RESULTS OF FOREST INSECT AND DISEASE SURVEYS IN THE NORTH CENTRAL REGION OF ONTARIO 1990

(FOREST DISTRICTS: ATIKOKAN, THUNDER BAY, NIPIGON, GERALDTON AND TERRACE BAY)

H.J. Evans and S. Melbourne

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SURVEY HIGHLIGHTS

This report summarizes forest insect and disease problems encountered during the 1990 field season in the North Central Region of Ontario. It also records the results of special surveys and tree damage resulting from abiotic causes. Included in a new section, Forest Health, is a report on birch dieback.

Major outbreaks of the spruce budworm and the forest tent caterpillar dominated insect activity in the Region. Damaging levels of three plantation insects (the white pine weevil, the eastern pine shoot borer and the yellow-headed spruce sawfly) were reported in some instances. A new infestation by the spearmarked black moth was recorded, whereas infestations by the Bruce spanworm and the linden looper collapsed.

Scleroderris canker, Armillaria root rot, western gall rust and spruce needle rusts were some of the diseases that continue to cause problems for trees in the Region. Abiotic or weather-related problems included blowdown, frost damage and winter drying.

A survey of some of the Region's seed orchards replaced the annual survey of coniferous plantations in 1990. Examinations were also made at the Region's provincial tree nursery and at the acid rain monitoring plots. The first collection of gypsy moth since 1984 was made.

The format for this report remains unchanged from that of 1989. Insects and diseases are categorized as follows:

Major Insects or Diseases

capable of causing serious injury to or death of living trees or shrubs

Minor Insects or Diseases

capable of causing sporadic or localized injury but not usually a threat to living trees or shrubs

Other Forest Insects/Diseases (Tables)

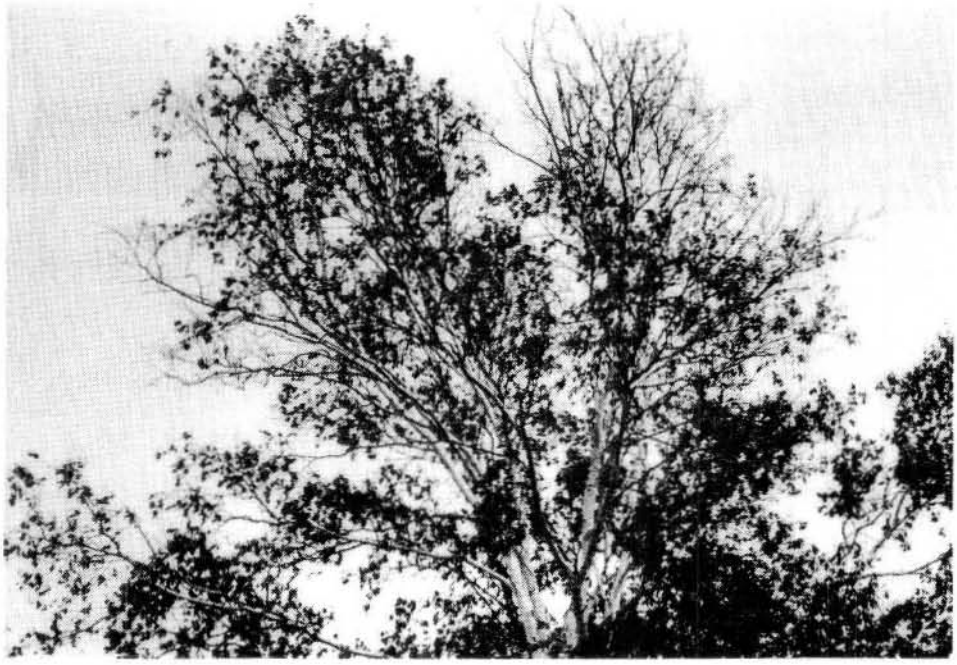
These tables provide information on two types of pest:

1) those that are of minor importance and have not been known to cause serious damage to forest trees
2) those that are capable of causing serious damage but, because of low population levels or for other reasons, did not cause serious damage in 1990.

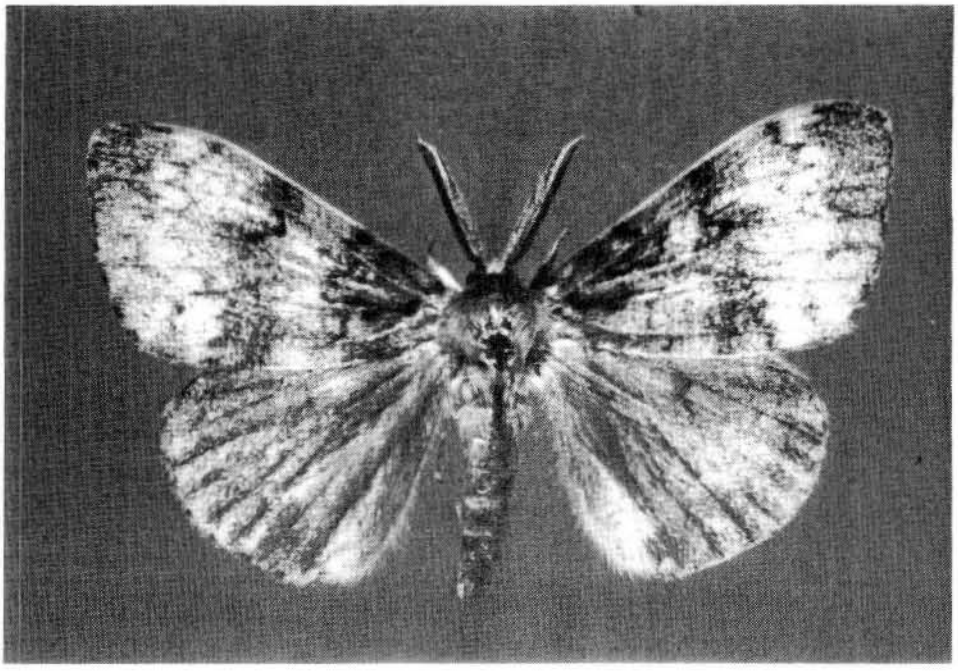
The authors gratefully acknowledge the cooperation and assistance of personnel of the Ontario Ministry of Natural Resources (OMNR) and various forest industries in the Region.

Hugh Evans
Simon Melbourne

FRONTISPIECE



Dieback of white birch (*Betula papyrifera* Marsh.) in Terrace Bay District



An adult male gypsy moth (*Lymantria dispar* [L.])

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INSECTS

Major Insects

Spruce Budworm, *Choristoneura fumiferana* (Clem.)

The spruce budworm outbreak in Ontario increased in intensity for the second consecutive year. The total gross area of moderate-to-severe defoliation expanded from 6,239,261 ha in 1989 to 6,783,261 ha this year. The largest expansion occurred in North Central Region, where increases were experienced in all districts except for Atikokan and the total increase was close to one million hectares. In Northwestern Region, the only district with an increase was Red Lake; all other districts had a decline in the total area infested. The most significant decrease occurred in Fort Frances District, where the area infested decreased from 199,084 ha to 6,720 ha. After 3 years of being confined to the North Central and Northwestern regions, the outbreak now includes relatively small areas of infestation, 6,392 ha and 2,815 ha, respectively, in Hearst District, Northern Region, and Algonquin Park District, Algonquin Region (Fig. 1).

The district in North Central Region with the largest increase was Thunder Bay, where the total area within which moderate-to-severe defoliation occurred more than doubled, to 1,273,723 ha. Increases of more than 100,000 ha occurred in each of the Nipigon, Terrace Bay and Geraldton districts, but the infestation declined in Atikokan District. This decrease totaled 71,831 ha (Fig. 2, Table 1).

There were extremely high budworm population levels in 1990, and this caused the infestation to intensify in many areas of North Central Region. Again, except for Atikokan District, areas of severe (>75%) defoliation were up in comparison with areas of moderate (25-75%) defoliation in all districts of the Region. Hosts affected included balsam fir (*Abies balsamea* [L.] Mill.) and white spruce (*Picea glauca* [Moench] Voss). The less-favored host, black spruce (*P. mariana* [Mill.] B.S.P.), sustained heavier damage than usual, particularly in the eastern half of the Region. In some instances, the damage to black spruce equalled that on balsam fir and white spruce. Larval populations in some areas were large enough to cause severe defoliation of tamarack (*Larix laricina* [DuRoi] K. Koch).

In all, 221 locations across the Region were included in the annual egg-mass survey for forecasting changes in the infestation for 1991. A number of these locations (148) were common to both 1989 and 1990, and a comparison of the egg-mass densities showed that, over all, there was a 22% decline (Table 2). In spite of this decrease, egg-mass densities are still high enough that moderate-to-severe defoliation will probably persist throughout most of the area infested in 1990. There will not likely be much expansion of the infestation, as the outbreak area is limited by a lack of the forest type preferred by the budworm and some areas will not support budworm populations because of widespread host mortality. This latter fact will become more of a factor as tree mortality increases, as is now becoming evident in Atikokan District. The egg-mass-sample locations, the 1990 foliar damage forecast for 1991, and the accumulated hazard rating are presented in the Appendix and on a regional map (Fig. 3).

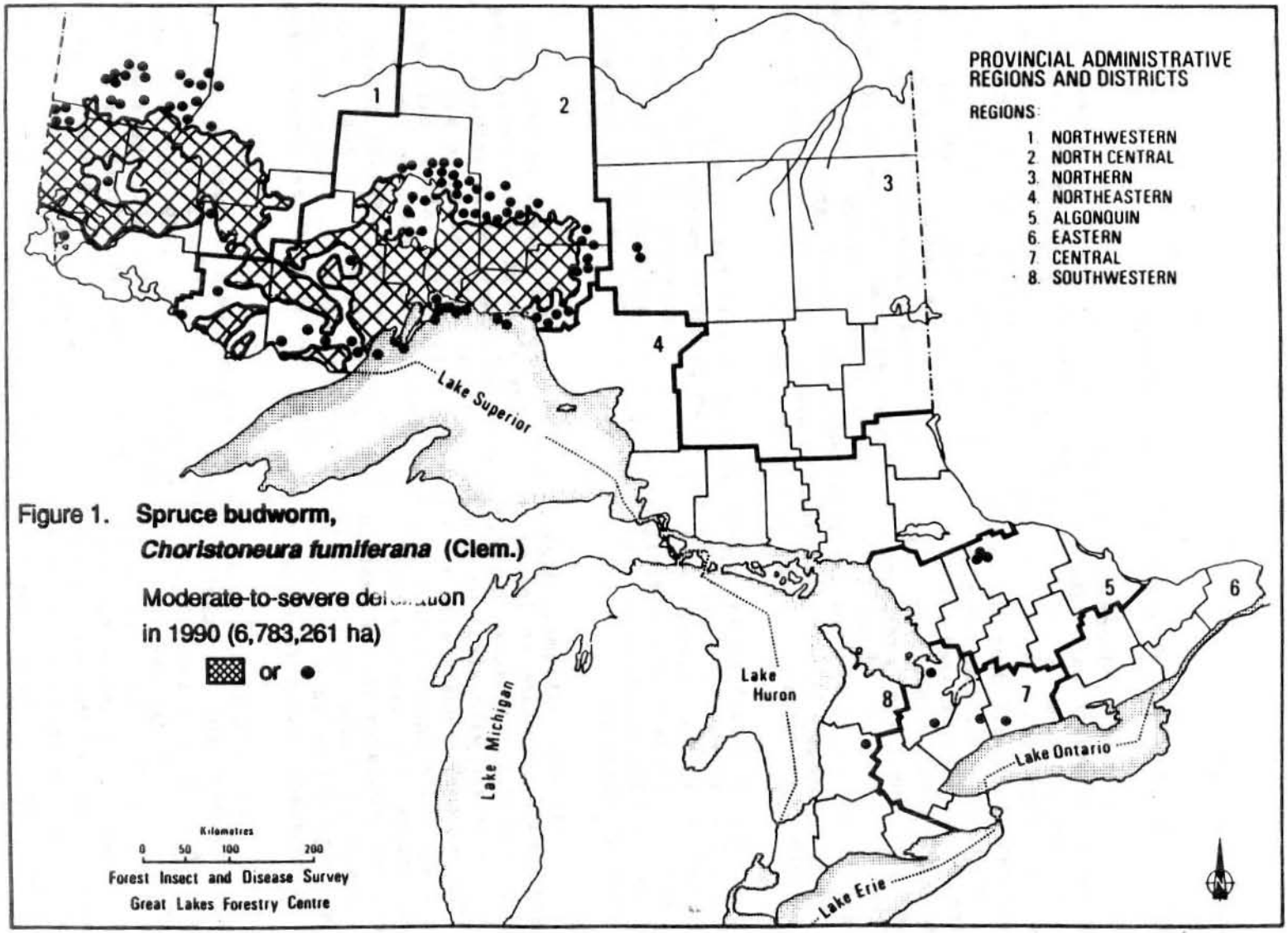

Figure 1. **Spruce budworm,**
***Choristoneura fumiferana* (Clem.)**

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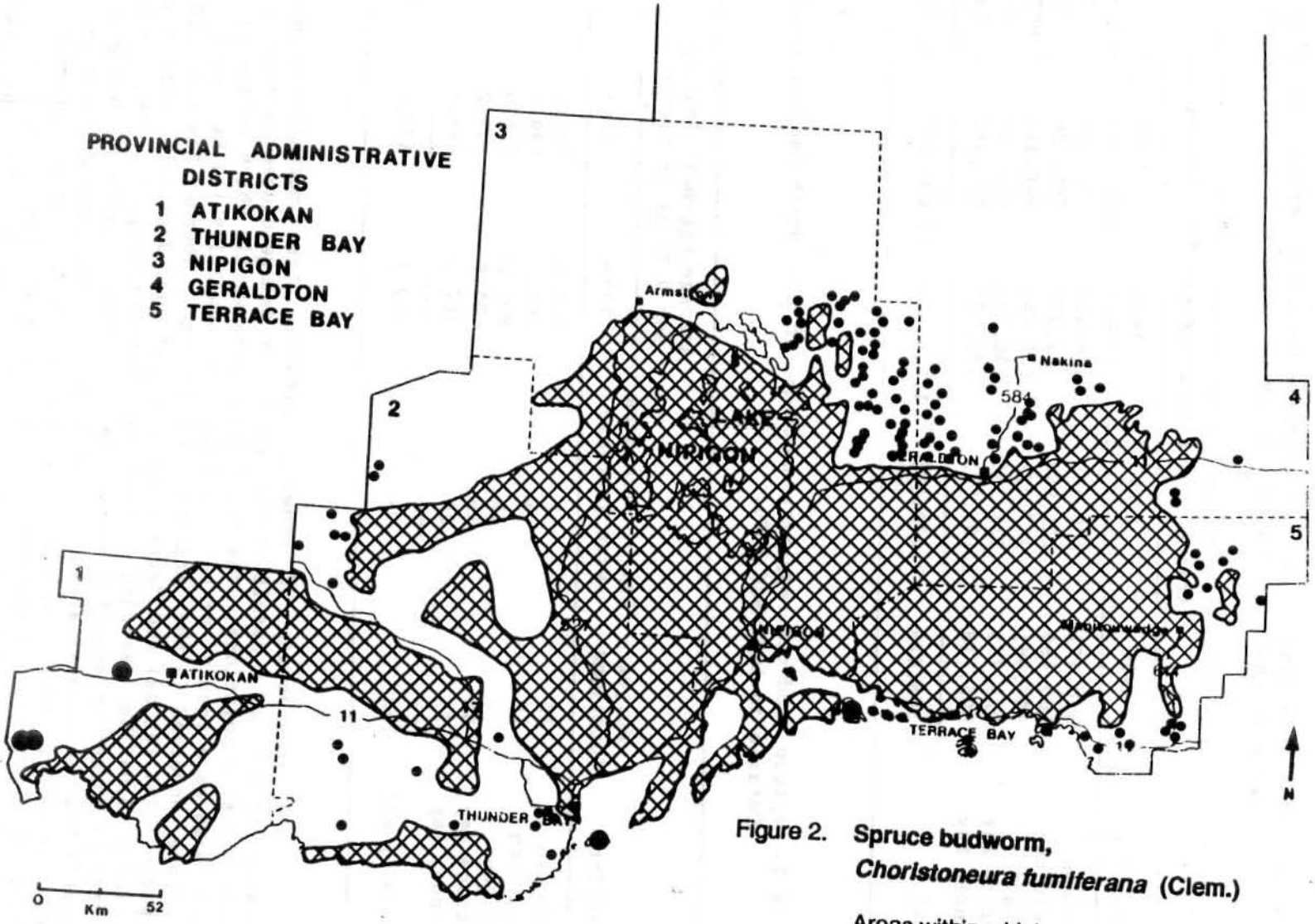

Figure 2. **Spruce budworm, *Choristoneura fumiferana* (Clem.)**

Areas within which moderate-to-severe defoliation occurred in 1990 ▨ or ●

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Table 1. Gross area (ha) of current moderate-to-severe defoliation by spruce budworm in the North Central Region of Ontario from 1986 to 1990.

	Area of moderate-to-severe defoliation (ha)				
District	1986	1987	1988	1989	1990
Atikokan	890,691	808,508	578,464	482,208	410,377
Geraldton	400,486	211,954	13,956	389,750	493,011
Nipigon	985,961	987,526	605,741	940,513	1,087,868
Terrace Bay	1,023,773	528,555	260,393	624,724	761,251
Thunder Bay	2,005,718	1,101,963	376,395	597,382	1,273,723
Total	5,306,629	3,638,506	1,834,949	3,034,577	4,026,230

Table 2. Spruce budworm egg-mass densities in the North Central Region of Ontario in 1989 and 1990.

			Average egg-mass density per 9.29 m² of branch		
District	No. of locations	No. of locations with increase	1989	1990	% change
Atikokan	15	1	313.5	145.2	-54
Geraldton	18	9	708.7	699.6	-1
Nipigon	23	11	801.2	675.6	-16
Terrace Bay	33	15	605.9	302.2	-15
Thunder Bay	59	28	262.5	264.4	+1
Over all	148	64	482.2	377.6	-22

The progression of budworm-associated tree mortality accelerated greatly in 1990 as a result of the extensive damage caused by exceptionally large larval populations. The total gross area within which balsam fir trees have died as a result of budworm damage is now 2,309,149 ha. Much of the increase occurred in the Atikokan (430,426 ha), Thunder Bay (217,110 ha), Nipigon (244,161 ha) and Terrace Bay (152,116 ha) districts, with a smaller increase (5,047 ha) recorded in Geraldton District (Fig. 4). Results of tree mortality counts in specific stands are presented in Table 3. New plots were established in several areas of new mortality and some white spruce trees were tallied as well. In some areas such as in the southern part of Nipigon District, white spruce appears to be declining as fast as balsam fir. Many trees, tallied as living, were nearly dead, as evidenced by the presence of infestation by secondary insects. The balsam fir bark beetle (*Pityokteines sparsus* [LeC.]) was found infesting the main stems of many living balsam fir at several plots.

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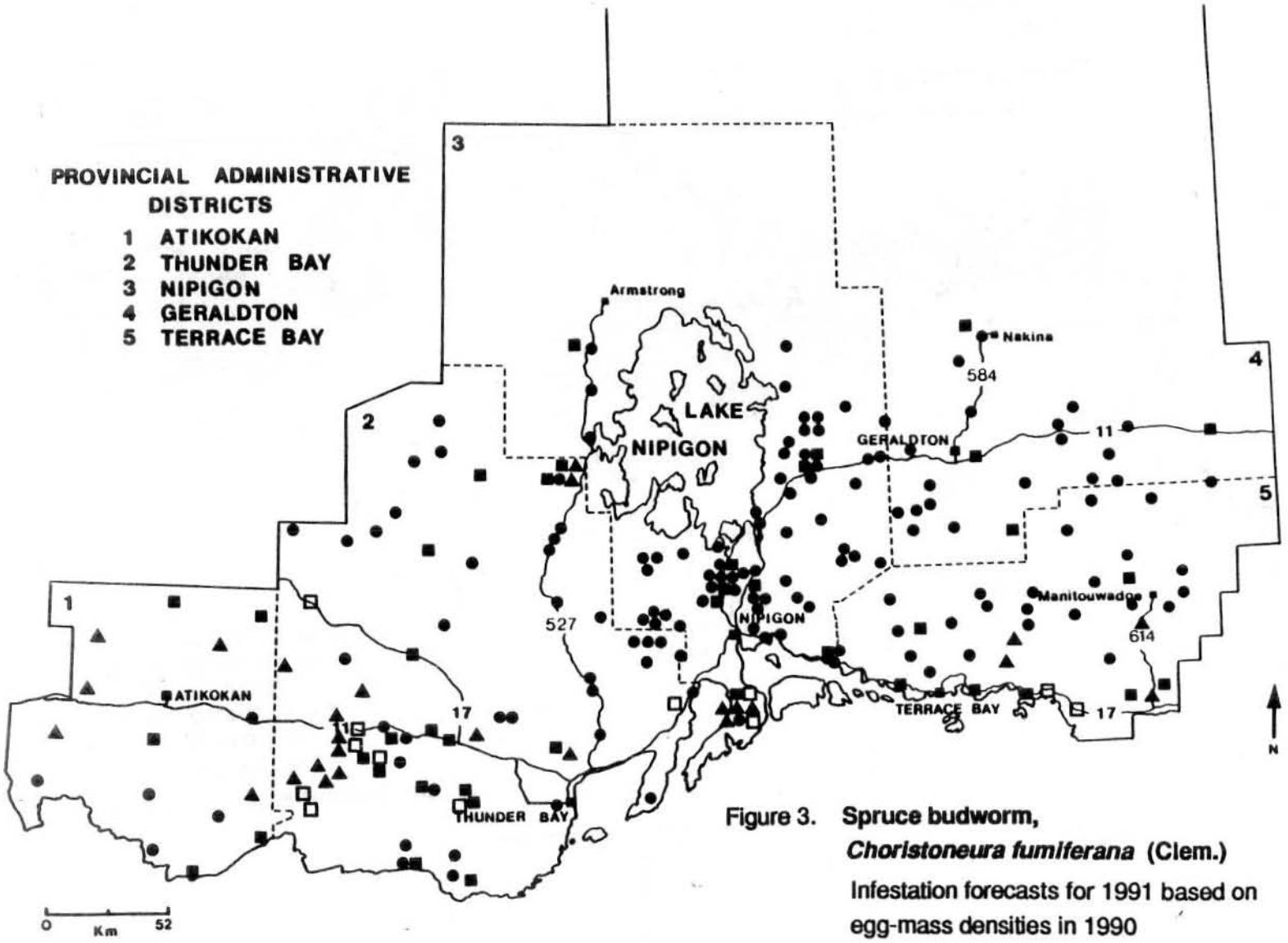

Figure 3. **Spruce budworm, *Choristoneura fumiferana* (Clem.)**

Infestation forecasts for 1991 based on egg-mass densities in 1990

severe. . . . . ● light. . . . . ▲
moderate. . . . ■ nil. . . . . □

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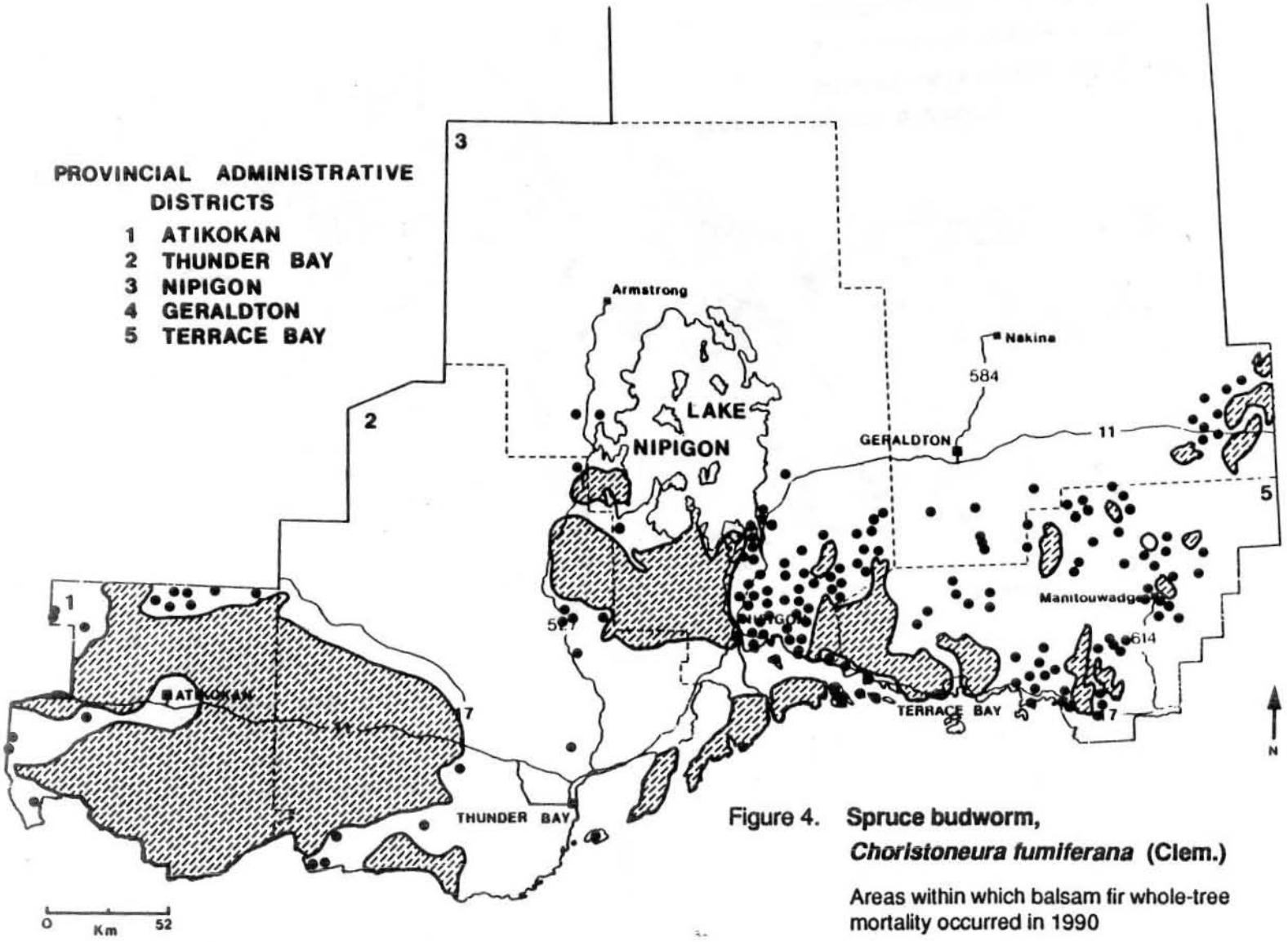

Figure 4. **Spruce budworm, *Choristoneura fumiferana* (Clem.)**

Areas within which balsam fir whole-tree mortality occurred in 1990

▨ or ●

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Table 3. North Central Region: Summary of spruce budworm-associated tree mortality, based on ground checks for the past 3 years.

Location	Host[a]	Tree mortality (%) 1988	1989	1990
Atikokan District				
Seine River	bF	58	82	98
Geraldton District				
Hwy 11, east of Nibs Lake	bF	69	80	93
Nibs Lake impact plot	bF	-	24	36
Nipigon District				
Adamson Twp	bF	9	25	28
Black Sturgeon Lake	bF	11	19	44
Booth Twp	bF	-	-	11
	wS	-	-	12
Cedar Mountain Rd	bF	-	42	49
	wS	-	-	35
Kabitotikwia Lake	bF	-	9	24
	wS	-	-	0
Lett Twp	bF	-	-	15
Limestone Lake	bF	-	-	9
Lyon Twp	bF	-	-	2
McIvor Twp	bF	-	4	19
	wS	-	-	0
McKirdy Lake	bF	-	-	25
Muskrat River	bF	21	26	28
Nipigon Twp	bF	-	9	11
Polly Lake Impact Plot	bF	-	0	10
	wS	-	0	0
Purdom Twp	bF	-	-	12
	wS	-	-	12
Shillabeer Creek	bF	24	35	36
Squawk Lake Rd	bF	-	-	7
Squawk Lake Rd	bF	-	-	4
Trapnarrows Lake	bF	-	-	8
Upper Roslyn Lake	bF	-	-	13
Terrace Bay District				
Grain Twp	bF	50	56	60
Kagiano Lake Rd	bF	-	-	7
Lyne Lake Rd	bF	-	16	85
Yesno Twp	bF	-	-	44

(cont'd)

Table 3. North Central Region: Summary of spruce budworm-associated tree mortality based on ground checks for the past 3 years (concl.).

Location	Host[a]	Tree mortality (%) 1988	1989	1990
Thunder Bay District				
Burchell Lake	bF	75	82	83
Cheeseman Lake	bF	32	59	61
	wS	0	12	13
Conacher Twp	bF	53	79	88
Fallscamp Lake	bF	-	-	9
Jacques Twp	bF	-	-	9
Mountain Lake	bF	-	13	26
Open Bay (Lac des Mille Lacs)	bF	-	14	23
Sibley Twp	bF	-	4	7
Sibley Twp	bF	-	-	5
Sump Lake	bF	20	37	41

[a] bF = balsam fir, wS = white spruce

The annual aerial spraying program to combat large populations and to protect foliage in selected areas was carried out by the Ontario Ministry of Natural Resources (OMNR) from 5 to 25 June. A total of 49,627 ha was sprayed and, of this, 44,189 ha were in Nipigon District and the remaining 5,438 ha were west of Kabitotikwia Lake in Thunder Bay District. The treated areas all received one application except for 15,326 ha in Nipigon District, which were sprayed twice. The biological insecticide *Bacillus thuringiensis* (B.t.) was used in all instances. Results of the spray program varied from nil to good among blocks. Overall results were only fair, and were the worst of the past 8 years. Reasons for these less than desirable results were (1) exceptionally large larval populations and (2) excessive rain during the spray period, which caused untimely delays in the program. A report dealing with the specifics of the aerial spray operation for 1990 will be published later.

Eastern Pine Shoot Borer, *Eucosma gloriola* Heinr.

This pest of jack pine (*Pinus banksiana* Lamb.) regeneration was again prevalent through the Atikokan and Thunder Bay districts. Lower population levels were found in Nipigon District. The shoot borer attacks new shoots of the tree, but seems to prefer the main leader, where its impact is greatest. The highest incidence of leader damage (19.5%) occurred at the Bluebird Lake family-test site, Thunder Bay District. Results for the surveyed areas are summarized in Table 4.

Table 4. Damage to jack pine caused by the eastern pine shoot borer in three districts of the North Central Region of Ontario in 1990 (counts based on an examination of a minimum of 150 trees at each location).

Location	Area affected (ha)	Estimated no. of trees/ha	Avg. ht. of trees (m)	Leaders attacked (%) 1989	1990
Atikokan District					
Bending Lake Road	5	2,500	1.4	–	5.5
Hwy 11 - Lerome Lake	10	3,000	2.9	18.0	18.0
Sapawe-Upsala Road	10	2,000	3.0	20.0	16.0
Nipigon District					
Kopka Lake	47	4,000	2.2	2.0	0
Waweig Lake	10	3,000	3.4	1.0	3.0
Thunder Bay District					
Bluebird Lake	5	2,500	0.7	–	10.0
English River	20	2,500	1.5	8.0	16.0
Fallscamp Lake	5	2,500	0.8	–	19.5
Granite River	20	3,000	1.6	–	17.0
Hagey Twp	2	2,500	2.2	–	4.0
Kakabeka Falls	15	3,730	0.9	–	2.5
Robson Twp	5	2,500	0.9	–	5.0

Birch Leafminer, *Fenusa pusilla* (Lep.)

This pest of white birch (*Betula papyrifera* Marsh.) recurred at damaging levels in many areas of the Region. Damage was quite late in showing up in the eastern part of the Region because of colder-than-normal weather conditions. Since its introduction to North America in 1923, this pest has become the most troublesome leafminer of birch, at least in eastern Canada. Feeding damage at moderate or heavy levels causes a distinct browning of the foliage.

There were several areas of forest tree damage in which 80 to 100% of the trees were affected, with 60 to 100% defoliation. Such damage occurred in a 40-ha area along the Pigeon River in Pardee Township and in two separate 30-ha areas of O'Connor Township, both in Thunder Bay District; in a 15-ha area along Highway 614, Terrace Bay District; within an 8-ha stand in Oakes Township, Geraldton District; and along the Gorge Creek Road, Nipigon District, where 25 ha were affected. Similar damage to smaller clumps of birch was evident at several other locations, particularly in the rural area surrounding the city of Thunder Bay and the town of Nipigon. In addition, varying degrees of damage to ornamentals were reported from most urban areas of the Region.

Forest Tent Caterpillar, *Malacosoma disstria* Hbn.

There was a marked expansion of the forest tent caterpillar outbreak in North Central Region in 1990. Dramatic increases in the total area of infestation were experienced in each of the five districts and, over all, the infestation enlarged to more than three times its 1989 size (Table 5, Fig. 5). Although trembling aspen (*Populus tremuloides* Michx.) is the primary host in northern Ontario, other deciduous trees, shrubs and ground cover were also attacked where population levels were high. Other trees commonly attacked were balsam poplar (*Populus balsamifera* L.) and white birch.

Table 5. Gross area of current moderate-to-severe defoliation by the forest tent caterpillar in the North Central Region of Ontario from 1987 to 1990.

	Area of moderate-to-severe defoliation (ha)			
District	1987	1988	1989	1990
Atikokan	1,770	28,160	423,404	816,998
Geraldton	0	0	180	74,730
Nipigon	0	560	8,535	176,686
Terrace Bay	380	690	4,255	35,065
Thunder Bay	280	4,230	19,739	310,307
Total	2,430	33,640	456,113	1,413,786

Populations of the caterpillar also increased within most of the infested areas. In some areas, the host trees were stripped of their foliage before the larvae had matured. Detailed monitoring of larval development and host damage at one location in Terrace Bay District showed that 100% defoliation occurred 2 weeks earlier than in 1989 despite later and slower larval development in 1990. The cool, wet weather during the caterpillar's feeding period did not appear to interfere with its development or feeding habits. In general, foliar damage of 70 to 100% was common in all infested areas, but lighter damage (50 to 80%) was sometimes more prevalent, particularly in newly infested areas.

Atikokan District continues to have the largest area of defoliation. Here, more than 70% of the district is within the outbreak boundaries and foliar damage throughout most of this area was generally severe (>70%). The only exception occurred in the southeastern portion of Quetico Provincial Park around Basswood and Kawnipi lakes, where defoliation decreased even though the area of infestation increased.

In Thunder Bay District, the infestation spilled over from Atikokan District into the English River-Graham-Upsala areas. Various-sized pockets of defoliation were evident north and east of these areas. The size of the

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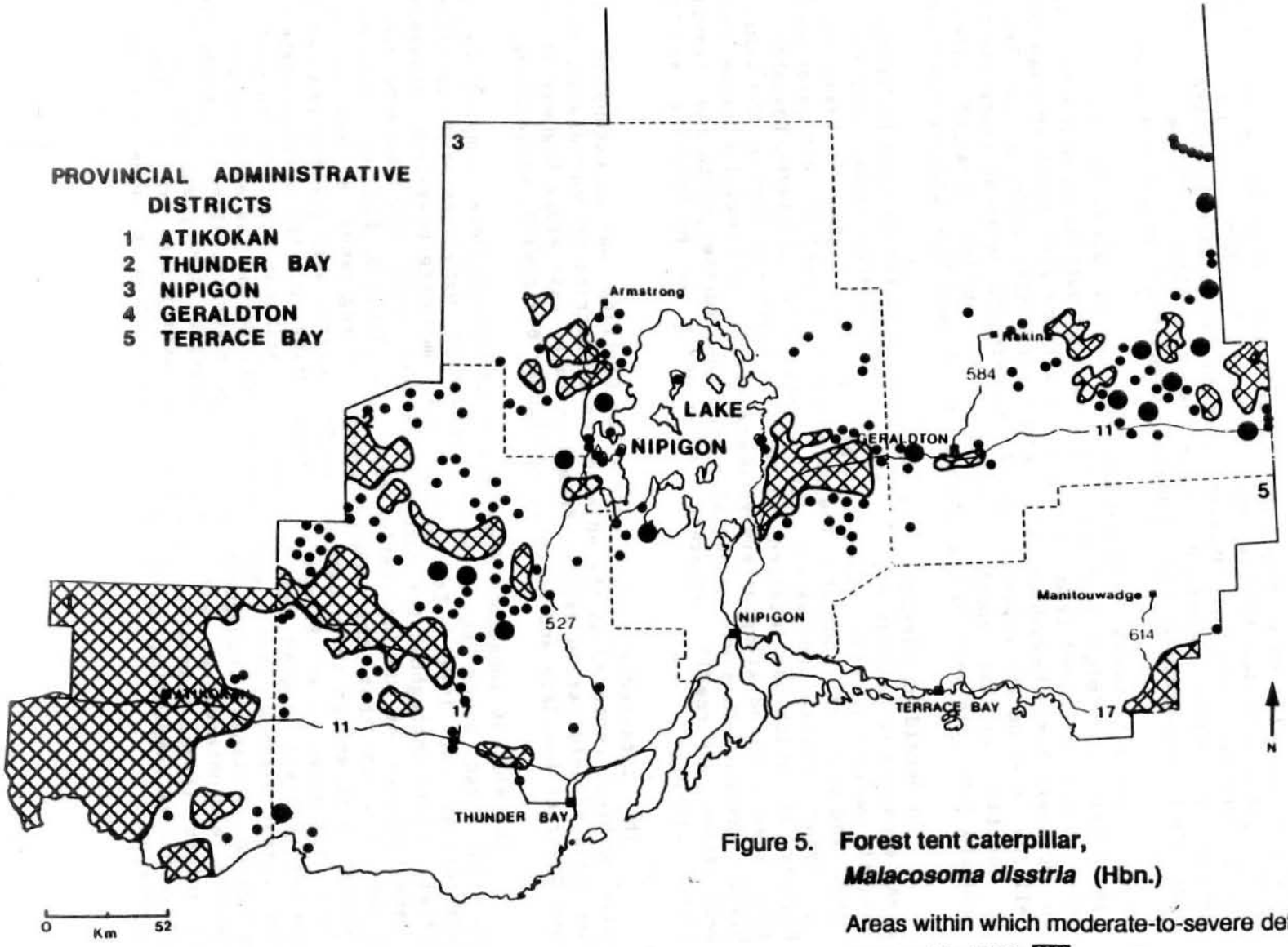

Figure 5. Forest tent caterpillar, *Malacosoma disstria* (Hbn.)

Areas within which moderate-to-severe defoliation occurred in 1990 ▨ or ●

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Sunshine infestation enlarged considerably and there were a few relatively small pockets of new defoliation in McTavish Township and north of the city of Thunder Bay. The only decline occurred in the Kashabowie area, where the infestation almost collapsed. There was a parallel collapse of the Bruce spanworm (*Operophtera bruceata* [Hlst.]) populations in the same area.

Medium-to-heavy infestations were evident along the western side of Lake Nipigon in Nipigon District. The numerous outbreaks, which were all new infestations, extended from the Collins-Armstrong area south through Gull Bay to McIntyre Bay. Meanwhile, the second-year infestation in the Beardmore-Jellicoe area on the eastern side of Lake Nipigon expanded along the Highway 11 corridor as far south as Orient Bay. Smaller areas of infestation occurred from Lake Jean in the south to the Onaman Lake area in the north.

In Geraldton District, the infestation in the MacLeod Provincial Park area expanded to include all of the park and adjacent area, and there were several smaller pockets along Highway 11. The biggest increase occurred north and east of Longlac. The numerous outbreaks in this area were all first-year infestations except for a small area in Clavet Township along Highway 11, which was infested in 1989. A large portion of the damage in this area occurred along waterways where stands of trembling aspen occur on higher ground. This was especially true the further north one travelled. Defoliation was readily apparent as far north as the Drowning and Little Current rivers.

The infested area in Terrace Bay District was an extension of the large outbreak centered in the adjacent Wawa District of Northeastern Region. The area of defoliation extends from Rous Lake east along Highway 17 to the Wawa District boundary and north along Highway 614 towards Manitouwadge.

In all, 56 locations from across the Region were sampled for over-wintering egg bands to forecast population densities and defoliation expectations for 1991. It appears that moderate-to-severe damage will prevail again throughout the currently infested area and some expansion and intensification of the infestation may occur (Table 6, Fig. 6). However, it should be noted that the actual numbers of egg bands at some locations, although high enough to be categorized as severe, were greatly reduced from 1989. For example, at Flanders, Atikokan District, the average number of eggs per tree was reduced from 104.0 to 7.3. Atikokan District, in part, has been infested since 1987, and may very well be in the early stages of a population decline. Throughout much of the district, diseased larvae were commonly encountered, as was the pupal parasite *Sarcophaga aldrichi* Park. Late-instar larval starvation, whereby the caterpillars exhaust their food supply before completing development, also occurred in some parts of the district.

Table 6. Forest tent caterpillar egg-band counts on trembling aspen in the North Central Region of Ontario in 1990, with infestation forecasts for 1991.

Location	Avg. DBH of trees (cm)	Avg. no. of egg bands per tree	Infestation forecast for 1991
Atikokan District			
Flanders	13	7.3	Severe
French Lake	11	10.7	Severe
Grey Trout Lake	17	29.5	Severe
Hardtack Road	11	21.0	Severe
Hwy 11 - Lerome Lake	10	12.5	Severe
Ramsay-Wright Twp	13	18.5	Severe
Geraldton District			
Ashmore Twp	12	21.0	Severe
Castlebar Lake Lodge	12	21.0	Severe
Chipman Lake Rd	13	13.0	Severe
Fernow Lake	10	1.6	Light
Fish Creek, Hwy 11	11	14.5	Severe
Hwy 584, Biscuit Lake	12	0.7	Light
Hwy 11, Pagwachuan River	11	9.0	Severe
Hwy 11, east of Pagwachuan River	9	1.5	Light
Lindsley Twp	11	9.3	Severe
O'Meara Twp	9	0.7	Light
Nipigon District			
Eva Twp - Hwy 580	10	18.0	Severe
Hwy 11 - south of Beardmore	13	23.0	Severe
Hwy 527 - Gull Bay	10	14.0	Severe
Hwy 527 - Kopka River	16	47.0	Severe
Hwy 527 - McKenzie Lake	12	19.5	Severe
Hwy 801	9	4.0	Moderate
Lapierre Twp	18	33.0	Severe
Ledger Twp	12	0	Nil
Lett Twp	21	53.0	Severe
Muskrat Lake	12	14.5	Severe
Orient Bay	11	26.0	Severe
Pifher Twp	12	61.0	Severe
Pine Portage	10	1.0	Light
Red Rock	10	1.3	Light
Shillabeer Lake	9	2.3	Moderate
Walters Twp	14	23.0	Severe

(cont'd)

Table 6. Forest tent caterpillar egg-band counts on trembling aspen in the North Central Region of Ontario in 1990, with infestation forecasts for 1991 (concl.)

Location	Avg. DBH of trees (cm)	Avg. no. of egg bands per tree	Infestation forecast for 1991
Terrace Bay District			
Hwy 614, Eric Lake	8	1.3	Light
Hwy 614, Phillips Creek	13	21.0	Severe
Lecours Twp	11	3.0	Moderate
Pic Twp	11	0	Nil
Thunder Bay District			
Aldina Twp	14	1.3	Light
Aylsworth Lake	12	25.0	Severe
Blackwell Twp	14	33.0	Severe
City of Thunder Bay	12	2.7	Moderate
Crooks Twp	14	0.3	Light
Fallis Twp	11	21.0	Severe
Grew River Road	22	21.5	Severe
Hainey Twp - Kashabowie	16	6.3	Moderate
Hwy 527 - Hicks Lake	17	52.0	Severe
Hwy 527 - Rinker Lake	8	16.5	Severe
Jack Lake	12	52.0	Severe
Jacques Twp	13	11.5	Severe
Kabitotikwia Lake	14	59.0	Severe
MacGregor Twp	11	0.7	Light
McTavish Twp	10	15.5	Severe
Northern Light Lake	28	2.7	Light
Paipoonge Twp	13	0.7	Light
Pyramid Twp	19	47.0	Severe
Sunshine	11	25.0	Severe
Upsala Twp	12	29.0	Severe

Pine Sawflies, *Neodiprion n. nanulus* Schedl. and *N. pratti banksianae* Roh.

These two pine sawflies were again prevalent throughout much of the Atikokan and Thunder Bay districts and at occasional locations in Geraldton District. Affected jack pine were mostly on the fringes of forest stands and foliar damage ranged from 5 to 40%, with occasional trees sustaining as much as 90% defoliation. In Thunder Bay District, defoliation averaged 20% near Huronia and in Fallis and Robson townships. Five percent foliar damage occurred on fringe trees near English River. In Atikokan District, 10% defoliation was reported at Nym Lake and near Kawene, whereas foliar damage averaged 40% on trees near French Lake. Defoliation averaging 5% occurred at two points in Ashmore Township, Geraldton District. The only plantation with any significant damage was near Perch Lake, Atikokan District, where 5% of the 3-m trees sustained 20% defoliation.

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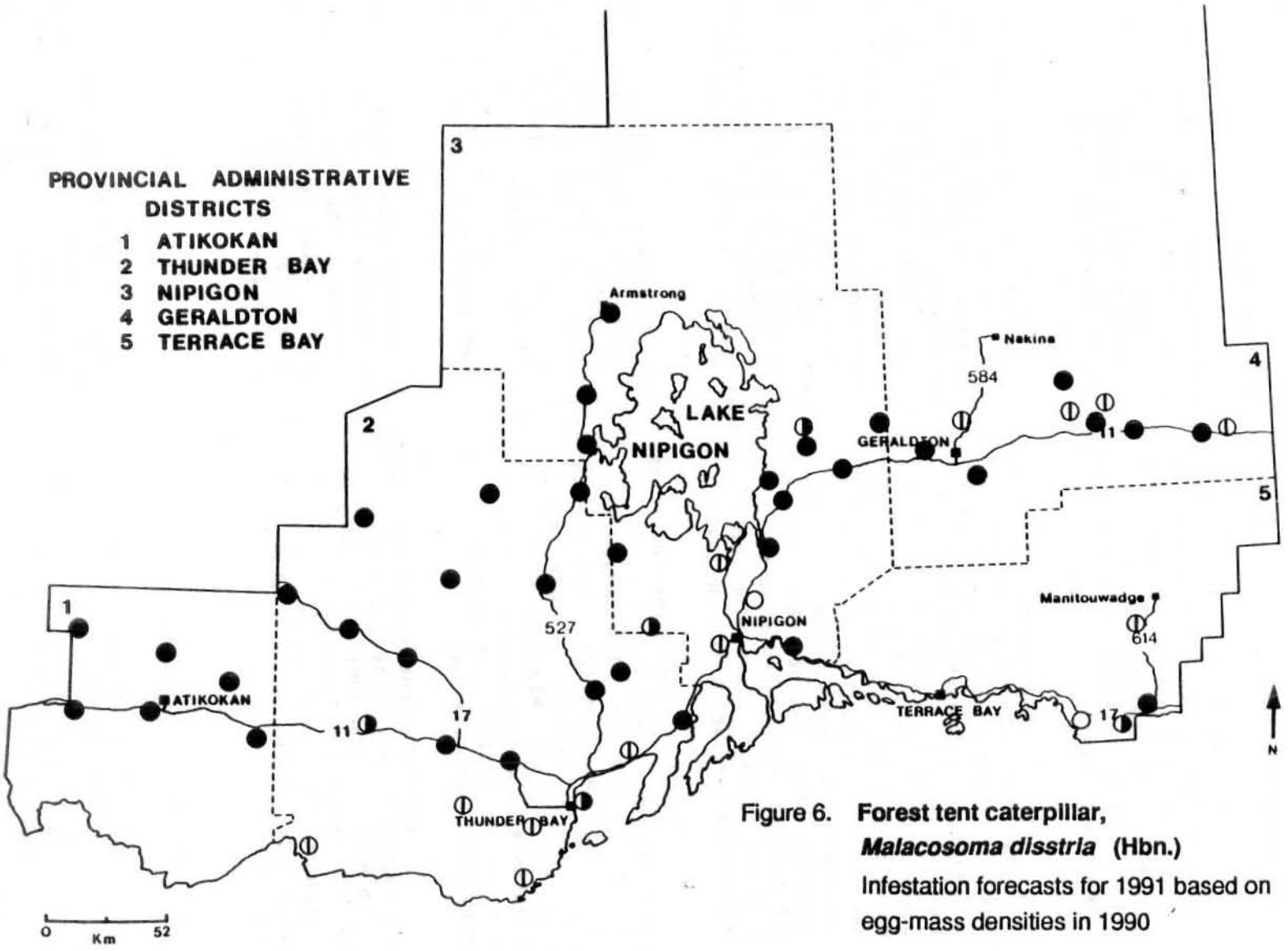

Figure 6. **Forest tent caterpillar, *Malacosoma disstria* (Hbn.)**
Infestation forecasts for 1991 based on egg-mass densities in 1990

severe. . . . . ● light. . . . . ◐
moderate. . . . ◑ nil. . . . . ○

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

Populations of the yellowheaded spruce sawfly increased throughout much of the Atikokan and Thunder Bay districts but remained similar to 1989 levels in the Geraldton and Terrace Bay districts. The insect was not collected in Nipigon District in 1990. Feeding damage occurred in plantations, on fringe and shoreline trees, and on hedgerows and ornamental trees (see photo page).

In Roberta Township, Terrace Bay District, an ongoing infestation in a 6-ha plantation of young black spruce caused an average of 55% defoliation despite a spray operation carried out by OMNR. There are pockets of 70% defoliation in nearby stands. Better results were obtained at the O'Connor Seed Orchard in Thunder Bay District, which was also sprayed by OMNR. Here, black spruce averaged 11% defoliation on 40% of the trees and 14% of the white spruce averaged 6% foliar damage. Other damaged plantations in Thunder Bay District were located at the Mattawin Seed Orchard, where black spruce averaged 15% defoliation on 14% of the trees, and at the Pearson Seed Orchard, where 13% of the black spruce averaged 5% defoliation. Repeated defoliation has caused almost 50% cumulative mortality in a 1-ha area within a black spruce plantation near Burrows Lake, Geraldton District, with defoliation averaging 60% in 1990.

Damage to shoreline and fringe trees was usually confined to sapling black spruce. Trees 2 to 6 m tall in groups of up to 25 sustained an average of 60% defoliation, with damage ranging up to 100% along the shores of Cache Bay, Atikokan District, and at Crayfish, Hood, Hoof and McGinnis lakes, Thunder Bay District. Fringe trees of similar size averaged 80% defoliation near French and Windigoostigwan lakes, Atikokan District, and in the Kashabowie and Shebandowan areas, Thunder Bay District. In Strey Township, Terrace Bay District, a number of young, open-grown roadside white spruce averaged 65% defoliation.

There were many instances in which moderate-to-severe damage occurred to ornamentals and on hedgerow trees. This was common in and around the city of Thunder Bay and increased damage was also noted in the town of Atikokan. Typical damage was recorded in Lybster Township, Thunder Bay District, where a group of 20 4-m black spruce sustained 70% average defoliation. Similar damage also occurred at nearby locations in Blake, Oliver and O'Connor townships.

White Pine Weevil, *Pissodes strobi* (Peck)

Populations of the white pine weevil were generally smaller than in 1989. A comparison of eight common locations from across the Region showed that the average number of leaders affected decreased from 9.5% in 1989 to 7.2% in 1990. The highest incidences of affected leaders were 14% on jack pine in Hagey Township, Thunder Bay District, and on white spruce in Davies Township, Terrace Bay District. A number of other locations of coniferous regeneration were surveyed for this pest (Table 7), and a number of negative evaluations were also reported.

Table 7. Damage caused by the white pine weevil in five districts in the North Central Region of Ontario in 1990 (counts based on an examination of at least 150 trees at each location).

Location	Area affected (ha)	Estimated no. of trees/ha	Host[a]	Avg. ht. of trees (m)	Leaders attacked (%)
Atikokan District					
Bending Lake Road	5	2,500	jP	1.4	3.0
Hwy 11 - Lerome Lake	10	3,000	jP	2.9	3.0
Sapawe - Upsala Road	10	2,000	jP	3.0	3.0
Geraldton District					
Blob Lake	85	5,000	jP	2.4	0
Burrows Lake	50	2,500	bS	2.6	0.7
Castlebar Lake	10	1,200	bS	2.3	9.3
Exton Twp	120	2,500	jP	2.2	0
McPherson Seed Orchard	1.4	-	bS	5.2	2.7
Pagwa River SPA[b]	5	1,500	wS	3.8	0.7
Nipigon District					
Kopka Lake	47	4,000	jP	1.4	2.0
Ledger Twp	125	3,500	bS	3.7	9.3
Limestone Lake	50	4,000	jP	4.3	0
Limestone Lake	60	3,000	bS	2.6	5.3
Waweig Lake	10	3,000	jP	3.4	7.0
Terrace Bay District					
Davies Twp	25	1,600	wS	2.5	10.0
Davies Twp	35	1,600	wS	1.9	14.0
Deadhorse Road	80	1,200	wS	1.6	0
Thunder Bay District					
Bluebird Lake	5	2,500	jP	0.7	4.0
English River	20	2,500	jP	1.5	11.0
Fallscamp Lake	5	2,500	jP	0.8	3.5
Granite River	20	3,000	jP	1.6	5.0
Grew River Road	5	2,500	bS	0.4	1.5
Hagey Twp	2	2,500	jP	2.2	14.0
Kakabeka Falls	15	3,730	jP	0.9	0.5
Robson Twp	5	2,500	jP	0.9	6.0

[a] bS = black spruce, jP = jack pine, wS = white spruce.
[b] seed production area

Spearmarked Black Moth, *Rheumaptera hastata* (L.)

This insect, which feeds on white birch, caused moderate-to-severe defoliation in many stands in Quetico Provincial Park in the southern part of

Atikokan District. The damage was not consistent throughout the area, but occurred in many small areas of damage from within an area bounded by Argo Lake east along the American border to Cache Bay and north to Olifant Lake (Fig. 7). The total area of moderate-to-severe defoliation was 9000 ha.

The larvae of this insect feed on the upper layers of the leaf surface from within an enclosure formed by two leaves webbed together. Heavy feeding damage becomes evident by early August, when the foliage turns brown. Infestations by this pest are of short duration (2 years), as populations usually decline sharply from natural causes.

There have been no reports of this insect in the Region since the 1977-1980 period, when it was common in some areas. During that time there were no large areas of defoliation; however, during an earlier period (1961-1963), medium and heavy infestations occurred in the Thunder Bay, Nipigon and Terrace Bay districts.

Table 8. Other forest insects.

Insect	Host(s)	Remarks
Alsophila pometaria (Harr.) Fall cankerworm	wE, mM	An average of 40% defoliation occurred on a dozen ornamental maple (*Acer* spp.) in the Westfort area and a single elm (*Ulmus* sp.) had 80% defoliation in the university area, both in the city of Thunder Bay.
Caloptilia negundella (Cham.) Boxelder leafroller	mM	Foliar damage of 40 to 70% was recorded at two locations in the city of Thunder Bay and at another two locations in adjacent Paipoonge Twp.
Choristoneura p. pinus Free. Jack pine budworm	jP	In Ledger Twp, Nipigon District, a 6-ha plantation had 19% of the trees affected, with a small larval population.
Cinara banksiana P. & T. Jack pine aphid	jP	In the Flynne Lake area of Geraldton District, a 15-ha plantation had 3.3% of the trees affected, and an 8-ha plantation in the same area had 5.3% of the trees affected. Approximately 30% of the 0.9-m trees at the Kakabeka Falls Seed Orchard in Thunder Bay District supported colonies.

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ATIKOKAN DISTRICT

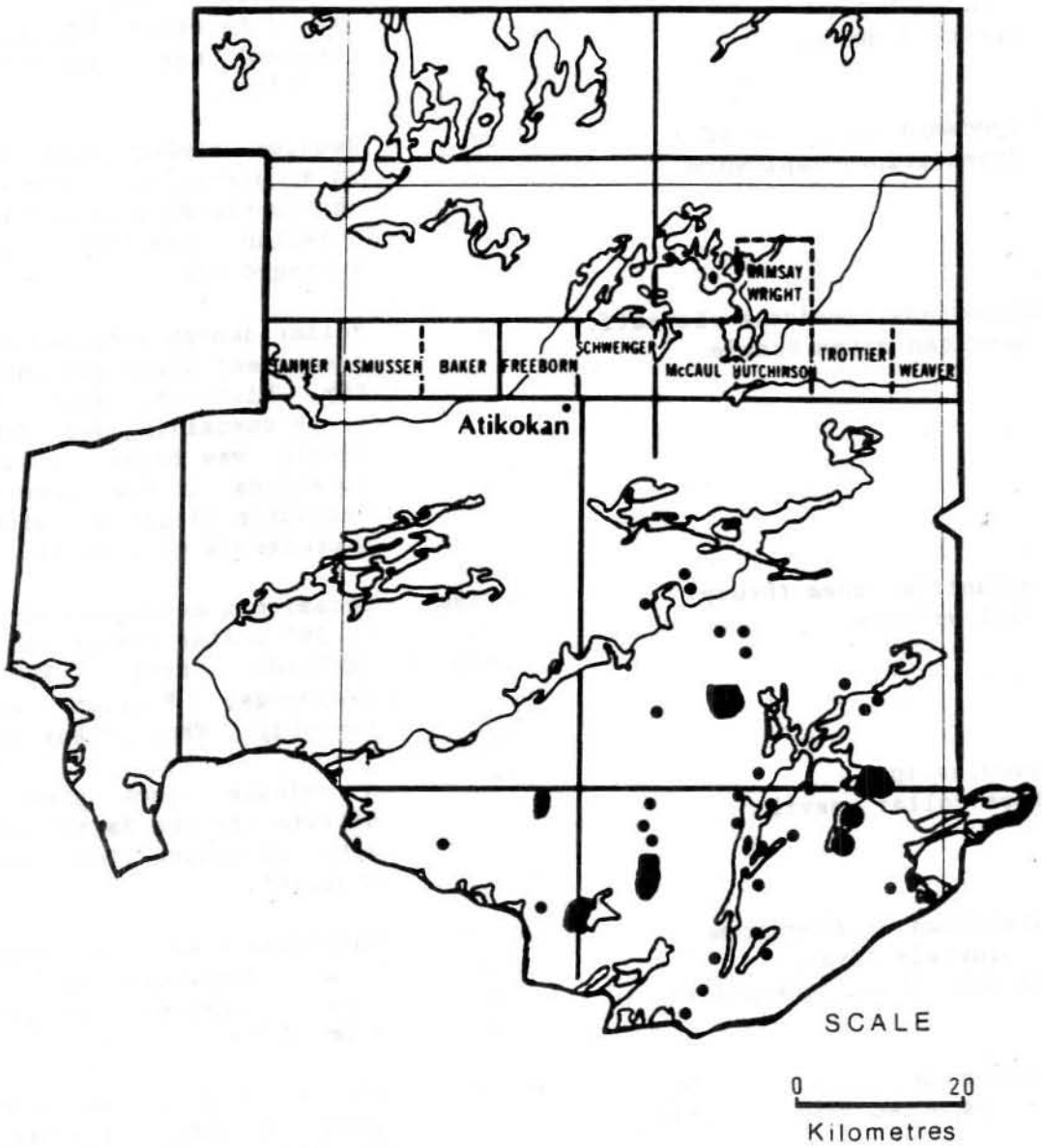


Figure 7. **Spearmarked black moth,**
***Rheumaptera hastata* (L.)**

Areas within which moderate-to-severe defoliation occurred in 1990 ■ or •

Table 8. Other forest insects (cont'd).

Insect	Host(s)	Remarks
Dioryctria reniculelloides Mut & Mun. Spruce coneworm	wS	estimated to total 10% of the larvae (the other 90% being spruce budworm) near Cox Lake, Nipigon District
Dryocampa rubicunda (F.) Greenstriped mapleworm	rM	Reduced numbers were encountered in a previously affected area in the Turtle-Finlayson lakes area of Atikokan District. Defoliation averaged 17%.
Gonioctena americana (Schaeff.) American aspen beetle	tA	Foliar damage averaged 20% on 6-m trees near Eaglehead Lake, Thunder Bay District, with occasional trees sustaining 80% damage. The beetle was found at a number of locations in the Terrace Bay and Geraldton districts, with defoliation levels of only 5%.
Hyphantria cunea (Drury) Fall webworm	deciduous trees	Occasional colonies caused up 50% to 50% foliar damage on scattered roadside trees in Oliver, Paipoonge, Pearson and Blake townships, Thunder Bay District.
Hylobius sp. Root collar weevil	jP	A single jack pine tree was affected at the Raith family-test site in Robson Twp, Thunder Bay District.
Malacosoma californicum pluviale (Dyar) Northern tent caterpillar	deciduous trees & shrubs	This insect was very common again in all districts, with defoliation on scattered shrubs ranging from 15 to 100%.
Monochamus scutellatus (Say) Whitespotted sawyer beetle	wS,bF	Adults caused an undetermined amount of damage (feeding complete but flagging not yet apparent) to 6-m trees adjacent to a log pile at the Mattawin Seed Orchard, Thunder Bay District. The insect was collected along Highway 614, Terrace Bay District, in an area of ongoing balsam fir mortality.

(cont'd)

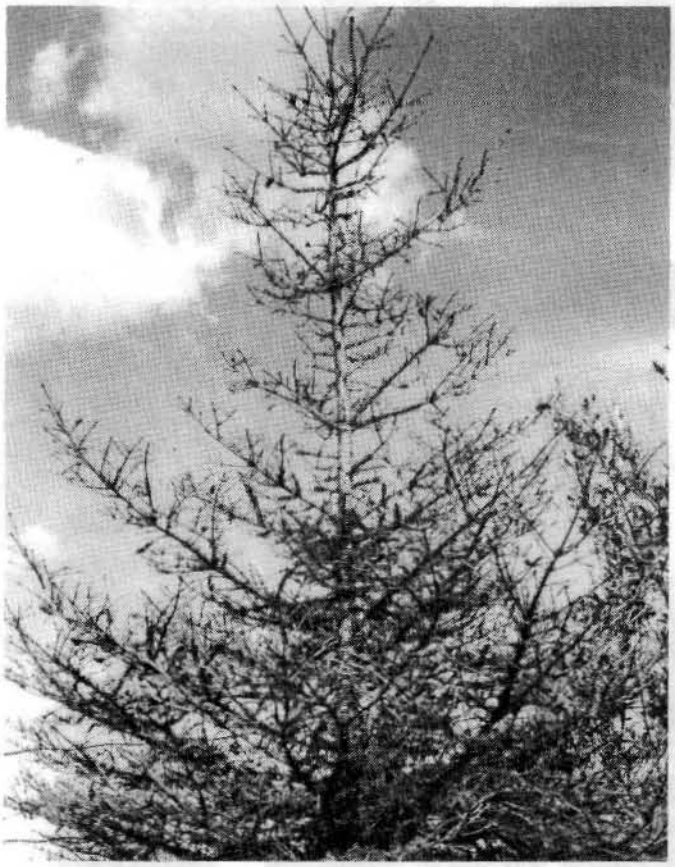
Table 8. Other forest insects (cont'd)

Insect	Host(s)	Remarks
Neodiprion maurus Roh. Pine sawfly	jP	Caused 25% defoliation on 3% of the trees and 22% defoliation on 4% of the trees in family tests at Bluebird Lake and in Robson Twp, respectively. At the Mattawin Seed Orchard, 1.6-m volunteer trees had 20% damage on 23% of the trees. All three areas are in Thunder Bay District.
Neodiprion virginiana complex Redheaded jack pine sawfly	jP	Defoliation of 30% occurred on 4% of the trees at the Kakabeka Falls Seed Orchard in Thunder Bay District.
Otiorhynchus ovatus (L.) Strawberry rootweevil	wS	Numerous larvae were found on 2-0 stock being lifted in the spring at the Thunder Bay Forest Nursery, with no apparent damage.
Petrova albicapitana (Bsk.) Northern pitch twig moth	jP	In Strey Twp, Terrace Bay District, an 80-ha plantation had 1.6% of the trees affected. In Thunder Bay District, the following locations were affected: Kakabeka Falls Seed Orchard, 3.5% affected; Bluebird Lake, Falls Camp Lake and Raith family tests, 1.0, 2.0 and 2.0% affected, respectively.
Phyllonorycter ontario (Free.) Aspen leafblotch miner	tA	Along Hwy 625 in Geraldton District, much of the young aspen (*Populus* spp.) averaged 80% foliar damage, and in the Polly Lake area of Nipigon District, 100% of the trees were affected, with 90% foliar damage.
Pityokteines sparsus (LeC.) Balsam fir bark beetle	bF	associated with spruce budworm-caused dead and dying trees in several areas of recent mortality in the Thunder Bay and Nipigon districts

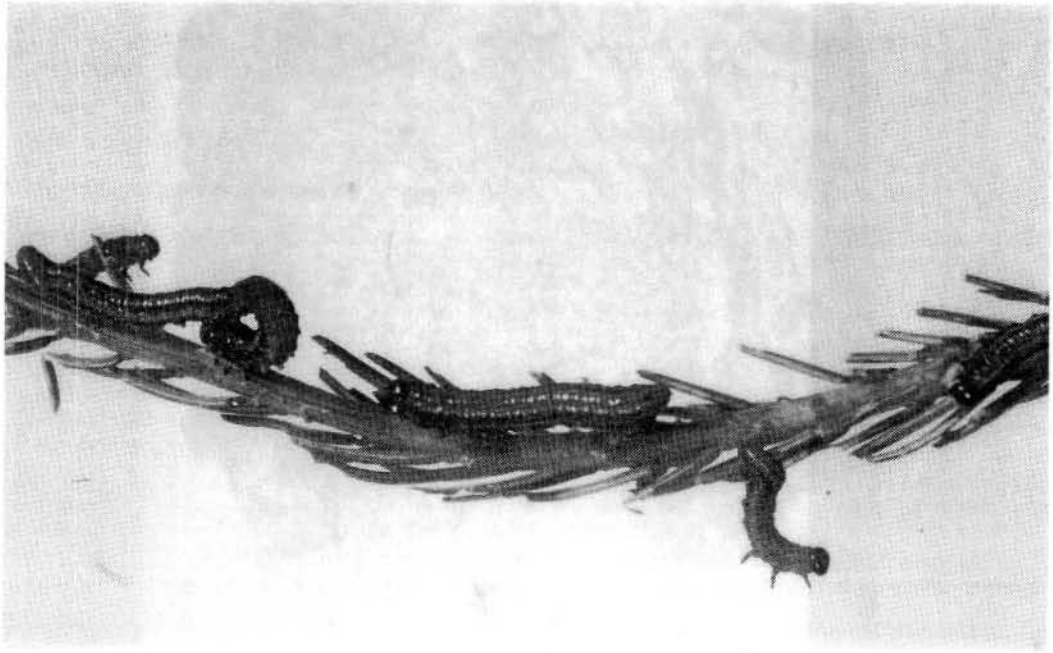
(cont'd)

Table 8. Other forest insects (cont'd.)

Insect	Host(s)	Remarks
Pristiphora geniculata (Htg.) Mountain-ash sawfly	aMo	The sawfly was common across the the work area. Typical damage included 30% defoliation near Sapawe, Atikokan District, and 50% damage to one large tree in Cecil Twp, Terrace Bay District.
Pseudexentera oregonana (Wlsm.) Early aspen leafcurler	tA	Low population levels occurred at Lerome Lake, Atikokan District, but their impact was concealed by heavy forest tent caterpillar damage in the area.
Toumeyella parvicornis (Ckll.) Pine tortoise scale	jP	Heavy infections over the past couple of years have caused damage to roadside trees in the Graham area of Thunder Bay District. At one point, 11% mortality occurred in a small, densely stocked area of 5-m trees.

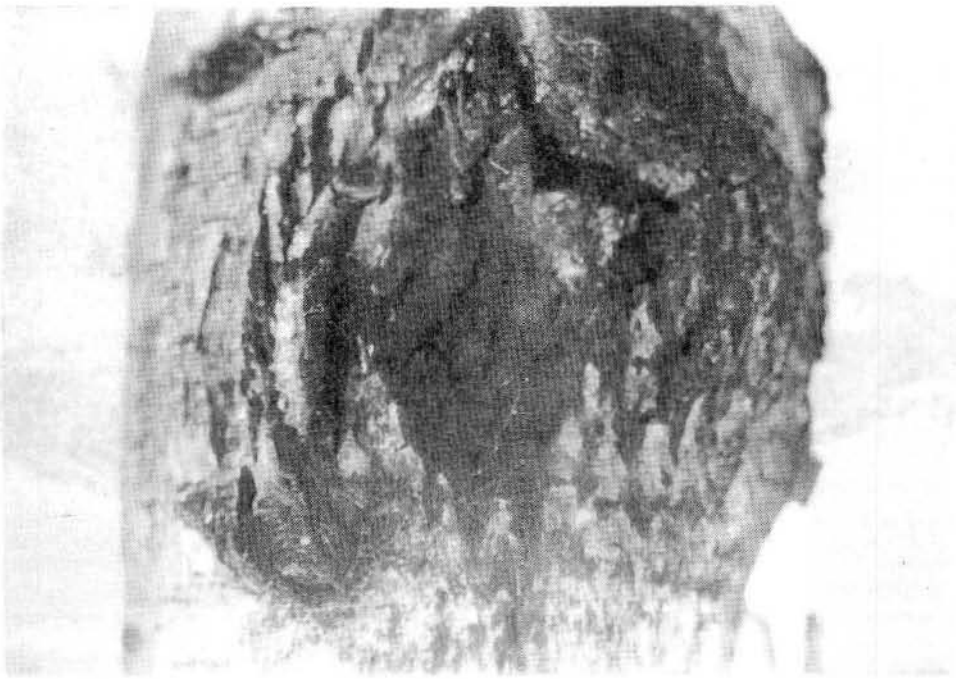


Defoliation by the yellowheaded spruce sawfly (*Pikonema alaskensis* [Roh.]) on young white spruce (*Picea glauca* [Moench] Voss)



Larvae of the yellowheaded spruce sawfly.

Scleroderris canker (*Ascocalyx abietina* [Lagerb.] Schläpfer-Bernhard) on a tree's main stem



Closeup of a target canker (*Neonectria fimbriata* Ell. & Halsted)

TREE DISEASES

Major Diseases

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

Surveys conducted throughout the Region in 1990 indicated an overall decline in the percentage of mortality recorded, particularly in the eastern part of the work area, where a number of reports of no new mortality were recorded.

Jack pine, black spruce and white spruce were evaluated, with mortality ranging from 1 to 2%. The exceptions to this were as follows: in Thunder Bay District, evaluations revealed a mortality rate of 7% at jack pine family tests at Bluebird Lake, 2.5% mortality at Fallscamp Lake, and 5.5% mortality at Raith, in Robson Township. In McQuesten Township, Geraldton District, two small block cuts along Highway 584 had mortality rates of 5.3 and 9.3% on 1.5- and 2.5-m jack pine trees, respectively.

Scleroderris Canker, *Ascocalyx abietina* (Lagerb.) Schläpfer-Bernhard

An ongoing effort to detect the presence of the North American race and the more virulent European race of this fungus resulted in the detection of the former at six different locations in 1990. The highest incidence was recorded in Cecil Twp, Terrace Bay District, where 56% of the 3.6-m jack pine in a 30-ha plantation were infected. Also in Terrace Bay District, an 80-ha plantation of 2.1-m jack pine had a 44% infection rate; in Neys Provincial Park, a number of scattered 1- to 2-m red pine (*Pinus resinosa* Ait.) were affected, with some mortality; and just north of Hillsport, about 10 fringe jack pine had varying degrees of branch mortality. In the Lukinto Lake area of Geraldton District, 23% of the 4.5-m jack pine were affected, and in the Sturgeon River area of Nipigon District, 25% of the trees in a 20-ha plantation were affected (see photo page).

Spruce Needle Rusts, *Chrysomyxa ledicola* (Peck) Lagerh. and
Chrysomyxa ledi (Alb. & Schwein.) de Bary var. *ledi*
and var. *cassandrae* (Peck & G.P. Clinton) Savile

The incidence of needle rust was again widespread in 1990, affecting both black spruce and white spruce in plantations and natural stands. In many of the plantations, 100% of the trees were affected, with varying damage levels. In Thunder Bay District, the heaviest seed orchard damage was recorded at the Grew River Family Test Site, where 90% of the trees averaged 12% foliar damage. Considerably heavier damage was observed along Highway 811 west of Highway 527 in both plantations and natural stands; 60% defoliation levels on 100% of the trees were typical. Moderate-to-severe damage was recorded in the Upsala area, where a fungus parasitic on the needle rust was also collected. At the Kimberly-Clark Seed Orchard in Geraldton District, 100% of the 6.8-m white spruce were affected, with 26% foliar damage; 100% of the 5.2-m black spruce were affected, with 6% defoliation. The most severe

damage to a plantation occurred in Davies Twp, Terrace Bay District, where 100% of the 2.5-m white spruce sustained an average of 35% defoliation.

Ink Spot of Aspen, *Ciborinia whetzelii* (Seaver) Seaver

Foliar damage to trembling aspen by this fungus was observed at numerous locations in 1990. In Terrace Bay District, the heaviest defoliation occurred along Industrial Road, where a 0.5-ha area had 75% foliar damage and another 0.5-ha stand had 30% defoliation in Bomby Township. In Thunder Bay District, the largest area of damage detected (5 ha) was in Pardee Township, where defoliation was 30%. Foliar damage ranging from 15 to 30% in small (0.5 to 1.0 ha) areas was recorded at several other locations in Conmee, Sackville, Ware, Oliver and Paipoonge townships. Relatively light damage occurred at various points in the Atikokan, Nipigon and Geraldton districts.

Pine Needle Rust, *Coleosporium asterum* (Dietel) Sydow

As in past years, most infections by this needle-rust fungus were in the Flynne Creek area in the eastern part of Geraldton District. Three jack pine plantations were surveyed in this area. A 15-ha plantation of 2.1-m trees was 100% affected, with 4% foliar damage; an 8-ha plantation of 2-m trees was 100% affected, with 14.5% foliar damage; and a 5-ha plantation of 2-m trees was 100% affected, with 15% foliar damage. In Nipigon District, a 6-ha plantation in Ledger Township had 100% of the 3.7-m jack pine affected, with 2.3% foliar damage. Near the Namakan River in Atikokan District, 20% of the 1.2-m jack pine averaged 30% foliar damage in a 5-ha area.

Western Gall Rust, *Endocronartium harknessii* (J.P. Moore) Y. Hirats.

This disease was commonly encountered in areas of jack pine regeneration in 1990. In the western part of the Region, the most severe damage was recorded near the Namakan River in Atikokan District, where 12.7% of the trees were affected in a 5-ha area, with 10.7% severely galled. In the eastern part of the Region, the highest damage level recorded was in Strey Township, Terrace Bay District, where an 80-ha plantation had 21% of the trees affected, 4.6% with stem galls (Table 9).

Table 9. Damage to jack pine caused by western gall rust in the North Central Region of Ontario in 1990 (counts based on an examination of 150 trees at each location).

Location	Area affected (ha)	Estimated no. of trees/ha	Avg. tree ht. (m)	Trees affected (%)	Severely affected (%)
Atikokan District					
Eltrut Road	15	2,500	1.2	3.0	2.0
Namakan River	20	4,000	1.2	12.7	10.7
Geraldton District					
Flynne Lake	15	1,200	2.1	0	0
Highway 625	25	1,100	1.0	0	0
Lukinto Lake	50	2,500	4.5	13.3	5.0
Salsberg Twp	30	1,995	3.1	2.5	0.7
Nipigon District					
Ledger Twp	6	2,500	3.7	0	0
Namewaminikan River	20	2,500	4.0	3.3	0.7
Terrace Bay District					
Cecil Twp	30	3,500	3.6	0	0
Strey Twp	80	8,000	2.1	21.0	4.6
Thunder Bay District					
Bluebird Lake	5	2,500	0.6	0	0
Fallscamp Lake	5	2,500	0.8	0.7	0
Kakabeka Falls	15	3,730	0.8	0	0
Robson Twp	5	2,500	0.7	0	0

Table 10. Other forest diseases.

Disease	Host	Remarks
Ceratocystis fimbriata Ell. & Halsted Target canker	tA	There was a 30% infection rate recorded on 9-m trees in a 2-ha area on the Stanton Bay Road, Atikokan District (see photo page).
Cronartium comandrae Peck Comandra blister rust	jP	Approximately 1 to 2% of the trees in the Kakabeka Falls Seed Orchard in Paipoonge Twp, Thunder Bay District, were affected by this rust.

(cont'd)

Table 10. Other forest diseases.

Disease	Host	Remarks
Cronartium ribicola J.C. Fischer White pine blister rust	wP	In regeneration white pine near Caldwell Lake, Atikokan District, 12% were affected, 8% severely. Trees averaged 2 m tall.
Davisomycella ampla (J. Davis) Darker Tar spot needle cast	jP	In the Sturgeon River area south of Hwy 11 in Nipigon District, a 20-ha plantation of 4-m trees had 24.6% of the trees affected, with an average of 3.2% foliar damage.
Gymnosporangium cornutum Arthur ex Kern Gall rust	aMo	In Lahontan Twp, Terrace Bay District, one tree had 90% foliar damage.
Inonotus obliquus (Pers. : Fr.) Pilát Clinker conk	wB	In the white birch dieback in Lahontan Twp, Terrace Bay District, 7% of the trees in the plot were infected by this fungus.
Inonotus tomentosus (Fr.) Teng. Tomentosus root rot	bS	This rot caused tree mortality at numerous locations on 12-m hedgerow trees at the Thunder Bay Forest Nursery.
Marssonina brunnea (Ell. & Ev.) Magnus Marssonina leaf spot	tA	Along the Goldfield Road in Geraldton District, 100% of the trees in a 0.5-ha stand were affected, with 85% foliar damage.
Melampsorella caryophyllacearum Schröter Fir broom rust	bF	At Inwood Twp Park near Upsala, Thunder Bay District, this disease was found at an infection rate of 10%.
Mycosphaerella effigurata (Schwein.) House Ash leaf spot	bAs	Approximately 60% of the trees were affected, with an average of 30% foliar damage in Blake Twp, Thunder Bay District.

(cont'd)

Table 10. Other forest diseases (concl.).

Disease	Host	Remarks
Mycosphaerella populicola G.E. Thompson Leaf spot	bPo	Found at a number of locations in the Nipigon, Geraldton and Terrace Bay Districts, with defoliation levels ranging from 60 to 90%.
Septoria betulae Pass. Leaf blight	wB	The incidence of this leaf blight decreased markedly and was observed in only a few small stands, causing 85 to 100% damage.
Venturia macularis (Fr.) E. Müller & v. Arx Shoot blight	tA	This shoot blight was prevalent in many stands of regeneration aspen north of Nakina in Geraldton District, causing 60 to 90% shoot death in many cases.

ABIOTIC DAMAGE

Blowdown

There were two small areas of blowdown recorded in the summer of 1990. The first occurred in the Shebandowan Lake area of Haines and Hagey townships, Thunder Bay District. The total area affected was 270 ha. The second area started near Sandford Lake in Atikokan District, and damage could be seen going east in a discontinous line past Norway Lake and Van Nostrand Lake and then into Hanniwell Township in Thunder Bay District. A narrow band of blowdown continued through parts of Colliver and Stedman townships. This second area of damage totaled approximately 1,670 ha. In both areas, all species of trees within the path of the storms were affected.

Frost Damage

Eleven areas (all seed orchards or family-test sites in Thunder Bay District) were examined for frost damage. The most severe shoot mortality occurred at the Rollason Lake family-test area, where 75% of the black spruce were affected, with 35% shoot damage. At the Grew River Road family-test site, 66% of the trees were affected, with 20% shoot damage, and at the Mattawin Seed Orchard, 90% of the trees sustained damage, with 12% shoot mortality. The other sites evaluated all sustained less than 5% average shoot damage. Light damage was also recorded on balsam fir in Aldina Township and near Mawn Lake, Thunder Bay District, and at Shillabeer Creek, Nipigon District.

Winter Drying

Winter drying was very evident at the Thunder Bay Forest Nursery on spruce transplant stock. In most instances, however, the buds were not affected, and new growth proceeded normally. Also in Thunder Bay District, average defoliation of 25 and 10% occurred at the Bluebird Lake and Fallscamp Lake family-test sites, respectively, on approximately 8% of the jack pine in both instances. At the Albert Nikulasson Orchard in Robson Township, an estimated 15% of the black spruce sustained an average of 40% foliar damage. Severe (80%) damage occurred on a group of 20 red pine saplings at French Lake, Atikokan District.

FOREST HEALTH

Acid Rain National Early Warning System (ARNEWS)

The three ARNEWS plots in North Central Region are part of a national network of such plots designed to monitor symptoms of damage from air pollutants, particularly acidic precipitation. In addition, trees on these plots are evaluated with respect to level, extent, and intensity of any insect or disease problems that occur naturally. No damage attributable to airborne pollutants was detected at any of the three plots in 1990. Spruce budworm defoliation was by far the biggest problem in all three plots. In Fowler Township, Thunder Bay District, budworm damage averaged 30% on black spruce and 75% on balsam fir. There were also trace defoliation levels (2%) by spruce needle rust.

In Wiggins Township, Terrace Bay District, spruce budworm defoliation averaged 85% on white spruce and 45% on black spruce. There was some additional mortality as a result of windthrow that occurred in 1989. In the Margo Lake plot in Geraldton District, foliar damage from spruce budworm averaged 90% on black spruce as a result of feeding within the new buds before they had time to develop. In addition, there is a recurring presence of western gall rust on the jack pine. The 5-year assessment was repeated in each plot in 1990; this involved updating additional information such as tree heights and DBHs, soil sampling and determination of annual foliage retention.

White Birch Dieback

In 1989, the Ministry of the Environment expressed concern about birch dieback in some areas of Ontario, and a cooperative program to monitor the apparent decline of white birch was initiated by setting up 100-tree plots in stands already showing some degree of dieback. In North Central Region, a plot was established in Lahontan Township, Terrace Bay District, along Highway 17 just west of Rainbow Falls Provincial Park. This is a mixed-age stand with only a minimal degree of dieback (see photo page); thus it is a good site for ongoing monitoring. Table 11 shows the number of trees with dieback in 1989 and 1990, expressed as the current year's dieback and as a cumulative total. There are two types of fungus that show a fairly signif-

icant occurrence in both years: The target canker (*Nectria* sp.) affected 7% of the trees in 1989 and 1990. The clinker fungus (*Inonotus obliquus* [Pers.:Fr.] Pilát) affected 5% of the trees in 1989 and 7% in 1990. The contribution these fungi will make towards any ongoing decline may become clearer as evaluations are carried out in subsequent years.

Table 11. Birch health at one location in the North Central Region of Ontario, based on an examination of 100 trees.

Location	Avg. ht. (m)	Avg. DBH (cm)	Current dieback[a] 0	1	2	3	4	5	Cumulative dieback[a] 0	1	2	3	4	5
			----------No. of trees----------						----------No. of trees----------					
Terrace Bay District														
Lahontan Twp														
1989	14.2	24.3	94	5	1	0	0	0	74	22	2	1	1	0
1990	14.2	24.3	96	3	1	0	0	0	69	25	3	1	2	0

[a] Class 0 = 0-5%, 1 = 6-20%, 2 = 21-40%, 3 = 41-60%, 4 = >60%, 5 = dead tree

SPECIAL SURVEYS

Gypsy Moth, *Lymantria dispar* (L.)

The pheromone trapping program designed to attract and capture male moths (see Frontispiece) was repeated in 1990. This program, in which two traps are deployed in provincial parks in the Region, began in 1979 in the Nipigon, Terrace Bay and Geraldton districts and expanded to include the Atikokan and Thunder Bay districts in 1984. In all, 11 locations were monitored in 1990 and all results were negative, with the exception of one male moth trapped at the Dawson Trail Campground at French Lake in Quetico Provincial Park, Atikokan District. This is only the second catch in the Region; the other occurred in 1984 at Rainbow Falls Provincial Park in Terrace Bay District. In 1991, a more intensive trapping program will be carried out at French Lake to determine if the gypsy moth catch was an anomaly or if a resident population of the insect exists at that site.

Forest Tree Nursery Report

Several visits were made to the Thunder Bay Forest Nursery from May to October 1990 to monitor seedlings and surrounding trees for potentially damaging pests.

There was a marked increase in spruce budworm populations in the area, but timely control measures on spruce hedgerows and in selected

seedling compartments minimized damage. Defoliation of large mature white spruce trees averaged only 21%; however, there was a large number of egg masses found on foliar samples, which indicates that severe damage may occur in 1991.

Another pest that required control measures was a species of cutworm, but prompt action resulted in little damage to seedlings. A sample submitted for identification revealed the presence of both the *Euxoa lidia* (Stoll) cutworm and the black army cutworm (*Actebia fennica* [Tausch.]). The population-monitoring program for the black army cutworm through the use of pheromone traps, which lure and trap male moths, was repeated in 1990. A total of 189 moths was collected in three traps this year, compared with 183 moths in eight traps in 1989. A survey of ground vegetation at the 1989 trap sites revealed only trace levels of damage that could be attributed to cutworm feeding.

Winter-drying damage to spruce transplant stock was quite evident during May and June; however, the buds were not affected in most instances and once the new growth started, the general appearance of the stock improved and losses were minimal.

There was an increased incidence of the yellowheaded spruce sawfly on spruce trees at the nursery. There were pockets of 50% foliar damage on 3-m black spruce and 16% of the 1.5-m white spruce averaged 7% defoliation in one area. Pine tortoise scale populations also increased. Experimental grafted jack pine stock in compartments 3 and 52 sustained light damage, with 32% of the trees affected.

Young eastern white cedar (*Thuja occidentalis* L.) hedgerows 1 to 3 m tall were examined for damage, which ranged from branch flagging to whole-tree mortality. Samples tested for Phomopsis blight (*Phomopsis juniperovora* Hahn) and Armillaria root rot were negative. A blue stain fungus (*Ceratocystis* sp.) and the northern cedar bark beetle (*Phloeosinus canadensis* Swaine) were identified on the samples taken, but neither is considered to be a primary pathogenic organism. Surveys will continue in an attempt to determine the cause of this condition.

Samples of the fruiting bodies of Tomentosus root rot (*Inonotus tomentosus* [Fr.] Teng) on the ground near dead and dying black spruce windbreak trees confirmed that this fungus was the cause of some dieback. There have been numerous instances of dying trees that required removal over the past few years. This disease can spread by root contact, resulting in a widening area of mortality. It occurs in both plantations and natural areas, and trees often become susceptible at 25 years of age or more, the current situation at the nursery.

Other pests found at the nursery included the strawberry rootweevil, which was detected during spring lifting of 2-0 white spruce. Root damage was negligible. Small numbers of balsam twig aphids (*Mindarus abietinus* Koch) were found on white spruce hedgerow trees, and the redheaded jack pine sawfly caused 95% defoliation to a single 3-m tree bordering the nursery property.

Seed Orchard Survey

This survey was initiated in 1990 to develop an inventory of disease and insect problems in seed orchards. During the field season, two visits were made to each orchard and family-test site in the Region. Three tree species (jack pine, black spruce and white spruce) are involved.

The four jack pine locations were all in Thunder Bay District and of approximately the same height and age. The most serious problems were Armillaria root rot, which occurred at three of the four sites, and the white pine weevil and the eastern pine shoot borer, both of which caused leader damage on up to 19.5% of the trees. A low percentage of trees was affected by the northern pitch twig moth and jack pine sawflies, and there was damage from winter drying at two locations (Table 12). The sawflies were identified as the redheaded jack pine sawfly (Kakabeka Falls) and the pine sawfly (*Neodiprion maurus* Roh.) at the Bluebird and Raith sites. The larvae had completed feeding and the only evident damage was at the Fallscamp location.

Table 12. Damage detected in a special survey of jack pine seed orchards and family tests in 1990 in the North Central Region of Ontario (percentages based on an examination of 150 trees at each location).

	Kakabeka Falls Seed Orchard	Bluebird Lake Family Test	Fallscamp Lake Family Test	Raith Family Test
Avg. ht. of trees (m)	0.9	0.7	0.8	0.9
Plantation area (ha)	15	5	5	5
White pine weevil:				
leaders attacked	0.5	4.0	3.5	6.0
Eastern pine shoot borer:				
leaders attacked (%)	2.5	10.0	19.5	5.0
laterals attacked (%)	0.5	6.0	6.0	2.0
Jack pine sawflies:				
trees affected (%)	4.0	3.0	2.0	4.0
defoliation (%)	30.0	25.0	22.0	22.0
Winter drying:				
trees affected (%)	0	7.3	8.0	0
defoliation (%)	0	25	10	0
Armillaria root rot:				
trees affected (%)	0	7.0	2.5	5.5

Other potentially damaging pests that were found included the jack pine tip beetle (*Conophthorus banksianae* McP.), which affected 0.5% of the leaders at both the Bluebird and Raith sites. At Kakabeka Falls, approximately 30% of the trees supported colonies of the jack pine aphid (*Cinara banksianae* P. & T.) and 1% of the main stems were affected by Comandra blister rust (*Cronartium comandrae* Peck). Near the Raith location, a single tree was infested with a root-collar weevil (*Hylobius* sp.) and a single tree at the Fallscamp site had a branch infection by western gall rust.

The spruce budworm was recorded at all of the spruce locations; however, significant damage occurred only at the James Angus McPherson and Mattawin orchards, which have larger (5 to 6.5 m) trees. The spruce coneworm contributed to the feeding damage at five locations. The yellowheaded spruce sawfly was found at seven of the 15 sites. It caused problems at the O'Connor Seed Orchard, where control measures were again used against the population, and at the Mattawin Seed Orchard, where a few trees sustained close to 100% foliar damage. The heaviest damage from spruce needle rust occurred on white spruce at the James Angus McPherson Seed Orchard, where 100% of the trees averaged 26% defoliation. Frost damage was reported from two-thirds of the locations, but damage was generally light. Armillaria root rot was found at five black spruce sites and at one white spruce site (Table 13a and 13b).

Other problems included the presence of shootworms (*Zeiraphera* spp.) on 33% of the trees and the spruce gall adelgid (*Adelges lariciatus* [Patch]) on 19.3% of the white spruce at the Pearson Orchard. Extremely heavy vegetative competition made it difficult to locate the trees at the Partridge Falls Orchard. Here, 10% of the trees were also severely chlorotic, indicating a nutrient deficiency. Sawyer beetle (*Monochamus* sp.) damage occurred on twigs and branches along the southern side of the Mattawin Orchard. The extent of the damage has yet to be determined. A single black spruce that was affected by Armillaria root rot at the Mattawin Orchard was infested with secondary insects, the long-horned wood-boring beetle (*Meriellium proteus* Kby.) and by sawyer beetle larvae. The spruce gall adelgid occurred on 6 and 4% of the white spruce at the Thunder Bay Breeding Orchard and the O'Connor Orchard, respectively. Winter drying caused some damage at the Albert Nikulasson Orchard, where an estimated 15% of the trees sustained an average of 40% foliar damage. A major planting failure occurred at the Rollanson family-test site, with the poor survival rate attributed to drought. White pine weevil affected 1.5% of the leaders at the Grew River family-test site and 2.7% at the James Angus McPherson Orchard. Burls of an unknown cause also affected 6% of the trees at the latter location.

Climatic Data

Atmospheric conditions, both natural and man-made, may have devastating effects on forest trees. For example, there were three reports of tree damage in North Central Region in 1990 resulting from adverse weather conditions, namely blowdown, frost damage and winter drying. Because of the importance of weather, temperature and precipitation records for two weather stations in the Region are presented in Table 14.

Table 13a. Damage detected in a special survey of spruce seed orchards, family tests and breeding orchards in 1990 in the North Central Region of Ontario (percentages based on an examination of 150 trees at each location).

Location	Species	Avg. ht. of trees (m)	Plantation area (ha)	Spruce budworm		Yellowheaded spruce sawfly	
				Trees attacked (%)	Defoliation (%)	Trees attacked (%)	Defoliation (%)
Geraldton District							
McPherson Seed Orchard	bS	5.2	1.4	100	45	0	0
McPherson Seed Orchard	wS	6.8	1.4	100	75	0	0
Thunder Bay District							
Pearson Seed Orchard	wS	3.7	1.0	100	9	0	0
	bS	1.9	1.0	100	5	12.7	5
Partridge Falls Seed Orchard	bS	0.3	16.0	28	10	0	0
Mattawin Seed Orchard	wS	6.5	5.0	100	33	0	0
	bS	6.2	5.0	100	22	14	15
Thunder Bay Nursery Breeding Orchard	wS	1.2	1.0	100	7	2	10
	bS	1.3	1.0	70	2	4	4
O'Connor Seed Orchard	wS	2.8	5.0	96	5	14	6
	bS	1.9	5.0	92	5	40	11
Albert Nikulasson Seed Orchard	bS	0.5	10.0	27	5	0.5	2
Raith Family Test	bS	0.5	5.0	31	7	0	0
Grew River Road Family Test	bS	0.4	5.0	59	3	0	0
Rollason Lake Family Test	bS	0.3	5.0	40	10	0	0

Table 13b. Damage detected in a special survey of spruce seed orchards, family tests and breeding orchards in 1990 in the North Central Region of Ontario (percentages based on an examination of 150 trees at each location).

Location	Species	Avg. ht. of trees (m)	Plantation area (ha)	Needle rust		Frost		Armillaria root rot
				Trees attacked (%)	Defoliation (%)	Trees affected (%)	Defoliation (%)	Trees attacked (%)
Geraldton District								
McPherson Seed Orchard	bS	5.2	1.4	100	5.5	0	0	0
McPherson Seed Orchard	wS	6.8	1.4	100	26.0	0	0	0
Thunder Bay District								
Pearson Seed Orchard	wS	3.7	1.0	0	0	17.3	3.8	0
	bS	1.9	1.0	16	1	0	0	0
Partridge Falls Seed orchard	bS	0.3	16.0	0	0	0	0	0
Mattawin Seed Orchard	wS	6.5	5.0	0	0	90.0	12.0	0.7
	bS	6.2	5.0	98	2	60.0	4.0	0.7
Thunder Bay Nursery Breeding Orchard	wS	1.2	1.0	0	0	46.0	5.0	0
	bS	1.3	1.0	0	0	4.0	5.0	0.7
O'Connor Seed Orchard	wS	2.8	5.0	0	0	2.0	1.0	0
	bS	1.9	5.0	0	0	0	0	0
Albert Nikulasson Seed Orchard	bS	0.5	10.0	55	4	49.0	15.0	1.0
Raith Family Test	bS	0.5	5.0	66	5	24.0	11.0	0.5
Grew River Road Family Test	bS	0.4	5.0	90	12	66.0	20.0	1.0
Rollason Lake Family Test	bS	0.3	5.0	10	1	75.0	35.0	0

Table 14. Summary of climatic data at two weather stations in the North Central Region of Ontario in 1990.

Location	Month	Mean temperature (°C) Actual	Mean temperature (°C) Normal	Deviation from normal (°C)	Total precipitation (mm) Actual	Total precipitation (mm) Normal	Deviation from normal (%)
Thunder Bay Airport	January	-10.1	-15.4	+5.3	38.3	40.9	-6
	February	-12.7	-13.0	+0.3	14.4	28.3	-49
	March	-3.9	-6.3	+2.4	29.7	45.0	-34
	April	2.9	2.5	+0.4	63.0	50.7	+24
	May	7.9	8.8	-0.9	58.7	73.3	-20
	June	14.0	14.0	0.0	135.1	76.6	+76
	July	17.3	17.6	-0.3	91.0	75.4	+21
	August	16.8	16.4	+0.4	63.2	83.1	-24
	September	11.6	11.1	+0.5	63.2	89.1	-29
	October	4.2	5.7	-1.5	82.9	54.8	+51
	November	-1.8	-2.6	+0.8	50.0	52.9	-5
	December	-12.3	-11.1	-1.2	48.4	41.1	+18
Geraldton Airport	January	-14.8	-20.0	+5.2	45.0	38.2	+18
	February	-15.2	-17.9	+2.7	17.8	33.3	-47
	March	-7.0	-11.0	+4.0	25.4	38.2	-34
	April	-0.1	-0.5	+0.4	44.6	43.3	+3
	May	6.8	7.7	-0.9	36.6	63.2	-42
	June	13.3	13.5	-0.2	137.4	91.9	+50
	July	17.1	16.3	+0.8	64.0	81.6	-22
	August	16.0	14.6	+1.4	91.8	66.8	+37
	September	8.5	9.3	-0.8	64.0	75.6	-15
	October	2.5	3.9	-1.4	85.8	64.6	+33
	November	-3.5	-5.5	+2.0	52.4	61.5	-15
	December	-17.3	-15.4	-1.9	40.0	38.8	+3

APPENDIX: North Central Region - Spruce Budworm: Summary of defoliation estimates and egg- mass counts in 1990, and infestation forecasts for 1991.

Location	Host	Estimated defoliation in 1990 (%)	No. of egg masses per 9.29 m² of foliage	Infestation forecasts for 1991[a]	Accumulated damage[b]
Atikokan District (15 locations)					
Agnes Lake	bF	79	237	S	7
Basswood Lake - Prairie Portage	bF	62	135	M-S	5
Burton Lake	bF	10	46	L-M	-
Cache Bay	bF	16	105	M-S	+
Clearwater West Lake	bF	23	8	L	5
French Lake	bF	31	303	S	7
Irene Lake	bF	39	90	M-S	5
Joe Lake	bF	13	51	M-S	-
Kawa Bay	bF	25	23	L-M	1
Little Eva Lake	bF	34	320	S	7
Lizard Lake	bF	54	39	L-M	6
Oriana Lake	bF	81	139	M-S	6
Poohbah Lake	bF	43	294	S	7
Tuck Lake	bF	75	228	S	6
Van Nostrand Lake	bF	63	160	M-S	7
Geraldton District (22 locations)					
Ashmore Twp	bF	78	186	M-S	1
Caramat Rd - 2.8 km south of Hwy 11	bF	78	904	S	2
Catlonite Rd - km 115.7	bF	94	1,076	S	2
- Spider Lake	bF	91	77	M-S	2
Esnagami Lake	bF	7	66	M-S	2
Fleming Lake	bF	85	935	S	2
Florrie Road	wS	51	390	S	1
Goldfield Road - Kenogamisis River	bF	95	522	S	2
- Rogers Lake	bF	94	929	S	2
- Wig Lake	bF	95	219	S	2
Hwy 584 - Burrows Lake	bF	46	539	S	2
Industrial Rd - south of Caramat	bF	69	664	S	1
Kimberly-Clark SPA[c]	wS	63	2,179	S	1
Kirby Twp	bF	93	658	S	2
Klotz Lake Prov. Pk	bF	91	276	S	2
Long Lake - West Side	bF	94	901	S	3

(cont'd)

APPENDIX: North Central Region - Spruce Budworm: Summary of defoliation estimates and egg- mass counts in 1990, and infestation forecasts for 1991 (cont'd).

Location	Host	Estimated defoliation in 1990 (%)	No. of egg masses per 9.29 m² of foliage	Infestation forecasts for 1991[a]	Accumulated damage[b]
Geraldton District (concl.)					
Nakina Twp	bF	93	764	S	2
Nibs Lake - Impact Plot	bF	69	113	M-S	3
O'Meara Twp	wS	88	677	S	2
Pagwachuan Lake					
- southwest	bF	90	624	S	1
- northeast	bF	67	337	S	2
Wintering Lake	bF	95	1,285	S	2
Nipigon District (73 locations)					
Altitude Lake[d]	bF	61	303	S	1
Barbara Lake[d]					
- Block 26, Plot 1	bF	94	853	S	2
	wS	99	889	S	2
- Block 26, Plot 2	bF	98	307	S	2
Black Bay[d]					
- Block 102, Plot 2	bF	88	80	M-S	3
	wS	83	0	0	3
- Block 104, Plot 5	bF	93	26	L-M	3
	wS	90	0	0	2
- Block 106, Plot 3	bF	47	38	L-M	4
	wS	59	436	S	3
- Block 106, Plot 4	bF	72	64	M-S	3
	wS	36	11	L-M	3
Black Sturgeon Lake					
- Block 91[d]	bF	80	371	S	4
	wS	95	499	S	3
- Check Plot	wS	86	579	S	4
Booth Twp - Parmachene	bF	95	100	M-S	5
Camp 75 Rd	bF	94	659	S	2
Central Lake	bF	88	691	S	2
Corrigal Twp - Hwy 17	wS	92	717	S	3
Corrigal Twp					
- Lloyd Lake	bF	90	375	S	4
Cosgrove Lake	bF	95	658	S	2
Dragonfly Lake					
- Plantation	wS	64	862	S	2
Frank Lake	bF	89	1,215	S	1
Gurney Lake	bF	100	529	S	5
Hwy 527 - Gull River	bF	95	281	S	4
- Kopka River	bF	96	267	S	4
- Waweig Lake	bF	99	412	S	4

(cont'd)

APPENDIX: North Central Region - Spruce Budworm: Summary of defoliation estimates and egg- mass counts in 1990, and infestation forecasts for 1991 (cont'd).

Location	Host	Estimated defoliation in 1990 (%)	No. of egg masses per 9.29 m² of foliage	Infestation forecasts for 1991[a]	Accumulated damage[b]
Nipigon District (cont'd)					
Innes Twp	bF	95	335	S	4
Kilkenny Twp					
- Lake Nipigon Prov. Pk[d]	bF	82	391	S	3
	wS	88	2,240	S	3
Ledger Twp - Block 7[d]	bF	95	273	S	3
	wS	93	1,776	S	3
Legault Twp - Block 68[d]	bF	89	2,358	S	2
- Block 69[d]	bF	91	258	S	2
Limestone Lake					
- Block 10, Plot 2[d]	wS	68	490	S	2
- Block 10, Plot 3[d]	wS	61	235	S	2
- Unsprayed	wS	76	230	S	2
- Check Plot	wS	80	138	M-S	2
Northwind Lake					
- Block 80, Plot 4[d]	bF	85	514	S	2
	wS	86	593	S	2
- Block 81, Plot 3[d]	bF	63	239	S	2
	wS	56	502	S	2
Obonga Lake	bF	83	167	M-S	2
Onaman Lake	bF	36	622	S	2
Onaman River	bF	95	2,868	S	2
Oskawe Lake	bF	95	362	S	4
Parks Lake	bF	100	861	S	2
Patience Twp	bF	95	718	S	1
Polly Lake					
- Impact Plot	bF	95	353	S	3
Purdom Twp					
- Block 2, Plot 3[d]	bF	96	389	S	3
	wS	76	164	M-S	2
- Block 86, Plot 1[d]	bF	21	239	S	3
- Plot 2[d]	bF	64	286	S	2
- Plot 3[d]	wS	83	859	S	2
- Check Plot 2	bF	95	572	S	2
- Check Plot 3	bF	78	123	M-S	2
- Check Plot	wS	95	336	S	1
Shillabeer Creek	bF	59	810	S	6
Shillabeer Lake					
- Block 85, Plot 1[d]	bF	78	1,525	S	2
	wS	95	591	S	2
- Plot 2[d]	bF	49	367	S	2
	wS	90	278	S	2

(cont'd)

APPENDIX: North Central Region - Spruce Budworm: Summary of defoliation estimates and egg- mass counts in 1990, and infestation forecasts for 1991 (cont'd).

Location	Host	Estimated defoliation in 1990 (%)	No. of egg masses per 9.29 m² of foliage	Infestation forecasts for 1991[a]	Accumulated damage[b]
Nipigon District (concl.)					
Spool Lake	bF	100	1,526	S	2
Summers Twp					
- North of Beardmore	bF	91	489	S	3
- South of Beardmore[d]	bF	100	870	S	2
Tyrol Lake - Block 77[d]	wS	87	449	S	2
- Block 78[d]	wS	74	394	S	2
Upper Roslyn Lake	bF	98	401	S	5
Windigokan Lake					
- Block 73[d]	bF	36	197	M-S	2
	wS	58	954	S	2
- Block 75[d]	bF	88	302	S	2
	wS	21	108	M-S	2
- Check Plot	bF	95	526	S	2
Terrace Bay District (38 locations)					
Barbara Lake - SPA[c]	wS	15	50	L-M	1
Big Duck Lake	bF	95	822	S	3
Blue Jay Lake	bF	93	222	S	2
Cairngorm Lake	bF	95	302	S	5
Catlonite Rd - km 46.7	bF	93	589	S	3
Cirrus Lake	bF	94	456	S	5
Cornish Lake	bF	91	422	S	3
Dead Otter Lake	bF	20	108	M-S	1
Deutzia Lake	bF	95	715	S	3
Ducell Lake	bF	95	615	S	5
Fakeloo Lake	bF	83	333	S	2
Foxtrap Lake	bF	91	8	L	3
Garnham Lake	bF	61	260	S	1
Gertrude Twp					
- Morley Lake Rd	bF	78	632	S	2
Gowan Lake	bF	13	195	M-S	5
Greenhedge Lake	bF	95	373	S	3
Hwy 614 - Stand 360	bF	45	40	L-M	1
Industrial and					
Camp 15 Rd	bF	50	323	S	2
Kagiano Lake	bF	93	766	S	2
Killala Lake	bF	95	816	S	2
Killraine Twp					
- Rainbow Falls					
Prov. Pk	bF	91	166	M-S	1
Leslie Twp	bF	48	282	S	2

(cont'd)

APPENDIX: North Central Region - Spruce Budworm: Summary of defoliation estimates and egg- mass counts in 1990, and infestation forecasts for 1991 (cont'd).

Location	Host	Estimated defoliation in 1990 (%)	No. of egg masses per 9.29 m² of foliage	Infestation forecasts for 1991[a]	Accumulated damage[b]
Terrace Bay District (concl.)					
Little Nama Creek	bF	66	96	M-S	1
McCoy Twp	bF	8	0	0	1
Neys Prov. Pk	bF	70	147	M-S	2
Nickle Twp	bF	67	579	S	1
Pearly Lake	bF	82	332	S	2
Pic Twp - Black River	wS	19	0	0	1
- Pukaskwa Pk Hdqtrs	wS	42	0	0	1
Portage Lake	wS	84	28	L-M	2
Rocke Lake	bF	95	124	M-S	3
Steel Lake	bF	95	372	S	2
Stevens					
- Microwave Tower	bF	95	459	S	2
Syine Twp	wS	92	157	M-S	2
Vein Lake	bF	93	743	S	2
Wiggins Twp	bF	93	113	M-S	3
- Stand 90	bF	95	280	S	4
- Stand 90	wS	95	562	S	4
Thunder Bay District					
(73 locations)					
Abigogami Lake					
- 1989 Spray Plot 2	bF	68	329	S	2
- 1989 Spray Plot 7	bF	78	464	S	2
- 1989 Spray Plot 10	bF	68	429	S	2
Abitibi Price - Camp 11	bF	24	398	S	1
Abitibi Price - Camp 230	bF	68	204	M-S	2
Aldina Twp					
- Impact Plot, Stand 19	bF	68	263	S	8
Bedivere Lake	bF	40	46	M	7
Blackwell Twp	bF	33	93	M-S	7
Bo Lake	bF	32	103	M-S	1
Brightsand Lake	bF	100	594	S	4
Burchell Lake					
- Stand 125	bF	13	29	L-M	-
Camp 45 Rd	bF	94	492	S	4
Cheeseman Lake					
- km 130	bF	100	299	S	7
	wS	96	1,252	S	7
Conacher Twp					
- Stand 459	bF	36	154	M-S	8
Crayfish Lake	bF	26	54	L-M	+

(cont'd)

APPENDIX: North Central Region - Spruce Budworm: Summary of defoliation estimates and egg- mass counts in 1990, and infestation forecasts for 1991 (cont'd).

Location	Host	Estimated defoliation in 1990 (%)	No. of egg masses per 9.29 m² of foliage	Infestation forecasts for 1991[a]	Accumulated damage[b]
Thunder Bay District (cont'd)					
Devon Twp	bF	72	92	M-S	5
Dog Lake - Hawk Bay	bF	82	344	S	2
Dorian Twp					
- Hurkett Cove[e]	bF	100	379	S	3
- Plantation	wS	5	0	0	0
Forbes Twp - Flett	bF	30	31	L-M	3
Fowler Twp - Plantation	wS	88	786	S	1
Gorham Twp					
- Hazelwood[e]	bF	81	188	M-S	1
- Wishart[e]	bF	7	8	L	0
Greenwater Lake					
- southeast	bF	13	0	0	-
- Shelter Island	bF	85	158	M-S	+
Greenwood Lake	bF	16	0	0	-
Grew River	bF	18	135	M-S	1
Hagey Twp - Hwy 586	bF	53	189	M-S	+
- Plantation	wS	43	847	S	0
Haines Twp - Postans	bF	23	324	S	-
Harmon Lake	bF	85	333	S	5
Hartington Twp					
- Plantation	wS	65	669	S	1
Hicks Lake	bF	52	398	S	3
Hood Lake	bF	14	25	L-M	-
Hoof Lake	bF	28	128	M-S	-
Hwy 11					
- west of 802, Stand 590	bF	26	24	L-M	-
- west of 802, Stand 601	bF	8	0	0	-
Kabitotikwia Lake	bF	100	111	M-S	5
- Block 96, Plot 2[d]	wS	47	48	L-M	2
- Block 96, Plot 3[d]	bF	78	171	M-S	2
- Block 96, Plot 5[d]	bF	63	212	S	2
	wS	91	61	M-S	2
Kekekuab Lake	bF	83	425	S	-
Lac Des Mille Lacs					
- Bolton Bay	bF	58	58	L-M	5
- Honkonen Narrows	bF	61	402	S	5
Lismore Twp	bF	78	269	S	4
Marks Twp - Plantation	wS	5	0	0	0
Mattawin Rd					
- Tree Seed Orchard	wS	13	111	M-S	1

(cont'd)

APPENDIX: North Central Region - Spruce Budworm: Summary of defoliation estimates and egg- mass counts in 1990, and infestation forecasts for 1991 (concl.).

Location	Host	Estimated defoliation in 1990 (%)	No. of egg masses per 9.29 m² of foliage	Infestation forecasts for 1991[a]	Accumulated damage[b]
Thunder Bay District (concl.)					
McGinnis Lake	bF	15	36	L-M	-
McMaster Twp					
- Fog Lake Rd	bF	94	546	S	4
Moss Lake	bF	21	60	L-M	-
Mountain Lake	bF	77	781	S	6
	wS	82	124	M-S	6
Mug Lake	bF	65	293	S	1
O'Connor Twp					
- Cedar Falls[e]	bF	44	144	M-S	1
- OMNR SPA[c]	wS	14	142	M-S	0
Paipoonge Twp					
- OMNR Nursery	wS	21	326	S	2
Pakashkan Lake					
- Outlet Bay	bF	58	355	S	3
Plummes Lake	bF	13	0	0	-
Sandstone Lake	bF	58	280	S	6
Savanne Twp	bF	25	118	M-S	2
Shebandowan Lake	bF	8	0	0	-
Sleeping Giant Prov. Pk	bF	98	430	S	5
Sparkling Lake	bF	70	409	S	3
Squeers Lake	bF	8	9	L	-
Sump Lake	bF	85	1,532	S	6
Tib Lake	bF	74	398	S	1
Trewartha Twp	bF	13	0	0	1
Wawang Lake	bF	88	486	S	3
Weaver Lake	bF	100	762	S	5
Whitelily Lake					
- Hwy 527	bF	45	234	S	1
Wolf River Rd - km 28	bF	88	398	S	4

[a] S = severe, M = moderate, L = light, 0 = nil

[b] Accumulated Damage: 0 = undamaged; 1 = light damage, <25% total defoliation, usually one season of severe defoliation; 2 = moderate damage, 25 to 60% total defoliation, two or three seasons of severe defoliation; 3 = severe damage, 60 to 80% total defoliation, three to five seasons of severe defoliation, will recover; 4 = moribund or dying, 80 to 100% total defoliation, crowns grey in appearance to dead or bare 50 to 150 cm; 5 = less than 25% of stand dead; 6 = 25 to 50% of stand dead; 7 = 50 to 70% of stand dead; 8 = more than 70% of stand dead; 9 = less than 25% of stand dead, no significant (i.e., <25%) defoliation for several years; + = 25 to 50% of stand dead, no significant defoliation for several years; - = 51 to 70% of stand dead, no significant defoliation for several years.

[c] SPA = Seed Production Area

[d] Aerially sprayed with B.t. in 1990

[e] Lakehead Region Conservation Authority