

THE 1976 SPRUCE BUDWORM SITUATION
IN ONTARIO
PART A: DAMAGE AND FORECASTS
PART B: AERIAL SPRAYING OPERATIONS

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We wish to remind all management and unit foresters, industrial or provincial, that if they require more specific information than is contained in this report about spruce budworm conditions in their districts they should contact the appropriate Forest Research Technician or write to the Head, Forest Insect and Disease Survey Unit, Great Lakes Forest Research Centre.

ABSTRACT

The spruce budworm situation eased considerably in southern Ontario but continued to worsen in northeastern and northwestern Ontario in 1976. Part A of this report describes changes in the infestations in 1976 and forecasts, in cartographic and tabular form, the damage liable to occur in 1977. Part B describes aerial spraying operations covering 40 000 ha (100,000 acres) which were conducted against the spruce budworm in Ontario in 1976 as part of a joint strategy developed by the Canadian Forestry Service and the Ontario Ministry of Natural Resources.

RÉSUMÉ

En 1976, l'infestation de la tordeuse des bourgeons de l'épinette s'est apaisée considérablement dans le sud de l'Ontario mais a continué d'empirer dans le nord-est et le nord-ouest de l'Ontario. La partie A de ce rapport décrit les fluctuations des infestations survenues en 1976 et prévoit, en se basant sur des cartes et des tableaux, les dégâts probables en 1977. La partie B décrit les arrosages aériens effectués en 1976 sur une superficie de 40 000 ha (100,000 acres), lors de la réalisation d'un programme conjoint entre le Service canadien des forêts et le Ministère des richesses naturelles de l'Ontario.

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COVER PHOTOGRAPH

The oft-stated, never-proven relationship between spruce budworm-caused damage and increased fire hazard is depicted on the cover. This particular subject is the focus of current efforts by the Forest Fire Research Group at GLFRC. Photograph of forest fire by B. J. Stocks.

PART A: DAMAGE AND FORECASTS

INTRODUCTION

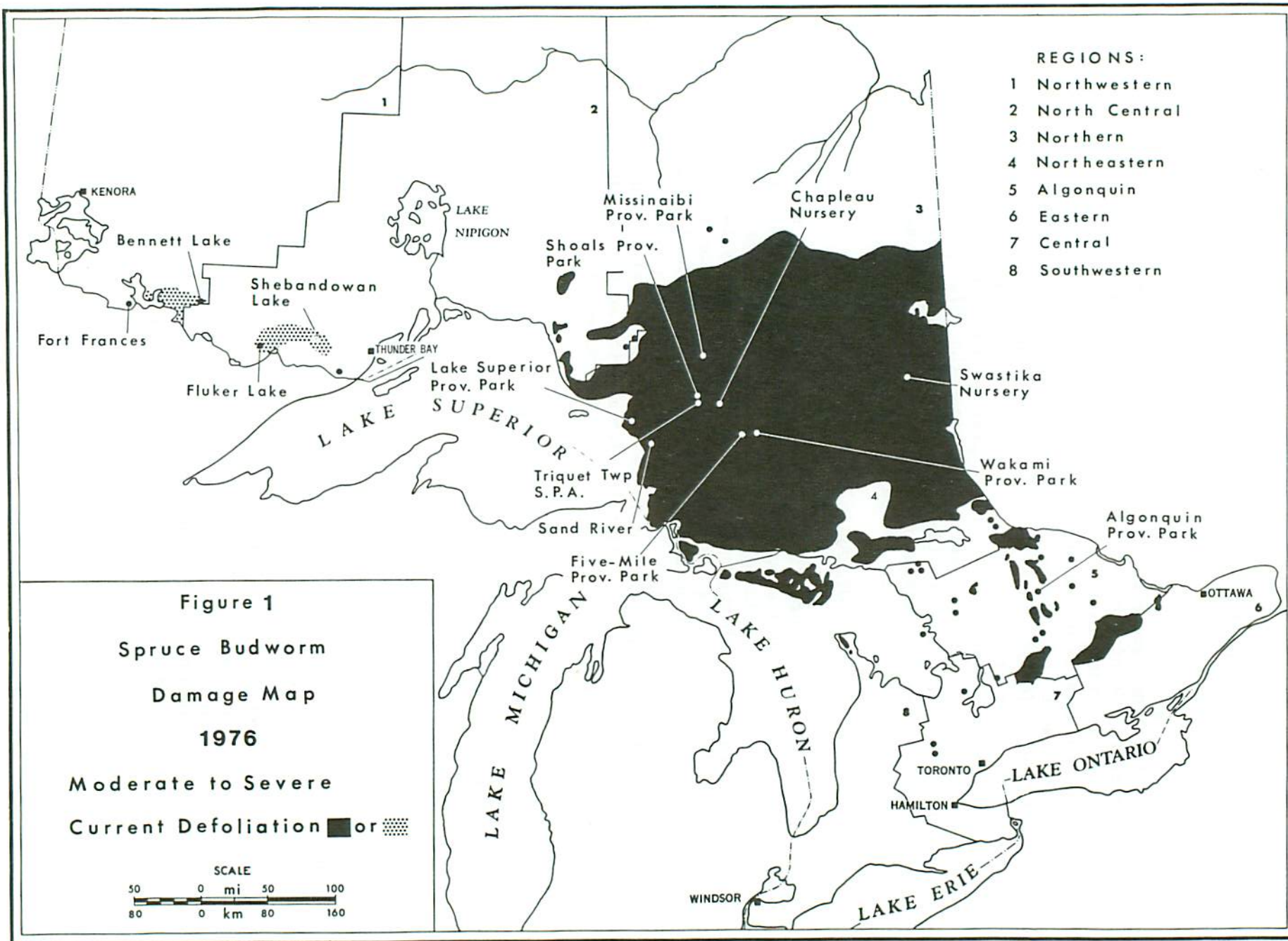
Ontario has experienced ten consecutive years of ever expanding spruce budworm (*Choristoneura fumiferana* [Clem.]) infestations throughout the province starting in 1967. In 1971, the first of an annual series of reports on the status of the spruce budworm in Ontario was prepared by the Forest Insect and Disease Survey (FIDS) Unit of the Great Lakes Forest Research Centre (GLFRC) in Sault Ste. Marie. The purpose of these reports is to provide forest managers with up-to-date, accurate information about Canada's most important forest insect pest on a province-wide basis. This report, the seventh in the series, describes the 1976 spruce budworm situation in Ontario and provides damage forecasts for 1977. Also included are the best available information, data and maps describing budworm-caused tree mortality to date.

OVERALL SITUATION, 1976

The spruce budworm situation in Ontario continued to worsen in 1976. Aerial and ground surveys revealed moderate-to-severe defoliation of balsam fir (*Abies balsamea* [L.] Mill.) and white spruce (*Picea glauca* [Moench] Voss) trees throughout an area of approximately 14.6 million ha (36.45 million acres) (Fig. 1). This total represents an increase of 1.3 million ha (3.2 million acres) or about 10% over the 13.3 million ha (33.245 million acres) mapped in 1975. Regionally, in 1976 the picture showed a decline of 1.76 million ha (4.4 million acres) in southern Ontario, an increase of 3 million ha (7.5 million acres) in northeastern Ontario and an increase of 42 800 ha (107,000 acres) in northwestern Ontario.

Listed below are the areas, expressed in hectares (1 ha = 2.5 acres), that have been mapped as moderately to severely defoliated each year for the three regional outbreaks since their eruption in 1967.

<u>Year</u>	<u>Southern</u>	<u>Northeastern</u>	<u>Northwestern</u>	<u>Total</u>
1967	60,000	3,000	16,000	79,000
1968	120,000	200,000	0	320,000
1969	307,200	660,000	1,600	968,000
1970	640,000	2,080,000	52,000	2,772,000
1971	1,800,000	3,440,000	52,000	5,292,000
1972	2,320,000	5,360,000	28,000	7,708,000
1973	2,400,000	5,000,000	4,000	7,404,000
1974	2,200,000	7,400,000	4,680	9,604,680
1975	2,400,000	10,880,000	18,000	13,298,000
1976	640,000	13,880,000	60,800	14,580,800



A feature of the 1976 season was a period of unusually warm weather that occurred throughout most of an area south of Sault Ste. Marie, Sudbury and North Bay during the Easter weekend. Temperatures became progressively warmer over a 4-day period, April 15-18, reaching as high as 27-28°C (low 80's F). This warm spell was then followed by a period of relatively cool weather during the latter part of April and early May with temperatures as low as -5°C (23°F). Within the region affected by the warm weather, some early emergence of budworm larvae occurred and it was thought that some of these early emergers might eventually have been adversely affected by the subsequent cold temperatures. However, overwintering larval population data and third-instar larvae established on 45-cm (18-in.) tips indicate that spring emergence and survival of second- and third-instar larvae were higher than normal in 1976. This in turn indicates that the weather did not have an obvious impact on budworm populations in southern Ontario in 1976.

Elsewhere in Ontario, temperatures were relatively normal through the Easter weekend although a warming trend was evident. Dates of budworm emergence were quite variable throughout the province. Emergence, other than that occurring during the Easter weekend, occurred in early May in southern Ontario, on or about May 8 in the vicinity of Sault Ste. Marie and not until about May 23-25 in the vicinity of Chapleau. In northwestern Ontario, emergence was under way by May 12 in the vicinity of Bennett Lake in the Fort Frances District.

Unfortunately, the concerns expressed in last year's report about the budworm situation in northwestern Ontario were realized with defoliation totalling more than 60 000 ha (150,000 acres), despite extensive spraying, in 1976. Since 1968, chemical control operations of varying magnitude have been carried out annually by the Ontario Ministry of Natural Resources (OMNR) in northwestern Ontario for the purpose of suppressing or eliminating infestations that appeared to have a potential for buildup and expansion into a widespread outbreak. Generally, this policy has been quite successful, particularly when contrasted with the situation in northeastern and southern Ontario. However, in view of the current situation, it appears evident that the population suppression approach may no longer be practical and alternative strategies will have to be considered.

In Minnesota, a total of 634 000 ha (1,586,000 acres) of defoliation and tree mortality caused by budworm were reported in 1976, an increase of 234 000 ha (586,000 acres) compared to the 400 000 ha (1,000,000 acres) mapped in 1975. Most of the infested area was in the Superior National Forest with several small infestations either straddling or adjacent to the Ontario-Minnesota border in the vicinity of Basswood Lake and the Kabetogama Peninsula. In Manitoba, to the west of Ontario, a 600 ha (1,500 acre) budworm infestation was detected in the Whiteshell Provincial Park, about 40 km (25 miles) west of the Manitoba-Ontario border.

Several other infestations further to the west in Manitoba were reported in 1976. The largest of these consisted of some 110 000 ha (275,000 acres) of moderate-to-severe defoliation in the Interlake area about 120 km (75 miles) north of Winnipeg.

Southern Ontario

Situation in 1976: For five years, i.e., from 1971 to 1975, the major area of budworm outbreak in southern Ontario centered on the districts of Algonquin Park, Pembroke and Bancroft. Virtually all of the balsam fir-white spruce stands in these districts experienced extremely high budworm populations (which peaked in 1973) and suffered the effects of several consecutive years of severe defoliation. Considerable tree mortality and top kill is evident throughout this region. In 1976 (Fig. 2) larval population levels declined considerably and the outbreak decreased to 640 000 ha (1.6 million acres) from the 2.4 million ha (6.0 million acres) of moderate-to-severe defoliation mapped in 1975, a reduction of over 70% in terms of the extent of area defoliated. Some 20 pockets of moderate-to-severe defoliation, ranging in size from a few hundred hectares to 252 000 hectares (630,000 acres), were mapped in 1976. These were, for the most part, located on the outer edges of the area infested from 1971 to 1975. The largest of these, a 252 000 ha (630,000 acres) infestation, was located in the southern part of the Pembroke District (Matawatchan, Brougham and Blithfield townships, the northwest corner of the Lanark District, Lavant Township), the northern part of the Tweed District (North and South Canonto, Miller, Denbigh, Abinger, Ashby, Effingham, Grimsthorpe, Tudor and Lake townships) and the eastern part of the Bancroft District (Cashel and Limerick townships). A pocket of defoliation totalling 116 000 ha (290,000 acres) was located some 40 km (25 miles) to the west of the infestation in the Tweed District, in the southern part of the Minden District covering the townships of Cavendish, Galway and Somerville and parts of adjacent townships such as Monmouth, Harvey and Verulam. The third largest infestation in southern Ontario, 112 000 ha (280,000 acres) in size, was mapped in the southeast corner of the North Bay District (Calvin, Lauder, Papineau, Boyd and Cameron townships) and in Clara Township in the adjoining Algonquin Park District. Several large pockets of defoliation were present in the central and southern part of the Algonquin Park District, namely 33 000 ha (82,000 acres) in Anglin, Dickson and Preston townships, 14 000 ha (34,000 acres) in Osler, Bishop and McLaughlin townships and 12 000 ha (30,000 acres) in Clyde Township. Numerous other small pockets of defoliation were found elsewhere throughout the Algonquin Park and Pembroke districts. With the exception of those pockets of moderate-to-severe defoliation previously noted, most of the fir-spruce stands in Algonquin Park, Pembroke and Bancroft districts exhibited light defoliation. Further to the east, in Lanark, Ottawa and Cornwall districts no defoliation other than trace or light was noted except for a pocket of moderate-to-severe defoliation located south of Arnprior in McNab and Pakenham townships straddling the Pembroke-Lanark district boundary.

West of Algonquin Park, several new infestations that were detected and mapped in 1975 in the North Bay District, south of Lake Nipissing and Parry Sound District, changed considerably. In general, populations were lower and the extent of defoliation was less in 1976 than in 1975. Nevertheless, small pockets of moderate-to-severe defoliation remained in Patterson Township in North Bay District and in McConkey, Blair, Lount, Spence and Monteith townships in Parry Sound District. The only defoliation mapped in the Bracebridge District was located between Bernard and Pickerel lakes north of Burk's Falls in Armour and Strong townships.

Generally speaking, in the Southwestern Region, larval population levels were much lower in 1976 than those of the previous year and little defoliation was evident. In the Owen Sound District, scattered pockets of moderate-to-severe defoliation occurred to balsam fir and white spruce in Lindsay and St. Edmunds townships on the Bruce Peninsula and in scattered pockets of white spruce in Glenelg Township. Budworm larval populations were also lower throughout the Central Region although numerous pockets of infestation and defoliation were evident. For example, medium or heavy infestations were reported on planted spruce trees in Vespra, Oro, Mono and Essa townships in the Huronia District and Albion and Uxbridge townships in the Maple District. Ornamental spruce trees suffered light or moderate defoliation at a number of scattered locations throughout the region.

Spraying operations (aerial and ground) using *Bacillus thuringiensis* were carried out in Algonquin Provincial Park in 1976 to protect foliage of host trees in high-value stands. Please refer to Part B of this report for further details.

Infestation Forecasts for 1977: Spruce budworm egg-mass counts and defoliation surveys were carried out in southern Ontario during August, 1976. Foliage samples were collected from a total of 124 locations, egg masses were counted, defoliation was estimated and damage forecasts for 1977 were prepared (Fig. 3; for detailed results see Table 1).

At this point, it would be appropriate to point out a few of the pitfalls of forecasting. In the first place, we attempt to forecast the damage expected from larval feeding in the following year based on the number of egg masses per unit area of foliage obtained in August or September. An egg-mass count for foliage samples from the same stands year after year is a powerful yet sensitive approach that provides a reasonably accurate estimate of population levels but more particularly, trends in population levels in those particular stands from year to year. Such data should not be extrapolated to estimate population levels or trends for larger areas such as townships or districts unless a properly designed survey is carried out for that

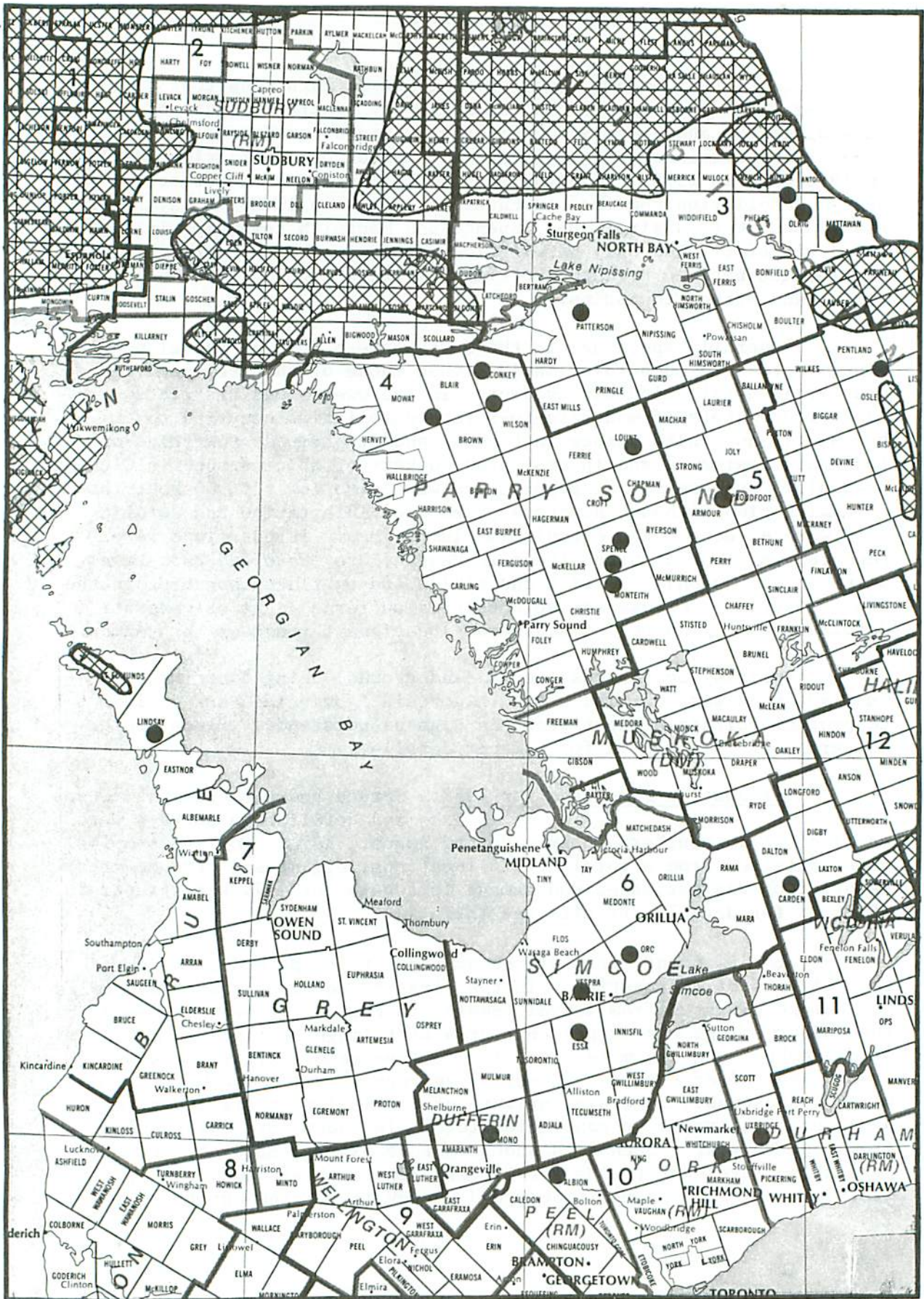




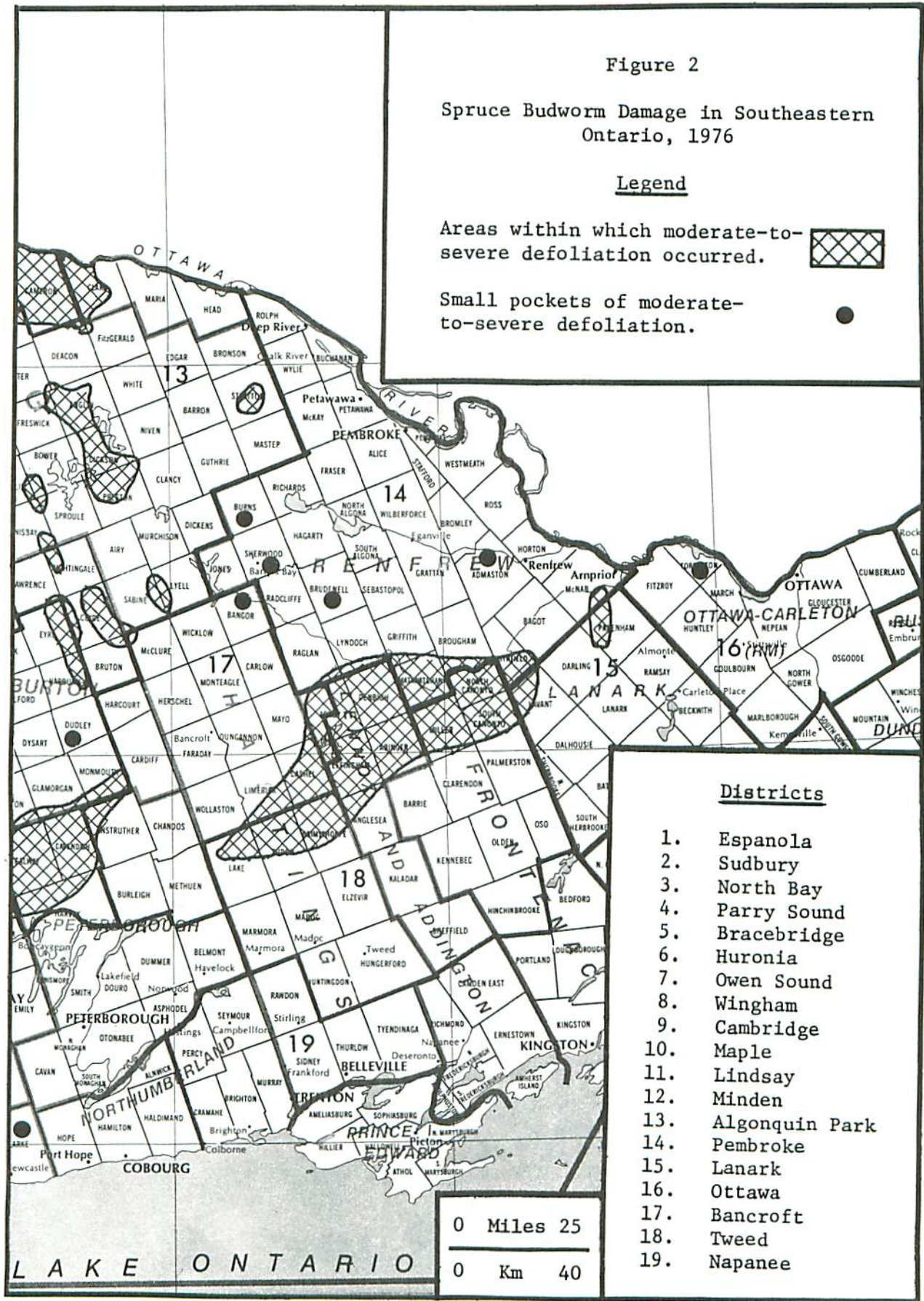
Figure 2

Spruce Budworm Damage in Southeastern Ontario, 1976

Legend

Areas within which moderate-to-severe defoliation occurred. 

Small pockets of moderate-to-severe defoliation. 



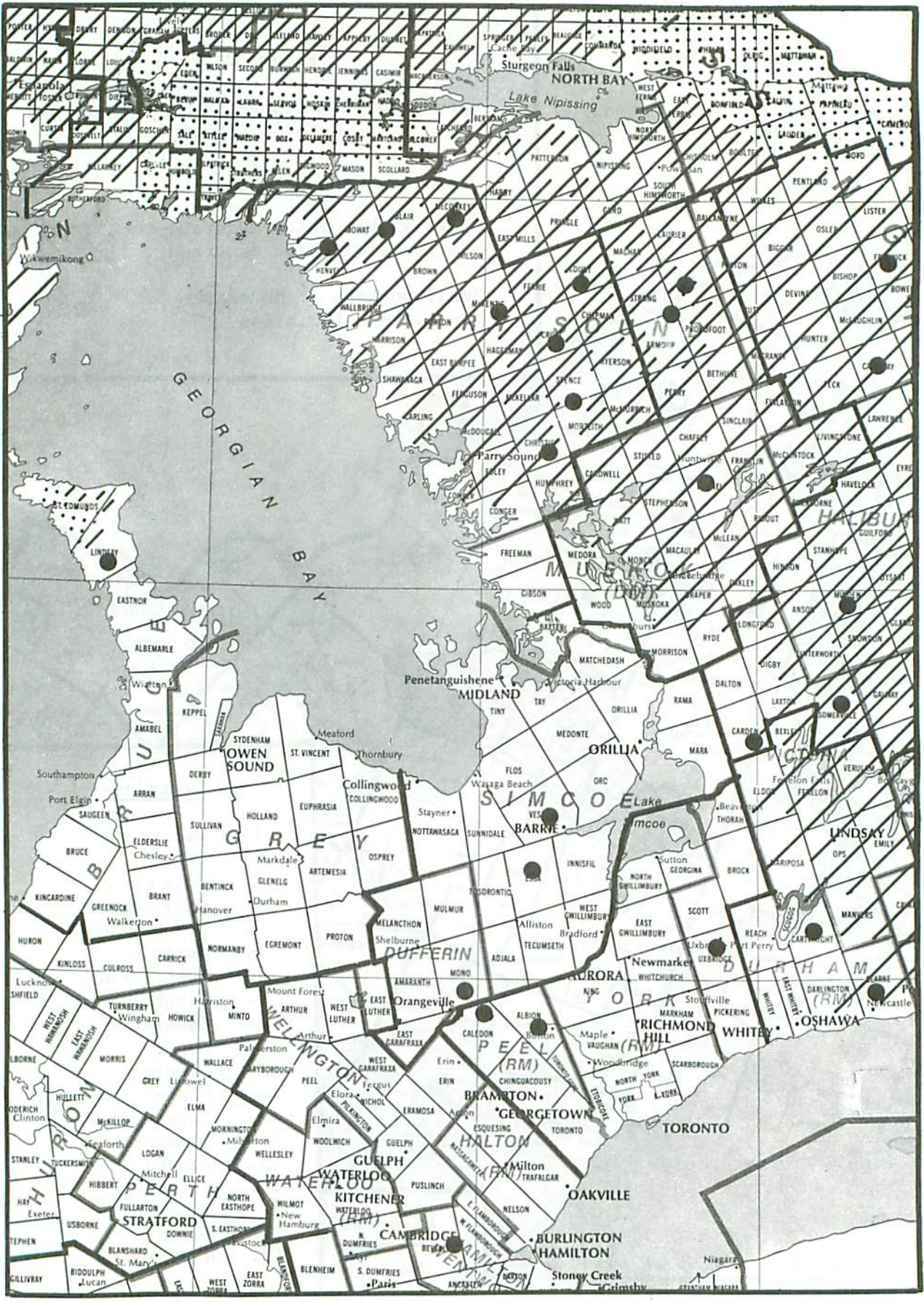
Districts

1. Espanola
2. Sudbury
3. North Bay
4. Parry Sound
5. Bracebridge
6. Huronia
7. Owen Sound
8. Wingham
9. Cambridge
10. Maple
11. Lindsay
12. Minden
13. Algonquin Park
14. Pembroke
15. Lanark
16. Ottawa
17. Bancroft
18. Tweed
19. Napanee

0 Miles 25

0 Km 40

LAKE ONTARIO



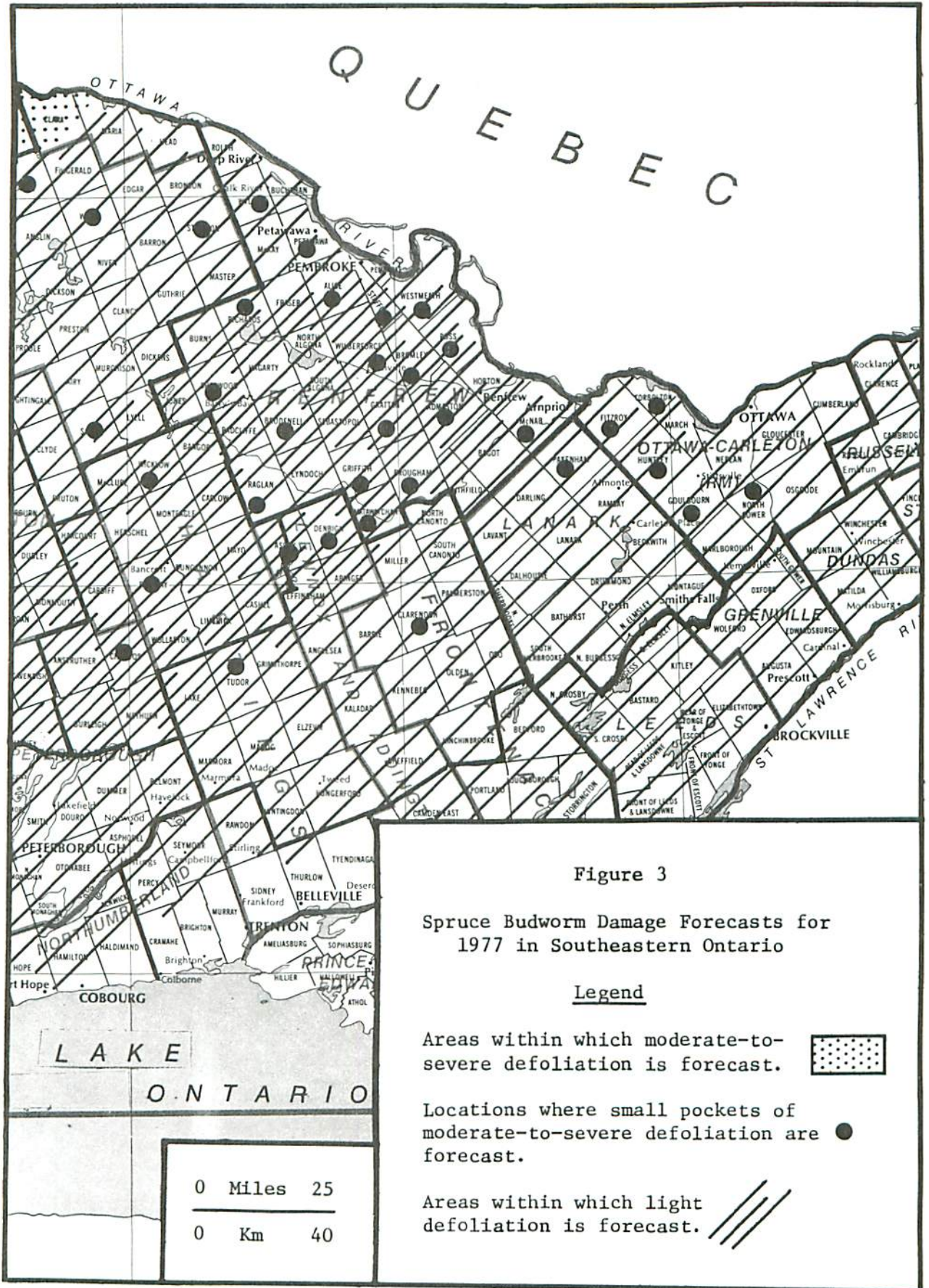



Figure 3

Spruce Budworm Damage Forecasts for 1977 in Southeastern Ontario

Legend

Areas within which moderate-to-severe defoliation is forecast. 

Locations where small pockets of moderate-to-severe defoliation are forecast. ●


Areas within which light defoliation is forecast. 

Table 1. Southern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg masses per 9.29 sq. m (100 sq. ft) of foliage	Infestation forecasts for 1977 ^a
<u>Algonquin Park District</u>				
(25 locations)				
Airy Twp - East Gate ^b	wS	12	27	L-M
Bruton Twp	bF	2	0	0
Canisbay Twp - Cache Lake	bF	6	23	L-M
- Lake of Two Rivers ^b	wS	33	108	M-S
- Mew Lake ^b	bF	3	45	L-M
- Pog Lake ^b	bF	2	7	L
Clara Twp - Dieux Rivières	bF	3	11	L
Clyde Twp	bF	7	43	L-M
Deacon Twp - North River	bF	70	67	M-S
Dickens Twp	bF	3	0	0
Dickson Twp - Annie Bay	bF	10	22	L-M
Finlayson Twp				
- Oxtongue River	bF	1	0	0
Freswick Twp - Hogan Lake	bF	19	112	M-S
Guthrie Twp	bF	12	17	L-M
- North of Basin Depot	wS	7	276	S
Head Twp - Grant Creek	wS	2	39	L-M
Peck Twp - Smoke Lake	bF	2	0	0
Preston Twp				
- Annie Bay Dam	bF	4	21	L-M
- Tattler Lake	bF	12	204	M-S
Sabine Twp - McCoy Lake	wS	3	0	0
Sproule Twp				
- Fisheries Res. Stn.	bF	25	43	L-M
Stratton Twp				
- Achray (Plot C)	bF	15	91	M-S
- Lone Creek	bF	6	341	S
White Twp				
- Otterpaw Creek	bF	4	132	M-S
Wilkes Twp - Wilkes Lake	bF	1	38	L-M
<u>Aylmer District</u>				
(1 location)				
London Twp				
- City of London	wS	0	56	M

(cont'd.)

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Location	Host	Estimated per cent of defoliation 1976	No. of egg masses per 9.29 sq. m (100 sq. ft) of foliage	Infestation forecasts for 1977 ^a
<u>Bancroft District</u>				
(5 locations)				
Ashby Twp	bF	68	350	S
Cardiff Twp	bF	2	0	0
Chandos Twp	bF	15	137	M-S
Faraday Twp	bF	15	128	M-S
Wicklow Twp	bF	7	200	M-S
<u>Bracebridge District</u>				
(8 locations)				
Brunel Twp				
- south of Huntsville	bF	9	62	M-S
Butt Twp	bF	5	37	L-M
Cardwell Twp	bF	0	5	L
Joly Twp - Faisley Lake	bF	19	82	M-S
Monck Twp - Bardsville	bF	5	15	L-M
Oakley Twp - Clear Lake	bF	0	0	0
Ridout Twp	bF	0	0	0
Sinclair Twp - Bella Lake	bF	8	18	L-M
<u>Brockville District</u>				
(1 location)				
Oxford Twp				
- OMNR Tree Nursery, Kemptville	wS	5	23	L-M
<u>Cambridge District</u>				
(2 locations)				
Beverly Twp	wS	2	193	M-S
Binbrook Twp	wS	1	28	L-M
<u>Chatham District</u>				
(1 location)				
Sarnia Twp				
- City of Sarnia	wS	0	38	L-M

(cont'd.)

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<u>Cornwall District</u> (4 locations)				
Cambridge Twp				
- 2 miles north of Casselman	wS	4	0	0
- Larose Forest, Spruce Rd	wS	6	44	L-M
Clarence Twp				
- Larose Forest	wS	2	28	L-M
Kenyon Twp	wS	4	12	L
<u>Huron District</u> (5 locations)				
Essa Twp	wS	4	90	M-S
Vespra Twp				
- Jct. Hwy 26 & 27	wS	43	423	S
- OMNR Tree Nursery Windbreaks, Midhurst ^c	wS	2	192	M-S
- OMNR Tree Nursery Windbreaks, Midhurst ^c	nS	2	147	M-S
- OMNR Tree Nursery Windbreaks, Midhurst ^c	bIS	12	114	M-S
<u>Lanark District</u> (4 locations)				
Dalhousie Twp				
- northeast of Dalhousie Lake	bF	4	0	0
Darling Twp				
- Lot 10, Con VII	bF	1	10	L
Lavant Twp				
- Robertson Lake	wS	8	43	L-M
Pakenham Twp	wS	10	199	M-S

(cont'd.)

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Location	Host	Estimated per cent of defoliation 1976	No. of egg masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Lindsay District</u> (3 locations)				
Cartwright Twp	wS	10	164	M-S
Smith Twp	bF	3	0	0
Clarke Twp - OMNR Tree Nursery, Orono	wS	18	264	S
<u>Maple District</u> (3 locations)				
Albion Twp	wS	6	276	S
Uxbridge Twp	wS	53	425	S
Vaughan Twp	wS	4	24	L-M
<u>Minden District</u> (9 locations)				
Carden Twp	wS	27	146	M-S
Cavendish Twp - Pencil Lake	bF	8	45	L-M
Dudley Twp - Kennibik Lake	bF	2	7	L
Eyre Twp	bF	3	0	0
Glamorgan Twp - Koshlong Lake	bF	2	26	L-M
Guilford Twp	bF	5	32	L-M
Harvey Twp - Nogies Creek	bF	79	41	L-M
Minden Twp	bF	6	76	M-S
Somerville Twp	bF	69	119	M-S
<u>Ottawa District</u> (6 locations)				
Fitzroy Twp - Lot 6, Con. IV	wS	11	78	M-S
Goulbourn Twp - Hwy 7	wS	10	163	M-S

(cont'd.)

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Location	Host	Estimated per cent of defoliation 1976	No. of egg masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Ottawa District</u> (cont'd.) (6 locations)				
Huntley Twp				
- Lot 16, Con. IV	wS	4	106	M-S
North Gower Twp	wS	5	100	M-S
Torbolton Twp	bF	28	50	L-M
- Lot 20, Con. I	wS	3	79	M-S
<u>Owen Sound District</u> (2 locations)				
Glenelg Twp	wS	14	160	M-S
St. Edmunds Twp	wS	70	826	S
<u>Parry Sound District</u> (10 locations)				
Blair Twp - Blair Camp	wS	5	107	M-S
- Lost Channel	bF	3	131	M-S
Christie Twp	bF	23	71	M-S
Croft Twp	bF	5	90	M-S
Lount Twp	wS	50	187	M-S
McConkey Twp	wS	5	67	M-S
McKenzie Twp	bF	5	105	M-S
McMurrich Twp - Doe Lake	bF	0	39	L-M
Mowat Twp - Grundy Prov. Pk.	wS	12	362	S
Spence Twp	bF	31	59	M-S
<u>Pembroke District</u> (27 locations)				
Admaston Twp				
- Bonnechere River	wS	5	164	M-S
- Mount St. Patrick	bF	5	47	L-M
Alice Twp	bF	61	184	M-S
Bromley Twp	wS	10	208	M-S

(cont'd.)

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Location	Host	Estimated per cent of defoliation 1976	No. of egg masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Pembroke District (cont'd.)</u> (27 locations)				
Brougham Twp	bF	4	184	M-S
Brudenell Twp	bF	12	63	M-S
Grattan Twp	wS	13	400	S
Griffith Twp	wS	7	964	S
Matawatchan Twp	bF	23	387	S
McNab Twp	wS	5	98	M-S
Petawawa Twp				
- Antler Creek	wS	12	27	L-M
Raglan Twp	wS	4	627	S
Richards Twp - Round Lake	bF	3	79	M-S
Rolph Twp	wS	20	84	M-S
Ross Twp - Dist. Boundary	wS	2	69	M
- Garage	wS	1	250	S
Sherwood Twp				
- west of Barry's Bay	wS	43	446	S
South Algona Twp - Ruby	bF	3	14	L-M
Stafford Twp - Mixburg	wS	21	348	S
- Plot 5, 1972				
N.P.V., Rankin	wS	5	46	L-M
- Plot 5, 1972				
N.P.V., Rankin	bF	2	73	M-S
Westmeath Twp				
- east of Westmeath	bF	2	66	M-S
- Quarry	wS	3	169	M-S
Wilberforce Twp				
- northwest of Douglas	wS	4	610	S
- 1 mile north of Rankin	wS	7	71	M-S
Wylie and Buchanan Twp				
(Petawawa Forest Exp. Stn.)				
- Deluthier Rd., 1971 N.P.V. (Plot G)	wS	4	148	M-S
- Orange Rd., (check plot)	wS	1	146	M-S

(cont'd.)

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Location	Host	Estimated per cent of defoliation 1976	No. of egg masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Simcoe District</u> (1 location)				
South Walsingham Twp - OMNR Tree Nursery, St. Williams	wS	0	10	L
<u>Tweed District</u> (5 locations)				
Clarendon Twp	wS	13	198	M-S
Denbigh Twp - Slate Falls Rd	bF	27	139	M-S
Kaladar Twp	bF	0	0	0
Marmora Twp	bF	5	0	0
Tudor Twp	wS	20	377	S
<u>Wingham District</u> (2 locations)				
Colborne Twp - Auburn	wS	0	25	L-M
Downie Twp	wS	0	31	L-M

^a S = severe, M = moderate, L = light, 0 = nil

^b Aerially sprayed, *Bacillus thuringiensis*, 1976

^c Ground spray, Fenitrothion, 1976

purpose. Thus, estimates such as those presented in Table 1 apply in a statistical and biological sense only to the stands sampled. However, when considered in concert with other information and data such as observations and counts of larval numbers, extent and severity of defoliation, incidence of moths, moth flights, etc. (obtained on a widespread basis throughout districts or regions), egg-mass counts assume greater significance. Although there is still no valid statistical basis even with this additional information, we can make biological statements that apply to extensive areas with greater confidence.

For example, there are the two samples from the Wingham District that showed a decrease of 92% in egg-mass densities from 1975 to 1976. If these were the only data available, it would not be realistic to conclude that budworm populations in this district had declined by 92%. However, when all the egg-mass samples taken in southwestern Ontario (see below) are considered in conjunction with observations and data from throughout the region (e.g., larval populations were much lower--about 80% lower based on data for Owen Sound, Simcoe and Wingham districts) and the incidence, extent and severity of defoliation was considerably less in 1976), then we feel confident of forecasting with reasonable assurance that budworm populations and resultant damage will in fact be much lower in 1977 throughout southwestern Ontario.

No. of egg masses per 9.29 sq. m (100 sq. ft) of foliage				
District	Locations sampled	1975	1976	% Change
Aylmer	1	593	56	-91
Cambridge	2	502	221	-56
Chatham	1	320	38	-88
Owen Sound	2	1347	986	-27
Simcoe	1	271	10	-96
Wingham	2	704	56	-92
Total	9	3737	1367	-63

Secondly, the reader should realize that forecasting biological events is a difficult enough process at the best of times without the vagaries of factors such as weather. There are many assumptions (some stated, some implied) involved in forecasting damage levels caused by spruce budworm. For example, the methods used to classify budworm infestation levels and forecast damage were originally developed for balsam fir in New Brunswick¹. These methods have been used in Ontario in recent years for both balsam fir and white spruce simply because there are no methods developed specifically for white spruce or for either host species in Ontario forests. Thus, an obvious assumption that has been made is that the New Brunswick method for balsam fir is satisfactory for both species under Ontario conditions. This may not be the case. Operational experience in Ontario indicates that, in general, the method provides reasonably accurate and reliable forecasts for balsam fir but forecasts for white spruce may be too high at lower or intermediate population levels, i.e., from 50 to 200 egg masses/9.29 sq. m (100 sq. ft). This is especially critical because populations in this range are usually in a state of flux, undergoing considerable increase or decline from generation to generation with the overall situation being extremely dynamic in terms of infestations building up or collapsing. Forecasts for damage to white spruce seem to become more consistently reliable when populations exceed the intermediate range and reach relatively high levels (500 + egg masses/9.29 sq. m [100 sq. ft]) or decline to very low levels (fewer than 25 egg masses/9.29 sq. in. [100 sq. ft]). Thus, with the foregoing comments in mind, let us proceed to a detailed description of infestation forecasts for 1977.

The results of the survey for southern Ontario (124 locations) show that, on the average, egg-mass densities have decreased in 1976 by about 36% compared to similar counts made in 1975. This is the third consecutive year of decline in egg-mass counts since populations reached a peak in 1973. Decreases of 35% and 57% were recorded in 1974 and 1975, respectively. Decreases in egg-mass counts were most pronounced in the Algonquin, Pembroke, Ottawa and Lanark districts and throughout most of the Central Region (Huron, Maple and Cambridge districts) and South-western Region (Owen Sound, Wingham, Aylmer, Simcoe and Chatham districts). Contrary to the general trend, however, increases were recorded for sample locations in the Parry Sound, Bracebridge, Bancroft, Tweed, Lindsay and Cornwall districts while little change was apparent in Minden District. The average egg-mass count on balsam fir in southern Ontario in 1976

¹ Morris, R.F. 1954. A sequential sampling technique for spruce budworm egg surveys. *Can. J. Zool.* 32:302-313.

(63 locations) is 59 egg masses per 9.29 sq. m (100 sq. ft) of foliage and 182 on white spruce (61 locations). The highest egg-mass count recorded in southern Ontario in 1976 was from a white spruce sample collected in Griffith Township in the Pembroke District where the count was 964 egg masses per 9.29 sq. m (100 sq. ft).

Although the majority of forecasts still call for moderate or higher levels of defoliation for 1977, closer examination reveals that most of these higher forecasts are based on white spruce samples. Thus, keeping in mind that these forecasts may be misleading, i.e., too high (for reasons discussed earlier) and in view of other indicators such as the continued decline in egg-mass counts and a great decrease in the extent of moderate-to-severe defoliation in 1976, the general forecast for 1977 for southern Ontario (Fig. 3) calls for generally light defoliation throughout the Algonquin and the northern and western parts of the Eastern Region (namely, Ottawa, Lanark and Tweed districts) with small, scattered pockets of moderate-to-severe defoliation throughout this area. Elsewhere in southern Ontario, i.e., throughout the Central and South-western regions, scattered individuals or groups of white spruce trees (ornamentals, plantations or natural stands) will likely experience trace or light defoliation although moderate defoliation (or worse) may be evident in a few cases. Thus, it seems evident that in 1977 spruce budworm populations in southern Ontario will reach their lowest levels since the late 1960s and that the outbreak is collapsing.

Tree Mortality: Since 1974, FIDS aerial observers have mapped the location and extent of spruce budworm associated tree mortality in fir-spruce stands in southern Ontario. Trees or stands that are considered dead or moribund are identified from the air by their grey color which appears after several consecutive years of severe defoliation. However, not all trees in such "grey" stands are necessarily dead and ground cruises at as many locations as resources permit are required to confirm the presence and establish the degree of mortality. These checks or ground cruises consist of examining 100 balsam fir trees (and white spruce where that species is a major component of the stand) to determine their condition, i.e., live, dead or dead top, and the percentage of tree mortality is determined. All trees checked are dominants or co-dominants within the stand and 8.9 cm (3.5 in.) dbh or larger.

Based on this type of aerial mapping and subsequent ground checking, areas with significant balsam fir tree and top mortality following the 1976 field season are shown in Fig. 4.

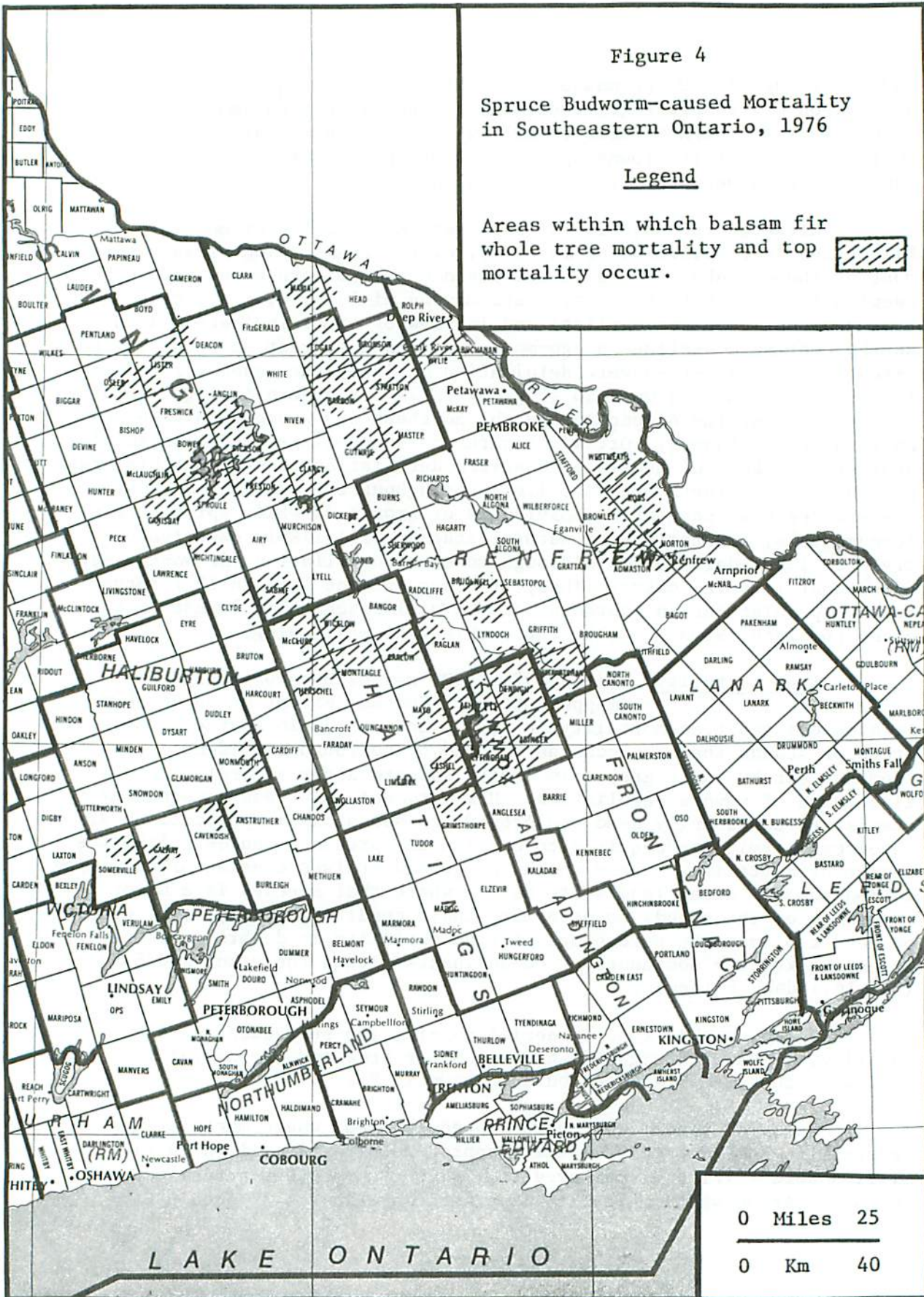
In 1976, aerial observers mapped 14 areas where mortality is present (to some degree) totalling approximately .64 million ha (1.6 million acres) (Fig. 4) compared to 120 000 ha (300,000 acres) mapped in 1975. Areas where mortality is present are in the Algonquin Park,

Figure 4

Spruce Budworm-caused Mortality
in Southeastern Ontario, 1976

Legend

Areas within which balsam fir
whole tree mortality and top
mortality occur.



Pembroke, Bancroft, Tweed and Minden districts. Some 22 ground checks were made throughout these five districts in August or September, 1976. Some of these ground checks were in stands that had been checked in 1975 or 1974, and this allows us to compare the changes or increases in mortality in the same stands. In general, mortality levels were in the 35-40% range and there were apparently only small increases from 1975 to 1976. Heavy mortality (balsam fir - 92%, white spruce - 50%) was reported in 1975 at Lone Creek in Stratton Township, Algonquin Park District but most of this has now been harvested. A summary of all the spruce budworm-associated tree mortality based on 100 tree ground checks for the past three years for southern Ontario is presented in Table 2.

Northeastern Ontario

Situation in 1976: In northeastern Ontario, the outbreak increased by nearly 30% over 1975 with significant extensions occurring along the northern and northwestern fronts of the outbreak (Fig. 5). In 1976, the total area within which moderate-to-severe defoliation of balsam fir and white spruce was mapped increased to 13.88 million ha (34.7 million acres) from the 10.88 million ha (27.2 million acres) in 1975. The major expansion occurred along the northern boundary in Kapuskasing and Cochrane districts where budworm defoliation was mapped 120-130 km (75-80 miles) north of the 1975 boundary. All of the Kirkland Lake and Timmins districts were infested in 1976 along with the southern parts of the Cochrane and Kapuskasing districts. Thus moderate-to-severe defoliation was mapped for the first time in the current outbreak throughout a large area totalling nearly 2.0 million ha (5.0 million acres) bounded by Kapuskasing on the west, Timmins on the south, Lake Abitibi north to Bradette Township on the east (along the Ontario-Quebec border) and Guilfoyle Township in the north. Small pockets of defoliation were noted as much as 40 km (25 miles) north of the main infestation, for example in Pinard Township in the Cochrane District and in Harmon, Fleck and Eilber townships in the Kapuskasing District. To the west, in Hearst and Wawa districts, modest extensions ranging from 10 to 40 km (6 to 25 miles) occurred generally along the northwestern boundary of the outbreak. Virtually all of the Wawa District is now infested and the Hearst District showed the presence of defoliation throughout the southeastern part of the district as far as a line extending from Chelsea Township (south of Hornepayne) on the west to Orkney Township in the east. A small isolated pocket of defoliation was mapped northeast of Hearst in Casgrain Township. All of the Chapleau and Gogama districts are infested to one degree or another, as are the Sault Ste. Marie, Blind River and Espanola districts which means that there was little if any change—at least in terms of defoliation boundaries—from 1975. However, some changes, mainly reductions, occurred to infestation boundaries in the Sudbury and North Bay districts.

Table 2. Southern Ontario - Summary of spruce budworm-associated mortality based on 100 tree ground checks for the past three years.

<u>Location</u>	<u>Host</u>	<u>Tree mortality</u>		
		<u>1974</u>	<u>1975</u>	<u>1976</u>
(<u>%</u>)				
<u>Algonquin Park District</u>				
Canisbay Twp - Wildlife Station	bF	25		32
- Madawaska River	bF	55		
Nightingale Twp - Rock Lake	bF		49	33
Preston Twp - Annie Bay Dam	bF	38		41
- Booth Lake	bF	52	71	78
- Kitty Lake	bF	25	68	
- Shirley Lake	bF	24		
Sabrina Twp - HW 127, Hay Lake Rd	bF			49
Stratton Twp - Achray	bF	50		56
- "	WS	57		
- Lone Creek	bF	80	92	
- " "	WS	16	50	
<u>Bancroft District</u>				
Carlow Twp - New Carlow	bF	36		
Dungannon Twp	bF			34
Faraday Twp	bF		24	
Herschel Twp	bF			21
Mayo Twp	bF			14
McClure Twp	bF	15		21
Monteagle Twp	bF	39		
Wicklow Twp	bF		45	49
<u>Minden District</u>				
Cavendish Twp	bF	32		45
Galway Twp - Bass Lake	bF	47		68
- Crystal Lake	bF	10		
Harvey Twp	bF	15		
Monmouth Twp	bF			60
Somerville Twp - Victoria Co. Forest	bF	31		37
<u>Pembroke District</u>				
Griffith Twp	bF	36	57	
Matawatchan Twp - Camel Chute	bF		38	43
- " "	WS		10	
Wylie Twp - PFES	bF		65	
<u>Tweed District</u>				
Abinger Twp - HW 41	bF			35
" " - Lot 27, Con XI	bF			32
- " " " "	WS			0
Ashby Twp	bF			6
Denbigh Twp - Slate Falls Road	bF		18	24
- North of Denbigh on HW 41	bF		5	
- South " " " " "	bF		4	
Effingham Twp	bF			8

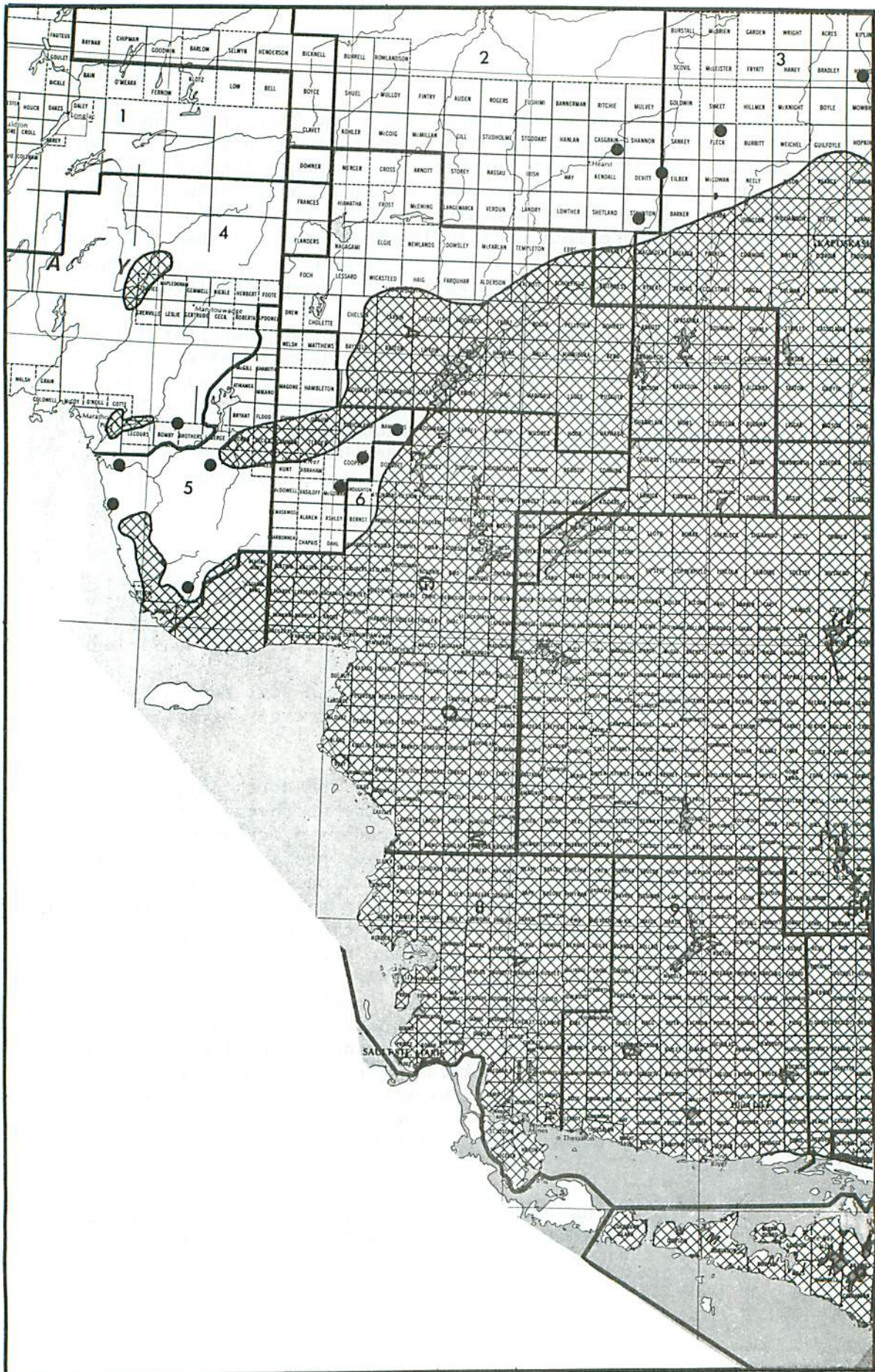
The main reduction occurred north of Capreol and Wanapitei Lake north and west of Levack. Other infestations south of Sudbury were somewhat reduced in size. In the North Bay District, changes (reductions) were observed along the north shore of Lake Nipissing and northwest of Mattawa to Eddy Township along the Ottawa River. South of Lake Nipissing, several sizeable pockets of defoliation in Indian Reserve No. 9 (Hardy Township), Patterson and Boulter townships that were mapped in 1975 were reduced to one small pocket of defoliation in Patterson Township in 1976.

A literal interpretation of Fig. 5 would suggest that all of the spruce-fir stands in the Chapleau District were defoliated at moderate-to-severe levels (25-100% loss of current foliage) in 1976. However, within this area were many pockets which were too small for observers to map where only light (1-25%) defoliation occurred. Most of these pockets were located within stands that contained balsam fir tree mortality and probably reflect the fact that the budworm has virtually starved itself out in these areas.

Evidently a similar type of phenomenon occurred in the Sault Ste. Marie District in an area between Ranger Lake and Highway 129 and north of Ranger Lake to the border between the Sault Ste. Marie and Chapleau districts. The same thing happened in numerous locations south of Highway 101 in Wawa District where infestation intensities declined and light defoliation occurred. It was noted that stands in these areas have been severely defoliated for the past several years and this has resulted in considerable balsam fir tree mortality and top killing.

In the districts of Espanola, Sudbury and North Bay, defoliation levels remained moderate to severe in the northern portions of the three districts but generally declined to moderate intensity (or less) in the south and of course were accompanied by considerable boundary changes and reductions in the size of infestations in the latter two districts. In the Temagami District, little change in population levels was noted in 1976 compared to 1975. Severe defoliation of spruce-fir stands recurred over the entire district and backfeeding was noted at several locations. In the Timmins and Kirkland Lake districts population levels were generally the same as in 1975 except in the northern part of the Timmins District and the adjoining northwestern part of the Kirkland Lake District where severe defoliation occurred for the first time in the current outbreak. Otherwise, throughout both districts, defoliation was generally severe and backfeeding was observed in several locations. An exception to the generally severe defoliation was observed in Milner Township, west of Gowganda where trees were only lightly defoliated.

A total of 4 800 ha (12,000 acres) was sprayed by OMNR in Wawa, Chapleau and Kirkland Lake districts in 1976 to minimize damage in high-value forest areas. Please refer to Part B for further details.



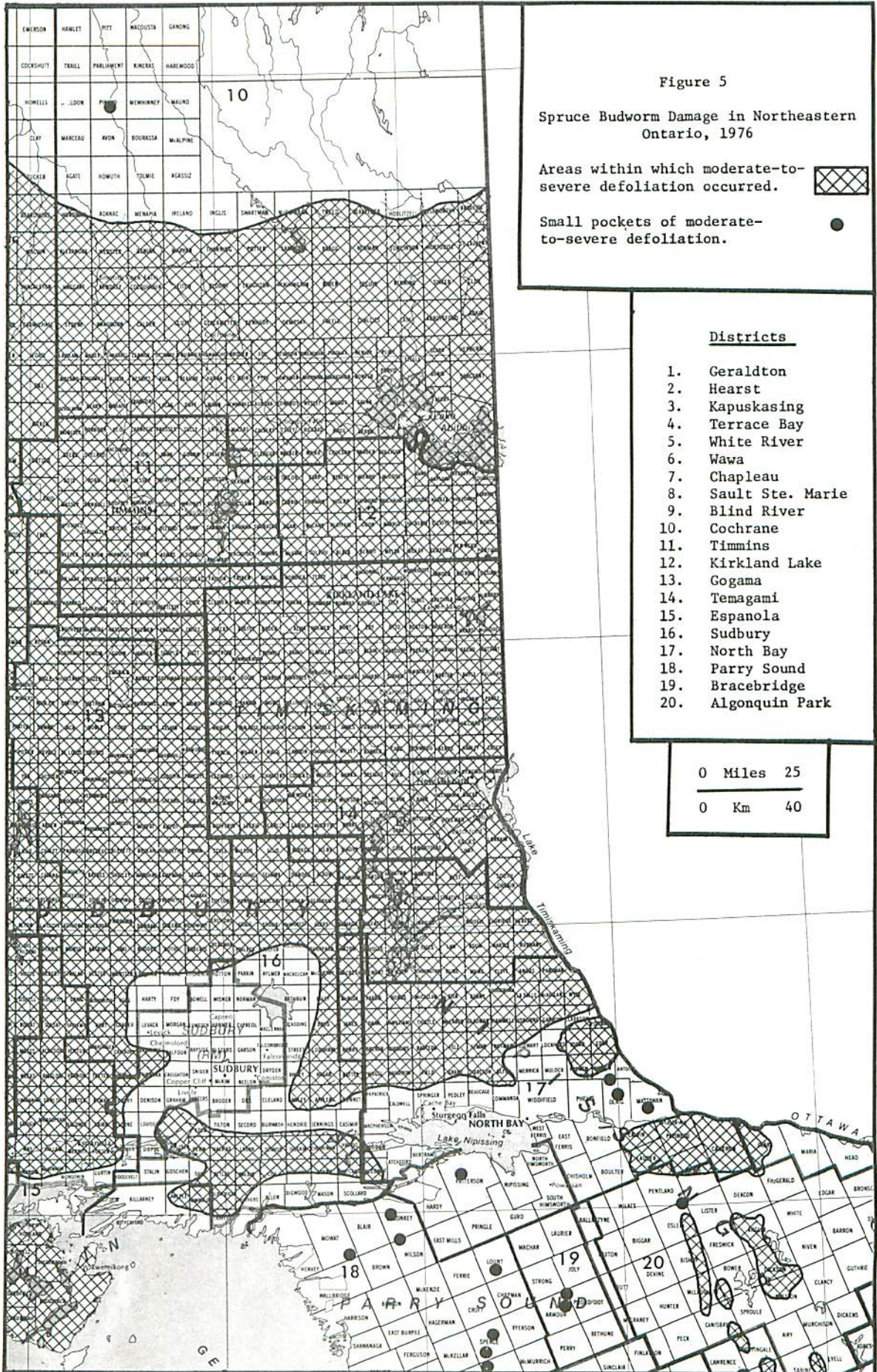


Figure 5

Spruce Budworm Damage in Northeastern Ontario, 1976

Areas within which moderate-to-severe defoliation occurred.



Small pockets of moderate-to-severe defoliation.



Districts

1. Geraldton
2. Hearst
3. Kapuskasing
4. Terrace Bay
5. White River
6. Wawa
7. Chapleau
8. Sault Ste. Marie
9. Blind River
10. Cochrane
11. Timmins
12. Kirkland Lake
13. Gogama
14. Temagami
15. Espanola
16. Sudbury
17. North Bay
18. Parry Sound
19. Bracebridge
20. Algonquin Park

0 Miles 25

0 Km 40

Infestation Forecasts for 1977: Egg-mass counts were obtained for 265 locations throughout northeastern Ontario in August, 1976 (Table 3). Based on locations that were sampled in 1975 and 1976 (total of 228), egg-mass densities have declined by approximately 16%. This is the second consecutive decrease on an overall basis since egg-mass counts were 40% lower in 1975 compared to 1974. As in 1975, although the overall trend is downward, some districts experienced increases. In general, increases occurred in eastern and northeastern districts whereas decreases were the rule in most central, western and southern districts. Percentage population increases were recorded for districts as follows: Kirkland Lake 65%, Cochrane 14%, Timmins 7% and Temagami 2%. Population decreases occurred in districts as follows: Hearst 4%, Espanola 7%, Wawa 21%, North Bay 23%, Blind River 25%, Chapleau 28%, Sudbury 31%, Sault Ste. Marie 32%, Kapuskasing 33% and Gogama 58%. The decrease of 33% for Kapuskasing was unexpected; however, closer examination of the data shows that this overall decline for the district is accounted for primarily by large decreases in egg-mass counts for the southwestern part of the district which has been infested for several years. Populations have probably peaked in this area and are now on the decline whereas populations are increasing elsewhere in the district. The average egg-mass count for northeastern Ontario in 1976 was 370 egg masses per 9.29 sq. m (100 sq. ft) of foliage compared to 442 in 1975 (based on sample locations common to both years). On a district basis, the highest average egg-mass count occurs in Timmins District, 716 egg masses per 9.29 sq. m (100 sq. ft) of foliage, followed by Temagami, Kirkland Lake, Cochrane and Chapleau districts. The highest single egg-mass count in northeastern Ontario, 1968 egg masses per 9.29 sq. m (100 sq. ft), was obtained from a balsam fir sample collected in Pharand Township, Timmins District.

The outbreak will probably expand further in 1977 to approximately 16 million ha (40 million acres) (Fig. 6). Most of this expansion is expected to occur northward from the 1976 northern boundary of the outbreak in Hearst, Kapuskasing and Cochrane districts. The amount of balsam fir may be a major factor in limiting further northward spread of the budworm in this part of the province, particularly in Cochrane and Kapuskasing districts. North of the 50th parallel, in the Hudson Bay Lowlands Section, balsam is generally confined to the riverbank levees along the rivers draining north into James Bay. Furthermore, weather, particularly in the form of late spring frosts, is also a possible limiting factor to further northward spread. Thus, between these two factors, it is difficult to forecast precisely how much further north budworm will cause damage. There are populations high enough to cause severe defoliation next year in Harmon Township, Kapuskasing District and in Pinard Township, Cochrane District, 32 and 45 km (20 and 28 miles) respectively north of the 1976 defoliation boundary. There appears to be more room for expansion in Hearst District, particularly to the north and northwest of the defoliation mapped in 1976. However, egg-mass

Table 3. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Blind River District</u> (24 locations)				
Albanel Twp (169)	bF	96	188	M-S
Bouck Twp (150)	bF	76	172	M-S
Bridgland Twp				
- Plot 2 ^b	wS	29	190	M-S
- Plot 3 ^b	wS	38	414	S
- Plot 5, check	wS	9	176	M-S
- Plot 5, check	bF	34	42	L-M
Bright Twp	bF	94	602	S
Dagle Twp (1F)	bF	100	259	S
Kirkwood Twp				
- O.M.N.R. Tree Nursery	wS	75	869	S
- Plot 1 ^b	wS	14	510	S
- Plot 6 ^c	wS	68	39	L-M
- Plot 6 ^c	bF	98	89	M-S
LeFroy Twp - Plot 5 ^c	wS	2	182	M-S
Morin Twp	bF	95	376	S
Raimbault Twp (157)				
- Mississagi Prov. Pk	bF	94	102	M-S
Parkinson Twp	wS	47	549	S
Spragge Twp	bF	52	216	S
Thessalon Twp				
- Plot 1, check	wS	31	681	S
- Plot 1, check	bF	64	138	M-S
Timbrell Twp (3F)	bF	37	144	M-S
Wells Twp				
- Plot 4 ^c	wS	28	229	S
- Plot 4 ^c	bF	47	126	M-S
- Plot 8, check	wS	1	122	M-S
- Plot 8, check	bF	2	54	L-M
<u>Chapleau District</u> (40 locations)				
Abney Twp - Spanish Lake	bF	45	484	S

(cont'd.)

Table 3. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Chapleau District (cont'd.)</u> (40 locations)				
Barclay Twp				
- Missinaibi Prov. Pk ^d	bF	46	615	S
- Missinaibi Prov. Pk ^d	wS	42	663	S
Birch Twp (9D)	bF	26	162	M-S
Bordeleau Twp (12H)				
- Gale Lake	bF	23	352	S
Bordon Twp	bF	43	271	S
Brutus Twp	bF	93	850	S
Caouette Twp (32)	bF	35	52	L-M
Carew Twp	bF	28	289	S
Carruthers Twp (8F)				
- Prairie Grass Lake	bF	86	622	S
Cull Twp (12G)				
- Sample Lake	bF	40	275	S
Denyes Twp - Denyes Lake	bF	75	726	S
Fawn Twp	bF	24	204	M-S
Foleyet Twp	bF	95	806	S
Genoa Twp	bF	37	222	S
Halsey Twp - Nemegos Rd	bF	35	185	M-S
Hill Twp	bF	76	574	S
Horwood Twp - Horwood Lake	bF	74	404	S
Iris Twp	bF	30	245	S
Ivanhoe Twp				
- Ivanhoe Prov. Pk	bF	81	1385	S
Ivy Twp - Miniwaski Lake	bF	25	28	L-M
Kapuskasing Twp	bF	78	175	M-S
Kirkwall Twp				
- Dunrankin Lake	bF	48	110	M-S
Leeson Twp	bF	64	257	S
Lincoln Twp - Lincoln Lake	bF	84	807	S
Lloyd Twp - Makonie Lake	bF	73	1007	S
Margaret Twp	bF	40	551	S
Moen Twp (23, Rge 16)	bF	32	91	M-S

(cont'd.)

Table 3. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Chapleau District</u> (cont'd.)				
(40 locations)				
Montcalm Twp - Elf Lake	bF	50	338	S
Neelands Twp (11B)				
- Wakami Prov. Pk ^d	bF	25	151	M-S
Ossin Twp - Ossin Lake	bF	93	360	S
Oswald Twp	bF	99	1389	S
Penhorwood Twp	bF	89	1035	S
Peters Twp				
- Shoals Prov. Pk ^d	bF	37	220	S
Reaney Twp (11D)				
- Five Mile Prov. Pk ^e	bF	15	207	M-S
Reeves Twp				
- O.M.N.R. Tree Seed Production Plot	wS	50	720	S
Sadler Twp	bF	88	1034	S
Sandy Twp	bF	86	268	S
Whigham Twp	bF	31	714	S
Whitehead Twp (10F)				
- Vezina Lake	bF	44	354	S
<u>Cochrane District</u>				
(10 locations)				
Adair Twp	bF	81	349	S
Adanac Twp - Mile 23	bF	16	338	S
Blakelock Twp				
- Mikiwan Lake	bF	0	11	L
Bonis Twp	bF	63	1925	S
Colquhoun Twp				
- Greenwater Prov. Pk	bF	0	41	L-M
Freele Twp	bF	34	113	M-S
Laughton Twp	bF	8	190	M-S
Pinard Twp				
- Abitibi Canyon	bF	28	284	S
Swartzman Twp	bF	75	1742	S
Sydere Twp - Mile 8	bF	38	116	M-S

(cont'd.)

Table 3. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Espanola District</u> (31 locations)				
Baldwin Twp	bF	13	42	L-M
Bidwell Twp	bF	23	85	M-S
Burpee Twp	bF	41	163	M-S
Campbell Twp	bF	17	207	M-S
Cockburn Island	bF	28	143	M-S
Comox Twp - Comox Lake	bF	45	204	M-S
Craig Twp				
- Bluewater Lake	bF	37	367	S
Dawson Twp	bF	24	137	M-S
Gough Twp	bF	1	0	0
Manitoulin Island				
- Plot F, 1974 NPV	wS	19	353	S
- Plot G, 1974 NPV	wS	29	754	S
- Plot G, 1974 NPV	bF	53	128	M-S
- Plot H, 1974 NPV	wS	4	956	S
- Plot 1, 1975 NPV	wS	25	787	S
- Plot 1, 1975 NPV	bF	26	262	S
- Plot 4, 1975 NPV	wS	63	738	S
- Plot 4, 1975 NPV	bF	7	129	M-S
- Plot 6, check	wS	47	286	S
- Plot 6, check	bF	3	24	L-M
- Plot 9, check, Poplar	wS	54	795	S
- Plot 9, check, Poplar	bF	43	393	S
Monestime Twp (J)				
- Russian Lake	bF	5	34	L-M
Oshell Twp (B)	bF	14	102	M-S
Plourde Twp (M) - Plaunt Rd	bF	33	269	S
Rowat Twp (A)				
- West Branch Rd	bF	32	64	M-S
Salter Twp				
- Plot 3, 1973, NPV	wS	55	763	S
- Plot 3, 1973, NPV	bF	48	333	S
- South check plot	wS	45	956	S
- South check plot	bF	61	368	S
Tehkumamah Twp	bF	34	121	M-S
Weeks Twp (119)	bF	8	152	M-S

(cont'd.)

Table 3. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Gogama District</u> (13 locations)				
Beulah Twp - Meteor Lake	bF	41	206	M-S
Edinburgh Twp	bF	28	541	S
Garvey Twp	bF	50	330	S
Hazen Twp	bF	39	120	M-S
MacMurphy Twp	bF	43	541	S
Marquette Twp	bF	40	290	S
Middleboro Twp	bF	33	74	M-S
Miramichi Twp	bF	33	439	S
Potier Twp	bF	68	1073	S
Scotia Twp	bF	42	288	S
St. Louis Twp	bF	60	187	M-S
Stull Twp	bF	26	174	M-S
Togo Twp	bF	29	328	S
<u>Hearst District</u> (11 locations)				
Alderson Twp				
- Mawgi Lake	bF	4	11	L
Caithness Twp				
- Big Pike Lake	bF	91	247	S
Cholette Twp				
- Obakamiga Lake	bF	0	0	0
Derry Twp - Cameron Lake	bF	66	655	S
Farquhar Twp	bF	8	0	0
Gourlay Twp - Gourlay Lake	bF	0	11	L
Lowther Twp	bF	10	41	L-M
McMillan Twp	bF	8	67	M-S
Minipuka Twp - Goat Lake	bF	95	174	M-S
Staunton Twp	bF	70	265	S
Wicksteed Twp				
- 1/2 mile south of Hornepayne	bF	0	27	L-M

(cont'd.)

Table 3. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Kapuskasing District</u> (16 locations)				
Bourinot Twp - Mile 33	bF	75	185	M-S
Buchan Twp - Mile 6	bF	48	362	S
Cummings Twp	bF	70	236	S
Cromlech Twp				
- Brunswick Lake	bF	93	1064	S
Fauquier Twp				
- Remi Lake Prov. Pk	bF	80	234	S
Fenton Twp				
- Mile 23				
Chain of Lakes Rd	bF	45	269	S
Fergus Twp	bF	38	184	M-S
Guilfoyle Twp				
- Guilfoyle Lake	bF	92	854	S
Griffin Twp				
- Griffin Lake	bF	54	171	M-S
Harmon Twp - Mile 82	bF	50	339	S
Lisgar Twp				
- Chain of Lakes Rd	bF	47	472	S
McCrea Twp	bF	55	591	S
Nixon Twp	bF	26	182	M-S
Opasatika Twp				
- Rufus Lake	bF	76	119	M-S
Stringer Twp				
- Groundhog River	bF	58	189	M-S
Tucker Twp	bF	83	10	L
<u>Kirkland Lake District</u> (22 locations)				
Alma Twp	bF	100	1174	S
Ben Nevis Twp	bF	50	521	S
Blain Twp	bF	80	578	S
Bowman Twp	bF	0	15	L-M
Burt Twp				
- OMNR Tree Nursery ^e	wS	10	1086	S

(cont'd.)

Table 3. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Kirkland Lake District (cont'd.)</u> (22 locations)				
Corkill Twp	bF	5	275	S
Dack Twp	bF	10	138	M-S
Eby Twp	bF	85	600	S
Hearst Twp	bF	70	738	S
James Twp	bF	25	476	S
Katrine Twp	bF	65	406	S
Lamplugh Twp	bF	100	1402	S
Maisonville Twp	bF	100	324	S
Marriott Twp	bF	100	727	S
Milner Twp	bF	60	371	S
Montrose Twp	bF	60	889	S
Mulligan Twp	bF	60	951	S
Pacaud Twp	bF	70	604	S
Ratray Twp	bF	60	391	S
Truax Twp	bF	75	283	S
Tyrell Twp	bF	10	112	M-S
Yarrow Twp	bF	30	250	S
<u>North Bay District</u> (12 locations)				
Calvin Twp	bF	70	313	S
Cameron Twp	bF	10	504	S
Clement Twp	bF	9	65	M-S
Commanda Twp	bF	1	38	L-M
Crerar Twp	bF	7	73	M-S
Jocko Twp	bF	20	288	S
Mattawan Twp				
- Hwy 533, 10 miles north of Mattawa	bF	14	91	M-S
Notman Twp	bF	44	868	S
Patterson Twp				
- Restoule Prov. Pk	bF	5	36	L-M
Phelps Twp	bF	1	240	S
South Himsworth Twp	bF	5	32	L-M
Thistle Twp	bF	41	589	S

(cont'd.)

Table 3. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Sault Ste. Marie District</u> (16 locations)				
Aberdeen Additional Twp	bF	33	52	L-M
Butcher Twp (7H)	bF	5	58	M-S
Fenwick Twp	bF	91	69	M-S
Fisher Twp	bF	99	680	S
Gapp Twp (23, Rge 13)				
- Hanes Lake	bF	78	56	M
Gaudette Twp				
- Abitibi Plantation, (Tree Seed Orchard)	wS	6	360	S
- Whitman Dam Rd, Pheromone spray, 1975	wS	23	250	S
Herrick Twp				
- Pancake Prov. Pk	bF	72	209	M-S
Haviland Twp	bF	82	69	M-S
Jollineau Twp (3H)				
- Mile 20	bF	72	333	S
Palmer Twp	bF	77	107	M-S
Pine Twp (5H)				
- Tujak Lake	bF	30	68	M-S
Shields Twp	bF	69	53	L-M
Tarbutt Additional Twp	bF	97	419	S
Vibert Twp (25, Rge 14)				
- Wart Lake	bF	98	37	L-M
Whitman Twp	bF	56	76	M-S
<u>Sudbury District</u> (17 locations)				
Antrim Twp - Halfway Lake	bF	2	117	M-S
Beaumont Twp - Helen Lake	bF	14	495	S
Creelman Twp	bF	44	275	S
Davis Twp	bF	5	54	L-M
Delamere Twp	wS	1	738	S
DeMorest Twp	bF	56	235	S

(cont'd.)

Table 3. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Sudbury District (cont'd.)</u> (17 locations)				
Dunnett Twp	bF	1	24	L-M
Fairbank Twp	bF	6	124	M-S
Hawley Twp	bF	27	187	M-S
Hess Twp	bF	23	154	M-S
Howey Twp	bF	78	272	S
Hyman Twp	bF	12	35	L-M
Indian Reserve #6 - LaVase Lake	wS	55	651	S
Killarney Twp - Killarney Prov. Pk	bF	1	51	L-M
Muldrew Twp	bF	22	355	S
Tyrone Twp - Michaud Lake	bF	23	299	S
Waldie Twp	wS	8	610	S
<u>Temagami District</u> (14 locations)				
Askin Twp	bF	90	436	S
Aston Twp	bF	40	135	M-S
Barr Twp	bF	100	1043	S
Belfast Twp	bF	90	567	S
Dane Twp	bF	90	562	S
Flett Twp	bF	100	510	S
Gamble Twp	bF	100	289	S
Gillies Limit Twp	bF	100	1043	S
Parker Twp	bF	65	592	S
Rorke Twp	bF	100	722	S
Shelburne Twp	bF	100	492	S
South Lorrain Twp	bF	90	398	S
Strathy Twp	bF	90	740	S
Torrington Twp	bF	80	545	S

(cont'd.)

Table 3. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Timmins District</u>				
(9 locations)				
Bartlett Twp				
- Texmont Rd	bF	85	486	S
English Twp - English Lake	bF	90	418	S
Evelyn Twp	bF	95	490	S
Hassard Twp	bF	75	438	S
Langmuir Twp	bF	80	620	S
McKeown Twp	bF	95	680	S
Pharand Twp	bF	80	1968	S
Robb Twp	bF	95	968	S
Sewell Twp				
- Lapierre Rd	bF	100	375	S
<u>Wawa District</u>				
(31 locations)				
Abigo Twp - Apisabigo Lake	bF	98	853	S
Asselin Twp (30, Rge 19)				
- Gargantua Rd at Hwy 17 ^f	bF	63	302	S
Bailloquet Twp (30, Rge 24)				
- Black Trout Lake	bF	86	448	S
Barager Twp (29, Rge 19)				
- Sand River #2 ^d	bF	5	157	M-S
Barnes Twp (28, Rge 19)				
- Sand River #3 ^d	bF	15	213	M-S
Brimacombe Twp (30, Rge 18)				
- Camp 101	bF	70	156	M-S
Bullock Twp (28, Rge 18)	bF	84	99	M-S
Challener Twp	bF	80	353	S
Cudney Twp - Esnagi Lake	bF	92	297	S
Debassige Twp (26, Rge 25)				
- Manitowik Lake	bF	6	125	M-S
Dunphy Twp (28, Rge 27)	bF	95	747	S
Eaket Twp (25, Rge 18)				
- Tikamaganda Lake	bF	17	63	M-S

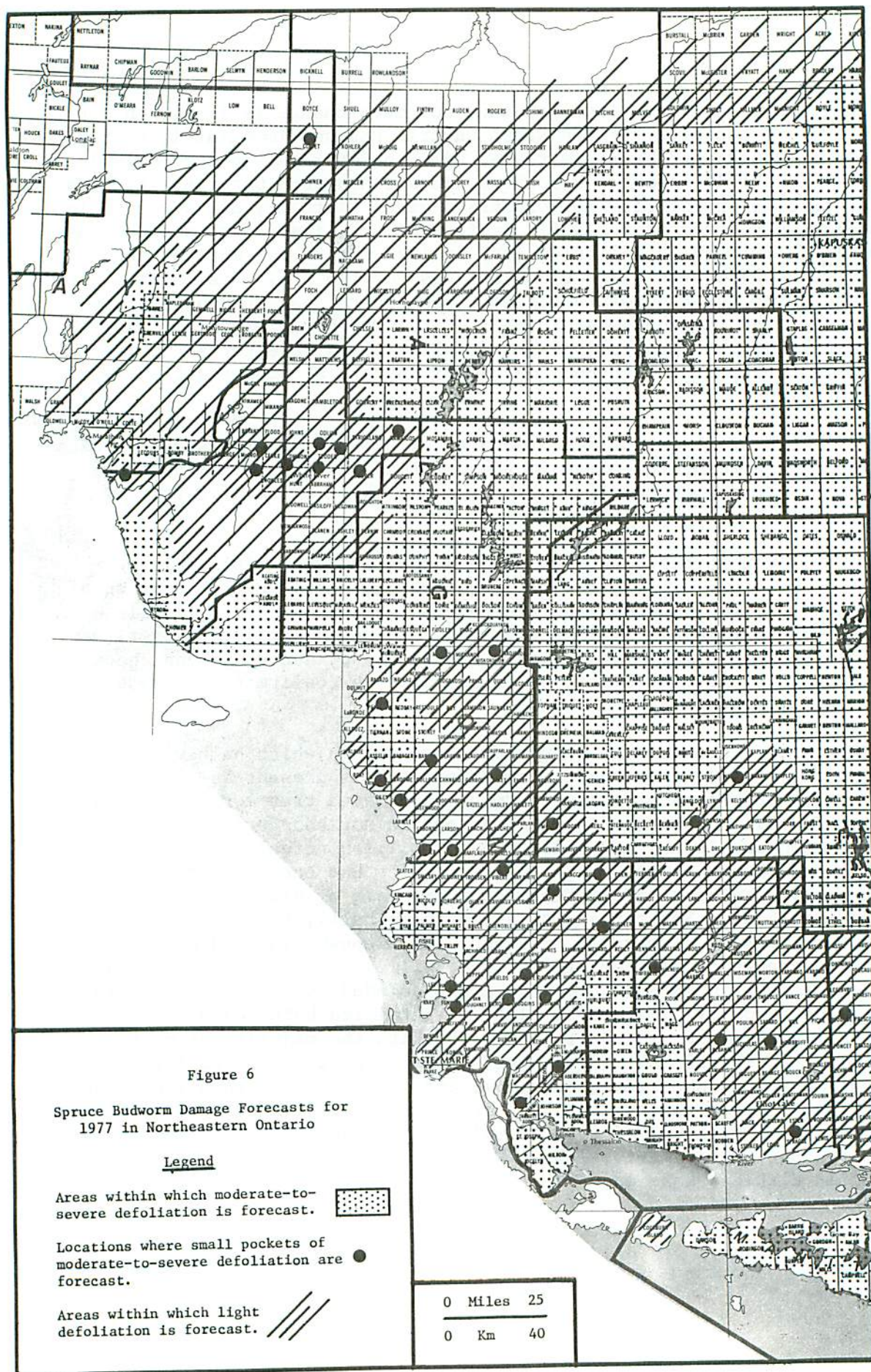
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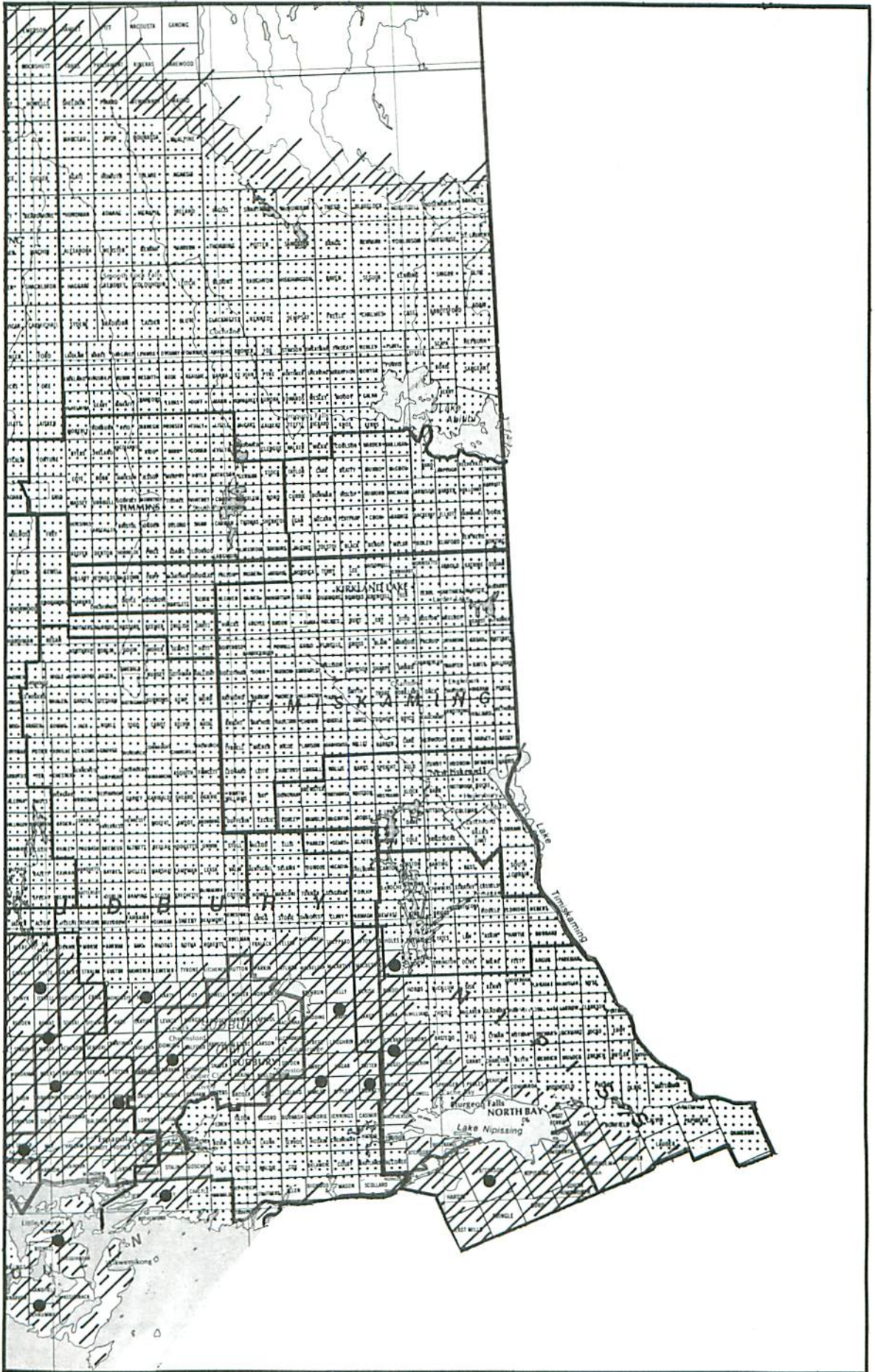
counts from this area indicate that not much change is likely to occur in 1977. Forecasts for the North Central Region, immediately to the west of Hearst and Wawa districts, will be described in the following section of this report. Elsewhere, in northeastern Ontario, there is very little opportunity for expansion since virtually all susceptible stands were infested in 1976. In fact, it is likely that populations will be lower and defoliation less in 1977 throughout most of the southern half of the Wawa District, most of the Sault Ste. Marie, Blind River and Espanola districts, the central part of the Sudbury District and the southwestern half of the North Bay District. As shown in Fig. 6, generally light defoliation is forecast for this area, interspersed with numerous small pockets of moderate-to-severe defoliation.

While it is still too soon to be certain, there is some indication that a general decline in the outbreak may take place over the next few years, especially in those areas where balsam fir tree mortality has begun.

Tree Mortality: During the summer of 1976, FIDS field personnel repeated the aerial sketch mapping of stands that had reached the "grey phase" and appeared dead. This had been done previously in 1974 and 1975. As noted earlier, however, many trees in these "grey" stands were not dead and, hence, ground checks were made at as many locations as possible to confirm the presence and amount of mortality.

The location and extent of areas within which balsam fir mortality (whole tree and/or top mortality) is present is shown in Fig. 7. This area of spruce budworm-associated tree mortality totalled some 2.6 million ha (6.5 million acres) in northeastern Ontario in 1976, more than double the 1.2 million ha (3 million acres) mapped in 1975. Extensive areas within which tree mortality has occurred are present in the following districts: Wawa (southern half of district), Chapleau (western half), Sault Ste. Marie (northern half), Blind River, Espanola, Sudbury, Gogama, Temagami, Kirkland Lake, Kapuskasing and Hearst. Ground checks consisting of 100 tree tallies were made at more than 50 locations in 1976 (Table 4). Also included in Table 4 are mortality plot data for 1975. Some 30 plots were tallied both years. Levels of mortality in 1976 ranged from 0 to 95% with the majority of plots falling in the 20-80% range. The overall average of mortality was 38%. Based on plots checked in both 1975 and 1976 (some 30 locations) the incidence of mortality increased from 25% to 42%. Looking at individual districts, the level of tree mortality increased 25% in Blind River, 27% in Sault Ste. Marie, 16% in Wawa, 8% in Chapleau, 36% in Temagami, 30% in Kirkland Lake and 20% in Sudbury.





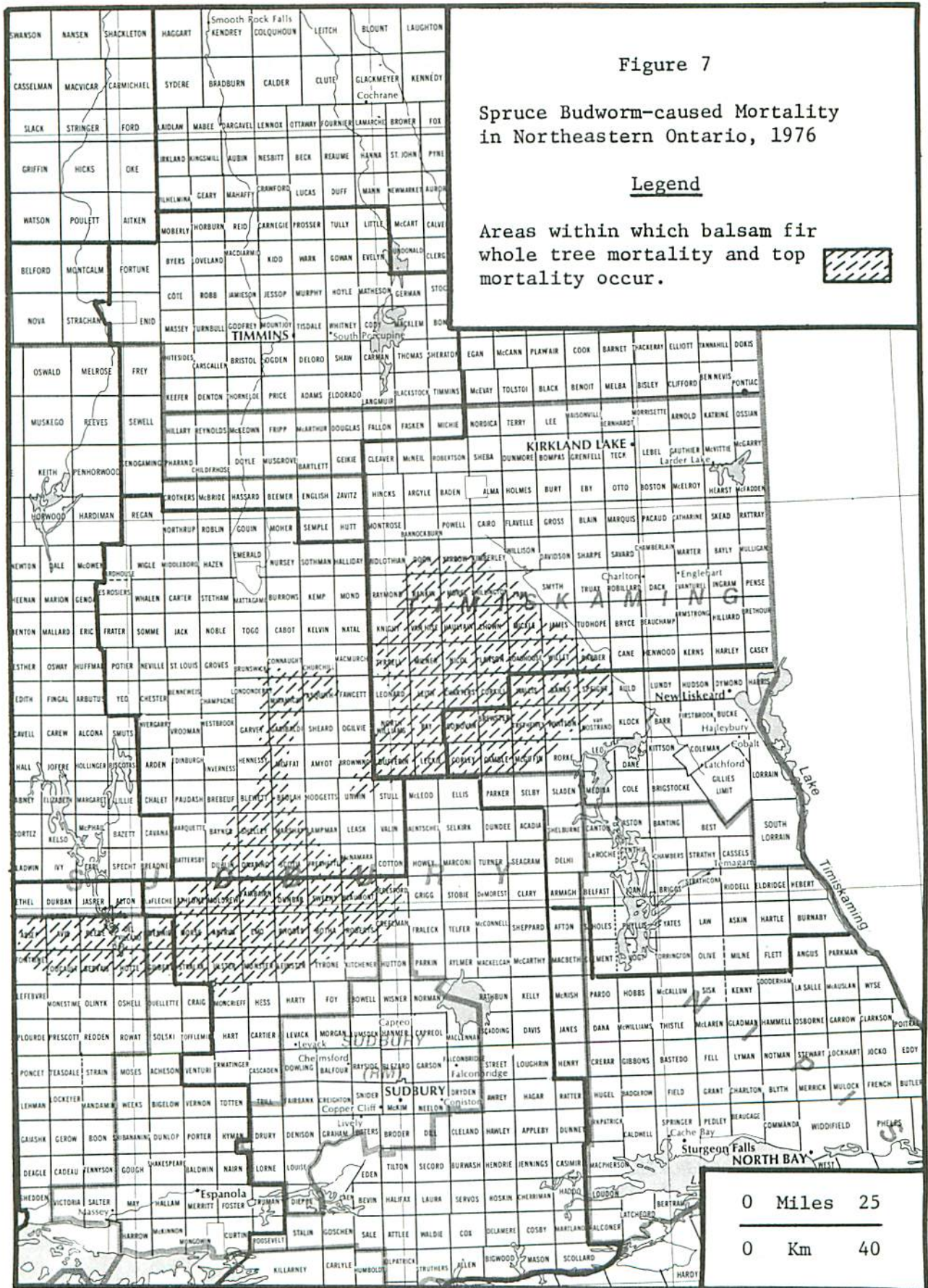


Table 4. Northeastern Ontario - Summary of spruce budworm-associated balsam fir tree mortality based on 100 tree ground checks for 1975 and 1976.

<u>Location</u>	<u>Tree mortality</u>	
	<u>1975</u>	<u>1976</u>
<u>Temagami District</u>		
	(%)	
Barr Twp - Mowat Landing		7
Corley Twp - Smoothwater Lake (S. end)	11	56
Donovan Twp - Smoothwater Lake	15	
Gillies Limit Twp - Westside Bay Lake		0
Speight Twp - Mendelssohn Lake (S. end)	17	
" " - " " (N. end)	36	65
Strathcona Twp		4
Wallis Twp		33
<u>Kirkland Lake District</u>		
Charters Twp - Montreal River	14	44
Chown Twp - 3 miles east Longpoint Lake		3
Gross Twp		7
Milner Twp	4	
Truax Twp		36
Van Hise Twp		51
Yarrow Twp - Mistimikon Lake		75
<u>Sudbury District</u>		
Antrim Twp - Halfway Lake	62	86
Beaumont Twp - Graveyard Lake	89	
" " - Helen Lake	81	
Botha Twp - between Botha and Rome lakes	82	
" " - west of Morin Lake	65	
Dunbar Twp - Scotia Lake	93	
Emo Twp - Onaping Lake	54	
Fairbairn Twp - Onaping Lake	68	
Muldrew Twp - Elboga Lake	54	71
Munster Twp - Rome Lake Road	64	
Rhodes Twp - Richardson Lake	30	
Sweeny Twp - Ayotte	67	
Ulster Twp - Sideburn Lake	38	
<u>Gogama District</u>		
Asquith Twp		39
Marshay Twp - Ladyfair Lake	39	
Miramichi Twp - HW 560, near Opikinimika River		70
Onaping Twp - Onaping Lake, East Bay	77	
<u>Blind River District</u>		
McNie Twp - Aubinadong Rd., River Rd. Jct.	4	
Renwick Twp (4F) - 3 mi. N. of Ranger L. cutoff on Aubinadong Rd.	26	68
" " (4F) - 1 mi. S. of Ranger L. Rd. and Aubinadong Rd. Jct.	15	24
" " (4F) - .7 mi. W. of Ranger L. Rd. and Aubinadong Rd. Jct.	2	47
Sturgeon Twp (2F) - HW 129, 1 mi. S. of Seymour L. Rd.	1	6
Timbrell Twp (3F) - Approx. 4 mi. on Ranger L. Rd. from HW 129	16	55
Villeneuve Twp (3E) - HW 129, 1 mi. S. of Ranger L. Rd.	3	10
<u>Sault Ste. Marie District</u>		
Bracci Twp (Twp 22 Rge 14) - North Chubb Lake	13	
Butcher Twp (7H) - Goulais Lake	22	
Hoffman Twp (6H) - Gong L. Rd., 1 mi. N. of Welcome L. turn	6	
Pine Twp (5H) - Mi. 19.3 Aubinadong Rd.	9	27
" " " - Mi. 21.5	7	22
Smilsky Twp (Twp 28 Rge 14) - N.E. of Huff Lake	44	93
Wlasy Twp (Twp 23 Rge 14) - Dyson Lake	29	

Location	Tree mortality	
	1975	1976
	(%)	
<u>Wawa District</u>		
Asselin Twp (Twp 30 Rge 19) - Gargantua Rd., W. of Baldhead R.		15
Beaudry Twp (Twp 26 Rge 19) - Black Spruce Lake	91	
Beauparlant Twp (Twp 25 Rge 19) - McEwen Lake	47	
Brimacombe Twp (Twp 30 Rge 18) - HW 17 North		4
Copenace Twp (Twp 45) - Poon Lake	27	
Esquega Twp (Twp 28 Rge 24) - HW 101, 2 mi W. of HW 547		8
Giles Twp (Twp 30 Rge 17) - Coldwater R.	31	
Hallett Twp (Twp 24 Rge 17) - Hoppy Lake	71	
Labelle Twp (Twp 29 Rge 16) - Agawa	8	14
Laforme Twp (Twp 24 Rge 24) - HW 651, .5 mi. N. of L. Jackpine R.	31	53
LaRonde Twp (Twp 31 Rge 21) - HW 17, 1 mi. N. of Old Woman Bay		23
Larson Twp (Twp 27 Rge 16) - Little Agawa Lake	48	
Michano Twp (Twp 26 Rge 23), Miskokomon Twp (Twp 25 Rge 23) - Boundary on HW 101	63	89
Naveau Twp (Twp 29 Rge 22) - High Falls Road	16	21
Nebonaionquet Twp (Twp 28 Rge 22) - Anjigami Road	53	
Quill Twp (Twp 25 Rge 22) - Mile 1.5 on Budd Lake Rd		95
Runnalls Twp (Twp 25 Rge 15) - Grey Owl Lake	30	
Tiernan Twp (Twp 30 Rge 20) - Mijin Rd., Peller Lake	40	61
<u>Chapleau District</u>		
Bliss Twp (Twp 36) - Esher-Healey Rd., N. of Prim Lake	14	30
Bonar Twp		25
Bordeleau Twp (12H) - Gale Lake	64	
Borden Twp - HW 101, 12.4 mi. E. of HW 129	55	73
" " - HW 101, Westover Lake	19	20
Brutus Twp - Missinaibi L. Rd.		13
Buckland Twp - Addison Lake		74
Caouette Twp (Twp 32) - HW 101	27	39
Chewett Twp - HW 101	10	15
" " - Cedric Lake Rd.	0	
Cochrane Twp - Kaniphow Road	28	32
" " - HW 101	52	
Cosens Twp - HW 101, 3 mi. W. of Prairie Bee R.	2	10
Dalmas Twp (13H)	32	
Dupuis Twp (12E) - HW 129, Watershed Sign	56	71
Fitzsimmons Twp (Twp 22 Rge 18) - Island Lake Lumber Rd.	25	
Foley Twp - HW 101	0	
Gilliland Twp (Twp 35) - HW 101, .2 mi E. of Peters Twp	21	33
Green Twp (11G) - Sheppard and Morse Road	8	10
Halsay Twp - Nemegos Road	42	
Hill Twp	8	
Hoey Twp - HW 101, Lawson Lake	55	55
Lipsett Twp - Lafrienier Lumber Road		30
" " - Chapleau Lumber Road		35
Marshall Twp	23	
Pattison Twp - 2.2 mi. S. of Martel's Camp	9	
Reaney Twp (11D) - HW 129, 2.6 mi. S. of 5-Mile Park	10	
" " " " " " " " .6 mi. S. of 5-Mile Park	22	
Sadler Twp - 2 mi. N. of Martel's Camp	21	
Windego Twp (Twp 23 Rge 20) - Abitibi Road, Mile 16		66
<u>Kapuskasing District</u>		
Cromlech Twp - Brunswick Lake		14
Opasatika Twp - Opasatika Lake, N.W. End		2

It is difficult to judge if the extent, amount and rates of tree mortality for northeastern Ontario as of 1976 are "normal" in relation to previous outbreaks. Some observers² believe that these statistics of tree mortality are considerably lower than normal for this outbreak and state that it may be due to a virtual absence of bark beetles, namely balsam fir beetle, *Pityokteines sparsus*. It has been observed that the number of current bark beetle attacks in dying and recently killed balsam in northeastern Ontario seemed extremely low compared to an outbreak in the 1940s in the Lake Nipigon region where practically all dying and recently killed balsam trees were heavily infested with *P. sparsus*. Fewer than 1% of dead trees recently examined in northeastern Ontario show any evidence of bark beetles. It seems likely that in the absence of bark beetles, balsam trees can tolerate more cumulative defoliation over a longer period before beginning to die and that dead balsam appear to be salvageable over a longer period following death owing to slower development of sap rot caused by *Polyporus abietinus* than when bark beetles are abundant.

It is apparent that both the extent and incidence of tree mortality will increase in 1977 in all districts that were affected in 1976. The magnitude of the increase will in all likelihood be related to whether or not a bark beetle buildup occurs or to the type of weather (mainly the amount of precipitation) that occurs during the growing season. For example, drought conditions at the critical time could add sufficient stress in many cases to accelerate mortality rates. Drought could also trigger a bark beetle outbreak.

North Central Ontario

Situation in 1976: For the purposes of this report, north central Ontario will be regarded as that part of Ontario that includes the districts of White River, Terrace Bay, Geraldton and Nipigon. From 1967 to 1974, budworm outbreaks had not developed in these districts and populations remained generally quite low. Consequently, information concerning budworm in this area was included as part of the writeup for northwestern Ontario in previous reports of this series. However, the picture changed sufficiently in 1975 and a brief but separate section describing the budworm situation in north central Ontario was included in last year's report, O-X-250.

In 1975, several new infestations were found in the Pukaskwa area in the White River District (Fig. 5). In 1976, these infestations which exist primarily in the balsam stands along the valleys of White Gravel,

² Sippell, W.L. and J.T. Basham, 1976. Incidence of bark beetle attacks in dead balsam occasioned by repeated spruce budworm infestation in Ontario. Report prepared for the Annual Forest Pest Control Forum, Ottawa, November 23-24, 1976.

Swallow, Cascade, Pukaskwa and East Pukaskwa rivers, coalesced and joined the infestations expanding from the western part of the Wawa District along the north shore of Lake Superior. In addition to the area infested in the Pukaskwa, many other pockets of defoliation were noted in the eastern and central parts of the district. Further to the west, a sizeable pocket of defoliation was found near the mouth of the White River. Moderate-to-severe defoliation was mapped throughout an area totalling 66 800 ha (167,000 acres) in the White River District in 1976.

Several new infestations were noted in the Terrace Bay District (Fig. 5). The largest consisted of a very heavy infestation on large white spruce trees at Hour Glass Lake about 20 km (12 miles) northwest of the village of Manitouwadge. Virtually complete defoliation occurred to the current foliage of host trees throughout an area of some 800 ha (2,000 acres). Pockets of light and medium infestation spread out from the nucleus at Hour Glass Lake mainly to the southwest along the Pic River throughout a total area of some 30 000 ha (75,000 acres). This infestation (at Hour Glass Lake) is located about 64 km (40 miles) from the nearest known infestation and is presumably the result of an influx of moths from some source to the south or east. Other infestations in the Terrace Bay District were located along the Black River (north of Highway 17), near Heron Bay South, close to Marathon, Neys Provincial Park and near the junction of Highways 614 and 17. Defoliation in this district totalled about 40 000 ha (100,000 acres). No significant infestations or defoliation were detected in Geraldton or Nipigon districts, and generally populations were quite low throughout these two districts.

Based on data from a series of monitoring plots (13 plots) in the Nipigon, Geraldton and Terrace Bay districts, larval populations increased by 60% in 1976 compared to similar samples obtained in 1975. However, virtually all of the increase occurred in the plots in the Nipigon District with very little change in Geraldton or Terrace Bay districts. Data are presented in Table 5. Monitoring plots were established in the early 1970s throughout north central and northwestern Ontario to help detect population changes at low densities. Counts consist of two beating samples taken from each of ten trees at each location when larvae should have developed to sixth instar. Counts for any single location are probably not too meaningful in terms of reflecting population changes. However, if all locations (or a majority) follow the same pattern, the trend is probably biologically significant and populations are probably being monitored fairly accurately. Indeed, the data indicate that larval populations were at their lowest level in 1974 and have almost tripled in the last two years. In general, this follows the same pattern as the egg-mass population data.

Table 5. Results of monitoring plot samples for a three-year period for plots in North Central Ontario.

<u>Location</u>	<u>Host</u>	<u>No. of larvae per 20-mat sample</u>		
		<u>1974</u>	<u>1975</u>	<u>1976</u>
<u>Nipigon District</u>				
Black Sturgeon Road	bF	0	7	6
Purdom Twp	wS	0	4	23
Legault Twp	bF	0	0	0
Ledger Twp	bF	1	3	13
Summers Twp	bF	<u>0</u>	<u>0</u>	<u>2</u>
		1	14	44
<u>Geraldton District</u>				
Caramat Road	wS	0	1	0
Croll Twp	bF	3	0	2
Klotz Lake	bF	<u>0</u>	<u>0</u>	<u>2</u>
		3	1	4
<u>Terrace Bay District</u>				
Anwri	bF	11	5	5
Syine Twp (Twp 82)	wS	1	16	16
Lecours Twp (Twp 74)	wS	4	8	6
Stevens Tower Hill	bF	3	2	0
Catlonite Lake	bF	<u>5</u>	<u>2</u>	<u>2</u>
		24	33	29
	Totals	28	48	77

Infestation Forecasts for 1977: Egg-mass counts were obtained in 1976 for a total of 46 locations in the four districts that comprise north central Ontario. These data are listed in Table 6. The large infestation in the Pukaskwa area of the White River District will likely continue to expand in size. Population increases and related defoliation are likely to be common elsewhere throughout the White River District and the southern part of Terrace Bay District. Egg-mass counts taken in the same locations have increased in 1976 about 3 1/2 times in Geraldton District, about 1 1/2 times in Nipigon District, declined slightly (about 10%) in Terrace Bay District and nearly doubled in White River District. Average densities

Table 6. North Central Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Geraldton District</u>				
(7 locations)				
Caramat - (1.8 miles south)	bF	0	0	0
Caramat Road - Mile 15	bF	1	8	L
Catlonite Rd				
- Mile 72.3	bF	3	0	0
Croll Twp	bF	1	7	L
Klotz Lake	bF	0	0	0
Pagwa River - Mile 2.5	wS	4	71	M-S
Wintering Lake	bF	0	8	L
<u>Nipigon District</u>				
(9 locations)				
Black Sturgeon Lake	BF	1	0	0
Jackpine River				
- Mile 9	bF	2	0	0
Ledger Twp - gas line	bF	15	8	L
Legault Twp	bF	3	14	L-M
Macdiarmid	bF	1	7	L
Parks Twp				
- Mile 30.7 Domtar Rd	bF	1	0	0
Poshkokagan River	bF	0	0	0
Purdon Twp				
- Cameron Falls	wS	15	0	0
Summers Twp	bF	0	7	L
<u>Terrace Bay District</u>				
(14 locations)				
Amwri Station	bF	5	0	0
Black River - Hwy 17	wS	11	0	0
Catlonite Lake	bF	1	0	0
Gertrude Twp	bF	8	7	L
Gravel River - Mile 1 east	bF	3	7	L
Hour Glass Lake	wS	97	1000	S
Hour Glass Lake				
- (1/4 mile northwest)	bF	17	18	L-M

(cont'd.)

Table 6. North Central Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg-masses per 9.29 sq. m (100 sq. ft) of foliage	Infestation forecasts for 1977 ^a
<u>Terrace Bay District (cont'd.)</u> (14 locations)				
Jct. of Industrial and Camp 15 (old Camp 5) Rd	bF	3	13	L
Killraine Twp (85)				
- Rainbow Falls Prov. Pk	bF	2	0	0
Manitou Falls	wS	11	12	L
Manitouwadge Road				
- Mile 1.5	bF	47	114	M-S
Marathon - 1/2 mile north of Hwy 17	bF	4	0	0
Stevens C.N.R.				
- Monitoring and pheromone plots	bF	6	0	0
Syine Twp (82)				
- Jackfish Lake	bF	3	0	0
<u>White River District</u> (16 locations)				
Abraham Twp (66)	bF	3	9	L
Cecile Twp	bF	43	153	M-S
Cooper Twp	wS	14	76	M-S
Hydro Rd - Mile 2	bF	22	0	0
Hydro Rd - Mile 14.5	bF	80	265	S
McCron Twp (70)				
- Access Rd	bF	7	18	L-M
Obatanga Prov. Pk	bF	3	8	L
Pukaskwa National Pk				
- Bonami Cove	bF	96	271	S
- Cascade River	bF	75	423	S
- Louie Lake	bF	18	20	L
- Oiseau Bay	bF	54	37	M
(7 miles east of)	bF	8	24	L-M
- Otter Cove Radio Tower	bF	91	361	S
- Simons Harbour	bF	2	48	M
- Tip Top Mountain (2 miles southwest of)	bF	19	370	S

(cont'd.)

Table 6. North Central Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>White River District (cont'd.)</u> (16 locations)				
Regan (8.8 miles south)	bF	27	24	L-M

^a S = severe, M = moderate, L = light, 0 = nil

of egg-mass populations however are still quite low in Nipigon, Geraldton and most of the Terrace Bay districts and defoliation other than trace or light is not expected. In any event, most indications point to a continued buildup in budworm populations throughout this part of Ontario and an outbreak seems imminent.

Northwestern Ontario

Situation in 1976: Unfortunately, forecasts of the budworm situation in northwestern Ontario for 1976 proved accurate. Many new infestations and pockets of defoliation appeared in Thunder Bay, Atikokan and Fort Frances districts. Moderate-to-severe defoliation totalled 60 800 ha (152,000 acres) compared to the 18 000 ha (45,000 acres) mapped in 1975.


Numerous pockets (at least 25) of moderate-to-severe defoliation totalling 30 000 ha (75,000 acres) were mapped within an area stretching from Kawnipi Lake in Quetico Provincial Park in the Atikokan District northeast to Lower Shebandowan Lake and Aldina Township in Thunder Bay District (Fig. 8). Many of these pockets of defoliation were ground checked and the heaviest defoliation was observed at Swallow, Batwing, Greenwater, Clay and Ross lakes. Although only three pockets of moderate-to-severe defoliation were mapped from the air in the Batwing-Swallow-Hoof lakes area, ground checks showed that many scattered individual trees, not in those areas mapped as defoliated, bore evidence of considerable budworm feeding. The total area within which these pockets of defoliation (25 or so) were concentrated amounted to about 200 000 ha (500,000 acres). It was within this same area that population buildups occurred in 1967 and 110 000 ha (275,000 acres) were sprayed in 1968 in what became a successful effort to suppress the outbreak. An additional 3 600 ha (9,000 acres) of defoliation was mapped along the Pigeon River south of Thunder Bay in the same area where 6 600 ha (16,500 acres) had been defoliated in 1975. Several small pockets of defoliation totalling 200-300 ha (500-750 acres) recurred at Prairie Portage in Quetico on the Ontario-Minnesota border. Considerable feeding was observed on white spruce in the Boulevard Lake-Centennial Park area in the city of Thunder Bay, light feeding on balsam fir south of Stepstone in Gorham Township and on the Sibley Peninsula. Moderate numbers of budworm were found along the Northern Light Lake road between Sandstone Lake and Prelate Lake and at Mountain Lake. Low numbers of larvae were found south of Athelstane Lake in Thunder Bay District and north of Williamson Lake in Atikokan District. Otherwise, budworm were scarce in these two districts, particularly north of Highway 11 and 11-17 combined.


In the Fort Frances District, aerial observers mapped approximately 27 000 ha (68,000 acres) of defoliation, consisting of numerous small pockets between Tanner and Bennett townships at the eastern edge of the Fort Frances District and Watten Township, some 72 km (45 miles)

Figure 8

Spruce Budworm Damage in Northwestern Ontario, 1976

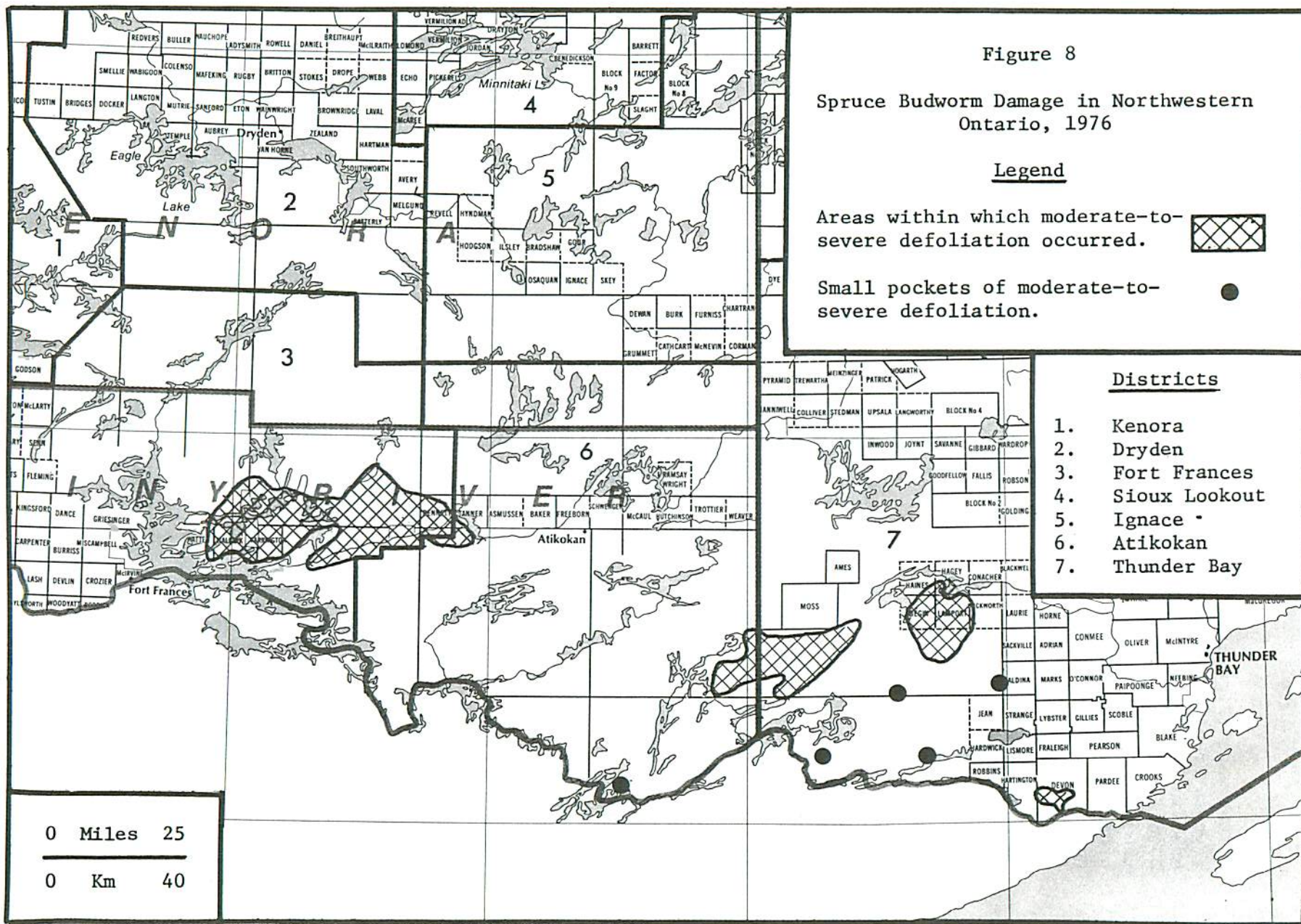
Legend

Areas within which moderate-to-severe defoliation occurred. 

Small pockets of moderate-to-severe defoliation. 

Districts

1. Kenora
2. Dryden
3. Fort Frances
4. Sioux Lookout
5. Ignace
6. Atikokan
7. Thunder Bay



to the west (Fig. 8). These pockets of defoliation are contained within a gross area of some 180 000 ha (450,000 acres). The scale of the map used in Fig. 8 prevents us from showing the individual pockets of defoliation and, consequently, what is depicted is the area within which the pockets are present. It should be kept in mind that there are probably many stands of balsam fir within the area indicated that showed no evidence of defoliation in 1976, at least at levels detectable from the air. Some of the pockets of defoliation were within an area sprayed in 1976; most, however were outside of the treated area. A total of 34 860 ha (87,153 acres) was sprayed in the vicinity of Bennett Lake in June, 1976 to try to prevent the increase and spread of budworm into neighboring susceptible forests. For details concerning aerial spraying operations in northwestern Ontario in 1976, refer to Part B of this report.

Elsewhere in the Fort Frances District and in other districts in northwestern Ontario, numbers of budworm larvae were quite scarce with the exception of light populations found in Ewart Township, Kenora District and at Osbourne Bay on Eagle Lake in the Dryden District.

The total number of sixth instar larvae collected at 24 monitoring stations throughout northwestern Ontario doubled in 1976 compared to similar counts made in 1975 (Table 7). These data should be interpreted very carefully, however, since virtually all of the increase occurred in two plots in the Thunder Bay District. In fact, a decreased number of larvae was recovered in the majority of plots and the incidence of negative counts increased somewhat. Thus, the implications of this interpretation of the data are that possibly lower than normal (or expected) survival occurred during the early or mid-instar larval stage resulting in reduced numbers of late instar larvae.

Infestation Forecasts for 1977: The egg-mass survey carried out in August, 1976 confirmed that an apparent leveling off (decreases in some cases) of budworm populations has occurred across the Thunder Bay, Atikokan and Fort Frances districts (Table 8). However, the egg-mass data must be interpreted with caution for the same reasons that we urged caution in interpreting the monitoring plot data. A total of 241 locations were sampled in 1976 of which 179 were common to both 1975 and 1976. Based on those locations sampled in both years, egg-mass densities in 1976 on an overall basis were 47% lower than those of 1975 and have returned to an average level similar to 1975. The incidence of positive counts declined to 45% compared to the 52% in 1975 and 37% in 1974. On an individual district basis, egg-mass densities decreased by 6% in Thunder Bay, 32% in Atikokan and 65% in Fort Frances districts.

Numerous pockets of defoliation concentrated in the Greenwater, Hoof, Swallow, Batwing and Kekekaub lakes area of the Thunder Bay District (Fig. 9) will likely occur in 1977. Another group of pockets of

Table 7. Results of monitoring plot samples for a five-year period for plots in northwestern Ontario.

<u>Location</u>	<u>Host</u>	<u>No. of larvae per 20-mat sample</u>				
		<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>
<u>Sioux Lookout District</u>						
McAree Twp	bF	0	0	0	0	0
Drayton Twp	wS	0	0	0	0	0
Minnitaki Lake	bF	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$
<u>Red Lake District</u>						
Wenasaga Lake	bF	0	0	0	0	0
<u>Dryden District</u>						
Aubrey Twp	bF	0	0	1	3	0
Redvers Twp	bF	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{1}{2}$	$\frac{6}{9}$	$\frac{0}{0}$
<u>Kenora District</u>						
Melick Twp	bF	0	0	0	0	0
Redditt Twp	bF	$\frac{-}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{2}{2}$	$\frac{1}{1}$
<u>Fort Frances District</u>						
Sifton Twp	wS	-	0	1	2	0
Potts Twp	bF	1	0	1	0	0
Mather Twp	bF	$\frac{3}{4}$	$\frac{1}{1}$	$\frac{1}{3}$	$\frac{2}{4}$	$\frac{0}{0}$
<u>Ignace District</u>						
Norway Lake	bF	0	0	0	0	1
Lumberjack Lodge	wS	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{0}{0}$	$\frac{2}{2}$	$\frac{1}{2}$
<u>Atikokan District</u>						
White Otter Lake	wS	0	0	2	7	2
Saganagons Lake	bF	0	2	0	12	2
Tanner Lake	bF	$\frac{-}{0}$	$\frac{19}{21}$	$\frac{1}{3}$	$\frac{8}{27}$	$\frac{1}{5}$
<u>Thunder Bay District</u>						
McTavish Twp	wS	0	6	0	0	33
Sibley Peninsula	bF	0	0	0	0	7
Little Harry Lake	bF	0	0	0	4	0
Hagey Twp	bF	0	1	5	14	5
Aldina Twp	bF	1	0	0	1	75
Spruce River Road	bF	0	0	1	4	1
Holingshead Lake	bF	$\frac{0}{1}$	$\frac{0}{7}$	$\frac{0}{6}$	$\frac{1}{24}$	$\frac{0}{121}$
	Total	5	29	14	68	129

Table 8. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Atikokan District</u>				
(88 locations)				
Agnes Lake	bF	0	0	0
Airport Road	bF	4	16	L-M
Allan Lake - west side	bF	0	0	0
Argo Lake - west side	bF	0	0	0
Basswood Lake - Bayley Bay	bF	0	0	0
- Canadian Point	bF	0	15	L-M
- North Bay	bF	0	0	0
- Prairie Portage	bF	33	149	M-S
- Ranger Bay	bF	0	10	L
Beaverhouse Lake	bF	0	11	L
Brent Lake - north central	bF	0	0	0
Buckingham Lake	bF	7	0	0
Cache Bay	bF	0	0	0
Cache Lake	bF	0	0	0
Cairn Lake	bF	0	0	0
Calm Lake	bF	1	0	0
Camel Lake	bF	0	0	0
Captain Tom Lake	bF	0	19	L-M
Carp Lake	bF	0	0	0
Crooked Lake - east end	bF	0	11	L
- Gardner Bay	bF	0	0	0
- northeast of Sunday Bay	bF	0	0	0
Darky Lake	bF	0	13	L
David Lake	bF	0	28	L-M
Delahey Lake	bF	0	0	0
Duff Lake	bF	5	0	0
Emerald Lake	bF	0	0	0
Eye Lake	bF	0	13	L
Factor Lake	bF	0	0	0
Ferguson Lake	bF	1	0	0
French Lake	wS	6	0	0
French Lake	bF	6	0	0
Gehl Lake	bF	0	0	0
Greer Lake	bF	1	19	L-M
Harnett Lake - northeast	bF	2	0	0
Hydro Line - Hwy 11	bF	23	0	0

(cont'd.)

Table 8. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Atikokan District (cont'd.)</u> (88 locations)				
Joe Lake	bF	1	0	0
Joyce Lake	bF	0	21	L-M
Kawa Bay - #116	bF	0	12	L
Kawa Bay - west end	bF	0	0	0
Kawnipi Lake - Devine Creek	bF	1	8	L
Lac La Croix - Campbells	bF	0	21	L-M
- I.R. 25 D (central)	bF	0	0	0
- I.R. 25 D (east)	bF	0	0	0
- Martin Bay (central)	bF	0	0	0
- Martin Bay (west)	bF	1	0	0
Lilac Lake	bF	0	0	0
Little Eva Lake	bF	0	0	0
Louisa Lake - north end	bF	0	0	0
- south end	bF	1	0	0
Mack Lake	bF	1	0	0
McAree Lake - Lookout	bF	0	0	0
McCaulay Lake Rd	bF	0	0	0
McEwan Lake	bF	0	0	0
McIntyre Lake	bF	0	0	0
McKenzie Lake				
- east side	bF	0	9	L
- southwest end	bF	1	38	L-M
- Tower	bF	1	0	0
Melema Lake	bF	0	0	0
Mercutio Lake	bF	0	0	0
Minn Lake	bF	0	14	L-M
Niven Lake	bF	2	0	0
Olifaunt Lake	bF	2	0	0
Oriana Lake	bF	0	0	0
Orion Lake	bF	0	0	0
Pipestone River				
- east of Melin Lake	bF	1	28	L-M
Pipestone River				
- Whalen Lake Rd	bF	0	6	L
Poacher Lake	bF	0	82	M-S

(cont'd.)

Table 8. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Atikokan District (cont'd.)</u> (88 locations)				
Poohbah Lake	bF	1	16	L-M
Price Lake ^b	bF	2	0	0
Quetico Lake	bF	0	0	0
Robinson Lake	bF	0	0	0
Saganagons Lake - north end	bF	1	9	L
Snow Lake	bF	0	0	0
Sturgeon Lake				
- northeast end	bF	0	0	0
- west end	bF	0	0	0
Sunday Lake	bF	0	0	0
Surprise Lake	bF	4	0	0
Tanner Lake	bF	0	15	L-M
Thompson Lake	bF	0	0	0
Trousers Lake	bF	1	0	0
Tuck Lake	bF	0	0	0
Wet Lake	bF	0	0	0
Whalen Lake	bF	1	60	M-S
Wicksteed Lake	bF	0	0	0
William Lake - east end	bF	0	0	0
- west end	bF	0	0	0
Wolseley Lake				
north central	bF	0	12	L
<u>Fort Frances District</u> (69 locations)				
Bear Pass				
(3.2 miles east of)	bF	25	0	0
Bear Pass				
(1.5 miles west of)	bF	76	654	S
Bennett Creek				
- east of Glenorchy ^b	bF	1	0	0
Bennett Lake - west end ^b	bF	1	10	L
Beynon Lake	bF	1	0	0

(cont'd.)

Table 8. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Fort Frances District (cont'd.)</u> (69 locations)				
Big Sawbill Lake	bF	0	0	0
Boffin Lake				
- northeast side	bF	0	0	0
Crilly Rd ^b	bF	72	286	S
Eldridge Lake (south of)	bF	12	12	L
Eli Lake	bF	1	0	0
Eltrut Lake	bF	8	12	L
Grassy Lake (1 mile south of)	bF	0	0	0
Hepburn Lake	bF	1	0	0
Heron Lake	bF	6	5	L
Hwy 11 - Farrington Twp	bF	18	0	0
- south of Olive	bF	2	0	0
- south of Turtle	bF	1	6	L
- Seine River ^b	bF	16	9	L
- Mine Centre	bF	4	28	L-M
- Sturgeon Falls I.R. west side ^b	bF	8	0	0
Law Lake (2 miles east of)	bF	17	0	0
Little Sawbill Lake - south side	bF	8	0	0
Little Turtle Lake Rd - Mile 9.4	bF	2	13	L
Little Turtle Lake - south side	bF	3	17	L-M
Little Turtle River				
- #9 ^c	bF	2	13	L
- #11 ^c	bF	71	126	M-S
- #12 ^c	bF	1	0	0
- #15 (1 mi. north of) ^c	bF	3	80	M-S
- west of falls ^c	bF	2	38	L-M
Mainville Lake - northeast side	bF	3	0	0

(cont'd.)

Table 8. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Fort Frances District (cont'd.)</u> (69 locations)				
Makomesut Lake				
- southeast side	bF	8	5	L
Manion Lake				
- southeast corner	bF	1	67	M-S
Manion Lake Rd				
- at Hwy 11 ^b	bF	32	169	M-S
- Hillyer Creek ^c	bF	26	96	M-S
- Little Turtle River ^c	bF	71	94	M-S
- Mile 6.5 ^d	bF	76	90	M-S
- Mile 9 ^d	bF	1	26	L-M
- Mile 11 ^d	bF	38	65	M-S
- Mile 14.5 ^e	bF	5	41	L-M
Mather Twp	bF	1	0	0
McPherson Lake	bF	2	0	0
Melin Lake	bF	1	0	0
Moosetrack Lake				
- west side ^d	bF	14	8	L
Otukamamoan Lake				
- southeast side	bF	8	10	L
- west side	bF	0	0	0
Partridge Crop Lake ^b	bF	1	28	L-M
Pettit Lake	bF	4	62	M-S
Pickwick Lake - south side	bF	4	0	0
Potts Twp	bF	4	0	0
Rainy Lake				
- Ash Bay, west end	bF	0	0	0
- Black Sturgeon Bay	bF	12	9	L
- Chamberlain Point	bF	1	0	0
- Grassy Portage Bay	bF	8	20	L-M
- Little Grassy Bay	bF	1	0	0
- Moose Bay	bF	2	0	0
- Northeast Bay, south side	bF	1	0	0
- Rat River Bay (northeast of)	bF	1	0	0

(cont'd.)

Table 8. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Fort Frances District (cont'd.)</u> (69 locations)				
Rainy Lake				
- Red Gut Bay	bF	1	4	L
- Reef Point Rd	bF	0	7	L
- Swell Bay	bF	4	7	L
Roscoe Lake	bF	5	17	L-M
Shoal Lake	bF	8	7	L
Tessup Creek	bF	1	15	L-M
Tessup Lake				
(2 miles south of)	bF	1	0	0
Tupman Lake - south end	bF	2	0	0
Turtle River				
(2.5 miles southeast of)	bF	7	7	L
Weller Lake	bF	1	0	0
Wild Potato Lake				
(1 mile south of)	bF	15	9	L
(5 miles south of)	bF	2	11	L-M
<u>Ignace District</u> (4 locations)				
Bending Lake	bF	0	0	0
Campus Lake	bF	0	0	0
Kathleen Lake	bF	0	0	0
Scotch Lake	bF	0	0	0
<u>Thunder Bay District</u> (80 locations)				
Aldina Twp - 101	bF	71	21	L
Aldina Twp - 102	bF	47	54	M
Armistice Creek				
- 2 miles east of				
Sunday Lake	bF	0	0	0
Athelstane Lake	bF	2	21	L-M
Batwing Lake	bF	23	31	L-M
Batwing & Mark lakes Rd Jct	bF	2	0	0

(cont'd.)

Table 8. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Thunder Bay District (cont'd.)</u> (80 locations)				
Bedivere Lake	bF	2	0	0
Bemar Lake	bF	35	7	L
Blackwell Twp	bF	2	0	0
Blossom Lake	bF	3	11	L
Burchell Lake	bF	7	0	0
Clay Lake	bF	63	79	M-S
Clovenhoof Lake	bF	11	0	0
Crayfish Lake	bF	4	0	0
Cushing Lake	bF	1	6	L
Devil's Elbow	bF	18	11	L
Drift Lake Rd	bF	0	0	0
Flatrock Lake	bF	2	0	0
Fountain Lake	bF	1	7	L
Gorham Twp - Current River	bF	14	0	0
Greenwater Lake - east side	bF	78	232	S
- Shelter Island	bF	6	0	0
Greenwood Lake	bF	10	24	L-M
Gunflint Lake - west end	bF	16	79	M-S
- central	bF	5	0	0
Hagey Twp - Hwy 586	bF	33	18	L-M
Haines Twp - Postans	bF	0	0	0
Heaven Lake Rd	bF	1	0	0
Hood Lake	bF	37	64	M-S
Hoof Lake	bF	52	36	L-M
Huronian Lake	bF	2	0	0
Hwy 11				
- west of Burchell Lake Rd	bF	9	2	L
Hwy 800				
- Kabitotikwia River	bF	0	12	L
Icarus Lake	bF	15	0	0
Kashabowie Lake	bF	5	0	0
Kekekuab Lake	bF	20	31	L-M

(cont'd.)

Table 8. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Thunder Bay District (cont'd.)</u> (80 locations)				
Lac des Mille Lacs				
- Baril Bay	bF	0	6	L
- Bolton Bay	bF	5	0	0
- Pine Point	bF	3	0	0
- Poplar Point	bF	2	0	0
- Portage Bay	bF	0	10	L
Marks Lake	bF	15	18	L-M
McGinnis Lake	bF	17	0	0
McGrath Lake	bF	5	4	L
McMaster Twp	bF	1	0	0
Moss Lake	bF	3	0	0
Mountain Lake	bF	28	8	L
Myrt Lake	bF	56	127	M-S
Nelson Lake	bF	4	0	0
Northern Light Lake				
- Curran Bay	bF	12	0	0
- Gravel Pit	bF	10	5	L
- South Island	bF	10	6	L
- Trafalgar Bay	bF	15	20	L-M
- Trout Bay Rd (Pupal sample point)	bF	17	0	0
North Fowl Lake Rd				
- Mile 2.3	bF	71	74	M-S
- Mile 2.5	bF	11	5	L
Pearson Twp	bF	2	0	0
Pigeon River				
- #1 Hwy 61 at Larsen Rd	bF	10	0	0
- #2	bF	9	12	L
- #3 Arrow River at Devon Rd	bF	8	0	0
Pinecone Lake	bF	8	22	L-M
Plummes Lake	bF	22	29	L-M
Powell Lake	bF	30	32	L-M
Prelate Lake	bF	4	0	0

(cont'd.)

Table 8. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1976, and infestation forecasts for 1977

Location	Host	Estimated per cent of defoliation 1976	No. of egg- masses per 9.29 sq. m (100 sq. ft) of foliage	Infesta- tion forecasts for 1977 ^a
<u>Thunder Bay District</u> (cont'd.)				
(80 locations)				
Ross Lake	bF	61	356	S
Sandstone Lake	bF	8	5	L
Shebandowan Lake				
- Sawmill Bay	bF	7	14	L-M
Sibley Peninsula				
- Joeboy Lake	bF	1	8	L
Sleigh Lake	bF	13	12	L
South Fowl Lake	bF	2	0	0
Squeers Lake	bF	12	14	L-M
Swallow Lake	bF	79	97	M-S
Thunder Bay				
- OMNR Tree Nursery	wS	4	0	0
- Centennial Pk	wS	67	162	M-S
Tilley Lake	bF	4	7	L
Titmarsh Lake	bF	20	0	0
Twinhouse Lake	bF	28	79	M-S
Upsala - Inwood Prov. Pk	bF	2	0	0
Weikwabinonaw Lake	bF	7	16	L-M
Whitefish Lake	bF	2	0	0

^a S = severe, M = moderate, L = light, 0 = nil

^b Aerially sprayed - Matacil, 1 application, 1976

^c Aerially sprayed - Matacil + Fenitrothion, 1 application each, 1976

^d Aerially sprayed - Fenitrothion, 2 applications, 1976

^e Aerially sprayed - Fenitrothion, 1 application, 1976

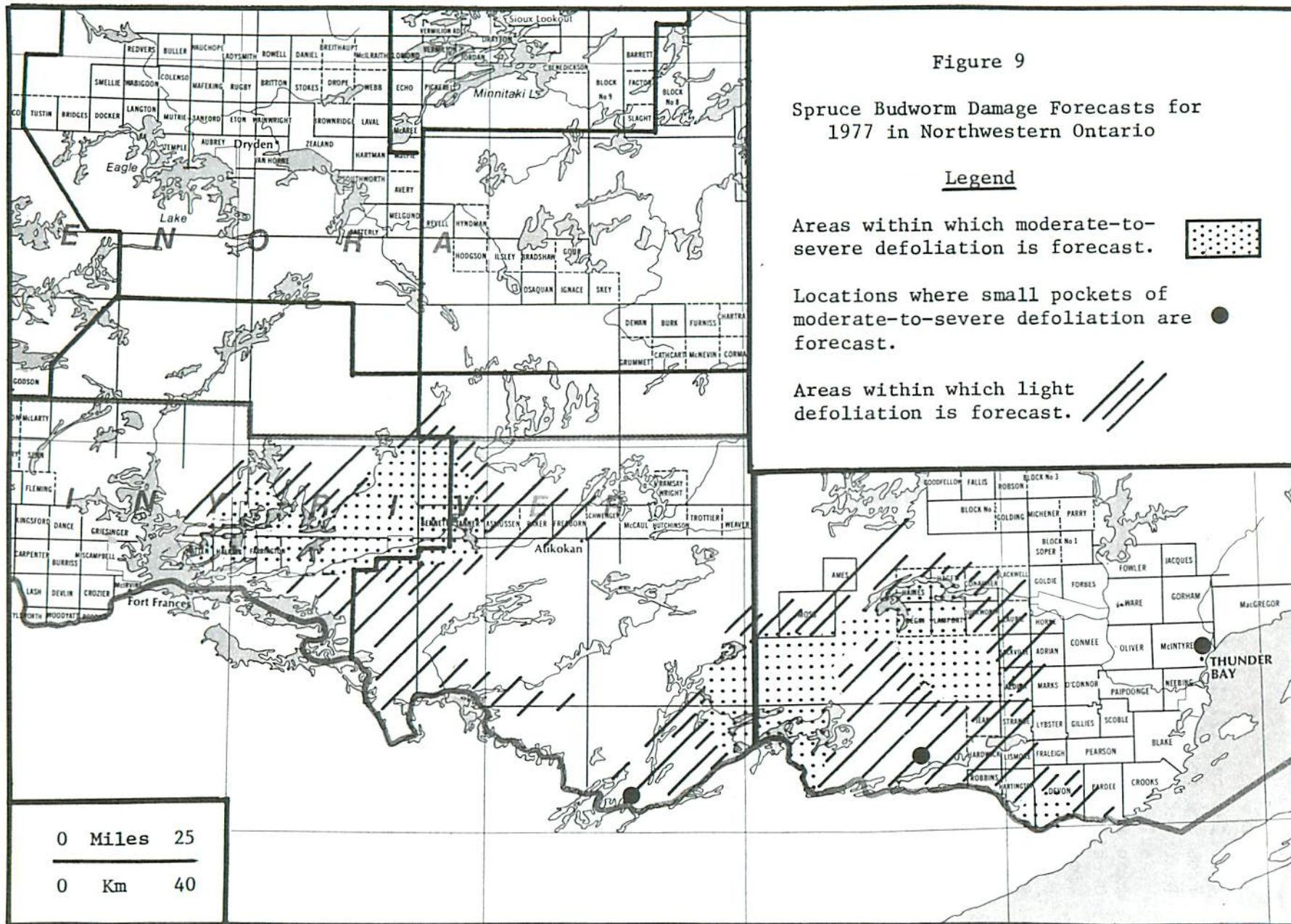





Figure 9

Spruce Budworm Damage Forecasts for 1977 in Northwestern Ontario

Legend

Areas within which moderate-to-severe defoliation is forecast. 

Locations where small pockets of moderate-to-severe defoliation are forecast. 

Areas within which light defoliation is forecast. 

0 Miles 25

0 Km 40

defoliation will likely occur further to the west in the area extending from Squeers Lake in the Thunder Bay District to Kawnipi Lake in Atikokan District. Defoliation may also be found again at the Pigeon River and Prairie Portage locations. Population levels and intensity of defoliation in the aforementioned areas in 1977 will likely be similar to 1976. Outside of the indicated areas, budworm will be very scarce and defoliation should generally be limited to trace levels.

In the Fort Frances District, it seems fairly evident, despite the appearance of many pockets of defoliation in 1976, that the spraying for the past two years of the main population buildup in the vicinity of Bennett Lake has had a pronounced effect on the overall situation. It is likely that in 1977 pockets of infestation will occur again throughout the area affected in 1976, although the number, extent and intensity of these infestations will probably be reduced considerably. Generally speaking, budworm should be scarce outside of this area.

The situation has, at least temporarily, eased somewhat in northwestern Ontario for reasons that we cannot ascertain although, barring unforeseen circumstances, a foundation for continued population buildup is present in the area. It seems likely that the situation in 1977 will be the same as that in 1976 and in fact, infestations may be somewhat reduced, particularly in the Fort Frances District. Thus, 1977 looms as a crucial year in determining in which direction and to what extent the balance will be tipped, particularly in view of the decision this past winter by the Ontario Ministry of Natural Resources not to conduct large-scale spraying operations to try to suppress budworm populations.

Tree Mortality: Prior to 1976, there were no (known) significant areas of tree mortality in northwestern Ontario caused by spruce budworm during the 1968-1975 period. However, in 1976, several pockets of balsam fir mortality as evidenced by the appearance of "grey phase" stands were detected in the vicinity of Bennett Lake. More specifically these pockets of apparent mortality occurred within an area bounded by Bennett Creek to the south, Little Turtle River to the north and Bennett Lake to the east. An additional pocket lies to the north of this area between the Little Turtle River and Hillyer Creek. These observations have not yet been confirmed by ground checks owing to the inaccessibility of the stands.

PART B: AERIAL SPRAYING OPERATIONS

INTRODUCTION

The Ontario Ministry of Natural Resources conducted aerial spraying operations covering some 40 000 ha (100,000 acres) against spruce budworm in 1976. The Great Lakes Forest Research Centre provided the biological information necessary for the planning, execution, timing and assessment of these operations. In addition, GLFRC carried out province-wide surveys for spruce budworm defoliation and egg-mass counts with support from OMNR in the form of aircraft and casual help in order to determine the overall situation and provide forecasts for 1977.

The spray contractor was General Airspray Ltd., St. Thomas, Ontario. Two Stearmans, two Agcats and a fifth aircraft, a Piper Pawnee subcontracted from Central Ag-Air Ltd., St. Thomas were employed. Each aircraft was equipped with 4 Micronair AU 3000 dispersal units. Fenitrothion (Sumithion, Sumitomo Chemical Co. Ltd.) mixed with appropriate amounts of Arotex was applied to 17 344 ha (43,360 acres) in single or double applications of 113.4 g in .38 liters of spray mixture per .4 ha (4 oz (a.i.) in 12.8 fluid ounces of spray mixture per acre). Matacil (aminocarb, Chemagro Ltd.) mixed with fuel oil was applied to 14 298 ha (35,745 acres) at 42.5 g in .38 liters per .4 ha (1.5 oz (a.i.) in 12.8 fluid ounces of spray mixture per acre). Some 7 320 ha (18,300 acres) were treated with Matacil 42.5 g/.4 ha (1.5 oz/ac) followed by Fenitrothion 113.4 g/ha (4 oz/ac). Orthene (Chevron Chemical Ltd.) mixed with water was applied to about 720 ha (1,800 acres) at 113.4, 226.8 and 340.2 g (4, 8 and 12 oz (a.i.)) in .95 or 1.9 liters per .4 ha (.25 or .5 gallons (U.S.) per acre). Thuricide 16B (Sandoz, Inc.) was applied to about 800 ha (2,000 acres) at 4 BIU/1.9 liters/.4 ha (4 BIU/.5 gpa). Operational statistics are summarized in Tables 9 and 10.

The following description of the operations and results is taken from a report by Howse et al. (1976).

Southern Ontario

1976 Operations: A total of 768 ha (1920 acres) was sprayed with *Bacillus thuringiensis* (B.t.) from an aircraft in Algonquin Provincial Park in 1976. Another 40 ha (100 acres) or so were treated with B.t. from a mistblower. As in previous years, the purpose of the spraying was to protect foliage on host trees in high value areas, namely, organized campgrounds, scenic or hiking areas, along Highway 60. The provincial tree nursery at Midhurst was sprayed with Fenitrothion from a mistblower.

Table 9. Summary of operational statistics - spruce budworm
aerial spraying operations in Ontario, 1976

Insecticide	Hectares	No. of applications	Dosage	Diluent	Application rate
Fenitrothion	1 493	1	113.4 g	Arotex	.38 l/.4 ha
	<u>15 851</u>	2	113.4 g x 2	Arotex	.38 l/.4 ha
	17 344				
Matacil	14 168	1	42.5 g	fuel oil	.38 l/.4 ha
	<u>130</u>	2	42.5 g x 2	fuel oil	.38 l/.4 ha
	14 298				
Matacil + Fenitrothion	7 329	2	42.5 g + 113.4 g	Arotex fuel oil	.38 l/.4 ha .38 l/.4 ha
Orthene	146	1	113.4 g	water	.95 l/.4 ha
	538	1	226.8 g	water	1.9 l/.4 ha
	<u>40</u>	2	113.4 + 226.8 g	water	.95 + 1.9 l/.4 ha
	724				
Thuricide 16B	768	1	4 BIU	water	1.9 l/.4 ha
	<u>40</u>	1	7:1	water to Bt - mistblower	
	808				
Total = 40 503					

Conversion factors

1 ha = 2.5 acres

28.35 g = 1 oz

29.57 ml = 1 fl oz (U.S.)

Table 10. Summary of aerial spraying operations in Ontario against spruce budworm larvae by the Ministry of Natural Resources, 1976

District	Location	Hectares	Treatment
<u>Northwestern Ontario</u>			
Fort Frances	Bennett Lake	10 288	Matacil 42.5 g/.4 ha
		7 329	Matacil 42.5 g + Fenitrothion 113.4 g
		1 393	Fenitrothion 113.4 g
		<u>15 851</u>	Fenitrothion 113.4 g + 113.4 g
		34 861	
<u>Northeastern Ontario</u>			
Wawa	Lake Superior Prov. Park	2 962	Matacil 42.5 g
		100	Fenitrothion 113.4 g
		146	Orthene 113.4 g
		182	Orthene 226.8 g
		40	Orthene 226.8 g + 113.4 g
		<u>3 430</u>	
Chapleau	Provincial parks, nursery, seed production area	276	Orthene 226.8 g
		918	Matacil 42.5 g
		130	Matacil 42.5 g + 42.5 g
		<u>1 324</u>	
Kirkland Lake	Swastika Nursery	80	Orthene 226.8 g
<u>Southern Ontario</u>			
Algonquin	Algonquin Prov. Park	768	Thuricide 4 BIU
		40	Thuricide - mistblower
		<u>808</u>	
		Total = 40 503	

Originally, OMNR had planned to use Orthene in Algonquin but this material was delayed en route from San Francisco to Toronto. Consequently, it was decided to use Thuricide 16B which had originally been purchased to spray forest tent caterpillar infestations in provincial parks in Parry Sound and Bracebridge districts. These operations against forest tent caterpillar were cancelled after populations collapsed in the parks allowing the B.t. to be used against budworm in Algonquin.

Another problem became evident in early June when prespray larval counts showed that overall populations were lower than expected. Consideration was given to cancelling the operation but since high counts were present in some locations it was decided to go ahead with the original plan except for substituting B.t. for Orthene.

The aircraft, a Piper Pawnee, arrived on June 6 and sprayed on June 8 and 9. Insect development was fourth and fifth instar at time of spraying. Mistblower applications were done June 5-9.

Results: Generally speaking, results appeared quite satisfactory with substantial larval reduction and foliage protection recorded for most of the sample locations. A summary of the results is presented in Table 11.

Proposed Aerial Spraying Operations for 1977: Owing to the decline in budworm populations, protection spraying should not be required for at least one season in Algonquin Provincial Park. Hence, it is likely that there will be no aerial spraying operations for spruce budworm in southern Ontario in 1977.

Northeastern Ontario

1976 Operations: A total of 4 834 ha (12,083 acres) was sprayed in northeastern Ontario in 1976. The locations, areas and treatments are listed in Table 12.

The primary purpose of the spraying in the provincial parks was to minimize the intensity of budworm-caused damage within selected areas that have recreational, aesthetic or timber values. In addition, provincial nurseries at Chapleau and Swastika and a seed production area in Triquet Township were sprayed.

Spraying was carried out from June 11 to June 21 in the Chapleau District using a Piper Pawnee and on June 22 in Lake Superior Provincial Park using the Pawnee and a Stearman. Budworm were in fourth and fifth instar on June 11. Development progressed to mostly sixths with some fifths present by June 22. The work in Chapleau District was plagued

Table 11. Population reduction and foliage protection attributable to B.t. spraying on balsam fir and white spruce in Algonquin Provincial Park, 1976. Budworm development at time of spraying was L4. Data from 20 plots (13 spray, 7 check)

	Prespray larvae/ 46 cm (18 in) branch tip		Surviving pupae/ 46 cm (18 in) branch tip		% Population reduction due to treatment		% 1976 Defoliation		
	bF	wS	bF	wS	bF	wS	bF	wS	
<u>B.t. - aircraft application 4 BIU/1.9 liters/.4 ha (4 BIU/.5 gpa)</u>									
Spray	13.4	23.3	.3	2.1	78	21	18	20	
Check	14.0	22.9	1.4	2.6	--	--	25	25	
<u>B.t. - aircraft application 4 BIU/1.9 liters/.4 ha (4 BIU/.5 gpa + mistblower application)</u>									
Spray	13.1	17.8	.2	1.1	83	52	7	12	
Check	14.0	18.3	1.4	2.3	--	--	18	27	
<u>B.t. - mistblower applications (two)</u>									
Spray	6.3	9.3	.1	.2	60	56	4	9	
Check	7.4	10.4	.3	.5	--	--	17	13	

Table 12. Detailed breakdown of aerial spraying operations (locations, areas and treatments) carried out in northeastern Ontario in 1976

Location	Hectares	Treatment
<u>Chapleau District</u>		
Five Mile Prov. Park	272	Orthene 226.8 g
Chapleau Nursery	4	Orthene 226.8 g
		Orthene 226.8 g
Shoals Prov. Park	546	Matacil 42.5 g
	50	Matacil 42.5 g + 42.5 g
Wakami Prov. Park	92	Matacil 42.5 g
	32	Matacil 42.5 g + 42.5 g
Missinaibi Prov. Park	152	Matacil 42.5 g
	48	Matacil 42.5 g + 42.5 g
Triquet Twp. Seed Production Area	<u>128</u>	Matacil 42.5 g
	1 324	
<u>Kirkland Lake District</u>		
Swastika Nursery	80	
<u>Wawa District</u>		
Lake Superior Prov. Park		
- Sand River	2 076	Matacil 42.5 g
- Mijin Lake	656	Matacil 42.5 g
- Mijin Road	230	Matacil 42.5 g
- Mijin Road	100	Fenitrothion 113.4 g
- Mijin Road	40	Orthene 113.4 g
- Mijin Road	56	Orthene 226.8 g
- Mijin Road	40	Orthene 226.8 g + 113.4 g
- Rabbit Blanket	20	Orthene 226.8 g
- HW 17	106	Orthene 113.4 g
- HW 17	<u>106</u>	Orthene 226.8 g
	3 430	
Total	= 4 834	

by poor weather and generally unsuitable spraying conditions in contrast with the completion of nearly 3 400 ha (8,500 acres) in one day at Lake Superior Provincial Park.

Results: Most of the treatments in Chapleau and Wawa districts were assessed (for results see Tables 13, 14 and 15). Table 13 presents a summary of results for Chapleau District, Table 14 has a summary of results for Wawa District and Table 15 compares the amount of defoliation present at the time of treatment and when larvae ceased feeding in Wawa District.

Prespray larval populations were lower than expected in two of the Chapleau District parks, namely Five-Mile and Wakami. Two applications of Matacil provided good larval kill and some foliage protection in the Shoals and Wakami Provincial parks whereas no larval mortality could be shown to have occurred at Missinaibi (Table 13). An operational application of Orthene at Five-Mile Provincial Park provided good population reduction on both host species (Table 13). However, it is difficult to draw conclusions concerning foliage protection mainly because of the low populations that were present at the time of spraying. Orthene spray deposit at Five-Mile was monitored using conventional Krome-Kote cards on the ground along roads or in large openings. Deposit ranged from 1 to 29 droplets per cm^2 and averaged only 10 per cm^2 . A more detailed listing of results on a plot by plot basis within each treatment for the Chapleau District is presented in Table 16.

Operational trials comparing Matacil, Fenitrothion and Orthene were carried out in Lake Superior Provincial Park. A summary of results is presented in Table 14. Good larval kill occurred for all materials on balsam fir and white spruce with the exception of Fenitrothion on white spruce. In general, there was no foliage protection achieved by the treatments; however, this is explained by the data in Table 15 which show that most of the defoliation measured after the cessation of larval feeding had occurred by the day of treatment. The data in Table 15 also show that feeding did not increase appreciably in treated areas following treatment. Deposit data for the Orthene applications show that, in general, good deposits were achieved in the order of 30-80 droplets per cm^2 but there were very poor correlations between deposit, application rate, dosage and larval mortality. For example, there do not seem to be biologically significant differences among results for the three Orthene applications. Detailed results of the operational trials conducted in Lake Superior Provincial Park are contained in Table 17.

Proposed Aerial Spraying Operations for 1977: It is likely that an operational spraying program similar to that of 1976 will be carried out next year. In addition, OMNR officials in the Northern Region have been asked to review

Table 13. Summary of population reduction and foliage protection attributable to various spray treatments on balsam fir and white spruce in four provincial parks, Chapleau District, 1976. Budworm development at time of spraying was L4-L5-L6.

	Prespray larvae/ 46 cm (18 in) branch tip		Surviving pupae/ 46 cm (18 in) branch tip		% Population reduction due to treatment		% 1976 Defoliation	
	bF	wS	bF	wS	bF	wS	bF	wS
<u>Matacil, 2 applications 42.5 + 42.5 g/.4 ha (1.5 + 1.5 oz/ac) L5-L6</u>								
Shoals Prov. Park	20.0	19.8	.9	2.5	82	64	68	39
Check	20.5	20.5	5.2	7.2			75	63
Wakami Prov. Park	8.5	14.7	1.4	4.2	65	37	18	28
Check	9.4	15.4	4.4	7.1			34	43
Missinaibi Prov. Park	23.8	7.7	13.1	5.0	0	0	63	22
Check	24.8	9.2	5.2	3.4			97	13
<u>Orthene, 1 application 226.8 g/.4 ha (8 oz/ac) L4-L5</u>								
5-Mile Prov. Park	5.0	8.7	.6	.5	77	83	18	12
Check	5.6	10.2	2.8	3.6			18	23

Table 14. Summary of population reduction and foliage protection attributable to various spray treatments on balsam fir and white spruce in Lake Superior Provincial Park, Wawa District, 1976. Budworm development at time of spraying was L5-L6.

	Prespray larvae/ 46 cm (18 in) branch tip		Surviving pupae/ 46 cm (18 in) branch tip		% Population reduction due to treatment		% 1976 Defoliation	
	bF	wS	bF	wS	bF	wS	bF	wS
<u>Matacil, 1 application 42.5 g/.4 ha (1.5 oz/ac)</u>								
Spray	17.9	20.8	1.56	4.24	73	46	65	61
Check	17.5	20.1	5.72	7.56			72	60
<u>Fenitrothion, 1 application 113.4 g/.4 ha (4 oz/ac)</u>								
Spray	21.2	27.2	2.12	10.40	61	9	78	63
Check	20.1	27.3	5.22	11.44			71	88
<u>Orthene, 2 applications 340.2 g/.4 ha (12 oz/ac), 226.8 + 113.4 g/.4 ha (8 + 4 oz/ac)</u>								
Spray	26.0	42.7	1.20	4.15	82	67	97	87
Check	32.6	41.8	8.2	12.20			98	81
<u>Orthene, 1 application 226.8 g/.4 ha (8 oz/ac)</u>								
Spray	17.5	31.8	.85	5.25	83	51	84	90
Check	18.6	29.3	5.24	9.95			60	71
<u>Orthene, 1 application 113.4 g/.4 ha (4 oz/ac)</u>								
Spray	24.7	33.2	2.32	4.40	67	57	85	82
Check	24.0	32.8	6.84	10.04			81	81

Table 15. Comparison of the amount of defoliation of balsam fir and white spruce in spray plots and untreated check plots in Lake Superior Provincial Park, 1976 at the time of treatment and about two weeks later when larval feeding had ceased.

Spray plots	% Current defoliation at time of treatment			% Current defoliation when feeding completed		
	Date	bF	wS	Date	bF	wS
Matacil - Plot 1	22/6/76	38	39	6/7/76	45	64
- Plot 4	22/6/76	83	89	6/7/76	96	98
Fenitrothion - Plot 3	22/6/76	85	87	6/7/76	81	98
- Plot 5	22/6/76	56	45	6/7/76	67	63
Orthene - 340.2 g (12 oz) - Plot 2	23/6/76	93	79	5/7/76	95	79
- Plot 4	23/6/76	98	97	5/7/76	98	98
Orthene - 226.8 g (8 oz) - Plot 4	21/6/76	93	-	5/7/76	83	-
Orthene - 113.4 g (4 oz) - Plots 2, 3, 4	22/6/76	<u>68</u>	<u>69</u>	6/7/76	<u>78</u>	<u>76</u>
	Average	77	72		80	82
<u>Check Plots</u>						
1	23/6/76	88	81	7/7/76	99	99
2	23/6/76	30	19	6/7/76	44	30
3	23/6/76	84	59	6/7/76	90	76
4	22/6/76	82	80	7/7/76	98	81
5	22/6/76	<u>97</u>	<u>88</u>	7/7/76	<u>95</u>	<u>96</u>
	Average	76	49		85	76

Table 16. Population reduction and foliage protection attributable to various spray treatments in individual plots on balsam fir and white spruce in four provincial parks, Chapleau District, 1976. Budworm development at time of spraying was L4-L5-L6.

	Prespray larvae/ 46 cm (18 in.) branch tip		Surviving pupae/ 46 cm. (18 in.) branch tip		% Population reduction due to treatment		% 1976 Defoliation	
	bF	wS	bF	wS	bF	wS	bF	wS
<u>Shoals Provincial Park - Matacil, 2 applications, 42.5 g/.4 ha each</u> <u>(1.5 oz/ac each), L5-L6</u>								
Plot 1	17.4	25.2	.2	3.4	97	73	43	39
Check	17.8	24.8	6.8	12.6			63	99
Plot 2	23.2	14.8	0	.6	100	90	51	18
Check	24.8	14.2	5.2	5.6			97	30
Plot 3	25.6	26.6	1.4	2.8	74	50	94	60
Check	24.8	30.4	5.2	6.4			97	76
Plot 4	14.0	12.8	2.0	3.2	42	25	83	38
Check	14.6	12.6	3.6	4.2			44	46
Overall	20.0	19.8	.9	2.5	82	64	68	39
Check	20.5	20.5	5.2	7.2			75	63
<u>Wakami Provincial Park - Matacil, 2 applications, 42.5 g/.4 ha each</u> <u>(1.5 oz/ac each), L5-L6</u>								
Plot 1	4.6	5.8	1.2	4.8	48	0	6	10
Check	5.0	9.2	2.5	3.4			15	13
Plot 2	9.6	25.0	1.6	2.2	64	83	21	31
Check	12.4	24.8	5.8	12.6			47	99
Plot 3	8.0	8.4	.6	2.0	84	35	25	46
Check	7.6	9.2	3.6	3.4			25	13
Plot 4	11.6	19.6	2.2	8.0	59	16	21	25
Check	12.4	18.6	5.8	9.0			47	47
Overall	8.5	14.7	1.4	4.2	65	37	18	28
Check	9.4	15.4	4.4	7.1			34	43
<u>Missinaibi Provincial Park - Matacil, 2 applications, 42.5 g/.4 ha each</u> <u>(1.5 oz/ac each), L5-L6</u>								
Plot 1	23.8	7.7	13.1	5.0	0	0	63	22
Check	24.8	9.2	5.2	3.4			97	13
<u>5-Mile Provincial Park - Orthene, 1 application, 226.8 g/.4 ha</u> <u>(8 oz/ac), L4-L5</u>								
Plot 1	4.6	9.0	.6	.6	74	82	4	4
Check	5.0	9.2	2.5	3.4			15	13
Plot 2	5.2	10.8	.4	.8	85	80	39	13
Check	5.0	9.2	2.5	3.4			15	13
Plot 3	7.2	11.4	2.8	1.2	18	68	51	16
Check	7.6	12.6	3.6	4.2			25	46
Plot 4	3.2	11.8	0	1.0	100	74	7	28
Check	4.0	12.6	2.2	4.2			12	46
Plot 5	6.4	6.8	0	.4	100	84	11	13
Check	5.0	9.2	2.5	3.4			15	13
Plot 6	3.2	10.6	0	.4	100	90	6	11
Check	4.0	9.2	2.2	3.4			12	13
Plot 7	2.4	5.4	0	0	100	100	15	11
Check	4.0	9.2	2.2	3.4			12	13
Plot 8	6.2	5.6	0	0	100	100	6	13
Check	5.0	9.2	2.5	3.4			15	13
Plot 9	3.4	3.8	.4	.6	78	57	16	4
Check	4.0	9.2	2.2	3.4			12	13
Plot 10	8.6	12.2	1.6	.4	60	90	26	11
Check	12.4	12.6	5.8	4.2			47	46
Overall	5.0	8.7	.6	.5	77	83	18	12
Check	5.6	10.2	2.8	3.6			18	23

Table 17. Population reduction and foliage protection attributable to various spray treatments in individual plots on balsam fir and white spruce in Lake Superior Provincial Park, Wawa District, 1976. Budworm development at time of spraying was L5-L6.

	Prespray larvae/ 46 cm (18 in.) branch tip		Surviving pupae/ 46 cm (18 in.) branch tip		% Population reduction due to treatment		% 1976 Defoliation	
	bF	WS	bF	WS	bF	WS	bF	WS
<u>Matacil, 1 application, 42.5 g/.4 ha (1.5 oz/ac)</u>								
Plot 1	17.8	33.4	1.6	4.8	76	31	45	64
Check	17.8	30.4	6.8	6.4			63	76
Plot 2	17.9	18.4	.4	5.2	94	42	42	45
Check	17.8	18.6	6.8	9.0			63	47
Plot 3	19.6	12.2	1.4	4.0	76	3	68	47
Check	19.4	12.6	5.8	4.2			90	46
Plot 4	13.0	14.8	2.0	2.0	67	66	96	98
Check	12.4	14.2	5.8	5.6			47	30
Plot 5	21.2	25.4	2.4	5.2	33	58	76	72
Check	20.0	24.8	3.4	12.6			99	99
<u>Fenitrothion, 1 application, 133.4 g/.4 ha (4 oz/ac)</u>								
Plot 1	41.4	38.0	2.2	7.4	79	33	97	96
Check	32.6	41.8	8.2	12.2			98	81
Plot 2	9.0	24.2	.8	15.0	81	0	65	84
Check	12.4	24.8	5.8	12.6			47	99
Plot 3	24.6	30.8	1.0	6.4	81	2	81	98
Check	24.8	30.4	5.2	6.4			97	76
Plot 4	16.6	21.2	4.6	15.8	0	0	63	70
Check	16.0	19.8	3.3	13.0			70	91
Plot 5	14.2	21.6	2.0	7.4	43	48	67	63
Check	14.6	19.8	3.6	13.0			44	91
<u>Orthene, 340.2 g/.4 ha (12 oz/ac, 2 applications) 226.8 g/.4 ha + 113.4 g/.4 ha (8 + 4 oz/ac)</u>								
Plot 1	25.4	38.0	1.2	3.8	77	52	97	72
Plot 2	23.8	35.0	1.4	4.2	72	43	95	79
Plot 3	28.6	55.6	1.4	5.2	77	56	99	98
Plot 4	26.0	42.2	.8	3.4	85	62	98	98
Check	32.6	41.8	8.2	12.2			98	81
<u>Orthene, 1 application, 226.8 g/.4 ha (8 oz/ac)</u>								
Plot 1	24.2	44.8	1.4	7.2	77	45	99	97
Check	32.6	41.8	8.2	12.2			98	81
Plot 2	18.4	34.0	.6	4.0	88	44	71	73
Check	18.6	30.4	5.0	6.4			70	76
Plot 3	13.4	18.8	1.0	3.4	79	63	82	94
Check	13.5	18.6	4.7	9.0			46	47
Plot 4	14.0	29.4	.4	6.4	89	53	83	96
Check	14.6	26.4	3.6	12.2			44	81
Rabbit Blanket	30.0	26.4	8.2	12.2	0	9	98	81
Check	24.8	24.8	5.2	12.6			97	99
Red Rock	18.2	34.0	2.2	9.6	29	0	95	96
Check	20.0	30.4	3.4	6.4			99	76
<u>Orthene, 1 application, 113.4 g/.4 ha (4 oz/ac)</u>								
Plot 1	39.6	51.4	3.0	3.4	70	77	87	72
Check	32.6	41.8	8.2	12.2			98	81
Plot 2	24.2	20.2	4.0	1.6	22	88	76	66
Check	24.8	19.8	5.2	13.0			97	91
Plot 3	29.8	37.4	2.6	6.2	65	43	86	89
Check	32.6	41.8	8.2	12.2			98	81
Plot 4	18.0	27.4	1.0	4.2	86	24	73	74
Check	17.8	30.4	6.8	6.4			63	76
Plot 5	11.8	29.8	1.0	6.6	82	0	84	94
Check	12.4	30.4	5.8	6.4			47	76

the situation in their region in view of the northward expansion of budworm to determine if there are areas or stands of susceptible hosts with sufficient value to warrant protection.

Northwestern Ontario

1976 Operations: A total of 34 861 ha (87,153 acres) was sprayed in the vicinity of Bennett Lake in the Fort Frances District in 1976. Matacil was applied to 17 617 ha (44,044 acres) and Fenitrothion to the remaining 17 244 ha (43,109 acres). Much of this area, 23 180 ha (59,950 acres) received a second application of Fenitrothion (Table 10). Two Stearman aircraft and two Agcats worked from the bush airstrip constructed in 1975 on the Manion Lake Road near the north boundary of the spray block. The purpose of this operation was the same as in previous years, i.e., to prevent the increase and spread of budworm into susceptible forests, particularly to the east. In addition, it was originally planned to spray a block of 6 400 ha (16,000 acres) centering on an infestation at Fluker Lake on the eastern edge of the Atikokan District. This latter area was not sprayed owing to advanced development of budworm larvae. Larval development was primarily fourth instar when spraying started on June 6 and the first pupae were present when spraying was completed on June 20. Generally speaking, spraying conditions were not favorable; windy weather prevailed. The spray planes were able to work 11 times of a total of approximately 30 opportunities.

Results: Spraying results are presented in Table 18. Over all, the treatments averaged nearly 80% larval mortality. The highest larval reduction of 93% was recorded for the area treated with Matacil and Fenitrothion. The single application of Matacil resulted in 80% mortality while two applications of Fenitrothion caused only 62% mortality. Over all, postspray pupal populations on balsam fir were reduced to about 1.3 per 46 cm (18 in.) tip.

In early July, aerial observers mapped about 27 200 ha (68,000 acres) of defoliation, consisting of numerous, small pockets located between Bennett Lake and Rainy Lake. Some of these pockets of defoliation were within the area sprayed in 1976; most, however, were outside. These pockets of defoliation are contained within a gross area of some 180 000 ha (450,000 acres).

Egg-mass counts for 19 locations within the sprayed area showed a lower average density in 1976 than 1975. The change from 159 egg masses per 9.29 sq. m (100 ft²) of foliage in 1975 to 60 in 1976 was a decrease of 62%. Average defoliation for these 19 locations decreased from 32% in 1975 to 23% in 1976. Egg-mass counts for 27 locations in close proximity to the area sprayed in 1976 (but outside of the spray boundaries) also showed a decrease of 22% and the average density was much lower for these unsprayed areas.

Table 18. Population reduction and foliage protection attributable to various spray treatments on balsam fir at Bennett Lake, Fort Frances District, 1976. Budworm development at time of spraying was L4-L6.

	Prespray larvae/ 46 cm (18 in.) branch tip	Surviving pupae/ 46 cm (18 in.) branch tip	% Population reduction due to treatment	% 1976 Defoliation
<u>Matacil, 1 application, 42.5 g/.4 ha (1.5 oz/ac)</u>				
Spray	10.7	.9	80	22
Check	12.4	5.4		30
<u>Matacil, 42.5 g/.4 ha (1.5 oz/ac) + Fenitrothion, 113.4g/.4 ha (4 oz/ac)</u>				
Spray	24.8	.6	93	46
Check	19.4	6.5		34
<u>Fenitrothion, 2 applications, 113.4 g/.4 ha (4 oz/ac) + 113.4 g/.4 ha (4 oz/ac)</u>				
Spray	17.6	2.3	62	30
Check	19.4	6.5		34

Proposed Aerial Spraying Operations for 1977: In addition to the situation at Bennett Lake-Rainy Lake, numerous pockets of defoliation totalling 30 000 ha (75,000 acres) were mapped between Kawnipi Lake in the Atikokan District and Lower Shebandowan Lake and Aldina Township in Thunder Bay District. The total area within which these pockets of defoliation were concentrated amounted to about 200 000 ha (500,000 acres). It was within this area that population buildups became evident in 1967 and some 110 000 ha (275,000 acres) were treated in 1968 in a successful effort to suppress the outbreak. Another 3 600 ha (9,000 acres) of defoliation were mapped along the Pigeon River south of Thunder Bay in the same area where 6 600 ha (16,500 acres) had been defoliated in 1975. Several small pockets of defoliation totalling a few hundred hectares recurred at Bayley Bay on the Ontario-Minnesota border.

Generally speaking, numbers of sixth instar larvae collected at monitoring stations throughout northwestern Ontario have doubled although the incidence of negative counts has not changed. Changes in egg-mass counts have varied among districts: there was a 6% decrease in Thunder Bay, a 32% decrease in Atikokan and a 65% decrease in Fort Frances District. The latter probably reflects the effects of spraying.

Meetings were held between GLFRC and OMNR in the summer and fall of 1976 to exchange information and discuss plans for 1977. If the policy of attempting to suppress budworm outbreaks in northwestern Ontario was to be continued, it seemed evident that an operation totalling some 380 000 ha (950,000 acres) was necessary [Thunder Bay District 200 000 ha (500,000 acres) and Fort Frances District 180 000 ha (450,000 acres)]. In addition it was evident that the area defoliated in 1976, 60 000 ha (150,000 acres), should receive a second treatment for a total of .44 million ha (1.1 million acres). However, after further consideration by senior OMNR personnel, the province has decided against an operation of this magnitude on environmental and economic grounds. For example, the proposed operation would require the use of large aircraft which would undoubtedly result in the deposition of oil-based insecticide in streams, rivers and lakes. Thus, at the present time it appears that there will not be any aerial spraying operations in northwestern Ontario next year. In the event that the outbreak continues to develop and enlarge beyond the present situation, OMNR will likely revert to a policy of identifying and protecting high-value stands.

SUMMARY

Aerial spraying operations covering 40 503 ha (101,256 acres) were conducted against the spruce budworm in Ontario by the Ministry of Natural Resources in 1976. In northwestern Ontario, a total of 34 861 ha

(87,153 acres) was sprayed in the vicinity of Bennett Lake in the Fort Frances District, 4 834 ha (12,083 acres) in northeastern Ontario in Wawa, Chapleau and Kirkland Lake districts and 808 ha (2,020 acres) in Algonquin Provincial Park in southern Ontario. Fenitrothion was applied to a total of 17 344 ha (43,359 acres) at a rate of 113.4 g/.4 ha (4 oz/ac) and Matacil to 14 298 ha (38,745 acres) at 42.5 g/.4 ha (1.5 oz/ac). Another 7 329 ha (18,323 acres) received an application of Matacil followed by Fenitrothion. Orthene was used at 113.4, 226.8 and 340.2 g/.4 ha (4, 8 and 12 oz/ac) and B.t. was applied to 808 ha (2,020 acres) at 4 BIU/.4 ha (per acre). Two Stearman aircraft, two Agcats and a Piper Pawnee equipped with Micronairs were used to apply the sprays. Generally speaking, all materials used or tested achieved good to excellent larval reductions but in many cases, foliage protection was not satisfactory owing to the lateness of applications.

REFERENCE

- Howse, G.M., W.L. Sippell and K.B. Turner. 1976. Spruce budworm in Ontario, 1976 - Aerial spraying operation, outbreak status and forecasts and plans for 1977. Report to the Canadian Forest Pest Control Forum, Ottawa, November 23-24, 1976. 13 p. mimeo.