THE 1982 GYPSY MOTH SITUATION IN ONTARIO: GENERAL SURVEYS, SPRAY TRIALS AND FORECASTS FOR 1983

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ABSTRACT

In 1981, aerial and ground surveys, conducted by Forest Insect and Disease Survey (FIDS) field technicians, revealed that gypsy moth (**Lymantria dispar** [Linn.]) populations had increased significantly in southern Ontario. In 1982, additional surveys were conducted to monitor the overall gypsy moth situation in Ontario. In the Kaladar area of Tweed District, experimental aerial spray trials were carried out with both biological (**Bacillus thuringiensis** and nuclear polyhedrosis virus) and chemical (carbaryl) insecticides. Special surveys were conducted to assess the efficacy of these trials. The results of these surveys and forecasts of potential defoliation in 1983 are presented in this report.

RÉSUMÉ

En 1981, les relevés aériens et au sol effectués par les techniciens du Relevé des insectes et des maladies des arbres ont révélé que les populations de la spongieuse (**Lymantria dispar** [Linn.]) avaient augmenté de façon importante dans le sud de l'Ontario. En 1982, d'autres relevés ont été effectués pour connaître la situation générale de cet insecte en Ontario. Dans la région de Kaladar du district de Tweed, des épandages aériens expérimentaux ont été réalisés avec des insecticides biologiques (**Bacillus thuringiensis** et virus de la polyédrose nucléaire) et chimiques (carbaryl). L'efficacité de ces essais a été évaluée par des relevés spéciaux. Les auteurs présentent les résultats de ces relevés ainsi que des prévisions concernant la défoliation en 1983.

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INTRODUCTION

The gypsy moth (**Lymantria dispar** [Linn.]) was first detected in Ontario in 1969 on Wolfe Island near the city of Kingston. Originally introduced to the North American continent in Massachusetts in 1869, this forest pest has continually expanded its range. In 1981, over 5 million ha of gypsy moth-associated defoliation were mapped in the northeastern United States.

A key factor which has enabled this particular defoliator to expand so dramatically is its seemingly unlimited selection of host material. Gypsy moth larvae have been observed feeding on over 500 host plants, although they generally prefer all species of oak, alder, apple, birch, larch, aspen, willow, basswood and mountain ash. They will also consume beech, hemlock and all species of pine and spruce.

From 1969, when the gypsy moth was first detected in the province, until 1980, gypsy moth populations remained relatively low in southern Ontario. Then, in 1981, some 23 pockets of gypsy moth-associated defoliation were detected in the Eastern Region. Of particular concern were four pockets of defoliation totalling about 1000 ha (originally reported as 1750 ha and later revised) in the Kaladar area of Tweed District. Surveys were conducted by staff of the Forest Insect and Disease Survey Unit (FIDS) of the Great Lakes Forest Research Centre (GLFRC) in the fall of 1981 to delineate these infestations on the basis of egg-mass distribution and to forecast potential population levels in 1982 on the basis of egg-mass densities. The results of these surveys indicated that significant levels of defoliation would likely occur in the three largest infestations in 1982. The results and forecasts were presented to the newly formed Gypsy Moth Working Committee, whose members represent the Ontario Ministry of Natural Resources (OMNR), the Canadian Forestry Service (CFS) and Agriculture Canada.

SITUATION IN 1982

Aerial Surveys

In an effort to assess the gypsy moth situation in the province in 1982, FIDS staff conducted several surveys throughout southern Ontario during the summer of that year. In July, aerial surveys were conducted to detect areas of gypsy moth defoliation. The results of this survey are shown in Figure 1. The Eastern Region is the only region in which gypsy moth-associated defoliation was detected. Six pockets of severe defoliation totalling 269 ha and 12 pockets of moderate defoliation totalling another 3341 ha were detected in the Kaladar area of Tweed District. This is the same general area that was infested in 1981. New infestations causing moderate defoliation were mapped in a 130-ha area south of Fifth Depot Lake in Tweed District and in an area of about 1000 ha in Frontenac Provincial Park in Napanee District. Other pockets of light-to-moderate defoliation were detected in the Pitts Ferry (2 ha) and Wolfe Island (scattered) areas near Kingston. A number of other pockets were very small, ranging in size from single trees to about 10 ha, and populations were generally very low. The largest area consisting of approximately 10 ha of trembling aspen (**Populus tremuloides** Michx.) in Lochiel Township, Cornwall District, suffered moderate defoliation. Another 7 ha of aspen along Highway 417 in Caledonia Township, Cornwall District were severely defoliated. There was also scattered moderate-to-severe defoliation within the city of Belleville on the east side of the Moira River.

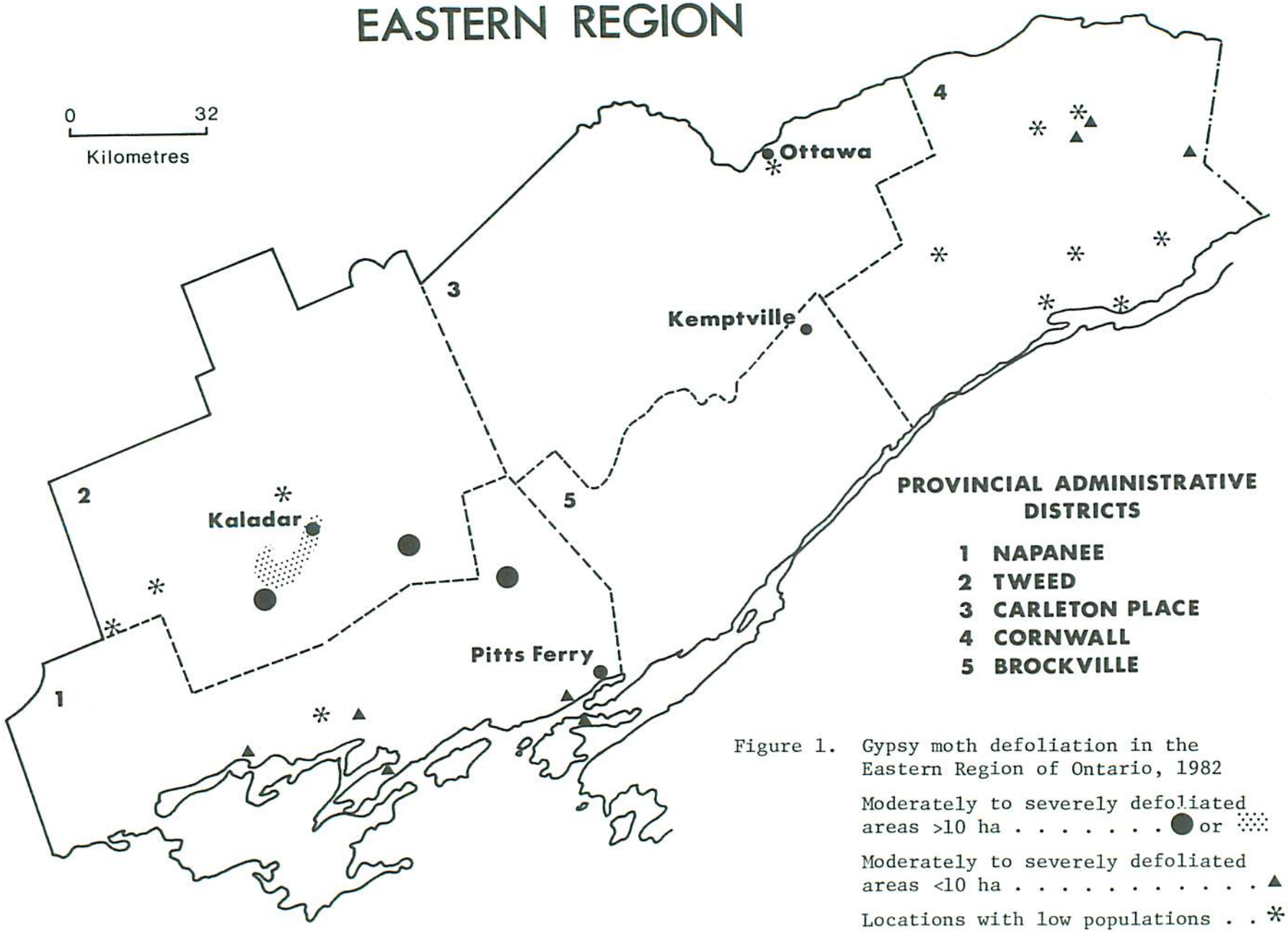


Figure 1. Gypsy moth defoliation in the Eastern Region of Ontario, 1982

Moderately to severely defoliated areas >10 ha . . . . . ● or ⁘

Moderately to severely defoliated areas <10 ha . . . . . ▲

Locations with low populations . . *

Moderate defoliation was observed in a 5-ha mixed deciduous woodlot west of the town of Napanee in Richmond Township, Napanee District. The rest of the sightings generally involved only one or two trees and were located in South Plantagenet, Caledonia, Charlottenburgh, Osnabruck, Winchester and Cornwall townships as well as in the city of Cornwall, Cornwall District; in Tyendinaga and Fredericksburgh townships, Napanee District; in Marmora Township, Tweed District; and in the city of Ottawa, Carleton Place District.

Pheromone Trapping Survey

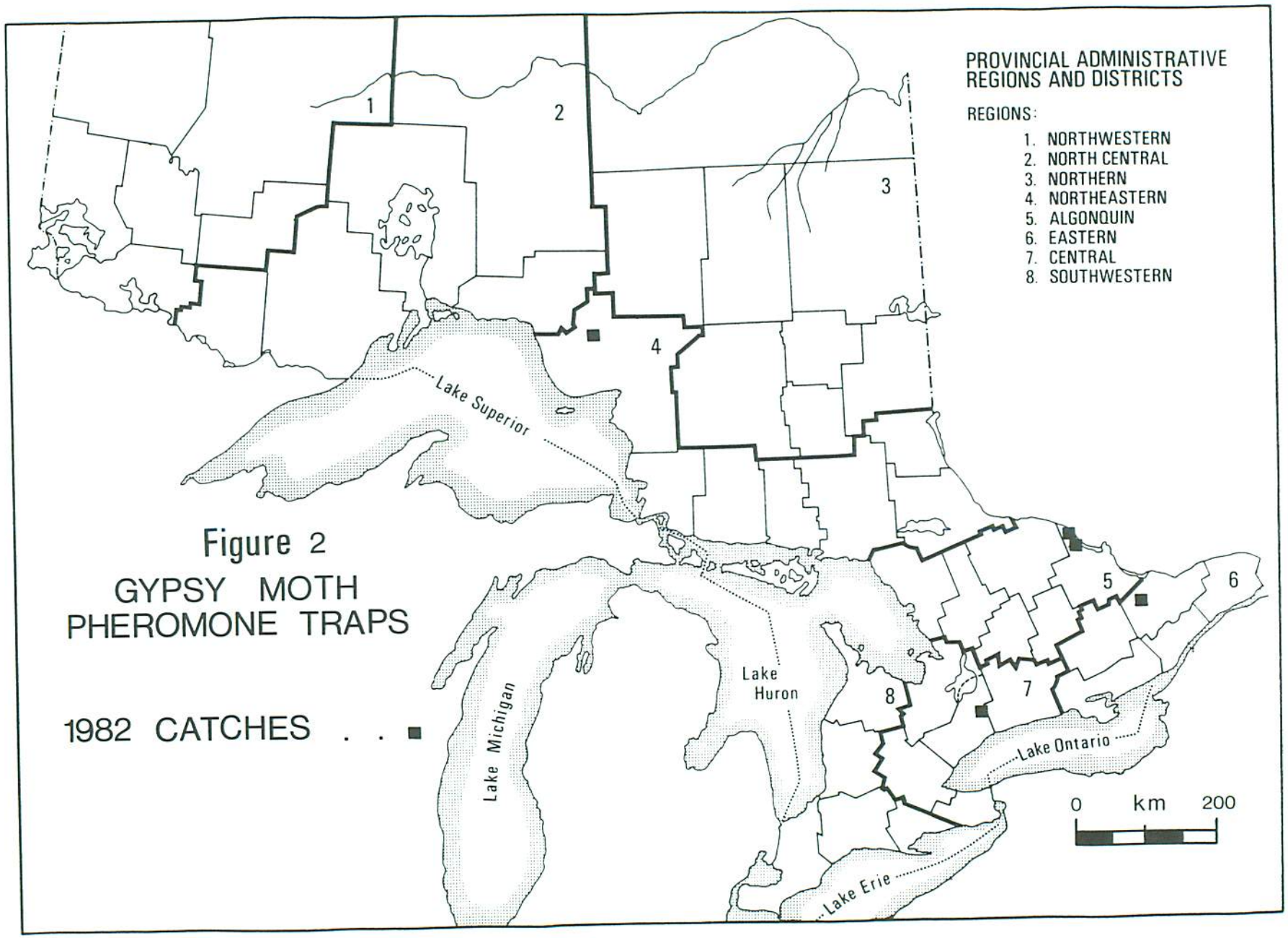
Since 1979, the FIDS Unit at GLFRC, in cooperation with Agriculture Canada, has deployed gypsy moth pheromone traps in 36 provincial parks and campgrounds throughout the Northern, North Central and Northeastern regions of the province. In 1982, pheromone traps were placed in 13 oak stands in southern Ontario and another 24 traps were set out in the Kaladar spray areas. These oak stands have been monitored for a number of years for a condition known as oak decline which is believed to be associated with repeated defoliation by insects. A single adult male was trapped at White Lake Provincial Park in Wawa District, two moths were trapped in Alice Township and one at the Petawawa National Forestry Institute in Pembroke District, a total of 30 moths were caught in two traps in Lavant Township in Carleton Place District and eight were trapped in the Durham Regional Forest in Maple District (Fig. 2). In all of these cases FIDS staff were unable to detect any further evidence of a resident gypsy moth population.

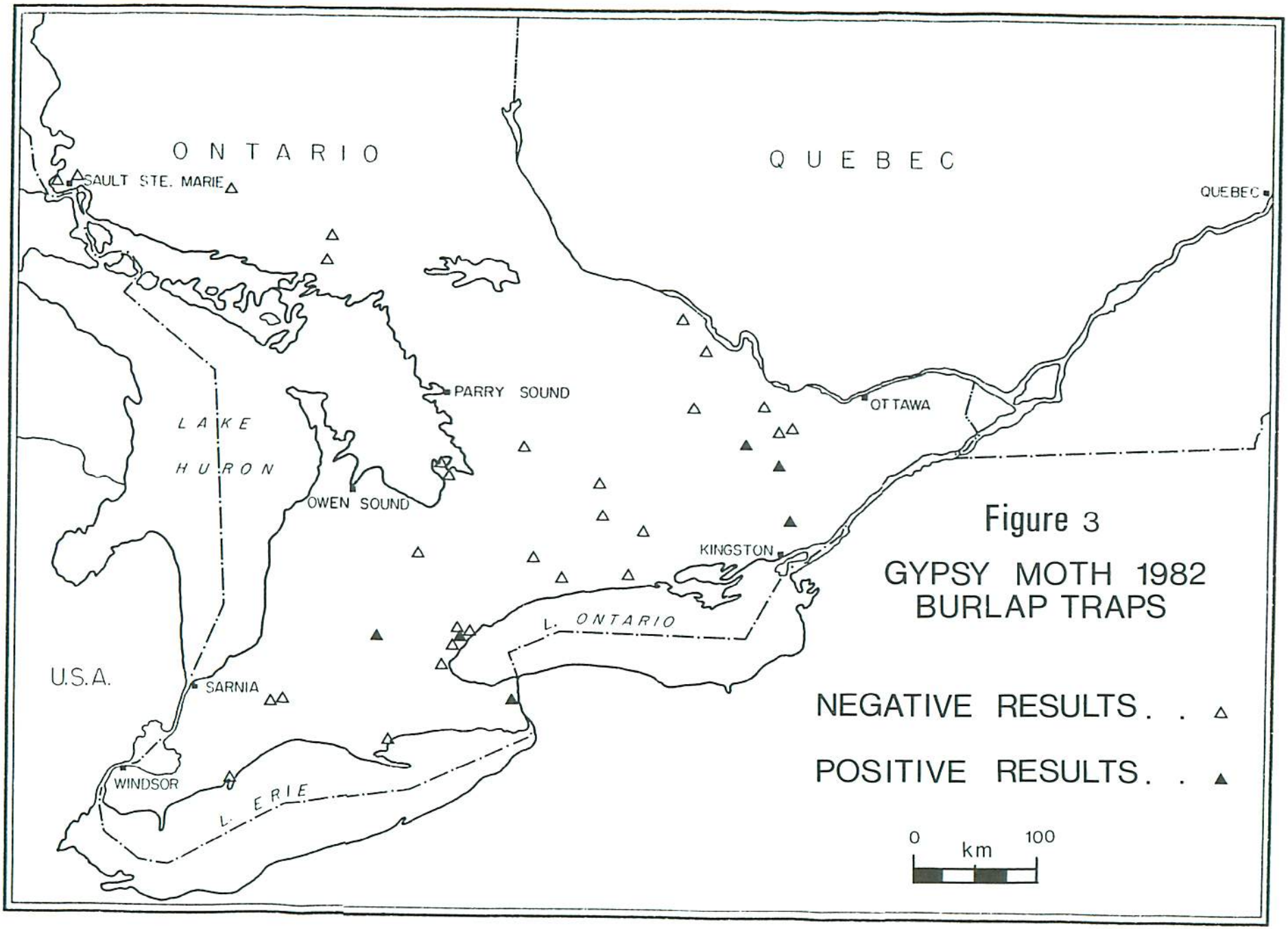
Larval Survey

In order to improve our knowledge of gypsy moth distribution in southern Ontario outside of the generally infested area, FIDS staff conducted larval surveys during the summer months of 1982. Stands initially selected for larval trapping were in areas in which Agriculture Canada had trapped substantial numbers of moths in 1980 or 1981, but no other evidence of a population had been observed. Strips of burlap were tied to the trunks of the trees in these potential hot spots to trap large larvae. A total of 39 plots, with 10 traps per plot, were set up in early June and checked several times during the next four weeks. As can be seen from Figure 3, several plots were located as far north as Sault Ste. Marie. Some plots were established in the pheromone hot spots, others were located in the oak decline plots, and the rest were set up in areas where there was an abundance of oak, the preferred host, or in areas of unexplained defoliation. Larvae or pupae were observed at six locations: in Sharbot Lake and Bon Echo provincial parks in Tweed District, in Frontenac Provincial Park in Napanee District, in the cities of Kitchener and Oakville in Cambridge District and in the city of Niagara Falls in Niagara District. Egg masses and adult moths were observed in the city of London but not on burlap traps.

AERIAL SPRAY TRIALS, 1982

Initially in 1982, OMNR planned to spray about 2000 ha of gypsy moth-infested forests as well as buffer zones near Kaladar, Tweed District for the purpose of population suppression. The chemical insecticide Sevin (carbaryl) was to be used on about 1600 ha, and trials involving two biological insecticides, Dipel 8 **(Bacillus thuringiensis [B.T.])** and Gypchek (nuclear polyhedrosis virus) were to be tested on the remaining 400 ha. Unfortunately, controversy erupted over the proposed use of carbaryl and, as a result, the original goal of population suppression was abandoned. Instead, a small block of crown land was sprayed with Sevin


PROVINCIAL ADMINISTRATIVE REGIONS AND DISTRICTS
REGIONS:
1. NORTHWESTERN
2. NORTH CENTRAL
3. NORTHERN
4. NORTHEASTERN
5. ALGONQUIN
6. EASTERN
7. CENTRAL
8. SOUTHWESTERN
1
2
3
4
5
6
7
8
Lake Superior
Lake Michigan
Lake Huron
Lake Ontario
Lake Erie
0 km 200
Figure 2
GYPSY MOTH
PHEROMONE TRAPS
1982 CATCHES . . ■


ONTARIO
QUEBEC
SAULT STE. MARIE
QUEBEC
PARRY SOUND
OTTAWA
LAKE
HURON
OWEN SOUND
KINGSTON
L. ONTARIO
U.S.A.
SARNIA
WINDSOR
L. ERIE
Figure 3
GYPSY MOTH 1982
BURLAP TRAPS
NEGATIVE RESULTS. . △
POSITIVE RESULTS. . ▲
0
km
100

by OMNR and the previously planned trials by the CFS involving Dipel and Gypchek were carried out. A total of 416 ha were treated with both biological and chemical pesticides (Fig 4). Sevin-4-Oil was applied to 90 ha, Dipel 88 to 263 ha at two dosages and Gypchek (NPV) to 63 ha (Table 1).

A number of special surveys were conducted in the Kaladar area to assess populations, spray efficacy, gypsy moth damage and impact, and potential damage in 1983. Results of these special surveys are provided in tables 2 to 12. The reader should refer to Figure 4 for the locations of the infestation and spray blocks identified in these tables.

Larval Development

On the basis of records from the province of Quebec, gypsy moth egg hatch was expected to occur during the second or third week of May. However, on 5 May eggs began hatching in the Kaladar area and continued for two or three weeks. Larval development was monitored before, during and after the control operations and is summarized briefly in Table 2. All spraying was conducted between 25 May and 2 June when the larvae were between the first and fourth instars.

Egg-Mass Mortality

Assessment of mortality of overwintering eggs was carried out in the quarantine facilities at the Great Lakes Forest Research Centre, using some 200 egg masses collected from the Kaladar infestations in April, 1982. This is an important factor to consider in the planning of a control operation, as heavy losses of overwintering eggs can influence the need for spraying. The results of this survey, summarized in Table 3, revealed that the mortality of overwintering eggs was quite high (approximately 95%) in egg masses deposited above ground level. Indeed, no larvae survived in any of the egg masses collected more than 30 cm above the ground. On the other hand, the mortality rate of the egg masses on the ground averaged 29% for the three infestations. Special surveys conducted in the fall of 1981 revealed that, over all, an average of 53% of the egg masses were deposited on the ground.

Table 1. Summary of the aerial spraying program against gypsy moth in the Kaladar area of Tweed District, Ontario in 1982.

Treatment	Area (ha)	Date sprayed	Dosage	No. of applications
Sevin-4-Oil	90	25 May	1.1 kg/2.4 L/ha	1
Dipel 88 **(B.t.)**	119	28 May and 2 June	20 BIU/5.9 L/ha	2
" " "	144	26 May and 30 May	30 BIU/8.8 L/ha	2
Gypchek (NPV)	36	25 May and 30 May	2.5×10^{11} PIB/18.8 L/ha	2
" "	27	25 May and 30 May	2.5×10^{11} PIB/18.8 L/ha	2
Total area (ha)	416			

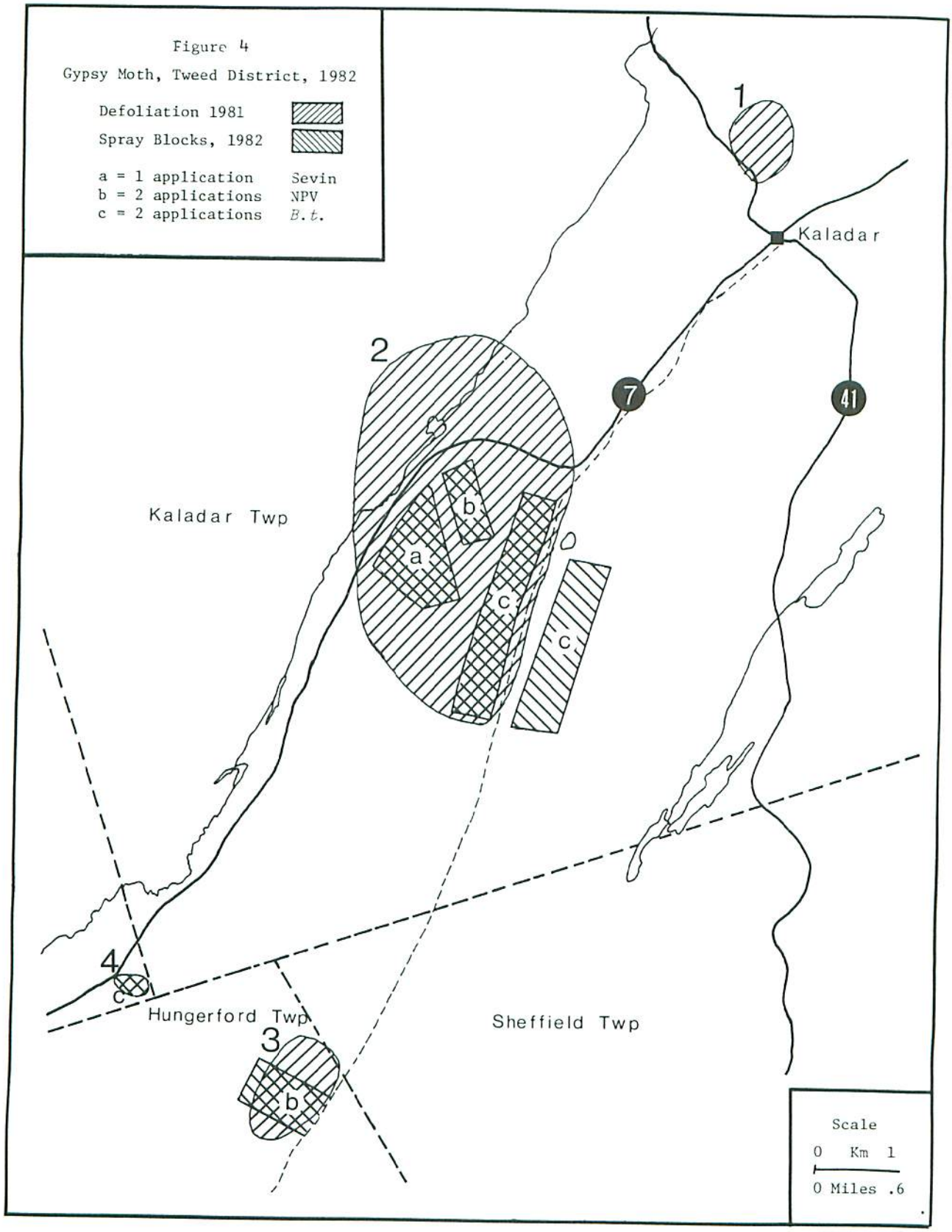


Figure 4
Gypsy Moth, Tweed District, 1982
Defoliation 1981
Spray Blocks, 1982
a = 1 application Sevin
b = 2 applications NPV
c = 2 applications B.t.
1
2
3
4
a
b
c
c
c
Kaladar
7
41
Kaladar Twp
Hungerford Twp
Sheffield Twp
Scale
0 Km 1
0 Miles .6

Table 2. Summary of gypsy moth larval development in the Kaladar area of Tweed District, 1982.

Date	Species*	Larval Development (%) I	II	III	IV	V	VI
5 May			Eggs Hatching				
17 May	wO	42	52	6			
	rO	32	44	24			
19 May	wO	80	20				
	rO	4	48	48			
24 May	wO	32	68				
	rO	32	52	16			
28 May	wO	24	48	24	4		
	rO	18	34	46	2		
1 June	wO		8	76	16		
	rO		4	44	44	8	
3 June	wO		4	48	36	12	
	rO		4	28	44	24	
10 June	wO			8	36	56	
	rO				60	28	12

* wO = white oak
rO = red oak

Table 3. Summary of 1981-1982 survival of overwintering gypsy moth egg-masses collected in April 1982 from two strata (ground and bole) in the Kaladar area, Tweed District.

Infestation	Stratum*	No. of egg masses	No. of egg masses hatched (%)	Mean no. of larvae per egg mass	Eggs per mass hatched (%)
1	G	10	10 (100)	371	98
	B	10	0 (0)	-	-
2	G	70	48 (69)	251	93
	B	70	5 (7)	157	78
3	G	20	13 (65)	102	85
	B	20	0 (0)	-	-
Over all	G	100	71 (71)	240	92
	B	100	5 (5)	157	78

* G = ground
B = bole (anything above ground level)

Larval Dispersal

Wind dispersal of first-instar larvae is a principal means of spread of the gypsy moth in eastern North America. Extensive dispersal of these larvae from an infested area could substantially reduce the effectiveness of any control operations conducted after emigration has occurred. Therefore, an attempt was made to monitor the dispersal of first-instar larvae from infestation No. 2 prior to the first insecticide application. Sheets of plastic (30 cm x 60 cm) coated with tanglefoot were taped to trees at 100-m intervals for a maximum distance of 500 m outside the infestation along the north, south, east and west compass lines. A total of 80 traps were set out and checked before and after the first spray. Results of this survey are presented in Table 4. The fact that gypsy moth larvae were caught on some traps suggests that some larvae may have been borne by the wind at least 500 m from the infestation. If this is so, it appears, on the basis of the small numbers of larvae caught, that short-distance dispersal of first-instar larvae was minimal. However, interpretation of these results is not certain, as gypsy moth egg masses, albeit at very low densities, were discovered outside of the delineated infestation in the vicinity of some of the dispersal traps.

Spray Deposit

Spray deposit was monitored for each application of insecticide in the Kaladar spray areas with Kromekote® cards placed at ground level throughout the spray blocks. The cards were exposed just before each spraying operation and were collected immediately after completion of each application. The results of this effort are summarized in Table 5. Generally, coverage of the spray blocks was very good, even though there was considerable variation at some locations.

Spray Results

A number of pre- and post-spray surveys were conducted in the Kaladar and Pitts Ferry areas to assess the effectiveness of the 1982 aerial control opera-

Table 4. Summary of dispersal of gypsy moth larvae from Infestation 2 in Tweed District, 1982.

Trap examination date	Compass bearing	Distance of trap from infestation (m)	No. of gypsy moth larvae*
19 May	0	200	1
	90	200	1
		300	1
	180	100	2
	270	500	1
28 May	0	200	2
		500	1
	180	100	1
		500	1
	270	500	1

* First-instar larvae

tions. Most of these surveys were carried out in or near the 10 m x 10 m plots used for the 1981 egg-mass survey and, because of the differing modes of action of the insecticides used in this year's program, it was necessary, in some cases, to use specific methods for specific treatments. For example, in the area treated with Sevin, a survey was conducted with 45-cm branch tips to determine pre- and post-spray larval densities. The results of this treatment, as shown in Table 6, were excellent in terms of larval mortality and foliage protection. Because of the time lag between application and effect of the biological insecticides and because larvae in the later instars discontinue feeding in the canopy during the day, this method could not be used to assess the effectiveness of the B.t. or virus treatments. Instead, the results of defoliation and egg-mass surveys were used to assess these treatments.

Table 5. Gypsy moth: summary of insecticide spray deposit on Kromekote® cards in the Kaladar spray areas, 1982.

Treatment	Date	Mean no. of droplets per cm^2	Range
Sevin-4-Oil	25 May	13.1	0 - 51.0
B.t. (20 BIU/ha)	28 May	16.1	6.0 - 26.8
	2 June	15.6	6.0 - 28.8
B.t. (30 BIU/ha)	26 May	6.4	1.2 - 9.8
	30 May	8.2	0.4 - 18.2
Gypchek (Infestation 2)	25 May	23.1	6.0 - 35.2
	30 May	23.4	0 - 52.4
Gypchek (Infestation 3)	25 May	51.7	0.2 - 173.4
	30 May	44.9	0 - 91.4

Table 6. Gypsy moth population reduction and foliage protection attributable to an aerial application of Sevin-4-Oil (1.1 kg/2.4 L/ha) in the Kaladar area of Tweed District, 1982.

	Species	Pre-spray larvae per 45-cm tip	Post-spray larvae per 45-cm tip	Population reduction as a result of treatment (%)	1982 defoliation (%)
Treated	w0	4.4	0.3	88	10
Check	w0	13.0	7.3		46
Treated	r0	2.5	0	100	10
Check	r0	4.1	3.1		44

In late July, a defoliation survey was conducted in the Kaladar and Pitts Ferry infestations in which the proportion of damaged leaves and loss of foliage on these leaves from 45-cm branch tips were estimated. Results of this survey are summarized in Table 7 and comparisons are made between treated and untreated areas. Generally, defoliation was lighter in the areas treated with B.t. and Gypchek[1] than in the check plots and, as mentioned earlier, excellent foliage protection was afforded the area treated with Sevin. This was the first time that this particular virus had been used in Ontario and, on the basis of the results of the defoliation survey, it seems to have been reasonably effective. The incidence of virus-infected larvae was assessed weekly over a six-week period (Table 8) by staff of the Forest Pest Management Institute (FPMI). While no dramatic virus epizootic developed, many dead larvae were seen hanging by their prolegs in the treated plots. Data from the first, second and third weeks after spraying indicate relatively high infection levels in treated areas in comparison with untreated areas, but the situation is not so obvious by weeks 4 and 5 when naturally occurring virus epizootics were recorded in the check plots. However, on average, treated areas had higher infection levels than did untreated areas.

Two hundred pupae were collected to determine emergence success in each of the treated and check plots. The intent was to collect 100 females and 100 males from each plot; however, the field workers were not able to distinguish females from males. Results, as shown in Table 9, indicate that emergence was similar in both treated and untreated plots. The highest pupal mortality was in a check plot which suffered the effects of a virus epizootic when larvae were in the later instars, and the lowest pupal mortality was at Pitts Ferry where the lowest incidence of naturally occurring NPV was recorded. The proportion of parasitized pupae was low in both treated and untreated areas and ranged from 3.0% to 6.0%. There are plans to check the treated and untreated areas in 1983 for signs of virus carryover.

[1] Dr. F.B. Lewis, USDA Forest Service, Hamden, Connecticut, provided the material for the Gypchek trials.

Table 7. Summary of gypsy moth defoliation of red oak and white oak in the Kaladar spray areas, 1982.

Treatment	No. of plots	Avg defoliation (%) and range	
		wO	rO
Sevin	4	10(9-12)	10(7-14)
B.t. (20 BIU)	3	15(10-18)	15(14-17)
B.t. (30 BIU)	3	9(5-14)	10(9-12)
Gypchek (Infestation 3)	3	21(16-28)	24(11-43)
Gypchek (Infestation 2)	3	15(11-23)	20(9-36)
Checks	4	46(23-81)	44(24-84)

As mentioned earlier, some 24 gypsy moth pheromone traps were set out in mid-July in treated and untreated plots in the Kaladar and Pitts Ferry areas. The results of this survey are summarized in Table 10. Adult gypsy moths were caught in each of the 24 traps, but differences between treated and untreated areas were not dramatic. Immigration of male moths from unsprayed areas into some of the treated areas may account for the similarity in trap catches. Generally, however, the traps in the treated areas contained fewer moths than those in the untreated plots.

Egg-mass surveys are frequently used as a means of evaluating the effectiveness of control programs and forecasting potential defoliation the following year. Results of the egg-mass survey conducted in the Kaladar area in October, 1982 are summarized by treatment and are compared with the 1981 results in Table 11.

Table 8. Levels of NPV infection in four populations of gypsy moth (two sprayed with NVP, two untreated) in eastern Ontario, 1982.

	Percent NPV Infection and No. Examined (within parentheses)					
		Weeks after spray				
Plot	Pre-spray	1	2	3	4	5
Treated						
Infestation 2	0.5(188)	13.9(187)	17.0(194)	20.0(200)	19.2(203)	48.1(187)
Infestation 3	1.7(177)	17.3(196)	17.2(198)	32.3(161)	14.4(195)	21.3(164)
Untreated						
Infestation 1	0(209)	2.1(188)	2.9(207)	5.6(142)	15.0(193)	41.2(182)
Pitts Ferry	0(195)	0(192)	0.5(205)	0(180)	2.5(200)	19.8(182)

Table 9. Emergence of 200 gypsy moth pupae from four collection sites (two sprayed with NVP, two untreated) in eastern Ontario, 1982.

Plot	Adult emergence (%)	Apparently diseased (%)	Parasitized (%)
Treated			
Infestation 3	66.0	29.0	3.0
Infestation 2	66.5	27.5	6.0
Check			
Infestatior 1	43.0	52.5	4.5
Pitts Ferry	81.0	13.5	5.5

Egg-mass densities were substantially reduced in each of the treated plots in infestations 2 and 3 whereas, in infestation 1, which was not treated, egg-mass counts increased considerably in all four plots. In the Pitts Ferry check plots, egg-mass densities decreased in two plots and increased in the third. On the basis of this survey, it appears that the 1982 control operations were very successful in reducing egg-mass densities and hence potential damage in 1983.

In summary, the aerial spraying trials conducted in 1982 against gypsy moth in the Kaladar area were very effective in terms of population reduction, foliage protection and egg-mass reduction. Of all the materials used, Sevin appeared to be the most effective, with **B.t.** at 30 BIU a close second. The effectiveness of **B.t.** at 20 BIU and of Gypchek was also very encouraging.

FORECASTS FOR 1983

Forecasts of potential oak defoliation in 1983 were made on the basis of total egg masses per hectare and then on the basis of egg masses per hectare on the ground only (Table 12). In view of the high mortality rate in egg masses deposited above the ground level, it is likely that the latter forecast is the more realistic. Another infestation was discovered this summer just south of the village of Kaladar on the west side of Highway 41. This area was also surveyed for egg masses in October and the results and forecast are included in Table 12.

Table 10. Summary of the gypsy moth pheromone trap survey in treated and untreated plots in the Kaladar and Pitts Ferry areas of southern Ontario in 1982.

Treatment	No. of traps	Mean no. of moths per trap	Range
Sevin-4-Oil	4	22	13-26
B.t. (20 BIU/ha)	3	21	18-28
B.t. (30 BIU/ha)	3	31	24-39
Gypchek (Infestation 2)	3	28	19-42
Gypchek (Infestation 3)	3	43	26-52
Checks			
Infestation 2	3	28	22-31
Infestation 1	3	36	28-36
Pitts Ferry	2	72	47-98

PLANS FOR 1983

A committee of intergovernmental (federal and provincial) representatives (Environment Canada, Agriculture Canada, OMNR and Ontario Ministry of Agriculture and Food) is currently developing a management strategy for the gypsy moth in Ontario. Recommendations developed by this committee will likely serve as guidelines for any future actions concerning gypsy moth within the province. At present, there are no plans for aerial spraying in 1983 but the gypsy moth situation in southern Ontario will continue to be monitored.

Table 11. Comparison of gypsy moth egg-mass densities in 1981 and 1982 in treated and untreated plots in eastern Ontario.

Treatment	No. of plots	Mean egg-mass density per 10 m^2 plot		Change (%)
		1981	1982	
Sevin-4-Oil	4	355	8	-98
Gypchek (Infestation 2)	3	2194	115	-95
Gypchek (Infestation 3)	4	560	58	-90
B.t. (30 BIU)	2	569	22	-96
Checks (Infestation 1)	4	54	229	+324
Checks (Pitts Ferry)	3	179	80	-55

Table 12. Gypsy moth egg-mass densities and forecasts of potential oak defoliation in 1983 in the Kaladar infestations.

Infestation	Total egg masses/ha	Defol. 1983*	Egg masses per ha (ground)	Defol. 1983*
1	5,725	M	2,325	L-M
2	1,336	L-M	729	L
3	1,450	L-M	150	L
Hwy 41 South	32,650	S	9,850	S

* L = light
M = moderate
S = severe