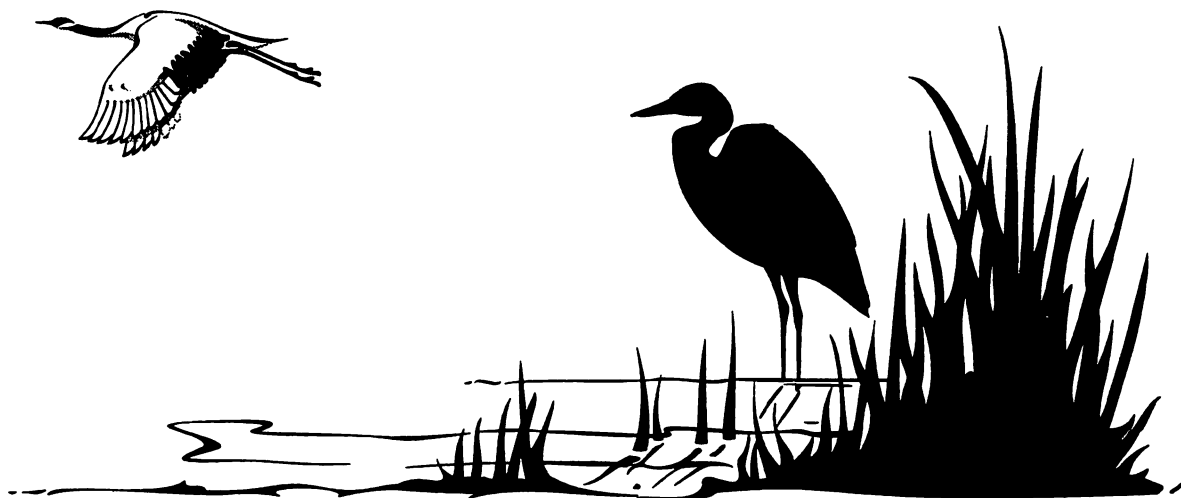


**FOREST HEALTH CONDITIONS
IN THE SOUTH CENTRAL REGION OF
ONTARIO, IN 1996**

FOREST DISTRICTS: *Algonquin Park, Aylmer, Bancroft, Cambridge,
Kemptville, Maple, Midhurst, Parry Sound,
Pembroke, and Tweed*

W. Ingram, D. Curry, M. Francis, and D. Rowlinson

**Natural Resources Canada
Canadian Forest Service
Great Lakes Forestry Centre**



OVERVIEW

The following report deals with both the biotic and abiotic conditions that affected forest health in the South Central Region (as outlined by the Ontario Ministry of Natural Resources) of Ontario in 1996.

Program reviews and budget reductions announced in February 1995 by the federal government have resulted in changes to the former Forest Insect and Disease Survey (FIDS) Program. The FIDS program has been merged with the former Long Range Transportation of Air Pollutants program to form a nationally focused Forest Health Network. The monitoring component of this network will include activities such as the Acid Rain National Early Warning System (ARNEWS); the North American Maple Project (NAMP); and spruce/fir, jack pine, sugar maple, and oak health plots. Major forest disturbances, including the spruce budworm, forest tent caterpillar, and jack pine budworm, as well as all other destructive forest pests, will be monitored. Similarly, quantitative surveys for the gypsy moth, pine shoot beetle, and other forest insects will continue.

The past field season presented a major change in the way that forests have traditionally been monitored, and more specifically a change in the approach to problematic small pockets of damage that are not large or severe enough to be classified as a major forest disturbance. Under the new mandate general surveys and extension work have been given a very low priority. Only major forest disturbances are handled outside of the Forest Health Plot Monitoring System.

Annual evaluation of the maple health plots and the North American Maple Project (NAMP) plots revealed little change from previous years in the vigor or dieback of the host trees. Some individual stands received light defoliation by leaftiers and leaf rollers in 1996. Similarly the oak health plots tallied across the region were basically unchanged, but showed some new dieback. Generally, this could be attributed to last year's dry spell. Three of the oak plots received moderate defoliation; two damaged by the flat leaftier, and the third, in the Pinery Provincial Park damaged by the gypsy moth. Acid rain monitoring also continued in plots across the region but, District the area damaged by this pest has expanded greatly and tree mortality is becoming a problem.

Forest tent caterpillar damage was down across the region, with only small pockets of sporadic damage aeri ally mapped in the Kempville District.

Oak leaf shredder damage persisted and even expanded somewhat in the Lafontaine area of the Midhurst District.

TABLE of CONTENTS

MAJOR FOREST DISTURBANCES

INSECTS

Pine False Webworm, <i>Acantholyda erythrocephala</i> (All districts)	1
Oak Leaf Shredder, <i>Acleris semipurpurana</i> (Midhurst District)	1
Spruce Budworm, <i>Choristoneura fumiferana</i> (Algonquin Park, Kemptville, Parry Sound, Pembroke, and Tweed districts)	2
Jack Pine Budworm, <i>Choristoneura p. pinus</i> (Algonquin Park, Parry Sound, and Pembroke districts)	6
Aspen Twoleaf Tier, <i>Enargia decolor</i> (Algonquin Park, Bancroft, Kemptville, Parry Sound, and Pembroke districts)	8
Hemlock Looper, <i>Lambdina f. fiscellaria</i> (Bancroft, and Tweed districts)	9
Forest Tent Caterpillar, <i>Malacosoma disstria</i> (Kemptville District)	12

DISEASES

Scleroderris Canker, <i>Gremmeniella abietina</i> (Parry Sound District)	12
---	----

ABIOTIC CONDITIONS

Winter drying (Algonquin Park, Parry Sound, and Pembroke districts)	12
--	----

OTHER AGENTS DAMAGING FOREST TREES

(All districts)	14
-----------------	----

FOREST HEALTH PLOT MONITORING

Acid Rain National Early Warning System (ARNEWS) (Algonquin Park, Aylmer, Bancroft, Cambridge, Kemptville, Midhurst, Parry Sound, Pembroke, and Tweed districts)	16
Maple Health (Algonquin Park, Aylmer, Bancroft, Cambridge, Kemptville, Maple, Midhurst, Parry Sound, and Pembroke districts)	16
North American Maple Project (NAMP) (Aylmer, Bancroft, Cambridge, Kemptville, Maple, Midhurst, Parry Sound, and Tweed districts)	19
Oak Health (Aylmer, Kemptville, Maple, Midhurst, Parry Sound, and Pembroke districts)	22
Spruce/Fir Health (Algonquin Park, Bancroft, Parry Sound, and Pembroke districts)	25

QUARANTINE PESTS

Gypsy Moth, <i>Lymantria dispar</i> (Aylmer District)	27
Pine Shoot Beetle, <i>Tomicus piniperda</i> (L.) (Kemptville, and Midhurst districts)	27

APPENDICES

APPENDIX 1.	Acid Rain National Early Warning System (Tables 8 to 13)
APPENDIX 2.	Maple Health (Table 14)
APPENDIX 3.	North American Maple Project (Tables 15 to 17)
APPENDIX 4.	Oak Health (Table 18)
APPENDIX 5.	Spruce\Fir Health (Tables 19 to 21)

MAJOR FOREST DISTURBANCES

INSECTS

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

Once again pine false webworm damage increased across the region in 1996. The heaviest damage was recorded on a 300-ha area of semimature red pine (*Pinus resinosa* Ait.) east of Craighurst in Oro Township, Midhurst District. All available pine hosts (Scots pine [*Pinus sylvestris* L.] and eastern white pine [*Pinus strobus* L.]) was affected to some level throughout Concessions II to V and along Lots 1 through 7. In some cases the natural eastern white pine (12 – 14 meters tall) were moderately affected. Mainly damage was confined to the upper crowns.

In the Craighurst area, additional mortality has been recorded within this area, here 25 ha of a heavily infested stand was removed as a control measure in late 1994. Severe defoliation was recorded in roadside plantations throughout the area now stretching from Craighurst to Highway 69.

Two smaller pockets of moderate (30 – 50 percent) defoliation were recorded in the Midhurst District. In Essa Township, a 1-ha pocket of large, 10-m red pine with a juvenile red pine and Scots pine understorey was recorded along Road 10 near the entrance to C.F.B. Borden. In Holland Township, near Chatsworth (along Highway 10), several plantations of red pine and Scots pine mix experienced moderate defoliation. Trees ranged from 5 to 12 meters in height over areas up to 5 ha in size.

Within the Pembroke District young red pine plantations were defoliated in Ross and Wilberforce townships. The heaviest damage (90 percent) was recorded over a 6-ha plantation in Ross Township; light defoliation (20 percent) was recorded over two smaller 0.5-ha sites, one in each of Ross and Wilberforce townships.

Throughout the remainder of the region trace levels of this insect could be found in most of the plantations examined.

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

Moderate to severe damage caused by the oak leaf shredder was recorded in the northeastern portion of the Midhurst District. Once again, the area of defoliation was confined to a 13- to 14-m-tall red oak (*Quercus rubra* L.) stand just west of the town of Lafontaine, Tiny Township, and along the Georgian Bay shoreline between the beach and the steep ridge. Host trees within this 250-ha area sustained an average of 75 percent defoliation, mainly in the upper crowns. In all cases the damaged trees had refoliated with smaller, lighter colored leaves. The entire area west of Lafontaine has now been damaged to some degree by this pest, and the only area still not affected in the immediate vicinity is south along the Georgian Bay shoreline.

Elsewhere in the region trace damage levels caused by the oak leaf shredder were recorded infrequently.

Spruce Budworm, *Choristoneura fumiferana* Clem.

Extremely heavy cone crops and untimely weather conditions (windy, rainy) adversely affected the aerial mapping of spruce budworm defoliation in 1996.

The majority of the damage was recorded in Algonquin Park, Kemptville, and Pembroke districts and adjacent to the areas recorded in 1995 (Fig.1). Within the Algonquin Park District some 15 000 ha of top and whole-tree mortality now exists in the long-lived current infestation (Fig.2).

Table 1. Gross area of moderate to severe defoliation and resultant top and/or whole-tree mortality caused by the spruce budworm in the South Central Region in 1996.

District	Area Affected (ha)	
	Defoliation	Mortality
Algonquin	10 234	15 582
Kemptonville	4 880	-
Parry Sound	438	-
Pembroke	3 826	-
Tweed	178	-
Total	21 556	15 582

Currently 19 000 ha of moderate to severe defoliation was recorded in the region (Table 1). The Algonquin Park District infestation persisted in Biggar and Devine townships and spread into a new area in Paxton Township, Parry Sound District. However it was reduced in severity in the surrounding townships. Moderate damage was also recorded, primarily on white spruce (*Picea glauca* [Moench] Voss), over smaller pockets in Stafford, Bromley, Adamston, Horton, and McNab townships in the Pembroke District. In the Kemptonville District heavy defoliation persisted on white spruce host throughout the area from Almonte to Stittsville. Across the remainder of the Kemptonville District budworm numbers were down in Cambridge and Gloucester townships and they virtually collapsed in the LaRose Forest, where control measures were carried out in 1996. Heavy defoliation was also recorded in the white spruce plantation in Balsam Lake Provincial Park, Tweed District, for the second consecutive year. At this location some top and branch-tip mortality was recorded.

Throughout the remainder of the region small isolated pockets of heavy defoliation were recorded in Whitechurch Township and north of Claremont, both in the Maple District. Defoliation may also develop in the St. Williams area, Aylmer District, and in Minto Township, Cambridge District. Results of pheromone trapping (Table 2) and egg-mass samples (Table 3) show a general decline in insect numbers over the 1995 levels at most locations. However, light to moderate populations should persist at most locations currently affected. Some areas of heavy defoliation may also develop in the St. Williams area, Aylmer District, and in Minto Township, Cambridge District.

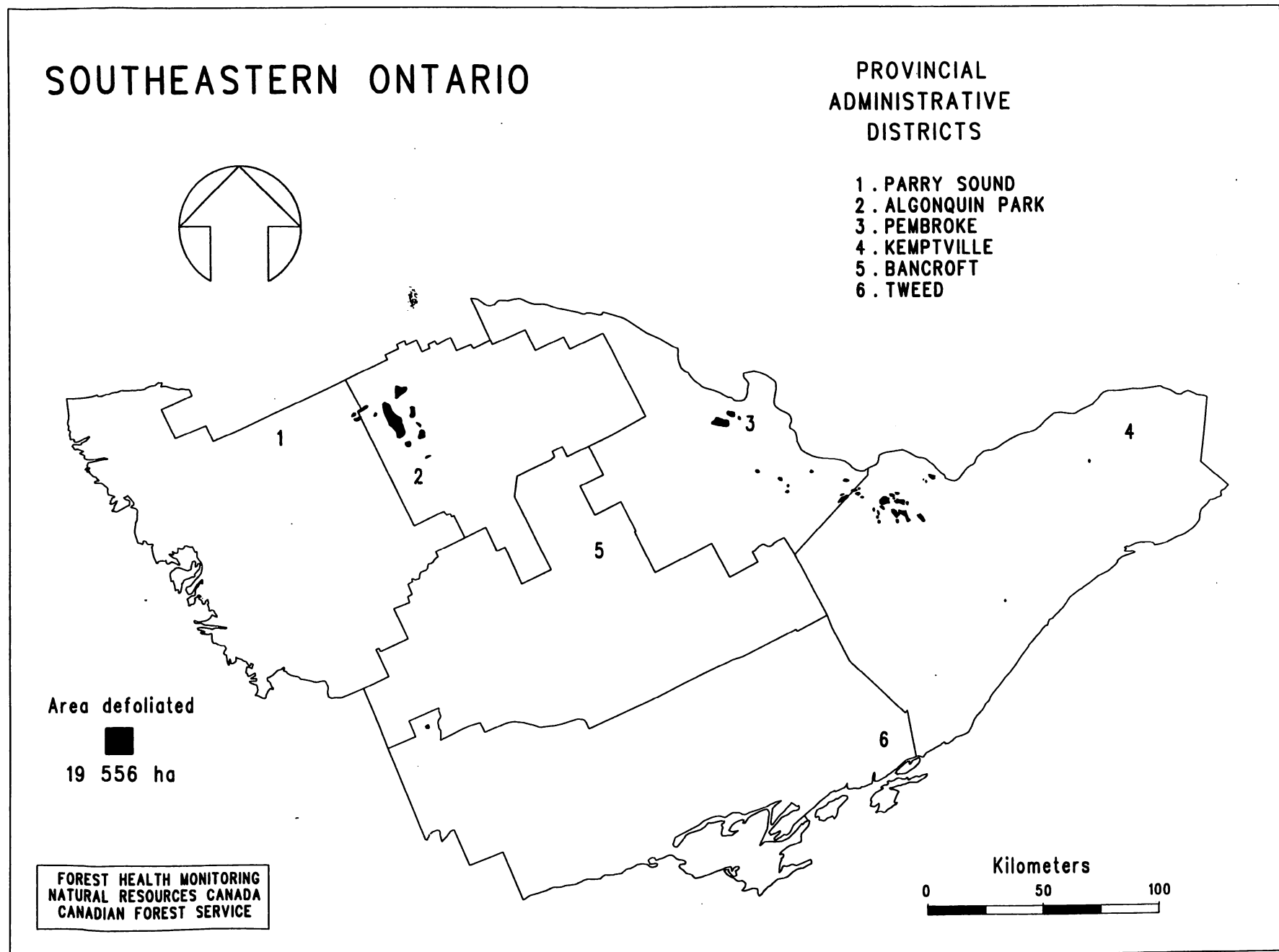
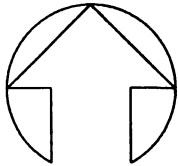


Figure 1. Areas within which moderate to severe defoliation caused by the spruce budworm (*Choristoneura fumiferana* [Clem].) occurred in 1996.

SOUTHEASTERN ONTARIO

PROVINCIAL ADMINISTRATIVE DISTRICTS

1. PARRY SOUND
2. ALGONQUIN PARK
3. PEMBROKE
4. KEMPTVILLE
5. BANCROFT
6. TWEED



Area of mortality



15 582 ha

FOREST HEALTH MONITORING
NATURAL RESOURCES CANADA
CANADIAN FOREST SERVICE

Kilometers
0 50 100

Figure 2. Areas within which partial or whole tree mortality was recorded due to spruce budworm (*Choristoneura fumiferana* [Clem.]) in 1996.

Table 2. Results of spruce budworm pheromone trapping in six locations in the South Central Region of Ontario from 1992 to 1996. (Three traps were used at each location.)

Location	Plot number	Total number of moths captured				
		1992	1993	1994	1995	1996
<i>Algonquin Park District</i>						
Stratton	5	643	482	112	33	14
White	6	962	501	194	29 ^a	14
<i>Bancroft District</i>						
Ridout	7	-	-	203	96	29
<i>Parry Sound District</i>						
Bethune	15	1 169	251	426	254	88 ^a
Mowat	20	-	-	-	-	159
Spence	21	414	117	226	112	56

^a - Total from 2 traps.

Table 3. Results of spruce budworm egg-mass counts for 1996 in the South Central Region of Ontario.

Location (township)	Plot number\ location	Host ^a	Estimated 1996 defoliation percent	Number of egg masses per 9.29sq m of foliage	Infestation forecast for 1997 ^b	Accumulated damage ^c
<i>Algonquin Park District</i>						
Airy	1	bF	0	0	N	0
Airy	1	wS	0	0	N	0
Stratton	5	bF	0	7	L-M	0
White	6	bF	0	0	N	0
<i>Aylmer District</i>						
Charlotteville	Turkey Point	wS	1	32	L-M	0
	St. Williams	wS	0	69	M-S	0
<i>Bancroft District</i>						
Chandos	Apsley	bF	0	0	N	0
Ridout	7	bF	0	0	N	0
	7	wS	1	0	N	0
<i>Cambridge District</i>						
Minto	Highway 9	wS	5	161	M-S	1
<i>Kemptville District</i>						
Cambridge	Check Plot 7	wS	5	0	N	0
Campbell	Check Plot 2	wS	2	55	L-M	0
Clarence	Spray Block A	wS	1	266	S	0
Clarence	Spray Block B	wS	5	37	L-M	1
Fitzroy	Highway 17	wS	45	1522	S	1
Gloucester	Arnews 519	wS	18	180	M-S	1
Oxford on	Nursery	wS	2	53	L-M	1
Rideau	Limerek Forest	wS	22	39	L-M	1
<i>Maple District</i>						
Whitechurch	Highway 9	wS	71	1096	S	1
Caledon	Highway 9	wS	0	0	N	0

Location (township)	Plot number/ location	Host ^a	Estimated 1996 defoliation percent	Number of egg masses per 9.29sq m of foliage	Infestation forecast for 1997 ^b	Accumulated damage ^c
<i>Parry Sound District</i>						
Bethune	15	bF	0	0	N	0
	15	wS	1	0	N	0
Macaulay	19	bF	0	0	N	0
Mowat	20	bF	1	0	N	0
	20	wS	0	0	N	0
Spence	21	bF	0	0	N	0
	21	wS	1	0	N	0
<i>Pembroke District</i>						
Admaston	Highway 60	bF	4	92	M-S	0
	Highway 60	wS	11	195	S	0
<i>Tweed District</i>						
Bexley	Balsam Lake	wS	67	962	S	1
	Provincial Park	wS	83	536	S	3
Madoc	Highway 7	bF	0	0	N	0

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

^b - N = nil, L = light (<25 percent), M = moderate (25 to 75 percent), S = severe (>75 percent).

^c - 0 = undamaged; 1 = light damage, <25 percent total defoliation, usually one season of severe defoliation; 2 = moderate damage, 25- 60 percent total defoliation, two or three seasons of severe defoliation; 3 = severe damage, 60-80 percent total defoliation, 3 to 5 years of severe defoliation, will recover.

Jack Pine Budworm, *Choristoneura pinus pinus* Free.

Heavy flowering and adverse weather conditions caused difficulties in aerial mapping for the jack pine budworm and, consequently, the maps produced had to be ground checked to verify suspected areas of infestation. The total area of defoliation in 1996 was reduced by 50 percent across the Algonquin Park, Parry Sound, and Pembroke districts (Fig.3; Table 4). Again the largest area of continual defoliation was recorded south of the Pickerel River throughout Wallbridge, Mowat, and Henvey townships and into the area of the Naiscoot River. North of this site several smaller pockets of infestation were recorded along Georgian Bay and east along the French River. In the Algonquin Park District damage was heavy throughout White, Edgar, and Clancy townships; moderate defoliation was recorded in Master and Guthrie townships. Budworm populations declined across the Pembroke District, with the only heavy damage recorded in Alice Township. Moderate damage was spread across Anglin, Stratton, Barrow, Head, Wylie, Buchanan, and Foster townships and north of Bonnecherre Provincial Park in Richards and Burns townships. In the Pembroke District moderate damage in Petawawa and Maria townships supported some top and whole-tree mortality for the first time this year. As previously recorded in the Parry Sound District, young eastern white pine host trees were also heavily defoliated at many locations in 1996. In the Chalk River area of the Pembroke District, a large stand of jack pine (*Pinus banksiana* Lamb.) showed an average defoliation of 30 percent. An adjacent, young eastern white pine stand was 95 percent defoliated by the jack pine budworm

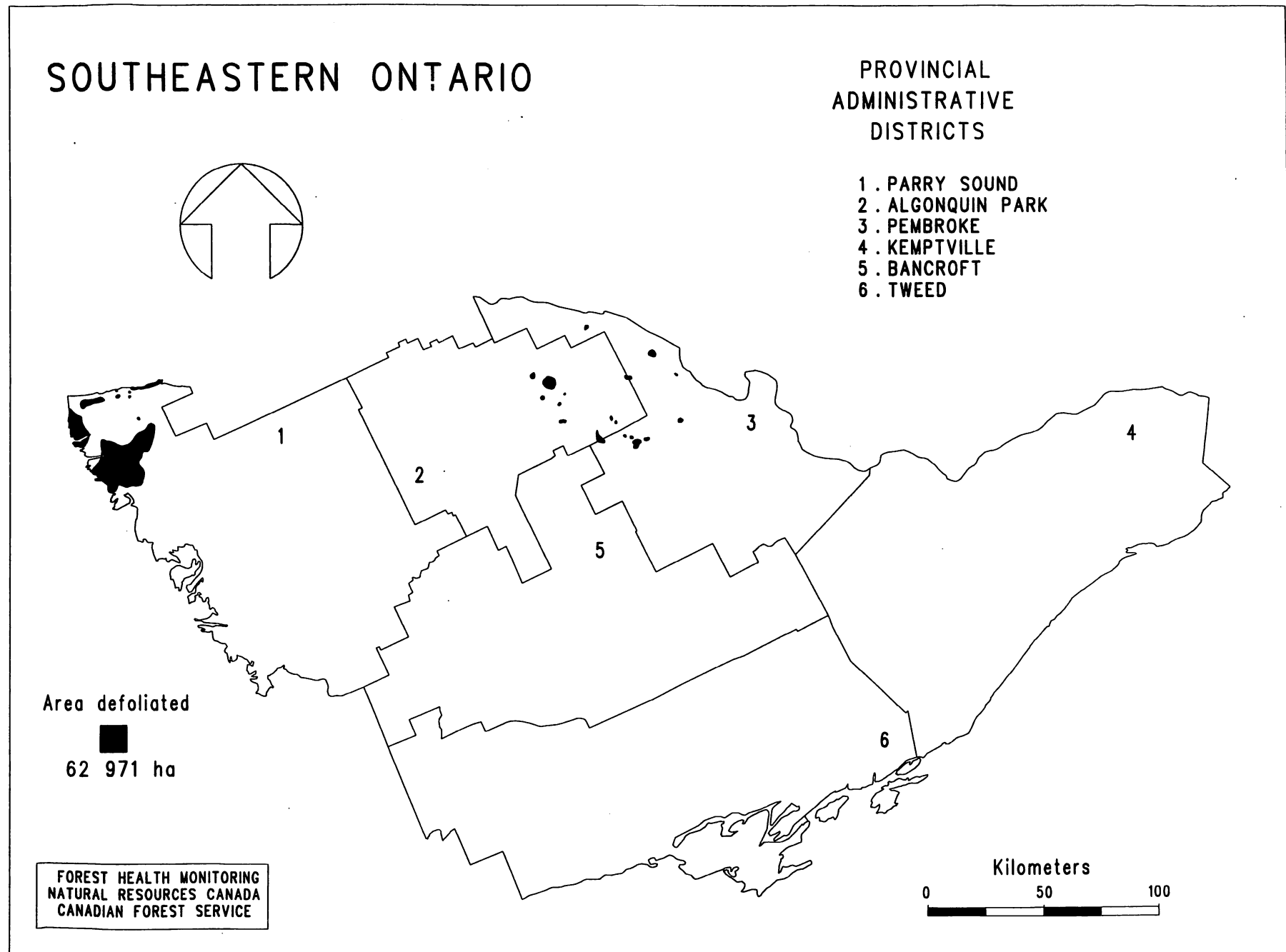


Figure 3. Areas within which moderate to severe defoliation caused by the jack pine budworm (*Choristoneura pinus pinus* Free.) occurred in 1996.

Table 4. Gross area of moderate to severe defoliation caused by the jack pine budworm in the South Central Region in 1995 and 1996.

District	Area of moderate to severe defoliation (ha)		
	1995	1996	Change
Algonquin	6 312	4 365	- 1 947
Parry Sound	129 272	55 289	- 73 983
Pembroke	7 077	3 317	- 3 760
Total	142 661	62 971	- 79 690 (55.8%)

In 1969, 2 500 ha of mature jack pine and eastern white pine host, as well as understory regeneration, was aerially sprayed in the northern portion of the Parry Sound District. This program represented an attempt to prevent mortality to mature eastern white pine and also to eastern white pine regeneration, which has been heavily defoliated over the previous 2 years. Results look promising to date, and only one location in Mowat Township is forecast to have heavy defoliation in 1997 (Table 5).

Table 5. Results of jack pine budworm egg mass counts in the South Central Region of Ontario in 1996.

Location (township)	Block	Plot number	Host ^a	Estimated 1996 defoliation percent	Total number egg masses 1996	Infestation forecast for 1997 ^b
<i>Algonquin Park District</i>						
White		n/a	jP	42	0	N
White		n/a	jP	7	0	N
<i>Parry Sound District</i>						
Archipelago	D	14	ewP	1	0	N
Harrison	D	1	ewP	4	1	L
Mowat	C	9	jP	3	3	M
Mowat	C	9	ewP	0	0	N
Mowat	C	13	ewP	1	0	N
Mowat	C	18	jP	3	6	S
Mowat	C	21	jP	3	0	N
Mowat	C	21	ewP	3	0	N

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

^b N = nil, L = light (<25 percent), M = moderate (26 to 75 percent), S = severe (>76 percent).

Aspen Twoleaf Tier, *Enargia decolor* (Wlk.)

Moderate to severe defoliation of trembling aspen (*Populus tremuloides* Michx.) and balsam poplar (*Populus balsamifera* L.) persisted across the eastern portion of the Algonquin Park District and into adjoining areas of the Bancroft and Pembroke districts. Another area of damage persisted in the northern portion of the Parry Sound District, in the area of the French and Key

rivers. (Fig.4; Table 6). Throughout the 469 867 ha of infestation in the region, defoliation levels rarely reached 100 percent. Smaller or fringe trees experienced heavier damage than did the larger, dominant trees in a stand.

Table 6. Gross area of moderate to severe defoliation caused by the aspen twoleaf tier in the South Central Region in 1996.

District	Area of moderate to severe defoliation (ha)
Algonquin	298 105
Bancroft	8 238
Parry Sound	32 640
Pembroke	130 884
Total	469 867

The heaviest damage was found in a concentrated area of aspen growing throughout the northeastern portion of Algonquin Park District and extending southeast along the Ottawa River into the Chalk River area of the Pembroke District.

Throughout the remainder of the region small pockets of moderate defoliation were recorded in conjunction with *Malacasoma disstria* Hbn. damage in the Kemptville District; and near Angus in Oro Township in the Midhurst District. At this last site the tier was noted feeding in conjunction with the leaf roller *Pseudexentera oregonana* (Wism.).

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

Defoliation caused by the hemlock looper was aerially mapped again this year in the Crotch Lake – Bone Lake area of Palmerston Township, Bancroft District. Population levels appear to be down across the region, and most areas showed no new damage or evidence of new tree mortality due to old damage. The primary species affected is eastern hemlock (*Tsuga canadensis* [L.] Carr.), but in most instances balsam fir (*Abies balsamea* [L.] Mill), white spruce, and eastern white cedar (*Thuja occidentalis* L.) are also severely defoliated.

Aerial mapping along the Tweed – Bancroft district border revealed several pockets of damage in the northern portion of Kennebec Township in the Tweed District and in the southern portions of Barrie and Clarendon townships in the Bancroft District. The main body of infestation continues to be in the Crotch Lake of Palmerston Township, Bancroft District (Fig.5).

Within the areas described above, current defoliation averages 70 to 80 percent, but it appears to be on the decline from previous years. The total area of defoliation now encompasses 910 ha across the two districts. The area of tree mortality is currently 189 ha, primarily located in the Crotch Lake area (Table 7).

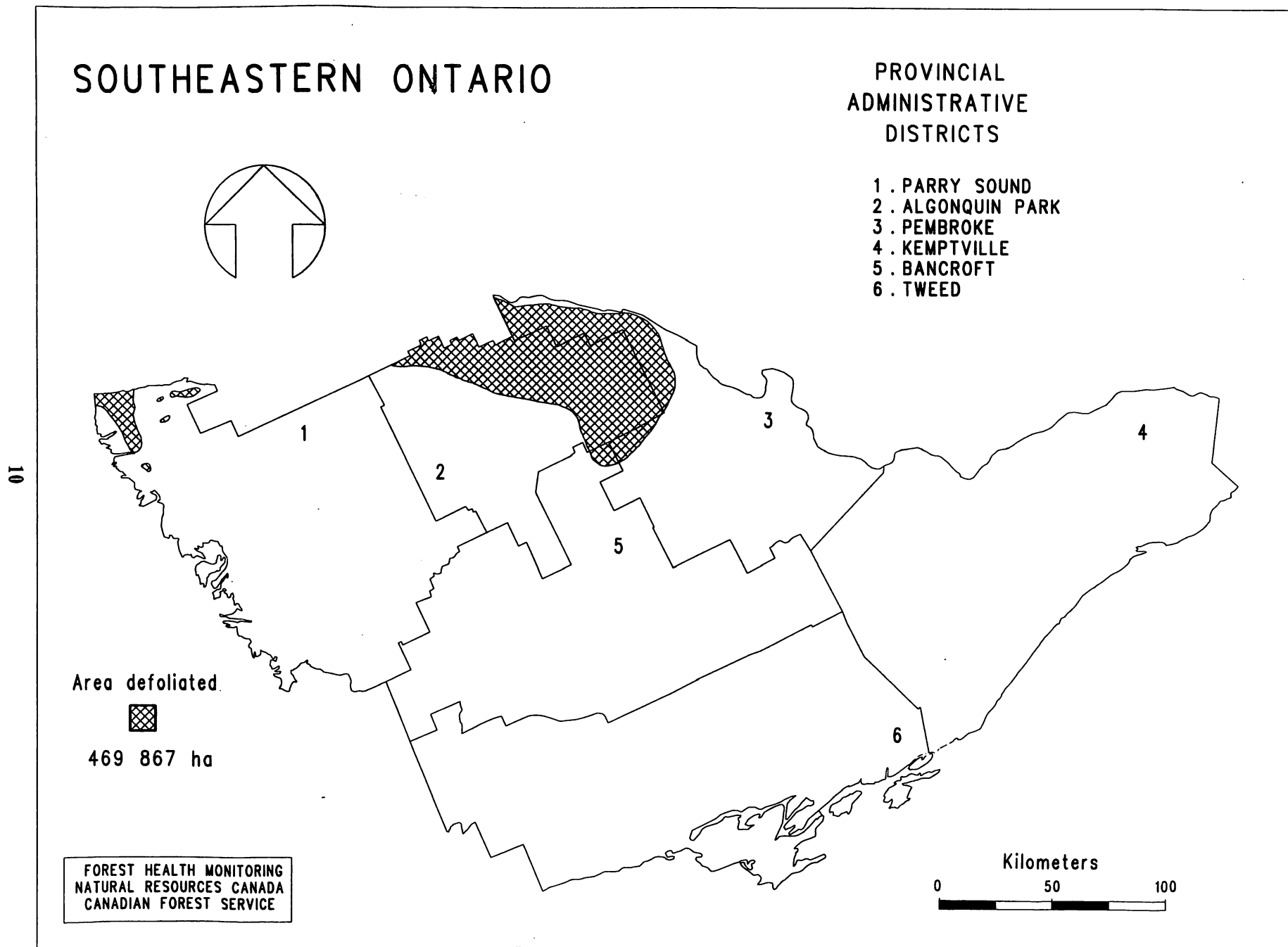


Figure 4. Areas within which moderate to severe defoliation caused by the aspen twoleaf tier (*Enargia decolor* [Wlk.]) occurred in 1996.

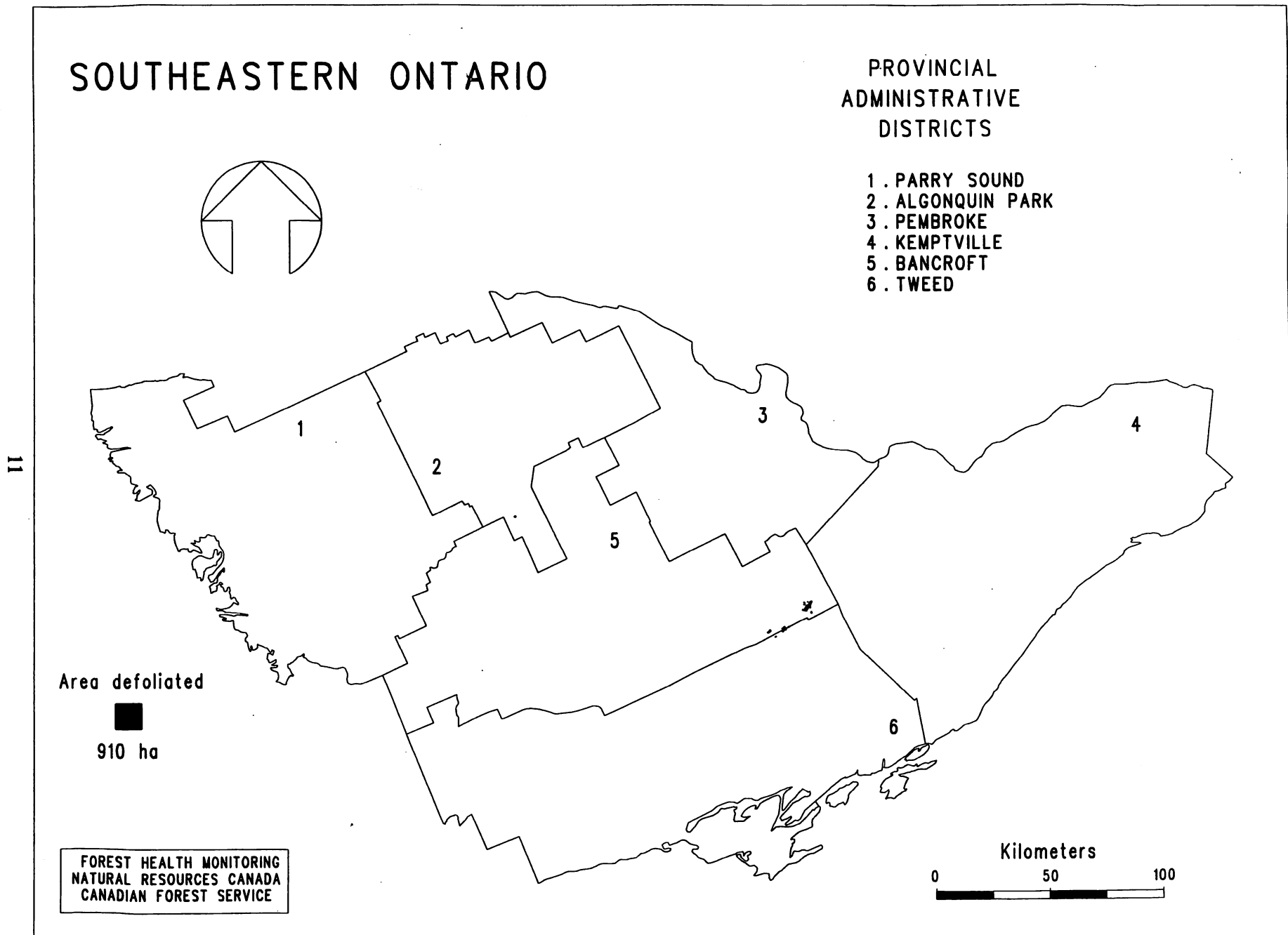


Figure 5. Areas within which moderate to severe defoliation and some whole-tree mortality occurred due to hemlock looper (*Lambdina f. fiscellaria* [Gn.]) in 1996.

Table 7. Gross area of moderate to severe defoliation and resultant top and/or whole-tree mortality caused by the hemlock looper in the South Central Region in 1996.

District	Area affected (ha)	
	Defoliation	Mortality
Bancroft	848	189
Tweed	62	-
Total	910	189

No new areas of damage were recorded across the remainder of the region in 1996.

Forest Tent Caterpillar, *Malacosoma disstria* Hbn.

Small pockets of moderate to severe defoliation persisted on trembling aspen stands at several locations in the Kemptville District in 1996. Damage, primarily in the upper crowns, was recorded across Osgoode, Cumberland, and Roxborough townships and in the Winchester Bog of Mountain Township (Fig. 6).

Ground checks revealed; heavy gypsy (*Lymantria dispar* (L)) moth populations feeding in the Osgoode Township area, and a combination of aspen twoleaf tier (*Enargia decolor* (Wlk)) and early aspen leafcurler (*Psuedexentera oregonana* (Wlshm.)) in the Mountain Township area. Although defoliation levels remained high in the above mentioned areas, the actual numbers of forest tent caterpillar larvae observed were down considerably from 1995 levels.

Elsewhere in the region single larva or light defoliation was encountered infrequently.

DISEASES

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

Because it is capable of causing a major forest disturbance, this potentially destructive disease was observed as part of the forest health network. As in previous years, the disease continued to cause damage at the hydro line location in McMurrich Township, Parry Sound District. Some top mortality has occurred at this site, but the area is not yet extensive enough to be able to aerially map. species Eastern white pine, scots pine, and red pine have been afflicted with the European strain of this fungus at this location.

ABIOTIC CONDITIONS

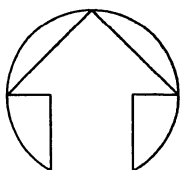
Winter Drying

Small pockets of red pine and Scots pine received moderate damage due to winter drying along Highway 60 through the Algonquin Park District and also along the Highway 17 corridor between Chalk River and Petawawa in the Pembroke District.

SOUTHEASTERN ONTARIO

PROVINCIAL ADMINISTRATIVE DISTRICTS

1. PARRY SOUND
2. ALGONQUIN PARK
3. PEMBROKE
4. KEMPTVILLE
5. BANCROFT
6. TWEED



Area defoliated



1 626 ha

FOREST HEALTH MONITORING
NATURAL RESOURCES CANADA
CANADIAN FOREST SERVICE

Kilometers
0 50 100

Figure 6. Areas within which moderate to severe defoliation caused by the forest tent caterpillar (*Malacosoma disstria* Hbn.) occurred in 1996.

OTHER AGENTS DAMAGING FOREST TREES

Birch skeletonizer, *Buccalatrix canadensisella* Cham.

Small pockets of damage persisted on birch (*Betula* spp.) in the Oxtongue River area of the Algonquin Park District and in the Haliburton, Wilberforce, and Bancroft areas of the Bancroft District. Trace levels of damage were also recorded in the Madoc– Marmora area of the Tweed District. In many instances the damage caused by this insect was masked by early fall discoloration and the presence of septoria leaf spot (*Septoria betulae* Pass.)

Fall Webworm, *Hyphantria cunea* (Drury)

Heavy single-tree damage and several larger areas of heavy damage caused by the fall webworm were recorded across the southern portion of the region. Single-tree damage tended to occur on birch, aspen, and cherry (*Prunus* spp.); larger areas of damage tended to occur in low-lying areas and defoliation was primarily confined to ash (white ash [*Fraxinus americana* L.] and black ash [*Fraxinus nigra* Marsh.]).

Satin Moth, *Leucoma salicis* (L.)

This introduced pest of silver poplar (*Populus alba* L.) and carolina poplar (*Populus eugenei* Simon-Lorin) corded at numerous locations on hedgerow and ornamental trees across the Aylmer, Bancroft, Cambridge, Maple, Midhurst, and Pembroke districts.

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

This needle disease of eastern white pine was recorded across the Parry Sound District, but was most prevalent in Macaulay, Draper, McLean, and Shawanaga townships. Scattered individuals, and in some instances small clumps of trees, had sparse upper crowns and new foliage was completely yellowed.

Red Pine Sawfly, *Neodiprion lecontei* (Fitch)

Heavy sawfly damage was recorded in young 1-m-tall red pine plantations at Canadian Forces Base (Borden) in the Midhurst District. Some trees were quite heavily defoliated, and a control operation using Leconte virus is planned for 1997 before any actual tree mortality occurs.

Jack Pine Sawflies: *Neodiprion pratti banksianae* Roh. and *Neodiprion pratti paradoxicus* Ross

Damage was generally confined to the known areas of defoliation identified in 1995 in the Kemptville and Tweed districts. Again the heaviest damage occurred in Kaladar and Sheffield townships in the Tweed District. Young, open-growing 10-m-tall jack pine trees in these two townships have now been heavily defoliated for 2 years, and have experienced some top and whole-tree mortality. A high incidence of damage was also recorded in conjunction with jack pine budworm defoliation in White, Edgar, Anglin, and Masters townships in the Algonquin Park District and in Richards Township in the Pembroke District.

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

Defoliation levels caused by this sawfly ranged from 30 to 100 percent on individual, open-grown spruce trees along the Highway 60 corridor in the Algonquin Park District, and along Highway 60 between Whitney and the Bancroft District.

Flat Leaftier, *Psilocorsis reflexella* Clem.

Heavy damage to individual red oak trees was recorded in oak stands growing on hilltops on the east side of Papineau Lake in Bangor Township, Bancroft District. Generally defoliation averaged 30 percent in these stands, but individual trees received up to 65 percent defoliation over an approximate 20-ha area.

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

Severe foliar browning resulted in heavy needle drop in the upper crowns of eastern white pine trees in several areas in the Pembroke and Algonquin Park districts. The main area of damage was found between Bonnechere Provincial Park and Basin Depot. Browning occurred predominantly on the upper crowns of both understory and mature trees.

Leaf Spot of Birch, *Septoria betulae* Pass.

This leaf spot of white birch (*Betula papyrifera* Marsh.) was recorded at widely scattered locations in the Algonquin Park, Bancroft, Parry Sound, and Pembroke districts. Individual trees and some small clumps of trees received foliar damage levels of up to 60 percent.

FOREST HEALTH PLOT MONITORING:

The term 'dieback' used in forest health monitoring to describe the amount of dead twig and branch material when evaluating the health of a tree. Precise definitions, supported by training and quality control checks are used by observers to ensure a highly standardized method of reporting.

Acid Rain National Early Warning System (ARNEWS)

A series of plots were established across Ontario in 1985 as part of a system to monitor the possible long-term affects of airborne pollutants. Currently fourteen plots are located within the South Central Region, in both coniferous and deciduous forest cover types (Fig.7). To date, all changes encountered within the Acid Rain plots (ARNEWS) appear to be attributable to insect and/or disease organisms, or to adverse weather patterns. Crown condition data for the purpose of comparison is presented for a 4-year (1993 – 1996) period, and by deciduous or coniferous forest types. A further breakdown is presented by individual plots so that one can appreciate the variability of damage encountered by specific tree species (Appendix 1; Tables 8 – 11). Information can also be extracted to show the mortality rate by species for plot trees over the 12- year period since the plots were established and monitoring was begun (Appendix 1; Table 12). Since average mortality figures mean little across an entire region (due to the extreme variability encountered), the information is also presented by plot and species over the same period (Appendix 1; Table 13).

Abiotic conditions experienced across the plots included dwarf foliage on 4.5 percent of the sugar maple trees in Plot 505; yellow chlorotic foliage to red needles on spruce host in Plots 514 and 515; and mottled edge discoloration on 10 percent of the red oak host trees in Plots 526, 527, and 539. In all instances the abiotic condition was recorded at trace levels (>5 percent).

Insect damage reported was due mainly to leaf roller activity and never exceeded 10 percent, although leaf rollers affected 89 percent of the hardwood plots examined. *Zeiraphera* damage was recorded on 96 percent of the trees at trace levels in the white spruce Plot 514 at Petawawa National Forest Institute. Sugar maple borer (*Glycobius speciosus* [Say]) damage was recorded on 23 percent of the sugar maple trees examined, and *Eutypella* canker (*Eutypella parasitica* R.W. Davidson & R.C. Lorenz) was found on 1 percent of the trees.

Maple Health

The monitoring of urban and roadside sugar maple plots was discontinued in 1996; however, 43 plots located in woodlots and natural undamaged stands throughout the region were assessed (Fig.8) . As is the case with the oak health plot monitoring, both crown dieback and defoliation levels by insect, disease, or abiotic conditions are assessed for each of the 25 trees on every plot. The main bole is also assessed annually for current tapping, new defects such as seams or wounds, and insect and/or disease damage. Although crown dieback figures for light damage (up to 25 percent) can vary from year to year (91.4 percent in 1995// 91.1 percent in 1996), it is from a comparison over a longer period that a more accurate picture of the true stand condition can be derived (Figure 9).

SOUTH CENTRAL REGION

PROVINCIAL ADMINISTRATIVE DISTRICTS

1. PARRY SOUND
2. ALGONQUIN PARK
3. PEMBROKE
4. KEMPTVILLE
5. BANCROFT
6. TWEED
7. MIDHURST
8. MAPLE
9. CAMBRIDGE
10. AYLMER

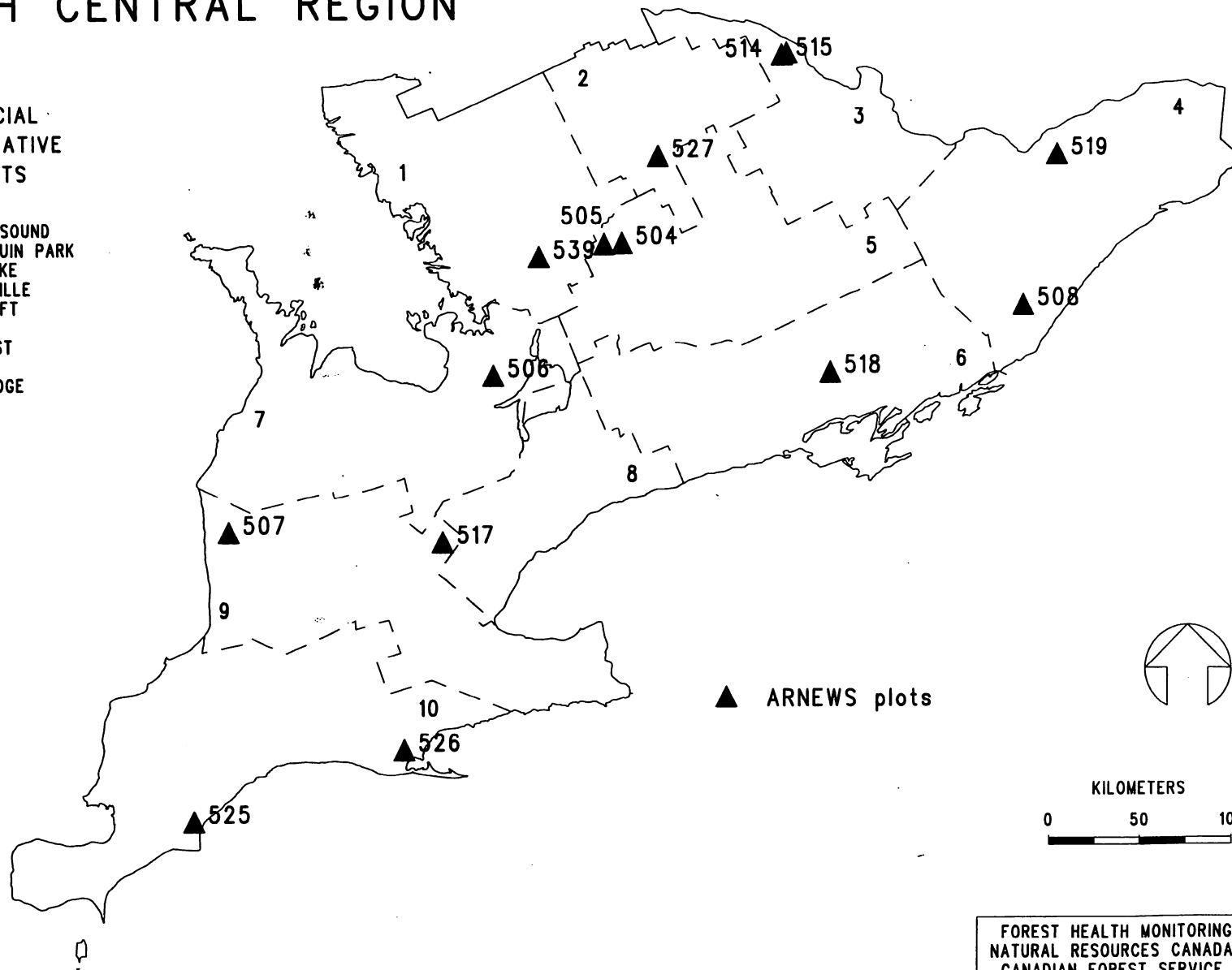


Figure 7. Location of Acid Rain National Early Warning System Plots within the region.

SOUTH CENTRAL REGION

PROVINCIAL ADMINISTRATIVE DISTRICTS

1. PARRY SOUND
2. ALGONQUIN PARK
3. PEMBROKE
4. KEMPTVILLE
5. BANCROFT
6. TWEED
7. MIDHURST
8. MAPLE
9. CAMBRIDGE
10. AYLMER

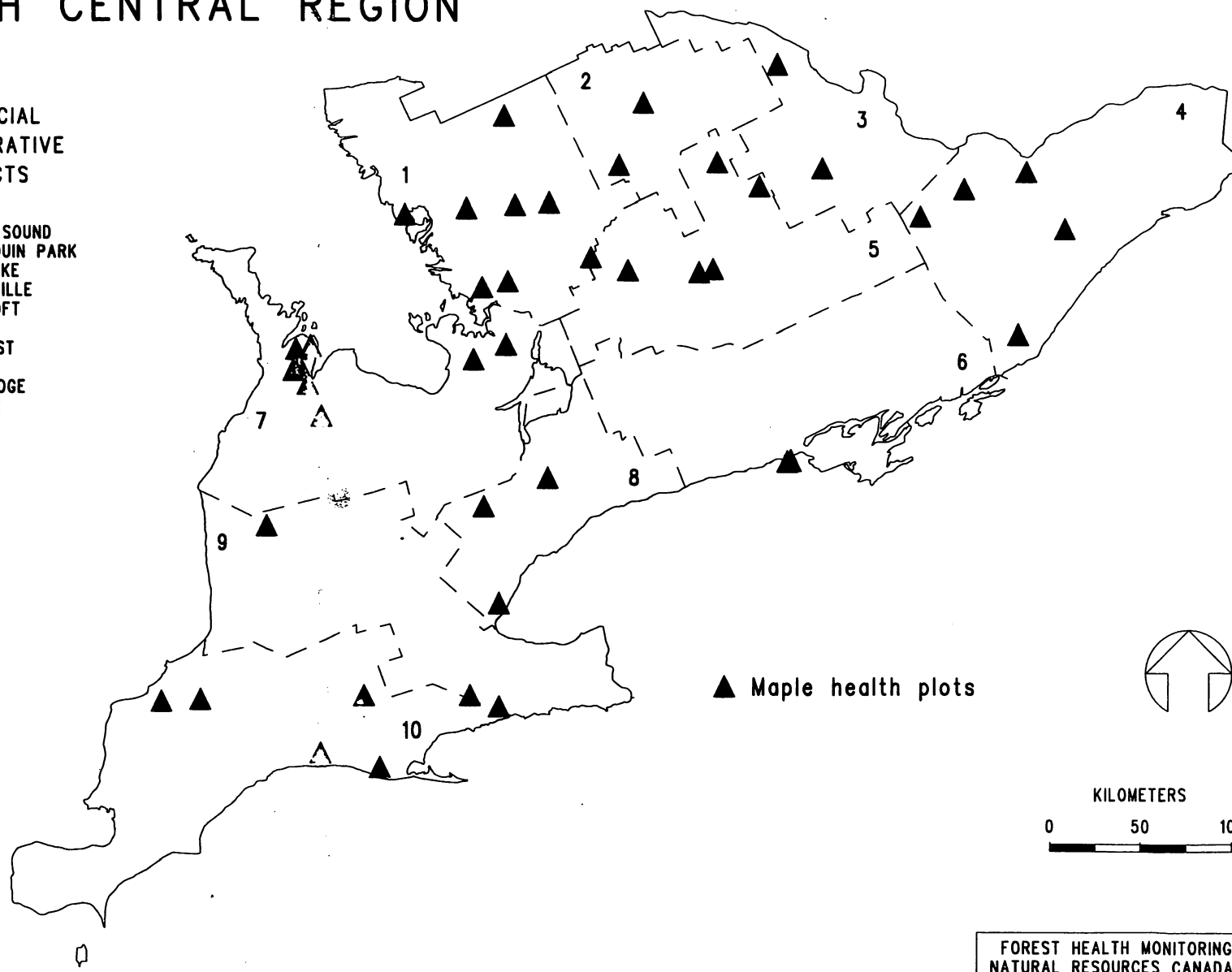


Figure 8. Location of Maple Health Plots within the region.

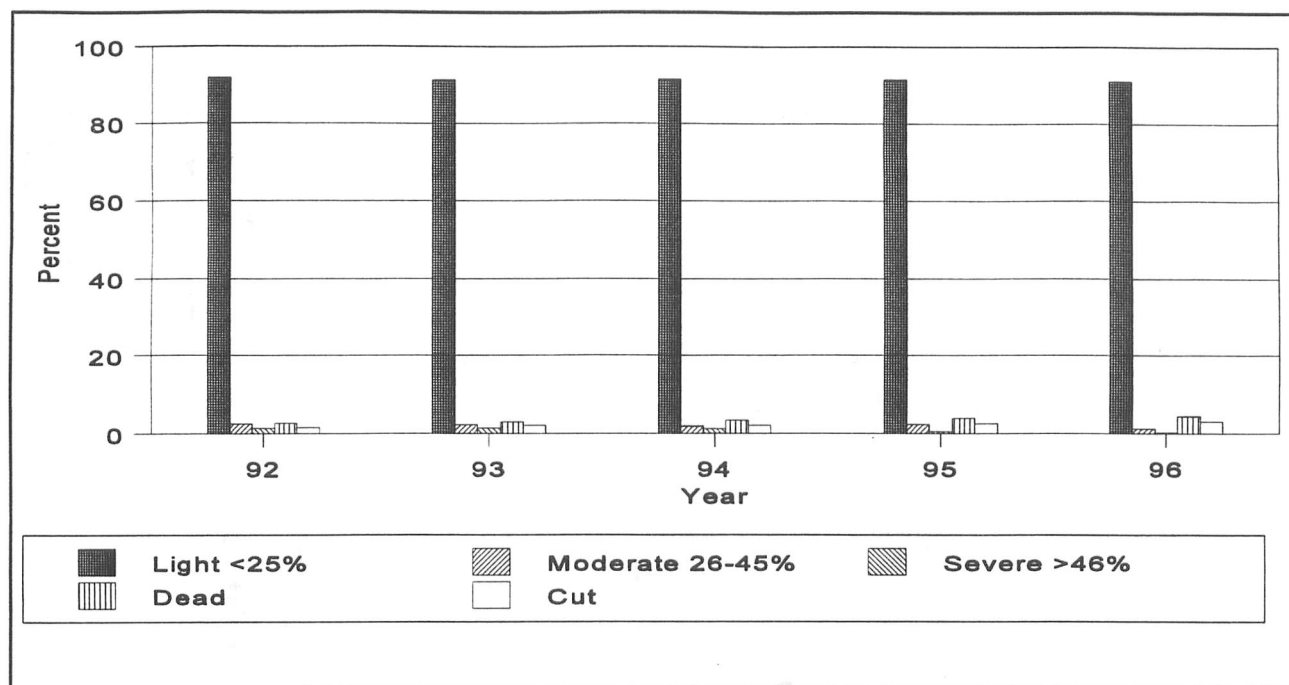


Figure 9. Annual crown dieback levels for all sugar maple health plots.

Individual plots can vary greatly from year to year so for the sake of comparison between plots, and against the average of all plots, the conditions encountered in the individual plots are outlined in Appendix 2; Table 14. Widespread light to moderate defoliation (up to 60%) was encountered on 14 percent of the trees examined in 1996. The majority of the damage was attributed to the maple leafroller (*Sparganothis acerivorana* Mack.) and the lesser maple leafroller (*Acleris chalybeana* (Fern.)). However, in most instances trace populations of maple webworm (*Tetralopha asperatella* (Clem)), maple trumpet skeletonizer (*Epinotia aceriella* (Clem.)), and maple leafcutter (*Paraclemensia acerifoliella* (Fitch)) were also recorded.

Bole defects on individual trees included: 1.8 percent of the trees bearing cankers (48% of which were Eutypella canker), seams and/or cracks on 16.3 percent of the trees (18% of which were wet and seeping), wounds on 47.3 percent of the trees (47% of these were still open), and 11.3 percent of the trees had associated decay or fruiting bodies in conjunction with the bole defects

As well 0.7 percent of the trees were attacked by sapsuckers and 4.9 percent of the trees were damaged by sugar maple borer tunnelling. Nine of the sample plots had been previously tapped and six of these are still being utilized for maple syrup production

North American Maple Project (NAMP)

In 1988 the North American Maple Project was established in eastern North America—from the Wisconsin area in the United States across the range of maple in Ontario and Quebec

SOUTH CENTRAL REGION

PROVINCIAL ADMINISTRATIVE DISTRICTS

1. PARRY SOUND
2. ALGONQUIN PARK
3. PEMBROKE
4. KEMPTVILLE
5. BANCROFT
6. TWEED
7. MIDHURST
8. MAPLE
9. CAMBRIDGE
10. AYLMER

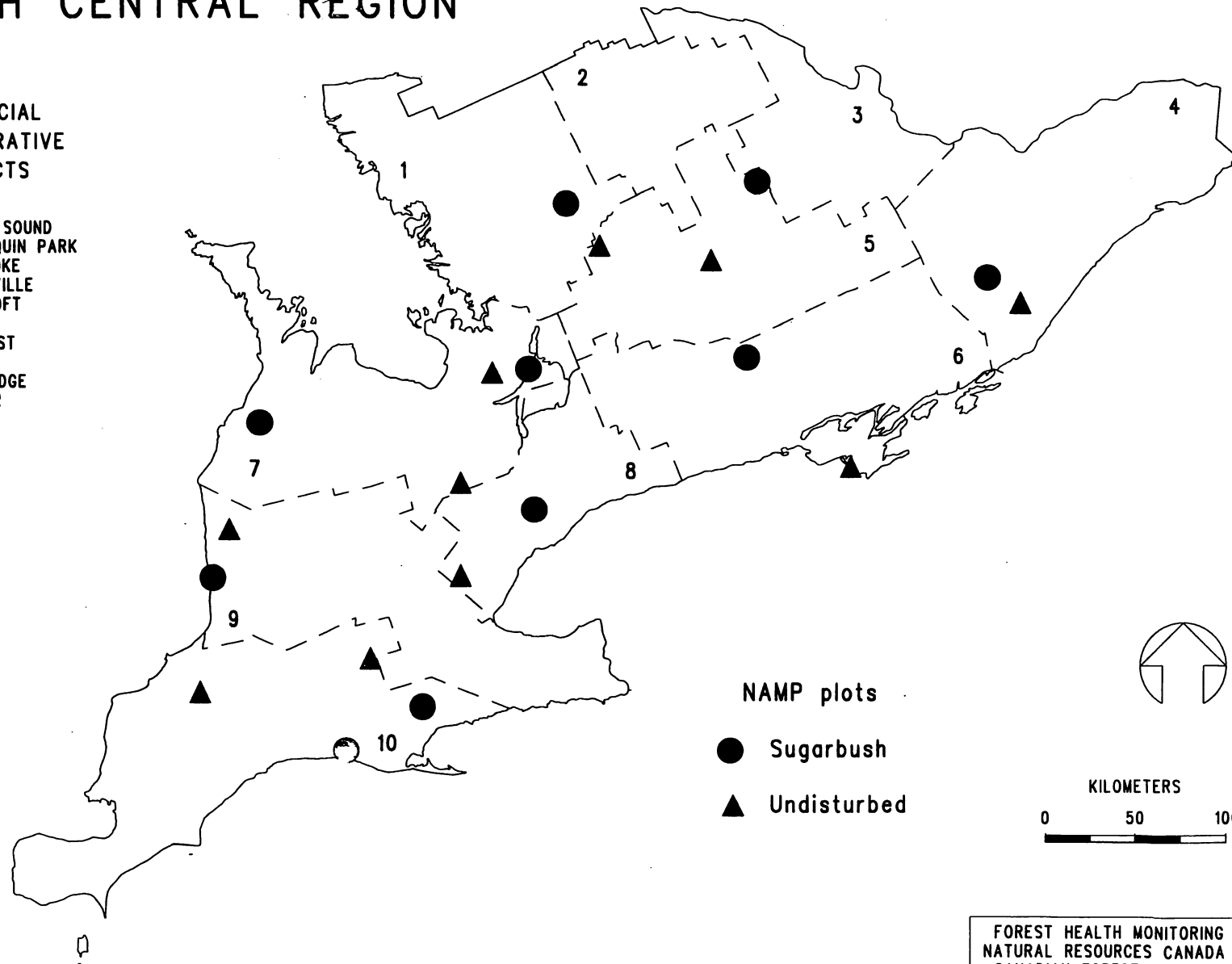


Figure 10. Location of North American sugar Maple Plots within the region.

and into Maine and Nova Scotia. In total, 233 plot clusters were established to determine the rate and degree of change in sugar maple conditions form year to year. As well, attempts were to be made at determining the possible cause of sugar maple decline and the geographical relationship between the cause and the extent of decline.

Within the South Central Region of Ontario there is a total of twenty plot clusters. (Fig. 10). These twenty plots are paired— ten are located within stands currently managed for maple syrup production and ten are located in untapped stands that have some degree of on-going management.

Tree vigor within the plots examined appears marginally variable within the 5-year period from 1992 to 1996 (Fig.11). However, when vigor in the untapped plots (Fig. 12) is compared to that of tapped plots (Fig. 13) one must be careful with interpretation.

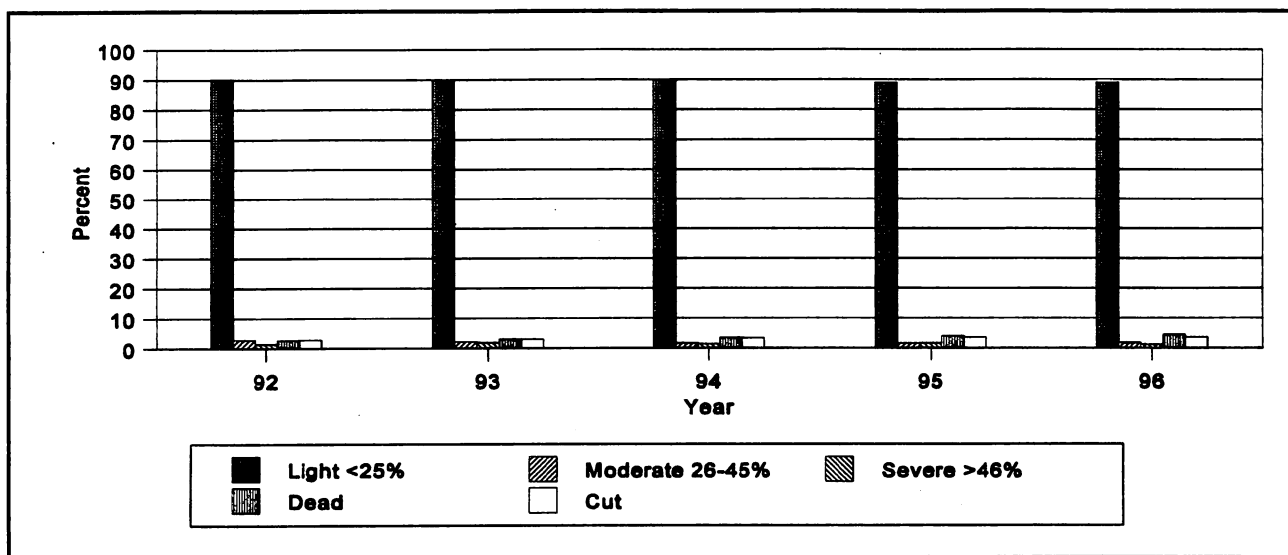


Figure 11. Tree vigour for all NAMP plots.

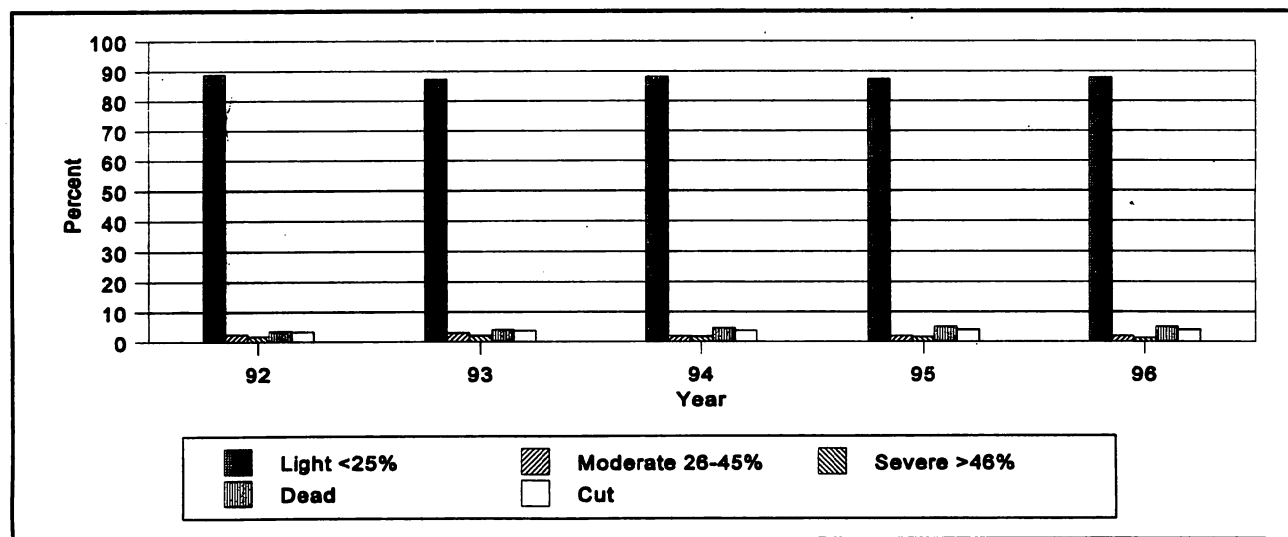


Figure 12. Tree vigour for all untapped NAMP plots.

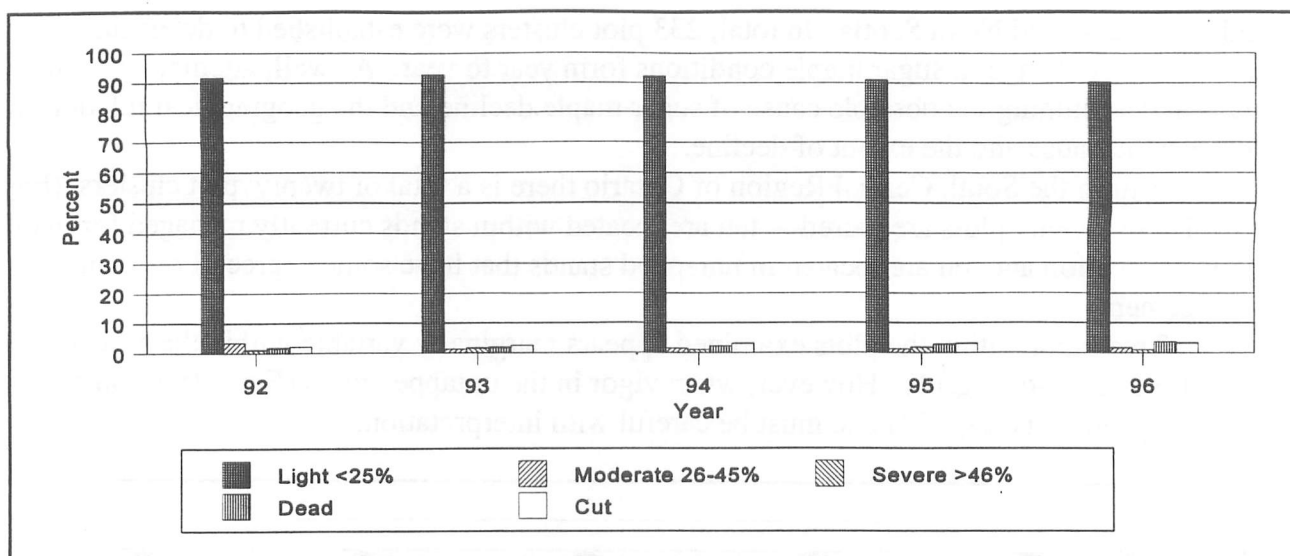


Figure 13. Tree vigour for all currently tapped NAMP plots.

Management of a forest for sawlog or firewood production removes larger, healthier trees and opens the stand up in most instances. On the other hand, larger trees in stands managed for maple syrup are left and tend to be quite heavily tapped. Unhealthy or suppressed trees that are unsuitable for syrup production are subsequently removed.

Tree condition, on the other hand, more accurately describes the trees as they appear each year of the tally (Appendix 3; Table 15). Also included are the tree condition tables by plot for the tapped (Appendix 3; Table 16) and untapped (Appendix 3; Table 17) trees for the 5-year period from 1992 to 1996. This data will allow a comparison of the average for all plots examined against individual plots in similar forest situations (i.e., tapped vs untapped).

Insect damage was recorded on all plots examined in 1996, with no preference shown to tapped or untapped stands. Defoliation varied greatly from plot to plot and even on trees within plots, but it rarely exceeded 50 percent in the worst situation. Insects that caused the heaviest damage included the maple-basswood leafroller (*Sparganothis pettitana* (Rob)), lesser maple leaf roller, maple webworm, and maple trumpet skeletonizer. Insects causing trace to light defoliation included the lesser maple spanworm (*Itame pustularia* (Gn.)), maple leaf cutter, and flat leaftier (*Psilocorsis reflexella* Clem.).

Bole defects recorded on individual trees throughout the plots included wounds on 6.6 percent of the trees (18 percent of which were smaller wounds) and seams on 1.4 percent of the trees. Sugar maple borer damage was recorded on seven of the 20 plots examined (35 percent) and, in affected plots, the damage was recorded on 7.3 percent of the trees.

Oak Health

Twelve red oak plots located across the region that are evaluated annually so as to develop a picture of the health of the oak forest (Fig. 14). To determine the condition of each of the 100 trees assessed in each plot, crown dieback, foliar pest damage, and abiotic factors affecting the tree are considered. New defects and/or insect and disease damage are also recorded if they affect

SOUTH CENTRAL REGION

PROVINCIAL ADMINISTRATIVE DISTRICTS

1. PARRY SOUND
2. ALGONQUIN PARK
3. PEMBROKE
4. KEMPTVILLE
5. BANCROFT
6. TWEED
7. MIDHURST
8. MAPLE
9. CAMBRIDGE
10. AYLMER

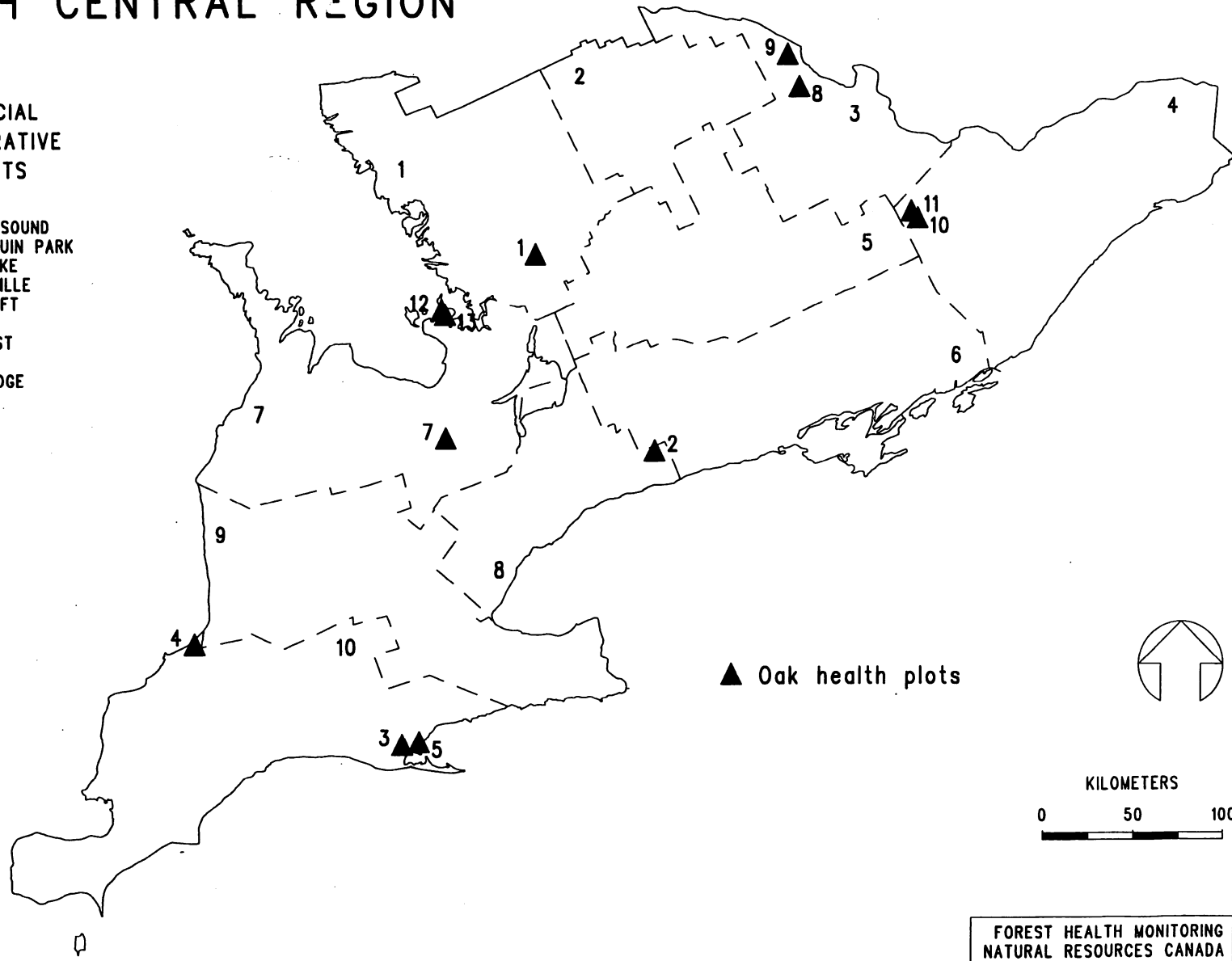


Figure 14. Location of Oak Health Plots within the region.

the bole (main stem) of the tree.

To produce a more accurate picture of current tree conditions, the data has been presented in a chart for a 5 year period from 1992 to 1996 (Figure 15).

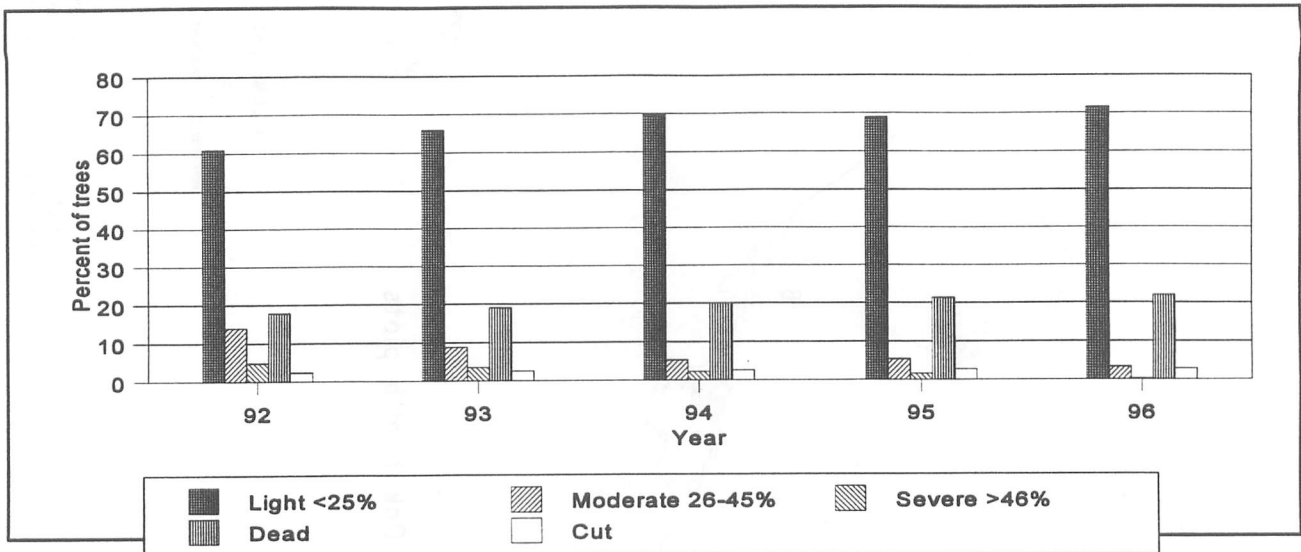


Figure 15. Annual crown dieback levels for all oak health plots.

From the data presented one can follow the gradual decline, and in some cases the eventual death, of most of the trees that were originally tallied in the moderate to severe crown-dieback categories. The remainder of the trees show variations from year to year but are generally more healthy (less dieback) now. Data is also presented over the same period for individual plots, as well as against the average for all plots (Appendix 4; Table 18). Insect defoliation was more prominent in 1996 than in previous years, particularly in three of the 12 plots examined. In plot 12 in Tiny Township, Midhurst District, 78 percent of the trees were affected at a moderate defoliation level (30–60 percent). In another of the plots (Plot 11) in Lavant Township, Kemptville District, 54 percent of the trees were up to 30 percent affected. At yet a third plot, Plot 4 in Bosanquet Township, Aylmer District 59 percent of the trees showed a moderate (30–60 percent) defoliation level. The principal insects that caused the damage in these three cases were oak trumpet skeletonizer (*Epinotia timidella* (Clem.)), oak skeletonizer (*Bucculatrix ainsiiella* Murt.), tortricid oakworm (*Argyrotoenia quercifolia* (Fitch)), and flat leaftier (*Psilocorsis reflexella* Clem.). The plot in the Pinery Provincial Park in Bosanquet Township, Aylmer District (Plot 4), had several additional problems: including, a light gypsy moth population, heavy oak lecanium (*Parthenolecanium quercifex* (Fitch)) and vines growing on living (and dead) trees. Mortality in this plot is now at 27 percent; there are three new dead trees and 18 of the living trees are heavily affected, or in some cases completely choked out, by an unidentified vine (possibly wild grape). The trees affected by these vines appear to be very unhealthy. Currently, 58 percent of the trees examined show open/closed wounds and seams that have rot or fruiting bodies associated with them. In Mulmur Township, Midhurst District, seven of the affected trees exhibited bleeding (wet) seams.

Spruce/Fir Health

A plot network was established in 1994 in different types of balsam fir/spruce stands under the Northern Forestry Programme (NFP) of the Northern Ontario Development Agreement (NODA). The objective of this project is to provide forest managers with a spruce budworm hazard rating index system for rating the vulnerability and susceptibility of different forest stands to spruce budworm attack. The plots have since been expanded to monitor the effects of all external conditions on all plot trees, not just the effects of spruce budworm defoliation.

A total of 15 plots is located within the region, primarily concentrated in the larger spruce/fir forests found in the Algonquin Park, Bancroft, Parry Sound, and Pembroke districts.(Fig. 16)

Since plot establishment, only trace levels of defoliation have been recorded in any of the plots in the region. Consequently, little or no impact data can be retrieved from the plot data tallied to date. However, mortality figures (Fig. 17) can be obtained when the live host trees present in the plots when they were established are compared to the 1996 assessments.

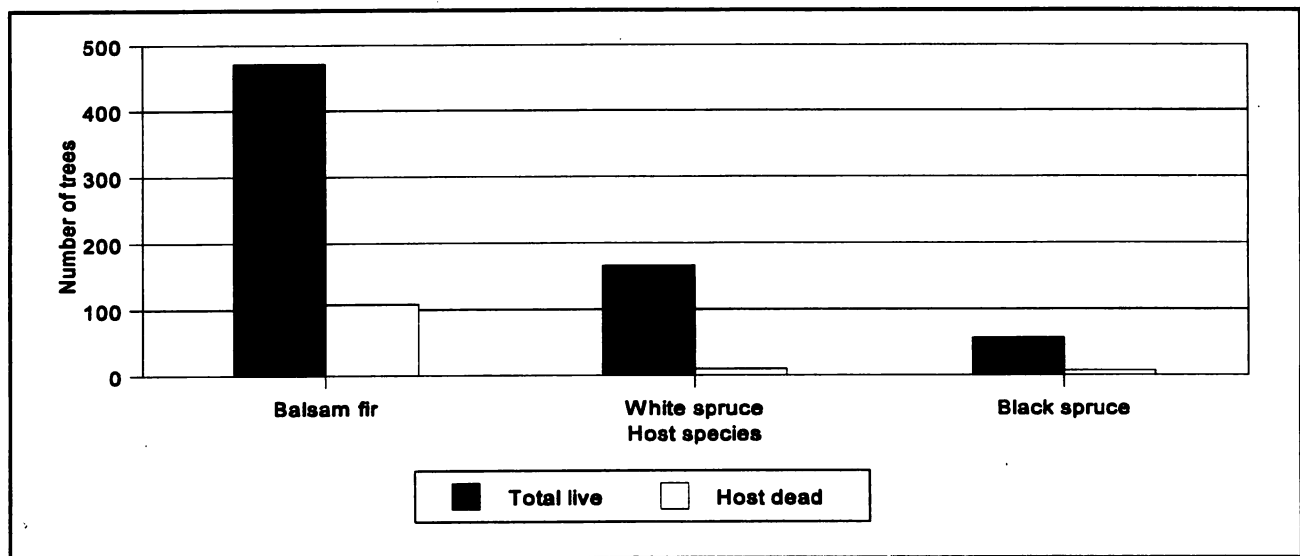


Figure 17. Tree mortality by host species.

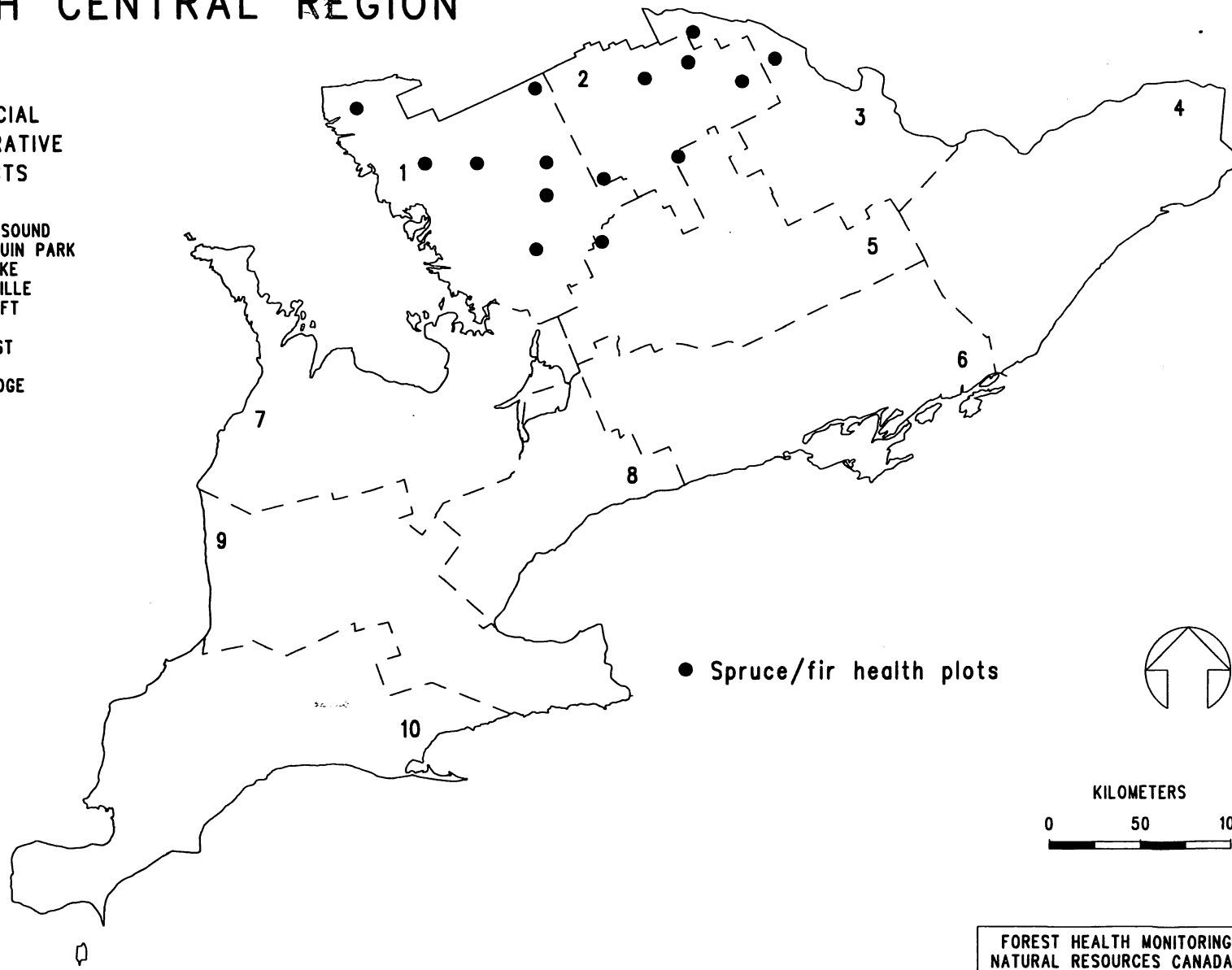
Annually, some host mortality still occurs in most plots (Appendix 5;Table 19). This can be attributed directly to old, heavy budworm defoliation and the presence of other secondary conditions (i.e.,the presence of *Armillaria ostoyae* (Romagn.) Herink.)

In an attempt to quantify the damage to the conifer crowns an overall damage rating was assigned to each tree (Appendix 5;Table 20).The live portion of the crowns are further rated by dividing them into thirds and assessing a damage level to each portion (Appendix 5;Table 21).

SOUTH CENTRAL REGION

PROVINCIAL ADMINISTRATIVE DISTRICTS

1. PARRY SOUND
2. ALGONQUIN PARK
3. PEMBROKE
4. KEMPTVILLE
5. BANCROFT
6. TWEED
7. MIDHURST
8. MAPLE
9. CAMBRIDGE
10. AYLMER



FOREST HEALTH MONITORING
NATURAL RESOURCES CANADA
CANADIAN FOREST SERVICE

Figure 16. Location of Spruce/fir Health Plots within the region.

QUARANTINE PESTS

Gypsy Moth, *Lymantria dispar* (L.)

Heavy defoliation due to the gypsy moth was aerially mapped near Kingsville in the Aylmer District (Fig.18). At this location 919 ha of oak (*Quercus* spp.) was severely defoliated. This compared to 208 ha in 1995. The infestation was generally along the Cedar Creek drainage basin in the eastern portion of Colchester South Township and the western portion of Gosfield South Township (along the two township boundaries and both north and south of Highway 18). Control operations were carried out in an oak stand adjacent to one of the fairways of the Kingsville Golf Course in 1996. Light gypsy moth defoliation was also recorded in conjunction with forest tent caterpillar damage in Osgoode and Edwards townships, Kemptville District.

Elsewhere in the region trace population levels of this pest were recorded in oak plots in Mulmur and Tiny townships, and also on the Angus Seed Plant property in Oro Township, all in Midhurst District. Low moth populations were also recorded on a sugar maple (*Acer saccharum* Marsh.) plot in Malahide Township and at the Pinery Provincial Park, Bosanquet Township, Aylmer District.

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

Surveys were also conducted for Pine Shoot Beetle, (*Tomicus piniperda* (L.)) across the South Central region. Typical host damage was collected at three locations in Simcoe County, and at one location near Kemptville in Ottawa Carleton County. In all instances the damaged host samples collected contained no associated insects to identify.

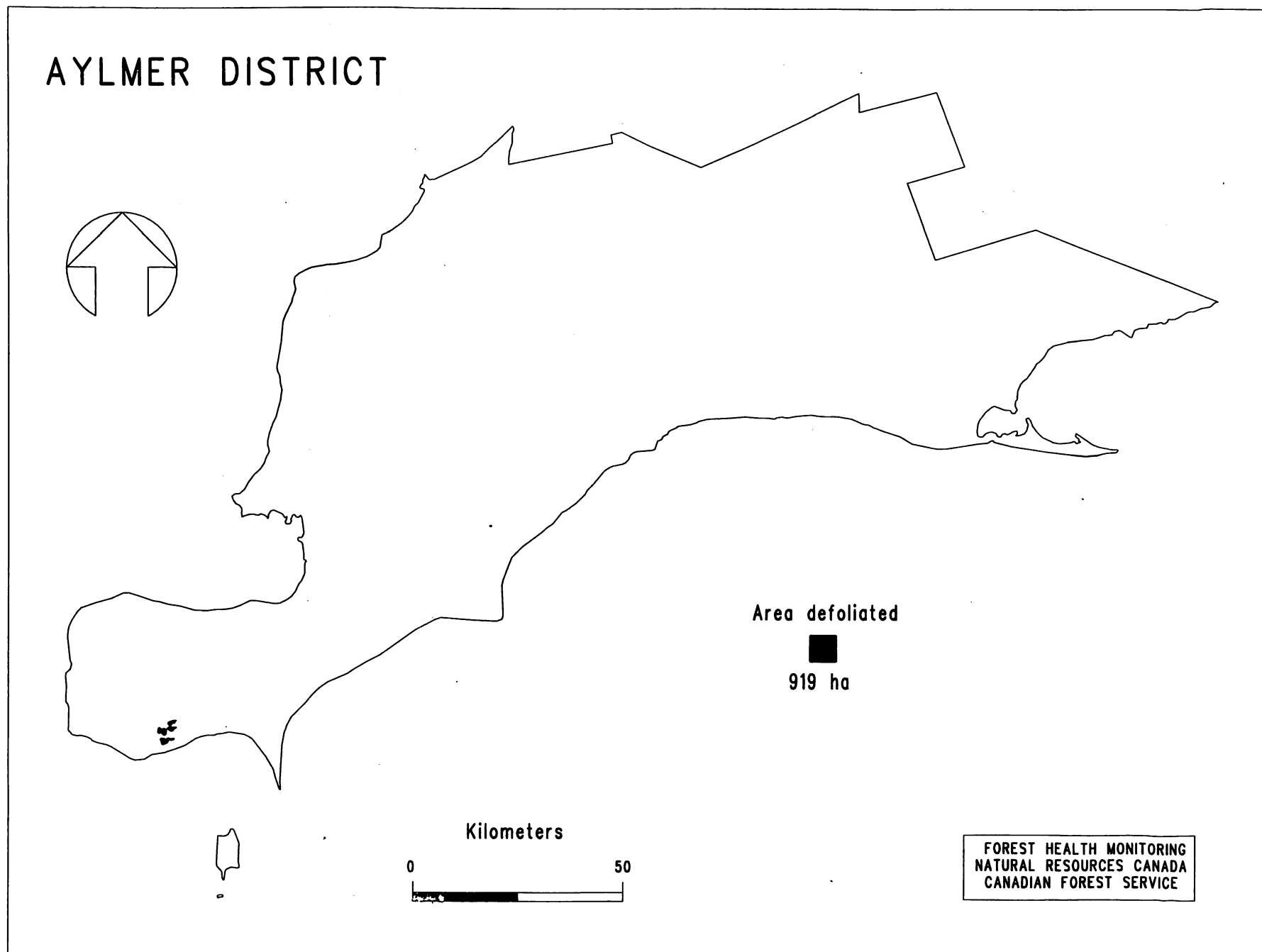


Figure 18. Areas within which moderate to severe defoliation caused by the gypsy moth (*Lymantria dispar* [L.]) occurred in 1996.

Appendix 1; Table 8 Deciduous crown condition and tree mortality from 1993 to 1996 for nine plots in the Acid Rain National Early Warning System located in the South Central Region of Ontario. Host species must represent ten percent or more of the deciduous content of the plot to be included.

Location (township)	Plot number	Host ^a	Number of trees examined	Year	Total crown damage ^b											Cumulative tree mortality		
					(number of trees)											New dead	Old dead	Trees cut
					10	20	30	35	40	45	50	55	60	65	70			
<i>Kemptville District</i>																		
Rear of Yonge	508	sM	13	1993	3	0	8	0	0	0	0	0	0	0	0	0	2	0
			13	1994	0	0	5	0	6	0	0	0	0	0	0	0	2	0
			13	1995	0	0	5	0	5	1	0	0	0	0	0	0	2	0
			13	1996	0	0	1	2	4	4	0	0	0	0	0	0	2	0
<i>Midhurst District</i>																		
Oro	506	sM	28	1993	3	0	8	1	16	0	0	0	0	0	0	0	0	0
			28	1994	4	0	8	0	16	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
			28	1996	2	0	7	8	8	2	0	0	0	0	0	0	1	0
<i>Parry Sound District</i>																		
Ridout	505	sM	21	1993	0	0	8	0	8	2	0	0	0	0	0	1	2	0
			21	1994	9	0	1	0	5	2	1	0	0	0	0	0	3	0
			21	1995	3	0	4	2	9	0	0	0	0	0	0	0	3	0
			21	1996	0	0	7	6	5	0	0	0	0	0	0	0	3	0
		yB	2	1993	0	0	0	0	2	0	0	0	0	0	0	0	0	0
			2	1994	0	0	0	0	1	1	0	0	0	0	0	0	0	0
			2	1995	0	0	0	0	1	1	0	0	0	0	0	0	0	0
			2	1996	0	0	0	1	1	0	0	0	0	0	0	0	0	0

^a rO = red oak, bO = black oak, wO = white oak, sM = sugar maple, yB = yellow birch.

^b 10 = full complement of foliage; 20 = foliage thin, off-color; 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 1; Table 8. Deciduous crown condition and tree mortality from 1993 to 1996 for nine plots in the Acid Rain National Early Warning System located in the South Central Region of Ontario. Host species must represent 10 percent or more of the deciduous content of the plot to be included.

Location (township)	Plot number	Host ^a	Number of trees examined	Year	Total crown damage											Cumulative tree mortality		
					(number of trees)											New dead	Old dead	Trees cut
					10	20	30	35	40	45	50	55	60	65	70			
Algonquin Park District																		
Sproule	527	rO	24	1993	0	0	1	5	11	3	2	0	0	0	0	0	2	0
			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
Parry Sound District																		
Macaulay	539	rO	15	1995	0	0	2	2	6	3	0	0	0	0	0	0	2	0
			15	1996	0	0	0	8	5	0	0	0	0	0	0	0	2	0
Aylmer District																		
Walshingham	526	bO	7	1993	0	0	0	0	3	3	0	1	0	0	0	0	0	0
			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
			7	1996	0	0	0	0	1	3	3	0	0	0	0	0	0	0
		wO	5	1993	1	0	1	0	3	0	0	0	0	0	0	0	0	0
			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
Howard	525	sM	9	1993	2	0	6	0	1	0	0	0	0	0	0	0	0	0
			9	1994	1	0	4	0	4	0	0	0	0	0	0	0	0	0
			9	1995	1	0	1	0	6	1	0	0	0	0	0	0	0	0
			9	1996	0	0	2	1	1	2	0	0	0	0	0	0	0	3
Bancroft District																		
Sherbourne	504	sM	12	1993	0	0	0	0	5	0	0	2	0	1	0	1	3	0
			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
Cambridge District																		
West Wawanosh	507	sM	14	1993	7	0	1	0	5	0	0	0	0	0	0	0	1	0
			14	1994	3	0	3	1	6	0	0	0	0	0	0	0	1	0
			14	1995	0	0	4	0	8	1	0	0	0	0	0	0	1	0
			14	1996	0	0	1	1	5	4	1	0	0	0	0	0	1	0

Appendix 1; Table 9. Summary of deciduous crown condition and tree mortality from 1993 to 1996 for nine plots in the Acid Rain National Early Warning System located in the South Central Region of Ontario. Host species must represent 10 percent or more of the deciduous content of the plot to be included.

Host ^a	Number of plots	Number of trees examined	Year	Total crown damage ^b											Cumulative tree mortality		
				(percent)											New dead	Old dead	Trees cut
				10	20	30	35	40	45	50	55	60	65	70			
rO	2	24	1993	0	0	4.2	20.8	45.8	12.5	8.3	0	0	0	0	0	8.3	0
		24	1994	0	0	4.2	8.3	58.3	12.5	8.3	0	0	0	0	0	8.3	0
		39	1995	0	0	5.1	20.5	38.5	20.5	5.1	0	0	0	0	0	10.3	0
		39	1996	0	0	0	30.8	38.5	15.4	2.6	0	0	2.6	0	0	10.3	0
bO	1	7	1993	0	0	0	0	42.9	42.9	0	14.3	0	0	0	0	0	0
		7	1994	0	0	0	0	42.9	42.9	0	14.3	0	0	0	0	0	0
		7	1995	0	0	0	0	42.9	28.6	14.3	14.3	0	0	0	0	0	0
		7	1996	0	0	0	0	14.3	42.9	42.9	0	0	0	0	0	0	0
wO	1	5	1993	20.0	0	20.0	0	60.0	0	0	0	0	0	0	0	0	0
		5	1994	0	0	40.0	0	40.0	20.00	0	0	0	0	0	0	0	0
		5	1995	0	0	40.0	20.0	40.0	0	0	0	0	0	0	0	0	0
		5	1996	0	0	20.0	40.0	20.0	20.00	0	0	0	0	0	0	0	0
sM	6	97	1993	15.5	0	32.0	1.03	36.1	2.1	0	2.1	0	1.0	0	2.1	8.3	0
		97	1994	17.5	0	21.6	1.03	39.2	4.1	3.1	1.0	1.0	0	0	1.0	10.3	0
		97	1995	5.2	0	21.6	6.19	45.4	7.2	0	1.0	0	0	1.0	1.0	11.3	0
		97	1996	3.1	0	20.6	19.6	24.7	13.5	1.0	1.0	0	0	0	1.0	12.4	3.1
yB	1	2	1993	0	0	0	0	100.0	0	0	0	0	0	0	0	0	0
		2	1994	0	0	0	0	50.0	50.0	0	0	0	0	0	0	0	0
		2	1995	0	0	0	0	50.0	50.0	0	0	0	0	0	0	0	0
		2	1996	0	0	0	50.0	50.0	0	0	0	0	0	0	0	0	0

^a bO = black oak, rO = red oak, sM = sugar maple, wO = white oak, yB = yellow birch

^b 10 = full complement 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 76 percent or more of crown; 70 = more than 50 percent of crown dead, only adventitious branches usually at base of crown.

Appendix 1; Table 10. Coniferous crown condition and tree mortality from 1993 to 1996 for 6 plots in the Acid Rain National Early Warning System located in the South Central Region of Ontario. Host species must represent ten percent or more of the conifer content of the plot to be included.

Location (township)	Plot number	Host ^a	Number of trees examined	Year	Total crown damage ^b							Cumulative tree mortality		
					(number of trees)							New dead	Old dead	Trees cut
					1	2	3	4	5	6	7			
<i>Bancroft District</i>														
Sherbourne	504	ewP	9	1993	7	0	0	0	0	0	0	0	2	0
			9	1994	7	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
<i>Cambridge District</i>														
Erin	517	ewP	28	1993	27	0	0	0	0	0	0	0	1	0
			28	1994	27	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
<i>Kemptville District</i>														
Gloucester	519	wS	58	1993	0	0	56	0	0	0	0	1	1	0
			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
<i>Pembroke District</i>														
Buchanan	514	wS	25	1993	20	5	0	0	0	0	0	0	0	0
			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
Buchanan	515	nS	31	1993	22	2	3	0	0	0	0	2	2	0
			31	1994	22	4	1	0	0	0	0	0	4	0
			31	1995	27	0	0	0	0	0	0	0	4	0
			32	1996	0	0	28	0	0	0	0	0	4	0
<i>Tweed District</i>														
Hungerford	518	ewP	54	1993	0	0	0	47	0	0	0	0	7	0
			54	1994	43	0	0	4	0	0	0	0	7	0
			54	1995	0	0	0	46	0	0	0	1	7	0
			54	1996	37	9	0	0	0	0	0	0	8	0

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

^b 1 = no defoliation; 2 = only current foliage defoliated, defoliation less than 25 percent; 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.

Appendix 1; Table 11. Summary of coniferous crown condition and tree mortality from 1993 to 1996 for six plots in the Acid Rain National Early Warning System located in the South Central Region of Ontario. Host species must represent ten percent or more of the conifer content of the plot to be included.

Host ^a	Number of plots	Number of trees examined	Year	Total crown damage a							Cumulative tree mortality	
				(percent)							New dead	Old dead
				1	2	3	4	5	6	7		
ewP	3	91	1993	37.4	0	0	0	51.6	0	0	0	11.0
		91	1994	84.6	0	0	0	4.4	0	0	0	11.0
		91	1995	36.8	0	0	0	50.6	0	1.1	1.1	11.0
		91	1996	69.2	11.0	6.6	1.1	0	0	0	0	12.1
wS	2	83	1993	24.1	6.0	67.5	0	0	0	0	1.2	1.2
		83	1994	16.9	13.3	56.6	8.4	0	1.2	0	1.2	2.4
		83	1995	2.4	26.5	30.1	21.7	8.4	6.0	0	1.2	3.6
		83	1996	2.4	24.1	25.3	33.7	6.0	0	1.2	2.4	4.8
nS	1	31	1993	71.0	6.5	9.7	0	0	0	0	6.5	6.5
		31	1994	71.0	12.9	3.7	0	0	0	0	0	12.9
		31	1995	87.1	0	0	0	0	0	0	0	12.9
		32	1996	0	0	90.3	0	0	0	0	0	12.9

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

^b 1 = no defoliation; 2 = only current foliage defoliated, defoliation less than 25 percent; 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

Appendix 1; Table 12. Summary of annual mortality for all tree species on 14 plots in the Acid Rain National Early Warning System in the South Central Region of Ontario.

Species	Plot numbers	Crown position ^a	Number of trees examined	Annual mortality number of trees												Totals	
				1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996		Percent
Sugar maple	504, 505, 506, 507, 508, 525, 539	1	69	0	1	0	0	1	0	1	0	0	0	0	3 ^b	3 ^c	4.4
		2	39	0	1	0	1	2	0	2	0	1	1	1	1	10	25.6
Red maple	504, 527, 539	1	4	0	0	0	0	0	0	1	0	0	0	0	0	1	25.0
		2	11	0	0	0	0	0	0	2	0	1	0	0	0	3	27.3
Black oak	526	1	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White oak	526	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red oak	527, 539	1	36	0	0	0	0	0	0	0	1	0	0	0	0	1	2.8
		2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
White birch	504	2	2	1	0	0	0	0	0	0	0	0	0	0	0	1	50.0
Yellow birch	505	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Black cherry	526, 527	2	6	0	0	0	1	1	0	0	0	0	0	0	0	2	33.4
Beech	505	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ironwood	505, 527	2	3	1	0	0	0	0	1	0	0	0	0	1	0	3	100.0
White ash	504	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	100.0
Eastern white pine	504, 517, 518, 526	1	82	1	2	0	1	0	4	0	0	0	0	1	0	9	11.0
		2	10	1	1	0	0	0	0	0	0	0	0	0	0	2	20.0
White spruce	514, 519	1	79	0	0	0	0	0	0	0	0	0	1	1	2	4	5.0
		2	4	1	0	0	0	0	0	0	0	1	0	0	0	2	50.0
Norway spruce	515	1	30	0	0	0	0	1	1	0	0	2	0	0	0	4	13.3
		2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Balsam fir	505	2	1	1	0	0	0	0	0	0	0	0	0	0	0	1	100.0

^a 1 = dominant and codominant, 2 = intermediate and suppressed.

^b selective cutting removed live trees from Plot 525.

^c total does not include live trees removed from Plot 525.

Appendix 1; Table 13. Summary of annual mortality for all tree species on 14 plots in the Acid Rain National Early Warning System in the South Central Region of Ontario.

Plot	Location (township)	Host ^a	Crown position ^b	Number of trees examined	Annual mortality number of trees												Totals		
					1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996			
527	Algonquin Park District Sproule	rM	1	4	0	0	0	0	0	0	0	1	0	0	0	0	0	1	25.0
			2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		rO	1	23	0	0	0	0	0	0	0	0	1	0	0	0	0	1	4.4
			2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		bC	2	3	0	0	0	1	1	0	0	0	0	0	0	0	0	2	66.7
		ir	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	100
525	Aylmer District Howard	sM	1	9	0	0	0	0	0	0	0	0	0	0	0	0	3 ^c	0 ^c	0
	526	South Walshingham	bO	1	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
wO			2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
bC			2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
ewP			2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
504	Bancroft District Sherbourne	sM	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2	11	0	1	0	0	2	0	1	0	0	1	0	1	6	54.5	
		rM	2	4	0	0	0	0	0	0	1	0	1	0	0	0	2	50.0	
		wB	2	2	1	0	0	0	0	0	0	0	0	0	0	0	1	50.0	
		wA	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	100	
		ewP	1	5	1	0	0	0	0	0	0	0	0	0	0	0	0	1	20.0
			2	4	1	0	0	0	0	0	0	0	0	0	0	0	0	1	25.0
517	Cambridge District Erin	ewP	1	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2	5	0	1	0	0	0	0	0	0	0	0	0	0	0	1	20.0
507	West Wawanosh	sM	1	13	0	0	0	0	1	0	0	0	0	0	0	0	0	1	7.7
			2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
519	Kemptville District Gloucester	wS	1	55	0	0	0	0	0	0	0	0	0	0	1	1	2	4	7.3
			2	3	0	1	0	0	0	0	0	0	0	1	0	0	0	2	66.7
508	Rear of Yonge	sM	1	12	0	1	0	0	0	0	1	0	0	0	0	0	0	2	16.7
			2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
506	Midhurst District Oro	sM	1	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2	10	0	0	0	0	0	0	0	0	0	0	0	1	0	1	10.0

Appendix 1; Table 13. Summary of annual mortality for all tree species on 14 plots in the Acid Rain National Early Warning System in the South Central Region of Ontario.

Plot	Location (township)	Host ^a	Crown position ^a	Number of trees examined	Annual mortality number of trees												Totals	
					1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996		
<i>Parry Sound District</i>																		
539	Macaulay	sM	2	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		rM	2	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		rO	1	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
505	Ridout	sM	1	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2	5	0	0	0	1	0	0	1	0	1	0	0	0	3	60.00
		yB	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		be	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		ir	2	2	1	0	0	0	0	0	0	0	0	0	1	0	2	100
		bF	2	1	1	0	0	0	0	0	0	0	0	0	0	0	1	100
		<i>Pembroke District</i>																
514	Buchanan	wS	1	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
515	Buchanan	nS	1	30	0	0	0	0	1	1	0	0	2	0	0	0	4	13.33
			2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Tweed District</i>																		
518	Hungerford	ewP	1	54	0	2	0	1	0	4	0	0	0	0	1	0	8	14.81

^a sM = sugar maple, rM = red maple, wO = white oak, bO = black oak, rO = red oak, wB = white birch, yB = yellow birch, wA = white ash, be = beech, bC = black cherry, ir = ironwood, ewP = eastern white pine, wS = white spruce, nS = norway spruce, bF = balsam fir

^b 1 = dominant and codominant, 2 = intermediate and suppressed

^c selective cutting removed live trees from plot 525 and total does not include these trees.

Appendix 2; Table 14. Summary of maple health at 43 locations in the South Central Region of Ontario for a five year period ending in 1996. (Data based on the examination of 25 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
Algonquin Park District										
Deacon (39)	32.5	1992	7	18	0	0	0	0	0	0
		1993	8	15	2	0	0	0	0	0
		1994	9	16	0	0	0	0	0	0
		1995	1	13	2	0	0	0	0	0
		1996	data unobtainable for 1996							
Peck (31)	36.3	1992	1	5	0	0	0	1	1	0
		1993	1	5	1	0	0	0	2	0
		1994	9	13	1	0	0	0	2	0
		1995	5	18	0	0	0	0	2	0
		1996	1	6	1	0	0	0	2	0
Aylmer District										
Houghton (14)	33.3	1992	2	0	0	0	0	0	0	0
		1993	2	1	0	0	0	0	0	0
		1994	2	0	0	0	0	0	0	0
		1995	2	0	0	0	0	0	0	0
		1996	2	0	0	0	0	0	0	0
Malahide (17) *	35.3	1992	2	2	0	0	0	0	0	0
		1993	2	1	0	0	0	0	0	0
		1994	2	0	0	0	0	0	0	0
		1995	2	1	0	0	0	0	0	0
		1996	1	6	0	0	0	0	0	0
North Norwich (15)	31.0	1992	2	0	0	0	0	0	0	0
		1993	2	0	0	0	0	0	0	0
		1994	2	0	0	0	0	0	0	0
		1995	2	0	0	0	0	0	0	0
		1996	2	1	0	0	0	0	0	0
Plympton (19)	29.3	1992	2	2	0	0	0	1	2	0
		1993	2	1	0	0	0	0	3	0
		1994	2	1	0	0	0	0	3	0
		1995	2	0	1	0	0	0	3	0
		1996	1	6	0	0	0	1	3	0
Warwick (13) *	31.3	1992	2	0	0	0	0	0	2	1
		1993	2	0	0	0	0	0	2	1
		1994	2	0	0	0	0	0	2	1
		1995	2	0	1	0	0	0	2	1
		1996	1	6	0	0	0	0	2	1
Bancroft District										
Bangor (34)	44.9	1992	1	10	0	1	0	0	1	1
		1993	7	13	2	1	0	0	1	1
		1994	2	18	2	1	0	0	1	1
		1995	3	17	2	0	1	0	1	1
		1996	6	15	1	1	0	0	1	1

Appendix 2; Table 14. Summary of maple health at 43 locations in the South Central Region of Ontario for a five year period ending in 1996. (Data based on the examination of 25 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>Bancroft District (cont'd)</i>										
Cardiff (32)	32.3	1992	13	9	1	0	0	1	1	0
		1993	11	12	0	0	0	0	2	0
		1994	17	6	0	0	0	0	2	0
		1995	18	4	0	0	0	1	2	0
		1996	21	1	0	0	0	0	3	0
Hindon (21)	35.9	1992	9	12	3	1	0	0	0	0
		1993	12	10	2	1	0	0	0	0
		1994	16	8	0	1	0	0	0	0
		1995	14	10	1	0	0	0	0	0
		1996	18	7	0	0	0	0	0	0
Minden (22)	41.0	1992	10	14	1	0	0	0	0	0
		1993	13	11	0	0	0	0	0	1
		1994	15	8	1	0	0	0	0	1
		1995	20	4	0	0	0	0	0	1
		1996	22	2	0	0	0	0	0	1
Monmouth (26)	30.4	1992	1	18	1	1	0	0	4	0
		1993	2	17	0	1	1	0	4	0
		1994	10	9	0	0	0	2	4	0
		1995	12	7	0	0	0	0	6	0
		1996	13	6	0	0	0	0	6	0
Murchison (35)	41.0	1992	14	11	0	0	0	0	0	0
		1993	11	14	0	0	0	0	0	0
		1994	9	16	0	0	0	0	0	0
		1995	6	19	0	0	0	0	0	0
		1996	16	9	0	0	0	0	0	0
<i>Cambridge District</i>										
Morris (20)	29.5	1992	25	0	0	0	0	0	0	0
		1993	25	0	0	0	0	0	0	0
		1994	25	0	0	0	0	0	0	0
		1995	25	0	0	0	0	0	0	0
		1996	22	3	0	0	0	0	0	0
Oneida (11)	40.4	1992	21	3	0	0	0	0	0	1
		1993	22	2	0	0	0	0	0	1
		1994	22	2	0	0	0	0	0	1
		1995	24	0	0	0	0	0	0	1
		1996	22	2	0	0	0	0	0	1
South Cayuga (12) *	21.2	1992	24	1	0	0	0	0	0	0
		1993	23	2	0	0	0	0	0	0
		1994	23	2	0	0	0	0	0	0
		1995	24	1	0	0	0	0	0	0
		1996	23	2	0	0	0	0	0	0

Appendix 2; Table 14. Summary of maple health at forty three locations in the South Central Region of Ontario for a five year period ending in 1996. (Data based on the examination of 25 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
Kemptville District										
Lavant (42)	37.6	1992	16	9	0	0	0	0	0	0
		1993	16	8	0	0	0	0	0	1
		1994	20	4	0	0	0	0	0	1
		1995	17	7	0	0	0	0	0	1
		1996	11	13	0	0	0	0	0	1
Nepean (50)	37.1	1992	15	9	0	0	0	0	1	0
		1993	18	6	0	0	0	0	1	0
		1994	20	4	0	0	0	0	1	0
		1995	16	8	0	0	0	0	1	0
		1996	22	2	0	0	0	0	1	0
Oxford on Rideau (45) *	35.6	1992	21	3	1	0	0	0	0	0
		1993	20	4	1	0	0	0	0	0
		1994	21	4	0	0	0	0	0	0
		1995	22	3	0	0	0	0	0	0
		1996	21	4	0	0	0	0	0	0
Pakenham (41) *	50.5	1992	7	13	4	0	0	1	0	0
		1993	8	12	4	0	0	0	1	0
		1994	14	7	3	0	0	0	1	0
		1995	5	15	4	0	0	0	1	0
		1996	8	15	1	0	0	0	1	0
Rear of Leeds and Lansdowne (43)	66.4	1992	16	2	0	0	0	0	4	3
		1993	14	2	0	0	0	0	4	5
		1994	15	1	0	0	0	0	4	5
		1995	10	6	0	0	0	0	4	5
		1996	10	6	0	0	0	0	4	5
Maple District										
Albion (8)	39.7	1992	24	1	0	0	0	0	0	0
		1993	25	0	0	0	0	0	0	0
		1994	25	0	0	0	0	0	0	0
		1995	24	1	0	0	0	0	0	0
		1996	22	3	0	0	0	0	0	0
Trafalgar (4)	43.6	1992	25	0	0	0	0	0	0	0
		1993	25	0	0	0	0	0	0	0
		1994	24	1	0	0	0	0	0	0
		1995	20	5	0	0	0	0	0	0
		1996	22	3	0	0	0	0	0	0
Whitechurch (7)	35.5	1992	25	0	0	0	0	0	0	0
		1993	25	0	0	0	0	0	0	0
		1994	25	0	0	0	0	0	0	0
		1995	23	2	0	0	0	0	0	0
		1996	20	5	0	0	0	0	0	0

Appendix 2; Table 14. Summary of maple health at forty three locations in the South Central Region of Ontario for a five year period ending in 1996. (Data based on the examination of 25 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
Midhurst District										
Derby (5)	31.6	1992	25	0	0	0	0	0	0	0
		1993	24	1	0	0	0	0	0	0
		1994	23	2	0	0	0	0	0	0
		1995	24	0	0	1	0	0	0	0
		1996	24	1	0	0	0	0	0	0
Flos (9)	33.4	1992	24	1	0	0	0	0	0	0
		1993	25	0	0	0	0	0	0	0
		1994	25	0	0	0	0	0	0	0
		1995	25	0	0	0	0	0	0	0
		1996	25	0	0	0	0	0	0	0
Keppel Concession I (92)	27.0	1992	24	1	0	0	0	0	0	0
		1993	24	1	0	0	0	0	0	0
		1994	24	1	0	0	0	0	0	0
		1995	24	1	0	0	0	0	0	0
		1996	20	1	0	0	0	0	0	4
Keppel Concession XIII (94)	23.0	1992	25	0	0	0	0	0	0	0
		1993	24	0	0	0	0	0	0	1
		1994	24	0	0	0	0	0	0	1
		1995	24	0	0	0	0	0	0	1
		1996	24	0	0	0	0	0	0	1
Keppel Concession XXI Lot 22 (93)	32.1	1992	23	1	0	0	0	0	0	1
		1993	23	1	0	0	0	0	0	1
		1994	23	0	1	0	0	0	0	1
		1995	22	1	0	0	1	0	0	1
		1996	20	2	0	0	0	1	0	2
Keppel Concession XXI Lot 40 (91)	38.3	1992	25	0	0	0	0	0	0	0
		1993	25	0	0	0	0	0	0	0
		1994	25	0	0	0	0	0	0	0
		1995	25	0	0	0	0	0	0	0
		1996	25	0	0	0	0	0	0	0
Medonte (10)	38.0	1992	11	13	1	0	0	0	0	0
		1993	15	10	0	0	0	0	0	0
		1994	17	8	0	0	0	0	0	0
		1995	12	13	0	0	0	0	0	0
		1996	13	9	3	0	0	0	0	0
Sullivan (6)	42.2	1992	22	2	0	0	1	0	0	0
		1993	23	1	0	0	0	1	0	0
		1994	23	1	0	0	0	0	1	0
		1995	19	0	0	0	0	0	1	5
		1996	16	3	0	0	0	0	1	5

Appendix 2; Table 14. Summary of maple health at forty three locations in the South Central Region of Ontario for a five year period ending in 1996. (Data based on the examination of 25 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
Parry Sound District										
Carling (25)	30.6	1992	16	7	1	0	0	1	0	0
		1993	16	7	1	0	0	0	1	0
		1994	16	7	1	0	0	0	1	0
		1995	18	6	0	0	0	0	1	0
		1996	18	5	1	0	0	0	1	0
Chaffey (23)	31.6	1992	9	7	0	0	0	0	3	6
		1993	9	7	0	0	0	0	3	6
		1994	15	1	0	0	0	0	3	6
		1995	12	2	0	0	1	1	3	6
		1996	13	1	0	0	1	0	4	6
Christie (29)	31.7	1992	2	17	3	2	1	0	0	0
		1993	2	17	2	2	1	1	0	0
		1994	4	16	0	2	2	0	1	0
		1995	10	13	0	0	0	1	1	0
		1996	14	5	2	0	1	1	2	0
Gibson (30)	27.1	1992	8	17	0	0	0	0	0	0
		1993	6	19	0	0	0	0	0	0
		1994	7	17	1	0	0	0	0	0
		1995	11	14	0	0	0	0	0	0
		1996	12	13	0	0	0	0	0	0
Machar (28)	34.4	1992	1	17	4	2	0	0	1	0
		1993	1	15	5	2	1	0	1	0
		1994	2	16	5	1	0	0	1	0
		1995	5	19	0	0	0	0	1	0
		1996	6	15	3	0	0	0	1	0
Sisted (27)	29.9	1992	2	18	3	0	2	0	0	0
		1993	5	17	1	0	2	0	0	0
		1994	8	12	1	1	2	1	0	0
		1995	7	14	1	0	0	2	1	0
		1996	16	5	1	0	0	0	3	0
Wood (24)	31.3	1992	15	8	0	0	0	0	2	0
		1993	13	10	0	0	0	0	2	0
		1994	14	8	0	0	0	1	2	0
		1995	17	5	0	0	0	0	3	0
		1996	21	1	0	0	0	0	3	0
Pembroke District										
Sebastopol (38) *	40.2	1992	11	12	2	0	0	0	0	0
		1993	8	15	2	0	0	0	0	0
		1994	8	15	2	0	0	0	0	0
		1995	7	13	4	0	1	0	0	0
		1996	14	11	0	0	0	0	0	0

Appendix 2; Table 14. Summary of maple health at forty three locations in the South Central Region of Ontario for a five year period ending in 1996. (Data based on the examination of 25 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>Pembroke District (cont'd)</i>										
Wylie (40)	37.0	1992	13	9	1	1	0	0	1	0
		1993	12	10	0	0	1	1	1	0
		1994	7	14	1	0	1	0	2	0
		1995	6	15	1	0	0	1	2	0
		1996	19	3	0	0	0	0	3	0
<i>Tweed District</i>										
Brighton Staff (46)	53.9	1992	14	8	1	0	1	0	1	0
		1993	19	4	1	0	0	0	1	0
		1994	21	2	1	0	0	0	1	0
		1995	23	1	0	0	0	0	1	0
		1996	19	5	0	0	0	0	1	0
Brighton Campground (49)	45.2	1992	11	8	0	1	1	0	0	4
		1993	13	6	0	2	0	0	0	4
		1994	16	3	0	1	1	0	0	4
		1995	14	6	0	0	1	0	0	4
		1996	10	10	0	0	0	1	0	4
Percent		1992	65.02	26.79	2.51	0.84	0.56	0.47	2.23	1.58
		1993	65.58	25.77	2.23	0.84	0.56	0.28	2.70	2.05
		1994	68.93	22.60	1.86	0.65	0.56	0.37	2.98	2.05
		1995	66.88	24.56	2.33	0.09	0.47	0.56	3.35	2.51
		1996	70.86	20.19	1.24	0.10	0.19	0.38	4.00	3.05

* Denotes a plot currently being tapped for maple syrup production

Appendix 3; Table 15. Comparison of plot conditions of sugar maples at between tapped and non tapped North American Maple Project plots in the South Central Region of Ontario for a five year period ending in 1996.

NAMP Plots	Average DBH (cm)	Year	Number of trees examined	Total percentage of dead crown					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
<i>Tapped</i>											
	35.3	1992	465	71.61	20.86	2.15	0.86	0.43	0.22	1.51	2.37
		1993	484	82.02	11.16	1.24	0.83	0.41	0.21	1.65	2.48
		1994	484	76.86	16.12	0.83	0.41	0.41	0.41	1.86	3.10
		1995	484	81.82	10.33	1.45	0.00	0.21	0.62	2.27	3.31
		1996	484	53.10	38.43	0.62	0.41	0.41	0.62	2.89	3.51
<i>Non tapped</i>											
	27.8	1992	565	69.56	20.00	1.59	0.88	0.88	0.35	3.36	3.36
		1993	573	75.22	13.44	1.92	0.70	1.22	0.17	3.66	3.66
		1994	573	76.79	13.44	0.87	0.52	0.17	0.70	3.84	3.66
		1995	573	82.37	8.03	0.52	0.00	0.00	0.52	4.54	4.00
		1996	573	61.08	27.75	1.40	0.70	0.00	0.00	5.06	4.00

Appendix 3; Table 16. Summary of plot conditions of sugar maples at ten North American Maple Project plots currently being tapped for maple syrup production in the South Central Region of Ontario for a 5- year period ending in 1996.

Location (township)	Average DBH (cm)	Year	Number of trees examined	Total percentage of dead crown					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
Aylmer District											
Bayham (1-14)	41.1	1992	40	35	3	1	0	0	0	1	0
		1993	41	36	3	1	0	0	0	1	0
		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
Townsend (1-15)	40.3	1992	32	23	3	2	1	2	0	0	1
		1993	32	22	3	1	2	2	1	0	1
		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
Bancroft District											
Bangor (1-23)	37.2	1992	53	7	38	1	1	0	0	2	4
		1993	53	23	22	1	1	0	0	2	4
		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
Cambridge District											
Goderich (1-13)	33.8	1992	62	56	2	1	0	0	1	0	2
		1993	63	56	4	0	0	0	0	1	2
		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
Kemptville District											
South Burgess (1-24)	40.0	1992	42	34	7	1	0	0	0	0	0
		1993	42	38	4	0	0	0	0	0	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

Appendix 3; Table 16. Summary of plot conditions of sugar maples at ten North American Maple Project plots currently being tapped for maple syrup production in the South Central Region of Ontario for a 5- year period ending in 1996.

Location (township)	Average DBH (cm)	Year	Number of trees examined	Total percentage of dead crown					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
Maple District											
Vaughan (1-18)	28.0	1992	47	41	3	0	0	0	0	0	3
		1993	59	56	0	0	0	0	0	0	3
		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
Midhurst District											
Orillia (1-17)	36.6	1992	53	42	10	1	0	0	0	0	0
		1993	55	50	4	0	0	0	0	0	1
		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
Saugeen District											
Saugeen (1-16)	37.1	1992	38	35	2	1	0	0	0	0	0
		1993	38	36	1	1	0	0	0	0	0
		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
Parry Sound District											
Franklin (1-22)	32.7	1992	44	23	14	2	2	0	0	3	0
		1993	47	36	5	2	1	0	0	3	0
		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
Tweed District											
Belmont (1-19)	26.3	1992	54	37	15	0	0	0	0	1	1
		1993	54	44	8	0	0	0	0	1	1
		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

Appendix 3; Table 17. Summary of plot conditions of sugar maples at ten North American Maple Project plots not tapped for maple syrup production in the South Central Region of Ontario for a 5- year period ending in 1996.

Location (township)	Average DBH (cm)	Year	Number of trees examined	Total percentage of dead crown					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
Aylmer District											
Blandford (2-02)	30.3	1992	42	41	1	0	0	0	0	0	0
		1993	42	41	1	0	0	0	0	0	0
		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
Warwick (2-01)	26.9	1992	48	37	5	0	0	0	0	1	5
		1993	48	39	3	0	0	0	0	1	5
		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
Bancroft District											
Cardiff (2-11)	21.4	1992	94	34	42	6	4	3	0	5	0
		1993	94	41	31	9	3	5	0	5	0
		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
Cambridge District											
West Wawanosh (2-04)	31.5	1992	36	35	1	0	0	0	0	0	0
		1993	37	36	0	0	0	1	0	0	0
		1994	37	34	2	0	0	1	0	0	0
		1995	37	37	0	0	0	0	0	0	0
		1996	37	25	12	0	0	0	0	0	0
Kemptville District											
Rear of Yonge (1-24)	19.9	1992	60	54	5	0	0	0	0	1	0
		1993	63	56	6	0	0	0	0	1	0
		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

Appendix 3; Table 17. Summary of plot conditions of sugar maples at ten North American Maple Project plots not tapped for maple syrup production in the South Central Region of Ontario for a 5- year period ending in 1996.

Location (township)	Average DBH (cm)	Year	Number of trees examined	Total percentage of dead crown					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
Maple District											
Nassagaweya	30.0	1992	49	42	5	0	0	1	0	1	0
(2-03)		1993	49	42	5	0	0	0	0	1	1
		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
Midhurst District											
Adjala	33.3	1992	65	38	20	1	1	1	1	3	0
(2-06)		1993	65	50	7	2	0	1	0	4	1
		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
Oro	24.8	1992	80	63	0	1	0	0	0	2	14
(2-05)		1993	80	62	2	0	0	0	0	2	14
		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
Parry Sound District											
Ridout	27.5	1992	61	34	20	1	0	0	0	6	0
(2-10)		1993	64	37	19	0	1	0	1	6	0
		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
Tweed District											
Hallowell	32.6	1992	30	15	14	0	0	0	1	0	0
(2-07)		1993	31	27	3	0	0	0	0	1	0
		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

Appendix 4; Table 18. Summary of oak health at 12 locations in the South Central Region of Ontario for a 5-year period ending in 1996. (Data based on the examination of 100 host trees at each location.)

Location (township)	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
Aylmer District										
Bosanquet (4)	29.0	1992	38	29	6	5	6	0	16	0
		1993	28	39	5	2	10	0	16	0
		1994	50	25	2	0	2	5	16	0
		1995	50	21	1	2	1	4	21	0
		1996	3	64	5	0	0	3	25	0
Charlotteville (5)	32.0	1992	14	52	23	3	1	1	6	0
		1993	36	51	3	0	2	1	7	0
		1994	57	33	0	0	1	1	8	0
		1995	42	36	8	0	1	3	9	1
		1996	19	59	9	0	0	0	12	1
South Walshingham (3)	22.0	1992	35	37	4	2	2	1	18	1
		1993	62	14	1	0	0	3	19	1
		1994	62	15	0	0	0	0	22	1
		1995	59	17	1	0	0	0	22	1
		1996	50	27	0	0	0	0	22	1
Kemptville District										
Lavant Flower Station (10)	20.6	1992	2	45	21	4	3	7	18	0
		1993	2	44	21	2	2	4	25	0
		1994	3	54	8	3	1	2	29	0
		1995	7	49	9	1	1	2	31	0
		1996	11	51	4	1	0	0	33	0
Lavant Joes Lake (11)	25.5	1992	0	31	41	7	4	1	16	0
		1993	0	49	26	4	3	1	17	0
		1994	1	56	18	4	3	0	18	0
		1995	3	56	15	4	1	3	18	0
		1996	5	65	8	1	0	0	21	0
Maple District										
Clarke (2)	24.5	1992	15	64	3	1	0	0	17	0
		1993	66	15	0	1	0	1	17	0
		1994	62	19	0	1	0	0	18	0
		1995	49	30	1	0	1	1	18	0
		1996	46	34	1	0	0	0	18	0
Midhurst District										
Mulmur (7)	28.8	1992	49	29	5	0	1	2	10	4
		1993	59	21	3	0	0	1	12	4
		1994	58	22	2	0	0	1	13	4
		1995	58	23	1	0	0	0	14	4
		1996	40	41	0	0	0	0	14	5
Tiny Awenda Provincial Park (12)	28.5	1992	20	39	6	2	1	2	15	15
		1993	54	10	1	2	0	1	17	15
		1994	55	10	0	1	1	0	18	15
		1995	51	15	1	0	0	0	18	15
		1996	42	22	1	0	0	2	18	15

Appendix 4; Table 18. Summary of oak health at 12 locations in the South Central Region of Ontario for a 5-year period ending in 1996. (Data based on the examination of 100 host trees at each location.)

Location (township)	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
Midhurst District (cont'd)										
Tiny	26.0	1992	32	19	1	2	3	1	38	5
Farlain Lake		1993	43	8	2	0	3	1	39	5
(13)		1994	42	8	2	1	1	2	40	5
		1995	42	7	3	0	1	0	42	5
		1996	27	25	0	0	0	1	42	5
Parry Sound District										
Macaulay	35.0	1992	1	66	18	3	0	0	12	0
(1)		1993	3	78	5	1	1	0	12	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
Pembroke District										
Alice	18.0	1992	1	47	22	1	6	5	14	4
(8)		1993	4	45	18	1	4	2	19	7
		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
Wylie	25.0	1992	0	66	18	1	1	2	12	0
(9)		1993	0	61	21	3	1	0	14	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
Overall		1992	17.25	43.67	14.00	2.58	2.33	1.83	16.00	2.33
Percentage		1993	29.75	36.25	8.83	1.33	2.17	1.25	17.83	2.58
		1994	33.33	36.50	5.25	1.08	1.17	1.00	19.08	2.58
		1995	32.58	36.33	5.42	0.75	0.83	1.25	20.08	2.75
		1996	26.42	45.17	3.33	0.25	0.00	0.67	21.33	2.83

Appendix 5; Table 19. Summary of top condition and tree mortality in the spruce/fir health plots from 1994 to 1996 in the South Central Region of Ontario.

Location (Township)	Plot number	Host ^a	Average height (m)	Year	Condition of top				Cumulative tree mortality
					Live	Bare	Dead	Unable to assess	
<i>Algonquin Park District</i>									
Airy	1	bF	12.6	1994	13	1	0	0	7
				1995	13	1	0	0	7
				1996	13	0	0	0	8
		wS	15.8	1994	36	0	2	0	2
				1995	36	0	2	0	2
				1996	35	0	1	1	3
Finlayson	2	bF	16.2	1994	29	0	0	0	15
				1995	29	0	0	0	15
				1996	26	0	0	0	18
		wS	19.0	1994	8	1	0	0	1
				1995	8	1	0	0	1
				1996	8	1	0	0	1
		bS	16.9	1994	10	0	0	0	0
				1995	10	0	0	0	0
				1996	10	0	0	0	0
Lister	3	bF	14.3	1994	40	0	0	0	2
				1995	40	0	0	0	2
				1996	38	0	0	0	4
		wS	17.2	1994	13	0	0	0	1
				1995	13	0	0	0	1
				1996	13	0	0	0	1
Straton	5	bF	14.9	1994	28	0	1	0	6
				1995	28	0	1	0	6
				1996	28	1	0	0	6
		wS	13.0	1994	15	0	1	0	1
				1995	15	0	1	0	1
				1996	14	0	0	2	1
White	6	bF	10.5	1994	31	0	0	0	1
				1995	31	0	0	0	1
				1996	29	1	0	0	2
		wS	15.1	1994	20	0	0	0	0
				1995	20	0	0	0	0
				1996	18	0	0	0	2
<i>Bancroft District</i>									
Ridout	7	bF	13.5	1994	40	0	0	0	3
				1995	40	0	0	0	3
				1996	38	0	0	0	5
		wS	16.4	1994	10	0	0	0	0
				1995	10	0	0	0	0
				1996	10	0	0	0	0
<i>Parry Sound District</i>									
Bethune	15	bF	13.4	1994	17	1	0	0	4
				1995	18	0	0	0	4
				1996	17	0	0	0	5

Appendix 5; Table 19. Summary of top condition and tree mortality in the spruce/fir health plots from 1994 to 1996 in the South Central Region of Ontario.

Location (township)	Plot number	Host ^a	Average height (m)	Year	Condition of top				Cumulative tree mortality
					Live	Bare	Dead	Unable	
					number of trees			to assess	
<i>Parry Sound District</i>									
Bethune	15	wS	15.9	1994	32	0	1	0	3
				1995	32	0	1	0	3
				1996	30	1	0	1	4
Chaffey	16	bF	13.4	1994	47	0	0	0	3
				1995	47	0	0	0	3
				1996	41	2	1	1	5
East Burpee	17	bF	13.5	1994	27	0	0	0	7
				1995	27	0	0	0	7
				1996	23	0	0	0	11
		bS	16.0	1994	20	0	0	0	1
				1995	20	0	0	0	1
				1996	20	0	0	0	1
Laurier	18	bF	16.2	1994	45	0	0	0	6
				1995	45	0	0	0	6
				1996	43	1	0	0	7
Macaulay	19	bF	13.9	1994	38	0	0	0	9
				1995	38	0	0	0	9
				1996	35	0	0	0	12
Mowatt	20	bF	13.5	1994	32	0	1	0	1
				1995	32	0	1	0	1
				1996	32	0	1	0	1
		wS	13.5	1994	13	0	0	0	0
				1995	13	0	0	0	0
				1996	13	0	0	0	0
Spence	21	bF	12.1	1994	18	1	0	0	16
				1995	19	0	0	0	16
				1996	19	0	0	0	16
		wS	18.2	1994	14	0	0	0	0
				1995	14	0	0	0	0
				1996	14	0	0	0	0
<i>Pembroke District</i>									
Maria	22	bF	11.4	1994	46	0	1	0	1
				1995	46	0	1	0	1
				1996	47	0	0	0	1
Wylie	23	bF	16.5	1994	35	2	0	0	4
				1995	35	2	0	0	4
				1996	31	1	1	1	7
		wS	19.8	1994	13	0	0	0	0
				1995	13	0	0	0	0
				1996	13	0	0	0	0

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

Appendix 5; Table 20. Spruce/fir health data for 1996 on 15 plots located in the South Central Region of Ontario. (Host species must represent 10 percent or more of the conifer content of the plot to be include.)

[illegible]

Table 20 Spruce/fir health data for 1996 on 15 plots located in the South Central Region of Ontario. (Host species must represent 10 percent or more of the conifer content of the plot to be included.)

Location (township)	Host ^a	Average DBH (cm)	Site class	Total crown damage ^b (number of trees)							Cumulative tree mortality		
				1	2	3	4	5	6	7	New dead	Old dead	Trees cut
M ^a Aulay (19)	bF	21.3	1	35	0	0	0	0	0	0	3	9	0
Mowatt (20)	bF	19.2	3	32	0	0	0	0	0	1	0	1	0
	wS	24.5	-	13	0	0	0	0	0	0	0	0	0
	bS	11.8	-	3	0	0	0	0	0	0	0	3	0
(21)	bF	17.3	3	19	0	0	0	0	0	0	0	16	0
	wS	32.5	-	14	0	0	0	0	0	0	0	0	0
<i>Pembroke district</i>													
Maria (22)	bF	11.7	2	47	0	0	0	0	0	0	0	1	0
Wylie (23)	bF	20.2	1	32	0	0	0	0	0	2	3	4	0
	wS	32.5	-	13	0	0	0	0	0	0	0	0	0

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

^b 1 = no defoliation; 2 = only current foliage defoliated, defoliation less than 25 percent; 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 = tree has died since last assessment; 9 = dead tree.

Appendix 5; Table 21.(a) Summary of balsam fir damage levels as seen in the upper, middle, and lower third of the crowns on the spruce/fir health plots for 1996 in the South Central Region of Ontario. (Counts are based on the examination of 468 living balsam fir trees.)

Crown damage levels ^a (percentage)	Tree crown		
	Upper ^b	Middle	Lower
	Number of trees		
none visible	364	27	3
1- 5	69	352	55
6-15	20	36	343
16-25	5	1	13
26-35	3	1	3
36-45	0	0	0
46-55	1	1	1
56-65	3	2	0
66-75	3	1	3
76-85	0	0	0
86-100	0	0	0

^a Includes all types of damage affecting tree vigor (e.g., dead twig, dead branches, dead tops, and missing or damaged foliage).

^b Includes trees with less than 3 meters of crown (assessed as upper only.)

Appendix 5; Table 21.(b) Summary of white spruce damage levels as seen in the upper, middle, and lower third of the crowns on the spruce/fir health plots for 1996 in the South Central Region of Ontario. (Counts are based on the examination of 164 living white spruce trees.)

Crown damage levels ^a (percentage)	Tree crown		
	Upper ^b	Middle	Lower
	Number of trees		
none visible	102	2	1
1-5	49	118	3
6-15	8	26	134
16-25	2	6	11
26-35	3	1	1
36-45	0	0	3
46-55	0	0	0
56-65	0	0	0
66-75	0	0	0
76-85	0	0	0
86-100	0	0	0

^a Includes all types of damage affecting tree vigor (e.g., dead twig, dead branches, dead tops, and missing or damaged foliage) .

^b Includes trees with less than 3 meters of crown (assessed as upper only.)

Appendix 5; Table 21.(c) Summary of black spruce damage levels as seen in the upper, middle, and lower third of the crowns on the spruce/fir health plots for 1996 in the South Central Region of Ontario. (Counts are based on the examination of 57 living black spruce trees.)

Crown damage levels ^a (percentage)	Tree crown		
	Upper ^b	Middle	Lower
	Number of trees		
none visible	49	13	3
1-5	6	36	10
6-15	1	3	36
16- 25	1	2	5
26- 35	0	1	0
36- 45	0	0	1
46- 55	0	0	0
56- 65	0	0	0
66- 75	0	0	0
76- 85	0	0	0
86- 100	0	0	0

^a Includes all types of damage affecting tree vigor (e.g., dead twig, dead branches, dead tops, and missing or damaged foliage).

^b Includes trees with less than 3 meters of crown (assessed as upper only.)