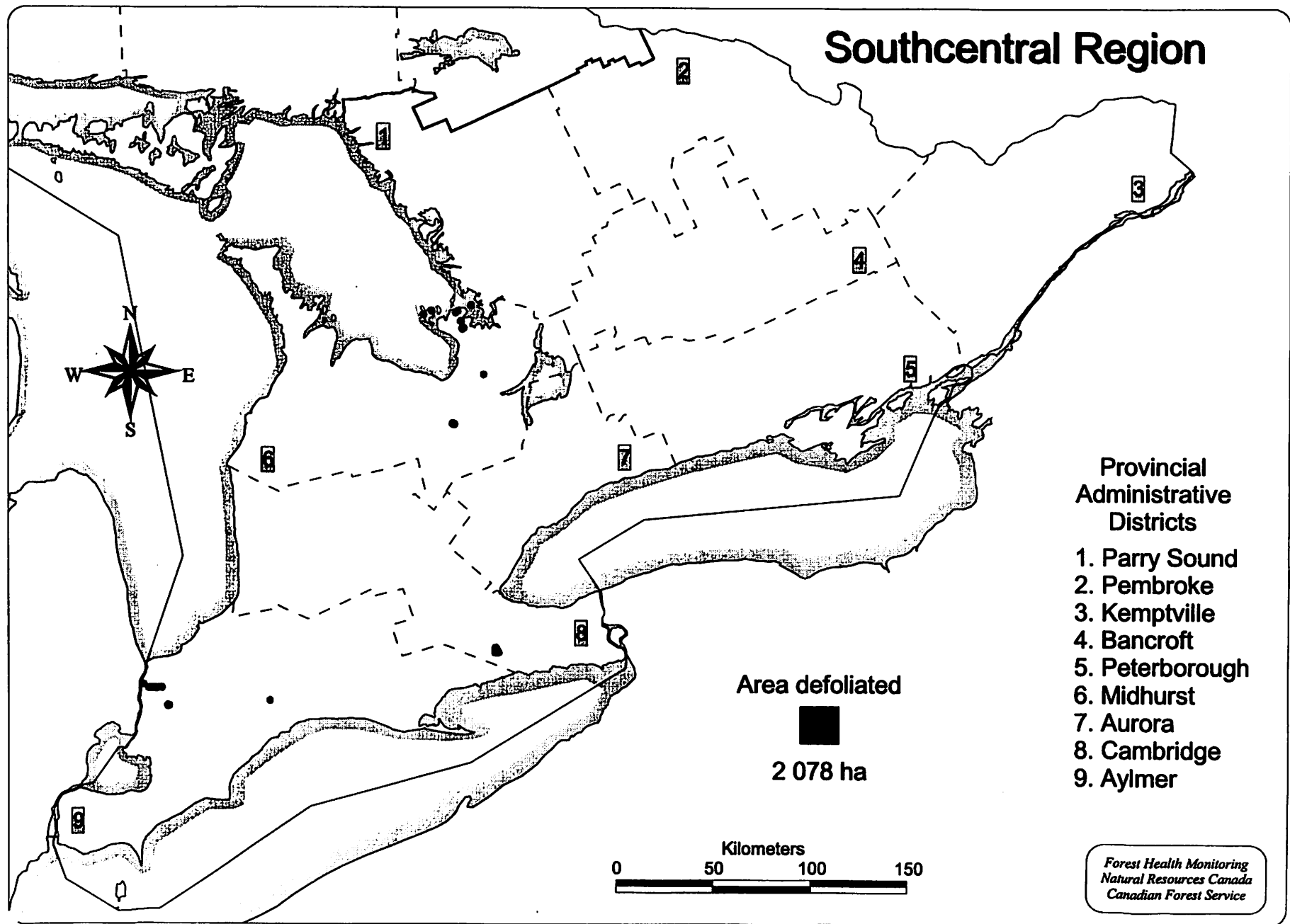


Figure 2. Areas of moderate to severe defoliation caused by the oak leaf shredder (*Acleris semipurpurana* [Kft.]) in 1998.

Methuen Township in the Bancroft District. Trace damage levels were observed around the town of Bancroft east to the village of McArthurs Mills.

Pinkstriped Oakworm, *Anisota virginiensis* (Dury)

For the second consecutive year defoliation was aerially mapped on oak ridges along the north shore of Bark Lake in Jones Township in the Pembroke District. The area of defoliation has increased from 15 ha recorded in 1997 to 780 ha in 1998. Drought damage was also recorded in this same area last year so this lack of moisture combined with defoliation by this late defoliator resulted in red oak branch, top and occasional whole tree mortality occurring this year.

At two locations in the defoliated area trace levels of gypsy moth were also present.

Spruce Budworm, *Choristoneura fumiferana* (Clem.)

Spruce Budworm has been on the decline for five consecutive years across Ontario. That decline continued in the older infestations of Northwestern Ontario. In contrast increases were evident in the Southcentral Region as moderate-to-severe defoliation was observed in all districts except Parry Sound and total defoliated area increased from 10 776 ha to 26 132 ha (Table 1.).

Table 1. Gross area of moderate to severe defoliation caused by the spruce budworm in the Southcentral Region from 1996 to 1998.

District	Area of Defoliation (ha)		
	1996	1997	1998
Aurora	0	12	36
Aylmer	0	0	4
Bancroft	0	0	131
Cambridge	0	0	9
Kemptville	4880	6870	15 755
Midhurst	0	63	27
Parry Sound	438	0	0
Pembroke	14 060	3 447	9 781
Peterborough	178	384	389
Total	19 556	10 776	26 132

There was a substantial increase in the area of defoliation in the adjacent districts of Pembroke and Kemptville. The largest area with the most severe defoliation once again occurred on white spruce (*Picea glauca* [Moench] Voss) and balsam fir (*Abies balsamea* [L.]Mill.) north and east of the town of Almonte in the adjoining areas of Lanark County and the Ottawa-Carleton Regional Municipality (Fig.3). Numerous pockets of primarily moderate defoliation were mapped in the Ottawa River Valley from the town of Pembroke southeast into the Almonte-Carp area. Numerous small pockets of defoliation were aerially mapped around the town of

Arnprior, south of the town of Pembroke, around Cobden, Mount St. Patrick and Renfrew areas in the Pembroke District. Small pockets of light defoliation persisted near the Kemptville Nursery and in the Larose Forest in the Kemptville District.

A new area of moderate defoliation totalling 131 ha was aerially mapped along the Eels River south of the town of Apsley in the Bancroft District.

In the Peterborough District severe defoliation and continuing tree mortality was observed again this year in white spruce plantations at Balsam Lake Provincial Park and a new area of approximately 5 ha of white spruce was severely defoliated in Manvers Township.

In 1997 spruce budworm was reported as causing noticeable defoliation at only 2 locations in the Aurora and Midhurst districts. In 1998, 30 widely spread pockets of moderate to severe defoliation ranging in size from 1 to 5 ha were observed in 16 townships, nine in Aurora District and seven in Midhurst District.

Two plantations of 25 metre tall white spruce and Norway spruce (*Picea abies* [L.] Karst.) were severely defoliated in a 2.4 ha area of the St. William's Crown Forest in South Walsingham Township, Aylmer District.

In the Cambridge District severe defoliation occurred in a 19 metre white spruce plantation in Flamborough Township, moderate defoliation was recorded in a white spruce stand that has been infested previously in the Smaele Tract in Minto Township and light defoliation was observed in a white spruce plantation in the Cumnock Tract in Nichol Township.

Again this year no egg-mass sampling was carried out in Ontario. Pheromone traps were deployed at five spruce/fir health plots and the resulting adult male moth catches are summarized in Table 2. None of these plots are in or adjacent to current infestations.

Table 2 Results of spruce budworm pheromone trapping in 5 locations in the Southcentral Region of Ontario from 1994 to 1998.

Location (township)	Plot number	Total moths from 3 traps				
		1994	1995	1996	1997	1998
<i>Parry Sound District</i>						
Bethune	15	426	254	88	63	45
Macauley	19	-	-	-	46	30*
Mowat	20	-	-	159	115	74
<i>Pembroke District</i>						
Lister	3	-	-	-	31	75
Wylie	23	-	-	-	111	45

* Total of two traps

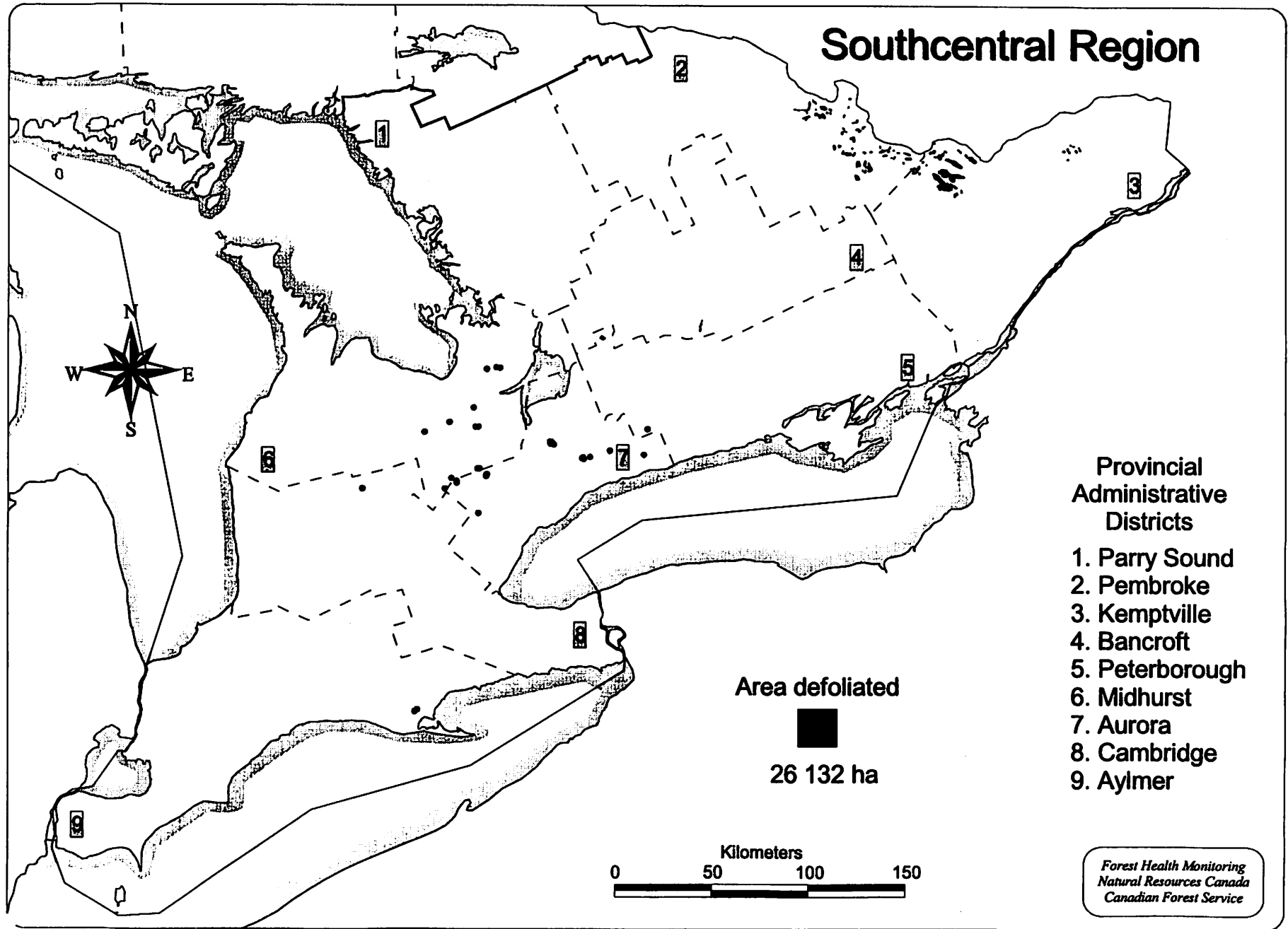


Figure 3. Areas of moderate to severe defoliation caused by the spruce budworm (*Choristoneura fumiferana* [Clem.]) in 1998.

Larch Casebearer, *Coleophora laricella* (Hbn.)

Damage to European larch (*Larix decidua* Mill.) and tamarack (*Larix laricina* [Du Roj] K. Koch) by this casebearer was generally less widespread and less intense in Parry Sound, Midhurst, Pembroke, Bancroft and Kemptville districts in 1998 compared to 1997. However there were areas in these five districts that are worthy of mention. Again the most noteworthy area was through the Parry Sound District where larch stands are more concentrated. As a result widespread variable defoliation was common. Heavy defoliation was observed in townships on both sides of Highway 11 from Bracebridge north to South River. It became apparent later this summer that stands through this area, that have suffered several years defoliation were deteriorating as yellowing needles were present in early August. Examination of several stands of larch revealed the presence of the eastern larch beetle (*Dendroctonus simplex* LeC.) and resultant widespread girdling of larch trees. In the past this beetle has been associated with larch mortality following larch casebearer infestations. Comprehensive surveys were not carried out to determine the extent of tree mortality but no doubt significant tree mortality will occur this fall and the problem will be more prevalent and widespread in 1999.

Small pockets of heavy feeding recurred in the Minesing swamp in Vespra Township, Midhurst District.

In the Pembroke District, stands with defoliation ranging from moderate to severe were noted in Paxton Township, adjacent to areas defoliated in Parry Sound District, and in Clyde Township. Light to moderate damage was observed along Highway 17 from Arnprior to Rolphton.

Isolated areas of damage were recorded in Dungannon and Herschel townships around the town of Bancroft, Bancroft District.

Feeding by this insect was common through the Kemptville District but heaviest damage was observed in the Limerick and Larose forests as well as near the town of Spencerville.

Up to 50% defoliation was observed in the Ganaraska Forest, Hope Township in Peterborough District.

Fall Webworm, *Hyphantria cunea* (Drury)

Population levels appeared to be up this year when compared to the observations made over the last few years. In part this increased defoliation damage was due to the early spring and long favourable feeding period. Conspicuous pockets of damage of up to 0.5 ha in size on a variety of hardwood species were recorded as early as July 3 and by early September pockets up to 2 ha in size were observed in Goulbourn Township south of the city of Ottawa in the Kemptville District.

Across the Peterborough, Bancroft and the south half of the Pembroke districts low-to-medium defoliation was observed. Similar damage levels were observed across the Aurora, Aylmer, Midhurst, Parry Sound, and Cambridge districts. Most notable areas were around the town of Bracebridge, Parry Sound District and in the County of Haldimand-Norfolk in Aylmer District.

Balsam Fir Sawfly, *Neodiprion abietis* complex

Balsam fir sawfly defoliation levels increased across the Southcentral Region in 1998. The most dramatic increase occurred in the Beachburg and Eganville areas of the Pembroke District where heavy top and also complete defoliation of balsam fir was observed. Light to moderate defoliation was observed throughout the remainder of the Pembroke District and in Palmerston Township in the Bancroft District.

Moderate defoliation was commonly observed across the Midhurst District. Essa, Tosorontio and Vespra townships southwest of Barrie and in Derby, Sullivan and Bentinck townships south of Owen Sound were two areas that displayed more consistent damage wherever balsam fir trees existed.

Maple Leafcutter, *Paraclemensia acerifoliella* (Fitch)

In 1998 an expansion occurred in the area of defoliation of sugar maple caused by this insect. In 1997 a 15 ha portion of Big Island in Pigeon Lake near the town of Bobcageon was aerially mapped in the Peterborough District. This same island was again defoliated as well as three new pockets to the northwest covering an area of approximately 625 ha. Two of the new areas are in Somerville Township south of the village of Burnt River and one area is in Laxton Township south of the village of Norland, Bancroft District. The area of defoliation on Big Island was not as severe as that which was recorded in 1997 nor as severe as the three new areas. Infestations normally last 4 to 6 years and the last major outbreak in Ontario ended in 1965.

Trace population levels could be found in most of the permanent sample plots across the Bancroft, Kemptville, Pembroke and Peterborough districts.

DISEASES

Dogwood Anthracnose, *Discula destructiva* Redlin

This summer was the first time dogwood anthracnose has ever been found in Ontario. This disease of Eastern flowering dogwood (*Cornus florida* L.) was collected from South Walsingham Township in the Alymer District and in Seneca Township in the Cambridge District.

This pathogen may have been introduced into North America. It has been reported from several western states and British Columbia and in the east from Massachusetts, Connecticut, New York, New Jersey, Pennsylvania and Delaware. Most recently the disease has been detected in Maryland, Virginia, North and South Carolina, Tennessee and Georgia.

Leaf symptoms first develop in the lower crown and progress up the tree. So far foliage damage ranges from 40 to 50 percent of the crown (basically the lower half of the infected trees). Foliar symptoms include tan spots that develop purple rims, necrotic veins and margins and large necrotic blotches. Eventually the entire leaf wilts and turns brown and necrotic. Infections often progress down the petiole of the blighted leaves into shoots, resulting in cankers that form on the twig. The cankers expand eventually girdling the infected area. So far this disease has caused 10 to 25 percent twig and branch dieback at the two affected locations in Ontario.

Linospora Leaf Blight, *Linospora tetraspora* G.E.Thomps.
Septoria Leaf Spot, *Mycosphaerella populicola* G.E.Thomps.

Because these two diseases were both responsible for the defoliation of balsam poplar (*Populus balsamifera* L.) this season and the damage is so similar in nature both diseases are considered the cause of damage in this report.

Widespread heavy leaf damage and resultant early leaf fall was recorded across the entire Southcentral Region. Balsam poplar of all ages were equally affected. Notable areas of severe damage included all of the Pembroke and Kemptville districts, Sheffield Township in the Peterborough District, Cardiff Township in the Bancroft District, between the cities of Toronto and Barrie west to the town of Orangeville in the Aurora and Midhurst districts and around the city of Guelph in the Cambridge District.

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

This disease was first identified in Ohio in 1930 and spread into Prescott County, Kemptville District in 1946. By the middle of the 1970's most of the mature elm in Ontario were dead.

In 1998 symptoms of this disease were commonly observed at ever increasing levels throughout much of the range of white elm (*Ulmus americana* L.) across most of the Southcentral Region. Juvenile trees that have grown since the last Dutch elm disease outbreak are showing signs such as flagging, entire branch mortality and total tree mortality. This occurrence of renewed mortality was most prevalent in the south and east part of the Kemptville District most likely because this was one of the first areas where this disease passed through on its east to west spread. The remaining districts to the west and north generally have widely scattered trees and clumps of trees with flagging and some branch mortality with no total tree mortality occurring yet. This new generation of elm trees is now old enough to have bark which is of a sufficient thickness to be attractive to the disease carrying native elm bark beetle (*Hylurgopinus rufipes* Eichhoff), and the smaller European elm bark beetle (*Scolytus multistriatus* Marsham).

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

Scots pine (*Pinus sylvestria* L.) plantations have been deteriorating across southern Ontario for many years. In the last two years this problem has increased dramatically especially in the southern portion of the Aurora and Midhurst districts where most older plantations are dying. Diplodia tip blight has been building up in these plantations since the 1980's and several recent dry seasons have added stress to these plantations increasing the amount of Diplodia tip blight as well as higher numbers of bark beetles such as the pine engraver (*Ips pini* Say) and the newly introduced pine shoot beetle (*Tomicus piniperda* L.) (see Quarantine Pests) .

Generally all the plantations west and south of the city of Peterborough are severely affected, turning reddish brown and dying whereas to the east Scots pine plantations have very little Diplodia tip blight.

ABIOTIC CONDITIONS

Drought Damage and Tree Mortality

Spotty mortality occurred in widely scattered stands as a direct result of the extensive areas of drought damage aerially mapped in 1997. The mortality showed up on red oak and maple species on hill tops in the southeast part of Algonquin Park and on the hills north of Aylen and Round lakes in Clancy, Guthrie and Master townships in the Pembroke District. Similar damage was aerially mapped in Effingham and Bangor townships in the Bancroft District. Also in the Bancroft District scattered dead red pine were detected in Methuen and Lake townships and scattered dead jack pine (*Pinus banksiana* Lamb.) trees were observed in Burleigh Township. No actual area figures can be given for drought damage because the damage was widespread and spotty.

In 1998 unusually dry spring weather caused widespread early drought conditions across much of the south half of the Bancroft and most of the Peterborough district. The heaviest damage observed was 90 percent affected foliage on eastern red cedar (*Juniperus virginiana* L.) along the St. Lawrence River from Prince Edward County to Howe Island in the Peterborough District. Widely scattered pockets of red ash (*Fraxinus pennsylvanica* Marsh.) had up to 30 percent foliage affected in Fenelon Township and many white elm were affected in Otonabee Township in the Peterborough District. White ash (*Fraxinus americana* L.) had up to 15 percent affected foliage in Faraday Township in the Bancroft District. However sufficient rain fell during the summer and the trees did recover.

Ice Storm Damage and Tree Recovery

This report does not address details on where or how much damage was done by the 1998 ice storm in southeastern Ontario. That information has been published in Ministry of Natural Resources News Releases & Fact Sheets and Natural Resources Canada's "Results of Forest Health Monitoring in the Southcentral Region of Ontario in 1997" report. For those interested information can also be found at the Ministry of Natural Resources web site ([HTTP://www.MNR.GOV.ON.CA/MNR/csb/news/feb10nr98.html](http://www.MNR.GOV.ON.CA/MNR/csb/news/feb10nr98.html)).

Damage, while severe, has caused very little whole tree mortality in natural stands and woodlots in this affected area of approximately 603 654 ha. Mortality did occur on open grown trees, ornamentals, fence rows and trees growing along the edge of stands. These trees are the most noticeable and made the ice storm damage seem much worse than it really was. These trees were the most exposed to the action of the wind which was a major contributing factor in determining which heavily ice laden trees were broken.

A series of 26 permanent tree health sample plots (20-25 sugar maple plots, 2-100 tree oak plots, 2 NAMP plots and 2 ARNEWS plots) in the Peterborough, Kemptville and Aurora districts were re-evaluated in 1998 for ice storm damage (Fig. 4). An assessment procedure established by United States Department of Agriculture to evaluate damage on international NAMP plots was applied to these 26 plots. Data recorded included percent of crown damage, percent of broken tops by four distinct categories, number of broken branches per tree and number of wounds per tree. This data is summarized by plot in Appendix 1. The results are quite

variable, consistent with what was observed from the air in January. When all 26 plots are lumped together the following observations are noteworthy - 27% of the trees had greater than 25% crown damage; 10% of the trees had the bole/s (single or multiple) broken off (category 1 and 3 of broken top); and an average of 2.3% (range 0-5.2%) major branches broken off per tree of the trees that still had boles.

Of the twenty 25 tree sugar maple plots 6 had no ice damage present but were close to the affected area and are used as a control whereas 14 were considered damaged by the ice storm. These 14 plots consist of four rural, four urban and six natural. Only trees alive at the time of the ice storm were tallied. Results, summarized in Appendix 2, indicate rural trees were the most severely damaged, having the highest percentage of bole loss (14%), the most broken branches per tree (avg. 3.4%) and the greatest number of wounds per tree (avg. 9.25). Urban trees were next and natural stands were the least affected. Crown damage was rated using branches left at time of assessment. A lot of the rural trees had already been cleaned up and branches cut off at the bole making assessment of the trees difficult.

All trees that were examined in these plots, even though some had lost the majority of their branches to ice damage, are still alive. Many have produced heavy epicormic branching. Severely affected basswood and hickory had the most prolific sprouting of epicormic shoots. Some shoots had grown up to 60 cm in and around broken branch sites.

Few secondary insects have been found in the hardwood trees so far. Heavy bark-beetle populations appear to have developed in the softwood trees in areas where previous beetle populations existed such as logged, snow damaged, or thinned areas where heavy slash was left.

It is still too early for much fungal activity and the full extent of disease organisms damaging the trees further may not become evident for many years.

Many of the damaged hardwoods had heavy seed crops this summer. Production of heavy seed crops can add even more stress on the already weakened trees. Whether the epicormic branching will support the tree is unknown and will only be answered with future monitoring.

Scorch

This problem caused by high temperatures accompanied by drying winds is a common occurrence. Leaves lose water faster than can be replaced by the tree. This abiotic condition started to appear on white ash and sugar maple around mid-June in the Midhurst and Aurora districts south of Highway 89 and west of Highway 400. Sugar maple were also affected on hill tops and shallow soils from Collingwood to west of Owen Sound. This condition also became apparent later in the summer across the south portion of the Bancroft District, the northern and eastern portion of the Peterborough District, the northwest portion of the Kemptville District and into the southeastern portion of the Pembroke District. Through this area aspen (*Populus* spp.) and birch (*Betula* spp.) were also affected.

This condition persisted throughout the remainder of the summer and in some instances appeared as early browning or fall colours.

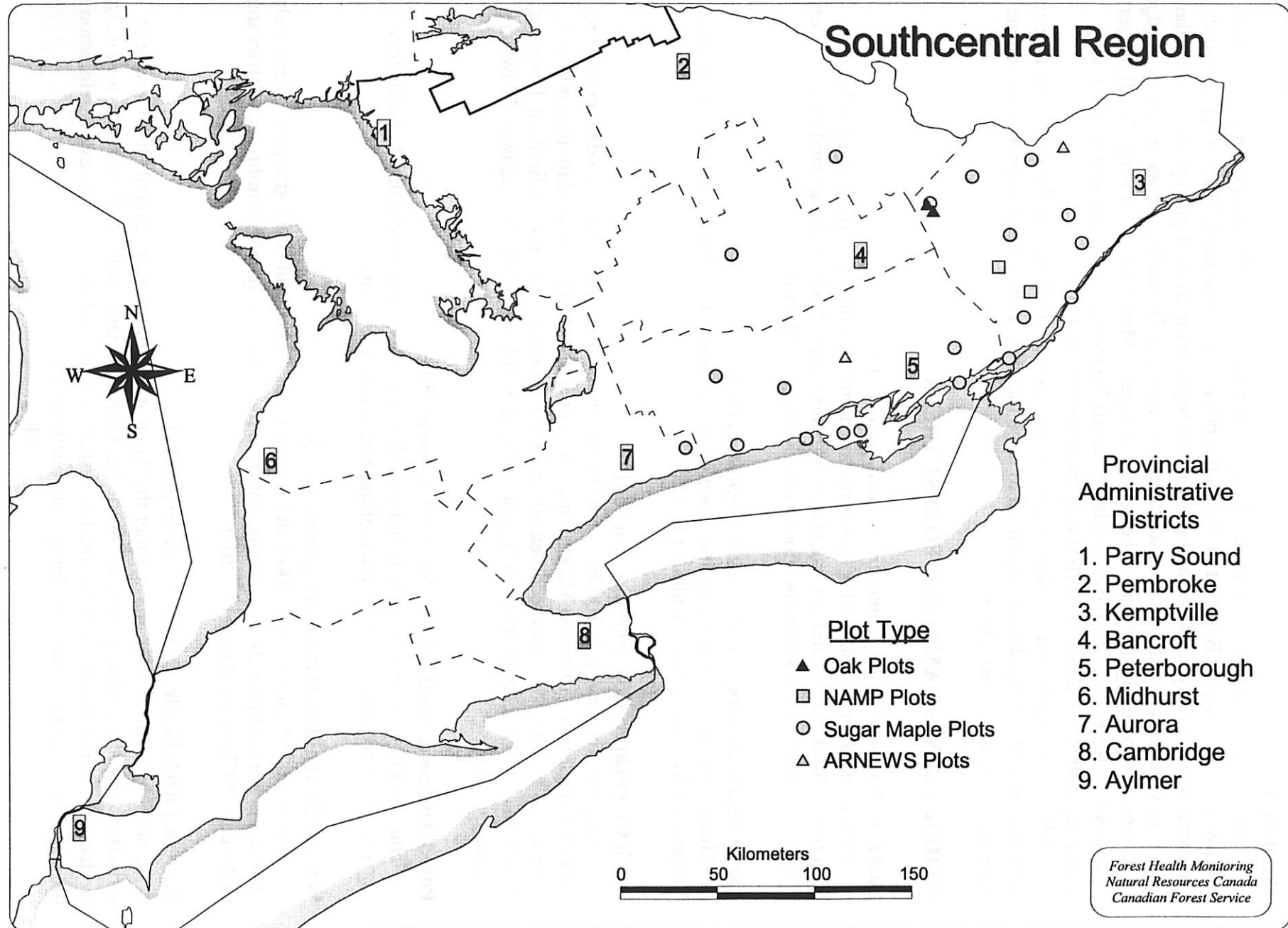


Figure 4. Locations of plots used to evaluate the effects of the 1998 ice storm damage.

Wind Damage

A very strong southwest wind caused approximately 319 ha of blowdown in mature forest southwest of the town of Bancroft in the central portion of the Bancroft District. The majority of the damage was widely scattered along a narrow strip starting from Highway 507 south of the village of Gooderham in the northeast corner of Cavendish Township, across the northern edge of Anstruther Township and across the southeast edge of Monmouth Township. Small pockets also occurred further east on the east side of Cardiff Township and the west side of Faraday Township east to the junction of Highway 28 and Highway 121.

In the most severely damaged areas all tree species were flattened. In the rest of the affected areas the majority of the damage occurred to large mature hardwood and overstory white pine trees in the form of broken tops.

OTHER AGENTS DAMAGING FOREST TREES

Solitary Oak Leafminer, *Cameraria hamadryadella* (Clem.)

Heavy leaf damage (80 to 100%) was recorded on red, white (*Quercus alba* L.), black (*Quercus velutina* Lam.) and bur oak (*Quercus macrocarpa* Michx.) along stand edges and on open grown trees at numerous locations in the Kemptville District.

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

Moderate defoliation of trembling aspen (*Populus tremuloides* Michx.) stands occurred in Vespra and Essa townships, Midhurst District.

Birch Casebearer, *Coleophora serratella* (L.)

Heavy defoliation (up to 100%) caused by this introduced insect was recorded on 6 metre white birch (*Betula papyrifera* Marsh.) in a 1 ha wet area in Huntly Township, Kemptville District; 80% defoliation was recorded along Hwy 10 south of Westport in Bedford Township, Peterborough District and light defoliation occurred at Hilton Falls in Nassagaweya Township, Aurora District.

Pitted Ambrosia Beetle, *Corthylus punctatissimus* (Zimm.)

This stem boring insect is very common at low numbers causing mortality to understory sugar maple regeneration across much of the Southcentral Region.

Walnut Caterpillar, *Datana integerrima* G.& R.

Heavy feeding caused 75 to 100% defoliation to individual and small groups of black walnut (*Juglans nigra* L.) up to 20 metres in height from the town of Bayfield, Cambridge District south to the city of Chatham, Aylmer District.

Eastern Larch Beetle, *Dendroctonus simplex* LeC.

It became apparent later this summer that larch stands in the Parry Sound District were in serious trouble. Historically this bark beetle has been associated with larch mortality following larch casebearer infestations. This area has sustained 3 years of moderate to severe defoliation by the casebearer and trees are now dying from beetle attack.

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

Trace levels of defoliation in sugar maple stands were commonly observed across the Aurora, Bancroft, Midhurst, Parry Sound and Peterborough districts.

Birch Leafminer, *Fenusa pusilla* (lep.)

This leafminer caused up to 75% defoliation at scattered points across the Ganaraska Forest, Peterborough District and along Highway 504 in Chandos Township, Bancroft District.

Frost Damage

Late spring frosts caused up to 40% foliar damage on young roadside white spruce along Highway 41 in Adinger Township and 10% foliar damage on young balsam fir along Highway 62 in Herchel Township, Bancroft District.

Pine Engraver, *Ips pini* (Say)

This bark beetle killed a few 6 metre red pine trees at the military base at Petawawa and 12 metre red pine trees in Griffith Township, Pembroke District.

Oystershell Scale, *Lepidosaphes ulmi* (L.)

Populations of this scale insect have increased at numerous locations across the Midhurst and Parry Sound districts. Twig and branch mortality was recorded on American beech (*Fagus grandifolia* Ehrh.) at several of the examined stands.

Needle Cast, *Lirula nervata* (Darker) Darker

Incidence of this organism has been increasing over the last few years. This year heavy damage of single balsam fir was recorded in Admaston Township, Pembroke District.

Dooks' Needle Blight, *Lophophacidium dooksii* Corlett & Shoemaker

Heavy foliage damage was observed on up to 25% of eastern white pine from Port Severn to Highway 169 and from Key River to the French River in the Parry Sound District. Similar incidence and damage levels were recorded in the east half of the Southcentral Region especially from the Charleston Lake area east to the LaRose Forest in Clarence Township, Kemptville District.

Forest Tent Caterpillar, *Malacosoma disstria* Hbn.

Trace levels of feeding were recorded on red oak and other hardwoods across the Aurora, Midhurst, Bancroft and Peterborough districts.

Red Band Needle Blight, *Mycosphaerella pini* Rostr.

Defoliation levels of 50% were recorded on 30% of the young 2 metre tall Scots pine trees in a plantation near Lafontaine in Tiny Township, Midhurst District.

Redheaded Pine Sawfly, *Neodiprion lecontei* (Fitch)

Increased populations caused 50% mortality in a 2 ha portion of a 10 ha one metre tall red pine plantation in Wollaston Township, Bancroft District. Several young plantations were again heavily infested at CFB Borden, Midhurst District. Widely scattered individual trees were observed with up to 10% defoliation across the Bancroft and Peterborough districts.

Red Pine Sawfly, *Neodiprion nanulus nanulus* Schedl

A 5 ha plantation of 3 metre red pine trees had 20% defoliation in Admaston Township and light defoliation was recorded in Ross, Raglan and Petawawa townships, Pembroke District. Light defoliation was also recorded on red pine in Dungannon Township, Bancroft District, in the Ganaraska Forest, Peterborough District and on scattered jack pine between the town of Parry Sound and the French River, Parry Sound District.

Jack Pine Sawfly, *Neodiprion pratti paradoxicus* Ross

Low levels of defoliation were observed in a 5 ha jack pine plantation in Huntly Township, Kemptville District. Up to 10% defoliation was recorded in natural stands in the Kaladar area, Peterborough District.

Northern Pine Weevil, *Pissodes nemorensis* Germ

High numbers were recorded on 15 metre tall Scots pine trees damaged by the 1998 ice storm in Clarence Township, Kemptville District.

Pine Gall Weevil, *Podapion gallicola* Riley

Scattered mature red pine trees had up to 30% branch mortality in Methuen Township, Bancroft District. Twig and branch mortality was also very noticeable around Midhurst, Vespra Township and in Dufferin County Forest in Mulmur Township, Midhurst District.

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

This early free feeder caused 80% defoliation on 200 ha of 15 metre trembling aspen in Delaware Township, Aylmer District.

European Pine Shoot Moth, *Ryaciona buoliana* (D.& S.)

Shoot mortality of 20% occurred on 100% of 4 metre Scots pine in a 1 ha plantation in Enniskillen Township, Aylmer District.

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

This disease was collected from numerous locations in an attempt to verify the presence of the disease wherever butternut (*Juglans cinerea* L.) trees exist across the Southcentral Region.

Willow Scab, *Venturia saliciperda* J. Nüesch

For the second consecutive year this disease has caused early browning with up to 80% defoliation on mature willow (*Salix* L.) trees along water courses and in low lying areas across the lower half of the Peterborough District.

QUARANTINE PESTS

An Asian Long-Horned Beetle, (ALB), *Anoplophora glabripennis* (Motchulsky)

This wood boring insect, native to Korea and China, is a serious pest of hardwoods. In its native country it attacks and kills healthy elms, poplars, maples, willows and fruit trees. In 1996 this insect was discovered in the communities of Brooklyn and Amityville in New York State and in 1998 trees were heavily affected in the city of Chicago in the state of Illinois. In the United States the beetle has been attacking mainly maple species, including Norway (*Acer platanoides* L.), red (*Acer rubrum* L.), sugar, silver (*Acer saccharinum* L.), Manitoba and sycamore maple (*Acer pseudoplatanus* L.). Horsechestnut (*Castanea dentata* [Marsh.] Borkh.) trees have also been attacked.

In 1998 this beetle was found in Canada at a warehouse in the City of Waterloo in southwestern Ontario and in Vancouver, British Columbia. In both incidences the introduction of the insect was associated with wooden crates used to import materials from China.

Following the discovery of a living beetle in the warehouse in Waterloo, ground surveys were conducted jointly between the Canadian Food Inspection Agency, the Ontario Ministry of Natural Resources and the Canadian Forest Service at nine locations in southern and southwestern Ontario. All crating material at the sites were destroyed or fumigated. No Asian long-horned beetles were found in these surveys which were concentrated within a 200 to 500 metre radius around the shipment areas.

In the beetle's native range adults can be found from May to October and it may have a one or two year life cycle depending on when the eggs are laid. The eggs that are laid in the bark in June and July hatch in about 11 days and the larva feed under the bark in the phloem and cambial layers until it reaches its 4th instar at which time it tunnels into the xylem and spends the winter. Early the next spring it pupates and emerges as an adult in May. Eggs laid in September and October can overwinter as an egg, larva or pupa and can feed throughout the next summer changing to an adult after the second winter.

This new insect poses a very serious threat to Canada's forests. It attacks and kills most healthy hardwoods of which the majority of Canada's broadleaf trees species are susceptible. The Southcentral Region's temperate climate may be particularly suitable for the growth and development of this beetle. As it is with most newly introduced insect there are no natural predators in North America.

Gypsy Moth, *Lymantria dispar* (L.)

There was a dramatic increase in gypsy moth populations and area infested this season. Aerial mapping revealed 3 060 ha of severe defoliation in 1998 compared to the 25 ha recorded in 1997 and overall there was an increase in the observation of larvae across the Region. The majority of this new defoliation was confined to two main areas, the first on the west side of the Aylmer District and the second area on the west side of the Kemptville District (Fig. 5).

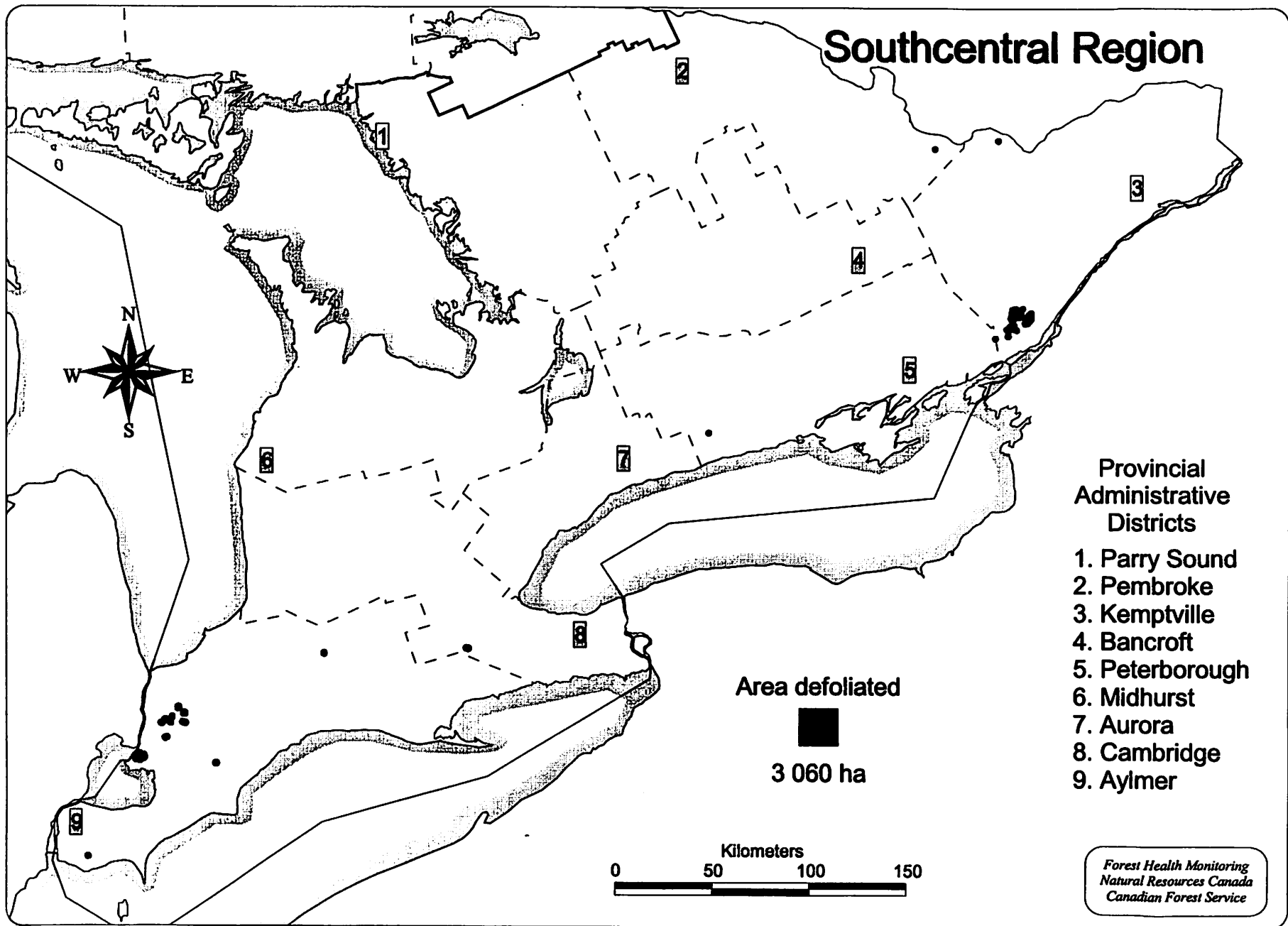


Figure 5. Areas of moderate to severe defoliation caused by the gypsy moth (*Lymantria dispar* [L.]) in 1998.

The largest amount of damage, totalling 1 548 ha, occurred in the Alymer District and was made up of four large pockets of defoliated red oak on Walpole Island near Wallaceburg and eleven other smaller pockets of defoliation ranging in size from 5 to 50 ha in nearby Moore, Enniskillen, Sombra and Dawn townships. Also small stands of oak were defoliated in Colchester South and Howard townships and a stand of willow was infested in London Township.

The second large area of damage occurred in the Kemptville District. Pockets of oak defoliation that totalled 20 ha in 1997 dramatically expanded to include 1 388 ha around the Charleston Lake area northeast of Kingston. Here numerous pockets of defoliation were detected, mainly on oak ridges. Elsewhere in the Kemptville District a 10 ha stand of red oak was defoliated in West Carlton Township.

In the Cambridge District, 112 ha were aerially mapped on the Six Nation Indian Reserve in Tuscarora, Canborough and Seneca townships.

Other noteworthy occurrences were a 10 ha stand in the Ganaraska Forest in Hope Township in the Peterborough District, a 2 ha stand in McNab Township in the Pembroke District and small pockets of moderate defoliation of trembling aspen in Essa Township, Midhurst District.

In November OMNR personnel carried out a survey in the aforementioned four districts to determine overwintering egg-mass densities. This survey was conducted in red oak stands and suggests gypsy moth will continue to increase in 1999 in areas infested this year.

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

This introduced pine pest was first discovered in North America in 1992 in the state of Ohio. During the following field season a concerted effort was put forth to determine if this European pine shoot beetle was present in southern Ontario. At that time the insect was positively identified from the following three townships in Cambridge District; South Cayuga Township in Haldimand-Norfolk Regional Municipality (RM), Bertie Township in Niagara RM and Flamborough Township in Hamilton-Wentworth RM.

Again in 1994 numerous pine plantations were examined to better determine how widespread was the occurrence of this insect. Beetles were recovered from two additional townships, Mono Township Dufferin County, Midhurst District and Puslinch Township in Wellington County, Cambridge District. As a result of the efforts of Forest Health Monitoring Unit and Animal and Plant Health Directorate by the end of 1994 three Regional Municipalities and five counties were declared infested by the pine shoot beetle. No new distribution records were made by the Forest Health Unit during the years 1995, 1996 and 1997.

This year a dramatic change in the occurrence, distribution and impact of this quarantine pest became apparent. 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 where they pupate. Adult beetles emerge a short time later, usually in June. 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. It was this later stage of attack of pine shoots that became obvious from mid August through to the end of September of 1998 through most of southwestern Ontario south and west of Barrie. Aurora, Aylmer, Cambridge and Midhurst districts all had heavy attack to scattered pine plantations. The main host was Scots pine of all ages that in most cases have been stressed due to the presence of Diplodia tip blight. Heavy damage was also observed on a couple of eastern white pine plantations and to a lesser extent on red and jack pine. Where damage occurred to Scots pine most trees affected had from 30-80% of shoots damaged. Conestogo Conservation Area, Maryborough Township in Cambridge District was the most severely infested area recorded. At this location 100% of 12-m Scots pine suffered 80% shoot mortality over an area of approximately 500 ha. Red, white and jack pine were also attacked at this location. A comprehensive survey was not carried out across the southwest but damage to Scots pine averaging 50% shoot damage or greater was observed in at least 23 townships (Fig. 6) .

Ground observations suggest this was a relatively new occurrence of the pest at such high numbers. Populations were so high it was common to find at least 3 adult beetles feeding in the same shoot. As a result of this increase in population this quarantine pest was found for the first time in the counties of Bruce, Elgin, Huron, Perth and Victoria and now 22 counties and/or Regional Municipalities (Fig. 6) are declared infested. Because of the high populations that existed in 1998 more widespread damage and tree mortality will probably occur in 1999.

FOREST HEALTH PLOT MONITORING

Acid Rain National Early Warning System (ARNEWS)

Currently there are 14 permanent plots in the Southcentral Region (Fig. 7). These were established in 1985 to measure long-term affects of airborne pollutants. Information collected at each permanent plot includes crown condition, foliar damage, woody tissue damage, occurrence of acid rain symptoms, presence of forest pests and annual tree mortality. Crown condition and cumulative tree mortality are summarized for the nine predominantly hardwood plots in Appendix 3 and five conifer plots in Appendix 4.

There are 7 plots with sugar maple and 5 of the plots (plot 505, 506, 507, 525 and 539) showed a slight improvement in the overall health of the trees. The plot in Sherborne Township (plot 504), Bancroft District had one tree with significant increase in the number of dead branches present. The plot in Rear of Yonge Township (plot 508), Kemptville District was within the ice storm damaged area and suffered considerable impact with 6 of the 11 trees suffering severe damage, 1 of which died. There are 3 plots of mostly oak content and 2 showed improvement in tree crown condition whereas the plot in Macauley Township (plot 539), Parry Sound District had 4 of the 13 living trees recorded with more branch mortality.

There are 6 plots with conifer host. The eastern white pine in plot 504 in Sherborne Township was the only plot that remained unchanged as an increase in crown damage was observed in all the other plots. Two eastern white pine trees in plot 517 and 6 in plot 518 were less healthy than last year. White spruce host were also rated as more severely affected in plots 514 and 519. The white spruce plantation in Gloucester Township (plot 519) suffered the effects of the ice storm where 4 trees died and several trees had more branch mortality. The Norway

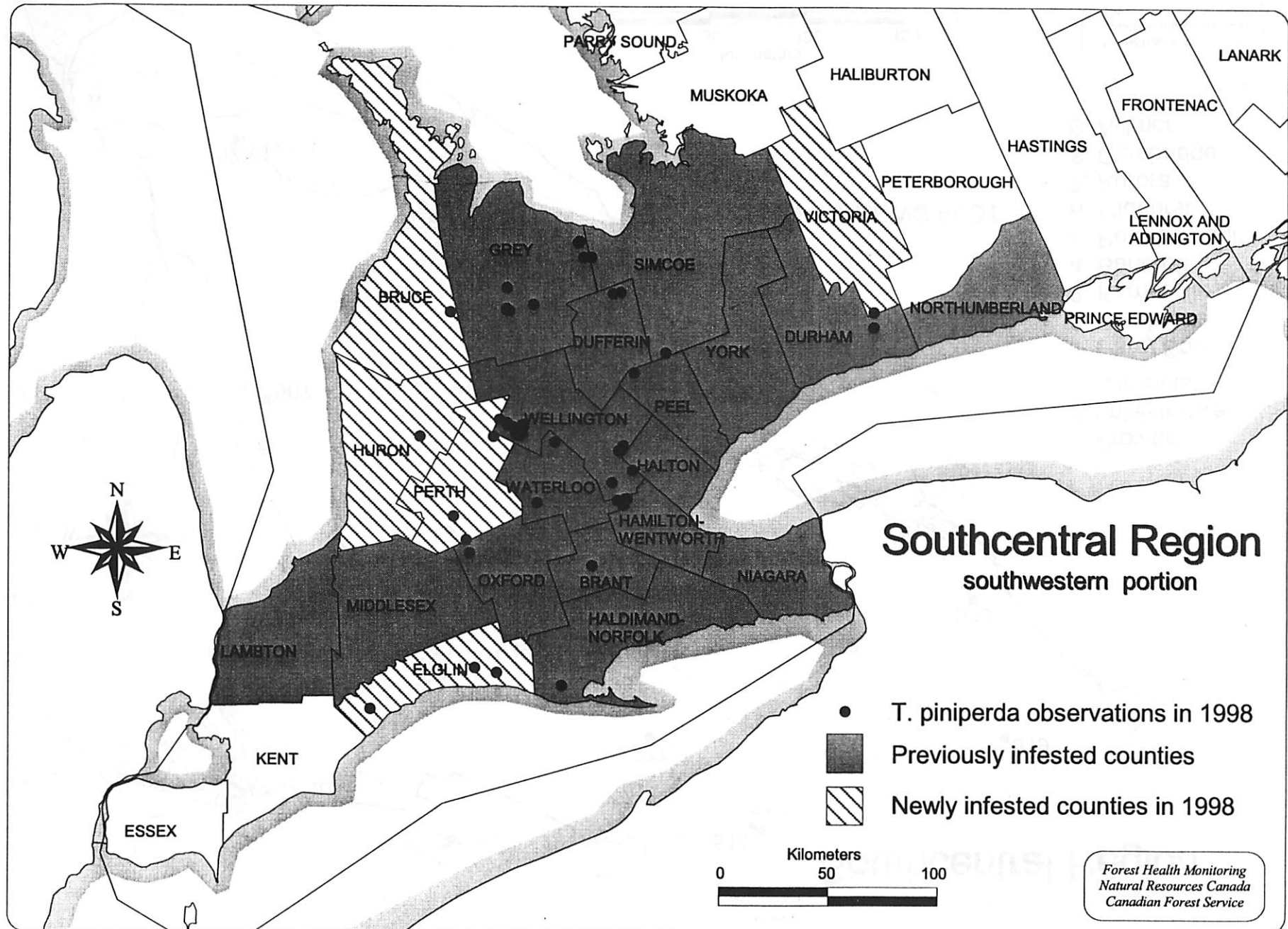


Figure 6. Locations of known damage caused by the pine shoot beetle (*Tomiscus piniperda* [L.]) and infested Counties and Regional Municipalities.

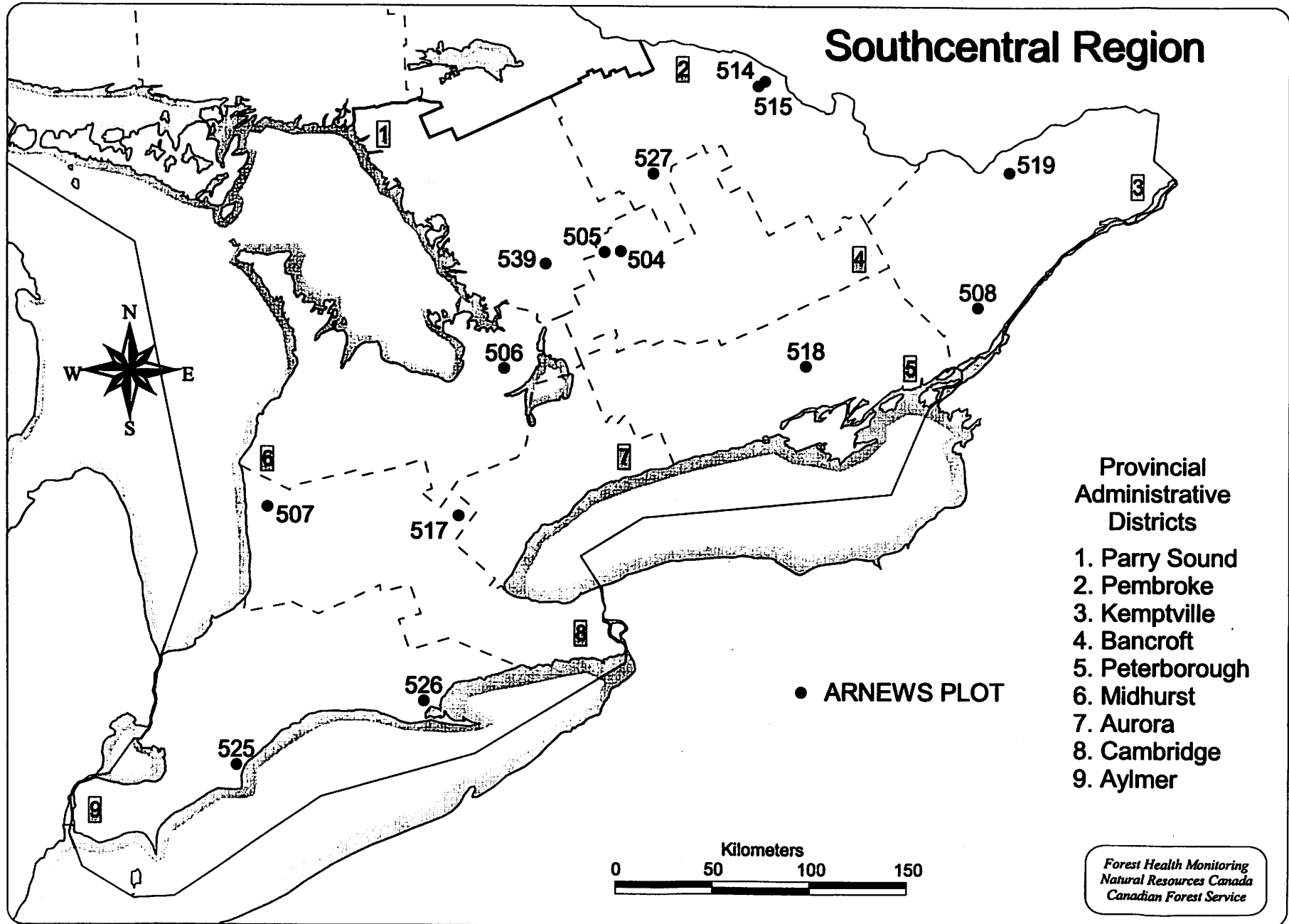


Figure 7. Location of the ARNEWS plots in 1998.

spruce in Buchanan Township also showed 2 trees with slightly worse crowns than in 1997.

There was no significant impact by insects at any hardwood plots. Even though the incidence of some insects was as high as 80%, defoliation was generally trace to light. The following are the insect pests present in 1998: lesser maple leafroller (*Acleris chalybeana* [Fern.]), pitted ambrosia beetle (*Corthylus punctatissimus* [Zimm.]), maple trumpet skeletonizer (*Epinotia aceriella* [Clem.]), gypsy moth and maple webworm (*Tetralopha asperatella* [Clem.]) on sugar maple; oak webworm (*Archips fervidana* [Clem.]), leaf tiers (*Psilocorsis* sp.) and striped oak webworm (*Tetralopha expandens* [Wlk.]) on oak.

No insects or diseases were found on the eastern white pine in 3 plots. Two white spruce in plot 514 had yellowheaded spruce sawfly (*Pikonema alaskensis* [Roh.]) at a trace level and in Gloucester Township an average of 31% defoliation by spruce budworm on 98% of the living white spruce trees is an increase from 1997.

North American Maple Project (NAMP)

This cooperative project initiated by the United States Forest Service and the Canadian Forest Service to study the health of sugar maple has been in place for 11 years. Every year plots are retallied by two trained observers recording tree vigor, crown condition, tapping status, bole quality, location of bole defects, percentage of crown dieback, foliar transparency, foliage discoloration, and defoliation estimates. Overall objectives are threefold - 1. to determine the overall rate of change in sugar maple tree condition; 2. to determine if the rate of change in these tree condition ratings differed between a) various levels of pollution b) sugar bush and undisturbed forest and c) various levels of initial stand conditions; and 3. to determine the possible causes of sugar maple decline and the geographical relationship to the causes and extent of decline. Within the Southcentral Region there are 20 plot clusters (Fig.8) consisting of ten stands currently managed for maple syrup production paired with ten untapped, undisturbed stands.

A summary of crown condition and tree mortality data (Appendix 5) indicates what appeared to be tree improvement in 1997 reversed and the overall crown dieback of sugar maple was worse in 1998. The average number of healthy (<25% twig and branch mortality) tapped trees dropped from 92.4% in 1997 to 81.7% this year and health of non tapped trees went from 90.3% to 85.3%. This year 13 trees died compared to 5 in 1997 and 3 in 1996. In addition 37 trees were cut of which 30 were in Bangor Township (Plot 23), Bancroft District.

Individual plot data is included in Appendix 6 & 7. Of the 10 tapped plots 3 plots remained unchanged (plots 13, 17 & 19), one tree was rated as having more crown mortality in each of 6 plots (plots 14, 15, 16, 18, 22 & 23); additionally one tree died in plots 15, 16, 22 and 23, and trees were cut in plots 18, 22, 23 & 24. The greatest impact due to the ice storm of January 1998 was at the plot in South Burgess Township, Kemptville District. At this plot 8 trees showed increased crown mortality and two trees were cut, probably due to heavy ice damage. The 10 untapped plots showed an even greater measure of tree decline. Three plots remained the same (plots 1, 4 & 5); plot 2 had one tree die; plots 6, 7 and 11 had one tree rated as less healthy; plot 3 had 3 trees with more crown damage and the plot in Rear of Yonge Township, Kemptville District was severely impacted by the ice storm with 14 trees with increased crown mortality and 5 new dead.

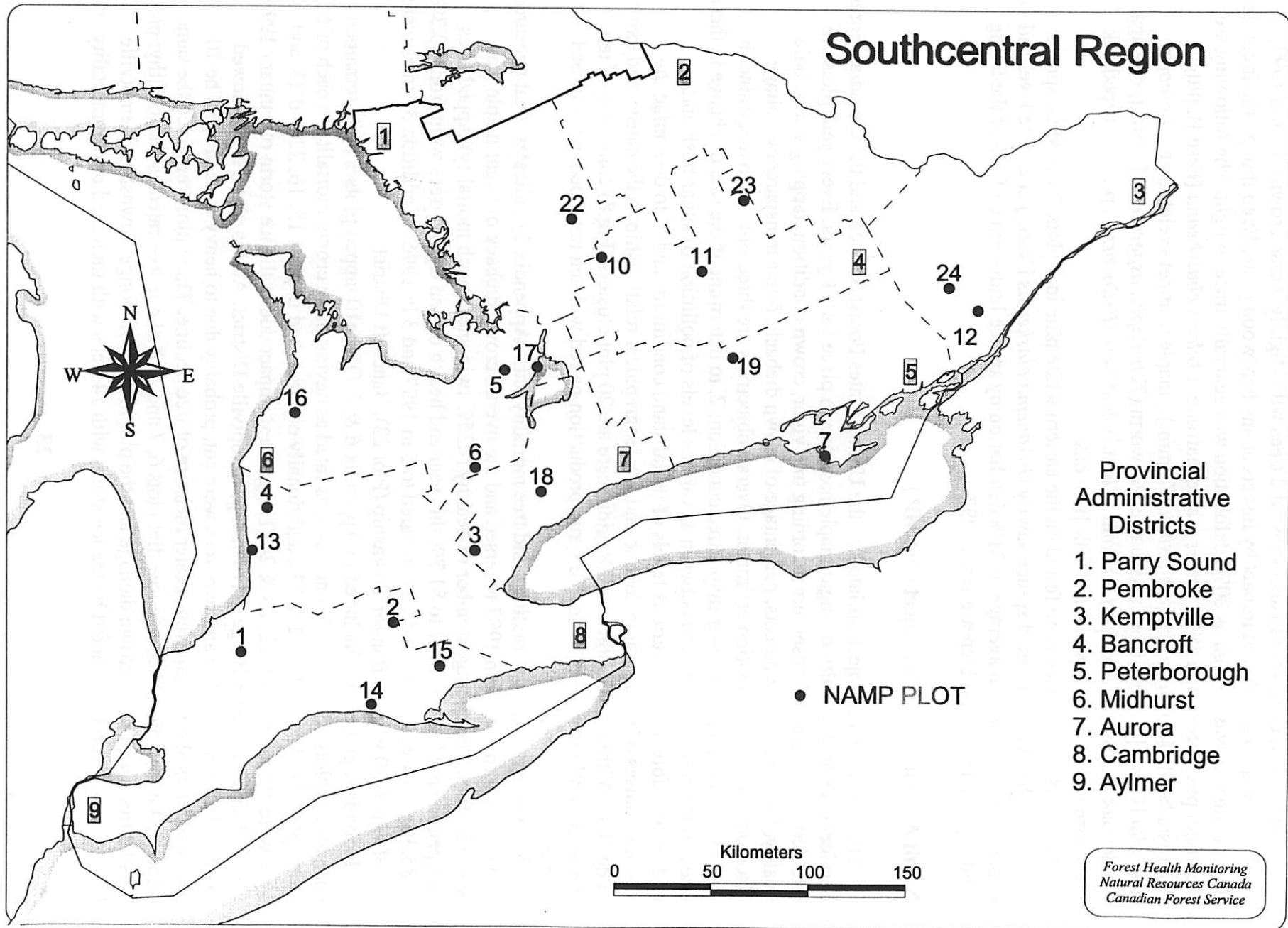


Figure 8. Location of the NAMP plots in 1998.

A variety of pest problems were encountered on most of the plots. Fourteen of the twenty had some defoliation but only 3 had more than light defoliation. The plot in Nassagaweya Township, Aurora District had six trees moderately defoliated and two trees severely defoliated by fall cankerworm. The plot in West Wawanosh Township, Cambridge District had two trees moderately defoliated by maple trumpet skeletonizer and the plot at South Burgess Township, Kemptville District had a couple of trees moderate-to-severely defoliated. The following are some of the insects encountered on the plots; lesser maple leafroller; maple leafblotch miner (*Cameraria aceriella* [Clem.]); the pitted ambrosia beetle; maple trumpet skeletonizer; saddled prominent (*Heterocampa guttivitta* [Wlk.]); maple leafcutter (*Paraclemensia acerifoliella* [Fitch]); flat leaftier (*Psilocorsis reflexella* Clem.); and maple webworm. Hardwood stem decays *Oxyporus populinus* (Schumach.:Fr.) Donk and *Phellinus igniarius* (L.:Fr.) Quel were again present on plot 11, Armillaria root rot (*Armillaria ostoyae* [Romagn.] Herink) was present on three trees in plot 22 and scorch symptoms were noted on a few trees in plots 1 and 4.

Seed production on sugar maple was the highest level seen in years. This condition could have an impact on the vigour of trees with heavy seed crop as a lot of energy goes into seed production resulting in smaller and fewer leaves. Of the living trees 26% had seed and 12 % of these produced a heavy seed crop.

Oak Health

Numerous plots were established in 1977 across southern Ontario to monitor the health of red oak (Fig.9). These plots were originally established because forest managers and the public were concerned about oak decline. This is now the 22nd year these plots have been assessed making them the oldest set of health plots existing in Ontario. Over the years data has been collected on crown dieback, foliar pest damage, disease damage and abiotic agents present. An effort has been made to summarize crown condition data to determine trends in the health of these stands over this time period (Fig10). It is apparent that the health of these stands has steadily improved after numerous years of decline. Dead twigs and branches were on the increase during the late 1970's but dead material has dropped off and the percentage of healthy trees (<26% crown mortality) has increased to 96% of living trees in 1998.

The percentage of dead crown and tree mortality per plot for the past five years is summarized in Appendix 8. The only noteworthy change in tree health since last year was the stand at Fowler Station, Lavant Township in Kemptville District where the ice storm had a significant impact. Crown condition was worse on 17 trees and one tree died.

Mortality has been consistent through the 22 years and this year 10 more trees (0.8%) died making 23% the cumulative mortality. In addition 2.9% of the trees were cut this year.

Light defoliation by various leafrollers, leafminers, leaftiers, leaf skeletonizers and free feeders was detected at all plots. Only the plots in Alice and Wylie townships, Pembroke District had trees with foliar damage exceeding 25% where a few trees sustained up to 40% damage by leaftiers and striped oak webworm. Other noteworthy insects detected were gypsy moth in plots in Tiny Township, Midhurst District; oak leaf shredder in plots in Tiny and Mulmur townships, Midhurst District and Bosanquent Township, Aylmer District and the hickory twig pruner in the two plots in Lavant Township in Kemptville District.

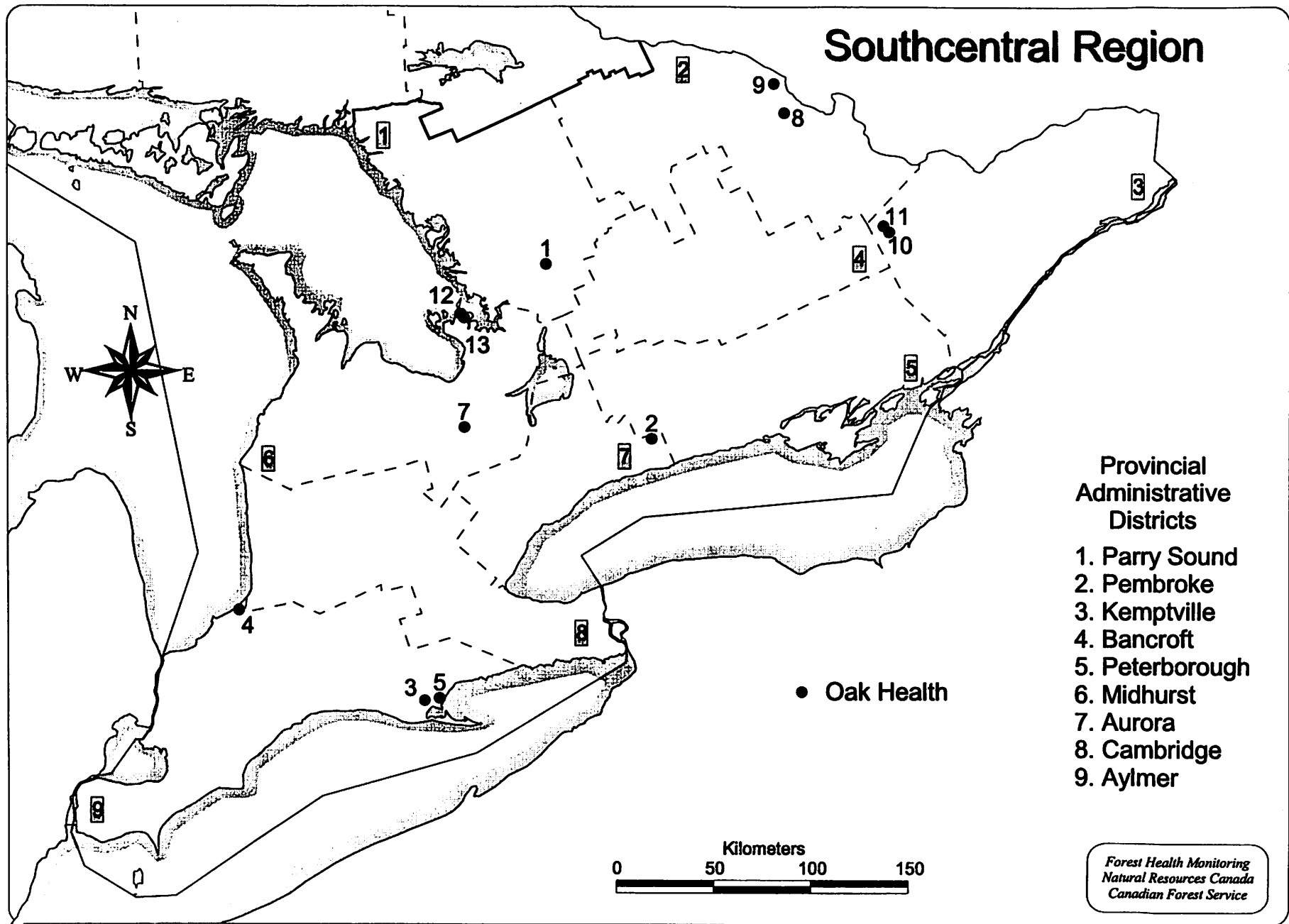


Figure 9. Location of the oak health plots in 1998.

Oak Health

Red oak crown condition

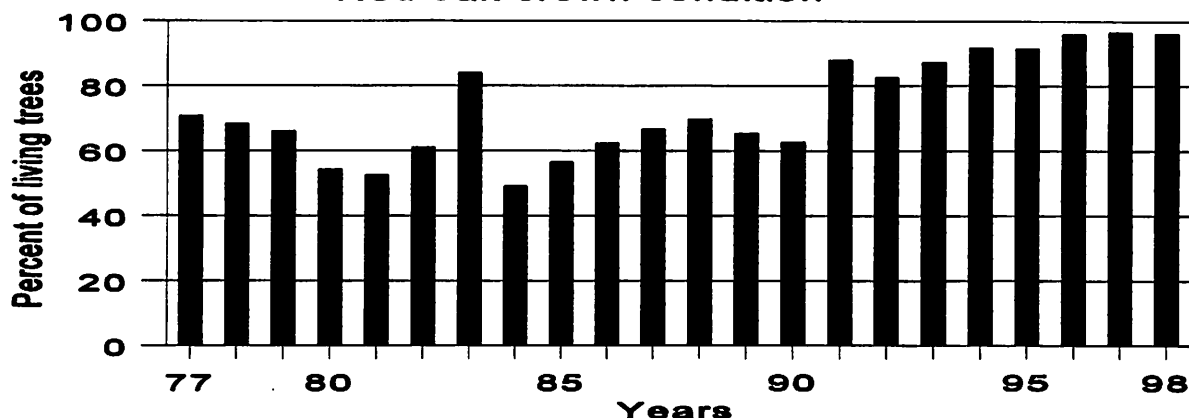


Figure 10. Summary of the healthy trees having 25 percent or less crown damage from 22 years of observations on 12 oak health plots in Southcentral Ontario not counting dead trees.

Armillaria root rot was associated with two dead trees in the plot in Clarke Township, Aurora District and single dead trees in Bosanquet Township, Aylmer District and Mulmur Township, Midhurst District. The hardwood decay fungus *Laetiporus sulphureus* (Bull.:Fr.)Murrill was present on a tree in Wylie Township, Pembroke District.

Spruce/Fir Health

In 1993 and 1994 there were 225 spruce/fir health plots established across the province. The main purpose of the plot network was to monitor the impact of spruce budworm on a variety of spruce and balsam fir stand types relative to tree age, stand content and site class. This would provide forest managers with a spruce budworm hazard rating system for rating the vulnerability and susceptibility of different forest stands to spruce budworm attack. A change in focus to forest health resulted in these plots being now part of the forest health network and all external conditions, not just the effects of spruce budworm defoliation, are monitored on all tree species present. Due to the reduction in staff the number of plots has decreased to 95 across Ontario. This year along with the three coniferous host species two deciduous hosts were also rated on 5 plots in the Southcentral Region as to the amount of crown damage, top condition and tree mortality (Appendix 9 & 10).

The most significant observation over the past five years has been the annual mortality of balsam fir trees. Four more trees died in 1998 and the cumulative mortality is now 20%. Trees that died were those having more than 50% foliage missing in 1997. This year of the 149 trees still alive only one tree was recorded as having more than 50% foliage missing. The percent of

trees with less than 50% foliage missing remained unchanged between 1997 and 1998.

There are 76 white spruce trees tallied on the five plots. Most of the trees remained unchanged. The only significant change from last year was in Bethune Township (plot 15) where 8 trees appear slightly worse.

This is the first year that hardwoods (24 trembling aspen & 8 white birch) have been rated. There is one dead white birch, the rest are healthy (<26% of crown dead). Of the 24 trembling aspen, 15 are healthy, 4 have more than 25% of crown dead and 5 are dead.

No major insect or disease conditions were encountered on any of the plots. The most noteworthy condition was the presence of heavy cone crop on balsam fir and white spruce in the Lister, Macaulay and Wylie township plots.

Appendix 1. Summary of the percent of crown damage, percent of broken tops, number of broken branches and number of wounds caused by the 1998 ice storm damage in and around the affected area on 26 permanent sample plots in the Aurora, Kemptville and Peterborough districts.

Location Twp	Plot type	Plot No.	Host ^a	No. of trees examined	% Crown Damage						% Broken tops ^b				No. of ^c broken branches per tree	No. of ^d wounds per tree
					0-10	11-25	26-50	51-75	76+	0	1	2	3	4		
Bancroft District																
Cardiff	25 tree natural	32	sM	22	100	0	0	0	0	100	0	0	0	0	0	0
Kemptville District																
Lavant	25 tree natural	42	sM	24	66	21	13	0	0	33	0	42	4	21	2.4	1.6
Nepean	25 tree natural	50	sM	24	26	33	37	4	0	13	0	74	0	13	2.0	6.1
Oxford on Rideau	25 tree natural	45	sM	25	8	8	52	20	12	4	0	40	52	4	3.7	9.6
Pakenham	25 tree natural	41	sM	24	42	28	17	13	0	13	0	66	4	17	2.5	5.3
Rear of Leeds & Lansdowne	25 tree natural	43	sM	15	0	47	40	13	0	0	0	87	13	0	3.9	7.5
Pembroke District																
Sebastopol	25 tree natural	38	sM	25	76	12	12	0	0	44	0	28	0	28	2.8	1.9

Appendix 1. Summary of the percent of crown damage, percent of broken tops, number of broken branches and number of wounds caused by the 1998 ice storm damage in and around the affected area on 26 permanent sample plots in the Aurora, Kemptville and Peterborough districts.

Location Twp	Plot type	Plot No.	Host ^a	No. of trees examined	% Crown Damage						% Broken tops ^b				No.of ^c broken branches per tree	No. of ^d wounds per tree
					0-10	11-25	26-50	51-75	76+	0	1	2	3	4		
Peterborough District																
Brighton	25 tree natural	46	sM	24	96	0	0	0	4	100	0	0	0	0	0	0
Aurora District																
Newcastle	25 tree rural	513	sM	21	100	0	0	0	0	100	0	0	0	0	0	0
Kemptville District																
Edwardsburgh	25 tree rural	523	sM	21	0	24	71	5	0	0	0	90	10	0	2.6	12.8
North Elmsley	25 tree rural	524	sM	19	5	58	26	11	0	0	0	53	47	0	5.2	9.8
Peterborough District																
Athol	25 tree rural	522	sM	23	92	4	4	0	0	92	4	4	0	0	2.4	1.6
Hillier	25 tree rural	521	sM	15	100	0	0	0	0	100	0	0	0	0	0	0
Loughborough	25 tree rural	520	sM	19	78	11	11	0	0	58	0	21	0	21	2.3	3.2

Appendix 1. Summary of the percent of crown damage, percent of broken tops, number of broken branches and number of wounds caused by the 1998 ice storm damage in and around the affected area on 26 permanent sample plots in the Aurora, Kemptville and Peterborough districts.

Location Twp	Plot type	Plot No.	Host ^a	No. of trees examined	% Crown Damage						% Broken tops ^b				No. of ^c broken branches per tree	No. of ^d wounds per tree
					0-10	11-25	26-50	51-75	76+	0	1	2	3	4		
Peterborough District																
Town of Cambellford	25 tree urban	820	sM	16	100	0	0	0	0	100	0	0	0	0	0	0
Town of Cobourg	25 tree urban	813	sM	21	81	0	0	19	0	100	0	0	0	0	1.6	0
City of Kingston	25 tree urban	819	sM	24	25	37	17	17	4	8	25	42	4	21	4.3	4.6
City of Peterborough	25 tree urban	811	sM	25	100	0	0	0	0	100	0	0	0	0	0	0
Kemptville District																
City of Brockville	25 tree urban	822	sM	15	13	40	40	7	0	0	0	73	7	20	4.5	7.1
Town of Gananoquae	25 tree urban	821	sM	20	20	50	20	10	0	0	0	75	5	20	2.4	6.6
Lavant	100 tree	10	rO	67	50	16	22	9	3	18	1	59	6	16	1.5	3.1
Lavant	100tree	11	rO	78	89	3	8	0	0	64	0	19	0	17	1.8	1.9
Rear of Yonge and Escott	NAMP	12	sM hH bHi bCh	78	48	21	15	10	6	29	1	23	14	33	2.8	2.8

Appendix 1. Summary of the percent of crown damage, percent of broken tops, number of broken branches and number of wounds caused by the 1998 ice storm damage in and around the affected area on 26 permanent sample plots in the Aurora, Kemptville and Peterborough districts.

Location Twp	Plot type	Plot No.	Host ^a	No. of trees examined	% Crown Damage						% Broken tops ^b				No.of ^c broken branches per tree	No. of ^d wounds per tree
					0-10	11-25	26-50	51-75	76+	0	1	2	3	4		
South Burgess	NAMP	24	sM	41	2	24	33	29	12	0	5	66	24	5	2.5	5.4
Gloucester	ARNEWS	519	wS	60	96	0	0	2	2	93	5	2	0	0	1.1	1.1
Rear of Yonge and Escott	ARNEWS	508	sM	10	0	0	50	30	20	0	0	80	20	0	8.1	4.1

^a sM = sugar maple, rO = red oak, hH = hop-hornbeam, bHi = bitternut hickory, bCh = black cherry, wS = white spruce

^b 0 = no broken top; 1 = single bole broken within crown; 2 = multiple bole some broken within crown but at least one unbroken; 3 = multiple bole all broken within crown; 4 = many branches broken within crown but no bole stems broken

^c Major branches broken less than 15cm from point of attachment

^d wound width greater than 20% of the circumference of bole

Appendix 2. Summary of percent crown damage, percent broken tops, number of broken branches and number of wounds by plot type (Natural, Rural and Urban) in 14 permanent 25 tree maple plots within the area damaged by the ice storm in the Kemptville and Peterborough districts.

Plot type	No. of plots	No. of trees examined	% Crown Damage					% Broken tops by level ^a					No. of broken branches per tree ^b	No. of wounds per tree ^c
			0-10	11-25	26-50	50-75	76-100	0	1	2	3	4		
Natural	6	137	39	23	28	8	2	19	0	54	12	15	3.1	5.7
Rural	4	82	45	23	28	4	0	40	1	41	13	5	3.4	9.2
Urban	4	80	37	30	18	14	1	29	8	44	4	15	3.2	6.0

^a 0 = no broken top; 1 = single bole broken within crown; 2 = multiple bole some broken within crown but at least one unbroken; 3 = multiple bole all broken within crown; 4 = many branches broken within crown but no bole stems broken

^b major branches broken less than 15 cm from point of attachment

^c wound width greater than 20% of the circumference of the bole

Appendix 3. Crown condition and tree mortality of deciduous host from 1994 to 1998 for nine plots in the Acid Rain National Early Warning System located in the Southcentral Region of Ontario. (Host species must represent ten percent or more of the deciduous content of the plot to be included.)

District Township	Plot number	Host ^a	Number of trees examined	Year	Total crown damage ^b											Cumulative tree mortality			
					<u>number of trees in each category</u>											New dead	Old dead	Trees cut	
					10	20	30	35	40	45	50	55	60	65	70				
<i>Aylmer District</i>																			
South Walsingham	526	bIO	7	1994	0	0	0	0	3	3	0	1	0	0	0	0	0	0	
			7	1995	0	0	0	0	3	2	1	1	0	0	0	0	0	0	0
			7	1996	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0
			7	1997	0	0	0	0	3	2	1	0	1	0	0	0	0	0	0
			7	1998	0	0	0	2	1	3	1	0	0	0	0	0	0	0	0
		wO	5	1994	0	0	2	0	2	1	0	0	0	0	0	0	0	0	
	5		1995	0	0	2	1	2	0	0	0	0	0	0	0	0	0		
	5		1996	0	0	1	2	1	1	0	0	0	0	0	0	0	0		
	5		1997	0	0	1	0	1	2	0	1	0	0	0	0	0	0		
	5		1998	0	0	1	1	1	0	0	2	0	0	0	0	0	0		
Howard	525	sM	9	1994	1	0	4	0	4	0	0	0	0	0	0	0	0		
			9	1995	1	0	1	0	6	1	0	0	0	0	0	0	0		
			9	1996	0	0	2	1	1	2	0	0	0	0	0	0	0	3	
			9	1997	0	0	0	0	4	1	1	0	0	0	0	0	0	3	
			9	1998	1	0	0	0	3	2	0	0	0	0	0	0	0	3	
<i>Bancroft District</i>																			
Sherborne	504	sM	12	1994	0	0	0	0	1	2	2	1	1	0	0	1	4	0	
			12	1995	0	0	1	1	2	1	0	1	0	0	1	0	5	0	
			12	1996	0	0	2	1	1	1	0	1	0	0	0	1	5	0	
			12	1997	0	0	0	0	2	4	0	0	0	0	0	0	6	0	
			12	1998	0	0	0	0	4	1	0	0	1	0	0	0	6	0	
Ridout	505	sM	21	1994	9	0	1	0	5	2	1	0	0	0	0	3	0		
			21	1995	3	0	4	2	9	0	0	0	0	0	0	3	0		
			21	1996	0	0	7	6	5	0	0	0	0	0	0	3	0		
			21	1997	0	0	0	0	7	6	5	0	0	0	0	3	0		
			21	1998	0	0	0	0	10	8	0	0	0	0	0	3	0		

Appendix 3. Crown condition and tree mortality of deciduous host from 1994 to 1998 for nine plots in the Acid Rain National Early Warning System located in the Southcentral Region of Ontario. (Host species must represent ten percent or more of the deciduous content of the plot to be included.)

District Township	Plot number	Host ^a	Number of trees examined	Year	Total crown damage ^b											Cumulative tree mortality			
					<u>number of trees in each category</u>											New dead	Old dead	Trees cut	
					10	20	30	35	40	45	50	55	60	65	70				
<i>Cambridge District</i>																			
West Wawanosh	507	sM	15	1994	3	0	3	1	6	0	0	0	0	0	0	0	0	1	1
			15	1995	0	0	4	0	8	1	0	0	0	0	0	0	0	1	1
			15	1996	1	0	1	1	5	4	1	0	0	0	0	0	0	1	1
			15	1997	0	0	0	0	6	7	0	0	0	0	0	0	0	1	1
			15	1998	0	0	3	1	5	2	1	1	0	0	0	0	0	1	1
<i>Kemptville District</i>																			
Rear of Yonge	508	sM	13	1994	0	0	5	0	6	0	0	0	0	0	0	0	0	2	0
			13	1995	0	0	5	0	5	1	0	0	0	0	0	0	0	2	0
			13	1996	0	0	1	2	4	4	0	0	0	0	0	0	0	2	0
			13	1997	0	0	0	0	9	2	0	0	0	0	0	0	0	2	0
			13	1998	0	0	1	1	0	3	1	3	0	0	1	1	2	0	0
<i>Midhurst District</i>																			
Oro	506	sM	28	1994	4	0	8	0	16	0	0	0	0	0	0	0	0	0	0
			28	1995	1	0	6	3	14	3	0	0	0	0	0	1	0	0	0
			28	1996	2	0	7	8	8	2	0	0	0	0	0	0	1	0	0
			28	1997	0	0	0	0	23	2	1	0	0	0	0	1	1	0	0
			28	1998	0	0	1	1	14	9	1	0	0	0	0	0	2	0	0
<i>Parry Sound District</i>																			
Macauley	539	rO	15	1995	0	0	2	2	6	3	0	0	0	0	0	0	2	0	0
			15	1996	0	0	0	8	5	0	0	0	0	0	0	0	2	0	0
			15	1997	0	0	0	0	5	6	1	1	0	0	0	0	2	0	0
			15	1998	0	0	0	0	0	7	5	1	0	0	0	0	2	0	0
		sM	11	1995	3	0	2	0	3	1	0	0	0	0	0	0	2	0	0
			11	1996	1	0	5	1	0	2	0	0	0	0	0	0	2	0	0
			11	1997	0	0	0	0	7	0	0	2	0	0	0	0	2	0	0
			11	1998	0	0	1	0	4	3	1	0	0	0	0	0	2	0	0

Appendix 3. Crown condition and tree mortality of deciduous host from 1994 to 1998 for nine plots in the Acid Rain National Early Warning System located in the Southcentral Region of Ontario. (Host species must represent ten percent or more of the deciduous content of the plot to be included.)

District Township	Plot number	Host ^a	Number of trees examined	Year	Total crown damage ^b											Cumulative tree mortality		
					<u>number of trees in each category</u>											New dead	Old dead	Trees cut
					10	20	30	35	40	45	50	55	60	65	70			
<i>Pembroke District</i>																		
Sproule	527	rO	24	1994	0	0	1	2	14	3	2	0	0	0	0	0	2	0
			24	1995	0	0	0	6	9	5	2	0	0	0	0	0	2	0
			24	1996	0	0	0	4	10	6	1	0	0	1	0	0	2	0
			24	1997	0	0	0	0	5	12	2	1	0	1	0	1	2	0
			24	1998	0	0	0	0	7	13	0	1	0	0	0	0	3	0

a - rO = red oak, bLO = black oak (*Quercus velutina* Lam.), wO = white oak (*Quercus alba* L.), sM = sugar maple

b - 10 = full complement of foliage; 20 = foliage thin, off-colour; 30 = no dead branches, bare twigs in up to 5 percent of crown; 35 = no dead branches, bare twigs in more than 6 percent of crown; 40 = dead branches and twigs in up to 15 percent of crown; 45 = dead branches and twigs in 16 - 25 percent of crown; 50 = dead branches and twigs in 26 - 37 percent of crown; 55 = dead branches and twigs in 38 - 50 percent of crown; 60 = dead branches and twigs in 51 - 75 percent of crown; 65 = dead branches and twigs in more than 76 percent of crown; 70 = more than 50 percent of crown dead, only adventitious branches usually at base of crown.

Appendix 4. Crown condition and tree mortality of coniferous host from 1994 to 1998 for six plots in the Acid Rain National Early Warning System located in the Southcentral Region of Ontario. (Host species must represent ten percent or more of the conifer content of the plot to be included.)

District Township	Plot number	Host ^a	Number of trees examined	Year	Total crown damage ^b							Cumulative tree mortality			
					<u>number of trees in each category</u>							New dead	Old dead	Trees cut	
					1	2	3	4	5	6	7				8
<i>Bancroft District</i>															
Sherborne	504	ewP	9	1994	7	0	0	0	0	0	0	0	0	2	0
			9	1995	6	0	0	0	0	0	1	0	2	0	
			9	1996	0	0	6	1	0	0	0	0	2	0	
			9	1997	0	0	6	1	0	0	0	0	2	0	
			9	1998	0	0	6	1	0	0	0	0	2	0	
<i>Cambridge District</i>															
Erin	517	ewP	28	1994	27	0	0	0	0	0	0	0	0	1	0
			28	1995	27	0	0	0	0	0	0	0	1	0	
			28	1996	26	1	0	0	0	0	0	0	1	0	
			28	1997	1	0	25	1	0	0	0	0	1	0	
			28	1998	10	0	14	2	1	0	0	0	1	0	
<i>Kemptville District</i>															
Gloucester	519	wS	58	1994	0	0	47	7	0	1	0	1	2	0	
			58	1995	0	0	25	17	7	5	0	1	3	0	
			58	1996	1	3	14	28	5	0	1	2	4	0	
			58	1997	0	0	25	22	3	0	1	1	6	0	
			58	1998	0	0	19	22	4	1	1	4	7	0	
<i>Pembroke District</i>															
Buchanan	514	wS	25	1994	14	11	0	0	0	0	0	0	0	0	
			25	1995	2	22	0	1	0	0	0	0	0	0	
			25	1996	1	17	7	0	0	0	0	0	0	0	
			25	1997	0	0	25	0	0	0	0	0	0	0	
			25	1998	0	0	15	10	0	0	0	0	0	0	
Buchanan	515	nS	31	1994	22	4	1	0	0	0	0	0	4	0	
			31	1995	27	0	0	0	0	0	0	0	4	0	
			31	1996	0	0	28	0	0	0	0	0	4	0	
			32	1997	0	0	28	0	0	0	0	0	4	0	
			32	1998	0	0	26	2	0	0	0	0	4	0	

Appendix 4. Crown condition and tree mortality of coniferous host from 1994 to 1998 for six plots in the Acid Rain National Early Warning System located in the Southcentral Region of Ontario. (Host species must represent ten percent or more of the conifer content of the plot to be included.)

District Township	Plot number	Host ^a	Number of trees examined	Year	Total crown damage ^b							Cumulative tree mortality			
					<u>number of trees in each category</u>							New dead	Old dead	Trees cut	
					1	2	3	4	5	6	7				8
<i>Peterborough District</i>															
Hungerford	518	ewP	55	1994	43	0	0	4	0	0	0	0	0	8	0
			55	1995	0	0	0	46	0	0	0	0	1	8	0
			55	1996	37	9	0	0	0	0	0	0	0	9	0
			55	1997	0	0	45	1	0	0	0	0	0	9	0
			55	1998	0	0	40	5	0	1	0	0	0	9	0

^a - ewP = eastern white pine, wS = white spruce, nS = norway spruce

^b - 1 = no defoliation; 2 = only current foliage defoliated, defoliation less than 25%; 3 = current and/or old foliage defoliated, defoliation less than 25 percent; 4 = 25-50 percent defoliation; 5 = 51-75 percent defoliation; 6 = 76-90 percent defoliation; 7 = greater than 90 percent defoliation; 8 = dead since last assessment; 9 = old dead

Appendix 5. Summary of crown conditions and tree mortality of ten tapped and ten non tapped sugar maples from the North American Maple Project plots in the South Central Region of Ontario from 1994 to 1998.

Plot History	Average DBH (cm)	Year	Number of trees on plots	Total percentage of dead crown					Tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
				Overall percentage of host trees					Overall percentage		
<i>Tapped plots</i>											
	35.2	1994	484	76.9	16.1	0.8	0.4	0.4	0.4	1.9	3.1
		1995	484	81.8	10.3	1.5	0.0	0.2	0.6	2.3	3.3
		1996	484	53.1	38.4	0.6	0.4	0.4	0.6	2.9	3.5
		1997	496 ^a	81.5	10.9	0.0	0.0	0.2	0.4	3.4	3.6
		1998	495 ^b	47.7	34.0	2.0	0.4	0.4	0.8	3.8	10.9
<i>Non tapped plots</i>											
	27.8	1994	573	76.8	13.4	0.9	0.5	0.2	0.7	3.8	3.7
		1995	573	82.4	8.0	0.5	0.0	0.0	0.5	4.6	4.0
		1996	573	61.1	27.7	1.4	0.7	0.0	0.0	5.1	4.0
		1997	584 ^a	83.1	7.2	0.2	0.0	0.0	0.5	5.0	4.0
		1998	584	56.9	28.4	2.6	1.0	0.0	1.5	5.5	4.1

^a includes trees growing on the plot that have now attained the 10 cm minimum diameter

^b 1 tree not ratable

Appendix 6. Summary of crown dieback and tree mortality of sugar maples at ten North American Maple Project plots currently being tapped for maple syrup production in the South Central Region of Ontario from 1994 to 1998.

Location <i>District</i> Township (Plot No.)	Average DBH (cm)	Year	Number of trees on plot	Total percentage of crown dieback					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
<u>Number of trees in each category</u>											
<i>Aurora District</i>											
Vaughan (1-18)	28.0	1994	59	55	1	0	0	0	0	0	3
		1995	59	53	3	0	0	0	0	0	3
		1996	59	36	20	0	0	0	0	0	3
		1997	64 ^a	49	11	0	0	0	0	0	4
		1998	64	33	24	0	0	1	0	0	6
<i>Aylmer District</i>											
Bayham (1-14)	41.1	1994	41	35	4	1	0	0	0	1	0
		1995	41	35	3	2	0	0	0	1	0
		1996	41	29	9	1	1	0	0	1	0
		1997	42 ^a	40	1	0	0	0	0	1	0
		1998	42	20	20	1	0	0	0	1	0
Townsend (1-15)	40.3	1994	32	23	4	0	0	2	1	1	1
		1995	32	23	5	0	0	1	0	2	1
		1996	32	23	5	0	0	0	1	2	1
		1997	33 ^a	28	1	0	0	0	0	3	1
		1998	33 ^b	14	12	1	0	0	1	3	1

Appendix 6. Summary of crown dieback and tree mortality of sugar maples at ten North American Maple Project plots currently being tapped for maple syrup production in the South Central Region of Ontario from 1994 to 1998. (Cont'd)

Location <i>District</i> Township (Plot No.)	Average DBH (cm)	Year	Number of trees on plot	Total percentage of crown dieback					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
				<u>Number of trees in each category</u>							
<i>Bancroft District</i>											
Bangor (1-23)	37.2	1994	53	18	25	1	2	0	0	2	5
		1995	53	33	9	2	0	0	2	2	5
		1996	53	25	16	1	0	2	0	4	5
		1997	53	33	9	0	0	1	1	4	5
		1998	53	0	11	1	0	0	1	5	35
<i>Cambridge District</i>											
Goderich (1-13)	33.8	1994	63	55	5	0	0	0	0	1	2
		1995	63	60	0	0	0	0	0	1	2
		1996	63	23	37	0	0	0	0	1	2
		1997	63	58	2	0	0	0	0	1	2
		1998	63	44	16	0	0	0	0	1	2
<i>Kemptville District</i>											
South Burgess (1-24)	40.0	1994	42	36	5	1	0	0	0	0	0
		1995	42	38	3	1	0	0	0	0	0
		1996	42	19	22	0	0	0	1	0	0
		1997	42	40	1	0	0	0	0	1	0
		1998	42	4	27	5	2	1	0	1	2
<i>Midhurst District</i>											
Orillia (1-17)	36.6	1994	55	44	10	0	0	0	0	0	1
		1995	55	48	6	0	0	0	0	0	1
		1996	55	32	22	0	0	0	0	0	1
		1997	55	44	10	0	0	0	0	0	1
		1998	55	40	14	0	0	0	0	0	1

Appendix 6. Summary of crown dieback and tree mortality of sugar maples at ten North American Maple Project plots currently being tapped for maple syrup production in the South Central Region of Ontario from 1994 to 1998. (Cont'd)

Location <i>District</i> Township (Plot No.)	Average DBH (cm)	Year	Number of trees on plot	Total percentage of crown dieback					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
<u>Number of trees in each category</u>											
<i>Midhurst District (Cont'd)</i>											
Saugeen (1-16)	37.1	1994	38	34	3	1	0	0	0	0	0
		1995	38	33	4	1	0	0	0	0	0
		1996	38	16	20	0	1	0	1	0	0
		1997	38	34	2	0	0	0	1	1	0
		1998	38	28	6	1	0	0	1	2	0
<i>Parry Sound District</i>											
Franklin (1-22)	32.7	1994	47	36	7	0	0	0	1	3	0
		1995	47	31	10	1	0	0	1	4	0
		1996	47	36	6	0	0	0	0	5	0
		1997	52 ^a	40	7	0	0	0	0	5	0
		1998	52	34	9	1	0	0	1	5	2
<i>Peterborough District</i>											
Belmont (1-19)	26.3	1994	54	36	14	0	0	0	0	1	3
		1995	54	42	7	0	0	0	0	1	4
		1996	54	18	29	1	0	0	0	1	5
		1997	54	38	10	0	0	0	0	1	5
		1998	54	19	29	0	0	0	0	1	5

^a includes trees growing on the plot that have now attained the 10 cm minimum diameter

^b 1 tree in plot not ratable

Appendix 7. Summary of crown dieback and tree mortality of sugar maples at ten North American Maple Project plots not tapped for maple syrup production in the South Central Region of Ontario from 1994 to 1998.

Location <i>District</i> Township (Plot No.)	Average DBH (cm)	Year	Number of trees on plot	Total percentage of crown dieback					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
<u>Number of trees in each category</u>											
<i>Aurora District</i>											
Nassagaweya (2-03)	30.0	1994	49	43	4	0	0	0	0	1	1
		1995	49	45	2	0	0	0	0	1	1
		1996	49	34	13	0	0	0	0	1	1
		1997	49	43	4	0	0	0	0	1	1
		1998	49	31	13	2	1	0	0	1	1
<i>Aylmer District</i>											
Blandford (2-02)	30.3	1994	42	38	4	0	0	0	0	0	0
		1995	42	42	0	0	0	0	0	0	0
		1996	42	33	9	0	0	0	0	0	0
		1997	42	40	1	0	0	0	1	0	0
		1998	42	26	14	0	0	0	1	1	0
Warwick (2-01)	26.9	1994	48	39	3	0	0	0	0	1	5
		1995	48	41	1	0	0	0	0	1	5
		1996	48	25	17	0	0	0	0	1	5
		1997	52 ^a	45	1	0	0	0	0	1	5
		1998	52	38	8	0	0	0	0	1	5

Appendix 7. Summary of crown dieback and tree mortality of sugar maples at ten North American Maple Project plots not tapped for maple syrup production in the South Central Region of Ontario from 1994 to 1998.

Location <i>District</i> Township (Plot No.)	Average DBH (cm)	Year	Number of trees on plot	Total percentage of crown dieback					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
				<u>Number of trees in each category</u>							
<i>Bancroft District</i>											
Cardiff (2-11)	21.4	1994	94	48	34	4	2	0	1	5	0
		1995	94	63	21	2	0	0	2	6	0
		1996	94	57	23	3	3	0	0	8	0
		1997	94	67	17	1	0	0	1	8	0
		1998	94	46	37	1	1	0	0	9	0
Ridout (2-10)	27.5	1994	64	48	8	0	0	0	1	7	0
		1995	64	52	4	0	0	0	0	8	0
		1996	64	47	8	0	1	0	0	8	0
		1997	67 ^a	54	5	0	0	0	0	8	0
		1998	67	49	7	0	0	0	3	8	0
<i>Cambridge District</i>											
West	31.5	1994	37	34	2	0	0	1	0	0	0
Wawanosh		1995	37	37	0	0	0	0	0	0	0
(2-04)		1996	37	25	12	0	0	0	0	0	0
		1997	37	36	1	0	0	0	0	0	0
		1998	37	29	8	0	0	0	0	0	0
<i>Kemptville District</i>											
Rear of Yonge (2-12)	19.9	1994	63	54	7	0	0	0	1	1	0
		1995	63	59	2	0	0	0	0	2	0
		1996	63	20	40	1	0	0	0	2	0
		1997	67 ^a	62	3	0	0	0	0	2	0
		1998	67	9	37	10	4	0	5	2	0

Appendix 7. Summary of crown dieback and tree mortality of sugar maples at ten North American Maple Project plots not tapped for maple syrup production in the South Central Region of Ontario from 1994 to 1998.

Location <i>District</i> Township (Plot No.)	Average DBH (cm)	Year	Number of trees on plot	Total percentage of crown dieback					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
				<u>Number of trees in each category</u>							
<i>Midhurst District</i>											
Adjala (2-06)	33.3	1994	65	56	1	1	1	0	1	4	1
		1995	65	52	5	0	0	0	0	5	3
		1996	65	43	12	2	0	0	0	5	3
		1997	65	55	2	0	0	0	0	5	3
		1998	65	39	16	1	0	0	0	5	4
Oro (2-05)	24.8	1994	80	58	6	0	0	0	0	2	14
		1995	80	56	7	1	0	0	0	2	14
		1996	80	50	12	2	0	0	0	2	14
		1997	80	57	6	0	0	0	1	2	14
		1998	80	42	21	0	0	0	0	3	14
<i>Peterborough District</i>											
Hallowell (2-07)	32.6	1994	31	22	8	0	0	0	0	1	0
		1995	31	25	4	0	0	0	1	1	0
		1996	31	16	13	0	0	0	0	2	0
		1997	31	27	2	0	0	0	0	2	0
		1998	31	23	5	1	0	0	0	2	0

^a includes trees growing on the plot that have now attained the 10 cm minimum diameter

Appendix 8. Summary of oak health at 12 locations in the South Central Region of Ontario for 5 year period ending in 1998. (Data based on the examination of 100 host trees at each location.)

Location Township (Plot No.)	Average DBH (cm)	Year	Total percentage of dead crown					Cumulative tree mortality		
			0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
<i>Aurora District</i>										
Clarke	24.5	1994	62	19	0	1	0	0	18	0
(2)		1995	49	30	1	0	1	1	18	0
		1996	46	34	1	0	0	0	18	1
		1997	42	39	0	0	0	0	18	1
		1998	31	47	1	0	0	2	18	1
<i>Aylmer District</i>										
Bosanquent	29.0	1994	50	25	2	0	2	5	16	0
(4)		1995	50	21	1	2	1	4	21	0
		1996	3	64	5	0	0	3	25	0
		1997	26	40	3	2	0	1	28	0
		1998	31	35	3	1	0	1	29	0
Charlotteville	32.0	1994	57	33	0	0	1	1	8	0
(5)		1995	42	36	8	0	1	3	9	1
		1996	19	59	9	0	0	0	12	1
		1997	16	71	0	0	0	0	12	1
		1998	34	53	0	0	0	0	12	1
South Walsingham		1994	62	15	0	0	0	0	22	1
(3)	22.0	1995	59	17	1	0	0	0	22	1
		1996	50	27	0	0	0	0	22	1
		1997	44	30	2	0	0	1	22	1
		1998	57	15	2	1	0	1	23	1
<i>Kemptville District</i>										
Lavant	20.6	1994	3	54	8	3	1	2	29	0
Flower Station		1995	7	49	9	1	1	2	31	0
(10)		1996	11	51	4	1	0	0	33	0
		1997	5	59	2	0	1	0	33	0
		1998	7	39	15	3	2	1	33	0

Appendix 8. Summary of oak health at 12 locations in the South Central Region of Ontario for 5 year period ending in 1998. (Data based on the examination of 100 host trees at each location.)

Location Township (Plot No.)	Average DBH (cm)	Year	Total percentage of dead crown					Cumulative tree mortality		
			0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
<i>Kemptville District (Cont'd)</i>										
Lavant	25.5	1994	1	56	18	4	3	0	18	0
Joe's Lake		1995	3	56	15	4	1	3	18	0
(11)		1996	5	65	8	1	0	0	21	0
		1997	5	66	6	2	0	0	21	0
		1998	31	43	2	2	0	1	21	0
<i>Midhurst District</i>										
Mulmur	28.8	1994	58	22	2	0	0	1	13	4
(7)		1995	58	23	1	0	0	0	14	4
		1996	40	41	0	0	0	0	14	5
		1997	46	34	0	0	1	0	14	5
		1998	21	57	1	0	0	2	14	5
Tiny Awenda Provincial Park	28.5	1994	55	10	0	1	1	0	18	15
(12)		1995	51	15	1	0	0	0	18	15
		1996	42	22	1	0	0	2	18	15
		1997	24	40	0	0	0	1	20	15
		1998	7	57	0	0	0	0	21	15
Tiny Farlain Lake	26.0	1994	42	8	2	1	1	2	40	4
(13)		1995	42	7	3	0	1	0	42	5
		1996	27	25	0	0	0	1	42	5
		1997	20	32	0	0	0	0	43	5
		1998	9	42	1	0	0	0	43	5

Appendix 8. Summary of oak health at 12 locations in the South Central Region of Ontario for 5 year period ending in 1998. (Data based on the examination of 100 host trees at each location.)

Location Township (Plot No.)	Average DBH (cm)	Year	Total percentage of dead crown					Cumulative tree mortality		
			0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
<i>Parry Sound District</i>										
Macaulay (1)	35.0	1994	4	76	7	0	1	0	12	0
		1995	19	66	2	0	0	1	12	0
		1996	23	62	2	0	0	0	13	0
		1997	60	27	0	0	0	0	13	0
		1998	26	59	2	0	0	0	13	0
<i>Pembroke District</i>										
Alice (8)	18.0	1994	3	54	10	1	3	1	21	7
		1995	8	54	7	0	2	0	22	7
		1996	29	39	3	0	0	0	22	7
		1997	23	46	1	1	0	0	22	7
		1998	32	39	0	0	0	0	22	7
Wylie (9)	25.0	1994	3	66	14	2	1	0	14	0
		1995	3	62	16	2	2	1	14	0
		1996	22	53	7	1	0	2	15	0
		1997	13	63	4	2	1	0	17	0
		1998	21	59	1	0	0	2	17	0
Overall Percentage		1994	33.3	36.5	5.2	1.1	1.2	1.0	19.1	2.6
		1995	32.6	36.3	5.4	0.8	0.8	1.2	20.1	2.8
		1996	26.4	45.2	3.3	0.2	0.0	0.7	21.3	2.9
		1997	27.0	45.6	1.5	0.6	0.3	0.2	21.9	2.9
		1998	25.6	45.4	2.3	0.6	0.2	0.8	22.2	2.9

Appendix 9. Summary of the crown condition, tree mortality, and top condition for three coniferous hosts in the 5 spruce/fir health plots from 1996 to 1998 in the Southcentral Region of Ontario.

Location (Plot no.)	Host ^a	Average DBH (cm)	Year	Crown condition ^b							Cumulative mortality ^c			Condition of top		
				1	2	3	4	5	6	7	New dead	Old dead	Trees cut	Live	Bare	Dead
				Number of trees												
Parry Sound District																
Bethune Township (15)	bF	14.7	1996	17	0	0	0	0	0	0	1	4	0	17	0	0
			1997	0	0	11	5	1	0	0	0	5	0	17	0	0
			1998	0	0	7	9	0	0	0	1	5	0	16	0	0
	wS	24.7	1996	32	0	0	0	0	0	0	1	3	0	31	1	0
			1997	0	0	22	8	1	0	0	1	4	0	31	0	0
			1998	0	0	14	15	2	0	0	0	5	0	31	0	0
Macaulay Township (19)	bF	21.3	1996	35	0	0	0	0	0	0	3	9	0	35	0	0
			1997	0	0	25	9	1	0	0	0	12	0	34	0	1
			1998	0	0	29	5	1	0	0	0	12	0	33	0	2
Mowat Township (20)	bF	19.2	1996	32	0	0	0	0	0	1	0	1	0	32	0	1
			1997	0	0	25	6	1	0	0	1	1	0	32	0	0
			1998	0	0	25	7	0	0	0	0	2	0	30	1	1
	wS	24.5	1996	13	0	0	0	0	0	0	0	0	0	13	0	0
			1997	0	0	7	5	1	0	0	0	0	0	13	0	0
			1998	0	0	9	3	1	0	0	0	0	0	13	0	0

Appendix 9. Summary of the crown condition, tree mortality, and top condition for three coniferous hosts in the 5 spruce/fir health plots from 1996 to 1998 in the Southcentral Region of Ontario.

Location (Plot no.)	Host ^a	Average DBH (cm)	Year	Crown condition ^b							Cumulative mortality ^c			Condition of top		
				1	2	3	4	5	6	7	New dead	Old dead	Trees cut	Live	Bare	Dead
Pembroke District																
Lister Township (3)	bF	15.9	1996	37	0	0	0	0	0	1	2	2	0	38	0	0
			1997	0	0	31	5	0	0	1	1	4	0	36	0	1
			1998	1	1	27	6	0	0	0	2	5	0	35	0	0
	wS	24.9	1996	13	0	0	0	0	0	0	0	1	0	13	0	0
			1997	0	0	12	1	0	0	0	0	1	0	13	0	0
			1998	0	0	11	2	0	0	0	0	1	0	13	0	0
Wylie Township (23)	bF	20.2	1996	32	0	0	0	0	0	2	3	4	0	32	1	1
			1997	0	0	30	1	0	0	1	2	7	0	31	0	1
			1998	0	18	8	5	0	0	0	1	9	0	31	0	0
	wS	32.5	1996	13	0	0	0	0	0	0	0	0	0	13	0	0
			1997	0	0	9	4	0	0	0	0	0	0	12	0	1
			1998	0	4	4	5	0	0	0	0	0	0	12	0	1

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

^b - 1 = no defoliation; 2 = only current foliage missing, less than 25 percent; 3 = current and/or old foliage missing, less than 25 percent; 4 = 25-50 percent foliage missing; 5 = 51-75 percent foliage missing; 6 = 76-90 percent foliage missing; 7 = greater than 90 percent foliage missing; 8 = tree has died since last assessment; 9 = old dead tree

Appendix 10. Summary of crown condition and tree mortality for trembling aspen and white birch present on 4 spruce/fir health plots for 1998 in the Southcentral Region

Location (plot No.)	Host ^a	Avg. DBH (cm)	Total crown damage ^b number of trees in each category											Cumulative tree mortality			
			10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead	Trees cut	
Parry Sound District																	
Bethune Township (15)	wB		0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
Mowat Township (20)	wB		0	0	3	0	1	0	0	0	0	0	0	0	0	1	0
	tA		0	0	0	0	5	7	1	3	0	0	0	1	4	0	0
Pembroke District																	
Lister Township (3)	wB		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Wylie Township (23)	tA		0	0	1	0	1	1	0	0	0	0	0	0	0	0	0

^a - wB = white birch, tA = trembling aspen

^b - 10 = full complement of foliage; 20 = foliage thin, off-colour; 30 = no dead branches, bare twigs in up to 5 percent of crown; 35 = no dead branches, bare twigs in more than 6 percent of crown; 40 = dead branches and twigs in up to 15 percent of crown; 45 = dead branches and twigs in 16 - 25 percent of crown; 50 = dead branches and twigs in 26 - 37 percent of crown; 55 = dead branches and twigs in 38 - 50 percent of crown; 60 = dead branches and twigs in 51 - 75 percent of crown; 65 = dead branches and twigs in more than 76 percent of crown; 70 = more than 50 percent of crown dead, only adventitious branches usually at base of crown.