Forest Health in Ontario, 2000.
Results of Canadian Forest Service Surveys

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Natural Resources Canada
Canadian forest Service
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Abstract

The following report deals with forest health conditions in Ontario for the year 2000. The report is the result of work conducted jointly by the Canadian Forest Service (CFS) and the Ontario Ministry of Natural Resources (OMNR) under the guidelines of a Memorandum of Understanding (MOU) between the two agencies. Forest health issues are annually monitored in the boreal and southern deciduous forests of Ontario using a variety of permanent sample plots in addition to aerial and ground surveys for pests. The main tree species monitored include maple *(Acer* spp.), oak (*Quercus* spp.), spruce (*Picea* spp.), balsam fir (*Abies balsamea* [L.]), and jack pine (*Pinus banksiana* Lamb.). Other tree species that naturally occur on the different plot types are also annually monitored or through special surveys.

An increase in crown dieback was recorded in 2000 on the crowns of the dominant and codominant sugar maple *(Acer saccharum* Marsh) in the North American Maple Project plots (NAMP). The CFS oak plots showed a marked increase in crown dieback, where as the OMNR oak plots revealed virtually no change in levels of dieback since the last tally in1998. A decrease in overall health was recorded throughout the spruce/fir and jack pine plots, and mortality rates increased on the spruce/fir plot network, especially for balsam fir, but decreased in the jack pine plot network.

Increases in areas within which defoliation was mapped in Ontario were caused by the spruce budworm (*Choristoneura fumiferana* Clem.), forest tent caterpillar (*Malacosoma disstria* Hübner.), oak leafshredder (*Acleris semipurpurana* [Kearfott]), gypsy moth (*Lymantria dispar* [Linnaeus]), introduced pine sawfly (*Diprion similus* [Hartig]), and the fall canker worm (*Alsophila pometaria* [Harris]). Population levels remain high in numerous locations in southern Ontario for the pine shoot beetle (*Tomicus piniperda* (L.), an introduced pine pest. A large area of aspen mortality and decline, 174,898 ha, was aerially sketch mapped in north eastern Ontario. This area has had a history of some 12 years of insect defoliation, involving at least three defoliators, and three years of drought. Age may also be a factor in this aspen decline.

Executive Summary

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Introduction

Six forest health technicians from the Canadian Forest Service (CFS) and six from the Ontario Ministry of Natural Resources (OMNR) work in partnership to monitor the health of Ontario's forests under a Memorandum of Understanding (MOU) between the two agencies. Under the agreement of this MOU, annually this co-operative determines the state of health of Ontario's forests by assessing major forest pest disturbances, exotic pest detection and the monitoring of permanent plot networks. The monitoring and detection of exotic pests is conducted under a MOU with the Canadian Food Inspection Agency http://www.inspection.gc.ca/ , who have the federal responsibility for quarantine pests in Canada.

This joint federal-provincial forest health team uses a series of permanent sample plots that have been established by both the CFS and OMNR to annually monitor the state of health of Ontario's forests. The annual program also involves aerial surveys of major forest disturbances such as insect defoliation and abiotic damage. Special surveys are annually conducted for the assessment of special events or circumstances, such as the effects of the ice storm that occurred in eastern Ontario in January, 1998.

Results

The monitoring of forest health and the assessment of pest damage in Ontario is conducted primarily on permanent plot networks (Figure 1). The boreal forest in northern Ontario is monitored using a series of jack pine and spruce/fir (*Picea/Abies* spp.) plots. All tree species on these two networks were evaluated using methodology adopted from the crown rating protocols developed for the Acid Rain National Early Warning System (ARNEWS) program (D'Eon et al. 1994) (http://www.cciw.ca/forest-health/reports.html).

The southern Ontario deciduous forests are monitored on a series of North American Maple Plots (NAMP), maple, and CFS and OMNR oak plots (Figure 2). These various plot types were evaluated using methodology adopted from the crown rating protocols that were developed for the NAMP program (Millers et al. 1991) (http://www.ccia.ca/forest-health/reports/html). Table 1 provides a summary of the historical establishment of the various plot networks and the number of plots annually monitored on each network.

Table 1. Summary of the historical establishment of the forest health monitoring plot networks and the number of plots evaluated in each network in 2000.

Plot type	Year established	Number of plots evaluated in 2000
CFS Maple	1987	20
CFS Oak	1977	12
OMNR Oak	1989	45
NAMP	1988	13
Jack Pine	1993	68
Spruce/Fir	1993	57

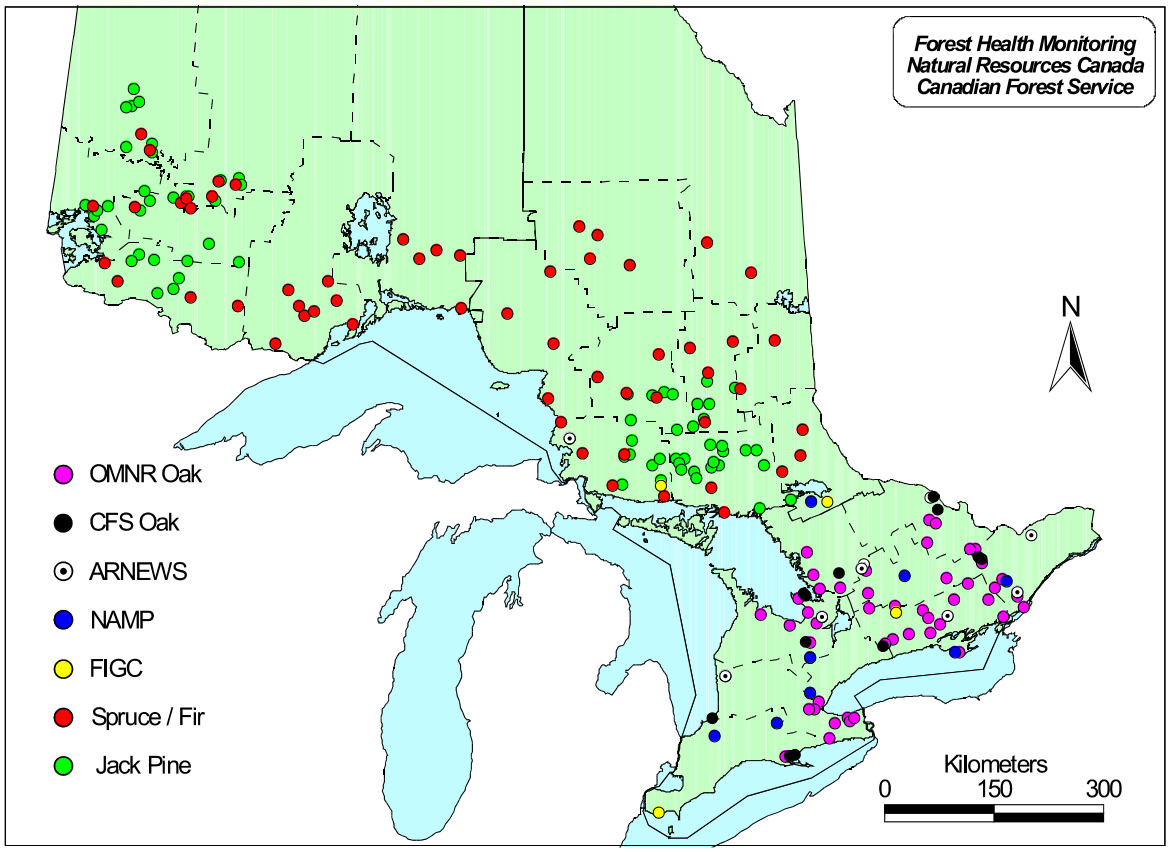

Figure 1. Locations of CFS and OMNR permanent plots annually assessed to monitor the state of health of Ontario's forests.

Southern Hardwoods

The southern Ontario deciduous forests are monitored on a series of plots previously established for various programs (Table 1, Figure 2). These plots were evaluated using methodology adopted from the crown rating protocols developed for the North American Maple Project, NAMP (Millers et.al. 1991). Details on the NAMP protocols can be found at http://www.cia.ca/forest-health/reports/html.

A series of maple and oak plots are monitored annually throughout the range of these species in southern Ontario (Figure 2). In 2000, maple health was assessed on 20, 25 tree maple plots and on 13 NAMP plots. Oak was evaluated on 12 CFS 100 tree plots and on 45 OMNR oak plots. The annual measurements include the percentage of crown dieback, defoliation, and pest damage levels.

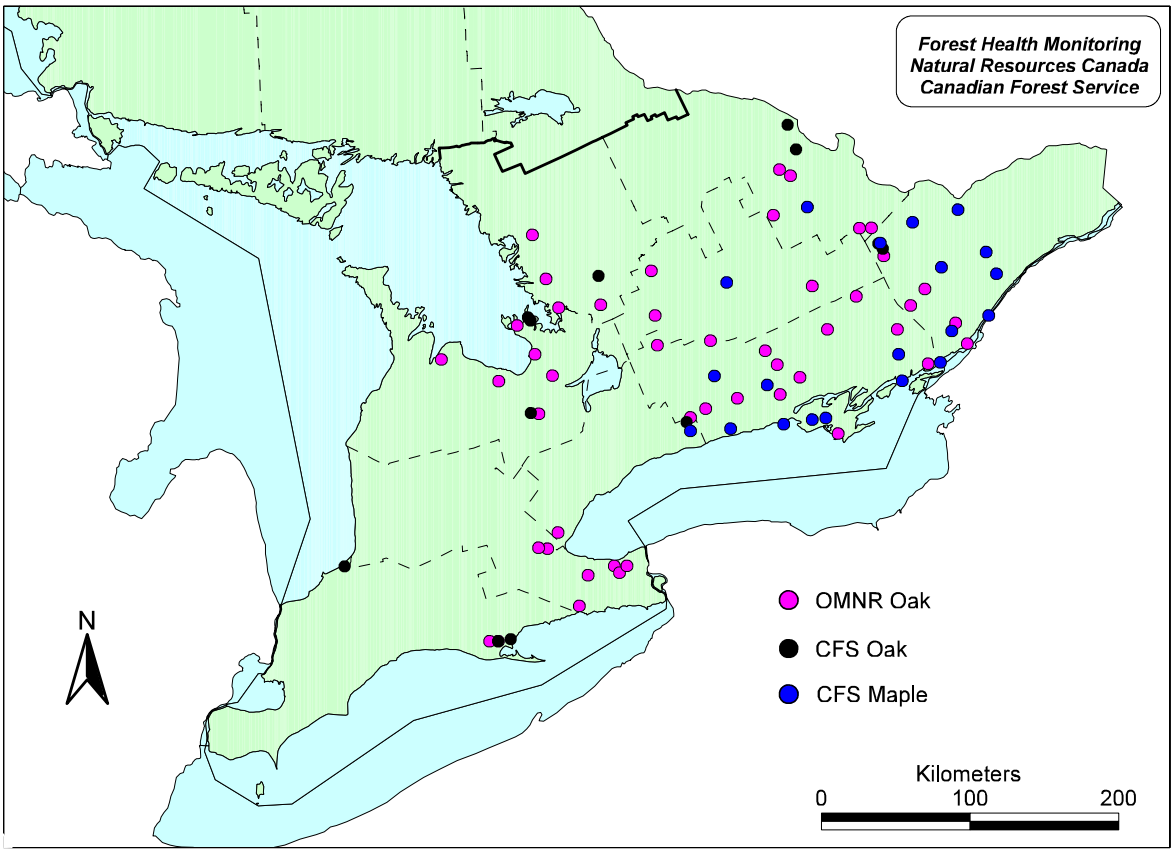

Figure 2. Locations of CFS and OMNR oak and maple plots in Ontario.

North American Maple Project (NAMP)

The NAMP was established in 1988 as a joint international project that involved the CFS and the United States Department of Agriculture Forest Service. It consisted of 233 plot locations in eastern North America, with 24 plots located in woodlots across southern Ontario. This project was terminated in1999, but 13 of the 24 Ontario NAMP plots were assessed in 2000 as part of the hardwood assessment program. Table 2 provides a summary of the number of various tree species, by dominance class, found throughout the NAMP plots.

Table 2 . Hardwood tree species count, by dominance class, for the 24 NAMP plots located across southern Ontario.

Tree species	Number of trees by crown class	
	Dominant/codominant	Intermediate/suppressed
Sugar maple	504	188
White ash	40	5
American beech	18	13
Basswood	23	6
Red oak	24	0
Black cherry	14	1
Hickory	8	2
Poplar	8	0
Yellow birch	4	4
Red maple	0	1
Ironwood	0	10

The mean dieback for the dominant and codominant sugar maple trees on these plots has increased from 8.9% in 1998 and 8.3% in1999, to 12.1%, in 2000. When all dominant and codominant hardwoods on the plots are examined, similar results are found with 9.2% recorded in 1998, 8.8% in 1999 and increasing to 13.9% this year (Figure 3).

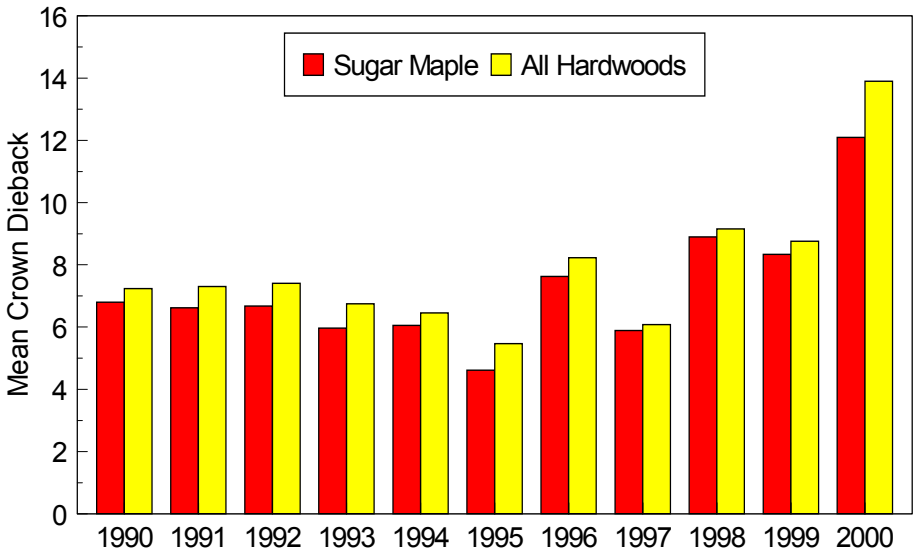

Figure 3. Mean plot crown dieback for the dominant and codominant hardwood trees on13 NAMP plots in Ontario from 1990 to 2000.

Transparency is a measurement of the crown foliar density, with an increase in transparency indicating a thinner crown. From 1995 to 1997 there was little change in the transparency of the dominant and codominant sugar maple trees. In 1998 the levels increased to 14.8%, and 17.2% by 2000. This trend was also seen on all of the dominant and codominant hardwood trees on the plot (Figure 4). These results plus the crown condition ratings would suggest some stress factors, other than insect defoliators which have been at low levels, are weakening these trees

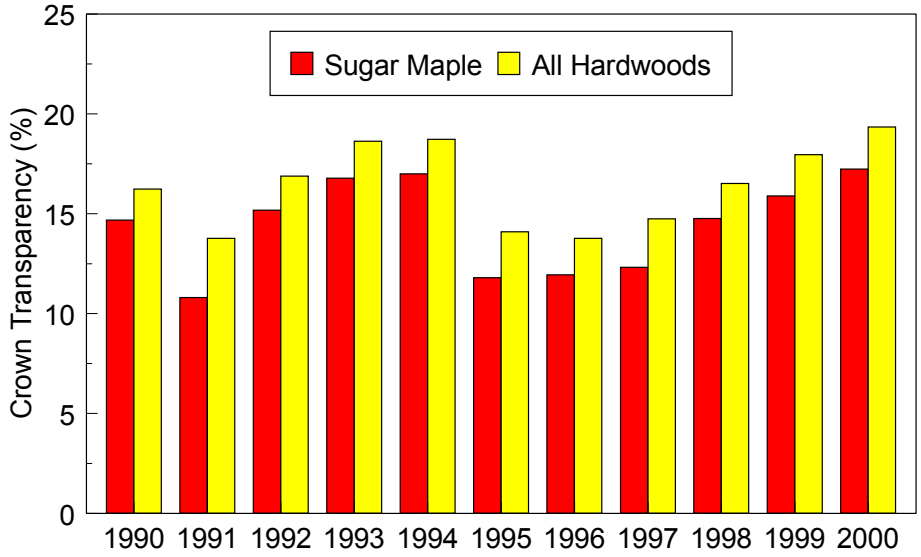

Figure 4. Mean plot percentage of crown transparency for the dominant and codominant hardwood trees on13 NAMP plots in Ontario from 1990 to 2000.

Although both crown damage ratings and crown transparency values have increased, tree mortality has remained low for sugar maples and other hardwoods. Current mortality has averaged less than 1% annually. The other hardwoods have fluctuated from a low of 0.2% in 1998 to 0.9% in 2000 (Figure 5)

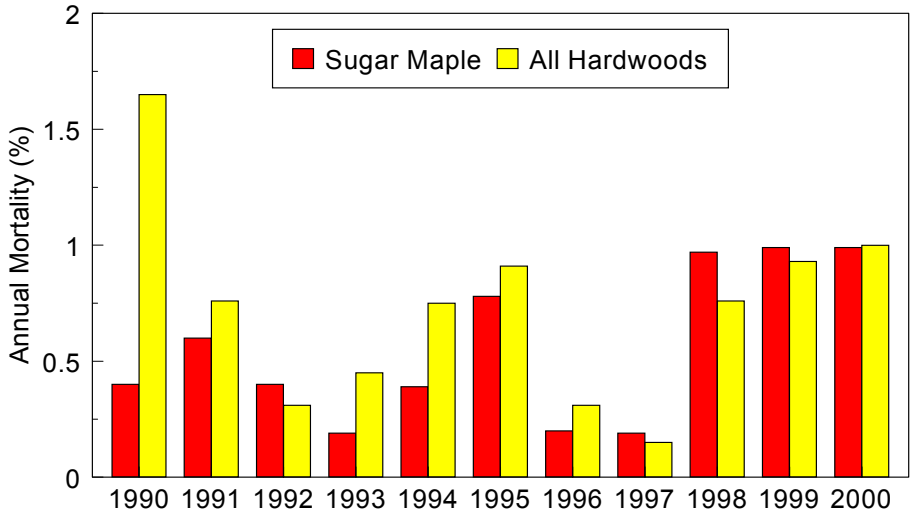

Figure 5. Annual mortality for the dominant and codominant hardwood trees on13 NAMP plots in Ontario from 1990 to 2000.

Oaks

Oak decline

Oaks have been monitored annually on plots by the CFS since 1977. In 1990, the OMNR established a series of oak plots to assess the impact of the gypsy moth. This season saw a marked increase in the average crown dieback across the CFS oak plots, increasing from 11 and 12% from the past three years to 20.9% in 2000. The largest increase occurred on the trees that were considered to have moderate levels of crown dieback, increasing from 5.3% in 1999 to 34.3% this season. There was also an increase in current levels of mortality, increasing from a low of 0.1% last year to 0.7% this year.

On the OMNR oak plots, 91% of the trees were considered to be healthy with less than 20% crown dieback in both 2000 and 1998 (no ratings were made in 1999). However there was an increase in annual mortality, from 0.5% in 1998, to 2.2% in 2000. Table 3 summarizes the dieback history from 1990 to date for both plot types.

An increase was recorded this season in the defoliation levels throughout the CFS plots. A total of 12.5% of the trees were tallied in the moderate level, (25-70%), compared to 2.1% last year. Gypsy moth was recorded as causing defoliation on 37.7% of the trees, oak leafshredder on 18.0%, and forest tent caterpillar on 12.9%. An unidentified spring defoliator was detected on 10.9% of the trees. A decline in defoliation levels was recorded on the OMNR plots in 2000 compared to the 1998 levels. No defoliation was recorded on 86.4% of the trees and only light defoliation (1-24%) on 8.7% of the oaks. Table 4 summarizes the defoliation history of the oak plots from 1990 to date.

Table 3. Percentage of trees in five crown condition classes on CFS and OMNR oaks plots in southern Ontario from 1990 to 2000.

	CFS Oak						OMNR Oak					
	Crown condition						Crown condition					
	% of trees n=						% of trees n=					
Year	0-5	6-20	21-60	61-99	Dead	Year	0-5	6-20	21-60	61-99	Dead
1990	12.3	50.4	33.0	2.4	1.9	1990	47.3	36.1	13.7	2.3	0.7
1991	18.7	58.0	18.8	2.0	2.5	1991	35.8	33.4	23.7	3.9	3.2
1992	21.2	53.4	20.3	2.9	2.2	1992	27.8	36.3	21.7	5.9	8.3
1993	37.3	45.6	12.9	2.7	1.5	1993	13.4	46.0	30.2	7.6	2.8
1994	42.5	46.6	8.1	1.5	1.3	1994	-	-	-	-	-
1995	42.2	47.1	8.0	1.1	1.6	1995	-	-	-	-	-
1996	34.8	59.6	4.7	0.0	0.9	1996	-	-	-	-	-
1997	35.9	58.8	4.7	0.3	0.3	1997	25.1	48.4	20.0	1.6	0.9[1]
1998	34.2	60.6	3.9	0.2	1.1	1998	49.3	42.8	6.3	1.8	0.5
1999	27.8	66.1	5.3	0.7	0.1	1999	-	-	-	-	-
2000	11.6	52.6	34.4	0.7	0.7	2000	54.8	37.1	4.7	1.3	2.2

[1] annual average mortality for 1993 - 1997

Table 4. Percentage of trees in four defoliation levels on the CFS oak plots in southern Ontario from 1995 to 2000 and the OMNR plots from 1998 to 2000.

	CFS Oak					OMNR Oak				
	Defoliation levels					Defoliation levels				
	% of trees					% of trees				
	0	1-24	25-70	71-100		0	1-24	25-70	71-100
Year	(%)	(%)	(%)	(%)	Year	(%)	(%)	(%)	(%)
1995	40.7	57.8	0.9	0.6	1998	12.3	84.2	3.5	0.0
1996	12.4	67.5	18.5	1.6	1999	-	-	-	-
1997	10.1	89.5	0.4	0.0	2000	86.4	8.7	4.6	0.4
1998	14.8	82.0	2.9	0.2					
1999	34.4	63.3	2.0	0.2					
2000	18.2	69.3	12.5	0.0					

Other Hardwoods

See Special Surveys: Forest Health Evaluation Plots

Coniferous Forest

Jack Pine


Jack pine stand

A total of 68 jack pine plots were evaluated in 2000. These plots contained 2910 trees , of which 2676 were over-story and 234 were intermediate or suppressed. In 2000, 88.6% of the over-story trees showed less than 25% crown damage. At the same time 60.7% of the under-story trees had a similar rating. The number of severely affected trees in the intermediate and suppressed crown classes increased this year, from 0% in 1999 to 1.3%. Annual mortality declined from 2.5% last year to 1.4% in the dominant and codominant trees, but increased slightly for the intermediate and suppressed trees, from 6.0% to 6.4% (Tables 4 and 5). The complete results of the current mortality data for 1996 to date is presented in Table 6.

No defoliation caused by the jack pine budworm (*Choristonuera p. pinus* Free.) was encountered on any of the plot trees in 2000.

Spruce/Fir


Mixed spruce/fir stand

In 2000 57 spruce/fir plots containing 1980 trees were assessed. Consisting of 274 dominant or codominant white spruce, 271 black spruce and 716 balsam fir, and 79 intermediate or suppressed white spruce, 128 black spruce and 512 balsam fir. There was a general decline recorded in the overall health of the spruce/fir plots from the improvement that has been reported for the past three years (Tables 5 and 6).

Most noticeably in 2000, the number of healthy overstory white spruce and balsam fir, decreased from 91.2%, to 81.0% and from 90.4% to 83.7% respectively; black spruce showing only minor change. Similar declines were recorded in the healthy intermediate and suppressed trees. Balsam fir declined from 85.3% to 71.3%, back spruce from 97.7% to 86.7%. Increases in tree mortality were recorded for the dominant and codominant trees. Balsam fir levels doubled from 3.2% in 1999 to 6.0% and white spruce increased from 0.4% to 1.1%. Mortality for black spruce actually declined, from 1.4% to 1.1% (Table 7).

Table 5. Crown condition for the dominant and codominant trees on the spruce/fir and jack pine plot networks in Ontario from 1996 to 2000 (counts based on active plots in 2000).

Tree Species	Year	Crown conditions[1] for dominant and codominant trees				
		Healthy	Light	Moderate	Severe	Current mortality
White spruce	1999	91.2	7.3	1.1	0	0.4
	2000	81	15	2.9	0	1.1
Black spruce	1999	96.4	1.8	0	0.4	1.4
	2000	93.4	4.8	0.4	0.4	1.1
Balsam fir	1999	90.4	4.5	1	1	3.2
	2000	83.7	7.5	1.8	1	6
Jack pine	1999	91.2	5.9	0.5	0.2	2.5
	2000	88.6	9	0.8	0.2	1.4

[1] Healthy = bare twigs on <15% of the crown, Light = dead twigs and branches on 15% to 25% of the crown, Moderate = dead branches and twigs on 26% to 75% of the crown, Severe = dead branches and twigs on >75% of the crown, Current mortality = tree dead since last assessment.

Table 6. Crown condition for the intermediate and suppressed trees on the spruce/fir and jack pine plot networks in Ontario from 1996 to 2000 (counts based on active plots in 2000).

Tree Species	Year	Crown conditions[1] for intermediate and suppressed trees				
		Healthy	Light	Moderate	Severe	Current mortality
White spruce	1999	81.9	13.2	0	0	4.8
	2000	81	15.2	2.5	0	1.3
Black spruce	1999	97.7	1.5	0	0	0.8
	2000	86.7	10.9	0.8	0	1.6
Balsam fir	1999	85.3	8.6	0.8	1.1	4.2
	2000	71.3	19.3	4.3	1.8	3.3
Jack pine	1999	71.5	18.1	4.4	0	6
	2000					

[1] Healthy = bare twigs on <15% of the crown, Light = dead twigs and branches on 15% to 25% of the crown, Moderate = dead branches and twigs on 26% to 75% of the crown, Severe = dead branches and twigs on >75% of the crown, Current mortality = tree dead since last assessment.

Table 7. Annual mortality by tree species and dominance class for the spruce/fir and jack pine plot network in Ontario from 1996 to 2000 (counts based on active plots in 2000).

Tree species	Year	Percent of current mortality: Dominant/ codominant (%)	Intermediate/ suppressed (%)
Balsam fir	1996	11.0	7.5
	1997	6.9	6.2
	1998	5.7	7.0
	1999	3.2	4.2
	2000	6.0	3.3
White spruce	1996	1.0	3.4
	1997	0.3	1.2
	1998	2.5	0.0
	1999	0.4	4.8
	2000	1.1	1.3
Black spruce	1996	1.4	0.7
	1997	3.1	0.8
	1998	2.1	1.5
	1999	1.4	0.8
	2000	1.1	1.6
Jack pine	1996	2.1	12.3
	1997	2.9	9.8
	1998	1.9	10.1
	1999	2.5	6.0
	2000	1.4	6.4

Special Surveys

Forest Health Evaluation Plots

In 2000, a special survey was conducted to evaluate the health of trees not included in the permanent plot system. About 8,470 trees at 218 selected locations across Ontario (Figure 6) were evaluated for crown condition and pest damage. In northern Ontario, eastern white pine, aspen and white birch were the target species of the survey, and in the south white ash, American beech and eastern white pine were evaluated. At each site, 50 over-story trees were examined, of which 20% had to be one of the target species. The site class, estimated area of the stand, basal area, average height of host trees and DBH measurements of 10 host trees were recorded for each site. The tree species was identified and recorded for all on plot trees.

Typical mixed wood stand

The survey revealed that overall white birch was fairly healthy across the survey, with some 88% of the trees being rated with < 25% crown dieback and only 10% in the moderate to severe category (>50% crown dieback). The highest levels of crown dieback was found in white ash, where only 48% were considered to be healthy and 45% were rated in the moderate to severe level. Figure 7 summarizes the percent of trees, by species, that were rated in the moderate to severe category. A complete summary of the crown conditions, including current mortality levels, for all the target species, is presented in Table 8.

All trees evaluated during the survey were examined for any evidence of foliar and non-foliar woody tissue pests. Some of the pests recorded were host specific, such as beech scale on American beech and Hypoxylon canker on trembling aspen, whereas the majority were common forest defoliators, such as forest tent caterpillar, or unknown spring open defoliators.

Unknown spring and fall open defoliators were commonly found affecting 1% to 30% of the trees. Forest tent caterpillar was recorded on 18% of the trembling aspen and gypsy moth on 9.7% of the American beech. Incident rates of foliar diseases ranged from a low of 0.2% on trembling aspen to a high 25.6% on white ash. Low levels of stem decays and open wounds were recorded on all the target species, except on American beech where open wounds were recorded on some 21.2% of the trees. Tables 9 and 10 provide a complete summary of the incident rates of the various pests detected during the survey.

Table 8. Summary of the crown conditions for all tree species evaluated on the 218 forest health evaluation plots in Ontario in 2000.

Tree species **Target species**	**No. of trees**	**Crown conditions[1]**			
		Healthy	**Light**	**Moderate**	**Severe**
Trembling aspen	2023	50.7	35.9	10.8	2.6
White birch	1795	57.1	32.7	7.6	2.7
White ash	11683	20.3	51.9	21.1	6.6
American beech	2139	9.2	35.2	33.9	21.7
Eastern white pin	2493	29.8	45.6	19.9	4.6
Other tree species	**No. of trees**	**Healthy**	**Light**	**Moderate**	**Severe**
Sugar maple	1370	33.5	52.2	12.3	2
Red maple	179	23.5	51.4	15.6	9.5
Red oak	121	13.2	52.1	32.2	2.5
Basswood	117	13.7	44.4	23.9	17.9
Red pine	187	54.5	32.6	11.8	1.1
Balsam fir	186	70.4	22	3.2	4.3
White spruce	137	83.2	16.1	0.7	0
Jack pine	114	75.4	14	7	3.5
Black spruce	91	94.5	4.4	1.1	0

[1] Healthy = <10% crown damage, Light = 10% to 25% crown damage, Moderate = 26% to 50% crown damage, Severe = >50% crown damage

Table 9. Summary of the incidence level of foliar pests detected on the 218 forest health evaluation plots located across Ontario in 2000.

Foliar Pests	Percent of trees affected				
	Trembling aspen (%)	White ash (%)	White birch (%)	American beech (%)	White pine (%)
Chlororsis	1.1	1	1.6	0.8	2.2
Spring defoliator	12.4	21	12.2	30	22
Fall defoliator	5.4	0.8	26.9	6.8	8.6
Unknown defoliator		24.7	2	13.4	2.2
Forest tent caterpillar	18	--	4.3	1	--
Gypsy moth	--	0.2	0.2	9.7	--
Unknown sawfly	–	–	–	--	3.5
Foliar disease	0.2	25.6	2.3	1.3	--
Dook's needle blight	–	–	–	--	4.2

Table 10. Summary of the incidence level of non-foliar woody tissue pests detected on the 218 forest health evaluation plots located across Ontario in 2000.

Woody stem pests	Percent of trees affected				
	Trembling aspen (%)	White ash (%)	White birch (%)	American beech (%)	White pine (%)
Ice/Snow damage	--	4.8	0.6	19.5	3.1
Stem canker	0.2	0.2	0.6	0.8	2.3
Hypoxylon canker	3.5	--	--	--	--
Nectria canker	--	--	4.1	2.2	--
Stem decay	7.9	0.2	1.2	3.9	0.1
Frost crack	1.2	0.8	1.1	11.6	0.8
Open wound	1.5	2.5	0.9	21.2	2.5
Closed wound	1.5	0.5	0.7	1.8	0.5
Wet Seam	0.5	0.1	0.6	2.7	--
Armillaria root rot	1.2	--	1.1	--	–
Beech scale	--	--	--	20	--
Stem borer	0.6	--	1.1	0.4	0.8
Stem insect	--	--	--	10	0.4
Sapsucker damage	--	--	0.2	0.8	0.6

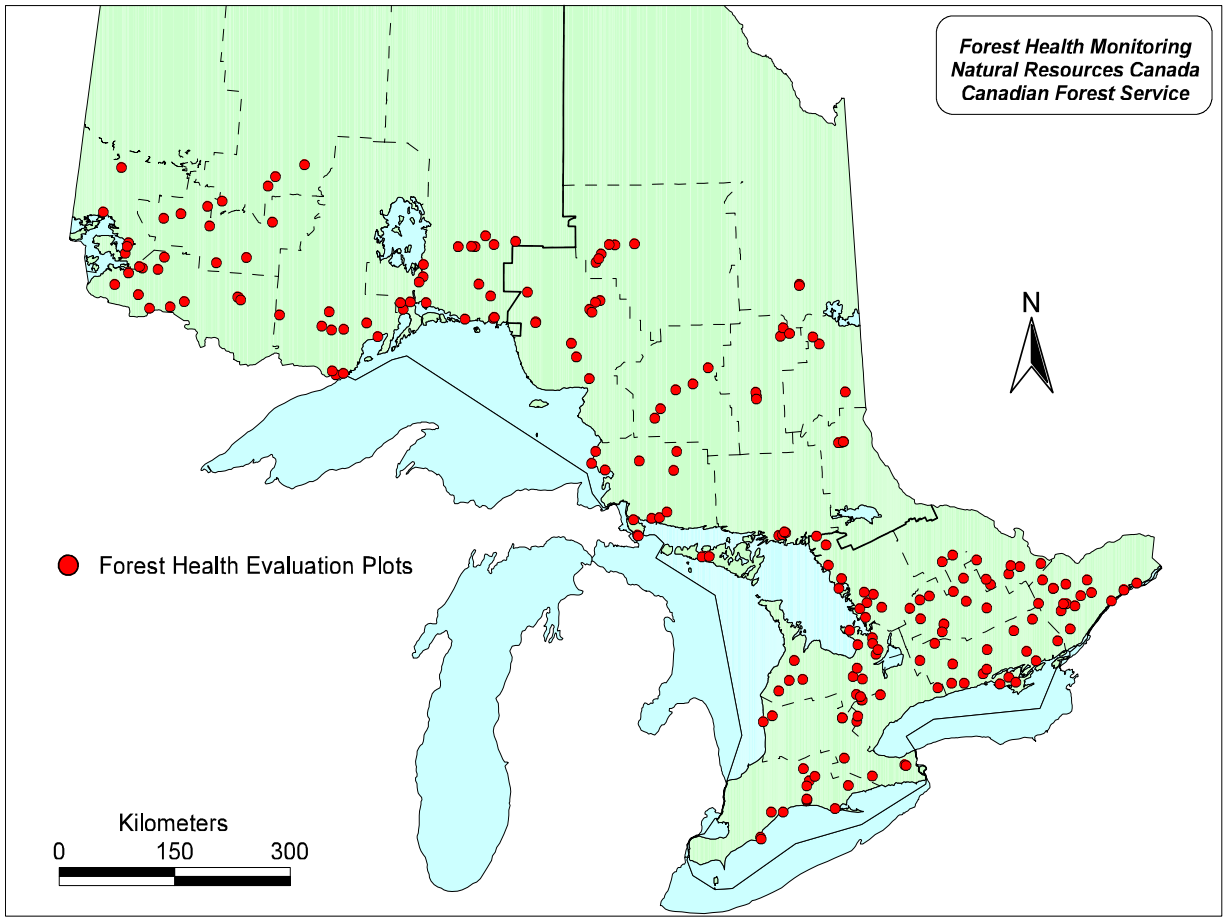

Figure 6. Locations of 218 forest health evaluation plots examined in Ontario in 2000.

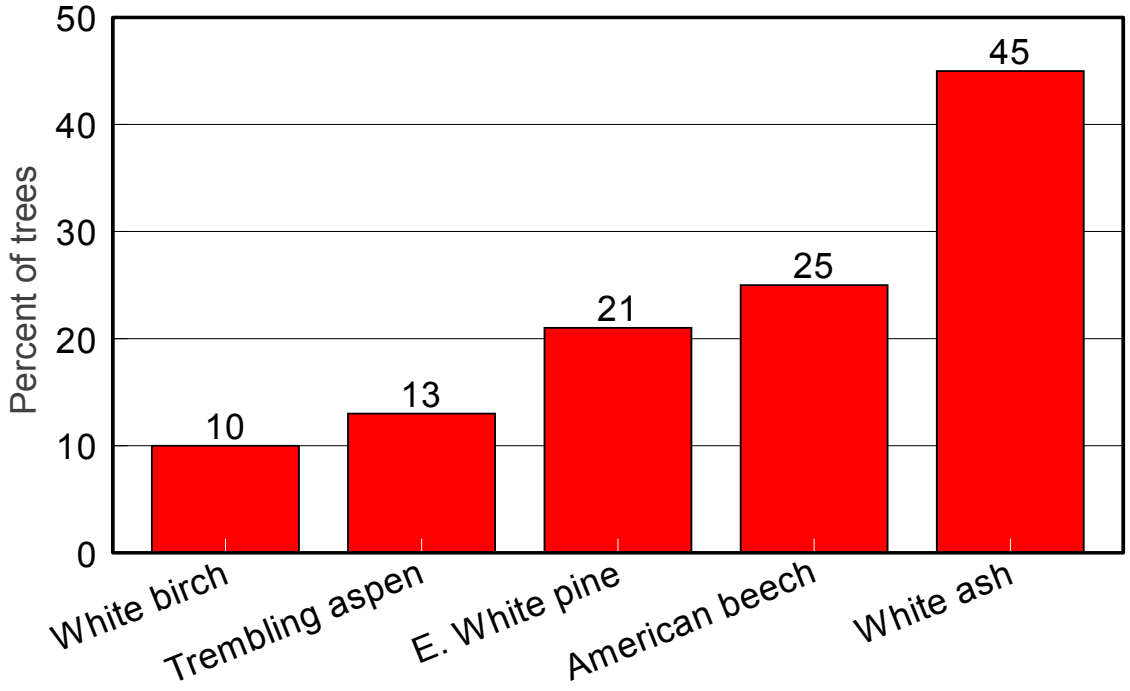

Figure 7. Summary of the percent of trees, by species, that were rated in the moderate to severe category (>25% crown damage) in 2000 (n = 1835).

Major Forest Disturbances

Spruce budworm defoliation

The total area of moderate-to-severe defoliation caused by the eastern spruce budworm in north eastern Ontario increased in size from approximately 81,204 ha in 1999 to 115,080 ha in 2000 (Table 11 and Figure 8). The area of moderate-to-severe defoliation caused by the forest tent caterpillar more than doubled in size in expanding from 3,653,583 ha in 1999 to 7,210,4332 ha (Table 11 and Figure 9). The total area of defoliation, scattered across three separate areas, in southern Ontario, caused by the oak leafshredder, increased from 1,580 ha to 7,124 ha (Table 11 and Figure 10), and numerous scattered pockets of moderate-to severe defoliation in southern Ontario, caused by gypsy moth, also increased in size from 15,399 ha to 18,732 ha (Table 11 and Figure 11). The introduced pine sawfly caused some 8,573 ha of moderate-to-severe defoliation in 2000 across numerous islands and the mainland in the Parry Sound area. In 1999 only 12 ha were reported to be infested by this sawfly in this area (Table 11 and Figure 12). The fall canker worm caused some 4,378 ha of moderate -to-severe defoliation in south central Ontario in 2000 (Table 5 and Figure 16).

Introduced pine sawfly defoliation

There was a marked decline in the area of moderate-to-severe defoliation in north western Ontario caused by the large aspen tortrix, (*Choristoneura conflictana* [Wlk.]), from 531,761ha in 1999 to 12,608 ha this season (Table 11 and Figure 13). Declines were also recorded in the areas of defoliation caused by the pine false webworm, (*Acantholyda erythrocephala* [L.]), from the 1,457 ha reported in 1999 to 865 ha in 2000 (Table 11 and Figure 14) and by the Bruce spanworm, (*Operophtera bruceata* [Hulst.]), from 3,251 ha in 1999 to 2,334 ha this season (Table 11 and Figure 15).

Areas of aspen mortality and decline were aerially sketch mapped in north central Ontario in 1999, throughout some 106,514 ha, and across some 174,898 ha in north eastern Ontario in 2000. The area of damage that was reported in north eastern Ontario this year occurred in a scattering of two large pockets (Figure 16). The area involved has sustained scattered pockets of moderate-to-severe defoliation, on and off, throughout a 12 year

period caused by three aspen defoliators; the forest tent caterpillar, the aspen twoleaf tier (*Enargia decolor* [Wlk.], and the early aspen leafcurler (*Pseudexentra oregonana* [Wlsm.]). Areas of drought damage have also been reported in north eastern Ontario for three consecutive years, starting in 1996. The age of the majority of the poplar stands in the affected areas may also play a major role in the decline. These biotic and abiotic factors may have contributed to this decline but further investigation of the condition is required. Table 11 is a summary of biotic and abiotic pests that were found to be affecting Ontario forests from 1998 to 2000.

Table 11. Summary of the major biotic and abiotic pest conditions in Ontario for 1998, 1999 and 2000.

	Area affected / defoliated (ha)		
Pest	1998	1999	2000
Insects			
Spruce budworm	141,287	81,204	115,080
Forest tent caterpillar	2,986,118	3,653,583	7,210,432
Large aspen tortrix	197,736	531,761	12,608
Pine false webworm	2,948	1,457	865
Oak leafshredder	2,078	1,580	7,124
Gypsy moth	3,060	15,399	18,732
Bruce spanworm	4,581	3,251	2,334
Introduced pine sawfly (*Diprion similus* [Htg.])	-	-	8,573
Fall canker worm	-	-	4,378
Abiotic			
Aspen mortality/decline	0	106,514[1]	174,898[2]
Frost	847,438	0	1,136
Blowdown	319	121,873	2,325
Scorch	368,098	0	109,090

[1] Aspen decline occurred in north central Ontario in 1999.
[2] Aspen mortality/decline occurred in north eastern Ontario in 2000.

Invasive Pests

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

Population levels remain high throughout the infested areas in southern Ontario. Scots pine (*Pinus sylvestris* L.) is the primary host and the majority of the severe damage is confined to Scots pine plantations. However eastern white pine (*P. Strobus* L.), red pine (*P. resinosa* Ait.) and jack pine have also been attacked by this introduced pest.

Lindgren adult beetle trap

The Forest Health Monitoring Unit cooperated with the Canadian Food Inspection Agency (CFIA) by conducting the northern portion of a survey carried out by the Agency in Ontario. The Unit monitored Lindgren adult traps that were set out at fifty high risk sites that had been identified in northern Ontario in 1999. The traps were place along the highway 17 corridor from Batchawana, north of Sault Ste Marie, east to North Bay. Each trap was checked every two weeks starting in late February and continuing until mid-June. The trap sites were visually checked for damage in mid-August. No pine shoot beetles were trapped and all visual checks for damage were negative along this corridor.

The number of counties and/or Regional Municipalities that have been declared infested has increased from an accumulated total of 25 in 1999 to 29 in 2000 (Table 12 and Figure 17). In addition, collections of the adult beetles were confirmed in 1999 from the County of Haliburton and in 2000 from the District of Parry Sound and the Municipality of Muskoka.

Table 12. Summary of the counties and Regional Municipalities from which pine shoot beetle (*Tomicus piniperda* [L.]) has historically been collected in Ontario from 1993 to 2000.

Year	Counties/Regional Municipalities
1993	Haldimand-Norfolk, Hamilton-Wentworth, Halton, Niagara, Peel, Waterloo and Wellington
1994	Brant, Dufferin and Oxford
1995	Durham, Grey, Simcoe and the City of Toronto
1996	Lambton, Middlesex and York
1997	Northumberland
1998	Bruce, Elgin, Huron, Perth and Victoria
1999	Essex and Kent
2000	Frontenac, Hastings, Lennox-Addington and Peterborough

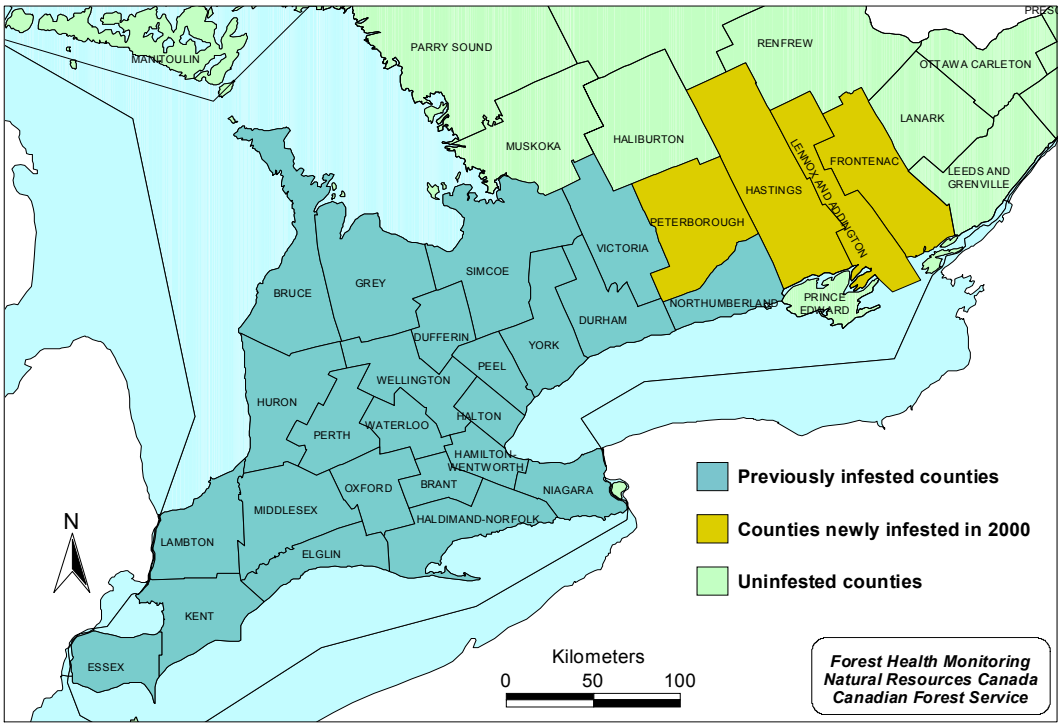

Figure 17. Counties and Regional Municipalities in southern Ontario that are currently infested with the pine shoot beetle (*Tomicus piniperda* [L.]).

Beech Bark Disease, *Nectria coccinea* (Pers.: Fr.) Fr. var. *faginata* Lohman, Watson & Ayers

Surveys were conducted across southern Ontario to determine the extent of beech bark disease. Woodlots that contained high numbers of American beech (*Fagus grandifolia* Ehrh.) were examined and it was determined that a total of 15 areas were now affected in Ontario. Infected trees were confirmed in stands extending from the Cornwall area in the east, westward through the Peterborough and Orangeville areas, then southward to the Hagersville and Niagara Falls area.

Beech scale (*Cryptococcus fagisuga* Lindeman) was found to be present at some 40 sites examined in southern Ontario (Figure. 18).

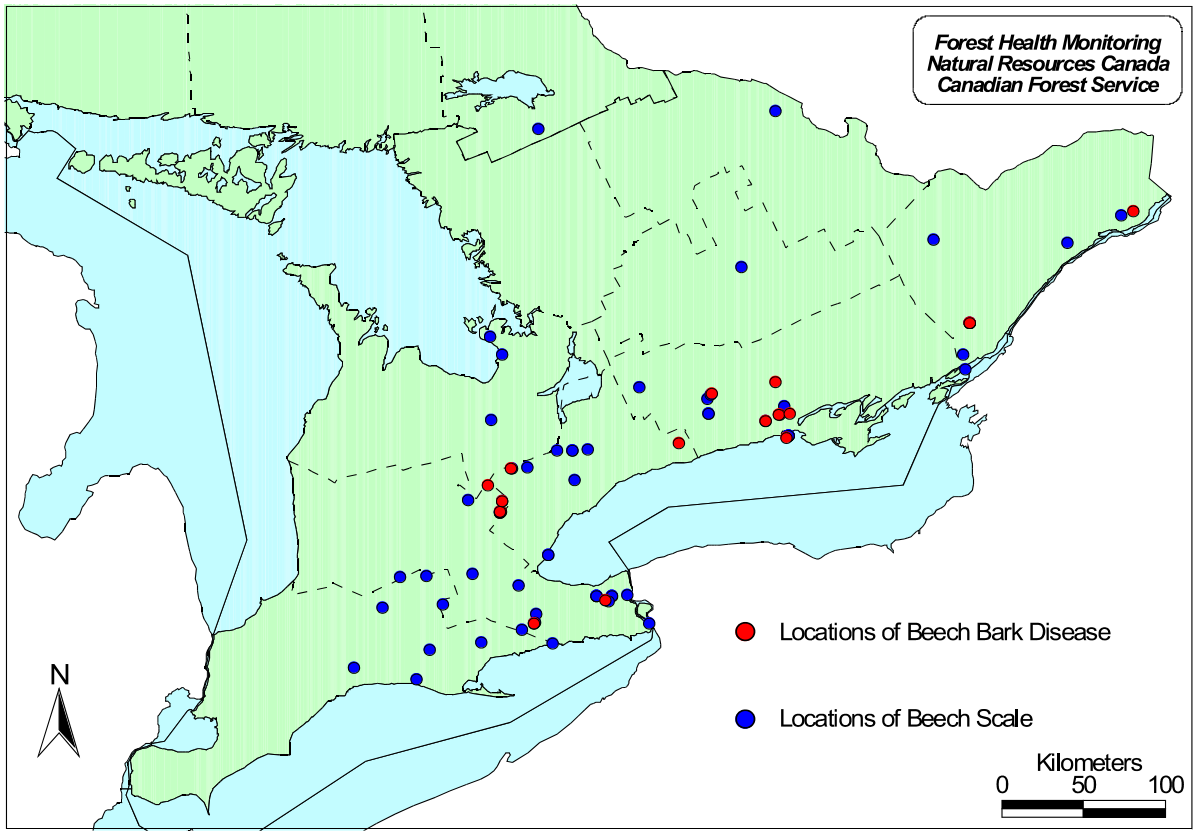

Figure 18. Confirmed locations of beech bark disease (*Nectria coccinea* (Pers.: Fr.) Fr. var. *faginata* Lohman, Watson & Ayers and the beech scale (*Cryptococcus fagisuga* Lindeman) in Ontario in 2000.

Dogwood Anthracnose, *Discula destructiva* Redlin

The origin of dogwood anthracnose is unknown; it is widely considered to be an introduced or exotic fungus. Another possibility is that a change in the environment may have altered host parasite relationships, enabling a previously innocuous fungus to become a significant pathogen. The disease kills eastern flowering dogwoods (*Cornus florida* L.) of all sizes, but is most severe on young seedlings and in understory forest trees. Infection is most likely to occur during cool, wet weather in spring and fall, but can occur at any time during the growing season. Drought and winter injury appear to increase host susceptibility.

The disease was first recorded in Ontario in 1998, in the Backus Woods in south Walsingham Township. At a single monitoring plot at this location it was determined that

46% of the trees that were infected in 1998 had died by 2000. The range of eastern flowering dogwood in Ontario and the location of known infections in 2000 are presented in Figure 19.

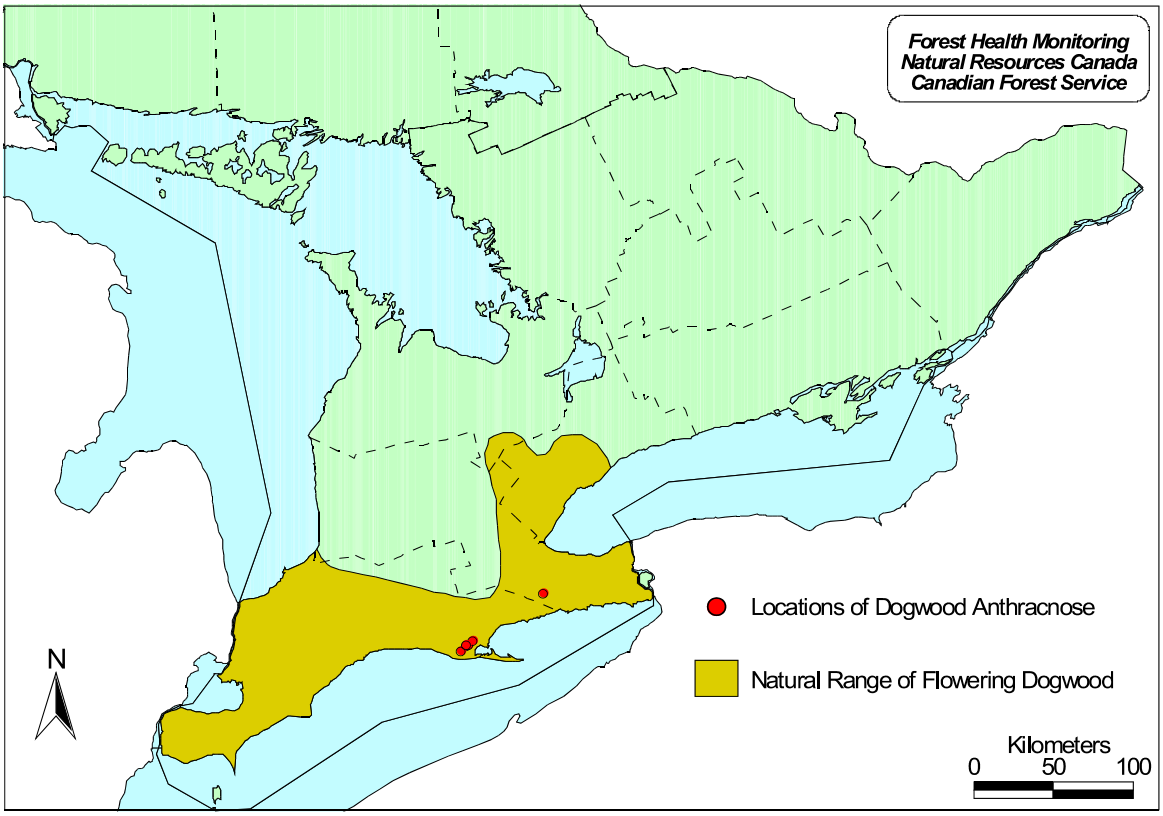

Figure 19. The range of eastern flowering dogwood (*Cornus florida* L.) in Ontario and the location of known infection sites of dogwood anthracnose (*Discula destructiva* Redlin).

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Appendix 1

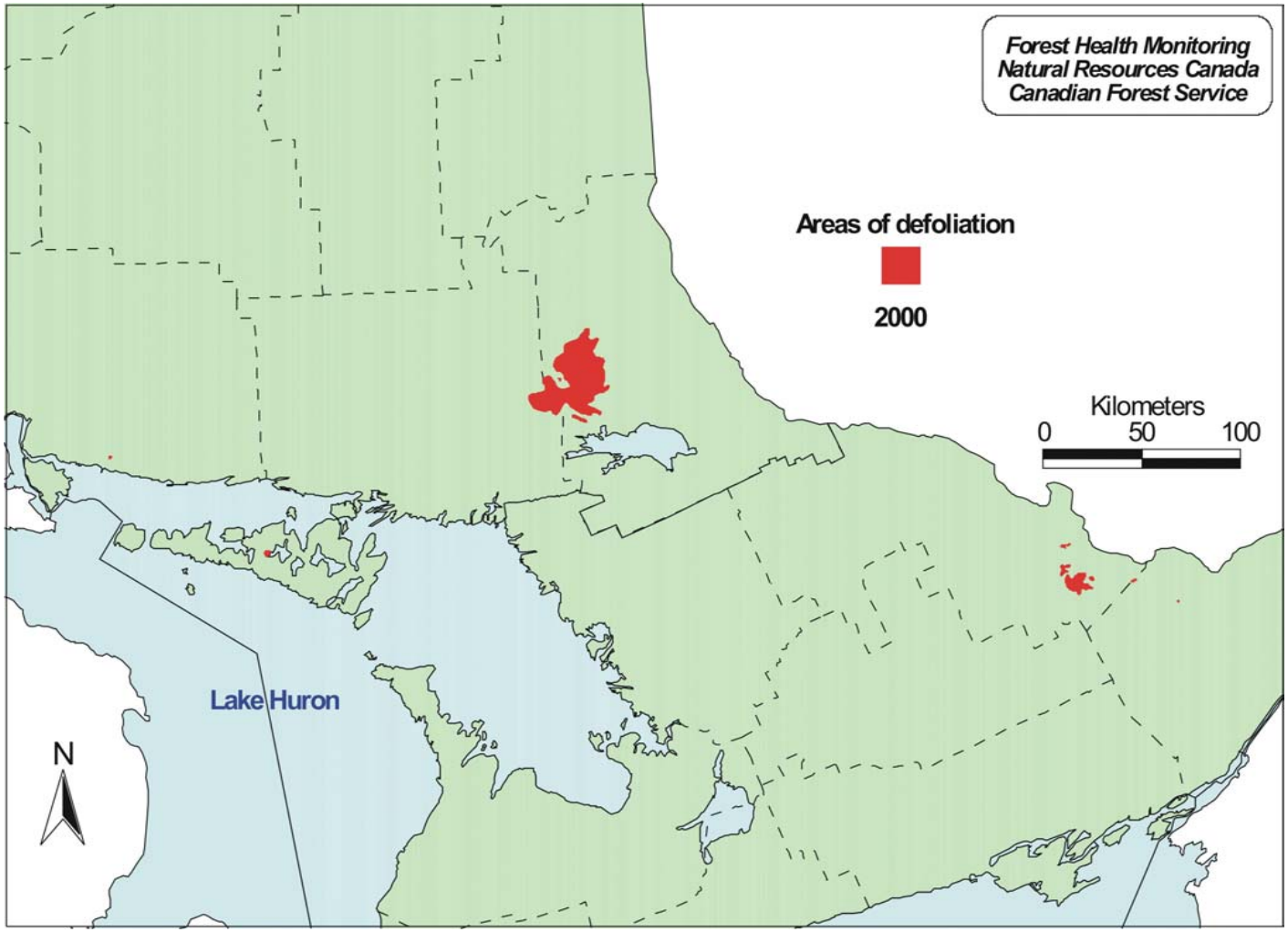

Figure 8. Areas within which moderate-to-severe defoliation caused by the spruce budworm, *Choristoneura fumiferana* (Clem.), occurred in Ontario in 2000.

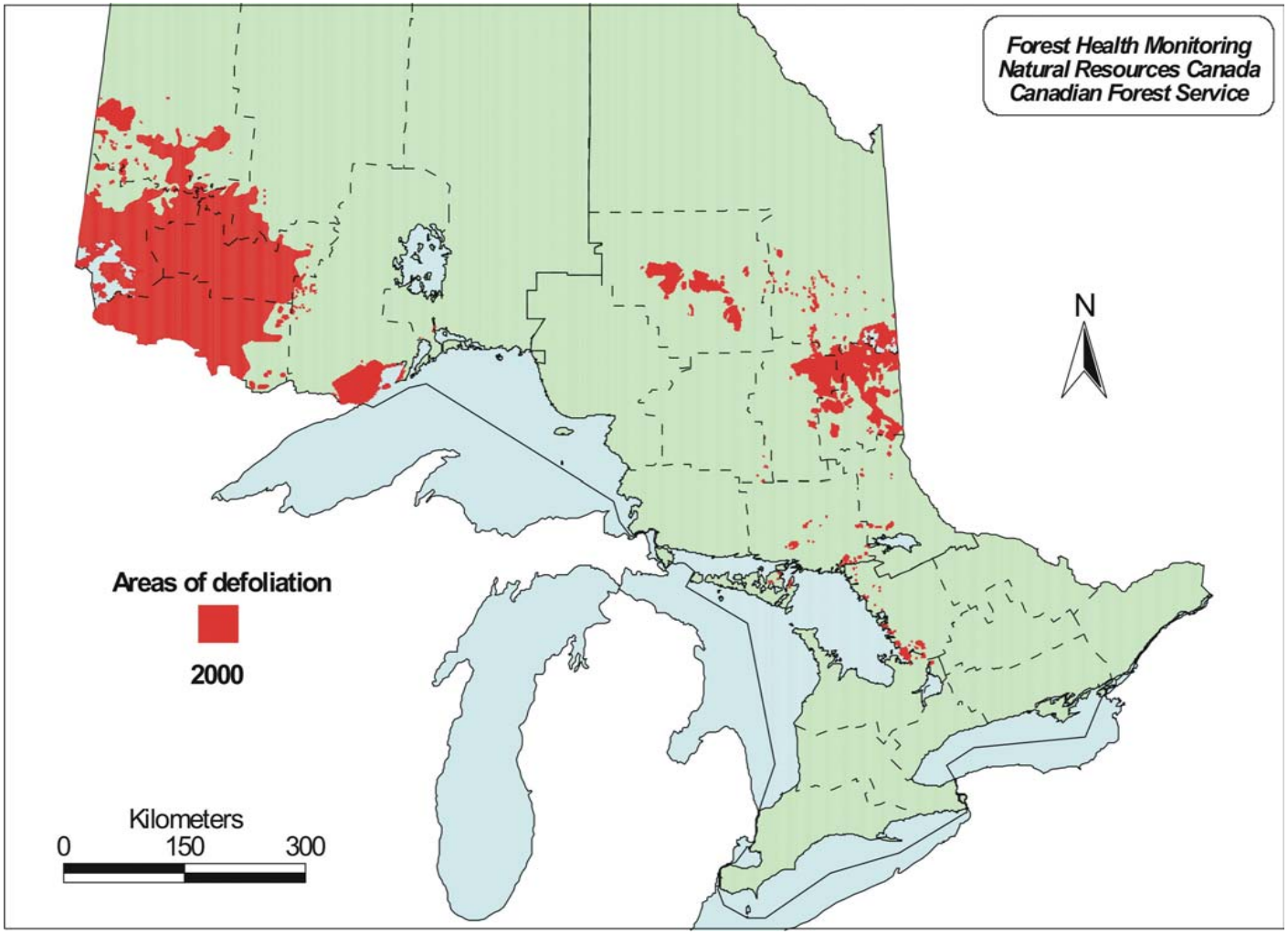

Figure 9. Areas within which moderate-to-severe defoliation caused by the forest tent caterpillar, *Malacosoma disstria* Hbn., occurred in Ontario in 2000.

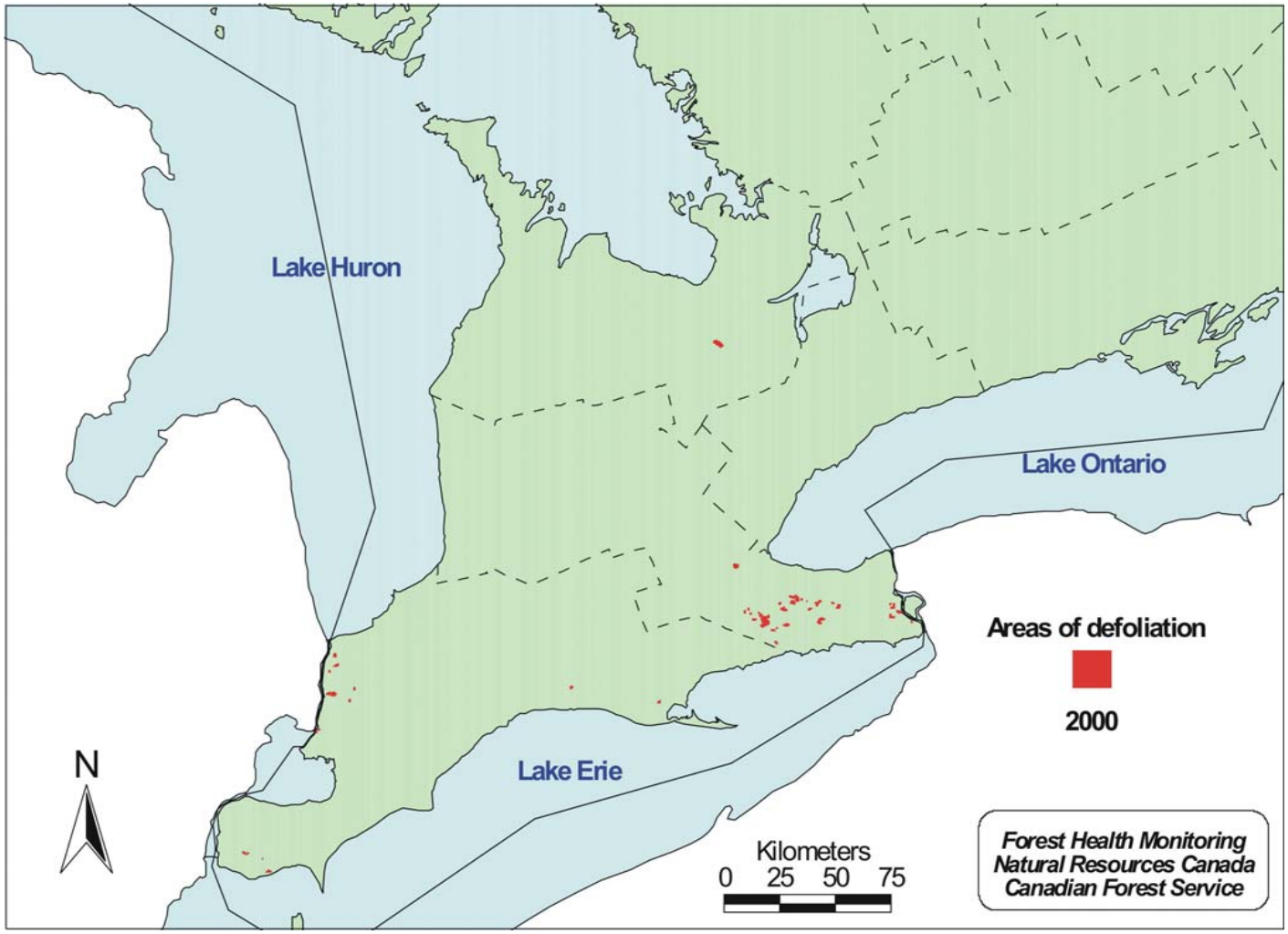

Figure 10. Areas within which moderate-to-severe defoliation caused by the oak leaf shredder, *Acleris semipurpurana* (Kft.), occurred in Ontario in 2000.

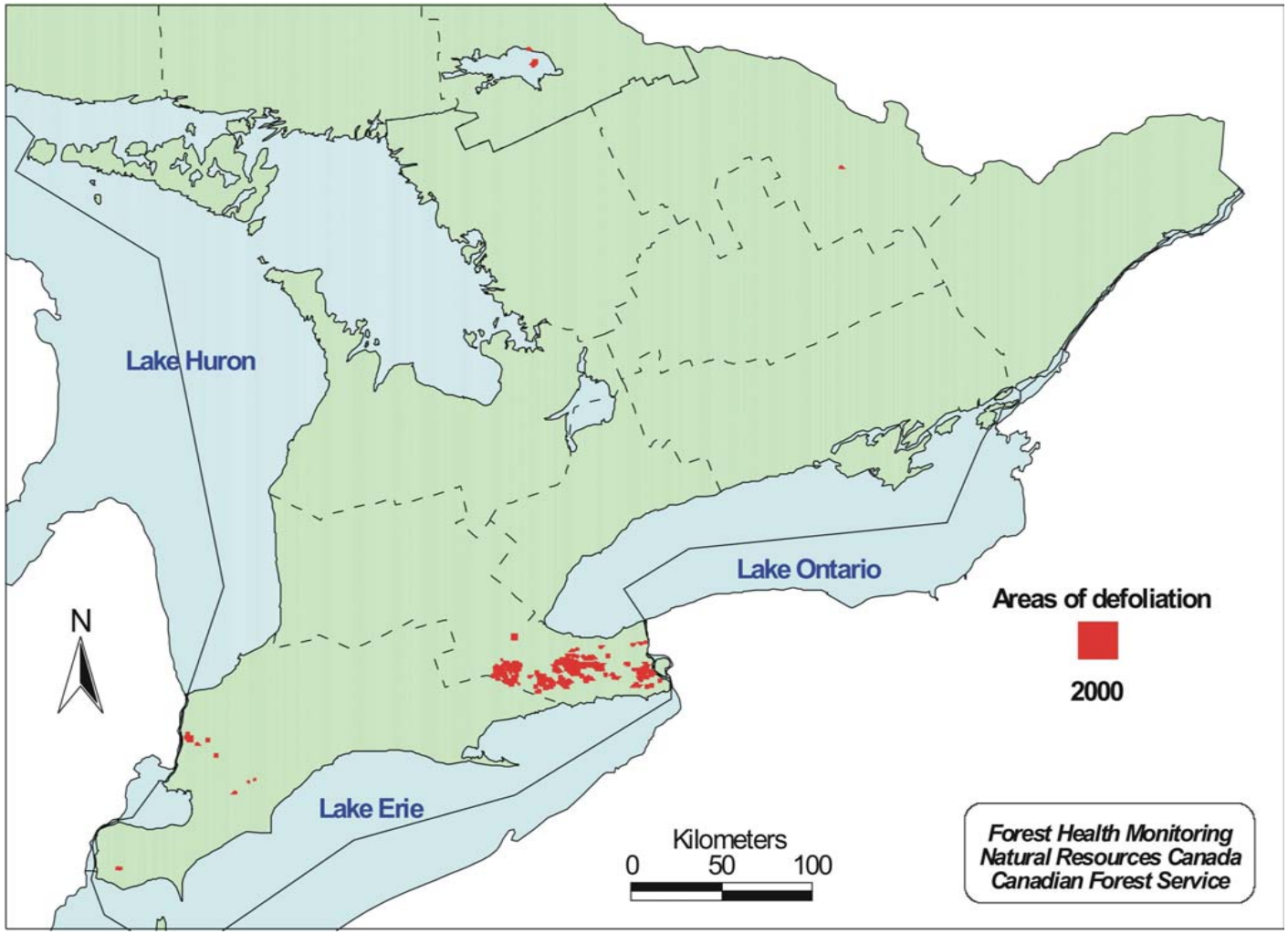

Figure 11. Areas within which moderate-to-severe defoliation caused by the gypsy moth, *Lymantria dispar* (L.), occurred in Ontario in 2000.

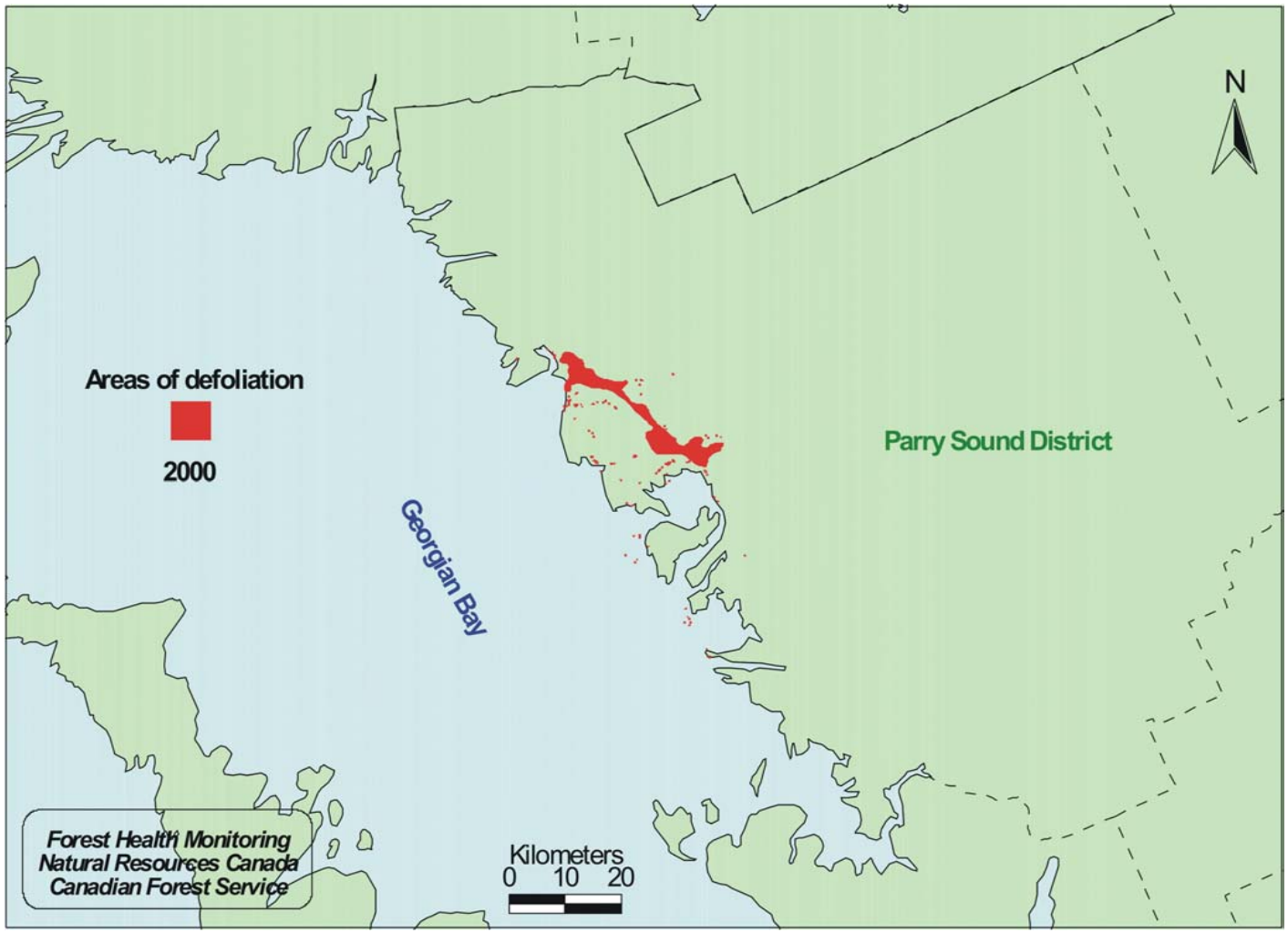

Figure 12. Areas within which moderate-to-severe defoliation caused by the introduce pine sawfly, *(Diprion similus* (Htg.), occurred in Ontario in 2000.

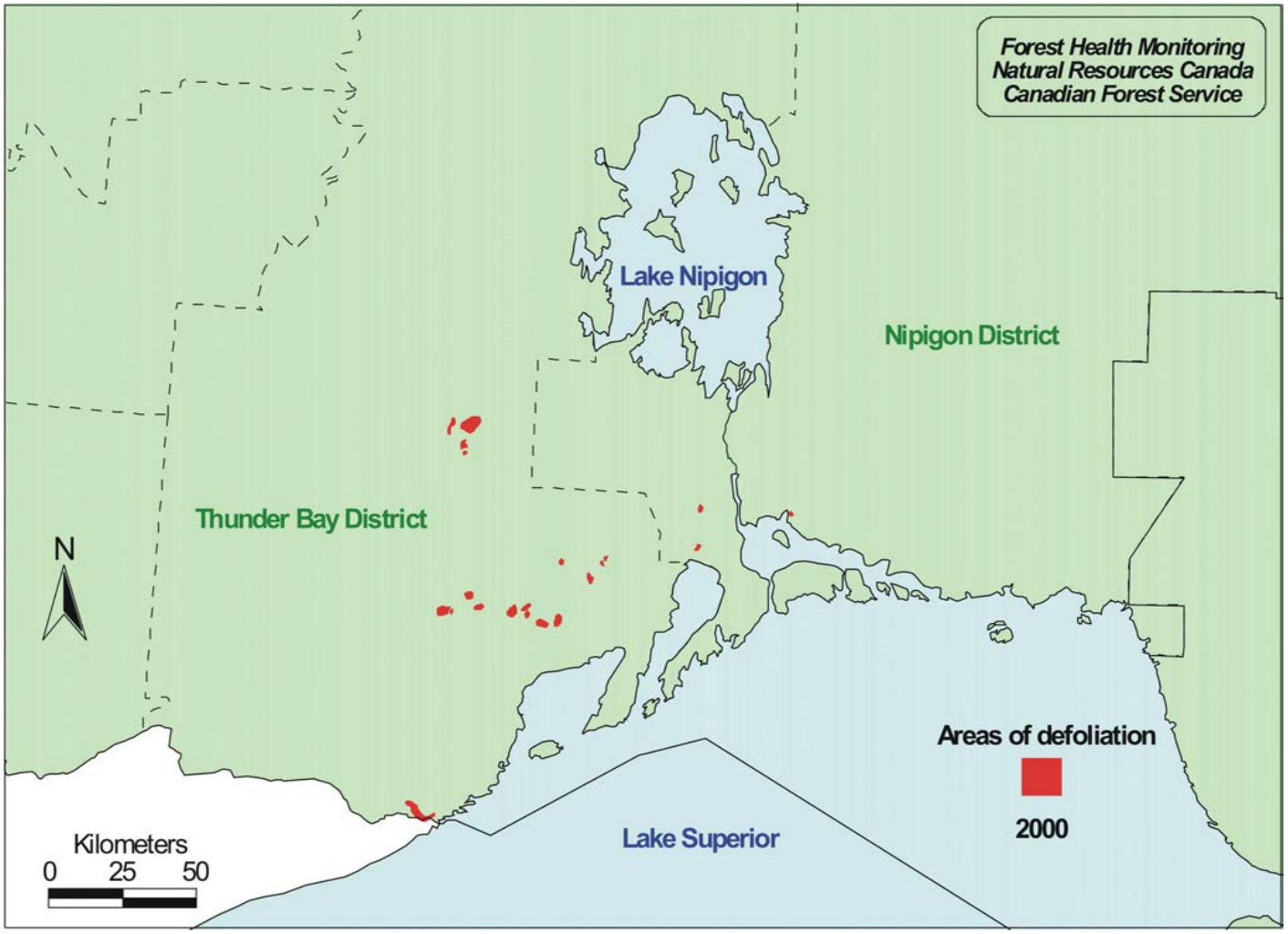

Figure 13. Areas within which moderate-to-severe defoliation caused by the large aspen tortrix, (Choristoneura conflictana (Wlk.), occurred in Ontario in 2000.

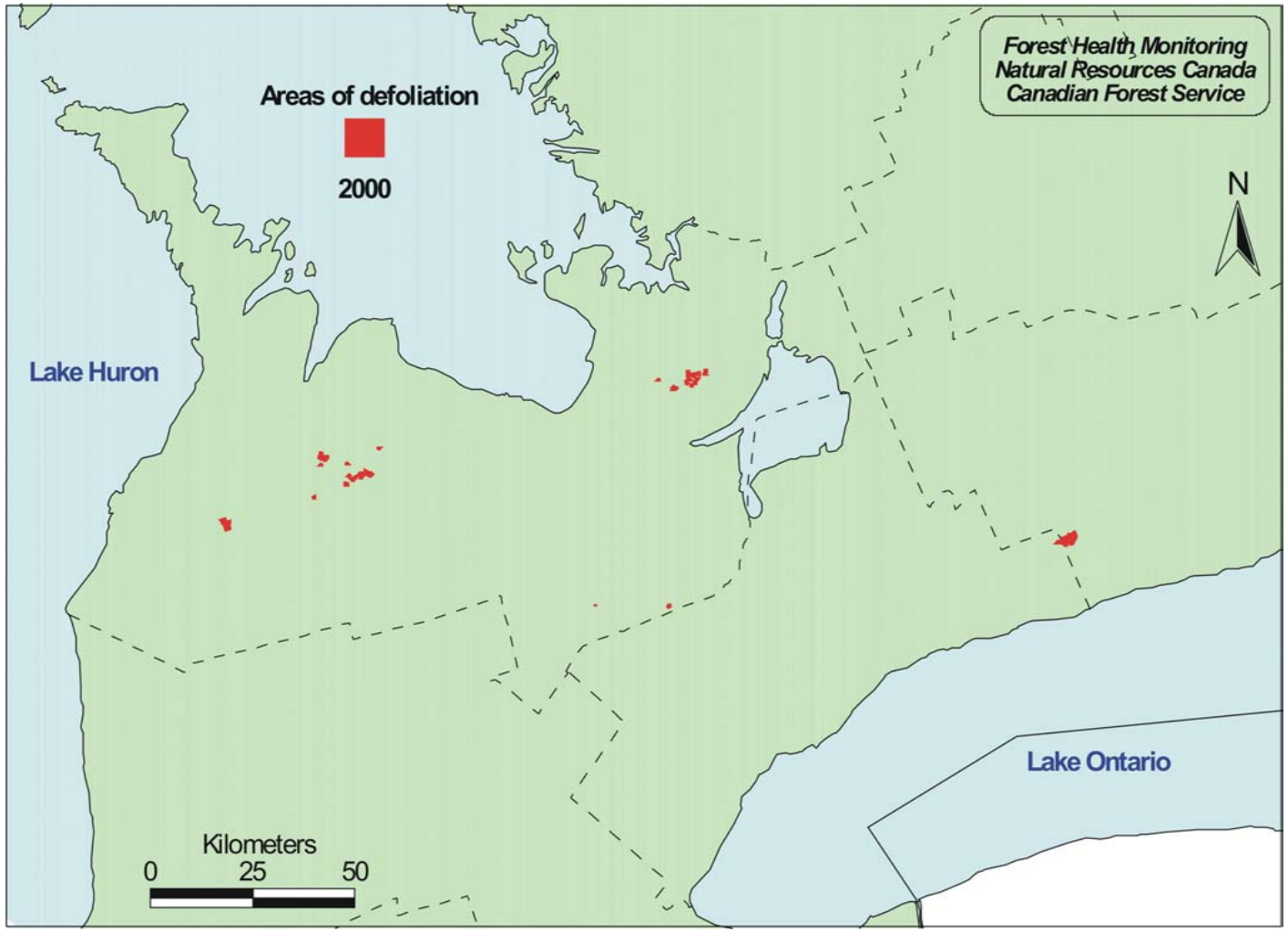

Figure 14. Areas within which moderate-to-severe defoliation caused by the pine false webworm, *Acantholyda erythrocephala* (L.), occurred in Ontario in 2000.

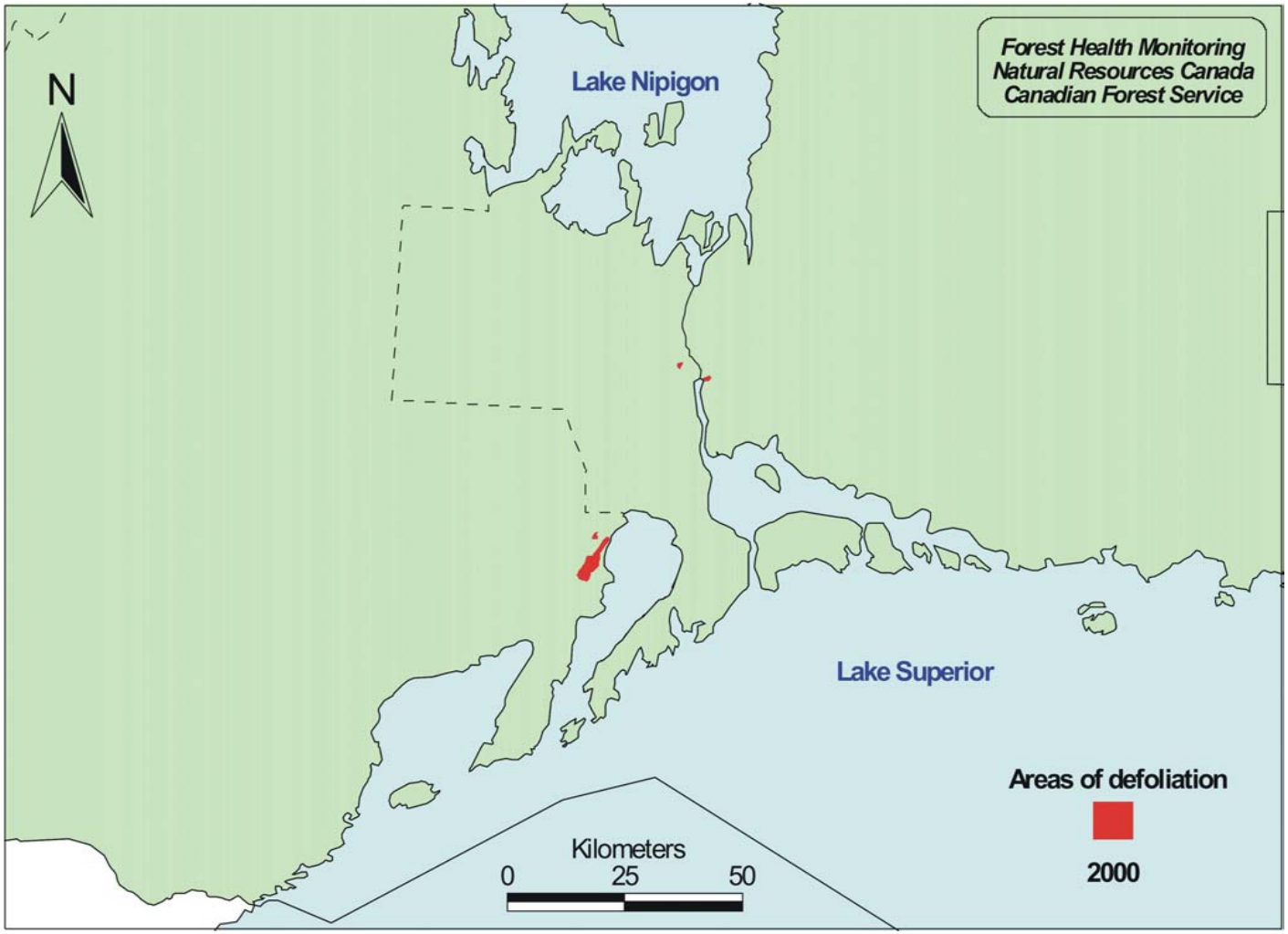

Figure 15. Area within which moderate-to-severe defoliation caused by the Bruce spanworm, *Operophtera bruceata* (Hlst.), occurred in Ontario in 2000.

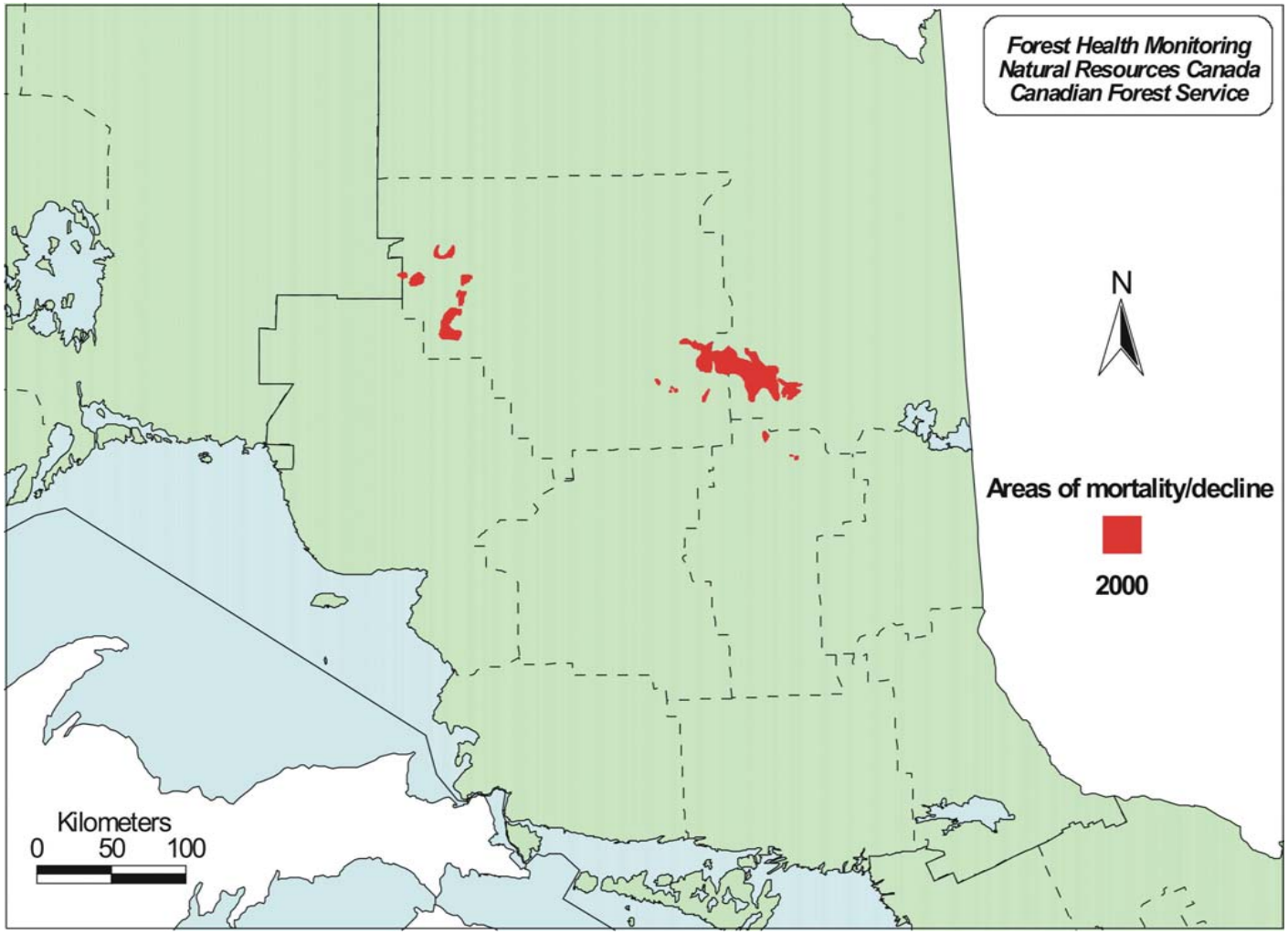

Figure 16. Areas within which aspen decline and whole tree mortality occurred in Ontario in 2000.