THE SPRUCE BUDWORM SITUATION IN ONTARIO, 1970

PART A: DAMAGE AND FORECASTS
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PART B: AERIAL SPRAYING OPERATIONS
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ABSTRACT

The spruce budworm outbreak in Ontario worsened considerably in 1970, and the amount of defoliation and browning of balsam fir and white spruce foliage is expected to increase again in 1971. Part A of this two-part report describes in some detail changes in boundaries of infestation and pattern of outbreak in 1970 in three major sectors of the Province where the spruce budworm is causing concern, and provides in cartographic and tabular form forecasts of damage in 1971. Part B describes aerial spraying operations carried out against this pest as part of a joint strategy being developed between the Insect and Disease Survey Unit of the Canadian Forestry Service and the Forest Protection Branch of the Ontario Department of Lands and Forests to knock out new incipient populations in areas where large volumes of valuable timber are endangered, and to protect highly-valued stands lying within massive outbreaks.

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INTRODUCTION

One of the major functions of the Insect and Disease Survey Unit, Ontario Region, Canadian Forestry Service, is to detect and evaluate insect and disease problems occurring in the forests of Ontario. Furthermore, the Unit is responsible for informing forest management about dangerous or potentially dangerous situations and helping to find appropriate solutions to these problems. The Survey Unit has been devoting increasing attention to the spruce budworm, *Choristoneura fumiferana* (Clem.), since 1967, when outbreaks became evident in three widely-separated parts of the province. The subsequent development of these outbreaks has been described in the Annual Report of the Forest Insect and Disease Survey (1967, 1968, 1969, and 1970 (in press)), in the Annual District Reports prepared by the Forest Research Technicians (more familiarly known as Insect Rangers), in periodic bulletins issued by the Unit each field season and in Information Reports originating within the group. The present report provides information concerning budworm in Ontario by presenting a province-wide description of the development of infestations in 1970, combined with forecasts of probable damage in 1971.

OVERALL SITUATION - 1970

The outbreaks that became evident in 1967 occurred in three distinct regions within the province; i.e., in the Ottawa Valley of southeastern Ontario, in the Chapleau District of northeastern Ontario and near Burchell Lake in the Thunder Bay District of northwestern Ontario. By 1970, the outbreaks in the first two regions, namely southeastern and northeastern Ontario, which reached 1,600,000 and 5,200,000 acres in size, respectively, contrast sharply with the situation in northwestern Ontario (Fig. 1). Management decisions, made by the Ontario Department of Lands and Forests with respect to spruce budworm, were based on the values of the forests endangered, and various strategies for dealing with major budworm situations were developed in collaboration with the Canadian Forestry Service. For example, in the northwestern region, aerial spraying operations designed to eliminate small and discrete infestations were carried out by the province in 1968, 1969 and 1970. On the other hand in northeastern and southeastern Ontario, where infestations developed rapidly over very broad areas, a policy of tree protection spraying in special value areas only (research plantations and provincial parks) was adopted. It is reasonable to assume that the infestations in northwestern Ontario in the absence of spraying in 1968 and 1969 would have developed by 1970 into a massive outbreak of several million acres, similar to the outbreaks in northeastern and southeastern Ontario and those known to occur in northern Minnesota. As illustrated in Figure 1, the area infested in 1970 in northwestern Ontario is relatively small and probably represents one of the few successful cases of budworm population suppression on record.

Although the information in this report and accompanying maps is confined to the situation within the province of Ontario, it is interesting to note that severe spruce budworm infestations are occurring throughout a relatively narrow band between 45° and 49° latitude starting in northern Minnesota and extending across Ontario, Quebec, Maine and New Brunswick to the Atlantic coast. It is possible that 1967 signalled the beginning of another series of budworm outbreaks in eastern North America that, based on past outbreaks, could last up to 10 or 20 years and eventually affect up to 65,000,000 acres.

SOUTHEASTERN ONTARIO

Situation in 1970

Figure 2 shows the location of budworm damage in southeastern Ontario in 1970. The total area within which moderate to severe defoliation of the current foliage of balsam fir and white spruce occurred in southeastern Ontario more than doubled from 750,000 acres in 1969 to about 1,600,000 acres in 1970.

Many new infestations became evident in 1970. One of these extended from Pembroke northwestward up the Ottawa Valley as far as Maria Township. Another new and major infestation, which is more than 150,000 acres in size, was found in south-central Algonquin Park in the vicinity of Opeongo Lake. This infestation includes either part of or all of the following townships: McLaughlin, Bower, Dickson, Canisbay, Sproule, Preston, Lawrence, Nightingale, Airy and Sabine. Infestations in Wylie and Buchanan townships which are part of the main Ottawa River Valley outbreak now extend into the northeast corner of Algonquin Park through Bronson and Edgar townships. An older infestation in Stratton Township, which is also in the east end of the park, more than doubled in size and spread into Barron Township.

Elsewhere, there were few significant changes. The infestation located to the southeast of Pembroke in Westmeath, Ross and Bromley townships and the adjoining infested area in the upper part of the Tweed District which includes the townships of Ashby, Denbigh, Matawatchan, Brougham, Grattan and Admaston changed very little in character and boundaries from 1969 to 1970. Similarly, in the Kemptville District, there was very little change in the infestation lying to the north of Carleton Place in Fitzroy and Huntley townships and an infestation to the east of Carleton Place in Goulbourn Township.

A large number of small, scattered pockets of defoliation were reported from several townships north of Peterborough in the Lindsay District, namely Harvey, Somerville, Galway, Cavendish, Glamorgan and Monmouth and from Wicklow, Monteagle, Carlow and Dungannon townships near Bancroft in the Tweed District.

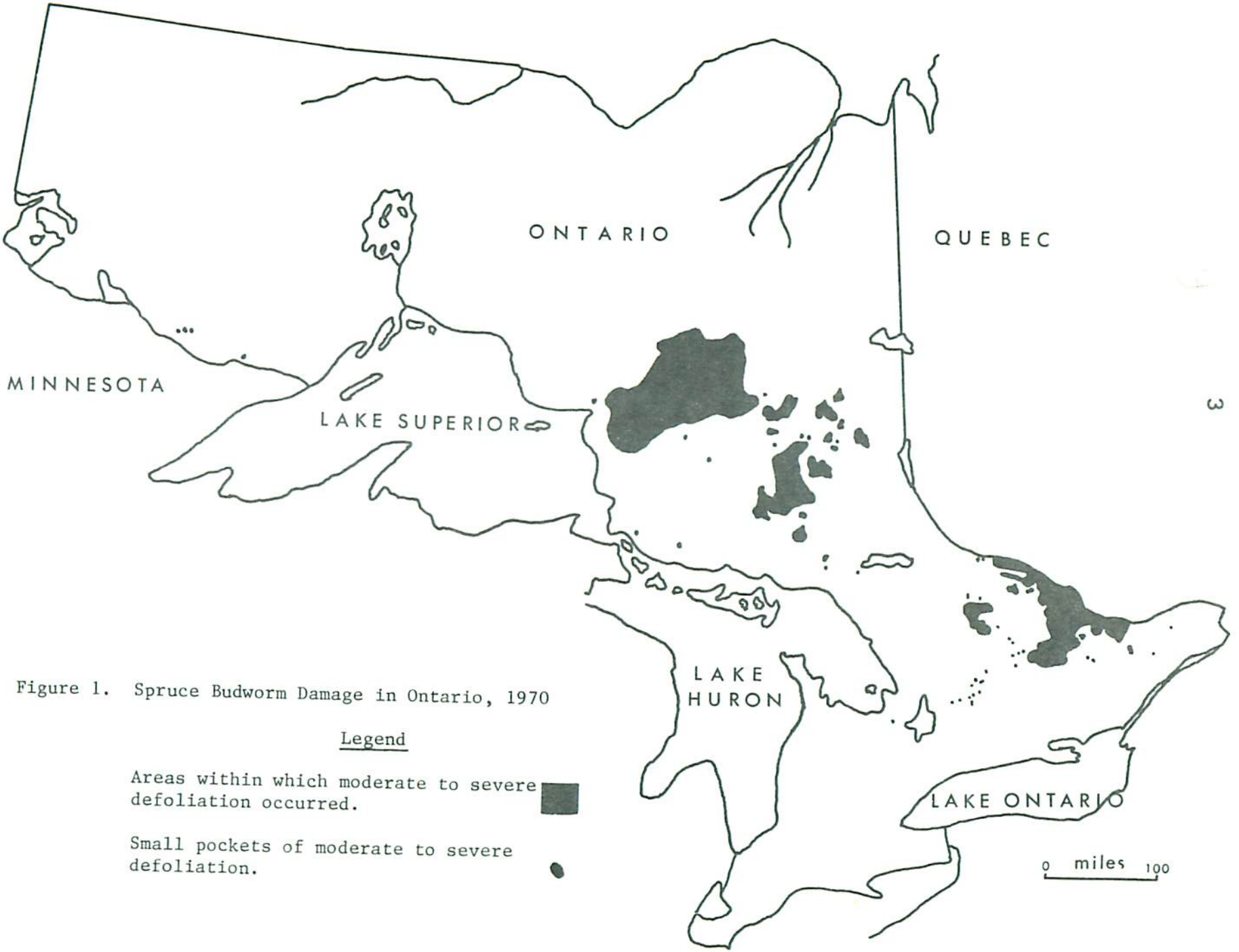


Figure 1. Spruce Budworm Damage in Ontario, 1970

Legend

Areas within which moderate to severe defoliation occurred.

Small pockets of moderate to severe defoliation.

Two aerial spraying operations, designed to protect special value trees from damage in 1970, were carried out in southeastern Ontario. The two locations sprayed were Larose Forest in the Kemptville District and the Petawawa Forest Experiment Station in the Pembroke District. For further details, the reader is referred to Part B of this report.

Damage Forecast for 1971

Population trends of spruce budworm are based on year-to-year changes in the density of new, hatched egg-masses on branches collected from the mid-crowns of the major host trees, balsam fir and white spruce. Thus, egg-mass surveys in August and September provide a means of forecasting the damage to be expected from larval feeding in the following year. The results of an egg-mass survey conducted in southeastern Ontario in 1970 show that extensive areas of moderate and severe defoliation can be expected to occur again in 1971 (Fig. 3 and Table 1). Moderate to severe damage is expected to recur in 1971 in essentially the same areas as in 1970. New infestations will likely be common in the Pembroke District where the outbreak is still on the increase in terms of area affected and population density. The only limits on expansion of the outbreak in the Pembroke District are the number, size and location of susceptible stands of host trees. It is expected that moderate to severe defoliation will occur throughout most of the Ottawa River Valley, particularly west and northwest of Pembroke. 1970 egg-mass populations on the Petawawa Forest Experiment Station, which is in Wylie and Buchanan townships, are again extremely high, in fact, higher than the 1969 counts which resulted from a massive moth flight into the area. The infestation around Opeongo Lake in Algonquin Park is also expected to expand further in 1971.

The only relatively bright note in southeastern Ontario is an apparent decrease in budworm numbers in the oldest infestations dating back to 1967 in the Pembroke, Tweed and Kemptville districts. The 1970 egg-mass densities are about one-half to one-third of the 1969 densities but are still high enough to cause appreciable damage. This population decline in the oldest infested areas is likely the result of moth dispersal especially in the Tweed and Kemptville districts where there are fewer susceptible stands than in the newly infested areas of the Pembroke District, where moths have a greater chance of finding suitable hosts. In any case, no appreciable increases in size are expected to occur in the infestations in the Tweed and Kemptville districts and, in fact, the size of these infestations may recede somewhat in 1971. Furthermore, damage within these areas should be less than that recorded in 1970.

In addition to the areas where moderate to severe defoliation is expected, light damage should occur throughout a large triangular-shaped area, about 12,000 square miles in size, extending from Lindsay in the southwest to Mattawa in the northwest and to Ottawa in the east.

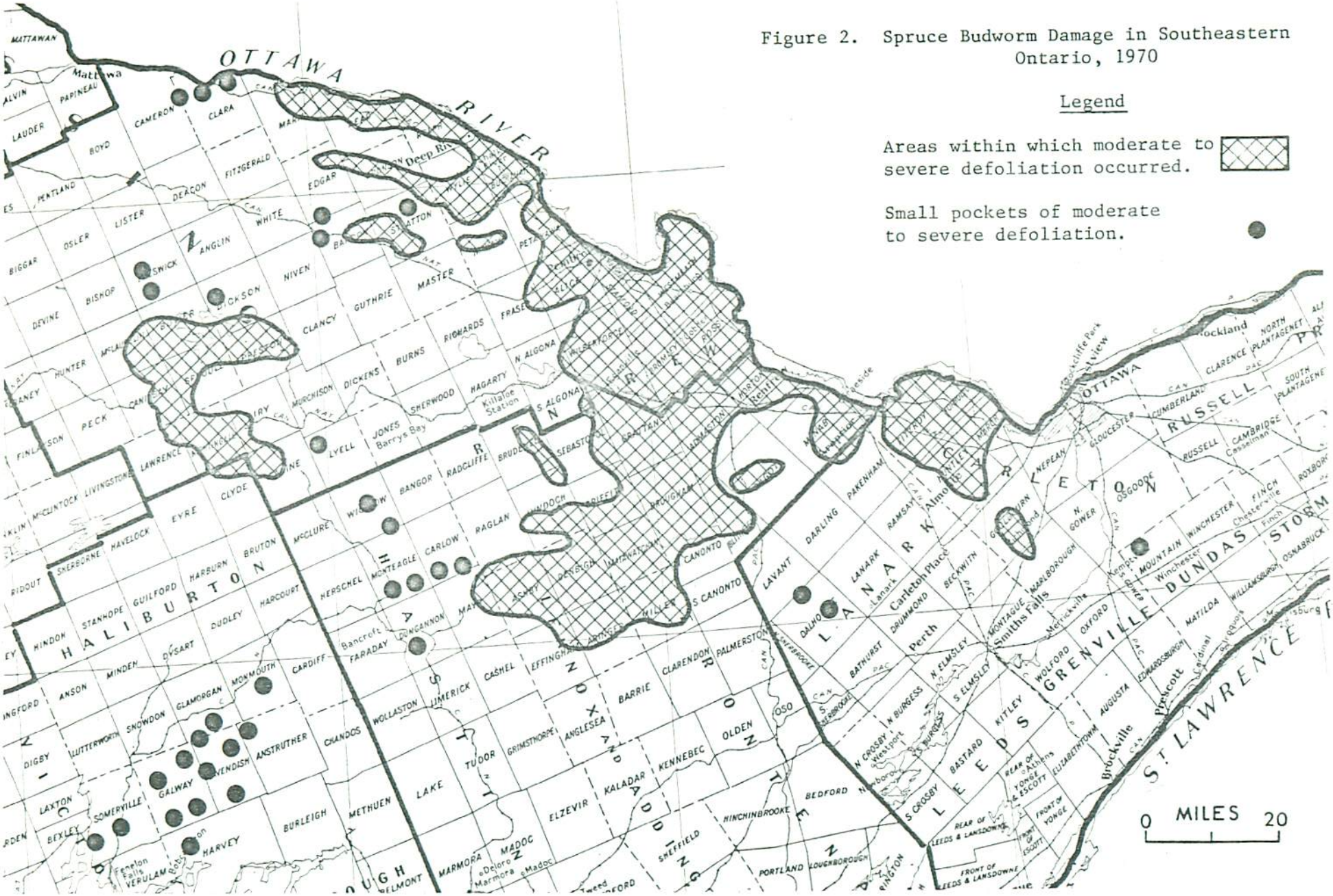


Figure 2. Spruce Budworm Damage in Southeastern Ontario, 1970

Legend

Areas within which moderate to severe defoliation occurred.

Small pockets of moderate to severe defoliation.

A massive infestation of at least 5 million acres exists north of the Ottawa River in Quebec. In effect, infestations on the Ontario side of the Ottawa River are actually part of a much larger outbreak. Perhaps the course of events in Quebec will decide the eventual fate of the infestation in southeastern Ontario. Large-scale aerial spraying operations are scheduled to begin in Quebec in 1971 in order to protect host trees from further damage. In 1971, it is expected that the only aerial spraying in southeastern Ontario will be an operation to protect the research stands at the Petawawa Forest Experiment Station.

NORTHEASTERN ONTARIO

Situation in 1970

A total of 5,200,000 acres of moderate to severe defoliation caused by spruce budworm was mapped from the air in 1970 (Fig. 4) which represents a threefold increase from 1,800,000 acres in 1969 in the size of the area affected in northeastern Ontario.

In the Chapleau District, much of the increase resulted from a 60-mile extension in the western boundary of the 1969 infestation and numerous small infestations which merged with the main outbreak. The result is a single vast infestation approximately 4,150,000 acres in size that extends from the southern part of the Kapuskasing District, through about half of the Chapleau District and into the southeastern part of the White River District, to just inside Lake Superior Provincial Park. This single infestation is 130 miles long and 90 miles across at its widest point. Missinaibi Provincial Park, part of which has been infested since 1968, and the Shoals Provincial Park located between Chapleau and Wawa along Highway 101 were engulfed in 1970. The infestation spread into the eastern part of Lake Superior Provincial Park in Twp. 28, Rge. 19 and Twp. 28, Rge. 20. The northern edge of this infestation, which reaches into the Kapuskasing District in the townships of Hayward, Champlain, Mons, Lisgar and Watson, changed very little from 1969.

In the Sudbury District, the 250,000-acre infestation lying north of Cartier and centered on Onaping Lake that was discovered in 1969, increased in size in 1970 to about 800,000 acres. Another major infestation of 150,000 acres was mapped north of the village of Gogama in upper Sudbury District in the townships of Middleboro, Hazen, Emerald and Gouin and reaching into the Cochrane District in Hassard and Beemer townships.

In the Swastika District, numerous infestations, ranging in size from a few hundred acres to 90,000 acres, were mapped in the southwest portion of the district, west and south of Kirkland Lake. The total area infested was nearly 300,000 acres, a considerable increase over the 40,000 acres reported in 1969.

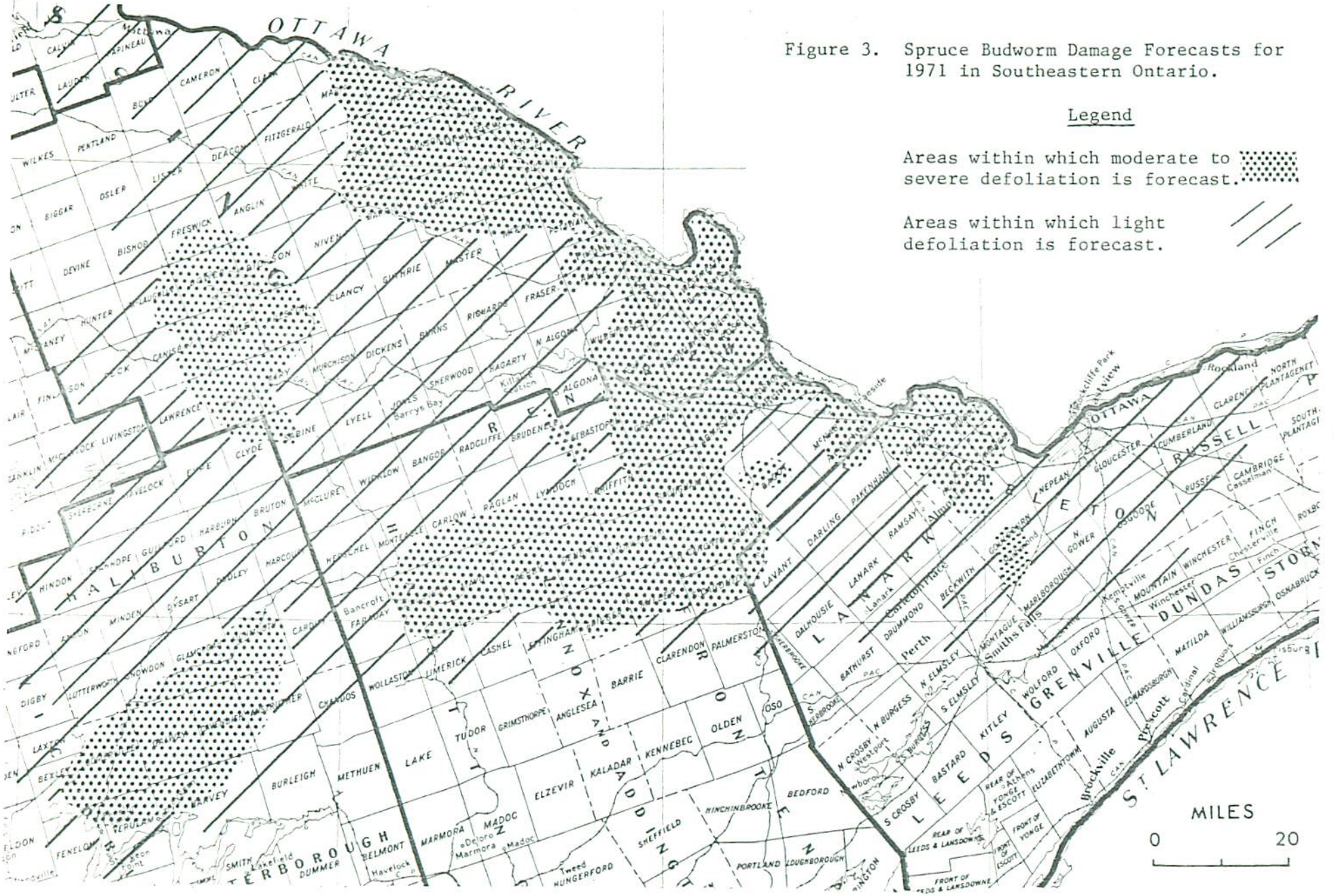


Figure 3. Spruce Budworm Damage Forecasts for 1971 in Southeastern Ontario.

The only defoliation detected in the North Bay District was a small pocket in Dunnet Township.

In Sault Ste. Marie District, the infestation in Parkinson Township persisted at high population levels although it did not increase in size. New, small pockets of defoliation were found in Tarbutt Additional and Laird townships. Elsewhere in the District, sampling revealed a widespread increase in numbers, especially in the Thessalon and Ranger Lake areas but defoliation was generally quite light.

Aerial spraying operations were carried out to prevent further damage in two provincial parks in northeastern Ontario in 1970. The reader is referred to Part B of this report for further details.

Damage Forecast for 1971

Spruce budworm egg-mass counts were obtained for 190 locations throughout northeastern Ontario in the fall of 1970. The results of this egg-mass survey and damage forecasts for 1971 are contained in Table 2 and Figure 5. It is expected that the 1971 boundaries of moderate-severe defoliation in the Chapleau infestation will be very similar to the 1970 boundaries with the exception of extensions occurring to the southwest as far as Lake Superior and a slight extension in the northeast to Griffin and Hicks townships in the Kapuskasing District. Within the main body of the Chapleau infestation, population levels have increased substantially. Egg-mass densities measured in the fall of 1970 have doubled compared with similar counts made in the fall of 1969. Thus, although no dramatic increases are expected in the size of the infestation, the overall intensity of damage is expected to rise sharply. Furthermore, balsam fir and white spruce stands in Borden, Chewett, McGee, and Cochrane townships have been under attack for 4 consecutive years and balsam mortality can be expected in 1971. Mortality and top-killing of balsam is also expected in other stands where damage has been particularly severe for 3 consecutive years.

North of the main infestation, a considerable area of light damage is expected in White River and Kapuskasing districts. This represents a significant shift in populations since, generally speaking, budworm egg-masses could not be found throughout this area in 1969 and no damage was recorded in 1970.

The infestations in Sudbury and Swastika districts are expected to persist, probably accompanied in some cases by modest enlargements. However, population levels in the fall of 1970 were the same as in the fall of 1969 and the degree of damage should not intensify in 1971. Light damage to balsam fir and white spruce is expected to occur throughout the remainder of the Sudbury District and the southern half of the Swastika District. Light damage is also expected in several townships south of Lake Abitibi further to the northeast.

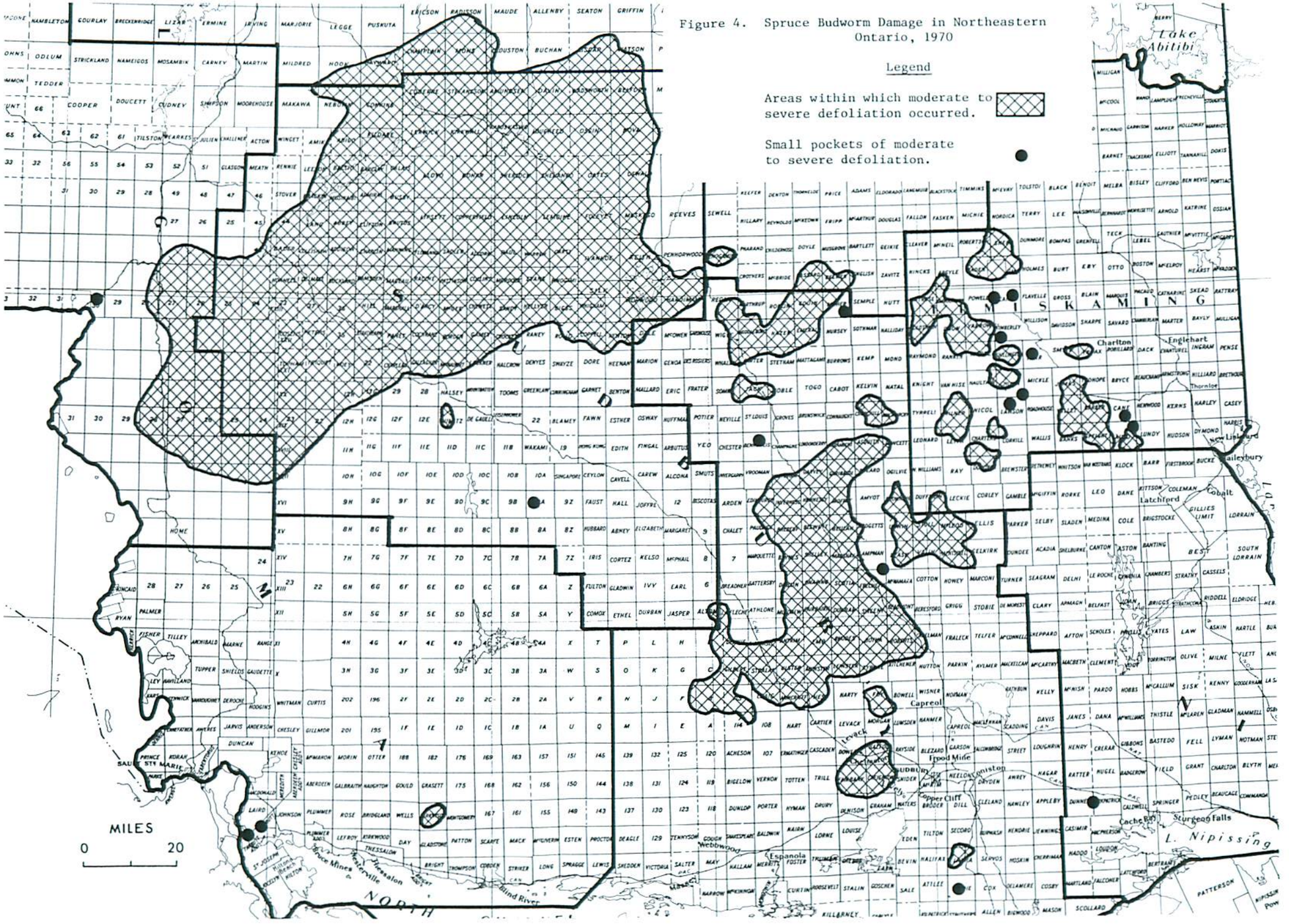


Figure 4. Spruce Budworm Damage in Northeastern Ontario, 1970

Legend

Areas within which moderate to severe defoliation occurred.

Small pockets of moderate to severe defoliation.

It is expected that aerial spraying operations in 1971 in northeastern Ontario will be confined to protecting trees in special value areas only, such as provincial parks. This is in line with current management strategies decided upon by provincial and federal authorities for the spruce budworm in northeastern Ontario. Consequently, parks such as Missinaibi, Ivanhoe, Shoals, Lake Superior, Five Mile and Wakami Lake have received and will continue to receive special attention during our surveys.

NORTHWESTERN ONTARIO

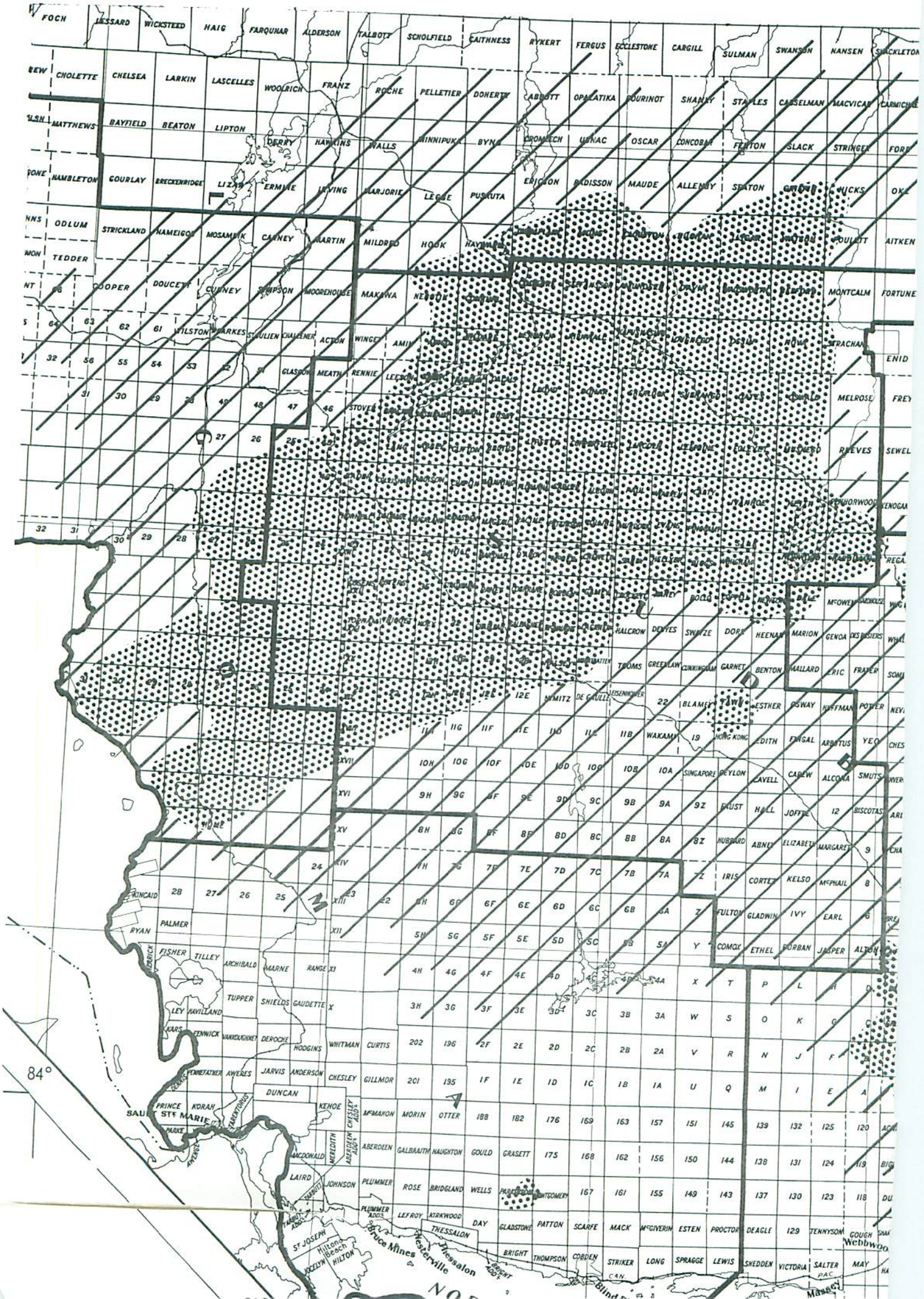
Situation in 1970

By the fall of 1969, the only significant spruce budworm populations known in northwestern Ontario were in two small infestations that were discovered at Northern Light Lake and Granite Lake in the Thunder Bay District, 2800 and 1200 acres in size, respectively. These two infestations were sprayed in June, 1970 but subsequent defoliation checks and egg-mass counts showed that high populations still remained in 750 acres at Northern Light Lake and 650 acres at Granite Lake. For complete details, see Part B of this report entitled "Aerial Spraying Operations."

Because of the large active budworm outbreak in northern Minnesota, Survey personnel paid very close attention to the Fort Frances District, particularly those areas adjacent to the International Border. A new infestation of 800 acres was found on the west end of Poohbah Lake in Quetico Provincial Park. Egg-mass surveys carried out in August and early September of 1970 provided evidence of additional areas that were infested in the Fort Frances District. Subsequently, a large part of the district was reflown in November and a total of at least 16,000 acres was found to have been defoliated in Quetico Provincial Park in the vicinity of Poohbah, Wink and Tanner lakes and Martin Bay on Lac la Croix. At least two other areas in the Fort Frances District are suspected of harbouring high budworm numbers. However, this will not be established definitely until the early spring of 1971 when further ground work will either confirm or deny the presence of additional infestations. Figure 6 shows the location of known infestations at the time of writing.

Damage Forecast for 1971

With a few exceptions, a low potential exists for damage by spruce budworm in 1971 throughout northwestern Ontario. A total of 154 locations were sampled for budworm egg-mass counts in 1970 (see Table 3). These egg-mass counts showed that budworm populations were very low throughout all of the area sampled in the Thunder Bay District except for the two small infestations at Northern Light Lake and Granite Lake. In both of these cases, the egg-mass counts are high enough to result in moderate to severe defoliation in 1971. Populations in formerly infested areas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MAKAWA
NELSON
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FORTUNE
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New Liskeard
Haileybury
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Capreol
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Cache Bay
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RORKE
LEO
DANE
KITTSON
COLEMAN
HODGETTS
ELLIS
PARKER
SELBY
SLADEN
MEDINA
COLE
BRIGSTOCKE
GILLIES LIMIT
LAMPMAN
SELKIRK
DUNDEE
ACADIA
SHELBURNE
CANTON
ASTON
BANTING
BEST
TURNER
SEAGRAM
DELHI
LE ROCHE
CHILTIA
CHAMBERS
STRATHY
CASSELS
MULDREW
BEAUMONT
BERESFORD
GLUBE
STOBIE
DE MOREST
CLARY
ARMAGH
BELFAST
LOGAN
BRIGGS
STRATHCONA
RIDDELL
ELDRIDGE
FRALECK
TELFER
McCONNELL
SHEPPARD
AFTON
SCHOLES
PHYLLIS
YATES
LAW
ASKIN
HARTLEY
KITCHENER
HUTTON
PARKIN
AYLMER
MACKELCAN
McCARTHY
MACBETH
CLEMENT
TORRINGTON
OLIVE
MILNE
FLETCHER
BOWELL
WISNER
NORMAN
RATHBUN
KELLY
McNISH
PARDO
HOBBS
McCALLUM
SISK
KENNY
GOODERHAM
MORGAN
LUMSDEN
BANMER
CAPREOL
MACLENNAN
SCADDING
DAVIS
JANES
DANA
McWILLIAMS
THISTLE
McLAREN
GLADMAN
HAMMOND
DOWLING
RAYSIDE
BLIZZARD
GARSON
FALCONBRIDGE
STREET
LOUGHRIN
HENRY
CRERAR
GIBBONS
BASTEDO
FELL
LYMAN
NOTMAN
VERNON
TOTTEN
TRILL
FAIRBAIRN
SNIDER
NEELON
DRYDEN
AWREY
HAGAR
RATTER
HUGEL
BADGEROW
FIELD
GRANT
CHARLTON
BLY
PORTER
HYMAN
DRURY
DENISON
GRAHAM
WATERS
BRODER
DILL
CLELAND
HAWLEY
APPLEBY
DUNNET
PATRICK
CALDWELL
SPRINGER
PEDLEY
BEAUCAGE
COMMANDA
BALDWIN
HAIRN
LORNE
LOUISE
TILTON
SECORD
BURWASH
HENDRIE
JENNINGS
CASIMIR
MACPHERSON
MERRITT
FOSTER
TRUMAN
DIXON
BEVIN
HALIFAX
SERVOS
HOSKIN
CHERRIMAN
HADDO
LOUDON
BERTRAND
CORTIN
ROOSEVELT
STALIN
GOSCHEN
SALE
WILLEE
COX
DELAMERE
COSBY
HARTLAND
FALCONER
LATCHFORD

near Burchell Lake in Thunder Bay District and French Lake in Fort Frances District that were sprayed in 1968 and 1969 and apparently successfully "knocked out" have remained very low for the second consecutive year.

However, the picture is not as bright in the Fort Frances District. High egg-mass counts indicate a potentially serious problem in the southern part of the district, along the International Border. Potentially, moderate to severe defoliation could develop in three areas in 1971. The first is in the Bayley Bay-Carp Lake area along the International Border in Quetico Provincial Park. The second and most probable area to show budworm damage is in the vicinity of Poohbah and Tanner lakes, also in Quetico Park; and the third is located immediately west of Quetico Park along the Minnesota-Ontario border in the Lilac-Trout lakes area and in the Little Eva-Redhorse lakes area.

Elsewhere in the Fort Frances, Kenora, Sioux Lookout and Geraldton districts, all evidence indicates that populations are low and no appreciable damage should occur.

CONCLUSIONS

Most of the evidence depicts a foreboding picture of the spruce budworm in Ontario. It caused moderate to severe defoliation of balsam fir and white spruce over some 7,000,000 acres in 1970 and is expected to damage the new shoots of host trees throughout 8,000,000 or more acres in 1971.

Indications of a levelling off or even population declines exist in various parts of the infestations in southeastern and northeastern Ontario. However, these favourable changes are considerably outweighed by significant increases in population levels and area affected elsewhere in these regions.

In northwestern Ontario, the situation in Thunder Bay District has been encouraging up to the present time, mainly as a result of the aerial spraying described in Part B. However, a worsening situation in the adjoining Fort Frances District and the continued presence of infestations in Minnesota combine to form an ominous threat to budworm susceptible forests of northwestern Ontario which have been unmolested for some 6 to 10 years.

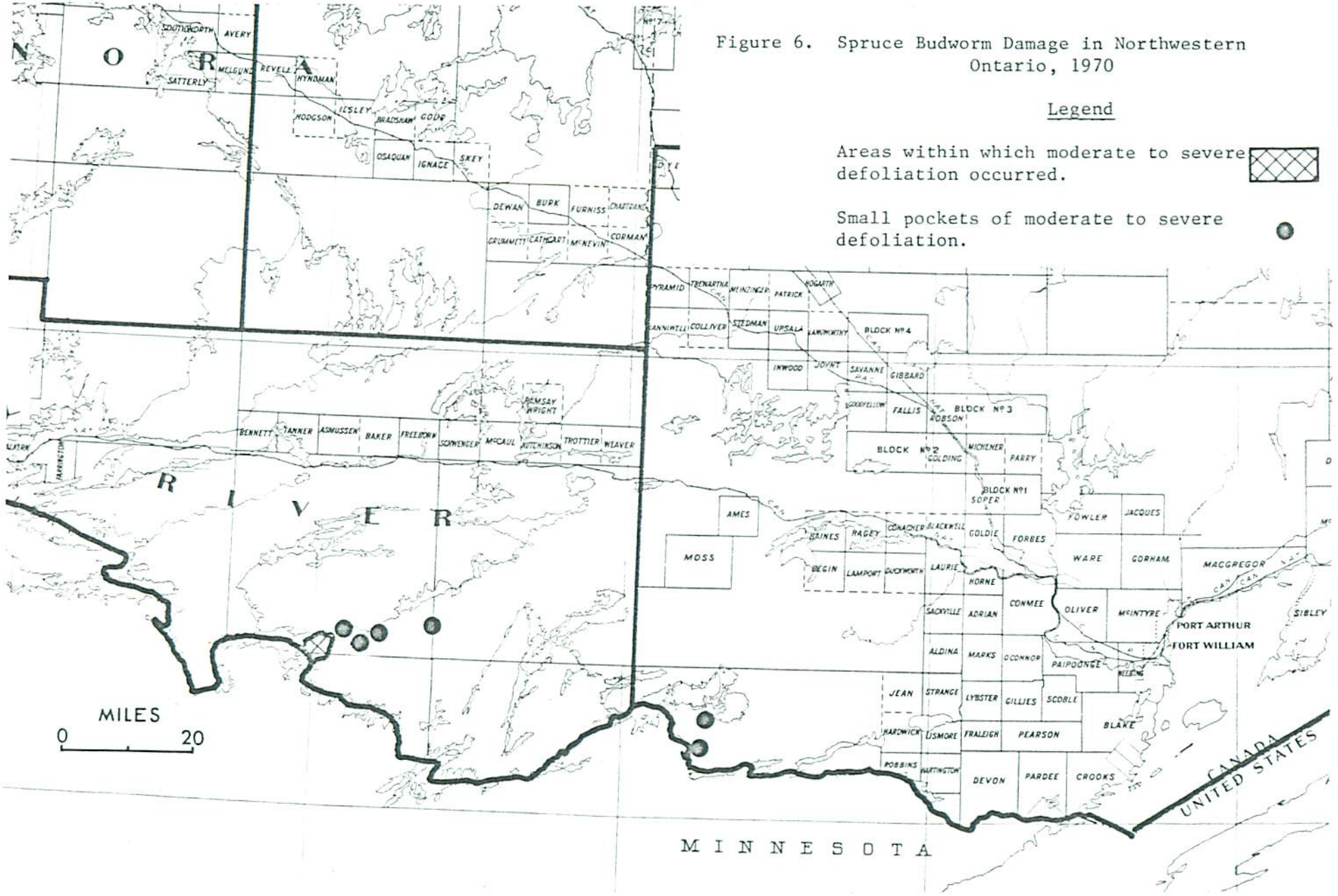

Figure 6. Spruce Budworm Damage in Northwestern Ontario, 1970

Table 1. Southeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971.

Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
Pembroke District (53 locations)				
Airy Twp. - East Gate	wS	50	236	S*
Alice Twp.	bF	53	13	L
Bower Twp. - Penaish Lake	wS	23	1389	S
Bromley Twp.	wS	88	453	S
Bronson Twp.	wS	6	56	M
Canisbay Twp.	wS	22	750	S
Clara Twp.	bF	13	23	L-M
Dickson Twp.	bF	54	61	M
Head Twp.	wS	14	110	M-S
Maria Twp.	wS	3	34	L-M
Nightingale Twp.	wS	12	95	M-S
Petawawa Twp.	wS	55	492	S
Preston Twp.	bF	41	640	S
Rolph Twp. - Deep River - Rolphton	wS	38	337	S
	wS	28	868	S
Ross Twp. - Dist. boundary - Garage	wS	39	28	L-M
	wS	56	520	S
Sabine Twp. - McCay Lake	wS	3	20	L-M
Stafford Twp.	wS	46	242	S
Stratton Twp. - Achray #1	wS	88	464	S
" #2	wS	51	340	S
" #3	bF	2	48	M
" #4	wS	27	238	S
" #5	bF	59	625	S
Stratton Twp. - Lone Creek #1	wS	9	438	S
" " #2	wS	80	414	S
" " #3	bF	80	386	S
Westmeath Twp. Quarry	wS	37	487	S
White Twp. - A.R.O.	wS	44	112	M-S

* S - severe, M - moderate, L - light,

(cont'd.)

Table 1. Southeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

	Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
	Pembroke Dist. (cont'd.)				
	Wilberforce Twp. (3.5 mi. N.W. Douglas)	wS	71	342	S*
	Wilberforce Twp. (1 mi. N. Rankin)	wS	69	846	S
	Petawawa For. Exp. Sta. Wylie and Buchanan Twps.				
	Baseline	bF	30	86	M-S
	By-Pass Road	bF	35	86	M
3	Headquarters	wS	44	383	S
	Meridian Rd.	bF	31	74	M
	Racehorse Rd.	bF	42	61	M
	Racehorse Rd.	wS	71	525	S
3	Spray #1	wS	26	637	S
3	#2	wS	13	177	S
3	#3	wS	42	125	S
3	#4	wS	74	438	S
3	#6	wS	34	165	M-S
3	#7	wS	37	309	S
3	#8	wS	88	774	S
3	#9	wS	28	593	S
3	#10	wS	35	584	S
3	#11	wS	11	160	M-S
3	#12	wS	78	293	S
3	#20	bF	3	6	L
	Thomas Lake	bF	41	205	S
	Young Creek Road	bF	53	374	S
	" " "	wS	35	991	S
3	Young Creek Arboretum	bF	0	186	S

3 Sprayed 1970

* S - severe, M - moderate, L - light

(cont'd.)

Table 1. Southeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

	Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
	Kemptville District (9 locations)				
	Cambridge Twp.	wS	1	17	L*
	Clarence Twp. -				
3	Larose Forest #1	wS	11	10	L
3	" " #2	wS	13	10	L
3	" " #3	wS	5	7	L
3	" " #4	wS	28	16	L
	Dalhousie Twp.	bF	51	23	L-M
	Fitzroy Twp.	wS	15	25	L-M
	Huntley Twp.	wS	51	348	S
	Kemptville Nursery	wS	5	12	L
	Tweed District (11 locations)				
	Admaston Twp. -				
	Bonnechere R.	wS	71	177	S
	Mt. St. Patrick Rd.	bF	21	33	L-M
	Ashby Twp.	bF	29	49	M
	Brougham Twp.	bF	9	0	0
	Denbigh Twp.	bF	33	53	M
	Gratton Twp.	wS	29	58	M
	Griffith Twp.	wS	60	318	S
	Matawatchan Twp.	bF	35	83	M
	McNab Twp.	wS	33	45	M
	Raglan Twp.	wS	53	266	S
	Wicklow Twp.	wS	23	328	S
	Lake Simcoe District (3 locations)				
	Essa Twp.	wS	10	10	L
	Uxbridge Twp.	wS	19	27	L-M
	Vespra Twp. - Midhurst	wS	34	28	L-M

3 Sprayed 1970

* S - severe, M - moderate, L - light, 0 - nil.

(cont'd.)

Table 1. Southeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (concl'd.)

Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
Lake Huron District (1 location)				
St. Edmunds Twp.	wS	25	65	M*

* S - severe, M - moderate, L - light, 0 - nil.

Table 2. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971.

	Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
	Chapleau District (43 locations)				
	Abney Twp. - Spanish Lake	bF	5	10	L*
	Amundsen Twp.	wS	30	488	S
3	Barclay Twp. - Missinaibi Lake Prov. Park	wS	15	280	S
3	Barclay Twp. - Missinaibi Lake Prov. Park	bF	82	363	S
	Borden Twp. - Westover Lake	bF	63	443	S
	Carew Twp.	bF	10	4	L
	Comox Twp. - Comox Lake	bF	10	7	L
	Conking Twp.	bF	32	211	S
	Coppell Twp.	bF	44	257	S
	Denyes Twp. - Denyes Lake	bF	3	6	L
	Fawn Twp.	bF	18	60	M
	Foleyet Twp.	bF	83	600	S
	Halsey Twp. - Nemegus Rd.	bF	37	211	M-S
	Hill Twp.	bF	63	384	S
	Horwood Twp. - Horwood Lake	bF	8	0	0
	Horwood Twp. - S.E. Arm	bF	88	622	S
3	Ivanhoe Twp. - Ivanhoe Lake Prov. Park	wS	55	716	S
3	Ivanhoe Twp. - Ivanhoe Lake Prov. Park	bF	20	257	S
	Ivy Twp. - Miniwaski Lake	bF	7	23	L-M
	Kapuskasing Twp. - Kapuskasing Lake	bF	46	372	S
	Keith Twp.	bF	67	302	S
	Leeson Twp. - Renabie	bF	5	20	L
	Lerwick Twp.	bF	48	402	S
	Margaret Twp. - Bisco Rd.	bF	2	4	L
	Montcalm Twp. - Elf Lake	bF	4	0	0
	Ossin Twp. - South end Ossin Lake	bF	49	261	S

3 Sprayed 1970

* S - severe, M - moderate, L - light, 0 - nil.

(cont'd.)

Table 2. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
Chapleau District (cont'd.)				
Penhorwood Twp. - Kukatush Road	bF	34	83	M*
Peters Twp. - Shoals Prov. Park	wS	15	580	S
Peters Twp. - Shoals Prov. Park	bF	26	214	S
Sadler Twp. - Robson Lake	bF	42	618	S
Twp. 8A - N.W. corner	bF	3	4	L
Twp. 8F - Prairie Grass Lake	bF	2	6	L
Twp. 9D - HW (129)	bF	3	0	0
Twp. 9H - Verse Lake	bF	3	10	L
Twp. 10F - Vezina Lake	bF	3	21	L
Twp. 11B - Wakami Lake Prov. Park	bF	12	10	L
Twp. 11D - 5 Mile Lake Prov. Park	bF	15	14	L
Twp. 12G - Sample Lake	bF	24	34	L-M
Twp. 12H	bF	46	529	S
Twp. 23 - Rge. 16, Lineus Lake	bF	13	19	L
Twp. 25 - Rge. 23	bF	67	149	M-S
Twp. 43 - Ogasiwi River	bF	19	64	M
Twp. 46 - Renabie Mine Rd.	bF	16	13	L
Cochrane District				
Bartlett Twp. - Texmont Rd.	bF	9	18	L
English Twp. - English Lake	bF	2	8	L
Hassard Twp.	bF	26	54	M
Sewell Twp. - Lapierre Rd.	bF	10	0	0
Sydere Twp. - Mile 8	bF	1	3	L

* S - severe, M - moderate, L - light, 0 - nil.

(cont'd.)

Table 2. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
Kapuskasing District (21 locations)				
Bourinot Twp. - Mile 33	bF	2	0	0*
Buchan Twp. - Mile 6, west branch	bF	17	127	M-S
Casselman Twp.	bF	2	6	L
Champlain Twp.	bF	9	40	M
Clouston	bF	2	26	L
Cromlech Twp. - Brunswick Lake	bF	3	8	L
Derry Twp. - Bullmoose Lake	bF	3	12	L
Farquhar Twp.	bF	2	2	L
Fenton Twp. - Mile 23, Chain of Lakes	bF	2	8	L
Gourlay Twp. - Gourlay Lake	bF	2	0	0
Griffin Twp. - Griffin Lake	wS	16	75	M
Lisgar Twp. - Chain of Lakes Road	bF	13	281	S
Mons Twp. - Mons Lake	bF	16	117	M-S
Nansen Twp.	bF	2	5	L
Opasatika Twp. - Opasatika Lake	bF	3	9	L
Puskuta Twp. - Puskuta Lake	bF	13	7	L
Radisson Twp.	bF	5	9	L
Seaton Twp. - Mile 34, Chain of Lakes	bF	2	5	L
Shanly Twp. - Groundhog R., Camp 15	bF	2	5	L
Stringer Twp. Groundhog R.,	bF	3	8	L
Wicksteed Twp. - 1.2 mi. S. of Hornepayne	bF	3	1	L

* S - severe, M - moderate, L - light, 0 - nil.

(cont'd.)

Table 2. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
North Bay District (2 locations)				
Calvin Twp.	wS	9	10	L*
Dunnet Twp.	bF	30	96	M-S
Sault Ste. Marie Dist. (5 locations)				
Parkinson Twp.	wS	84	480	S
Tarbutt Add'l.	bF	61	200	M-S
Twp. 23, Rge. 13 - Haynes Lake	bF	12	6	L
Twp. 3F	bF	16	11	L
Twp. 5H	bF	3	5	L
Sudbury District (70 locations)				
Antrim Twp. - Halfway Lake	bF	2	6	L
Antrim Twp.	bF	7	87	M
Arden Twp.	bF	3	21	L
Baldwin Twp.	bF	15	5	L
Beaumont Twp. - Helen Lake	bF	10	42	M
Beulah Twp.	bF	46	33	L-M
Beulah Twp. - Meteor Lake	bF	10	125	M-S
Botha Twp.	bF	88	195	M-S
Carter Twp.	bF	7	10	L
Craig Twp. - Blue Water Lake	bF	4	12	L
Creelman Twp. - Bessie Lake	bF	19	14	L
Drury Twp.	bF	3	13	L
Dunbar Twp.	bF	71	622	S
Edinborough Twp.	bF	13	0	0
Emo Twp.	bF	59	683	S
Fairbanks Twp.	bF	80	43	L-M
Garvey Twp.	bF	23	51	M
Genoa Twp. - Rush Lake	bF	7	18	L

* S - severe, M - moderate, L - light, 0 - nil.

(cont'd.)

Table 2. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
Sudbury District (cont'd.)				
Gilbert Twp. - 2nd mile from river	bF	59	216	S*
-1 mile W. Camp 11	bF	11	156	M-S
-Agnes River "D"	bF	14	63	M
-Agnes River "E"	bF	43	1156	S
-Agnes River "F"	bF	51	329	S
-Agnes River "G"	bF	47	454	S
Gough Twp.	bF	11	0	0
Hazen Twp.	bF	16	65	M
Hess Twp. - 4 mi. E. HW (144)	bF	67	342	S
Howey Twp.	bF	23	68	M
Hyman Twp.	bF	11	22	L
Inverness Twp. - Donnegama Lake	bF	27	167	S
Jack Twp.	bF	12	25	L-M
LaFleche Twp.	bF	19	20	L
Leask Twp.	bF	11	6	L
Lampman Twp.	bF	38	13	L
Londonderry Twp.	bF	1	0	0
MacMurchy Twp.	bF	7	28	L-M
MacMurchy Twp.	bF	59	448	S
Marquette Twp.	bF	3	26	L-M
Middleboro Twp.	bF	3	7	L
Miramichi Twp.	bF	80	264	S
Moncrieff Twp.	bF	17	76	M
Muldrew Twp.	bF	34	22	L
Muldrew Twp.	bF	14	96	M
Potier Twp.	bF	10	11	L
Regan	bF	30	8	L
Roblin Twp.	bF	47	525	S
Scotia Twp.	bF	10	63	M
Selkirk Twp. - Solace Lake	bF	1	10	L
Sheard Twp.	bF	24	13	L
Shelley Twp.	bF	86	195	S
St. Louis Twp.	bF	13	17	L

* S - severe, M - moderate, L - light, 0 - nil. (cont'd.)

Table 2. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
Sudbury District (cont'd.)				
Stull Twp.	bF	76	384	S*
Tyrone Twp. - Michaud Lake	bF	21	2	L
Waldie Twp.	wS	43	1677	S
Waldie Twp.	bF	35	885	S
Westbrook Twp.	bF	10	10	L
Twp. 7 - First Lake	bF	2	0	0
Twp. 107	bF	10	58	M
Twp. 115 - Agnes River "A"	bF	20	373	S
- Agnes River "B"	bF	58	594	S
- Agnes River "C"	bF	11	42	L-M
Twp. 125	bF	3	20	L
Twp. A	bF	12	194	S
Twp. B (7 1/2 mi. S. of Camp 1)	bF	28	20	L
Twp. B	bF	47	197	S
Twp. C (edge of Gilbert Twp.)	bF	59	333	S
Twp. D	bF	30	30	L-M
Twp. G (north)	bF	11	24	L
Twp. G	wS	71	435	S
Twp. J	bF	5	20	L
Swastika District (17 locations)				
Alma Twp.	bF	15	60	M
Catherine Twp.	bF	7	18	L
Corkill Twp.	bF	38	95	M-S
Eby Twp.	bF	1	7	L
Gamble Twp.	bF	13	17	L
James Twp.	bF	34	48	M
Katrine Twp.	bF	3	0	0
Lamplugh Twp. #1	bF	15	4	L
Lamplugh Twp. #2	wS	14	4	L
Marriott Twp.	bF	13	11	L

* S - severe, M - moderate, L - light, 0 - nil. (cont'd.)

Table 2. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
Swastika District (cont'd)				
Midlothian Twp.	bF	1	0	0*
Milner Twp.	bF	24	6	L
Mulligan Twp.	bF	2	8	L
Pacaud Twp.	bF	0	0	0
Rattray Twp.	bF	2	0	0
Tyrell Twp.	bF	13	12	L
Yarrow Twp.	bF	51	84	M
White River District (27 locations)				
Amwri (a village on Manitouwadge road)	bF	2	14	L
Challener Twp.	bF	3	8	L
Gertrude Twp.	bF	0	0	0
Home Twp. #1	bF	13	9	L
Home Twp. #2	bF	27	112	M-S
Mildred Twp.	bF	3	24	L
Simpson Twp. - Oba Lake	bF	3	6	L
Twp. 25, Rge. 18	bF	20	85	M
Twp. 26, Rge. 25	bF	12	80	M-S
Twp. 28, Rge. 15	bF	7	32	L-M
Twp. 28, Rge. 18	bF	12	19	L-M
Twp. 28, Rge. 20 - Sand Lake	bF	16	59	M
Twp. 28, Rge. 24 - Hawk Jct.	bF	10	13	L
Twp. 29, Rge. 16	bF	23	197	S
Twp. 29, Rge. 27	bF	2	0	0
Twp. 30, Rge. 17	bF	4	30	L-M
Twp. 30, Rge. 18	bF	38	54	L-M
Twp. 30, Rge. 19	bF	2	71	M
Twp. 30, Rge. 20	bF	23	0	0
Twp. 30, Rge. 20	bF	2	26	L-M
Twp. 30, Rge. 21	wS	16	13	L
Twp. 30, Rge. 21	bF	3	11	L

* S - severe, M - moderate, L - light, 0 - nil. (cont'd.)

Table 2. Northeastern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (concl'd.)

Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
White River Dist. (cont'd.)				
Twp. 30, Rge. 23	wS	10	18	L*
Twp. 30, Rge. 24	bF	1	20	L-M
Twp. 30, Rge. 26	bF	1	10	L
Twp. 48, Godin Lake	bF	0	0	0
Twp. 66 - mile 9, Hornepayne Rd.	bF	1	16	L

* S - severe, M - moderate, L - light, 0 - nil.

Table 3. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971.

	Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
	Fort Frances District (61 locations)				
	Agnes Lake	bF	0	52	M*
	Allan Lake	bF	3	26	L-M
	Argo Lake	bF	0	2	L
	Bayley Bay	bF	4	76	M
	Bear Pass	bF	1	4	L
	Bear Pelt Lake	bF	12	10	L
	Beaverhouse	bF	1	8	L
	Cache Lake	bF	1	0	0
	Cache Bay	bF	0	0	0
	Carp Lake	bF	16	35	L-M
	Conmee Lake	bF	2	11	L
	Dack Lake	bF	2	0	0
	Darky Lake	bF	5	8	L
	David Lake	bF	0	0	0
	Delahey Lake	bF	3	0	0
	Duff Lake	bF	3	0	0
	Emerald Lake	bF	2	0	0
	Factor Lake	bF	2	4	L
	Ferguson Lake	bF	0	0	0
2	French River (HW 11 and Hydro Line)	bF	1	0	0
2	French Lake Park	bF	0	3	L
	Gehl Lake	bF	12	7	L
	Hale Bay	bF	2	21	L
	Heronshaw Lake	bF	3	21	L
	Indian Reserve 25D	bF	14	22	L-M
	Joyce Lake	bF	2	0	0
	Kawene (Eva Lake)	bF	0	0	0
	Lac La Croix (Campbell's)	bF	2	5	L
	Lac La Croix (Ranger Sta.)	bF	3	36	L-M
	Little Eva Lake	bF	0	0	0
	Little Grassy Bay	bF	1	7	L
	Louisa Lake	bF	1	9	L

2 Sprayed in 1968 and 1969

* S - severe, M - moderate, L - light, 0 - nil. (cont'd.)

Table 3. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
Fort Frances Dist. (cont'd.)				
McAree Lake	bF	5	0	0*
McKenzie Lake (s/w end)	bF	1	9	L
McKenzie Lake (Tower)	bF	2	7	L
Moose Bay	bF	8	4	L
Namakan Lake	bF	0	10	L
North Bay	bF	0	11	L
Northland Gateway	bF	0	2	L
Nydia Lake	bF	0	3	L
Orion Lake	bF	3	13	L
2 Pickerel River	bF	1	0	0
Poohbah Lake (west end)	bF	76	604	S
Poohbah Lake (east end)	bF	5	11	L
Quetico Lake	bF	2	7	L
Ranger Bay (Basswood Lake)	bF	0	11	L
Rat River Bay	bF	1	2	L
Saganagons Lake	bF	0	0	0
Sarah Lake	bF	5	0	0
Seine River (HW 11)	bF	5	0	0
Shade Lake	bF	2	0	0
Shoal Lake	bF	0	0	0
Snow Lake	bF	3	6	L
Stokes Bay	bF	0	0	0
Sturgeon Lake	bF	2	0	0
Tanner Lake	bF	5	120	M-S
Thompson Lake	bF	0	0	0
Trout Lake	bF	51	33	L-M
Wicksteed Lake	bF	7	13	L
Wilkin's Bay	bF	5	13	L
William Lake	bF	7	15	L
Thunder Bay District (84 locations)				
Armstrong Road - mile 7	bF	0	5	L
Arrow Lake	bF	1	5	L

* S - severe, M - moderate, L - light, 0 - nil.

2 Sprayed in 1968 and 1969

(cont'd.)

Table 3. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

	Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
	Thunder Bay Dist. (cont'd.)				
	Athelstane Lake	bF	2	0	0*
1	Batwing Lake	bF	1	0	0
	Bedivere Lake	bF	3	3	L
	Bemar Lake	bF	0	0	0
	Beulah Lake	bF	0	3	L
	Black Sturgeon	bF	0	0	0
	Blackwell Township	bF	1	0	0
2	Burchell Lake	bF	2	8	L
2	Burchell Lake - 2 mi. S.E. (Stuart Ck.)	bF	0	0	0
	Canthook Lake	bF	4	23	L
1	Clovenhoof Lake	bF	1	6	L
1	Crayfish Lake	bF	1	7	L
	Devil's Elbow	bF	0	11	L
	Drift Lake	bF	2	0	0
2	Fountain Lake	bF	1	0	0
	Garden Lake	bF	3	5	L
3	Granite Lake - A	bF	12	168	M-S
3	Granite Lake - B	bF	30	193	M-S
3	Granite Lake - C	bF	46	106	M
1	Greenwater Lake	bF	2	0	0
1	Greenwater Lake (Shelter Island)	bF	0	0	0
1	Greenwood Lake	bF	0	6	L
3	Gunflint Lake (east end)	bF	2	0	0
3	Gunflint Lake (west end)	bF	1	38	L-M
	Gunflint Lake (4 mi. north of east end)	bF	0	0	0
	Hagey Township	bF	2	4	L

* S - severe, M - moderate, L - light, 0 - nil

1 Sprayed in 1968

2 Sprayed in 1968 and 1969

3 Sprayed in 1970

(cont'd.)

Table 3. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

	Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
	Thunder Bay Dist. (cont'd.)				
1	Haines Twp. (Postans - Big Broom)	bF	0	4	L*
1	HW 11 (2 mi. W. of Burchell Lake turn)	bF	0	0	0
1	Hood Lake	bF	0	0	0
	Hoof Lake	bF	0	8	L
	Huronian	bF	1	13	L
1	Huronian Lake	bF	1	7	L
	Icarus Lake	bF	1	0	0
	Iron Range Lake	bF	-	19	L
	Joe Lake	bF	2	4	L
1	Kashabowie Lake (lower)	bF	2	0	0
	Kashabowie Lake (upper)	bF	0	0	0
1	Kekekaub Lake	bF	0	0	0
	Lac des Mille Lacs				
	- Baril Bay	bF	4	11	L
	- Blind Bay	bF	0	0	0
	- Bolton Bay	bF	0	0	0
	- Cushing Lake	bF	0	0	0
	- Lily Lake	bF	1	0	0
	- Open Bay	bF	1	15	L
	- Pine Point	bF	2	2	L
	- Poplar Point (Ind. Res.)	bF	2	6	L
	- Portage Bay	bF	2	6	L
	Marks Lake	bF	1	6	L
	Marks Lake Road	bF	0	0	0
	Max Lake - Spruce River Rd.	bF	2	6	L
2	McGinnis Lake	bF	2	21	L

* S - severe, M - moderate, L - light, 0 - nil.

1 Sprayed in 1968

2 Sprayed in 1968 and 1969

3 Sprayed in 1970

(cont'd.)

Table 3. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (cont'd.)

	Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
	Thunder Bay Dist. (cont'd.)				
2	Moss Lake	bF	1	0	0*
	Nelson Lake	bF	0	8	L
	North Lake	bF	1	11	L
	Northern Light Lake				
	- Curran Bay	bF	0	0	0
	- Savage Bay	bF	3	9	L
	- South Arm	bF	0	3	L
3	- South Island	bF	38	80	M
	- Trafalgar Bay	bF	0	0	0
	- Trout Bay	bF	0	8	L
3	- Weather Sta.	bF	76	390	S
	Pakashkan Lake	bF	7	0	0
	Pigeon River	bF	0	0	0
	Plummes Lake	bF	0	5	L
1	Powell Lake	bF	1	2	L
	Prelate Lake	bF	2	3	L
	Prelate Lake - 1 mi. west	bF	-	5	L
	Ross Lake	bF	0	0	0
	Sandstone Lake	bF	1	0	0
	Savanne Lake	bF	1	5	L
	Shebandowan Lake - lower	bF	2	4	L
2	Shebandowan Lake - upper	bF	1	3	L
	Sleigh Lake	bF	0	0	0
	Spruce River Road - mile 26	bF	4	13	L
1	Squeers Lake	bF	2	0	0
	Sunbow Lake	bF	1	0	0
	Swallow Lake	bF	0	0	0

* S - severe, M - moderate, L - light, 0 - nil.

1 Sprayed in 1968

2 Sprayed in 1968 and 1969

3 Sprayed in 1970

(cont'd.)

Table 3. Northwestern Ontario - Spruce Budworm: Summary of defoliation estimates and egg-mass counts in 1970, and damage forecasts for 1971. (concl'd.)

Location	Host	Estimated Per cent of defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Damage forecast for 1971
Thunder Bay Dist. (cont'd.)				
Tilly Lake	bF	0	2	L*
Tilly Creek	bF	2	4	L
Titmarsh Lake	bF	0	0	0
Weikwabinonaw Lake	bF	0	11	L
Whitefish Lake	bF	2	6	L
Sioux Lookout District (5 locations)				
Red Paint Lake	bF	0	0	0
Old Man Lake	bF	0	0	0
Pyramid Lake	bF	0	0	0
Gulliver Lake	bF	0	0	0
Norway Lake	bF	0	0	0
Geraldton District (4 locations)				
Colter Twp. Sturgeon R.	bF	2	0	0
Caramat Rd. - mile 10	bF	2	4	L
Ledger Twp.	bF	2	0	0
Township 86	bF	2	0	0

* S - severe, M - moderate, L - light, 0 - nil.

PART B: AERIAL SPRAYING OPERATIONS

INTRODUCTION

In 1970, the Canadian Forestry Service and the Ontario Department of Lands and Forests, on a co-operative basis, carried out seven aerial spraying operations against the spruce budworm over some 23,000 acres in Ontario. Two of these operations were in southeastern Ontario, namely at the Petawawa Forest Experiment Station and Larose Forest; two in northeastern Ontario, Missinaibi and Ivanhoe provincial parks; and three in northwestern Ontario, Northern Light Lake, Granite Lake and Gunflint Lake. This statement describes each operation under the three aforementioned sections of Ontario and outlines the results obtained.

SOUTHEASTERN ONTARIO OPERATIONS

Background

The first of the two locations sprayed consisted of 800 acres of white spruce plantations in the Larose Forest, located in Clarence Township about 25 miles east of Ottawa. This demonstration forest is under the management of the Ontario Department of Lands and Forests, and they wished to prevent further severe damage to these plantations which had been heavily infested in 1968 and 1969. Secondly, at the Petawawa Forest Experiment Station (PFES), some 28 plantations and three natural stands totalling about 450 acres were sprayed to prevent damage to high value research areas. Although the spruce research areas suffered little defoliation in 1969, egg-mass counts in the fall of 1969 were so high on the PFES that some form of protection in 1970 was considered essential.

Pre-spray Larval Surveys and Larval Development Work

Pre-spray larval counts in May, 1970 at Larose and PFES confirmed the abundance of budworm at both locations. Larval counts at Petawawa were extraordinarily high. One stand of large white spruce, for example, yielded an *average* of 110 budworm larvae per 18" tip, with the highest count from a single 18" tip being 610. Spray boundary determination was not involved in pre-spray larval surveys in either case since areas to be treated were readily determined from compartment borders.

The original plans for Larose Forest called for the application of fenitrothion at 4.3 ounces per acre at the peak of fourth instar. For Petawawa, two applications of fenitrothion, each of 4.3 ounces per acre were to be applied hopefully no later than the peak of fourth instar and following the completion of the Larose operation.

Larval emergence at Larose and PFES occurred in early May and insect development proceeded at a normal pace with development at PFES lagging behind Larose by a few days. On May 21, the Canadian Forestry Service recommended that the appropriate time to begin spraying at Larose Forest was May 25, and that as soon as this job was completed the aircraft should proceed promptly to PFES.

Insect development on white spruce at Larose was mostly fourth instar with some fifths on May 25. Insect development on white spruce at Petawawa was mostly third instars with a few fourths on this date, hence the timing proved suitable and phenological differences developed as expected. However, a spray plane did not arrive at Larose until May 28. The spraying was carried out on May 29 and the aircraft then proceeded to PFES on May 30. By May 29, budworm development on white spruce at Larose had reached the peak of fifth instars and at PFES the peak of fourth instar. The delay in getting an aircraft to Larose was caused by poor spraying weather which prevented the spray contractor (General Airspray of St. Thomas, Ontario) from completing gypsy moth spraying operations near Kingston, Ontario and near Valleyfield, Quebec.

The Spraying

On the evening of May 29, a Stearman spray plane, working on floats, sprayed the 800 acres of planted white spruce at Larose with fenitrothion at a rate of 5.1 ounces per acre. Eighty acres which had been the most severely damaged received a second application of 5.1 ounces per acre. Observations made in the sprayed area on June 1 and again on June 5 showed no evidence of dead or dying larvae. Officials of the Ontario Department of Lands and Forests decided to respray and on June 7 a Super Agcat repeated the operation. At this point, the budworm was mostly in sixth instar with some pupae present. The respray consisted of one application of fenitrothion at a rate of 5.6 ounces per acre over 800 acres and a second application of 5.6 ounces per acre on the more severely damaged 80 acres. Thus, 80 acres in the Larose Forest received 21 ounces of fenitrothion per acre from a total of four separate applications and the remaining 720 acres received 10 ounces per acre from two separate applications. On June 8, large numbers of spruce budworm and black-headed budworm larvae were observed dropping from the trees.

On May 30, the spray plane proceeded to Petawawa. Poor spraying weather (wind and rainshowers) prevailed over the next three days. Despite the threatening weather conditions, it was decided to spray on the evening of May 31. No wind was noted, but a definite threat of rain existed. By this time, budworm development on white spruce had advanced to almost equal proportions of fourth and fifth instar larvae. About 300 acres were treated with fenitrothion at 4.3 ounces per acre before the pilot stopped spraying, with the onset of darkness at 9:00 p.m. Almost 1/2 inch of rain fell in a hard downpour starting at 11:00 p.m.;

thus for practical purposes the evening's work was considered a "wash out". On the morning of June 2, the remainder of the load from May 31 was sprayed on a large plantation of 5' to 10' spruce trees in gusty weather conditions. By the evening of June 3, the weather had settled and spraying under good conditions resumed. By this time, budworm larvae had developed to mostly fifth instars with some fourths and sixths present. After spraying about 300 acres at a rate of 5.1 ounces per acre, the aircraft crashlanded while attempting to land on Corry Lake and went to the bottom. This accident resulted in a further delay until another spray plane arrived at PFES on June 5. The operation was finally completed by the same pilot on June 7, by which time there were equal proportions of fifth and sixth instar larvae on white spruce. Thus, at PFES 450 acres received two applications of 5.1 ounces and 300 acres received on application of 4.3 ounces per acre (which was rained on).

Entomological Assessment

Pre-spray foliage samples collected from Larose Forest on May 24 averaged 11.4 budworm larvae per 18" tip. Post-spray samples collected June 18 yielded an average of 4.0 living or emerged pupae per 18" tip. However, defoliation was recorded as light, averaging only 14%, and egg-mass counts in August, 1970 were low and indicated light defoliation for 1971 (Table 1).

TABLE 1

Egg-mass Counts and Per cent Defoliation at Four Locations from Larose Forest, Clarence Township, 1970

	Per cent defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Predicted hazard 1971 1/
Larose Forest			
Centre of infestation	28	16	L
Centre of infestation	5	7	L
West edge of infestation	13	10	L
East edge of infestation	11	10	L

1/ L - light.

At Petawawa, a full entomological assessment was carried out, i.e., comparisons were made of population densities in sprayed plots and unsprayed check plots before and after spraying. Pupal counts from sprayed areas ranged from 0 to 24 per 18" tip and averaged about 7 per 18" tip. Defoliation in the sprayed plots was variable, ranging from

very light defoliation in some plantations to very severe in others. In unsprayed control plots, pupal densities overall averaged 16 per 18" tip and defoliation was uniformly severe. Plantations which were sprayed on the evening of May 31 and which were later rained on had lower pupal densities and less defoliation than plantations that were sprayed later for the first time under favourable weather conditions. Egg-mass counts (22 locations) at PFES virtually all supported a forecast of severe defoliation on spruce throughout the station in 1971. This was to be expected since PFES is surrounded by extensive infestations and flights of egg-laden moths were frequent.

Conclusions

Since the purpose of the Larose operation was to protect infested white spruce trees against heavy defoliation by the budworm, it is concluded that from this point of view the operation was successful.

At PFES, the purpose of spraying was similar but the trees had not previously sustained severe damage. Variable success was achieved here in that some plantations were not damaged or only lightly so, whereas others suffered severe defoliation of the current year's foliage despite spraying. It was abundantly clear that, at the population levels dealt with at PFES, feeding by all larval instars up to and including instar IV, against which sprays were applied, was alone sufficient to cause considerable defoliation. The primary causes of the poor protection achieved, therefore, were: the unusually high initial levels of larval populations, a delay in the arrival of the spray plane, a spell of poor flying weather, and the subsequent advanced stage of larval development beyond the fourth instar resulting from the lateness of spraying.

Detailed forecasts of damage in 1971 based on fall egg-cluster counts made in the fall of 1970 are given in Part A.

The experimental plots on the Petawawa Forest Experiment Station must be protected since the high values at stake remain unchanged and the 1970 fall egg-mass counts are high. Alternative operational methods are being planned for 1971 to prevent any further interference with the research goals by the spruce budworm.

NORTHEASTERN ONTARIO OPERATIONS

Background

Spraying was carried out in two provincial parks in the Chapleau District--Missinaibi and Ivanhoe. Only 8,000 of the 157,000 acres of Missinaibi Park were treated whereas all 3,000 acres in Ivanhoe Park were sprayed. Both of these areas contained a high component of white spruce and balsam and had been severely defoliated for two consecutive

years, 1968 and 1969. Forecasts based on egg-mass counts in 1969 were for severe defoliation in 1970, and it was hoped that, by spraying in 1970, a third consecutive year of severe defoliation could be prevented.

Pre-spray Larval Surveys and Insect Development

The determination of spray boundaries was a simple procedure in each of these operations. At Ivanhoe Park, since the entire park was sprayed, spray boundaries coincided with park boundaries, and at Missinaibi, spray boundaries were determined by the limits of defoliation in 1969. Pre-spray larval counts were made in the spring only to ensure that spraying was necessary. These counts showed a high overwintering survival at both locations; in some cases, more than 40 established larvae per 18" tip.

The Canadian Forestry Service was responsible for obtaining data on insect and host development and for following the accumulation of heat units in determining the start of spraying, namely when budworm populations peaked out at instar IV.

The Spraying

Based on advance notice of expected insect development, two spray planes arrived in Chapleau on the evening of June 9, ready to commence spraying immediately. The peak of fourth instar occurred on or about June 9, but poor spraying weather, owing primarily to windy conditions, delayed the operation until June 13. This delay, accompanied by very warm, dry, sunny weather, resulted in continued rapid larval development so that by the time spraying actually started on the morning of June 13, many fifth instars were present in the population. However, when started, the spraying was carried out quickly and was finished by the evening of June 15, by which time sixth instars were present. A total of 11,000 acres received one application of fenitrothion at a rate of 4.3 ounces per acre.

Entomological Assessment

Normally, the success of protection spraying is judged by the degree to which current foliage is preserved. In 1970, a condition characterized by the failure of most white spruce and balsam fir vegetative and flower buds to burst became evident throughout much of northern Ontario. This made it doubly difficult to achieve a good measure of protection, since under these conditions, not only must there remain after spraying a smaller proportion of surviving larvae commensurate with the reduced amount of new foliage on trees to be protected, but like all other protection spraying the reduction in numbers must be accomplished before the larvae cause appreciable damage to the opening buds. Any delay whatever in spraying, therefore, is critical to the

success of the operation. In this case, a high proportion of fifth and some sixth instar larvae were present when the parks were finally sprayed and much of the damage to new shoots which was to have been avoided already had occurred by the time spraying was underway. The difficulty of achieving a high level of protection is further complicated by the high larval densities which were present in the two parks.

During aerial defoliation surveys, both sprayed areas were categorized as being moderately to severely defoliated and no apparent differences in the degree of defoliation could be detected from the air between the sprayed areas and surrounding unsprayed forests. In general, ground checks in both areas confirmed these aerial observations.

High egg-mass counts were made in the sprayed areas in the fall of 1970. This was anticipated regardless of the degree of protection that might have been achieved, since both Ivanhoe and Missinaibi lie within a massive infestation over about some 4.5 million acres of northeastern Ontario.

Conclusions

Under the very confusing circumstances created by the failure of buds of white spruce and balsam to burst in the spring of 1970, it is difficult to draw sound conclusions. The extremes of high budworm populations, coupled with a major reduction in the number of new shoots on which these populations could feed, created a situation in which major damage had already been done by the time sprays were to have been applied. The lateness of spraying, owing almost completely in this case to unfavourable spraying conditions, further accentuated the difficulty. It is fairly certain that spraying accomplished little of measurable value in these two parks except perhaps to reduce the amount of back-feeding, i.e., feeding on old foliage.

Detailed forecasts of damage in 1971 based on egg-cluster counts made in the fall of 1970 are given in Part A.

NORTHWESTERN ONTARIO OPERATIONS

Background

In 1968 and 1969, aerial spraying operations were carried out in the Burchell Lake region of northwestern Ontario in an effort to *knock-out* a spruce budworm infestation that was threatening a nearby area of 4.5 million acres of susceptible spruce-fir forest around Lac des Mille Lacs. This area had not been severely damaged by budworm for over 40 years. These operations were successful in eliminating the Burchell Lake outbreak and by the fall of 1969, egg-mass surveys showed that very low population densities existed throughout the Burchell Lake and Lac des Mille Lacs regions.

However, also in the fall of 1969, two relatively small infestations, which could have resulted either from lingering populations that carried over from an earlier outbreak, or from moth flights from Minnesota, were discovered near the international border, about 25 miles south of Burchell Lake. One of these infestations was located on the south shore of Northern Light Lake and affected over 2,800 acres. The other infestation was located near Granite Lake and here 1,200 acres of defoliation was mapped. Egg-mass counts indicated moderate to severe defoliation in both areas for 1970, although counts at locations in the surrounding vicinity were low. This indicated that no significant spread had occurred and that the infestations were apparently discrete entities.

During the winter of 1969-70, discussions between the Ontario Department of Lands and Forest and the Canadian Forestry Service led to the decision to spray with the purpose of knocking out these infestations in June, 1970. It was felt that if these infestations were allowed to increase and spread, the objectives and results of the 1968 and 1969 operations would be compromised.

Pre-spray Surveys and Insect Development

The determination of meaningful spray boundaries was a major problem for which two possibilities lay open to forest management, namely,

1. Spraying could have been confined to those forests found to harbour high populations. This approach would have required rather intensive field sampling in the spring to determine spray boundaries.

2. Forested areas could have been roughly blocked out for spraying based simply on the defoliation information, egg sampling data, and a limited number of larval counts made in the spring.

Since it proved impractical to conduct an intensive pre-spray larval survey owing to the inaccessibility of terrain, the second of these two methods of delineating areas to be sprayed was employed. Defoliation maps, egg-mass sampling data, early instar larval counts from 45 locations, and information from forest type maps were used to block out the spray areas. It was decided to spray 5,200 acres at Northern Light Lake, 2,300 acres at Granite Lake, and 3,500 acres on the north shore of Gunflint Lake. The highest populations were found in the Northern Light Lake infestation and this area was to be sprayed twice.

An additional 50 locations were sampled in the Burchell Lake, French Lake and Lac des Mille Lacs regions. Very low larval counts were common throughout this entire area.

Emergence from hibernaculae was complete by May 18 which was about 10 days later than usual. Field personnel of the Canadian Forestry Service followed insect development and host development and this information combined with accumulated heat units was used to determine the optimum time for the start of spraying. Spraying was to start when the budworm had reached 50% third instar and 50% fourth instar.

The Spraying

It was recommended on June 6 that spraying should commence immediately, i.e., as soon as a spray plane could get to Northern Light Lake. However, a plane was not available until June 13. A period of exceptionally warm weather from June 6 to 10 resulted in rapid insect development, and about equal proportions of the larval population were in fourth and fifth instars when spraying actually commenced on the morning of June 14. Spraying was completed by June 26, but by then most of the budworm were in sixth instar with some pupae present. The continuance of spraying at this late time was, of course, commensurate with the objective here of knock-out spraying.

Fenitrothion was applied at the rate of 5.1 ounces per acre, except for the first four loads when 4.3 ounces per acre was applied. The dosage rate was increased owing to the advanced stage of larval development. A total of 5,250 acres at Northern Light Lake were treated twice with about 6 days between applications, and 2,250 acres at Granite Lake plus 3,500 acres at Gunflint Lake received a single application.

Entomological Assessment

Pupal counts in the sprayed areas showed that a substantial population, 1.6 pupae per 18" tip, survived in the Northern Light Lake infestation. No pupae were found at Granite Lake or Gunflint Lake. Aerial surveys showed considerably smaller areas of moderate to severe defoliation this year than last; 750 acres at Northern Light Lake compared to 2,800 acres in 1969, and 650 acres at Granite Lake compared to 1,200 acres in 1969. No defoliation was detected at Gunflint Lake.

Corresponding to the counts of pupae, egg-mass surveys in August, 1970 indicated the presence of populations high enough to cause moderate and severe defoliation at Northern Light Lake in 1971. However, at Granite Lake, one of the two sprayed areas where no pupae were found, the number of egg-masses present supported a forecast of moderate defoliation for 1971, thus suggesting the influx of moths. At the other, Gunflint Lake, the egg-mass counts were considerably lower and defoliation is not expected to exceed light intensity next year (Table 2).

TABLE 2

Egg-mass Counts and Per cent Defoliation in Sprayed Areas, Thunder Bay District, 1970

	Per cent defoliation 1970	No. of egg-masses per 100 sq. ft. of foliage	Predicted hazard 1971 1/
Northern Light Lake			
Location 1	76	390	S
" 2	38	80	M
Granite Lake			
Location 1	12	168	M-S
" 2	30	193	M-S
" 3	46	106	M
Gunflint Lake			
Location 1	0	38	L
" 2	2	0	Nil

1/ L - light defoliation; M - moderate defoliation; S - severe defoliation.

Egg-mass counts obtained from an additional 15 locations outside of but close proximity to sprayed areas revealed very low populations.

Conclusions

Since the primary objective of this operation was to eliminate the two pockets of heavy infestation, it must be concluded that the operation was not completely successful. The problems encountered were largely logistical in nature, such as the prompt procurement of a spray plane when spraying was to commence. Spraying of budworm when the larvae were in an advanced state of development undoubtedly contributed to the lack of adequate knock-down at Northern Light Lake and possible at Granite Lake. The consequence is that the status of these two infestations has changed little from 1969 to 1970 except that they have been reduced in size. Perhaps also due to spraying, no indication was found of population increases or of infestations spreading into surrounding forest.

Detailed forecasts of damage in 1971 and the general budworm picture in northwestern Ontario are given in Part A.

It is expected that aerial spraying operations designed to eliminate the Northern Light Lake and Granite Lake infestations in the Thunder Bay District will be resumed in 1971. However, decisions regarding spraying in the Fort Frances District cannot be made until additional surveys have been completed.