

**FOREST HEALTH CONDITIONS  
IN THE  
NORTHEAST REGION OF ONTARIO  
1998**

*Forest Districts: Chapleau, Cochrane,  
Hearst, Kirkland Lake, North Bay,  
Sault Ste. Marie, Sudbury, Timmins, and Wawa*

*H.J. Evans, A.J. Keizer,  
D.T. Rowlinson, and P.J. Wall*

**NATURAL RESOURCES CANADA**

**CANADIAN FOREST SERVICE**

**GREAT LAKES FORESTRY CENTRE**

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## OVERVIEW

The following report deals with the forest health conditions in the Northeast Region of Ontario for 1998, as defined by the Ontario Ministry of Natural Resources (OMNR) geographical boundaries. The report is divided into three sections which are 1) major forest disturbances, 2) forest health monitoring and 3) quarantine pests. 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. The latter are located in specific forest types and include assessments of jack pine, spruce/fir, oak and maple but other forest species are monitored on the plots as well.

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 the 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 forests 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 Northeast Region, the CFS personnel were Hugh Evans based in Sault Ste. Marie and Alan Keizer working out of Sudbury-Temagami. The OMNR staff were Dan Rowlinson, located in Chapleau and Peter Wall out of Hearst who provided coverage for the most northern part of the region.

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

H.J. Evans  
A.J. Keizer  
D.T. Rowlinson  
P.J. Wall

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## MAJOR FOREST DISTURBANCES

### Insects

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

The large aspen tortrix is a periodic pest of trembling aspen (*Populus tremuloides* Michx.) in Ontario. In 1998, a total of 2 638 ha of moderate to severe defoliation occurred in and around the city of Sault Ste. Marie (Fig.1). Defoliation was generally moderate, in the 40 to 70 percent range and averaged 50 percent overall. There were also a few small pockets (less than 1 ha) of moderate to severe damage in Jocelyn Township on St. Joseph's Island, Sault Ste. Marie District and in Billings Township on Manitoulin Island, Sudbury District.

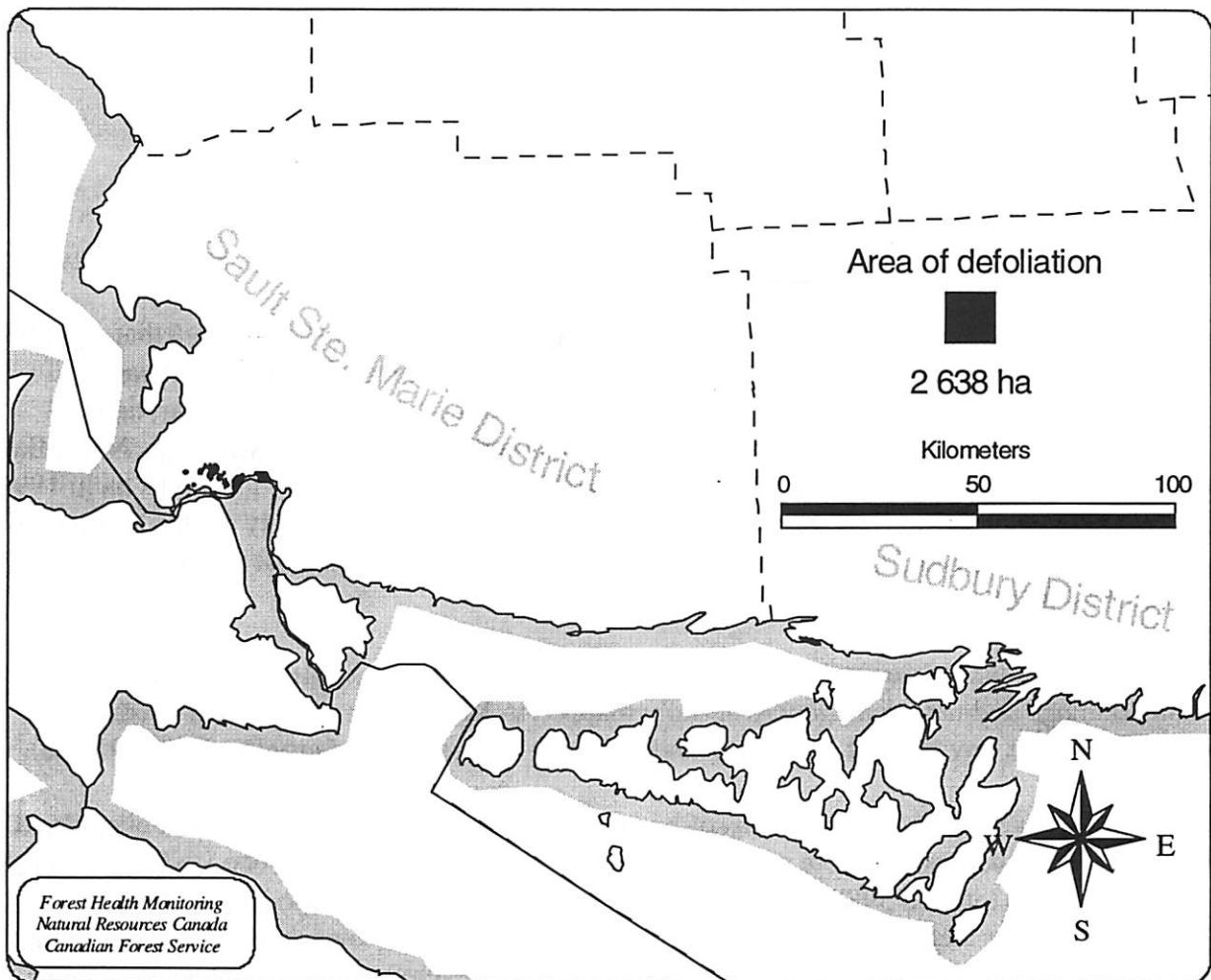


Figure 1. Areas of moderate to severe defoliation caused by the Large aspen tortrix (*Choristoneura conflictana* [Wlk.] ) in 1998.

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

The area infested by spruce budworm increased by over 22 000 ha in 1998. The total area of moderate to severe defoliation of balsam fir (*Abies balsamea* [L.] Mill.) and white spruce (*Picea glauca* [Moench] Voss) stands was 86 145 ha, compared with 63 584 ha in 1997 (Table 1 and Fig. 2).

**Table 1.** Gross area of moderate to severe defoliation caused by the spruce budworm in the Northeast Region of Ontario in 1997 and 1998.

District	Area of moderate to severe defoliation		
	1997	1998	Change (ha)
Hearst	3 520	1 900	-1 620
North Bay	33 758	47 661	+13 903
Sudbury	26 306	36 584	+10 278
Total	63 584	86 145	+22 561

The largest area of infestation occurred near the village of Warren, in an area that straddles the Sudbury-North Bay District boundary. This area of infestation included all that was previously infested in 1997 with expansions occurring into parts of Appleby, Hagar, and Loughrin townships, Sudbury District and into McWilliams and Caldwell townships, North Bay District. The total area of this infestation increased from 60 164 ha in 1997 to 83 513 ha in 1998. The intensity of the infestation dramatically increased. Last year the majority of the defoliation was in the moderate (25-75 percent defoliation) category but in 1998 almost all of the area of damage was at the severe (>75 percent defoliation) level.

Top and/or whole tree mortality has occurred in this area as a result of spruce budworm feeding damage and new damage was aerially mapped in Kirkpatrick, Hugel, and Crerar townships, North Bay District (2 144 ha) and in Ratter Township, Sudbury District (1 059 ha).

Also in the Sudbury District areas of budworm defoliation occurred on Manitoulin Island. There were two pockets of severe defoliation south of Gore Bay between Tobacco Lake and Lake Kagawong which totalled 598 ha. Most of this damage occurred in Campbell and Allan townships. Smaller areas of damage occurred in Mills and Gordon townships. The defoliation was quite intense within the infested area. It was all in the severe category and backfeeding on the older foliage occurred on both white spruce and balsam fir. Another 134 ha of moderate damage occurred north of Lake Kagawong.

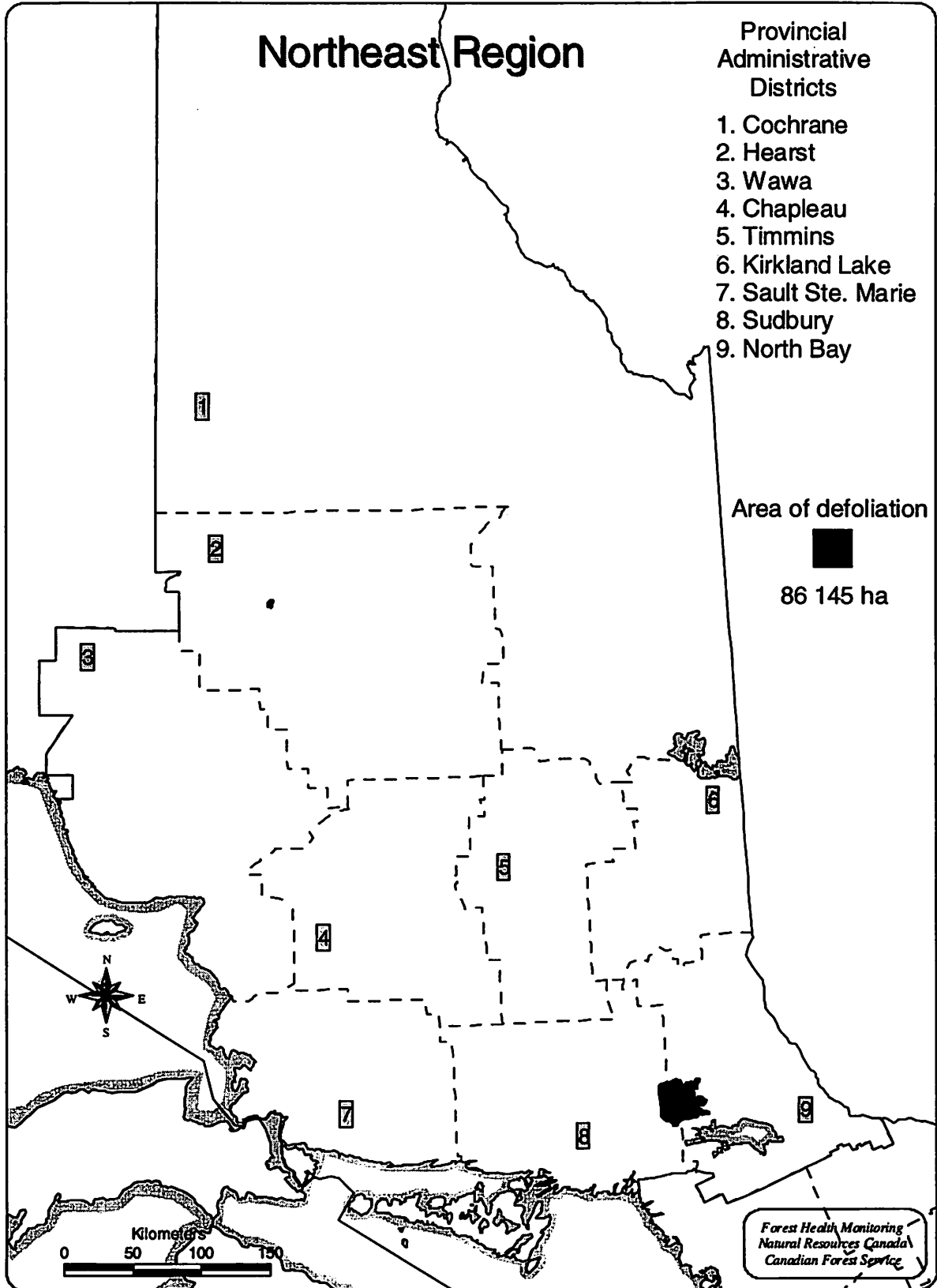


Figure 2. Areas of moderate to severe defoliation caused by the spruce budworm (*Choristoneura fumiferana* [Clem.]) in 1998.

An infestation persisted in the Hearst District where an area of 1 900 ha was defoliated in Rogers Township. The size and intensity of this infestation, as in the past few years, continued to decline. Moderate defoliation prevailed here in 1998.

Populations in previously infested areas in the Wawa, Chapleau, and Sault Ste. Marie districts declined to low levels. Larval feeding was recorded through many of these areas but generally the defoliation did not exceed 25 percent. Areas with these low populations were noted in the city of Sault Ste. Marie and in Kirkwood Township, Sault Ste. Marie District and in Billings Township, Sudbury District.

Spruce budworm pheromone trapping, an ongoing program, was repeated in 1998. Three traps were deployed at a total of 50 locations throughout the region. Significant numbers of moths were captured in Rogers Township, Hearst District and in Hugel and Thistle townships, North Bay District. Notable increases occurred in Lewis Township, Sault Ste. Marie District; in Laberge Township, Wawa District; and at Killarney, Nairn, and Servos townships, Sudbury District. Populations have stabilized at low levels at most of the other trapped locations (Table 2).

**Table 2.** Results of spruce budworm pheromone trapping in nine districts of the Northeast Region of Ontario from 1994 to 1998. (Three traps were located at each location.)

Location (Township)	<u>Total number of moths captured</u>				
	1994	1995	1996	1997	1998
<b><i>Chapleau District</i></b>					
Birch	188	82	21	19	27
Dupuis	-	67	47	18	12
Ivanhoe	38	11	5	3	2
Neelands	194	66	46	21	18
Peters	273	22	21	12	29
Sandy	171	45	20	13	5
Shipley	-	-	-	20	34
<b><i>Cochrane District</i></b>					
Dempsay	-	-	-	6	1 <sup>a</sup>
Homuth	-	21	22	4 <sup>b</sup>	7
Nesbitt	61	24	27	10 <sup>a</sup>	13 <sup>a</sup>



**Table 2. Results of spruce budworm pheromone trapping in nine districts of the Northeast Region of Ontario from 1994 to 1998. (Three traps were located at each location.)**

Location (Township)	<u>Total number of moths captured</u>				
	1994	1995	1996	1997	1998
<b><i>Hearst District</i></b>					
Ford	25	17	22	3	3
Frost	2 549	265	142	16	16
Hanlan	-	-	-	11	28
Landry	560	20	9	3	9 <sup>a</sup>
Oscar	361	20	31	14	21
Pearce	72	11	20 <sup>a</sup>	2	4 <sup>a</sup>
Ritchie	193	20	32	1	6
Rogers	1 976	1 618	1 764	117	406 <sup>a</sup>
Shearer	-	69	10	1	4
<b><i>Kirkland Lake District</i></b>					
Boston	91	122	73	9	1
Lamplugh	50	48	33	2	5
Maisonville	98	58	31	2	8
Tyrrell	257	60	54	11	6
<b><i>North Bay District</i></b>					
Hugel	1 544	2 786	1 903	1 150	410
Jocko	160	297	23	18	34
Strathcona	12	43	35	18	33
Thistle	219	164	134	51	260
<b><i>Sault Ste. Marie District</i></b>					
Asselin	101	-	-	18	24
Bridgland	-	-	-	8	43
Herrick	286	52	25	24	13
Jollineau	-	-	-	10	28

**Table 2. Results of spruce budworm pheromone trapping in nine districts of the Northeast Region of Ontario from 1994 to 1998. (Three traps were located at each location.)**

Location (Township)	<u>Total number of moths captured</u>				
	1994	1995	1996	1997	1998
<b><i>Sault Ste. Marie District (cont'd)</i></b>					
Lewis	-	392	79	18	107
Peever	244	28	19	27 <sup>a</sup>	18
Shields	-	-	-	19	35
Villeneuve	-	-	-	10	30
<b><i>Sudbury District</i></b>					
Killarney	-	-	-	56	94
Nairn	317	199	70	56	74
Parkin	200	533	216	43	18
Servos	119	-	-	24	61
Weeks	-	-	-	11	48
<b><i>Timmins District</i></b>					
Eldorado	77	35	26	1	4
Hazen	-	-	-	11	6 <sup>a</sup>
Invergarry	-	-	-	36	43
Marquette	134	108	77	10	29
Massey	-	-	-	8	4
Sewell	102	82	36	11	13
<b><i>Wawa District</i></b>					
Dumas	-	826	556	49	25
Laberge	-	170	167	25 <sup>a</sup>	60
Leslie	521	96	57	29	44
Wicksteed	756	93	53	15	27

<sup>a</sup>One trap destroyed.

<sup>b</sup>Two traps destroyed.

### **Larch Casebearer, *Coleophora laricella* (Hbn.)**

The larch casebearer caused moderate-to-severe damage to tamarack (*Larix laricina* [Du Roi] K. Koch) stands for the fourth consecutive year in the Northeast Region. Whereas the pest was found in the southern extremities of the region in previous years, in 1998 the damage from the insect extended further north. Affected areas ranged in size from 1 to 20 ha. The foliar browning caused by the feeding damage of the insect varied in intensity but ranged as high as 100 percent in some stands.

In the Hearst and Cochrane districts damage occurred in stands along most major roadways. The foliar browning was observed all along Highway 11 and the Detour Lake Road in Cochrane District. Similar damage was also observed in the Timmins District with pockets of damage occurring along Highway 101 as far west as Highway 144. Damage was also observed in Timmins and McKeown townships. In the Kirkland Lake District there were occurrences of the pest in Grenfell, Pense, and Brethour townships.

Damage in the North Bay District was reported in Hudson and Dymond townships in the New Liskeard area; from Temagami to Martin River along Highway 11; and in Widdifield Township near the city of North Bay. In the Sudbury District affected tamarack stands were seen near the communities of Cartier, Dowling, Walden, Lively, and Wahnapiatae in the vicinity of the city of Sudbury; in and around the town of Espanola; and large stands were defoliated west of the town of Massey. In Sault Ste. Marie District damage occurred in the airport area west of the city of Sault Ste. Marie and on Garden River First Nation land to the east of the city as well as near the communities of Bruce Mines and Iron Bridge.

### **Forest Tent Caterpillar, *Malacosoma disstria* Hbn.**

The forest tent caterpillar outbreak centered in the Hearst and Cochrane districts continued to enlarge for the fourth consecutive year. This year the infestation increased by over a million hectares to a total of 2 867 895 ha. There were areas of moderate to severe defoliation in five districts (Fig. 3). The primary host of the forest tent caterpillar is trembling aspen but in large outbreaks such as this almost all hardwood tree and shrub species are affected. Included are balsam poplar (*Populus balsamifera* L.) and white birch (*Betula papyrifera* Marsh.).

The largest expansion of 534 770 ha occurred in the Cochrane District. Much of this augmentation occurred in a easterly direction, almost to the Quebec boundary in the area north of Lake Abitibi. Smaller increases also occurred along the north leading edge of the infestation along the Abitibi River.

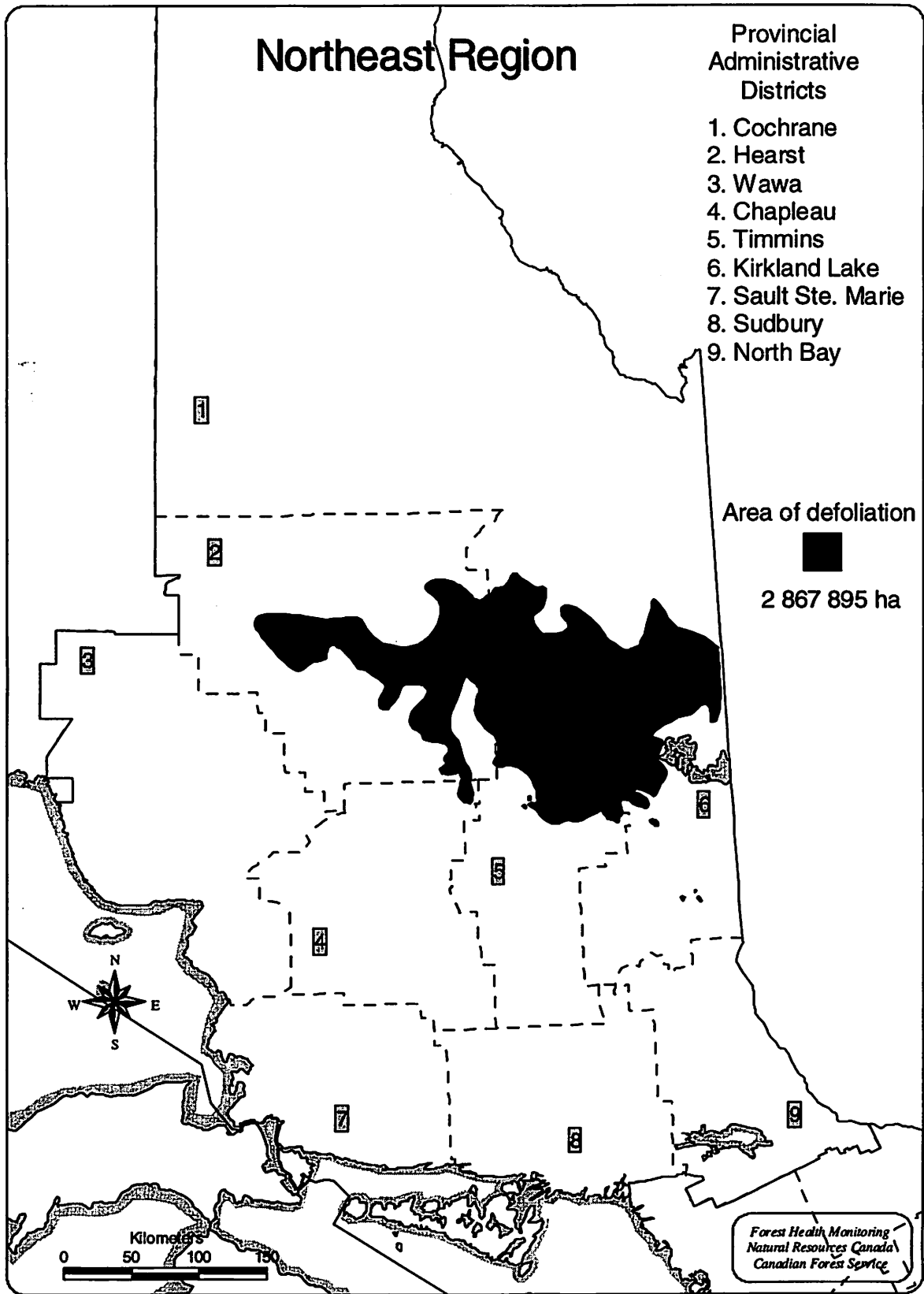


Figure 3 Areas of moderate to severe defoliation caused by the forest tent caterpillar ( *Malacosoma disstria* Hbn. ) in 1998.

An increase of 457 268 ha occurred in the infestation in the Hearst District. A large portion of this increase occurred along the Highway 11 corridor and westward as far as the community of Calstock, but expansion to the north also occurred along the Mattagami River to Harmon Township. Another increase occurred in the area south of the town of Kapuskasing and this extended as far south as Montcalm Township of Chapleau District.

Comparatively smaller increases of 46 230 ha and 47 528 ha occurred in the Kirkland Lake and Timmins districts, respectively. The area infested in 1997 in the Wawa District did not recur. However, this was offset by the newly infested area in the Chapleau District (Table 3).

A limited number of areas in the Studholme Township area of the Hearst District, within the outbreak area, were checked for egg-bands and sufficient numbers were found to indicate that this part of the infestation will continue. Several areas to the west of the infestation front were also checked but these were all negative, indicating that spread to the west will be limited.

In the Cochrane District where the infestation has been present for a few years, there were numerous observations of the parasitic fly, *Arachnidomyia aldrichi* (Park.). The presence of this parasite in such high numbers is usually a harbinger of a population decline.

**Table 3.** Gross area of moderate to severe defoliation caused by the forest tent caterpillar in the Northeast Region of Ontario from 1995 to 1998.

District	<u>Area of moderate to severe defoliation (ha)</u>			
	1995	1996	1997	1998
Chapleau	0	2 953	0	13 985
Cochrane	165 988	512 022	1 102 202	1 636 972
Hearst	72 329	255 094	432 841	890 109
Kirkland Lake	0	1 881	42 683	88 913
Timmins	3 470	80 693	190 388	237 916
Wawa	0	0	1 288	0
<b>Total</b>	<b>241 787</b>	<b>852 643</b>	<b>1 769 402</b>	<b>2 867 895</b>

## Bruce Spanworm, *Operophtera bruceata* (Hlst.)

In the Sault Ste. Marie District Bruce spanworm populations have been increasing for the past few years in the area around the city of Sault Ste. Marie. There were no areas of widespread defoliation until this year when a total of 4 581 ha of moderate-to-severe defoliation in sugar maple (*Acer saccharum* Marsh.) stands was mapped. Defoliation was detected in Prince, Dennis, Pennefather, Aweres, VanKoughnet, Fenwick, Havilland, Tupper, Tilley and Fisher townships north and northwest of Sault Ste. Marie. The insect also caused moderate defoliation in Hilton and Jocelyn townships on St. Joseph Island, east of Sault Ste. Marie (Fig. 4).

The last outbreak of Bruce spanworm reported in this area was from 1984 to 1988. It peaked in 1987 when there was a total of 202 206 ha of forested area that sustained moderate-to-severe defoliation. The insect, which is a geometridae, feeds very early, almost as the leaves first flush. It is quite often more conspicuous in the lower crowns of the trees and in the understory, where it can do a considerable amount of damage before being detected. The adults are active late in the fall and the females of the species are wingless. Observations during early November revealed a healthy population of moths in some of the affected stands indicating that this infestation will, in all probability, continue in 1999.

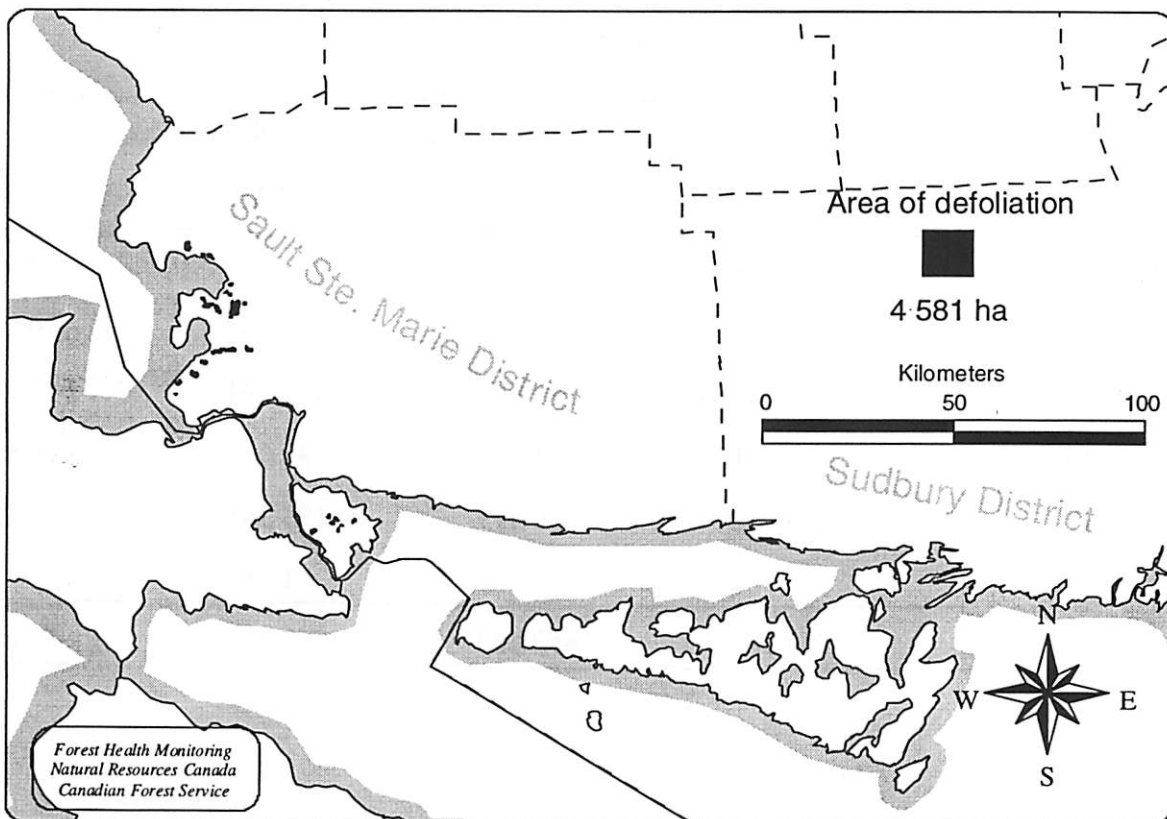


Figure 4. Areas of moderate to severe defoliation caused by the Bruce spanworm (*Operophtera bruceata* [Hlst.]) in 1998.

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

Yellowheaded spruce sawfly populations increased through the northern half of the region in 1998. Increased numbers were noted in Chapleau, Wawa, Timmins, and Hearst districts. The insect has a penchant for open-grown young trees along the fringes of stands, in plantations and on ornamentals. Affected species included both white spruce and black spruce (*Picea mariana* [Mill.] B.S.P.).

Exceptionally heavy defoliation occurred on naturally seeded spruce along the Highway 101 road corridor west of Timmins, in Keefer, Hillary and Sewell townships, Timmins District. At several locations in this area trees up to 2 metres in height were completely denuded of foliage. Similar damage occurred in Tiernan Township, Wawa District; at several points along Highway 101, west of the town of Chapleau, Chapleau District; and west of the town of Hearst along Highway 11 as far as Highway 631, Hearst District.

A small (0.2 ha) area within a large 10 year old black spruce plantation in the Dodd's Lake Road area, Arnott Township, Hearst District was heavily damaged. Almost all of the 2 metre tall trees in this area were affected at the moderate-to-severe level and numerous trees will either die or sustain permanent disfigurement.

### **Maple Leafroller, *Sparganothis acerivorana* Mack.**

This defoliator caused moderate-to-severe defoliation of sugar maple at two widely separated points in the region in 1998. A total of 448 ha were affected. Along with other insects which included the maple-basswood leafroller, (*Sparganothis pettitana* [Rob.]) foliar damage occurred to sugar maple on 284 ha on the south side of Comanda Lake in Patterson Township, North Bay District and on 164 ha in a forested area in Tarentorus Township, Sault Ste. Marie District. Defoliation averaged 30 percent at the former location and 80 percent at the latter. On Manitoulin Island, Sudbury District light defoliation ranging as high as 25 percent was noted on sugar maple and red maple, (*Acer rubrum* L.) in Allan and Billings townships and on basswood, (*Tilia americana* L.) in Bidwell Township.

## **Abiotic Conditions**

### **Frost**

An earlier spring this year advanced foliar development weeks beyond normal development. This was followed by a sudden drop in temperatures (as low as -10C in the Hearst area) in late May and early June. Extensive foliar damage resulted to balsam fir, white spruce and black

spruce throughout the Northeast Region. Low lying black ash (*Fraxinus nigra* Marsh.) was also notably affected at various locations.

Areas most severely affected were recorded in the Sault Ste Marie District where defoliation ranged from 20 to 80 per cent on primarily open-grown 1-3m tall balsam fir and white spruce trees. A 12 ha plantation of 3.5m tall black spruce trees in Jollineau Township sustained 20% foliar damage on 70% of the trees. A 5 ha plantation of 1m tall eastern white pine (*Pinus strobus* L.) trees in Hynes Township, averaged 20% shoot damage to 30% of the trees. Approximately 250 ha of black ash along the Goulais River in Gaudette, Hodgins and Deroche townships, averaged 50% foliar damage. Similar damage in smaller pockets ranging from 0.5 to 1.0 ha was noted along the Mississagi River in Villeneuve Township and along the Aubinadong River in Timbrell Township.

In Wawa District approximately 2 500 three metre tall white spruce sustained 65% foliar damage over a 2 ha plantation in Chenard Township. Balsam fir regeneration under 1m tall sustained 55% new shoot damage through Esquega Township. Similar damage to balsam fir was noted in low lying areas in the Chapleau District.

Elsewhere, light levels of blackened, curled dead foliage and drooping conifer shoots were evident on low lying and open grown host trees scattered throughout the region.

### Scorch / Drought

Drought damage occurred in the Northeast Region during 1997 affecting approximately 388 052 ha in the Chapleau, North Bay, Sault Ste Marie, Sudbury and Wawa districts<sup>1</sup>. Symptoms included full crown discolouration of hardwoods and drooping foliage of both hardwoods and conifers.

During 1998, a combination of the dry conditions experienced in 1997, followed by lower levels of snowfall during the 1997/98 winter and above normal mean temperatures this last spring, caused a variety of heat and moisture fluctuation symptoms to both hardwoods and conifers. These symptoms included premature foliar discolouration and leaf drop, leaf wilt, leaf curl, whole leaf/leaf margin necrosis and top/whole tree mortality. Damage was observed at varying levels throughout the Northeast Region during 1998. Aerial reconnaissance flights recorded higher levels of damage in the Wawa, Sault Ste Marie, Sudbury, Timmins and North Bay districts over approximately 368 098 ha (Fig. 5).

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<sup>1</sup>Evans, H.J.; Lawrence, H.D.; Rowlinson, D.T.; Marles, D.L. 1998. Forest Health Conditions in the Northeast Region of Ontario, 1997. Nat. Resour. Can., Canadian Forest Service-Ontario, Sault Ste. Marie, ON. Inf. Rep..



The largest area of symptomatic damage occurred in Sault Ste. Marie District where approximately 256 038 ha of white birch, sugar maple, trembling aspen, red maple, black spruce and jack pine (*Pinus banksiana* Lamb.) were affected. Hilltops, hill crests and shallow soiled-ridges sustained the heaviest damage due to the inability to retain moisture because of the higher reflected heat levels near the exposed rock outcrops. The largest pocket of damage stretched from Aweres Township, just north of Sault Ste. Marie, north to Slater Township, inland to Runnalls Township and east to Lunkie Township (near Ogidaki Mountain). Smaller pockets comprised the remainder of the damaged area stretching from Prince Township to the Sudbury District including Manitoulin Island. Single tree mortality was reported on 50% of the white birch, 33% of the trembling aspen and 10% of the black spruce at a point in Gaudry Township. In Esten Township south of Elliot Lake an area of jack pine sustained 24% top and/or whole tree mortality. Smaller sugar maple regeneration scattered through the Mississagi Provincial Park sustained occasional single tree mortality.

The Sudbury District contained the second largest area of damage with primarily premature leaf discolouration and leaf drop occurring to white birch, trembling aspen and maple (*Acer* spp.) over approximately 88 017 ha. The largest area was located around the city of Sudbury extending from Copper Cliff to Wanapitei Lake. Severe leaf scorching to smaller hardwood trees was evident along roadsides throughout the district causing entire leaf necrosis and occasional single tree mortality.

Severe scorch damage was also observed in Notman, Blyth and Merrick townships of the North Bay District. Scattered pockets of primarily hardwood tree damage were evident in Commanda, Phelps, Bonfield and Nipissing townships near the North Bay/Lake Nipissing areas and in Mattawan, Calvin and Papineau townships near Mattawa. The damaged areas in the North Bay District totalled 23 719 ha.

There were two adjacent jack pine plantations affected (8 & 15 years old, 1m & 2m tall, respectively) in Price Township, Timmins District. The lower one third of the crowns of approximately 50 ha of young jack pine were damaged by scorch and drought. Needles simply "dried up" and fell to piles onto the ground under the remaining crowns. These plantations contained high amounts of residual slash which increased reflective heat levels over the exposed sandy soils the trees were planted amongst. Whole tree mortality occurred to 4% of these trees.

Wawa District contained a single pocket of symptomatic damage to hardwoods covering approximately 324 ha. This pocket was located alongside Highway 17 in Labelle Township.

In the Hearst District 67% of a small jack pine plantation was affected while in Township 238 on the Fushimi Road another plantation of jack pine was severely affected (55%).

Moisture related deficiencies can take years to reveal their full impact. Trees may show slow crown decline and even death as the loss of desiccated roots and branch dieback take effect.

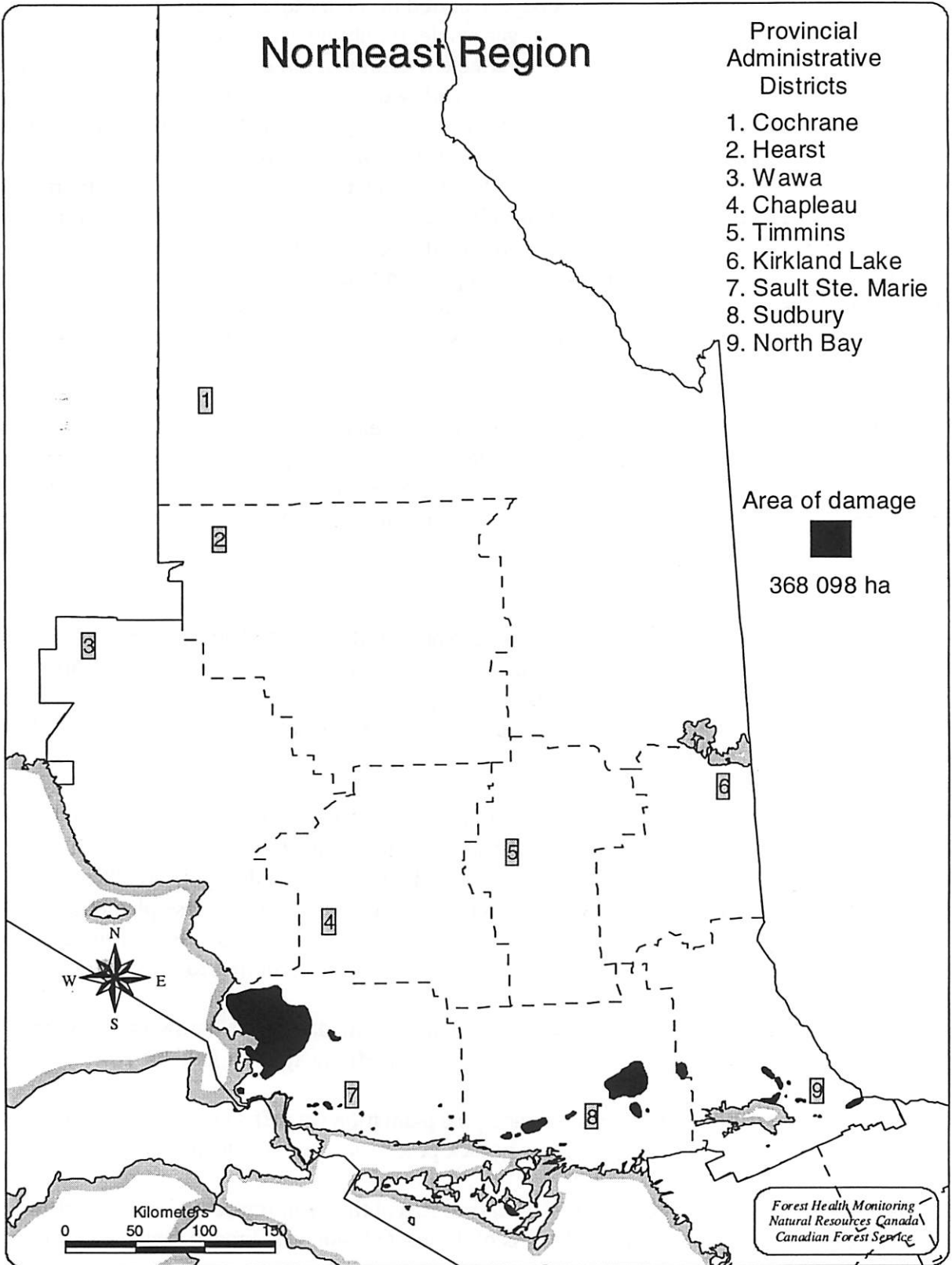


Figure 5. Areas of scorch and/or drought damage in 1998.

## Single Tree Balsam Fir Mortality (Stillwell's Syndrome)

“...Balsam fir trees, usually with a full complement of foliage and after exposure to varying amounts of defoliation by the spruce budworm for several years, sometimes turn bright red and die. This phenomenon has been known in stands where considerable damage or mortality has already occurred. ...Balsam fir trees stressed by repeated spruce budworm defoliation are susceptible to attack by numerous organisms that are normally considered to be of secondary importance....”<sup>2</sup>. For many years this problem has been identified through parts of the Northwestern Region of Ontario. This year elevated levels of this phenomenon have resulted in damage reports from the Wawa, Sudbury and North Bay districts of the Northeast Region.

In Wawa District three stands were chosen for permanent monitoring plot locations. These evaluations revealed a single high mortality rate of 11% at the Lampson Lake Road plot (based on the examination of 100 balsam fir trees per location). Two other locations revealed mortality rates of 3 & 4 per cent at the Gertrude Township plot and Hillsport Road plot, respectively. Single tree mortality was observed at scattered points along the Highway 17 corridor in Lake Superior Provincial Park.

In the Sudbury and North Bay districts, a spruce budworm infestation is shared along the district boundary near Warren which covers approximately 84 245 ha (see Spruce Budworm, p.2 ). Within this area trees were observed with the symptomatic bright red foliage. Pockets of mortality (estimate <1%) of were scattered through the Loughrin and Hagar townships of Sudbury District and Kirkpatrick, Hugel, Crerar and Henry townships of North Bay District. Single trees were also observed in Tennyson, May, Salter, and Hallam townships of Sudbury District.

## Other Agents Damaging Forest Trees

*Acantholyda erythrocephala* (L.), Pine false webworm. Occasional red pine (*Pinus resinosa* Ait.) and eastern white pine trees were observed through the Sault Ste. Marie, Sudbury, Timmins and North Bay Districts with damage levels ranging from 10 to 50%. One hectare of 1.3 m tall white pine at the Ontario Forest Research Institute nursery in Sault Ste. Marie sustained an average 50% defoliation to 90% of the trees.

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<sup>2</sup>Moody et al. 1988. Forest Insect and Disease Conditions in Canada, 1987. Forestry Canada, Canadian Forestry Service, Ottawa, ON. Cat. No. F021-1/1987E. 92p..

***Anelaphus parallelus* (Newm.), Hickory twig pruner.** Red oak (*Quercus rubra* L.) stands in Commanda and Beaucage townships, North Bay District sustained heavy damage from this boring insect. An average of 25 pruned branches per tree was assessed on 90 per cent of the trees at locations in both townships and to scattered individual hosts in the southern North Bay District.

***Acleris semipurpurana* (Kft.), Oak leaf shredder.** A 5 ha stand of red oak sustained 40% foliar damage in the west end of the city of Sault Ste. Marie.

***Chrysomyxa ledi* (Alb. & Schwein.) De Bary var. *ledi*, Spruce needle rust, & *C. ledicola* Lagerh., Large-spored spruce needle rust.** Increased infection levels were encountered throughout the Region. Both black and white spruce sustained severe infections in Gross and Burt townships, North Bay District and McGowan Township, Hearst District.

***Conophthorus resinosae* Hopk., Jack pine tip beetle / red pine cone beetle.** Four jack pine plantation assessments in Timmins and North Bay districts disclosed light lateral tip damage on 4 to 22 per cent of the trees. These trees ranged in height from 1.2 m to 3 m tall. In the Chapleau District estimates in three plantations also revealed light damage. Trees ranged from 1.3 m to 6.5 m tall and damage occurred on 5 to 25% of the trees. High numbers of damaged red pine cones were observed on the ground under semi- and mature red pine (16 m+ tall) in Finlayson Provincial Park, North Bay District.

***Cryptococcus fagisuga* Linding, Beech scale.** A single stand of American beech (*Fagus grandifolia* Ehrh.) and maple on Highway 524 near Farleys Corners in Pringle Township, North Bay District, contained high insect populations on 20% of the beech trees. This represents a new range extension of this insect in Ontario.

***Dryocampa r. rubicunda* (F.), Greenstriped mapleworm.** This insect was commonly observed in Bridgeland Kirkwood townships, Sault Ste. Marie District. In Kirkwood Township defoliation to 90% of the understory red and sugar maple trees in a mature red pine stand reached 80% .

***Epinotia solandriana* (L.), Birch-aspen leafroller.** This leafroller caused 15% foliar damage to 80% of the white birch trees in Rowat Township, Sudbury District.

***Erannis tiliaria* (Harr.), Linden looper.** Numerous larvae caused light defoliation in VanKoughnet Township, Sault Ste. Marie District.

***Eucosma gloriola* Heinr., Eastern pine shoot borer.** Three jack pine plantation assessments in Timmins District revealed terminal damage occurring on 19-32% of the trees. These trees ranged in height from 1.2 m to 2.1 m tall. Three plantations surveyed in the Chapleau District revealed incidence rates from 1% to 11% of the trees with leader damage. These jack pine plantations ranged in height from 1.3 m to 2.0 m.

***Isochnus rufipes* (LeC), Willow flea weevil & *Trichlochmaea decora decora* (Say), Gray willow leaf beetle.** These pests, either individually or in combination frequently caused 100% defoliation to stream and/or roadside willow (*Salix* spp.) bushes throughout the Northeast Region. The latter pest was also observed defoliating trembling aspen in Brutus Township, Chapleau District.

***Linospora tetraspora* G.E. Thomps., Linospora leaf blight & *Mycosphaerella populicola* G.E. Thomps., Septoria leaf spot.** Small stands and pockets of balsam poplar were severely affected by this leaf disease throughout the Sault Ste. Marie, Sudbury, North Bay, Kirkland Lake, Chapleau and Wawa districts. The largest affected area observed was in a 2 ha stand located in Askin Township, North Bay District where all of the 9 m tall trees were 100% infected.

***Lophodermium pinastri* (Schrad.:Fr.) Chevall., Pine needle cast.** A single 2 ha plantation of 7 m tall red pine was 100% affected in Gurd Township, North Bay District. The severity of damage allowed for aerial detection. Complete needle loss to all but the current foliage has been caused by repeated annual infections.

***Lophophacidium dooksii* Corlett & Shoemaker, Dooks' needle blight.** Single trees scattered through the Sault Ste. Marie, Sudbury, North Bay and Timmins districts were observed with defoliation levels ranging up to 100%. In the North Bay and Sudbury districts almost every stand was affected. Highest incidence rates were observed along Highway 637 in Carlyle and Humboldt townships, and in Bigwood Township, Sudbury District and along the Wolsley Bay Road (Hwy. 528) in Latchford Township, North Bay District where an estimated 5% of the trees were affected in each stand. In the Sault Ste Marie District a single occurrence of a 20% incidence was encountered in Scarfe Township. Single infected trees were also observed in a band extending from Gros Cap west of Sault Ste. Marie eastward along the north channel of Lake Huron to the Espanola area of Sudbury District.

***Neodriprion nanulus nanulus* Schedl, Red pine sawfly, & *N. pratti banksianae* Roh., jack pine sawfly.** High numbers of larvae have caused moderate defoliation for the third consecutive year in Merritt Township, Sudbury District. The 15 ha jack pine plantation of 5 m tall trees sustained 40% defoliation with noticeable branch and crown dieback occurring. A 16 ha plantation of 2.4 m tall jack pine trees in Howland Township, Sudbury District averaged 50% defoliation to 72% of the trees.

***Ophiostoma ulmi* (Buisman) Nannf., Dutch elm disease.** Symptoms occurred to 14% of the white elm (*Ulmus americana* L.) trees in the Wikwemikong Village area, Sudbury District.

***Pissodes strobi* (Peck), White pine weevil.** Four jack pine plantations, (1.2 m-3.0 m tall) and a single eastern white pine plantation (1.2 m tall) in the North Bay District contained damaged leaders ranging from 6 to 11 per cent. In the Chapleau District four jack pine plantations surveyed (1.2 m to 1.7 m tall) sustained terminal damage ranging from 3 to 15 per cent of the trees.

***Resseliella pinifoliae* (Felt), White pine needle midge.** Damage was observed throughout the Sault Ste. Marie, Sudbury and North Bay districts at light-to-moderate levels. The highest incidence occurred in a 4 ha plantation of 9 m tall white pine trees in Nairn Township, Sudbury District. Foliar damage here averaged 60% of the new growth but ranged as high as 100%, particularly in the upper crowns.

## **FOREST HEALTH PLOT MONITORING**

### **Acid Rain National Early Warning System (ARNEWS)**

There are 13 ARNEWS plots in the Northeast Region (Fig. 6). These plots form part of a national network designed specifically to detect damage from airborne pollutants, but also to rate the trees for other biotic or abiotic damage. Information on crown condition, foliar damage, woody tissue damage, and the occurrence of acid rain symptoms is collected annually. The plots are situated in various forest types and are scattered geographically across the region. There is a minimum of one plot in each district.

There were foliar damage symptoms from unknown abiotic origins recorded in two plots in 1998. In Calvin Township, North Bay District, there was 30 percent foliar damage to 6 percent of the trembling aspen due to a combination of stunted and chlorotic foliage. Similar foliar damage level occurred on white birch at this plot with 31 percent of the trees having stunted foliage and 8 percent having the chlorotic condition. At the plot in Hopkins Township, Hearst District the black spruce was affected by a red foliar discoloration on 6 percent of the trees at trace levels and chlorotic foliar symptoms occurred on 5 percent of the trees.

Numerous pests were found affecting plot trees as well as other species within the plot and on trees in the nearby surrounding area. These are listed in tabular form (Table 4). Additional tree mortality occurred at the Hyman Township, Sudbury District plot where a red maple died but the tree had been in decline for some time. Living sprouts thrived at the base of this tree. In Evelyn Township, Timmins District a single trembling aspen was knocked over by a neighbouring off-plot tree and at the Green Township, Chapleau District a white birch died from no apparent cause.

Summaries of crown conditions and tree mortality in the plots from 1994 to 1998 are presented in Appendix 1 and 2. Comparisons are made in the appendices between results of these years.

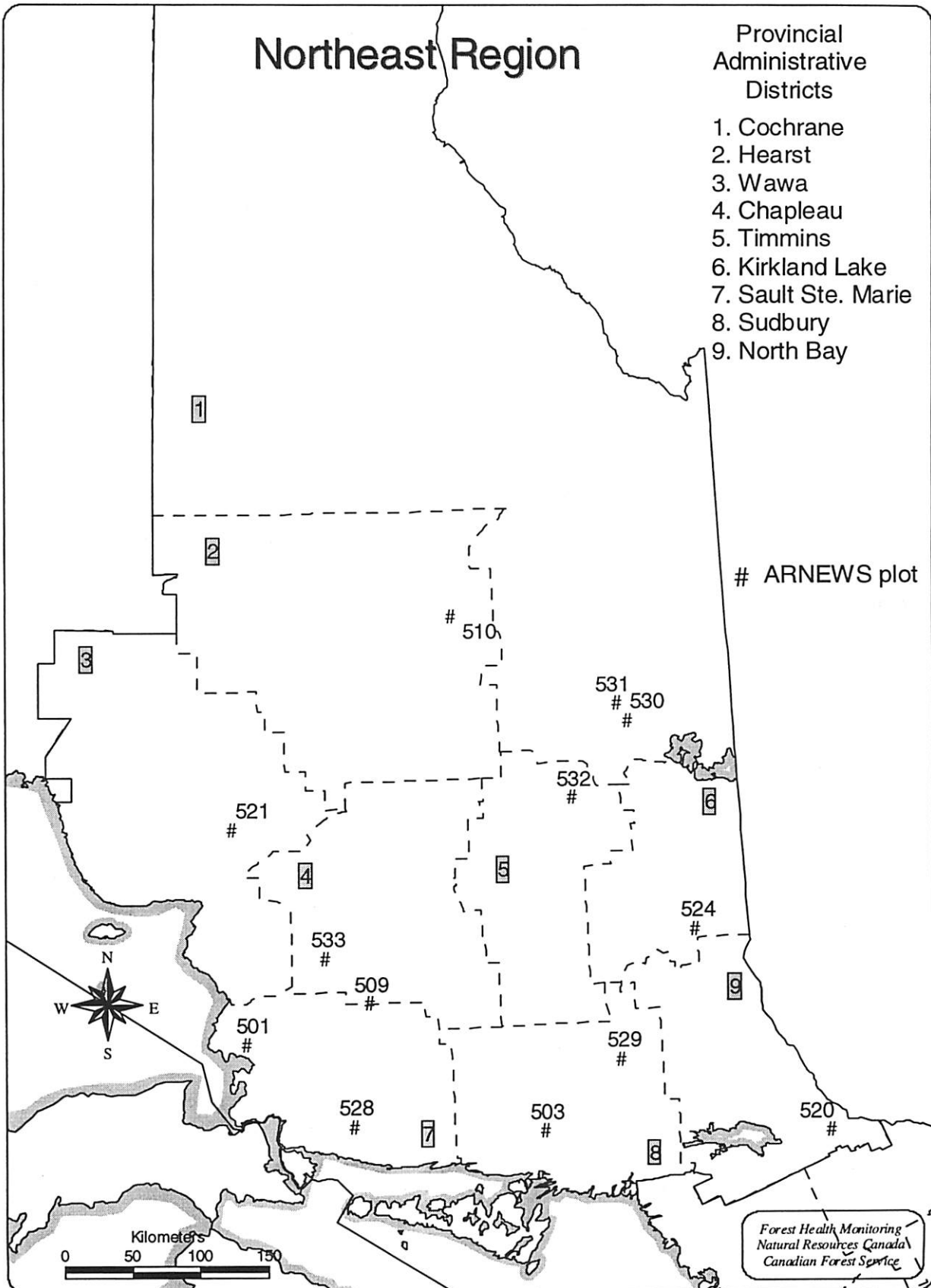


Figure 6. Locations of ARNEWS plots in 1998.

**Table 4. Summary of pest damage found in thirteen ARNEWS plots in the Northeast Region of Ontario in 1998**

Location	Agent	Host <sup>a</sup>	Remarks
<b>Chapleau District</b>			
Deans Twp.	Jack pine tip beetle, <i>Conophthorus resinosae</i> Hopk.	jP	Light damage to 25 percent of trees.
	Western gall rust, <i>Endocronartium harknessii</i> (J.P. Moore) Y. Hirats.		Light damage on 6 percent of trees.
	Armillaria root rot, <i>Armillaria ostoyae</i> (Romagn.) Herink		Contributing factor in the death of two trees.
	Spruce needle rust	bS	Understory was moderately affected.
	Aspen webworm, <i>Tetralopha applastella</i> (Hlst.)	tA	Foliar damage averaged 60 percent on 40 percent of the understory.
Green Twp.	Lepidopterous leafroller	wB	Trace damage occurred on 16 percent of trees.
	Tinder fungus, <i>Fomes fomentarius</i> (L.:Fr.) J. Kickx f.		Single tree affected with stem conk.
	Frost damage	bF	Light damage to new shoots.
<b>Cochrane District</b>			
Dempsay Twp.	Forest tent caterpillar	wB	Defoliation averaged 20 percent.
	Leaf spot, <i>Septoria betulae</i> Pass.		Moderate defoliation on regeneration.
Sweatman Twp.	Spruce needle rust	bS	Trace defoliation occurred on 23 percent of trees.
	Frost damage	bS	Foliar damage ranged from trace to light on 53 percent of trees.
<b>Hearst District</b>			
Hopkins Twp.	Frost damage	bS	Trace damage occurred on 83 percent of trees.
<b>Kirkland Lake District</b>			
Cane Twp.	Western gall rust	jP	Light damage on 64 percent of trees.
	Aspen leafblotch miner, <i>Phyllonorycter ontario</i> (Free.)	tA	Defoliation averaged 90 percent.
	Oak leaffolder, <i>Ancylis burgessiana</i> (Zell.)	pCh	Light damage on regeneration.
	Spearmarked black moth, <i>Rheumaptera hastata</i> (L.)	pCh	Light damage on regeneration.



**Table 4. Summary of pest damage found in thirteen ARNEWS plots in the Northeast Region of Ontario in 1998**

Location	Agent	Host <sup>a</sup>	Remarks
<b>North Bay District</b>			
Calvin Twp.	Aspen leafblotch miner	tA	Defoliation averaged 10 percent on all trees.
	Poplar false tinder fungus, <i>Phellinus tremulae</i>		Main stem incidence of 19 percent.
	Leafroller, <i>Acleris logiana</i>	wB	Average defoliation of 10 percent on all trees.
	Armillaria root rot		Associated with single newly dead tree.
<b>Sault Ste. Marie District</b>			
Gould Twp.	Oak leaf shredder,	rO	Trace defoliation on all host trees.
	Pinked striped oakworm, <i>Anisota virginiensis</i> (Drury)		Single tree affected with light damage.
	Armillaria root rot		Contributing factor in death of single tree.
	Maple leafblotch miner, <i>Cameraria aceriella</i> (Clem.)	sM	High numbers occurred on regeneration.
Wishart Twp.	Solitary birch leafroller, <i>Acleris semiannula</i> (Rob.)	sM	All trees had trace defoliation.
	Scorch		Forty percent of trees averaged 35 percent defoliation.
	Basswood looper, <i>Erannis tiliaria</i> (Harr.)	yB, hH	Trace defoliation on all trees.
<b>Sudbury District</b>			
Aylmer Twp.	Birch leafminer, <i>Profenusa alumna</i>	wB	Light defoliation on 100 percent of trees.
	Flat leaftier, <i>Psilocorsis reflexella</i>		Light defoliation on 100 percent of trees.
	Tinder fungus		Stem conks occurred on 14 percent of trees.
	Red fox, <i>Vulpes fulva</i>		Fox den causing the decline of one tree.
Hyman Twp.	Lesser maple leafroller, <i>Acleris chalybeana</i> (Fern.)	sM	Trace defoliation occurred on all host trees.
	Sugar maple borer, <i>Glycobius speciosus</i> (Say)		Single tree affected.
	Birch sawfly, <i>Arge pectoralis</i> (Leach)	wB	Trace numbers on off-plot tree.
	Pinked striped oakworm	rO	Trace numbers on off-plot tree.

**Table 4. Summary of pest damage found in thirteen ARNEWS plots in the Northeast Region of Ontario in 1998**

Location	Agent	Host <sup>a</sup>	Remarks
<i>Timmins District</i>			
Evelyn Twp.	Forest tent caterpillar	tA	Moderate to severe defoliation throughout plot.
	Aspen skeletonizer, <i>Phratora p. purpurea</i> Brown		Trace damage on regeneration.
	Hypoxylon canker, <i>Hypoxylon mammatum</i> (Wahlenb.) P. Karst.	tA	Factored in the death of one tree and cankers are developing on others.
<i>Wawa District</i>			
Huotari Twp.	Jack pine tip beetle	jP	Three percent of trees lightly affected.
	Western gall rust		Six percent of trees lightly affected.
	Red squirrel, <i>Tamiasciurus hudsonicus</i> (Erxleben)		Fourteen percent of trees had branch flagging.

<sup>a</sup> bF = balsam fir, bS = black spruce, hH = hop-hornbeam (*Ostrya virginiana* [Mill.] K. Koch), ltA = largetooth aspen (*Populus grandidentata* Michx.), jP = jack pine, pCh = pin cherry (*Prunus pensylvanica* L.f.), rM = red maple, rO = red oak, rM = red maple, sM = sugar maple, tA = trembling aspen, wB = white birch, and yB = yellow birch (*Betula alleghaniensis* Britton).

### 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 the following objectives:

1. To determine the rate of change in sugar maple tree condition ratings from 1988 to the present;
2. To determine if the rate of change in sugar maple tree condition ratings differed between: (a) various levels of pollution, measured as wet deposition, (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 between the causes and extent of decline.

In all, there are 171 plots in the northeastern United States and another 60 plots in eastern Canada. The 24 plots in Ontario were paired in each deposition zone; one was positioned in an undisturbed site and one in an active sugar bush. There are four plots in the Northeast Region; two in each of the North Bay and Sault Ste. Marie districts.

Although sugar maple is the primary species of interest, all trees in each plot were examined and the following quantitative data was recorded: diameter at breast height (DBH), tree vigor, crown condition, tapping status of the sugar maple, bole quality, location of bole defects, type of bole defects, percentage of crown dieback, foliar transparency, and defoliation. This information was obtained by a minimum of two trained observers. In 1997 ingrowth trees (trees growing on the plots which had attained the minimum diameter) were added and rated the same as other trees.

Table 5 compares the results of assessments from 1994 to 1998. For several years there was little change in the health of these trees but the difference between 1997 and 1998 is quite dramatic. At every location in 1998 there were more trees in the second category of healthiness (6-25 percent dieback) than in 1997 and in most cases these trees came from the first category (0-5 percent dieback). On a collective basis, between 1997 and 1998, the percentage of trees in the 0-5 percent dieback class dropped from 80 percent to 54 percent and increased from 18 percent to 43 percent in the 6-25 percent dieback class.

**Table 5.** Sugar maple crown conditions recorded in four North American Maple Project (NAMP) plots from 1994 to 1998 in the Northeast Region of Ontario.

Location (Township)	Average DBH (cm)	Year	Number of trees on plot	Total percentage of dead crown					Cumulative tree mortality		
				0-5	6-25	26-45	46-65	>65	New dead	Old dead	Trees cut
				Number of trees							
<i>North Bay District</i>											
Nipissing <sup>a</sup>	19.6	1994	113	83	23	1	4	1	0	1	0
		1995	113	71	23	2	0	1	3	1	12
		1996	113	69	27	1	0	0	0	4	12
		1997	113	72	21	2	0	0	1	4	13
		1998	113	64	29	2	0	0	0	5	13
Patterson <sup>b</sup>	19.6	1994	66	56	8	0	0	0	0	2	0
		1995	66	51	13	0	0	0	0	2	0
		1996	66	52	12	0	0	0	0	2	0
		1997	67 <sup>c</sup>	58	6	0	0	0	1	2	0
		1998	67	46	17	0	0	0	1	3	0
<i>Sault Ste Marie District</i>											
Tarentorus <sup>a</sup>	24.4	1994	84	63	18	0	0	0	0	1	2
		1995	84	63	17	0	0	1	0	1	2
		1996	84	63	14	0	0	0	0	1	2
		1997	84	67	13	1	0	0	0	1	2
		1998	84	21	58	1	0	0	1	1	2
Wishart <sup>b</sup>	27.6	1994	74	45	16	4	4	0	1	4	0
		1995	74	46	16	1	1	3	2	5	0
		1996	75	47	14	4	1	2	0	7	0
		1997	80 <sup>c</sup>	52	17	0	1	2	1	7	0
		1998	80	36	28	5	0	1	2	8	0

<sup>a</sup> Trees currently tapped for maple syrup

<sup>b</sup> Undisturbed woodlot.

<sup>c</sup> Ingrowth trees added

The vigor ratings reflect similar findings. There are four categories of vigor for the crowns of the living trees. Table 6 compares the crown vigor of the trees from 1994 to 1998. These results reflect the dieback ratings for 1997 and 1998. Overall, the number of healthy crowns decreased from 62 percent in 1997 to 35 percent in 1998, the number of crowns with light decline increased from 31 percent to 53 percent and the percentage of trees categorized as having moderate decline increased from 5 to 10 percent during the same time period. The decline was evident at every location.

Table 6. Sugar maple vigor conditions recorded in four North American Maple Project (NAMP) plots from 1994 to 1998 in the Northeast Region of Ontario.

Location (Township)	Average DBH (cm)	Year	Number of trees on plot	Vigor rating					
				Healthy	Light decline	Moderate decline	Severe decline	Trees dead	Trees cut
				Number of trees					
<i>North Bay District</i>									
Nipissing <sup>a</sup>	19.6	1994	113	100	7	4	1	1	0
		1995	113	90	5	0	2	4	12
		1996	113	88	7	1	1	4	12
		1997	113	37	50	6	2	5	13
		1998	113	18	59	15	3	5	13
Patterson <sup>b</sup>	19.6	1994	66	59	5	0	0	2	0
		1995	66	59	5	0	0	2	0
		1996	66	56	7	0	1	2	0
		1997	67 <sup>c</sup>	38	22	4	0	3	0
		1998	67	31	24	8	0	4	0
<i>Sault Ste. Marie District</i>									
Tarentorus <sup>a</sup>	24.4	1994	84	71	8	1	1	1	2
		1995	84	77	4	0	0	1	2
		1996	84	72	8	0	1	1	2
		1997	84	59	17	4	1	1	2
		1998	84	24	53	2	1	2	2
Wishart <sup>b</sup>	27.6	1994	75	53	10	3	4	5	0
		1995	75	57	6	2	3	7	0
		1996	75	52	9	4	3	7	0
		1997	80 <sup>c</sup>	60	7	1	4	8	0
		1998	80	36	26	6	2	10	0

<sup>a</sup> Trees currently tapped for maple syrup

<sup>b</sup> Undisturbed woodlot. <sup>c</sup> Ingrowth trees added

There were newly dead sugar maple at both of the untapped plots. There were three trees at the plot in Wishart Township, Sault Ste. Marie District that were infected with *Armillaria* root rot (two were dead and the other was in severe decline). There was noticeable scorch damage on 6 percent of the trees at this location and a single tree had 25 percent discoloration from chlorosis. There was light insect defoliation on the sugar maple probably from the solitary birch leafroller which was collected from the nearby ARNEWS plot.

At the Patterson Township, North Bay District plot, which also consisted of untapped trees, there were two trees with the tops snapped off. One sugar maple was newly dead because of this damage while a white ash (*Fraxinus americana* L.) remained living but severely affected. There was 10 percent defoliation on sugar maple from maple trumpet skeletonizer and on red oak similar damage was the result of oak leaf tier feeding. The yellow birch and beech in the plot were defoliated similarly from unknown free feeding insects.

One sugar maple has died since the last assessment at the tapped plot in Tarentorus Township, Sault Ste. Marie District. There was no obvious cause of death but the tree had begun to decline in 1997. There were trace levels of defoliation from maple trumpet skeletonizer and light foliar damage from Bruce spanworm. Also about 20 percent of the sugar maple displayed symptoms of drought which was manifested in smaller than normal leaf size as well as a general off-color appearance.

Scorch occurred on 5 percent of the sugar maple and caused an average of 10 percent foliar damage at the plot in Nipissing Township, North Bay District. Free feeding insects caused about 5 percent defoliation on all of the trees from free feeding defoliators. A couple of larvae of the white-marked tussock moth, (*Orgyia leucostigma intermedia* Fitch) were encountered during the plot visit. There was a medium incidence of the pitted ambrosia beetle, (*Corthylus punctatissimus* [Zimm.]) on the understory maple.

## **Jack Pine Health**

In 1992-1993 ninety jack pine plots were established in the Northeast Region of Ontario by the former Forest Insect and Disease Survey (FIDS) unit. The emphasis of the plot network is to examine all factors relating to the health of jack pine in Ontario. Due to staff and funding reductions the number of active plots being monitored annually has been reduced. In 1998, 53 of the original 90 plots established were visited on two separate occasions.

During the first visit the degree of male flowering was assessed. At this time and during the second visit, later in the summer, the trees were assessed for the level of pest and abiotic damage and newly dead trees were examined as to the cause of the mortality. At the time of the second visit the tree crowns were rated for the level of decline. The overall crown condition, a comparison with previous years results and the condition of the top is listed in Appendix 3. As part of this assessment the living crown was further examined and rated based on three equal vertical sections. Table 7 summarizes the upper, middle and lower crown condition and the indication is that the majority of the trees had less than 15% damage in all three levels of the crown. Generally the tree crown decline is greater in the bottom portion of the crown and this is the result of the intolerance jack pine has to shade. The results appear to be consistent with previous years.

There are fifty trees per plot and up until this year there were a total of 344 trees that have died or have been cut. In 1998, there were 56 trees cut (one entire plot and part of another) and an additional 69 trees (3.1%) died. Associated with the mortality was *Armillaria* root rot on 42 trees (1.9%); snow damage from 1997 on 9 trees (0.4%); bark beetles and borers (*Ips* spp. and *Monochamus* spp) on 5 trees (0.2%); and sweet fern blister rust, (*Cronartium comptoniae* Arthur) on a single tree (<0.1%). Another 12 trees (0.5%) died from no apparent cause.

There were several significant pests encountered on the living trees. Western gall rust was recorded on 16 plots damaging 60 trees (2.8%). Levels of damage were generally low. Sweet fern blister rust was found in 7 plots affecting 16 trees (0.7%) with stem cankers. Bark beetles were found on an additional 4 plots affecting 5 trees (0.2%). Storm damage was found affecting 9 trees (0.4%) on 4 plots. The jack pine tip beetle was found at light levels affecting 41 trees (1.9%) on 11 plots. Drought damage was obvious on one plot where 41 trees suffered discolouration and needle loss in the lower crown.

**Table 7.** Summary of damage levels as seen in the upper, middle, and lower third of the crowns of the jack pine health plots for 1997 and 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 2 301 living jack pine trees in 1997 and 2 179 in 1998.)

Crown damage levels <sup>a</sup> (%)	Tree crown					
	Upper <sup>b</sup>		Middle		Lower	
	Number of trees					
	1997	1998	1997	1998	1997	1998
None visible	350	342	46	197	2	12
1-5	1 044	886	510	241	51	143
6-15	492	618	803	803	439	372
16-25	170	148	496	515	831	592
26-35	94	57	242	216	551	448
36-45	46	35	77	69	232	316
46-55	33	39	33	32	61	144
56-65	24	16	12	14	34	46
66-75	12	11	7	9	28	18
76-85	6	7	2	5	4	6
86-100	30	20	7	8	2	12

<sup>a</sup> Includes all types of damage affecting tree vigor (e.g., dead twigs, dead branches, dead tops, missing foliage, and damaged foliage).

<sup>b</sup> All trees having crowns less than 3 m in length were assessed in this category.

## Spruce / Fir Health Network

The original design of this plot network was intended to provide forest managers with a hazard rating system predicting impact values from spruce budworm infestations to spruce and fir stands in Ontario. This network has now been adapted to include all health related variables affecting all species of trees encountered in these plots. Hardwood tree variables were assessed completely for the first time in all plots this year. Original plot establishment occurred during 1993 and 1994 and totalled 96 plots in the Northeast Region. Sixteen of these plots were discontinued in 1996 and another 30 were excluded from annual assessments in 1997. The remaining 50 plots were examined on at least one occasion during 1998.

Spruce budworm pheromone traps were installed at each location (Table 2) and the results are presented in the spruce budworm section of this report. Crown conditions were tabulated for the three major conifers (Tables 8-10) while crown conditions and mortality are presented in comparison with two previous years (1996 & 1997) in Appendices 4 & 5.

**Table 8.** Summary of balsam fir damage levels as seen in the upper, middle, and lower third of the crowns of the spruce/fir health plots for 1997 and 1998 in the Northeast Region of Ontario. (Counts are based on an examination of living balsam fir trees, 1 493 in 1997 and 1 454 in 1998.)

Crown damage levels* (%)	Tree crown					
	Upper <sup>b</sup>		Middle		Lower	
	Number of trees					
	1997	1998	1997	1998	1997	1998
None visible	840	556	309	261	18	51
1-5	350	505	591	276	267	198
6-15	153	248	279	448	547	302
16-25	52	64	103	253	308	234
26-35	51	27	78	80	130	276
36-45	19	12	41	36	73	212
46-55	8	19	12	20	52	69
56-65	9	11	7	9	20	30
66-75	3	2	3	5	7	8
76-85	3	2	1	1	1	7
86-100	5	7	1	4	2	6

\* Includes all types of damage affecting tree vigor (e.g., dead twigs, dead branches, dead tops, missing foliage, and damaged foliage).

<sup>b</sup> All trees having crowns less than 3 m in length were assessed in this category.

Of the 3 078 living trees assessed 67 recently died (2.2%). Conifers comprised of 2 272 trees (74%) of which 49 died (2.1%). Of the total number of conifers balsam fir was the largest component with 1454 trees (64%). Of the forty-nine dead conifer trees, forty were balsam fir. The largest contributor or cause of death was *Armillaria* root rot. This opportunistic fungi was found in 16 (40%) of the dead balsam fir. Bark beetles and woodborers were found in 6 trees. Other causes of mortality were attributed to snow damage, competition, Stillwell's syndrome, blowdown and unknown causes.

The total number of hardwoods (806 trees or 26%) decreased by 18 trees (2.2%). Of the 414 white birch trees (51%) eight died (1.9%). Five of these were due to *Armillaria* root rot. Trembling aspen comprised the second largest component with 321 living trees (40%). Eight of these trees (2.2%) fell to blowdown (3), unknown causes (2), *Armillaria* root rot (1), *Hypoxylon* canker (1) and a conk, (*Fomes* spp.) (1).

**Table 9.** Summary of white spruce damage levels as seen in the upper, middle, and lower third of the crowns of the spruce/fir health plots for 1997 and 1998 in the Northeast Region of Ontario. (Counts are based on an examination of living white spruce trees, 461 in 1997 and 458 in 1998.)

Crown damage levels <sup>a</sup> (%)	Tree crown					
	Upper <sup>b</sup>		Middle		Lower	
	Number of trees					
	1997	1998	1997	1998	1997	1998
None visible	194	128	81	53	24	19
1-5	186	204	174	87	70	42
6-15	45	80	119	180	169	105
16-25	16	24	39	91	103	134
26-35	14	11	20	26	50	80
36-45	3	4	8	5	13	47
46-55	0	4	4	6	11	16
56-65	0	2	0	1	5	5
66-75	1	0	1	1	1	1
76-85	1	0	1	0	1	1
86-100	1	1	1	1	1	1

<sup>a</sup>Includes all types of damage affecting tree vigor (e.g., dead twigs, dead branches, dead tops, missing foliage, and damaged foliage).

<sup>b</sup>All trees having crowns less than 3 m in length were assessed in this category.

Spruce budworm was found at three of the plots in 1998. The largest infested area was found around the Hugel Township plot in North Bay District where an average defoliation of 44% was encountered on balsam fir, 46% on white spruce and 14% on black spruce. Trace levels of balsam



fir defoliation were encountered in the Strathcona Township plot, also in North Bay District. Budworm populations in the Hearst District were reduced but the plot in Rogers Township was again affected with an average defoliation of 15% on balsam fir and 13% on white spruce.

Other organisms were encountered affecting tree health on 18 of the plots. Frost was encountered on 7 of the northern plots in Hearst and Cochrane districts. White spruce, balsam fir and black spruce sustained shoot and leader damage on up to 5% of the trees (average 10% defoliation). Spruce needle rust was observed on three white spruce trees and one black spruce tree from three plots. Defoliation levels ranged from 25 to 60%. Conks, (*Fomes* spp.), were encountered on two trembling aspen trees on two plots. A needlecast was observed on 3 balsam fir trees on two plots. Cedar leafminers (*Argyresthia canadensis* Free.), were found on seven eastern white cedar (*Thuja occidentalis* L.) trees on a single plot. Adelges gall makers, (*Adelges* spp.), were observed in light numbers on three white spruce trees in three plots.

**Table 10.** Summary of black spruce damage levels as seen in the upper, middle, and lower third of the crowns of the spruce/fir health plots for 1997 and 1998 in the Northeast Region of Ontario. (Counts are based on an examination of living black spruce trees, 268 in 1997 and 264 in 1998.)

Crown damage levels <sup>a</sup> (%)	Tree crown					
	Upper <sup>b</sup>		Middle		Lower	
	Number of trees					
	1997	1998	1997	1998	1997	1998
None visible	144	120	46	69	11	27
1-5	92	98	99	61	37	34
6-15	23	33	76	83	87	65
16-25	4	1	33	32	78	72
26-35	2	5	4	7	42	32
36-45	0	1	4	2	7	14
46-55	2	0	0	2	0	10
56-65	0	2	1	0	0	2
66-75	1	0	1	1	1	2
76-85	0	0	0	1	0	0
86-100	0	4	0	1	0	1

<sup>a</sup> Includes all types of damage affecting tree vigor (e.g., dead twigs, dead branches, dead tops, missing foliage, and damaged foliage).

<sup>b</sup> All trees having crowns less than 3 m in length were assessed in this category.

## QUARANTINE PESTS

### Gypsy Moth, *Lymantria dispar* (L.)

Gypsy moth populations remain at a very low level in the Northeast Region. In the North Bay District, once again there were collections made of generally low numbers of larvae. On a small island, in Macpherson Township in Lake Nipissing there were high numbers of larvae but the resultant defoliation was light (less than 10 percent). At a point along Highway 17 in Beaucage Township a small area of approximately 0.5 ha of 5-m trembling aspen and red oak sustained 60 percent foliar damage. Collections of larvae from Macpherson Township and nearby Commandra Township were infected with the larval fungus, (*Entomophaga maimaiga* Humber, Chimazu, and Soper), a natural control of the pest.

There were no areas of defoliation recorded in either the Sudbury or Sault Ste. Marie districts in 1997 or 1998. Prior to that there were six consecutive years (1991-1996) when moderate and severe foliar damage was mapped in the Sudbury District and in 1995 and 1996 in the Sault Ste. Marie District.

The annual pheromone trapping program was repeated in provincial parks and some other heavily travelled locations within the region. A total of forty sites were trapped. There was not significant change in the numbers of male moths trapped in 1998 compared with that of 1997 (Table 11).

**Table 11. Results of gypsy moth trapping in the Northeast Region of Ontario in 1997 and 1998**

Location	<u>Number of traps</u>		<u>Number of male moths captured</u>	
	1997	1998	1997	1998
<b><i>Chapleau District</i></b>				
Ivanhoe Lake Provincial Park	2	2	4	0
Missinaibi Lake Provincial Park	2	2	0	0
Mississagi Wild River Provincial Park	2	2	3	0
Shoals Provincial Park	2	2	0	0
Wakami Lake Provincial Park	2	2	0	1
<b><i>Cochrane District</i></b>				
Greenwater Provincial Park	2	2	0	0

**Table 11. Results of gypsy moth trapping in the Northeast Region of Ontario in 1997 and 1998**

Location	<u>Number of traps</u>		<u>Number of male moths captured</u>	
	1997	1998	1997	1998
<b><i>Hearst District</i></b>				
Fushimi Lake Provincial Park	2	2	0	0
Nagagamisis Lake Provincial Park	2	2	0	0
Rene Brunelle Provincial Park	2	2	0	0
<b><i>Kirkland Lake District</i></b>				
Esker Lakes Provincial Park	2	2	1	2
Kap-Kig-Iwan Provincial Park	2	2	7	1
<b><i>North Bay District</i></b>				
Finlayson Point Provincial Park	2	2	15	6
Lake Nipissing Scenic Lookout	1	2	17	31
Martin River Provincial Park	2	2	11	4
Mattawa Marina	-	1	-	12
Restoule Provincial Park	2	2	23	21
Samuel de Champlain Park	1	2	11	14
<b><i>Sault Ste. Marie District</i></b>				
Aubrey Falls Provincial Park	-	2	-	3
Day Township, Birchland Camp	-	2	-	21
Mississauga Provincial Park	2	2	19	9
Pancake Bay Provincial Park	2	2	9	5
Pointe des Chenes Park	2	2	9	18
<b><i>Sudbury District</i></b>				
Bidwall Township, Red Lodge	2	2	26	14
Chutes Provincial Park	2	1	33	10
Dawson Township, Mississagi Lighthouse Campground	2	2	6	16
Fairbanks Provincial Park	1	2	14	20

**Table 11. Results of gypsy moth trapping in the Northeast Region of Ontario in 1997 and 1998**

Location	<u>Number of traps</u>		<u>Number of male moths captured</u>	
	1997	1998	1997	1998
<b><i>Sudbury District (cont'd)</i></b>				
Gordon Township, Gordon's Lodge	2	2	27	21
Halfway Lake Provincial Park	2	2	5	6
Killarney Provincial Park	2	2	23	17
Skead Ranger Cabin	1	2	37	42
South Baymouth, Ferry Dock	1	2	4	34
Southbay Resort	2	2	4	35
Windy Lake Provincial Park	2	2	32	18
<b><i>Timmins District</i></b>				
Dublin Township Muldrew Lake	2	2	12	4
Kettle Lakes Provincial Park	2	2	0	0
<b><i>Wawa District</i></b>				
Lake Superior Provincial Park:				
Agawa Bay Campground	2	2	1	4
Crescent Lake Campground	2	2	0	4
Rabbit Blanket Lake Campground	2	2	1	4
Obatanga Provincial Park	2	2	3	1
White Lake Provincial Park	2	2	7	1

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

The pine shoot beetle, an introduced European bark beetle, was discovered in the state of Ohio in 1992. A detection program was then instituted in Ontario and in that year the pest was found in three areas of the Cambridge District. Since that time the insect has spread to most of southwestern Ontario. The main host of the pest is Scots pine (*Pinus sylvestris* L.) but eastern white pine, red pine and jack pine will also host the insect. There is one generation per year and it is the adult feeding damage to the new shoots that causes the tree damage. This becomes obvious in August and September when the shoots droop and turn reddish brown.

In the Northeast Region, the pest has not been detected to date. Efforts were made in the Sault Ste. Marie area to trap the adult stage of the insect using attractants in 1994, 1995 and 1996 but results were negative. Due to the potentially damaging consequences of this insect detection surveillance will be increased in 1999 in the Northeast Region.

### **An Asian Long-horned Beetle, *Anoplophora glabripennis* (Motschulsky)**

A new, non-native insect pest, the Asian long-horned beetle, was found at a warehouse in Waterloo, Ontario this past summer. The live adult beetle is thought to have arrived in wood packing material from China. This insect is native to Korea and China where it is a killer of its host trees. In China this pest is recognized as the most destructive pest of poplar (*Populus* spp.) trees.

The pest was first discovered in North America in 1996 in Brooklyn, New York. Since then it has been found in Amityville, New York and this past summer in some of the outlying suburbs of Chicago, Illinois. At these locations thousands of trees have been removed and destroyed in an effort to eradicate the pest. Wood crates and pallets that accompanied shipments from China are the probable sources of the infestations. This beetle poses a serious threat to urban and rural forests. Healthy maples, horsechestnut (*Castanea dentata* [March.]Borkh.), poplar, willow, elm (*Ulmus* spp), mulberry (*Morus* spp.) and black locust (*Robinia pseudoacacia* L.) trees have all been attacked in these areas. There is no effective treatment for an Asian Long-horned beetle infestation short of eradicating infested trees along with the eggs and larvae.

The Canadian Food Inspection Agency (CFIA) has the responsibility under the Plant Protection Act for introduced pests. In addition to the Waterloo discovery, an adult beetle as well as bore holes and sawdust were found in some crating in British Columbia that was bound for Toronto. In Ontario surveys were carried out by the CFIA with co-operation between the Forest Health Monitoring Unit and the Ministry of Natural Resources at various shipment sites. There has been no indication of any infestations by the Asian long-horned beetle in Ontario to this date.

Due to the potential threat to our hardwood forests here in Ontario, a continued involvement by all agencies will provide a quick response to any future interceptions. Informing and educating will be extremely important in getting needed co-operation from the general public in reporting any possible infestations.

The Forest Health Network of the Canadian Forest Service had a national program in 1998 that focussed on developing an enhanced monitoring system for exotic beetles. As part of this program there were three sites selected in Sault Ste. Marie where traps were deployed to catch beetles. There were four Lindgren 8 funnel traps set out at three locations and the traps were emptied and the contents examined periodically during the summer of 1998. Although a number of native beetles were caught, no 'exotics' were found from any of the traps.

Another aspect of the program was to examine wooden spools used to store and transport wire rope. This project is to provide an assessment of pest risk associated with domestic spools compared to those made off-shore. In Sault Ste. Marie ten domestic or Canadian-made spools were dismantled and each piece of wood was examined for evidence of insect activity. All results were negative.

**Appendix 1.** Summary of crown condition and tree mortality from 1994 to 1998 for the deciduous hosts in eight ARNEWS plots in the Northeast Region of Ontario. (Only host trees that consisted of 10 percent or more of the plot are included.)

Location (Township)	Plot number	Host <sup>a</sup>	Number of trees examined	Year	Crown condition <sup>b</sup>											Cumulative tree mortality			
					10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead		
					Number of trees														
<i>Chapleau District</i>																			
Green	533	wB	26	1994	18	0	8	0	0	0	0	0	0	0	0	0	0	0	
				1995	11	0	14	1	0	0	0	0	0	0	0	0	0	0	0
				1996	4	0	14	3	4	1	0	0	0	0	0	0	0	0	0
				1997	3	0	9	12	1	1	0	0	0	0	0	0	0	0	0
				1998	2	1	10	9	1	2	0	0	0	0	0	0	0	1	0
<i>Cochrane District</i>																			
Dempsey	531	wB	34	1994	1	0	16	0	15	1	1	0	0	0	0	0	0	0	
				1995	1	0	13	1	15	3	1	0	0	0	0	0	0	0	
				1996	0	0	12	1	16	4	0	0	1	0	0	0	0	0	
				1997	0	0	7	1	16	8	0	1	1	0	0	0	0	0	
				1998	0	0	3	3	19	7	0	1	0	1	0	0	0	0	
<i>North Bay District</i>																			
Calvin	520	wB	17	1994	0	0	3	0	5	2	0	0	0	0	2	1	4		
				1995	0	0	2	0	6	1	1	0	0	0	2	0	5		

**Appendix 1. Summary of crown condition and tree mortality from 1994 to 1998 for the deciduous hosts in eight ARNEWS plots in the Northeast Region of Ontario. (Only host trees that consisted of 10 percent or more of the plot are included.)**

Location (Township)	Plot number	Host <sup>a</sup>	Number of trees examined	Year	Crown condition <sup>b</sup>											Cumulative tree mortality	
					10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead
					Number of trees												
<i>North Bay District (cont'd)</i>																	
Calvin (cont'd)				1996	0	0	2	3	3	1	1	0	0	1	0	1	5
				1997	1	0	3	1	0	0	1	0	0	0	3	2	6
				1998	0	0	1	1	3	0	0	2	0	0	0	2	8
Calvin	520	tA	17	1994	0	0	0	0	12	0	0	0	0	0	0	0	5
				1995	0	0	0	0	10	1	1	0	0	0	0	0	5
				1996	0	0	0	4	5	1	0	0	0	0	2	5	
				1997	0	0	1	0	4	5	0	0	0	0	0	7	
				1998	0	0	2	1	4	2	1	0	0	0	0	7	
<i>Sault Ste. Marie District</i>																	
Gould	528	rO	47	1994	0	0	0	0	19	7	2	1	5	0	0	5	8
				1995	0	0	0	0	21	4	3	1	4	0	1	0	13
				1996	0	0	0	11	13	4	2	1	1	1	0	1	13



**Appendix 1. Summary of crown condition and tree mortality from 1994 to 1998 for the deciduous hosts in eight ARNEWS plots in the Northeast Region of Ontario. (Only host trees that consisted of 10 percent or more of the plot are included.)**

Location (Township)	Plot number	Host <sup>a</sup>	Number of trees examined	Year	Crown condition <sup>b</sup>											Cumulative tree mortality	
					10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead
					Number of trees												
				1997	0	0	0	2	20	6	1	0	1	1	1	1	14
				1998	0	0	0	8	15	5	1	0	1	1	0	1	15
<i>Sault Ste. Marie District (cont'd)</i>																	
Wishart	501	sM	16	1994	0	0	7	1	7	0	0	0	0	0	0	0	1
				1995	0	0	8	0	7	0	0	0	0	0	0	0	1
				1996	0	0	2	7	6	0	0	0	0	0	0	0	1
				1997	0	0	2	3	10	0	0	0	0	0	0	0	1
				1998	0	0	4	1	8	2	0	0	0	0	0	0	1
Wishart	501	yB	3	1994	1	0	0	0	1	0	0	0	0	0	0	0	1
				1995	0	0	0	0	2	0	0	0	0	0	0	0	1
				1996	0	0	0	1	1	0	0	0	0	0	0	0	1
				1997	0	0	0	0	2	0	0	0	0	0	0	0	1
				1998	0	0	0	0	2	0	0	0	0	0	0	0	1
<i>Sudbury District</i>																	

**Appendix 1. Summary of crown condition and tree mortality from 1994 to 1998 for the deciduous hosts in eight ARNEWS plots in the Northeast Region of Ontario. (Only host trees that consisted of 10 percent or more of the plot are included.)**

Location (Township)	Plot number	Host <sup>a</sup>	Number of trees examined	Year	Crown condition <sup>b</sup>											Cumulative tree mortality	
					10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead
					Number of trees												
Aylmer	529	wB	21	1994	0	0	4	0	13	3	0	0	0	1	0	0	0
				1995	0	0	11	0	6	1	0	1	1	1	0	0	0
				1996	0	0	6	8	6	1	0	0	0	0	0	0	0
<i>Sudbury District (cont'd)</i>				1997	0	0	5	0	11	0	1	2	0	0	2	0	0
Aylmer (cont'd)				1998	0	0	6	3	10	1	0	1	0	0	0	0	0
Hyman	503	rM	5	1994	0	0	2	0	1	0	1	0	0	0	0	0	1
				1995	0	0	0	0	3	0	1	0	0	0	0	0	1
				1996	0	0	0	1	2	1	0	0	0	0	0	0	1
				1997	0	0	1	0	1	1	0	0	1	0	0	0	1
				1998	0	0	0	1	2	0	0	0	0	0	0	1	1
Hyman	503	sM	10	1994	0	0	4	0	6	0	0	0	0	0	0	0	
				1995	0	0	3	1	6	0	0	0	0	0	0	0	
				1996	0	0	1	4	5	0	0	0	0	0	0	0	

**Appendix 1. Summary of crown condition and tree mortality from 1994 to 1998 for the deciduous hosts in eight ARNEWS plots in the Northeast Region of Ontario. (Only host trees that consisted of 10 percent or more of the plot are included.)**

Location (Township)	Plot number	Host <sup>a</sup>	Number of trees examined	Year	Crown condition <sup>b</sup>											Cumulative tree mortality			
					10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead		
					Number of trees														
Hyman	503	wB	7	1997	2	0	2	5	0	0	0	0	0	0	0	1	0	0	
				1998	0	0	0	5	0	4	0	0	0	0	0	1	0	0	
				1994	0	0	1	0	0	0	1	0	0	0	0	0	0	0	5
				1995	0	0	1	0	0	0	1	0	0	0	0	0	0	0	5
				<i>Sudbury District (cont'd)</i>															
Hyman (cont'd)				1996	0	0	0	1	0	0	0	0	0	0	0	0	1	5	
				1997	0	0	1	0	0	0	0	0	0	0	0	0	0	0	6
				1998	0	0	0	1	0	0	0	0	0	0	0	0	0	0	6
Hyman	503	ltA	6	1994	0	0	1	0	3	0	0	0	0	0	0	0	0	2	
				1995	0	0	0	0	4	0	0	0	0	0	0	0	0	2	
				1996	0	0	0	3	1	0	0	0	0	0	0	0	0	2	
				1997	0	0	1	0	2	1	0	0	0	0	0	0	0	2	
				1998	0	0	3	0	1	0	0	0	0	0	0	0	0	2	
<i>Timmins District</i>																			
Evelyn	532	tA	19	1994	7	0	9	0	0	0	0	0	0	1	0	0	2		
				1995	5	0	8	2	1	0	0	0	0	0	0	1	2		
				1996	0	0	0	1	13	2	0	0	0	0	0	0	0	3	
				1997	4	0	5	1	5	0	0	0	0	0	0	0	1	3	

**Appendix 1. Summary of crown condition and tree mortality from 1994 to 1998 for the deciduous hosts in eight ARNEWS plots in the Northeast Region of Ontario. (Only host trees that consisted of 10 percent or more of the plot are included.)**

Location (Township)	Plot number	Host <sup>a</sup>	Number of trees examined	Year	Crown condition <sup>b</sup>											Cumulative tree mortality		
					10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead	
					Number of trees													
					1998	0	0	6	2	4	1	0	0	0	0	0	2	4

<sup>a</sup>sM = sugar maple, rM = red maple, wB = white birch, yB = yellow birch, ltA = largetooth aspen, tA = trembling aspen, rO = red oak.

<sup>b</sup>10 = Full compliment of foliage no visible outer crown damage; 20 = foliage thin, off-color no dead branches or twigs; 30 = no dead branches, bare twigs present up to 5 percent of crown; 35 = no dead branches, bare twigs present on more than 6 percent of crown; 40 = dead branches and twigs present up to 15 percent of crown; 45 = dead branches and twigs present in 16 to 25 percent of crown; 50 = dead branches and twigs present in 26 to 37 percent of crown; 55 = dead branches and twigs present in 38 to 50 percent of crown; 60 = dead branches and twigs present in 51 to 75 percent of crown; 65 = dead branches and twigs present in 76 percent or more of crown; 70 = more than 50 percent of crown dead, only adventitious branches usually at base of crown.

**Appendix 2. Summary of crown condition and tree mortality from 1994 to 1998 for the coniferous hosts in six ARNEWS plots in the Northeast Region of Ontario. (Only host trees that consisted of 10 percent or more of the plot are included.)**

Location. (Township)	Plot number	Host <sup>a</sup>	Number of trees examined	Year	Crown condition <sup>b</sup>							Cumulative tree mortality		
					1	2	3	4	5	6	7	New dead	Old dead	
					Number of trees									
<i>Chapleau District</i>														
Deans	509	jP	53	1994	49	0	0	0	0	0	0	0	0	4
				1995	49	0	0	0	0	0	0	0	0	4
				1996	0	0	45	2	0	0	0	2	4	
				1997	0	0	41	3	1	0	1	1	6	
				1998	0	0	41	3	2	0	0	0	7	
Green	533	bF	3	1994	3	0	0	0	0	0	0	0	0	0
				1995	3	0	0	0	0	0	0	0	0	
				1996	0	0	3	0	0	0	0	0	0	
				1997	0	0	3	0	0	0	0	0	0	
				1998	0	0	3	0	0	0	0	0	0	
<i>Cochrane District</i>														
Sweatman	530	bS	82	1994	77	0	0	0	1	0	0	1	3	
				1995	77	0	0	0	0	0	0	1	4	

**Appendix 2.** Summary of crown condition and tree mortality from 1994 to 1998 for the coniferous hosts in six ARNEWS plots in the Northeast Region of Ontario. (Only host trees that consisted of 10 percent or more of the plot are included.)

Location. (Township)	Plot number	Host <sup>a</sup>	Number of trees examined	Year	Crown condition <sup>b</sup>							Cumulative tree mortality	
					1	2	3	4	5	6	7	New dead	Old dead
					Number of trees								
				1996	76	0	0	0	0	1	0	0	5
<b><i>Cochrane District (cont'd)</i></b>													
				1997	8	0	66	1	0	0	0	2	5
				1998	0	0	70	5	0	0	0	0	7
<b><i>Hearst District</i></b>													
Hopkins	510	bS	69	1994	62	0	0	1	0	0	0	0	6
			72	1995	66	0	0	0	0	0	0	0	6
				1996	65	0	0	0	0	0	0	1	6
				1997	12	0	52	0	0	0	0	1	7
				1998	0	0	63	1	0	0	0	0	8
<b><i>Kirkland Lake District</i></b>													
Cane	524	jP	68	1994	63	0	0	0	0	0	0	1	4
				1995	62	0	0	0	0	0	0	1	5
				1996	0	0	61	0	0	0	0	1	6
				1997	0	0	59	1	0	0	0	1	7

**Appendix 2.** Summary of crown condition and tree mortality from 1994 to 1998 for the coniferous hosts in six ARNEWS plots in the Northeast Region of Ontario. (Only host trees that consisted of 10 percent or more of the plot are included.)

Location. (Township)	Plot number	Host <sup>a</sup>	Number of trees examined	Year	Crown condition <sup>b</sup>							Cumulative tree mortality	
					1	2	3	4	5	6	7	New dead	Old dead
					Number of trees								
				1998	23	0	33	4	0	0	0	0	8
<b><i>Wawa District</i></b>													
Huotari	521	jP	36	1994	28	4	0	1	0	0	0	1	2
			36	1995	20	6	7	0	0	0	0	0	3
			38	1996	1	0	34	0	0	0	0	0	3
			38	1997	0	0	35	0	0	0	0	0	3
			38	1998	0	0	35	0	0	0	0	0	3

<sup>a</sup>bF = balsam fir, bS = black spruce, jP = jack pine

<sup>b</sup>1 = no defoliation; 2 = only current foliage defoliated; total defoliation less than 25%; 3 = current and/or some older foliage defoliated but total less than 25%; 4 = 25-50% total defoliation; 5 = 51-75% total defoliation; 6 = 76-90% total defoliation; 7 = more than 90% total defoliation.

**Appendix 3.** Summary of the crown condition, tree mortality and top condition in the 53 jack pine health plots from 1996 to 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 50 jack pine trees at each location.)

Location (Township)	Plot number	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
<i>Chapleau District</i>																
Bazett	64	24.6	1996	0	0	44	4	0	0	0	0	2	0	47	0	1
			1997	0	0	43	4	1	0	0	0	2	0	45	0	3
			1998	0	0	46	1	1	0	0	0	2	0	45	0	3
Deans	67	17.0	1996	0	0	43	1	0	0	0	3	3	0	44	0	0
			1997	0	0	38	2	2	0	0	2	6	0	40	0	2
			1998	0	0	36	4	1	0	0	1	8	0	40	0	1
Fawn NE	69	7.7	1996	0	0	37	7	0	0	0	2	4	0	40	1	3
			1997	0	0	30	8	0	1	1	4	6	0	34	0	6
			1998	0	0	28	4	6	0	0	2	10	0	31	0	7
Fawn S	71	4.7	1996	0	0	27	11	3	0	0	1	8	0	39	2	0
			1997	0	0	23	13	1	0	0	4	9	0	36	0	1
			1998	0	0	23	11	1	1	0	1	13	0	33	0	3
Ivy	74	6.5	1996	0	0	50	0	0	0	0	0	0	0	48	0	2



**Appendix 3.** Summary of the crown condition, tree mortality and top condition in the 53 jack pine health plots from 1996 to 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 50 jack pine trees at each location.)

Location (Township)	Plot numbe r	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
<i>Chapleau District (cont'd)</i>																
Ivy (cont'd)			1997	0	0	45	1	1	0	0	3	0	0	46	0	1
			1998	0	0	46	0	0	0	0	1	3	0	45	0	1
Kaplan N	76	14.3	1996	0	0	39	1	0	1	0	4	5	0	41	0	0
			1997	0	0	36	3	1	1	0	0	9	0	33	0	8
			1998	0	0	36	1	0	0	1	3	9	0	30	0	8
Nimitz	78	17.9	1996	0	0	46	2	0	0	0	0	2	0	47	0	1
			1997	0	0	43	3	0	0	0	2	2	0	44	0	2
			1998	0	0	41	4	0	0	0	1	4	0	42	1	2
Osway	79	9.2	1996	0	0	39	3	0	0	0	5	3	0	41	0	1
			1997	0	0	22	8	0	1	0	11	8	0	29	0	2
			1998	0	0	19	2	1	0	1	8	19	0	20	0	3
<i>North Bay District</i>																
Latchford	1	13.7	1996	0	0	34	5	1	0	1	3	6	0	36	1	4
			1997	0	0	21	15	2	0	0	3	9	0	35	0	3

**Appendix 3.** Summary of the crown condition, tree mortality and top condition in the 53 jack pine health plots from 1996 to 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 50 jack pine trees at each location.)

Location (Township)	Plot numbe r	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
			1998	0	0	31	5	1	0	0	1	12	0	37	0	0
<i>Sault Ste. Marie District</i>																
Bouck	2	19.6	1996	50	0	0	0	0	0	0	0	0	0	48	0	2
			1997	0	0	44	2	1	0	0	3	0	0	46	0	1
			1998	0	0	43	4	0	0	0	0	3	0	46	0	1
Martel	7	12.6	1996	47	0	0	0	0	0	0	2	1	0	41	2	4
			1997	0	0	34	5	0	0	0	8	3	0	37	0	2
			1998	0	0	29	6	1	0	0	3	11	0	33	0	3
Rioux	9	13.6	1996	44	0	0	0	0	0	0	4	2	0	44	0	0
			1997	0	0	41	2	1	0	0	0	6	0	44	0	0
			1998	0	0	39	4	0	0	0	1	6	0	43	0	0
Sagard	11	17.9	1996	0	0	38	8	0	0	0	3	1	0	43	1	2
			1997	0	0	35	8	2	0	0	1	4	0	43	0	2
			1998	0	0	36	7	1	0	0	1	5	0	42	0	2
Vance	13	12.1	1996	50	0	0	0	0	0	0	0	0	0	49	1	0

**Appendix 3.** Summary of the crown condition, tree mortality and top condition in the 53 jack pine health plots from 1996 to 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 50 jack pine trees at each location.)

Location (Township)	Plot numbe r	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
			1997	0	0	42	2	1	1	0	4	0	0	44	0	2
			1998	0	0	40	5	0	1	0	0	4	0	45	0	1
<i>Sault Ste. Marie District (cont'd)</i>																
Villeneuve	14	12.4	1996	45	0	0	0	1	0	0	3	1	0	45	0	1
			1997	0	0	30	3	0	0	0	13	4	0	32	0	1
			1998	0	0	24	5	0	0	0	4	17	0	29	0	0
Wells	17	20.6	1996	43	0	0	2	0	0	0	4	1	0	43	2	0
			1997	0	0	41	2	1	0	1	0	5	0	44	0	1
			1998	0	0	40	2	1	0	0	2	5	0	42	0	1
Winkler	18	10.2	1996	46	0	0	0	0	0	0	3	1	0	43	0	3
			1997	0	0	21	5	2	0	0	18	4	0	28	0	0
			1998	0	0	19	5	1	0	0	3	22	0	24	1	0
<i>Sudbury District</i>																
Allen	20	16.3	1996	0	0	20	9	6	0	2	3	10	0	25	0	12
			1997	0	0	8	22	5	1	0	1	13	0	22	0	14
			1998	0	0	16	13	4	0	0	3	14	0	21	1	11

**Appendix 3.** Summary of the crown condition, tree mortality and top condition in the 53 jack pine health plots from 1996 to 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 50 jack pine trees at each location.)

Location (Township)	Plot numbe r	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Antrim	21	19.9	1996	44	0	0	0	0	1	0	2	3	0	44	0	1
			1997	1	0	39	3	1	0	0	1	5	0	44	0	0
			1998	0	0	42	1	0	0	0	1	6	0	42	0	1
<i>Sudbury District (cont'd)</i>																
Aylmer	22	22.5	1996	13	0	12	5	0	0	0	12	8	0	2	0	28
			1997	0	0	1	21	0	0	0	8	20	0	0	0	22
			1998	0	0	16	6	0	0	0	0	28	0	5	0	17
Cartier	23	22.1	1996	41	0	2	4	0	0	0	0	3	0	46	0	1
			1997	0	0	41	5	0	0	0	1	3	0	45	0	1
			1998	1	0	38	6	1	0	0	0	4	0	45	1	0
Cartier	24	22.4	1996	42	0	4	2	1	0	0	0	1	0	47	0	2
			1997	0	0	23	21	2	0	0	3	1	0	41	0	5
			1998	1	0	42	0	2	0	0	1	4	0	44	0	1
Dunlop	26	12.6	1996	49	0	0	0	0	0	0	1	0	0	48	0	1
			1997	0	0	48	0	0	0	0	1	1	0	47	0	1

**Appendix 3.** Summary of the crown condition, tree mortality and top condition in the 53 jack pine health plots from 1996 to 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 50 jack pine trees at each location.)

Location (Township)	Plot numbe r	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Ermatinger	28	18.0	1998	0	0	48	0	0	0	0	0	2	0	48	0	0
			1996	46	0	0	0	0	0	0	1	3	0	41	1	4
			1997	0	0	39	3	4	0	0	0	4	0	41	0	5
			1998	0	0	43	0	2	0	0	1	4	0	42	3	0
<i>Sudbury District (cont'd)</i>																
Ermatinger	29	19.4	1996	45	0	0	1	0	0	0	2	2	0	46	0	0
			1997	0	0	40	3	1	1	0	1	4	0	44	0	1
			1998	0	0	42	0	1	0	0	2	5	0	40	0	3
Hart	31	5.8	1996	44	3	1	1	0	0	0	0	0	1	48	1	0
			1997	0	0	39	9	1	0	0	0	0	1	46	0	3
			1998	0	0	40	8	0	1	0	0	0	1	49	0	0
Hart	33	15.9	1996	46	0	0	0	0	0	0	2	2	0	45	0	1
			1997	0	0	42	3	0	0	0	1	4	0	43	1	1
			1998	0	0	43	2	0	0	0	0	5	0	44	0	1
Hutton	34	21.2	1996	44	0	1	2	0	0	0	3	0	43	1	3	

**Appendix 3.** Summary of the crown condition, tree mortality and top condition in the 53 jack pine health plots from 1996 to 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 50 jack pine trees at each location.)

Location (Township)	Plot numbe r	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top			
				1	2	3	4	5	6	7	New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead	
				Number of trees													
Lefebvre	35	13.8	1997	0	0	32	12	2	0	0	1	3	0	42	0	4	
			1998	2	0	38	3	0	1	0	2	4	0	43	0	1	
			1996	50	0	0	0	0	0	0	0	0	0	0	50	0	0
			1997	0	0	48	1	0	0	0	0	1	0	0	49	0	0
			1998	0	0	44	4	1	0	0	0	0	1	0	47	1	1
<i>Sudbury District (cont'd)</i>																	
Leinster	36	24.9	1996	45	0	0	1	1	0	0	1	2	0	44	0	3	
			1997	0	0	33	11	2	0	0	1	3	0	43	0	3	
			1998	0	0	34	2	1	0	1	0	4	8	36	0	2	
Moncrieff	38	4.5	1996	39	2	4	1	1	2	0	1	0	0	47	2	0	
			1997	0	0	27	14	2	1	0	5	1	0	39	1	4	
			1998	0	0	23	17	0	0	3	1	6	0	40	0	3	
Moncrieff (plot cut '98)	39	26.8	1996	45	0	0	0	1	0	0	0	1	3	45	0	1	
			1997	0	0	43	2	1	0	0	0	1	3	45	0	1	
			1998	0	0	0	0	0	0	0	0	1	49	0	0	0	

**Appendix 3.** Summary of the crown condition, tree mortality and top condition in the 53 jack pine health plots from 1996 to 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 50 jack pine trees at each location.)

Location (Township)	Plot numbe r	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Monestime	40	18.0	1996	47	0	0	0	0	0	0	3	0	0	32	0	15
			1997	0	0	38	5	3	0	1	0	3	0	35	0	12
			1998	0	0	37	4	4	0	0	2	3	0	33	0	12
Moses	41	8.9	1996	50	0	0	0	0	0	0	0	0	0	47	3	0
			1997	0	0	49	0	1	0	0	0	0	0	48	0	2
			1998	0	0	47	2	0	0	0	1	0	0	49	0	0
<i>Sudbury District (cont'd)</i>																
Moses	42	23.8	1996	44	0	0	0	0	0	0	2	4	0	42	0	2
			1997	0	0	36	4	3	0	0	1	6	0	39	0	4
			1998	0	0	40	2	0	0	0	1	7	0	39	0	3
Moses	43	10.8	1996	44	0	0	0	0	0	0	4	2	0	43	1	0
			1997	0	0	41	1	0	0	1	1	6	0	42	1	0
			1998	0	0	42	1	0	0	0	1	6	0	43	0	0
Olinyk	46	25.8	1996	46	0	0	0	0	0	2	0	2	0	45	0	3
			1997	0	0	41	4	0	0	0	3	2	0	45	0	0

**Appendix 3.** Summary of the crown condition, tree mortality and top condition in the 53 jack pine health plots from 1996 to 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 50 jack pine trees at each location.)

Location (Township)	Plot number	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Olinyk	47	24.0	1998	0	0	43	2	0	0	0	0	5	0	45	0	0
			1996	50	0	0	0	0	0	0	0	0	0	47	0	3
			1997	0	0	46	1	0	0	2	1	0	0	45	0	4
Prescott	48	19.9	1998	0	0	47	1	0	0	0	1	1	0	46	0	2
			1996	46	0	0	0	0	0	0	1	3	0	37	0	9
			1997	0	0	36	5	1	1	1	2	4	0	39	1	4
			1998	0	0	34	6	1	0	0	3	6	0	38	0	3
<i>Sudbury District (cont'd)</i>																
Rhodes	51	16.0	1996	45	0	3	0	0	0	0	0	2	0	46	1	1
			1997	0	0	29	16	2	0	0	1	2	0	44	0	3
			1998	0	0	39	8	0	0	0	0	3	0	43	0	4
Rowat	52	18.1	1996	47	0	0	0	0	0	0	2	1	0	47	0	0
			1997	0	0	39	4	0	0	0	4	3	0	41	2	0
			1998	0	0	39	2	0	0	0	2	7	0	41	0	0
Scadding	54	14.0	1996	42	0	0	0	0	0	1	2	5	0	42	0	1



**Appendix 3.** Summary of the crown condition, tree mortality and top condition in the 53 jack pine health plots from 1996 to 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 50 jack pine trees at each location.)

Location (Township)	Plot numbe r	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Scollard	57	9.8	1997	0	0	34	7	1	0	0	1	7	0	37	0	5
			1998	4	0	32	5	0	0	0	1	8	0	41	0	0
			1996	0	0	25	10	3	1	2	5	4	0	40	0	1
			1997	0	0	20	14	3	2	0	2	9	0	36	1	2
			1998	0	0	25	10	1	0	0	3	11	0	35	0	1
Street	59	11.9	1996	48	0	1	0	0	0	0	1	0	0	48	1	0
			1997	2	0	43	4	0	0	0	0	1	0	48	1	0
			1998	4	0	44	1	0	0	0	0	1	0	49	0	0
<i>Sudbury District (cont'd)</i>																
Teasdale	60	14.5	1996	49	0	0	0	0	0	0	1	0	0	48	0	1
			1997	0	0	45	3	0	0	0	1	1	0	47	0	1
			1998	0	0	45	3	0	0	0	0	2	0	47	0	1
Teasdale	61	22.5	1996	47	0	0	0	0	0	0	3	0	0	45	0	2
			1997	0	0	44	2	0	1	0	0	3	0	45	0	2
			1998	0	0	43	3	0	0	0	1	3	0	46	0	0

**Appendix 3.** Summary of the crown condition, tree mortality and top condition in the 53 jack pine health plots from 1996 to 1998 in the Northeast Region of Ontario. (Counts are based on an examination of 50 jack pine trees at each location.)

Location (Township)	Plot numbe r	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Weeks	63	14.2	1996	45	0	2	0	1	0	1	0	1	0	47	1	1
			1997	0	0	42	5	0	0	0	2	1	0	47	0	0
			1998	0	0	43	1	1	0	0	2	3	0	45	0	0
<i>Timmins District</i>																
Invergarry	82	8.5	1996	0	0	50	0	0	0	0	0	0	0	50	0	0
			1997	48	2	0	0	0	0	0	0	0	0	49	1	0
			1998	0	0	46	4	0	0	0	0	0	0	48	0	2
Macmurchy	83	19.4	1996	0	0	39	3	0	0	0	2	3	3	41	0	1
			1997	0	0	31	8	0	0	0	3	5	3	39	0	0
<i>Timmins District (cont'd)</i>																
Macmurchy (cont'd)			1998	0	0	32	4	0	1	0	2	8	3	36	0	1
Paudash	84	21.7	1996	0	0	43	4	0	0	0	1	2	0	46	1	0
			1997	0	0	41	4	0	0	0	2	3	0	43	2	0
			1998	0	0	39	3	0	0	2	1	5	0	43	0	1
Stetham	85	18.3	1996	0	0	48	2	0	0	0	0	0	50	0	0	

**Appendix 4. Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the Northeast Region of Ontario**

Location (Township)	Plot number	Average DBH (cm)	Year	Crown condition <sup>a</sup>							Cumulative mortality			Condition of top		
				Number of trees							New dead <sup>b</sup>	Old dead <sup>b</sup>	Trees cut	Live	Bare	Dead
				1	2	3	4	5	6	7						
Westbrook	87	16.8	1997	0	0	47	3	0	0	0	0	0	0	50	0	0
			1998	0	0	46	1	2	0	1	0	0	0	50	0	0
			1996	0	0	42	2	0	0	0	3	3	0	39	1	4
			1997	0	0	37	5	0	0	0	2	6	0	39	3	0
Westbrook	89	5.7	1998	0	0	30	7	0	2	0	3	8	0	36	0	3
			1996	0	0	32	7	2	0	0	5	4	0	33	3	5
			1997	0	0	31	2	4	0	0	4	9	0	32	2	3
			1998	0	0	26	8	0	1	0	2	13	0	31	0	4

<sup>a</sup> 1 = no defoliation; 2 = only current foliage defoliated less than 25 percent; 3 = current and/or some older foliage defoliated less than 25 percent; 4 = 25–50 percent defoliation; 5 = 51–75 percent defoliation; 6 = 76–90 percent defoliation; and 7 = more than 90 percent defoliation.

<sup>b</sup> Tree mortality resulting from natural causes.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				Number of trees							New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				1	2	3	4	5	6	7						
<b>Chapleau District</b>																
Birch (47)	bF	19.7	1996	0	0	11	0	0	0	0	0	7	0	11	0	0
			1997	0	0	11	0	0	0	0	0	7	0	11	0	0
			1998	0	0	11	0	0	0	0	0	7	0	11	0	0
	wS	24.6	1996	0	0	16	0	0	0	0	0	6	0	16	0	0

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top				
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead		
				Number of trees														
Dupuis (49)	bS	24.5	1997	0	0	15	0	0	0	0	1	6	0	15	0	0		
			1998	0	0	15	0	0	0	0	0	7	0	15	0	0		
			1996	0	0	2	0	0	0	0	0	0	0	0	2	0	0	
			1997	0	0	2	0	0	0	0	0	0	0	0	2	0	0	
			1998	0	0	1	1	0	0	0	0	0	0	0	2	0	0	
	bF	11.3	1996	3	0	24	0	0	0	0	0	5	0	27	0	0		
			1997	0	0	27	0	0	0	0	0	5	0	27	0	0		
			1998	0	0	27	0	0	0	0	0	5	0	27	0	0		
			wS	19.8	1996	1	0	1	0	0	0	0	0	0	0	2	0	0
					1997	0	0	2	0	0	0	0	0	0	0	2	0	0
			1998	0	0	2	0	0	0	0	0	0	2	0	0			
<i>Chapleau District (cont'd)</i>																		
Dupuis (49) (cont'd)	bS	23.3	1996	3	0	15	0	0	0	0	1	2	0	17	0	1		
			1997	0	0	18	0	0	0	0	0	3	0	18	0	0		
			1998	0	0	18	0	0	0	0	0	3	0	18	0	0		

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Ivanhoe (51)	bF	14.6	1996	0	1	50	0	0	0	0	1	28	0	49	2	0
			1997	0	0	49	0	0	0	0	2	29	0	47	2	0
			1998	0	0	48	1	0	0	0	0	31	0	48	1	0
	wS	32.1	1996	0	0	1	0	0	0	0	0	0	0	1	0	0
			1997	0	0	1	0	0	0	0	0	0	0	1	0	0
			1998	0	0	1	0	0	0	0	0	0	0	1	0	0
	bS	18.1	1996	0	0	1	0	0	0	0	0	0	0	1	0	0
			1997	0	0	1	0	0	0	0	0	0	0	1	0	0
			1998	0	0	1	0	0	0	0	0	0	0	1	0	0
Neelands (52)	bF	10.5	1996	0	0	20	2	0	0	0	0	14	0	20	2	0
			1997	0	0	14	3	1	1	0	3	14	0	17	0	2
			1998	0	0	14	1	1	0	0	3	17	0	16	0	0
<i>Chapleau District (cont'd)</i>																
Neelands (52) (cont'd)	wS	20.7	1996	0	0	9	0	0	0	0	0	0	0	9	0	0
			1997	0	0	9	0	0	0	0	0	0	0	9	0	0

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top			
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead	
				Number of trees													
Peters (53)	bS	20.5	1998	0	0	9	0	0	0	0	0	0	0	9	0	0	
			1996	0	0	9	1	0	0	0	0	0	0	0	10	0	0
			1997	0	0	10	0	0	0	0	0	0	0	0	10	0	0
	bF	14.7	1998	0	0	10	0	0	0	0	0	0	0	0	10	0	0
			1996	0	0	25	0	0	0	0	0	1	3	0	23	2	0
			1997	0	0	24	0	0	0	0	0	1	4	0	24	0	0
	wS	22.5	1998	0	0	24	0	0	0	0	0	0	5	0	24	0	0
			1996	2	0	4	0	0	0	0	0	0	5	0	6	0	0
			1997	0	0	6	0	0	0	0	0	0	5	0	6	0	0
Sandy (55)	bF	12.3	1998	0	0	6	0	0	0	0	0	5	0	6	0	0	
			1996	0	0	30	1	0	0	0	0	0	3	0	31	0	0
			1997	0	0	28	1	0	1	0	1	1	3	0	29	0	1
Sandy (55)	bF	12.3	1998	0	0	30	0	0	0	0	0	4	0	30	0	0	
			1996	0	0	30	1	0	0	0	0	0	3	0	31	0	0
			1997	0	0	28	1	0	1	0	1	1	3	0	29	0	1
<i>Chapleau District (cont'd)</i>																	
Sandy (55) (cont'd)	wS	24.8	1996	0	1	17	0	0	0	0	0	1	0	18	0	0	

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
Shipley (56)	bS	23.5	1997	0	0	18	0	0	0	0	0	1	0	18	0	0
			1998	0	0	18	0	0	0	0	0	1	0	18	0	0
			1996	0	0	3	0	0	0	0	0	0	0	3	0	0
			1997	0	0	3	0	0	0	0	0	0	0	3	0	0
			1998	0	0	3	0	0	0	0	0	0	0	3	0	0
			1996	0	0	25	0	0	0	0	0	0	0	25	0	0
	bF	15.7	1997	0	0	23	2	0	0	0	0	0	0	23	0	2
			1998	0	0	23	1	0	0	0	1	0	0	23	0	1
			1996	0	0	14	0	0	0	0	0	0	0	14	0	0
			1997	0	0	14	0	0	0	0	0	0	0	14	0	0
			1998	0	0	14	0	0	0	0	0	0	0	14	0	0
			1996	0	0	2	0	0	0	0	0	0	0	2	0	0
wS	23.7	1997	0	0	2	0	0	0	0	0	0	2	0	0		
		1998	0	0	2	0	0	0	0	0	0	2	0	0		
		1996	0	0	2	0	0	0	0	0	0	2	0	0		

*Cochrane District*

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top			
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead	
				Number of trees													
Dempsay (57)	bF	13.0	1996	45	0	0	0	0	0	0	0	1	3	0	45	0	0
			1997	1	0	42	1	0	0	0	1	4	0	44	0	0	
			1998	0	0	38	2	1	0	1	2	5	0	41	1	0	
	wS	16.3	1996	2	0	0	0	0	0	0	0	0	0	0	2	0	0
			1997	0	0	2	0	0	0	0	0	0	0	2	0	0	
			1998	0	0	2	0	0	0	0	0	0	0	2	0	0	
	bS	17.4	1996	6	0	0	0	0	0	0	0	0	0	0	6	0	0
			1997	0	0	6	0	0	0	0	0	0	0	6	0	0	
			1998	0	0	6	0	0	0	0	0	0	0	6	0	0	
Homuth (59)	bF	19.0	1996	72	0	0	0	0	0	0	4	9	0	72	0	0	
			1997	4	0	64	2	0	0	0	2	13	0	70	0	0	
			1998	0	0	66	2	0	0	0	2	15	0	68	0	0	
	wS	20.7	1996	3	0	0	0	0	0	0	0	0	0	3	0	0	
			1997	1	0	2	0	0	0	0	0	0	0	3	0	0	
			1998	0	0	3	0	0	0	0	0	0	0	3	0	0	



**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top			
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead	
				Number of trees													
<b><i>Cochrane District</i></b> (cont'd)																	
Homuth (59) (cont'd)	bS	15.3	1996	3	0	0	0	0	0	0	0	0	0	3	0	0	
			1997	2	0	1	0	0	0	0	0	0	0	0	3	0	0
			1998	0	0	3	0	0	0	0	0	0	0	0	3	0	0
Nesbitt (61)	bF	13.6	1996	51	0	0	0	0	0	0	1	5	0	51	0	0	
			1997	6	0	40	3	2	0	0	0	6	0	51	0	0	
			1998	0	0	40	7	0	0	1	3	6	0	48	0	0	
	wS	14.0	1996	8	0	0	0	0	0	0	0	0	0	8	0	0	
			1997	1	2	5	0	0	0	0	0	0	0	8	0	0	
			1998	0	0	8	0	0	0	0	0	0	0	8	0	0	
<b><i>Hearst District</i></b>																	
Ford (64)	bF	12.0	1996	54	0	0	0	0	0	0	1	5	0	54	0	0	
			1997	0	0	54	0	0	0	0	0	6	0	54	0	0	
			1998	0	0	52	1	0	0	0	1	6	0	52	0	1	
wS	15.6	1996	7	0	0	0	0	0	0	0	0	0	7	0	0		

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top							
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead					
				Number of trees																	
			1997	2	0	5	0	0	0	0	0	0	0	7	0	0					
<i>Hearst District (cont'd)</i>																					
Ford (64) (cont'd)			1998	0	0	6	1	0	0	0	0	0	0	7	0	0					
Frost (66)			1996	bF	17.8	0	0	9	12	0	0	0	15	32	0	15	6	0			
						1997	0	3	7	8	0	0	0	3	47	0	13	5	0		
						1998	0	0	11	2	0	2	1	2	50	0	12	0	4		
						1996	wS	41.5	0	0	1	4	0	0	0	1	0	5	0	0	
									1997	0	0	1	4	0	0	0	1	0	5	0	0
									1998	0	0	3	2	0	0	0	1	0	5	0	0
Hanlan (69)			1996	bF	13.6	14	0	0	0	0	0	0	24	0	14	0	0				
						1997	2	0	11	1	0	0	0	24	0	14	0	0			
						1998	0	0	14	0	0	0	0	24	0	14	0	0			
						1996	wS	16.7	9	0	0	0	0	0	0	0	9	0	0		
									1997	2	0	7	0	0	0	0	0	9	0	0	
									1998	0	0	9	0	0	0	0	0	9	0	0	

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top			
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead	
Landry (70)	bF	17.9	1996	44	0	0	0	0	0	0	1	8	0	44	0	0	
			1997	6	0	38	0	0	0	0	0	0	9	0	44	0	0
<i>Hearst District (cont'd)</i>																	
Landry (70) (cont'd)	wS	38.0	1998	0	0	44	0	0	0	0	0	9	0	44	0	0	
			1996	1	0	0	0	0	0	0	0	0	0	0	1	0	0
			1997	1	0	0	0	0	0	0	0	0	0	0	1	0	0
	bS	16.2	1998	0	0	1	0	0	0	0	0	0	0	0	1	0	0
			1996	6	0	0	0	0	0	0	0	0	0	0	6	0	0
			1997	3	0	3	0	0	0	0	0	0	0	0	6	0	0
Oscar (74)	bF	16.8	1998	0	0	6	0	0	0	0	0	0	0	6	0	0	
			1996	26	0	0	0	0	0	0	0	0	12	0	26	0	0
			1997	5	0	21	0	0	0	0	0	0	12	0	26	0	0
	wS	28.2	1998	0	0	24	2	0	0	0	0	0	12	0	26	0	0
			1996	17	0	0	0	0	0	0	0	0	3	0	17	0	0
			1997	12	0	5	0	0	0	0	0	3	0	17	0	0	

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Pearce (75)	bF	22.1	1998	0	0	17	0	0	0	0	0	3	0	17	0	0
			1996	46	0	0	0	0	0	0	1	10	0	46	0	0
			1997	5	0	39	0	0	0	0	2	11	0	44	0	0
<i>Hearst District (cont'd)</i>																
Pearce (75) (cont'd)	wS	31.3	1998	0	0	40	3	0	0	0	1	13	0	43	0	0
			1996	5	0	0	0	0	0	0	0	0	0	5	0	0
			1997	4	0	1	0	0	0	0	0	0	0	5	0	0
Ritchie (77)	bF	18.8	1998	0	0	5	0	0	0	0	0	0	0	5	0	0
			1996	19	0	0	0	0	0	0	1	5	0	19	0	0
			1997	0	0	20	0	0	0	0	0	6	0	20	0	0
	wS	24.4	1998	0	0	17	2	0	0	0	1	6	0	19	0	0
			1996	6	0	0	0	0	0	0	1	0	0	6	0	0
			1997	0	0	6	0	0	0	0	0	1	0	6	0	0
bS	14.3	1998	0	0	6	0	0	0	0	0	1	0	6	0	0	
		1996	19	0	0	0	0	0	0	1	3	0	19	0	0	

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
Rogers (78)	bF	17.6	1997	1	0	17	0	0	0	0	1	4	0	18	0	0
			1998	0	0	16	1	0	0	0	1	5	0	17	0	0
			1996	0	0	6	28	7	2	0	1	1	0	35	7	1
			1997	0	0	6	28	8	1	0	0	2	0	40	3	0
<i>Hearst District (cont'd)</i>																
Rogers (78) (cont'd)	wS	23.1	1998	0	0	25	11	3	2	0	2	2	0	40	0	1
1996			0	0	8	4	1	1	0	0	0	0	12	2	0	
1997			0	0	8	3	1	1	1	0	0	0	13	1	0	
1998			0	0	11	1	1	0	1	0	0	0	14	0	0	
Shearer (80)	bF	13.5	1996	70	0	0	0	0	0	0	0	1	0	70	0	0
			1997	37	0	33	0	0	0	0	0	1	0	70	0	0
			1998	0	0	66	4	0	0	0	0	1	0	69	1	0
	wS	14.9	1996	7	0	0	0	0	0	0	0	0	0	7	0	0
			1997	7	0	0	0	0	0	0	0	0	0	7	0	0
			1998	0	0	7	0	0	0	0	0	0	0	7	0	0

**Appendix 4. Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.**

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
<b><i>Kirkland Lake District</i></b>																
Boston (87)	bF	17.3	1996	0	0	18	0	0	0	0	1	11	0	18	0	0
			1997	0	0	12	6	0	0	0	0	12	0	17	0	1
			1998	0	0	14	1	0	0	0	0	12	0	18	0	0
	wS	25.6	1996	0	0	15	0	0	0	0	0	0	14	1	0	
<b><i>Kirkland Lake District (cont'd)</i></b>																
Boston (87) (cont'd)			1997	1	0	12	2	0	0	0	0	0	0	15	0	0
			1998	0	0	14	1	0	0	0	0	0	0	15	0	0
Lamplugh (89)	bF	15.9	1996	0	0	21	1	1	0	0	2	8	0	22	0	1
			1997	0	0	18	4	0	1	0	0	10	0	21	0	2
			1998	1	0	19	1	0	1	0	1	10	0	20	1	1
	wS	28.0	1996	0	0	4	1	0	0	0	0	0	0	5	0	0
1997			2	0	2	1	0	0	0	0	0	0	5	0	0	
1998			0	0	4	0	0	0	0	1	0	0	4	0	0	
	bS	16.0	1996	0	0	13	1	1	0	0	1	2	0	14	0	1

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Maisonville (90)	bF	15.1	1997	0	0	12	2	1	0	0	0	3	0	15	0	0
			1998	0	0	12	1	1	0	0	1	3	0	13	0	1
			1996	0	0	12	1	0	0	0	0	16	0	13	0	0
	wS	18.6	1997	2	0	10	1	0	0	0	0	16	0	13	0	0
			1998	1	0	9	2	0	0	0	1	16	0	12	0	0
			1996	0	0	4	0	0	0	0	0	1	0	4	0	0
<i>Kirkland Lake District (cont'd)</i>																
Maisonville (90) (cont'd)	bS	17.9	1997	0	0	4	0	0	0	0	0	1	0	4	0	0
			1998	0	0	3	1	0	0	0	0	1	0	4	0	0
			1996	0	0	22	0	0	0	0	0	3	0	21	1	0
	bF	15.5	1997	1	0	20	0	1	0	0	0	3	0	22	0	0
			1998	1	0	17	3	0	0	0	1	3	0	21	0	0
			1996	0	0	32	0	0	0	0	1	4	0	32	0	0
Tyrrell (92)	bF	15.5	1997	2	0	27	3	0	0	0	0	5	0	32	0	0
			1998	1	0	30	1	0	0	0	0	5	0	32	0	0

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
	wS	23.0	1996	0	0	1	0	0	0	0	0	0	0	1	0	0
			1997	0	0	1	0	0	0	0	0	0	0	1	0	0
			1998	0	0	1	0	0	0	0	0	0	0	1	0	0
	bS	16.8	1996	0	0	5	0	0	0	0	0	0	0	5	0	0
			1997	1	0	4	0	0	0	0	0	0	0	4	0	1
			1998	1	0	4	0	0	0	0	0	0	0	4	0	1
<i>North Bay District</i>																
Hugel (11)	bF	12.7	1996	0	3	24	6	1	0	0	0	11	0	27	3	4
			1997	0	0	16	16	2	0	0	0	11	0	31	1	2
			1998	0	0	10	15	9	0	0	0	11	0	32	1	1
	wS	20.5	1996	0	0	5	1	1	0	0	0	1	0	5	0	2
			1997	0	0	5	1	1	0	0	0	1	0	5	0	2
			1998	0	0	3	3	1	0	0	0	1	0	7	0	0
	bS	23.3	1996	0	2	1	0	0	0	0	0	0	0	3	0	0



**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top			
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead	
Jocko (12)	bF	16.8	1997	0	0	2	1	0	0	0	0	0	0	3	0	0	
			1998	0	0	3	0	0	0	0	0	0	0	3	0	0	
			1996	10	0	0	0	0	0	0	0	0	0	10	0	0	
			1997	2	0	7	1	0	0	0	0	0	0	10	0	0	
	wS	22.5	1996	12	0	0	0	0	0	0	0	0	1	0	12	0	0
			1997	0	0	11	1	0	0	0	0	0	1	0	12	0	0
			1998	7	5	0	0	0	0	0	0	0	1	0	12	0	0
			<i>North Bay District (cont'd)</i>														
Jocko (12)(cont'd)	bS	18.6	1996	21	0	0	0	0	0	0	1	3	0	21	0	0	
			1997	0	0	18	3	0	0	0	0	0	4	0	21	0	0
			1998	20	0	1	0	0	0	0	0	0	4	0	21	0	0
Strathcona (46)	bF	10.7	1996	27	0	0	0	0	0	0	0	5	0	26	0	1	
			1997	3	0	21	1	2	0	0	0	0	5	0	27	0	0
			1998	10	0	13	1	1	1	0	1	1	5	0	26	0	0

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Thistle (14)	wS	19.4	1996	19	0	0	0	0	0	0	0	1	0	19	0	0
			1997	1	0	13	4	1	0	0	0	1	0	19	0	0
			1998	3	0	11	5	0	0	0	0	1	0	19	0	0
	bF	14.2	1996	39	0	0	0	0	0	0	0	2	0	37	1	1
			1997	0	0	38	0	0	0	0	1	2	0	34	3	1
			1998	7	0	30	1	0	0	0	0	3	0	38	0	0
	wS	23.6	1996	8	0	0	0	0	0	0	0	0	0	8	0	0
			1997	1	0	8	0	0	0	0	0	0	0	9	0	0
			1998	1	0	8	0	0	0	0	0	0	0	9	0	0
<i>Sault Ste. Marie District</i>																
Asselin (24)	bF	24.1	1996	6	0	0	1	0	0	1	0	7	0	7	1	0
			1997	0	0	5	0	0	0	0	3	7	0	5	0	0
			1998	0	0	5	0	0	0	0	0	10	0	5	0	0
	wS	25.7	1996	40	0	0	0	0	0	0	0	2	0	40	0	0
			1997	0	0	39	1	0	0	0	0	2	0	40	0	0

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top			
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead	
				Number of trees													
Bridgland (26)	bF	19.6	1998	1	0	38	1	0	0	0	0	2	0	40	0	0	
			1996	20	0	0	0	0	0	0	0	7	0	20	0	0	
			1997	0	0	19	1	0	0	0	0	7	0	20	0	0	
	wS	26.1	1998	0	0	19	0	0	0	0	1	7	0	19	0	0	
			1996	10	0	0	0	0	0	0	0	0	0	10	0	0	
			1997	0	0	9	1	0	0	0	0	0	0	10	0	0	
		bS	21.0	1998	0	0	9	1	0	0	0	0	0	0	10	0	0
				1996	20	0	0	0	0	0	0	0	2	0	20	0	0
				1997	0	0	20	0	0	0	0	0	2	0	20	0	0
1998		1998	0	0	20	0	0	0	0	0	2	0	20	0	0		
<i>Sault Ste. Marie District (cont'd)</i>																	
Herrick (27)	bF	15.8	1996	22	0	0	0	0	0	0	1	9	0	22	0	0	
			1997	0	0	19	1	0	0	0	2	10	0	20	0	0	
			1998	0	0	18	1	0	0	0	1	12	0	19	0	0	
	wS	17.3	1996	6	0	0	0	0	0	0	0	0	0	6	0	0	

**Appendix 4. Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.**

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top			
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead	
				Number of trees													
Jollineau (28)	bS	18.8	1997	0	0	6	0	0	0	0	0	0	0	6	0	0	
			1998	0	0	6	0	0	0	0	0	0	0	0	6	0	0
			1996	9	0	0	0	0	0	0	0	2	1	0	9	0	0
			1997	0	0	9	0	0	0	0	0	0	3	0	9	0	0
			1998	0	0	9	0	0	0	0	0	0	3	0	9	0	0
			1996	16	0	0	0	0	0	0	0	1	13	0	16	0	0
	bF	16.0	1997	0	0	12	3	0	1	0	0	0	14	0	15	0	1
			1998	0	0	12	3	0	0	0	0	1	14	0	15	0	0
			1996	19	0	0	0	0	0	0	0	0	2	0	19	0	0
			1997	0	0	16	1	1	0	0	0	1	2	0	18	0	0
			1998	0	0	17	0	1	0	0	0	0	3	0	18	0	0
			1996	19	0	0	0	0	0	0	0	0	2	0	19	0	0
Jollineau (28) (cont'd)	bS	24.6	1996	9	0	0	0	0	0	0	0	0	0	9	0	0	
			1997	0	0	9	0	0	0	0	0	0	0	0	9	0	0
			1998	0	0	9	0	0	0	0	0	0	0	0	9	0	0

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top			
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead	
				Number of trees													
Lewis (31)	bF	12.1	1996	31	0	0	0	0	0	0	0	3	13	0	30	1	0
			1997	0	0	29	1	1	0	0	0	0	16	0	31	0	0
			1998	0	0	28	2	0	0	0	0	1	16	0	30	0	0
	wS	28.5	1996	3	10	0	0	0	0	0	0	0	0	0	13	0	0
			1997	0	0	11	2	0	0	0	0	0	0	0	13	0	0
			1998	0	0	11	2	0	0	0	0	0	0	0	13	0	0
	bS	16.0	1996	1	0	0	0	0	0	0	0	0	0	0	1	0	0
			1997	0	0	1	0	0	0	0	0	0	0	0	1	0	0
			1998	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Peever (32)	bF	16.3	1996	24	0	0	0	0	0	0	0	3	22	0	23	1	0
			1997	0	0	15	5	0	0	0	0	4	25	0	19	0	1
			1998	0	0	12	6	0	0	0	0	2	29	0	17	0	1
<i>Sault Ste. Marie District (cont'd)</i>																	
Peever (32) (cont'd)	wS	26.2	1996	10	0	0	0	0	0	0	0	0	0	0	10	0	0
			1997	0	0	9	1	0	0	0	0	0	0	0	10	0	0

**Appendix 4. Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.**

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top				
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead		
				Number of trees														
Shields (33)	bS	19.9	1998	0	0	7	3	0	0	0	0	0	0	10	0	0		
			1996	17	0	0	0	0	0	0	0	0	1	0	17	0	0	
			1997	0	0	17	0	0	0	0	0	0	0	1	0	17	0	0
	bF	22.0	1998	0	0	17	0	0	0	0	0	0	1	0	17	0	0	
			1996	6	0	0	0	0	1	0	0	0	0	0	6	0	1	
			1997	0	0	6	0	0	0	0	0	1	0	0	6	0	0	
		wS	24.6	1998	0	0	6	0	0	0	0	0	1	0	6	0	0	
				1996	47	0	0	0	0	0	0	0	0	0	0	47	0	0
				1997	0	0	43	4	0	0	0	0	0	0	0	46	0	1
Villeneuve (34)	bF	13.9	1998	0	0	44	3	0	0	0	0	0	0	47	0	0		
			1996	31	0	0	0	0	0	1	0	7	0	31	1	0		
			1997	0	0	29	1	1	0	0	1	7	0	31	0	0		
Sault Ste. Marie District (cont'd)	wS	14.3	1998	0	0	28	2	0	0	0	1	8	0	30	0	0		
			1996	6	0	0	0	0	0	0	0	0	0	6	0	0		
			1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
			1997	0	0	5	1	0	0	0	0	0	0	6	0	0
			1998	0	0	5	1	0	0	0	0	0	0	6	0	0
	bS	13.7	1996	9	0	0	0	0	0	0	0	0	0	9	0	0
			1997	0	0	9	0	0	0	0	0	0	0	9	0	0
			1998	0	0	8	0	0	0	1	0	0	0	8	1	0
<b><i>Sudbury District</i></b>																
Killarney (39)	bF	10.6	1996	43	0	0	0	0	1	0	0	4	0	42	2	0
			1997	3	0	32	7	0	1	0	1	4	0	43	0	0
			1998	3	0	34	2	0	0	0	4	5	0	39	0	0
	wS	21.2	1996	2	0	0	0	0	0	0	0	0	0	2	0	0
			1997	0	0	2	0	0	0	0	0	0	0	2	0	0
			1998	0	0	1	1	0	0	0	0	0	0	2	0	0
Nairn (40)	bF	17.1	1996	35	0	0	0	0	0	0	2	6	0	35	0	0
			1997	0	0	27	4	1	0	0	3	8	0	31	0	1

***Sudbury District*** (cont'd)

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Nairn (40) (cont'd)	wS	24.1	1998	0	0	29	0	1	0	0	2	11	0	30	0	0
			1996	15	0	0	0	0	0	0	0	0	0	15	0	0
			1997	2	0	13	0	0	0	0	0	0	0	14	1	0
			1998	0	0	13	2	0	0	0	0	0	0	15	0	0
Parkin (41)	bF	8.1	1996	41	0	0	0	0	0	0	0	1	0	41	0	0
			1997	5	0	33	2	0	0	0	2	1	0	40	0	0
			1998	10	0	30	0	0	0	0	0	3	0	40	0	0
	wS	16.5	1996	6	0	3	0	0	0	0	0	0	0	9	0	0
			1997	3	0	6	0	0	0	0	0	0	0	9	0	0
			1998	6	0	3	0	0	0	0	0	0	0	9	0	0
	bS	9.0	1996	2	0	0	0	0	0	0	0	0	0	2	0	0
			1997	1	0	1	0	0	0	0	0	0	0	2	0	0
			1998	0	0	2	0	0	0	0	0	0	0	2	0	0
Servos (43)	bF	12.2	1996	30	0	0	0	0	0	0	1	5	0	30	0	0
			1997	1	0	28	1	0	0	0	0	0	6	0	30	0



**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
<i>Sudbury District (cont'd)</i>																
Servos (43) (cont'd)	wS	17.8	1998	0	0	30	0	0	0	0	0	6	0	30	0	0
			1996	8	1	2	1	0	0	0	0	1	0	12	0	0
			1997	1	0	7	4	0	0	0	0	1	0	12	0	0
	bS	16.0	1998	1	0	10	1	0	0	0	0	1	0	12	0	0
			1996	4	0	0	0	0	0	0	0	0	0	4	0	0
			1997	0	0	4	0	0	0	0	0	0	0	4	0	0
Weeks (44)	bF	12.4	1998	0	0	4	0	0	0	0	0	0	0	4	0	0
			1996	39	0	0	0	0	0	0	1	3	0	38	0	1
			1997	0	0	38	1	0	0	0	0	4	0	39	0	0
	wS	18.0	1998	0	0	37	1	1	0	0	0	4	0	38	0	1
			1996	1	0	0	0	0	0	0	0	0	0	1	0	0
			1997	0	0	1	0	0	0	0	0	0	0	1	0	0
1998	0	0	1	0	0	0	0	0	0	0	1	0	0			

*Timmins District*

**Appendix 4. Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.**

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
Eldorado (95)	bF	13.4	1996	0	0	15	2	0	0	0	1	13	0	17	0	0
<i>Timmins District (cont'd)</i>																
Eldorado (95) (cont'd)			1997	0	0	15	0	0	0	0	1	14	0	15	0	0
			1998	0	0	10	3	0	0	0	3	15	0	13	0	0
	wS	25.4	1996	0	0	5	0	0	0	0	0	0	0	5	0	0
			1997	0	0	5	0	0	0	0	0	0	0	5	0	0
			1998	0	0	5	0	0	0	0	0	0	0	5	0	0
	bS	15.6	1996	0	0	13	0	0	0	0	0	2	0	13	0	0
			1997	4	0	7	0	0	0	0	2	2	0	11	0	0
			1998	0	0	10	1	0	0	0	0	4	0	11	0	0
Hazen (97)	bF	13.9	1996	0	0	39	2	0	0	0	1	6	0	41	0	0
			1997	1	0	37	2	0	0	0	1	7	0	40	0	0
			1998	3	0	37	0	0	0	0	0	8	0	40	0	0
	wS	20.3	1996	0	0	3	0	0	0	0	0	0	0	3	0	0
			1997	0	0	3	0	0	0	0	0	0	0	3	0	0

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Invergarry (98)	bF	10.0	1998	1	0	2	0	0	0	0	0	0	0	3	0	0
			1996	0	0	31	0	0	0	0	1	0	0	31	0	0
<i>Timmins District (cont'd)</i>																
Invergarry (98) (cont'd)			1997	1	0	28	2	0	0	0	0	1	0	31	0	0
			1998	8	0	23	0	0	0	0	0	1	0	31	0	0
	wS	17.0	1996	0	0	4	0	0	0	0	0	0	0	4	0	0
			1997	3	0	1	0	0	0	0	0	0	0	4	0	0
			1998	1	0	3	0	0	0	0	0	0	0	4	0	0
	bS	10.4	1996	0	0	17	0	0	0	0	0	0	0	17	0	0
			1997	6	0	10	0	0	1	0	0	0	0	16	0	1
Marquette (99)	bF	12.5	1998	8	0	8	0	0	0	0	1	0	0	16	0	0
			1996	0	0	19	1	0	0	0	1	25	0	18	0	2
			1997	1	0	15	4	0	0	0	0	26	0	18	0	2
	wS	28.8	1998	2	0	15	1	1	0	0	1	26	0	18	0	1
			1996	0	0	4	0	0	0	0	0	0	0	4	0	0

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
			1997	2	0	2	0	0	0	0	0	0	0	4	0	0
			1998	0	0	4	0	0	0	0	0	0	0	4	0	0
	bS	22.0	1996	0	0	1	0	0	0	0	0	1	0	1	0	0
<i>Timmins District (cont'd)</i>																
			1997	0	0	1	0	0	0	0	0	1	0	1	0	0
			1998	0	0	1	0	0	0	0	0	0	0	1	0	0
			1996	0	0	28	0	0	1	0	0	3	0	29	0	0
			1997	5	0	22	1	0	0	0	1	3	0	27	0	1
			1998	0	0	24	3	0	0	1	0	4	0	28	0	0
	wS	25.0	1996	0	0	7	1	1	0	0	0	0	0	9	0	0
			1997	2	0	7	0	0	0	0	0	0	0	9	0	0
			1998	0	0	8	1	0	0	0	0	0	0	9	0	0
	bS	17.0	1996	0	0	11	0	0	0	0	0	0	0	11	0	0
			1997	2	0	9	0	0	0	0	0	0	0	11	0	0
			1998	0	0	11	0	0	0	0	0	0	0	11	0	0

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
Sewell (102)	bF	13.6	1996	0	0	38	0	0	0	0	0	5	0	35	2	1
			1997	4	0	34	0	0	0	0	0	5	0	35	2	1
			1998	0	0	31	6	1	0	0	0	5	0	37	0	1
	wS	31.2	1996	0	0	12	0	0	0	0	0	0	12	0	0	
<i>Timmins District (cont'd)</i>																
Sewell (102) (cont'd)	bF	13.6	1997	2	0	10	0	0	0	0	0	0	0	12	0	0
			1998	0	0	11	1	0	0	0	0	0	0	12	0	0
			bS	15.0	1996	0	0	1	0	0	0	0	0	0	1	0
	1997	0	0	1	0	0	0	0	0	0	0	0	1	0	0	
	1998	0	0	1	0	0	0	0	0	0	0	0	1	0	0	
	<i>Wawa District</i>															
Dumas (104)	bF	15.2	1996	0	0	0	39	6	0	0	1	11	0	37	8	0
			1997	0	0	23	20	1	1	0	0	12	0	40	2	3
			1998	0	0	28	13	2	1	0	1	12	0	42	0	2
	wS	23.3	1996	0	0	0	0	3	0	0	0	0	0	3	0	0

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top		
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead
				Number of trees												
			1997	0	0	0	1	2	0	0	0	0	0	3	0	0
			1998	0	0	0	2	1	0	0	0	0	0	3	0	0
	bS	12.8	1996	0	0	6	0	0	0	0	0	3	0	6	0	0
			1997	0	0	6	0	0	0	0	0	3	0	6	0	0
			1998	0	0	5	1	0	0	0	0	3	0	5	0	1
<b>Wawa District (cont'd)</b>																
Laberge (106)	bF	14.8	1996	20	0	0	0	0	0	0	1	8	0	17	1	2
			1997	0	0	20	0	0	0	0	0	9	0	20	0	0
			1998	0	0	20	0	0	0	0	0	9	0	19	1	0
	wS	7.0	1996	1	0	0	0	0	0	0	0	0	0	1	0	0
			1997	0	0	1	0	0	0	0	0	0	0	1	0	0
			1998	0	0	1	0	0	0	0	0	0	0	1	0	0
Leslie (108)	bF	18.9	1996	3	0	0	0	0	0	0	7	30	0	2	0	1
			1997	0	0	0	2	0	0	0	1	37	0	2	0	0
			1998	0	0	0	1	0	0	0	1	38	0	1	0	0

**Appendix 4.** Summary of the crown condition, tree mortality and top condition for three coniferous hosts in the 50 spruce/fir health plots from 1996 to 1998 in the in the Northeast Region of Ontario.

Location Township (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Year	Crown condition <sup>b</sup>							Cumulative tree mortality			Condition of top			
				1	2	3	4	5	6	7	New dead <sup>c</sup>	Old dead <sup>c</sup>	Trees cut	Live	Bare	Dead	
Wicksteed (110)	wS	23.4	1996	8	0	0	0	0	0	0	1	0	0	8	0	0	
			1997	0	0	8	0	0	0	0	0	0	1	0	8	0	0
			1998	0	0	7	0	0	0	0	0	1	1	0	7	0	0
	bF	15.2	1996	43	0	0	1	0	0	0	2	2	0	44	0	0	
			1997	0	0	43	0	0	0	0	1	4	0	43	0	0	
			1998	0	0	41	1	1	0	0	0	5	0	42	0	1	
<i>Wawa District (cont'd)</i>																	
Wicksteed (110)	wS	24.5	1996	2	0	0	0	0	0	0	0	0	0	2	0	0	
			1997	0	0	1	1	0	0	0	0	0	0	0	2	0	0
			1998	0	0	1	0	0	0	0	0	1	0	0	1	0	0
	bS	14.4	1996	5	0	0	0	0	0	0	0	0	0	5	0	0	
			1997	0	0	5	0	0	0	0	0	0	0	5	0	0	
			1998	0	0	5	0	0	0	0	0	0	0	5	0	0	

<sup>a</sup> bF = balsam fir, wS = white spruce, bS = black spruce.

<sup>b</sup> 1 = no defoliation; 2 = only current foliage defoliated less than 25 percent; 3 = current and/or some older foliage defoliated less than 25 percent; 4 = 25–50 percent defoliation; 5 = 51–75 percent defoliation; 6 = 76–90 percent defoliation; and 7 = more than 90 percent defoliation.

<sup>c</sup> Tree mortality resulting from natural causes.

**Appendix 5.** Summary of the crown condition and tree mortality for two deciduous hosts in 49 spruce/fir health plots for 1998 in the Northeast Region of Ontario.

Location (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Crown condition <sup>b</sup>											Cumulative mortality <sup>c</sup>		
			10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead	Trees cut
			Number of trees													
<b><i>Chapleau District</i></b>																
Birch Township (47)	wB	30.5	2	0	2	2	6	10	1	0	0	0	0	0	1	0
Dupuis Township (49)	wB	16.5	3	0	0	1	0	0	0	0	0	0	0	0	2	0
	tA	21.1	5	1	5	4	1	0	0	0	0	0	0	0	2	0
Ivanhoe Township (51)	wB	15.7	9	1	3	1	0	0	0	0	0	0	0	0	0	0
	tA	27.3	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Neelands Township (52)	wB	14.7	3	0	4	4	1	2	0	0	0	0	0	0	0	0
Peters Township (53)	wB	20.4	2	0	8	4	1	2	0	0	0	0	0	0	12	0
	tA	32.7	1	0	0	0	1	1	0	0	0	0	0	0	2	0
Sandy Township (55)	wB	14.6	4	0	5	0	1	0	0	0	0	0	0	0	0	0
	tA	27.8	0	0	1	1	0	0	0	0	0	0	0	0	0	0



**Appendix 5.** Summary of the crown condition and tree mortality for two deciduous hosts in 49 spruce/fir health plots for 1998 in the Northeast Region of Ontario.

Location (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Crown condition <sup>b</sup>											Cumulative mortality <sup>c</sup>		
			10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead	Trees cut
ShIPLEY Township (56)	wB	14.5	3	1	2	0	0	0	0	0	0	0	0	0	0	0
	tA	10.9	2	1	1	3	4	1	0	0	0	0	0	1	1	0
<i>Cochrane District</i>																
Dempsay Township (57)	wB	21.0	0	0	3	0	3	2	0	0	0	0	0	0	0	0
Homuth Township (59)	wB	20.3	0	0	0	1	5	0	0	0	0	0	0	0	0	0
Nesbitt Township (61)	wB	26.6	0	0	0	0	1	1	1	1	1	0	0	0	0	0
<i>Hearst District</i>																
Ford Township (64)	wB	18.5	0	0	0	0	4	0	0	0	0	0	0	0	0	0
	tA	21.4	0	0	0	0	5	4	0	0	0	0	0	0	0	0
Frost Township (66)	wB	32.0	0	0	0	0	0	0	0	0	0	0	0	2	1	0
	tA	31.8	0	0	0	1	3	0	0	0	0	0	0	1	0	0
Hanlan Township (69)	wB	19.1	0	0	0	4	8	0	0	0	0	0	0	1	0	0
Landry Township (70)	wB	23.0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	tA	30.1	0	0	0	1	1	0	0	3	0	0	0	1	4	0
Oscar Township (74)	wB	25.3	0	0	1	0	4	1	0	0	0	0	0	0	0	0
	tA	40.4	0	0	0	0	3	5	1	1	1	0	0	0	0	0
Pearce Township (75)	wB	28.8	0	0	0	1	2	1	0	0	0	0	0	0	0	0

**Appendix 5.** Summary of the crown condition and tree mortality for two deciduous hosts in 49 spruce/fir health plots for 1998 in the Northeast Region of Ontario.

Location (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Crown condition <sup>b</sup>											Cumulative mortality <sup>c</sup>			
			10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead	Trees cut	
			Number of trees														
	tA	24.4	0	0	0	1	6	0	0	0	0	0	0	0	0	0	0
Ritchie Township (77)	wB	14.3	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
	tA	25.7	0	0	0	2	1	0	0	0	0	1	0	0	2	0	0
Rogers Township (78)	tA	12.8	0	0	2	1	1	0	0	0	0	0	0	0	0	0	0
<i>Kirkland Lake District</i>																	
Boston Township (87)	wB	12.0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
	tA	25.4	0	0	4	3	11	0	0	0	0	0	0	0	0	0	0
<i>Kirkland Lake District (cont'd)</i>																	
Lamplugh Township (89)	wB	23.4	1	0	1	4	4	0	0	0	0	0	0	0	0	0	0
Maisonville Township (90)	wB	11.5	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0
	tA	26.5	0	0	5	0	6	1	0	0	0	0	0	1	2	0	0
Tyrrell Township (92)	wB	24.2	0	0	2	2	1	0	0	0	0	0	0	0	0	0	0
	tA	22.3	1	0	7	2	7	3	4	0	0	0	0	1	4	0	0
<i>North Bay District</i>																	
Hugel Township(11)	wB	18.8	0	0	0	1	0	0	0	0	0	0	0	0	3	0	0
	tA	31.3	0	0	2	1	5	0	1	1	0	0	0	1	2	0	0
Jocko Township (12)	wB	13.8	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0

**Appendix 5.** Summary of the crown condition and tree mortality for two deciduous hosts in 49 spruce/fir health plots for 1998 in the Northeast Region of Ontario.

Location (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Crown condition <sup>b</sup>											Cumulative mortality <sup>c</sup>		
			10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead	Trees cut
Strathcona Township (46)	tA	31.0	3	2	1	0	0	0	0	0	0	0	0	0	0	0
	wB	12.9	0	0	5	1	4	0	0	0	0	0	0	0	0	0
Thistle Township (14)	tA	19.5	2	0	2	4	3	3	1	0	0	0	0	0	0	0
	wB	22.8	5	0	5	0	3	0	0	0	0	0	0	0	0	0
<i>Sault Ste. Marie District</i>																
Asselin Township (24)	wB	27.5	0	0	1	2	4	0	1	0	0	0	0	0	0	0
Bridgland Township (26)	wB	26.0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	tA	25.4	0	0	3	4	2	1	1	0	0	0	0	0	0	0
<i>Sault Ste. Marie District (cont'd)</i>																
Herrick Township (27)	wB	18.2	0	0	4	1	1	0	0	0	0	0	0	0	0	0
	tA	30.0	0	0	0	0	3	0	0	0	0	0	0	0	1	0
Jollineau Township (28)	wB	31.5	0	0	2	0	3	0	0	0	0	0	0	1	2	0
	tA	30.4	0	0	0	3	2	1	1	0	0	0	0	0	4	0
Lewis Township (31)	wB	15.5	0	0	0	1	0	1	0	0	0	0	0	0	0	0
	tA	27.0	0	0	0	0	0	0	1	0	1	0	0	0	1	0
Peever Township (32)	wB	28.0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Shields Township (33)	tA	27.4	0	0	9	9	10	2	0	0	0	0	0	0	4	0

**Appendix 5.** Summary of the crown condition and tree mortality for two deciduous hosts in 49 spruce/fir health plots for 1998 in the Northeast Region of Ontario.

Location (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Crown condition <sup>b</sup>											Cumulative mortality <sup>c</sup>			
			10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead	Trees cut	
Villeneuve Township (34)	wB	11.5	0	0	7	3	0	0	0	0	0	0	0	0	0	1	0
	tA	18.8	0	0	3	0	2	1	0	0	0	0	0	0	0	0	0
<i>Sudbury District</i>																	
Killarney Township (39)	wB	16.8	1	0	3	1	3	0	0	1	0	0	0	0	0	0	0
	tA	19.8	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0
Nairn Township (40)	wB	17.2	1	0	3	3	0	0	0	0	0	0	0	0	0	1	0
	tA	20.6	0	0	2	4	3	0	0	0	0	0	0	1	2	0	0
Parkin Township (41)	wB	19.6	0	0	9	3	8	0	0	0	0	0	0	0	1	0	0
	tA	9.0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
<i>Sudbury District (cont'd)</i>																	
Servos Township (43)	wB	12.0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0
Weeks Township (44)	wB	13.1	1	0	3	2	2	0	0	1	0	0	0	0	8	0	0
	tA	21.8	0	0	6	9	19	5	1	1	0	0	0	0	10	0	0
<i>Timmins District</i>																	
Eldorado Township (95)	wB	12.0	0	0	1	0	4	0	0	0	0	0	0	0	0	0	0
	tA	19.7	0	0	2	1	7	0	1	0	0	0	0	0	0	0	0
Hazen Township (97)	wB	26.6	0	0	3	3	2	0	0	0	0	0	0	0	0	0	0

**Appendix 5.** Summary of the crown condition and tree mortality for two deciduous hosts in 49 spruce/fir health plots for 1998 in the Northeast Region of Ontario.

Location (Plot no.)	Host <sup>a</sup>	Average DBH (cm)	Crown condition <sup>b</sup>											Cumulative mortality <sup>c</sup>		
			10	20	30	35	40	45	50	55	60	65	70	New dead	Old dead	Trees cut
	tA	41.7	0	0	1	0	9	4	1	0	2	0	0	0	2	0
Invergary Township (98)	wB	8.3	3	0	0	0	0	0	0	0	0	0	0	0	0	0
Marquette Township (99)	wB	19.2	1	0	15	3	6	0	0	0	0	0	0	0	1	0
	tA	21.0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Massey Township (100)	wB	19.0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Sewell Township (102)	wB	19.3	0	0	6	0	5	0	0	0	0	0	0	0	0	0
<i>Wawa District</i>																
Dumas Township (104)	wB	16.3	10	0	0	0	0	3	0	0	0	0	0	0	4	0
Laberge Township (106)	wB	17.4	5	0	24	14	8	6	2	0	1	2	0	4	17	0
	tA	33.0	0	0	0	0	0	3	1	0	0	0	0	0	2	0
<i>Wawa District (cont'd)</i>																
Leslie Township (108)	wB	26.1	1	0	1	1	2	2	0	0	0	0	0	0	1	0
Wicksteed Township (110)	wB	6.0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	tA	17.9	0	0	0	1	1	4	1	0	0	0	0	0	0	0

<sup>a</sup> wB = white birch and tA = trembling aspen.

<sup>b</sup> 10 = no damage; 20 = foliage thin, off-colour with no dead branches or bare twigs visible; 30 = no dead branches present and bare twigs present in up to 5 percent of the crown; 35 = no dead branches present and bare twigs present in more than 6 percent of the crown; 40 = dead branches and bare twigs present in up to 15 percent of the crown; 45 = dead branches and bare twigs present in 16 to 25 percent of the crown; 50 = dead branches and bare twigs present in 26 to 37 percent of the

**Appendix 5. Summary of the crown condition and tree mortality for two deciduous hosts in 49 spruce/fir health plots for 1998 in the Northeast Region of Ontario.**

crown; 55 = dead branches and bare twigs present in 38 to 50 percent of the crown; 60 = dead branches and bare twigs present in 51 to 75 percent of the crown; 65 = dead branches and bare twigs present in 76 percent or more of the crown; and 70 = more than 50 percent of the crown dead with only small adventitious branches present, usually at the base of the crown or stem.

\*Tree mortality resulting from natural causes, trees dead when plot installed are included with old dead.