THE EFFECT OF OPERATIONAL APPLICATION OF VARIOUS INSECTICIDES ON SMALL FOREST BIRDS AND MAMMALS

Project CC-014

by

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INTRODUCTION

Major infestations of the spruce budworm Choristoneura fumiferana Clem continue to damage the spruce-balsam forests of Eastern Canada. Operational and experimental control spray programs have been carried out since the early 1950's using a variety of chemical and biological insecticides.

In 1970 the Environmental Impact team of Chemical Control Research Institute initiated a monitoring program to assess the impact of some of the current control operations upon small forest vertebrate fauna. This report deals with the monitoring operations in New Brunswick, Quebec and Ontario in 1971-72.

(Fig 1)

METHODS

Songbird populations were assessed on treatment and control plots before and after the application of insecticides. Breeding territories of singing males were mapped on 20 acre plots using methods similar to those outlined by Kendeigh , 1944; and Buckner and Turnock, 1965.

Small mammal populations were monitored about a month after treatment. Snap-back mouse traps were used on plots measuring 100 yards X 4 yards. A center line is established and trap stations are marked at 10 yard intervals. 5 traps are placed at each station, one on the center line and two to each side at 1 yard intervals. Trap lines are checked twice daily during a period of three consecutive trap nights. All specimens taken are weighed, measured, aged, sexed, checked for breeding condition, all external parasites are removed and preserved for laboratory examination and chemical analysis.

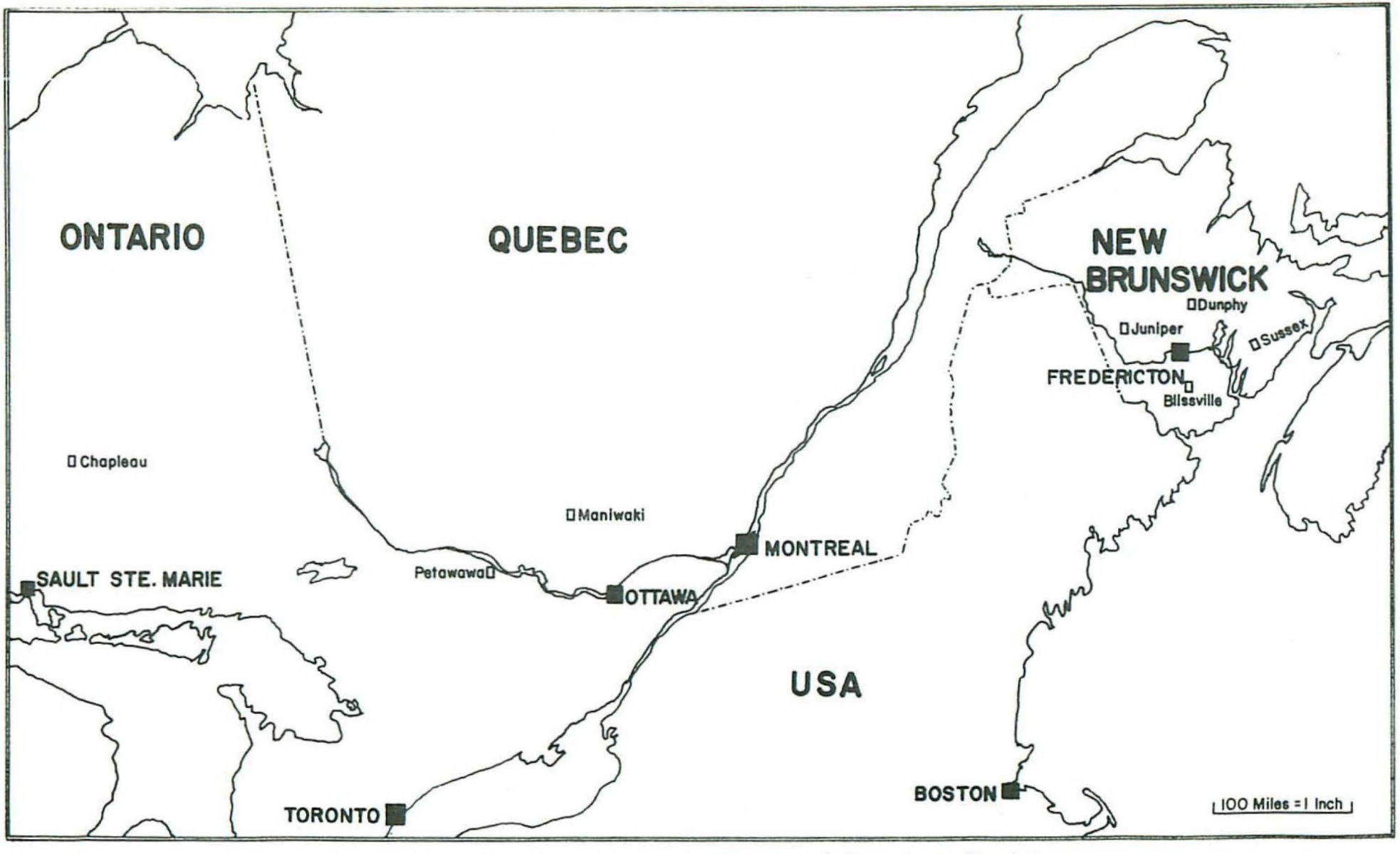

Figure 1. Locations at Environmental Impact monitoring operations in Eastern Canada, 1971-72.

NEW BRUNSWICK

Many forested areas of New Brunswick were treated with various insecticides in an attempt to reduce the damage of spruce budworm. Five of these operations were monitored for short term effects of the insecticide upon either breeding bird or small mammal populations.

HARCOURT - 1971

A plot of 12,000 acres near the settlement of Harcourt, about 40 miles east of the Dumphy air strip (Fig 4) was treated in early June 1971 with an operational application of Matacil^{R}. The spray was delivered by aircraft at the rate of 1.5 ozs. of active ingredient per acre in Panasol emitted at the rate of 0.15 gals. per acre (U.S.).

In mid July the Environmental Effects team monitored the impact of this chemical insecticide upon the small mammal complex inhabiting the spray plot. Personnel from the Canadian Wildlife Service monitored the effects on birds for this operation.

Methods

Populations of small mammals inhabiting the Harcourt spray plot were censused by means of standard small mammal snapback trap lines. Five lines were established in order to collect specimens to be used in determining the makeup of the complex, ages, breeding condition and impact on the young of the year.

Line one was established across an open grass covered meadow while the other four trap lines were located in forested areas. Line five followed the bank of a small running stream.

A total of four consecutive nights were trapped and all specimens collected were identified, sexed, aged, and preserved in 70% alcohol for examination at a later date in the laboratory.

Results

A total of 89 small mammals were collected from the Harcourt spray plot representing the following species; the meadow vole, Microtus pennsylvanicus (Ord); the red- backed vole, Clethrionomys gapperi (Vigors), the short-tailed shrew, Blarina brevicauda (Say); the white-footed mouse, Peromyscus maniculatus (Wagner); the woodland jumping mouse, Napaeozapus insignis (Miller) and long-tailed shrews, Sorex spp.

M. pennsylvanicus was taken only in the open meadow while C. gapperi and the other mammal species were trapped only in the forest habitat (appendix table 1). The two species of voles accounted for 78 of the animals trapped. Examination of the specimen revealed that sub-adults accounted for nearly 40% of the animals trapped (appendix table 2). As these animals were estimated to range in age from 4 to 8 weeks, many must have been on the plot at the time of treatment.

Adult female M. pennsylvanicus (13) and C. gapperi (5) were dissected and the genital tract examined to see if any interuption of breeding had occurred as a result of the insecticide spray.

TABLE I

FECUNDITY OF TWO SPECIES OF ADULT VOLES TRAPPED ON THE MATACIL SPRAY PLOT - HARCOURT, NEW BRUNSWICK - JULY 1972

Species	Not Pregnant	Not pregnant with placental scars	Embryos only	Placental scars and embryos
Microtus pennsylvanicus	2	2	5	4
Clethrionomys gapperi	0	0	5	0

All adult female specimens with the exception of two were either pregnant or contained placental scars indicating the recent birth of a litter.

snap-back trap line method. Six lines were run on the control plot and six each in the Matacil and Zectran spray plots. Trapping was carried out on three consecutive nights (Aug. 2-4) and produced a total of 159 small mammals representing 8 species. Only 2 species were taken in any numbers, the red-backed vole, Clethrionomys gapperi (Vigors) with 91 specimens, and the white-footed mouse, Peromyscus maniculatus (Wagner) with 53 specimens. Other species taken were the meadow jumping mouse, Zapus hudsonius (Zimmermann) 1; the woodland jumping mouse, Napaeozopus insignis (Miller) 6; the eastern chipmunk, Tamias striatus (Linnaeus) 5; the meadow vole, Microtus pennsylvanicus (Ord) 1; the red squirrel, Tamiasciurus hudsonicus (Erxleben) 1; and the short-tailed shrew, Blarina brevicauda (Say) with 1 (Table 7).

The adult female C. gapperi and P. maniculatus were dissected and the genital tract examined for the presence or absence of embryos or placental scars (Table 8). In addition to the snap-back trap lines, additional specimens from live traps were also brought to the laboratory for observation.

ONTARIO

CHAPLEAU 1972 Monitering tie effects of biological insecticides upon non target components of the environment were iniated in 1971 when Pox Virus spray trials were conducted in spruce budworm infestations in Algonquin Park (Buckner and Cunningham 1971).

The Environmental Impact team monitered two biological insecticide spray trials in the Chapleau area of Ontario in 1972 (Fig. 6). Standard 20 acre breeding bird plots were set up in areas to be treated with "Pox Virus" and "Nuclear Polyhedral Virus" and in control area.

43 species of birds representing 14 families recorded from the plots. 14 species of Parulids, 5 species Fringillids, and 4

Planned insecticide applications in this area were a double application of fenitrothion at the rate of 2 ozs. active ingredient per acre in oil base on Block #215, and a single 3 oz. per acre emulsion-base application on Block #223.

BLISSVILLE 1972 Resident breeding bird territories had become well established by the time the pre-spray population census was conducted on 2 treatment and 1 control plot, Fig 3. 47 species representing 14 families were monitered. Again the wood warblers (Parulidae) were the largest group recorded with 18 species, followed by the FRINGILLIDS with 6 species and TURDIDS with 5 (APPENDIX Table 4). Planned applications using fenitrothion at the rate of 4oz active ingredient per acre for block #392 and 3oz active ingredient per acre for block 334. Both sprays to be used in an oil base solution.

TABLE 3

BREEDING BIRD POPULATIONS RECORDED ON BLISSVILLE AREA PLOTS

NEW BRUNSWICK 1972

	Block #329		Block #334		Control	
	Pre Spray	Post Spray	Pre Spray	Post Spray	Pre Spray	Post Spray
No. of families	11	7	12	10	11	7
No. of species	28	21	26	23	24	27
Total Pairs/100 acres	245	220	295	285	255	293

JUNIPER-1972 51 species of birds representing 14 families were monitered on the Juniper area plots (Fig 4) 18 species of PARULIDS, 10 species of Fringilleds and 5 species of Turdids were the most common recorded (APPENDIX TABLE 5).

Planned application of fenitrothion for blocks 457H (Hardwoods) and 457 S (Softwoods) was for 3 oz of active ingredient per acre in an emulsion based solution.

TABLE 4

BREEDING BIRD POPULATIONS RECORDED ON JUNIPER AREA PLOTS

NEW BRUNSWICK 1972

	#457 Hardwood		#457 Softwood		Control*	
	Pre Spray	Post Spray	Pre Spray	Post Spray	Pre Spray	Post Spray
No. of families	9	8	11	10	9	7
No. of species	27	23	29	26	29	25
Total pairs/100 acres	460	372	369	288	407	341

DUNPHY 1972 Fifty species of birds representing 15 families were recorded on Block 125, the Priceville block and the control plot, (Fig. 4) (Both Dunphy and Juniper areas share a common control). The family Parilidae was most abundant with 17 species followed by Fringillidae with 8 species and TURDIDAE with 4 (Appendix Table 6).

Planned application of fenitrothion for block 125 was for a "two plus two" dosage of 2 oz. of active ingredient per acre in an oil base while the Priceville plot was to receive a single dosage of 3 oz. active ingredient per acre.

TABLE 5

BREEDING BIRD POPULATIONS RECORDED ON DUNPHY AREA PLOTS

NEW BRUNSWICK 1972

	Block #125		Priceville		Control*	
	Pre Spray	Post Spray	Pre Spray	Post Spray	Pre Spray	Post Spray
No. of families	10	11	12	10	9	7
No. of species	25	26	30	24	29	25
Total pairs/100 acres	259	272	335	248	407	341

QUEBEC

MANIWAKI-1972 Two candidate insecticides, Matacil^{R} (4-dimethylamino-m-tolyl methylcarbamate) and Zectran^{R} (4-dimethylamino-3,5-xylyl methylcarbamate) were aerially applied at the rate of 3/4 oz. active ingredient in 20 ozs. liquid per acre (Randall, unpublished manuscript) to two experimental blocks in the Mont Laurier area of Quebec (Fig. 5).

The impact of these two chemical insecticides upon populations of small mammals and songbirds was assessed by a team from Environmental Effects Section of the Chemical Control Research Institute.

Breeding bird populations were measured on standard 20-acre plots, two in a control area south of Maniwaki, two in the Zectran spray area between Grand Remous and Mont Laurier, and one in the Matacil spray area north of St. Michel.

Small mammal populations were measured on six standard snap-back trap lines in each area.

Breeding Birds

Most species of migratory songbirds had arrived from the south and had established nesting and foraging territories by the time the pre spray census was complete (June 1). A three-day population census was conducted on each plot before and after the spray. A total of 49 species representing 15 families were recorded on 5 plots.

TABLE 6

BREEDING BIRD POPULATIONS RECORDED ON MANIWAKI AREA

PLOTS QUEBEC 1972

	Control #1		Control #2		Zectran #3		Zectran#4		Matacil#5	
	pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
No. of Families	5	5	5	7	10	6	6	6	2	3
No. of species	21	18	15	15	34	18	17	11	3	5
Total pairs/100	230	245	115	230	200	170	185	95	60	45

The family PARULIDAE was the largest group recorded with 19 species, the family FRINGILLIDAE was next with 10 species (APPENDIX TABLE 7)

Small mammal populations were censused by the standard

TABLE 7

BREEDING DATA OF ADULT FEMALE Clethrionomys gapperi AND Peromyscus maniculatus FROM MANIWAKI SPRAY PLOTS

Plot	C. gapperi				P. maniculatus			
	Not Pregnant	Not Pregnant With Scars	Embryos Only	Embryos With Scars	Not Pregnant	Not Pregnant With Scars	Embryos Only	Embryos + Scars
Control Plot #1	0	1	0	0	0	0	0	1
Control Plot #2	0	0	0	1	0	1	0	0
Zectran Plot #3	0	2	0	3	0	3	1	2
Zectran Plot #4	2	3	1	3	1	0	1	4
Matacil Plot #5	0	2	0	2	1	2	0	1
Matacil Plot #6	1	2	1	4	0	1	0	1
TOTALS	3	10	2	13	2	7	2	9
		28				20		

Discussion

A 12,000 acre block of forest near the settlement of Harcourt was treated with an application of Matacil at the rate of 1.5 oz of active ingredient mixed with Panasol and emitted at the rate of 0.15 gals per acre (U.S.). A total of 89 small mammal specimens were trapped of which nearly 40% were sub adults under 8 weeks of age. Dissection of adult female M. pennsylvanicus and C. gapperi showed 89% in breeding condition.

Conclusions

The evidence obtained from specimens collected from the Harcourt spray plot would indicate that under the conditions of this application, Matacil had little or no detrimental effect upon populations of small mammals inhabiting either a forest or open environment.

SUSSEX Area, 1972. Breeding bird populations were monitored in three plots of the Sussex area spray. The control plot was located at Alma, treatment plot 233 in the Fundy National Park, and treatment plot 215 north east of Alma along highway 14.

A total of 37 species representing 13 families were recorded (Appendix table). The wood warblers, (Parulidae) made up the largest group with 15 species, followed by the sparrow, finch and grosbeak family (Fringillidae) with 7 species.

TABLE 2

BREEDING BIRD POPULATIONS RECORDED ON SUSSEX AREA PLOTS, NEWBRUNSWICK 1972

	Block # 215		Block #223		Control	
	Pre Spray	Post Spray	Pre Spray	Post Spray	Pre Spray	Post Spray
No. of families	8	5	9	8	8	6
No. of species	14	21	19	21	14	17
Total pairs/100 acres	162	300	185	269	158	219

species of TURDIDS were the most common migrants. 5 species of woodpeckers (Picidae) also inhabited the plots (Appendix Table 9).

TABLE 8

BREEDING BIRD POPULATIONS RECORDED ON CHAPLEAU SPRAY PLOTS

CHAPLEU ONTARIO 1972

	Pox Virus		NPV		Control	
	Pre Spray	Post Spray	Pre Spray	Post Spray	Pre Spray	Post Spray
No. of families	11	9	12	10	12	9
No. of species	21	21	19	20	19	24
Total pairs/100 acres	246	238	193	178	271	314

Analysis of the breeding bird data indicated that under the conditions if applications for these two biological insecticides little or no damage was inflected upon the breeding bird populations of the area.

PETAWAWA-1972 The Petawawa Forest Experiment Station is located about 120 miles northwest of Ottawa, just east of Algonquin Provincial Park (Fig. 1). In 1972, long-established spruce plantations were threatened once again by a spruce budwomm infestation. Operational sprays using Fenitrothion to be emitted at the rates of 2 and 18 ozs. of active ingredient per acre were applied by aircraft during the latter part of May and early June.

The Environmental Impact team monitored post spray bird populations to determine whether any population changes were produced by the program. Standard 20-acre bird plots on similar habitats were used in the population assessment: one control, one 2 oz. per acre plot, and two 18 oz. per acre, plots were monitored. APPENDIX TABLE 10

A total of 40 species of birds representing 15 families were recorded. Parulidae and Fringillidae were the two families most prevalent on the plots with 10 and 9 species respectively.

The Parulidae family as a group suffered a general decline in all spray plots as compared to the control while the Fringillid

family were reduced mainly in the 18 oz. per acre spray area. The two species of kinglets (Sylviidae) also suffered losses in all sprayed areas as did the family Tyrannidae. The group of three species of woodpeckers (Picidae) appeared to be non-affected as were the thrushes (Turdidae) and woodpeckers (Picidae).

ALGONQUIN PARK POXVIRUS

The area treated with poxvirus in 1971 (Buckner and Cunningham 1972) was re-examined for possible long-term effects in 1972. No significant differences were recorded for either birds or mammals on the treatment and control plots (Table 9).

TABLE 9

	Pox virus treatment	Control
Birds		
No. of families	9	10
No. of species	21	19
Breeding Pairs/100 acres	241	239
Mammals		
No. species	8	8
Population/100 acres	640	680
Mean no. embryos	6.3	6.2
Mean no. embryo scars	5.8	5.9

RESULTS

Analysis of data collected from eleven treatment and control plots would indicate that under the conditions of application, song bird population suffered no significant damage or loss.

RESULTS

BIRDS Analysis of the data received from the breeding bird plots would indicate that under the conditions of application no detectable harm resulted from the experimental spray programs.

SMALL MAMMALS The results obtained from the snap-back trap lines

indicate that no immediate effects were suffered by either of the two major species. Twenty-five of the 28 adult female C. gapperi, and 18 of the 20 P. maniculatus were either pregnant or contained placental scars indicating the occurrence of recent pregnancies (Table 7). Several pairs of live-trapped C. gapperi continued to breed normally in captivity in the laboratory.

ACKNOWLEDGMENTS

We are indebted to the following for assistance in the collection of data for these reports, the personnel of the Maritimes Forest research Center in Fredrecton N.B.; personnel of the Ontario Ministry of Natural Resources; Insect Pathology Research Institute in Sault Ste. Marie. We would like to acknowlege the following who assisted in the collection of field material, I.M. Ressor, J. Martin, S. Blais, S. Chalykoff, C. Metcalf, and R. Lidstone.

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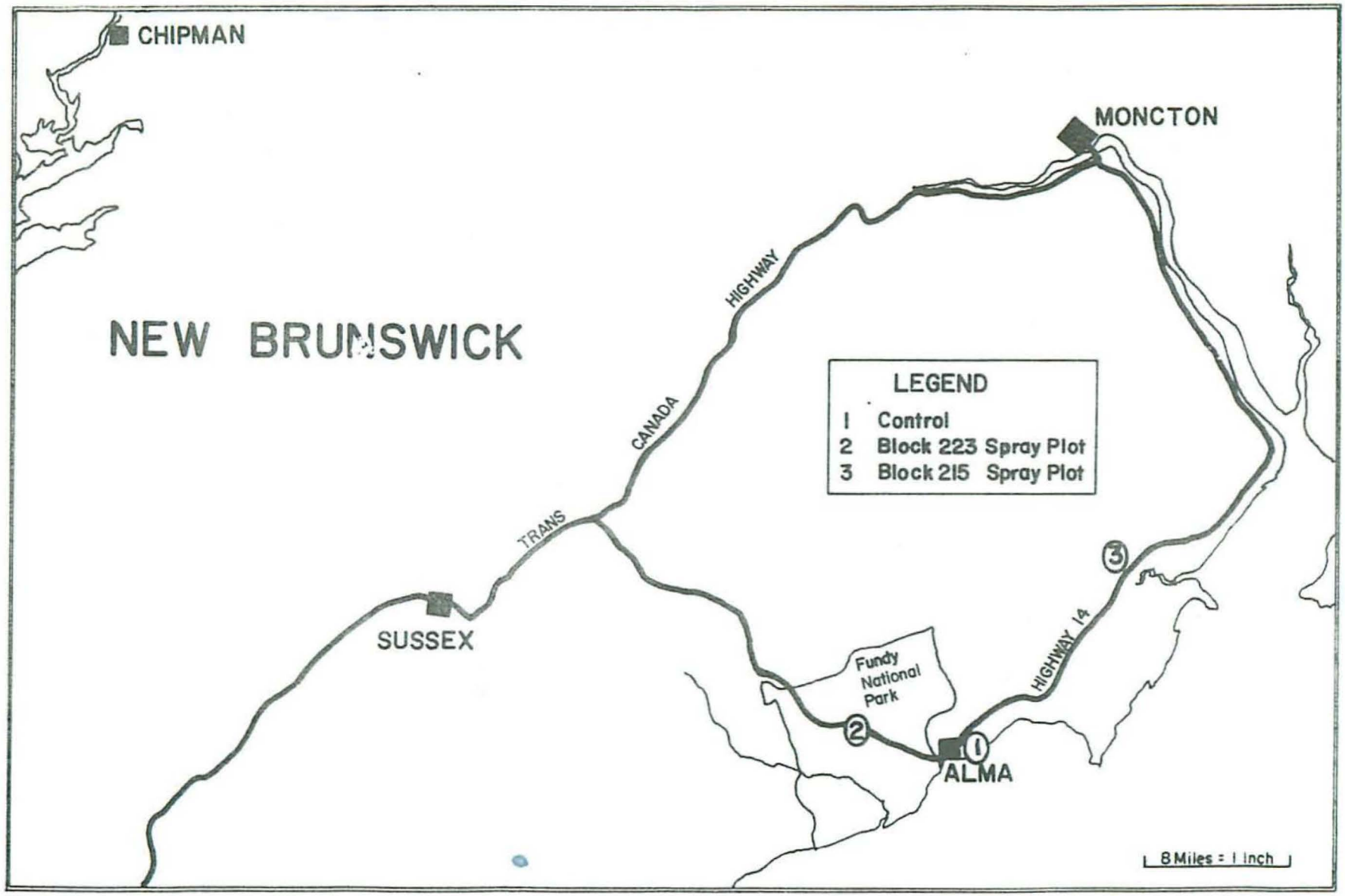

Figure 2 - Spray Plot locations, Sussex area of New Brunswick, 1972.

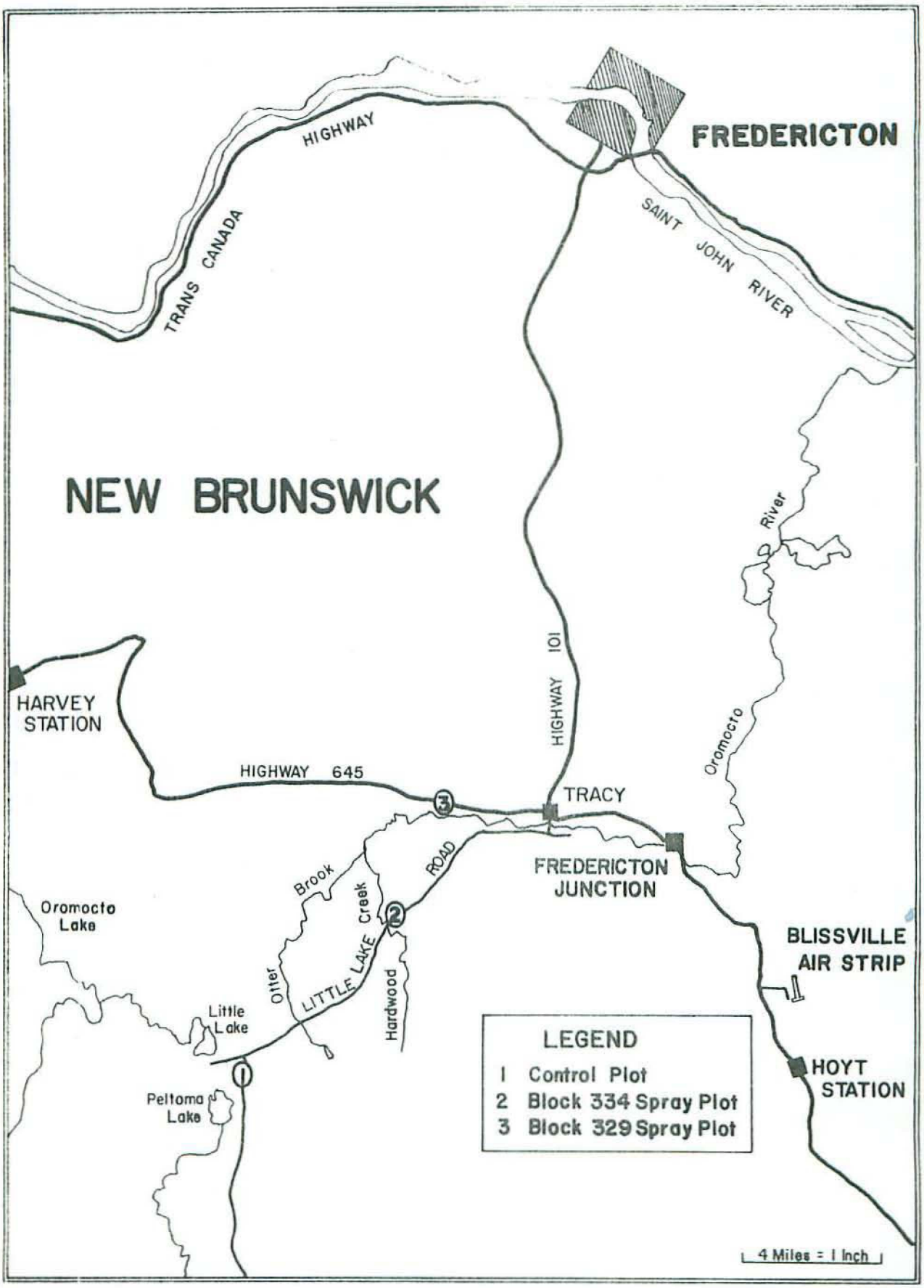

Figure 3 - Spray Plots locations, Blissville Area, New Brunswick 1972.

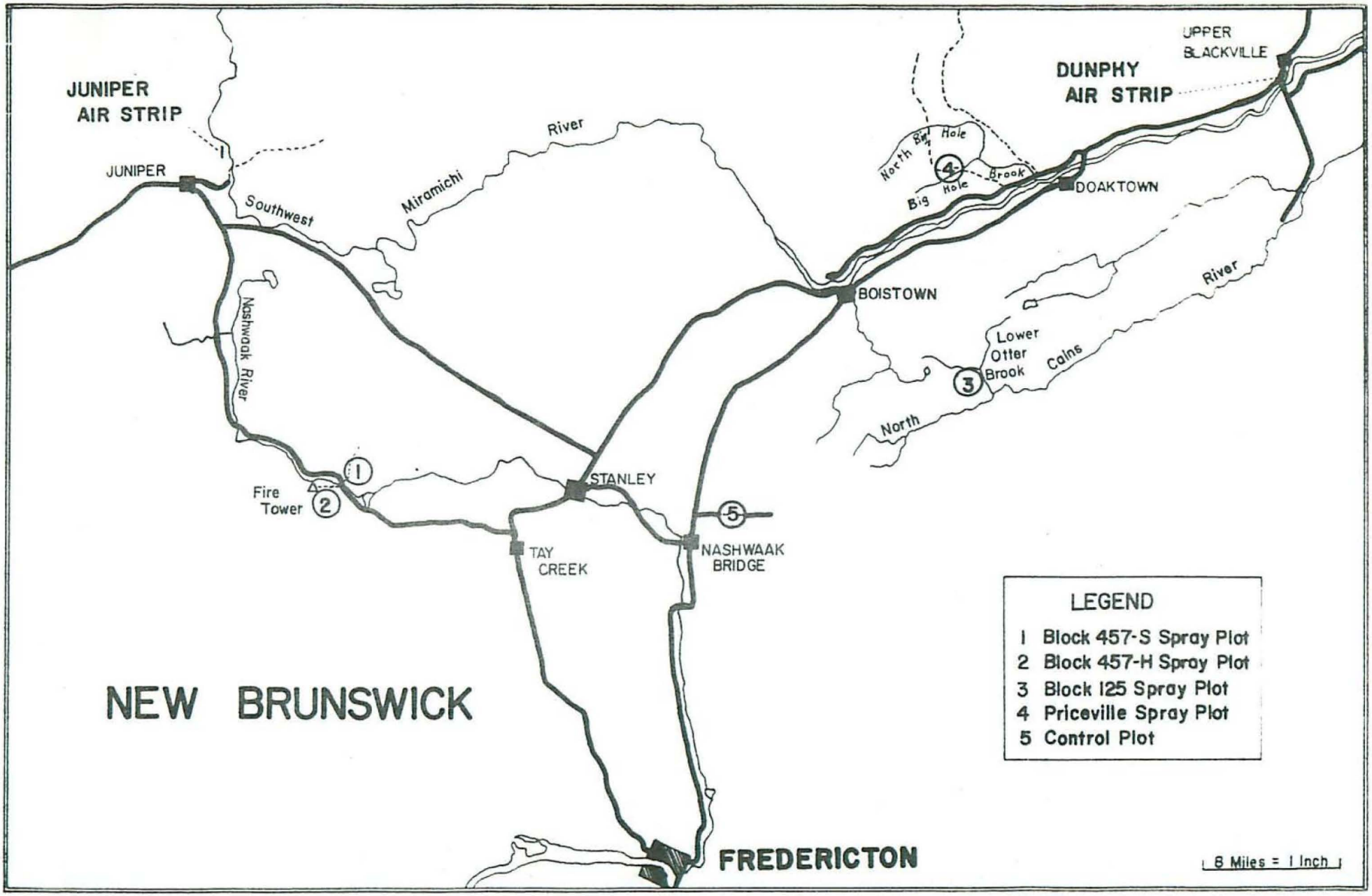

Figure 4 - Plot locations for the Juniper and Dunphy area sprays, New Brunswick, 1972.

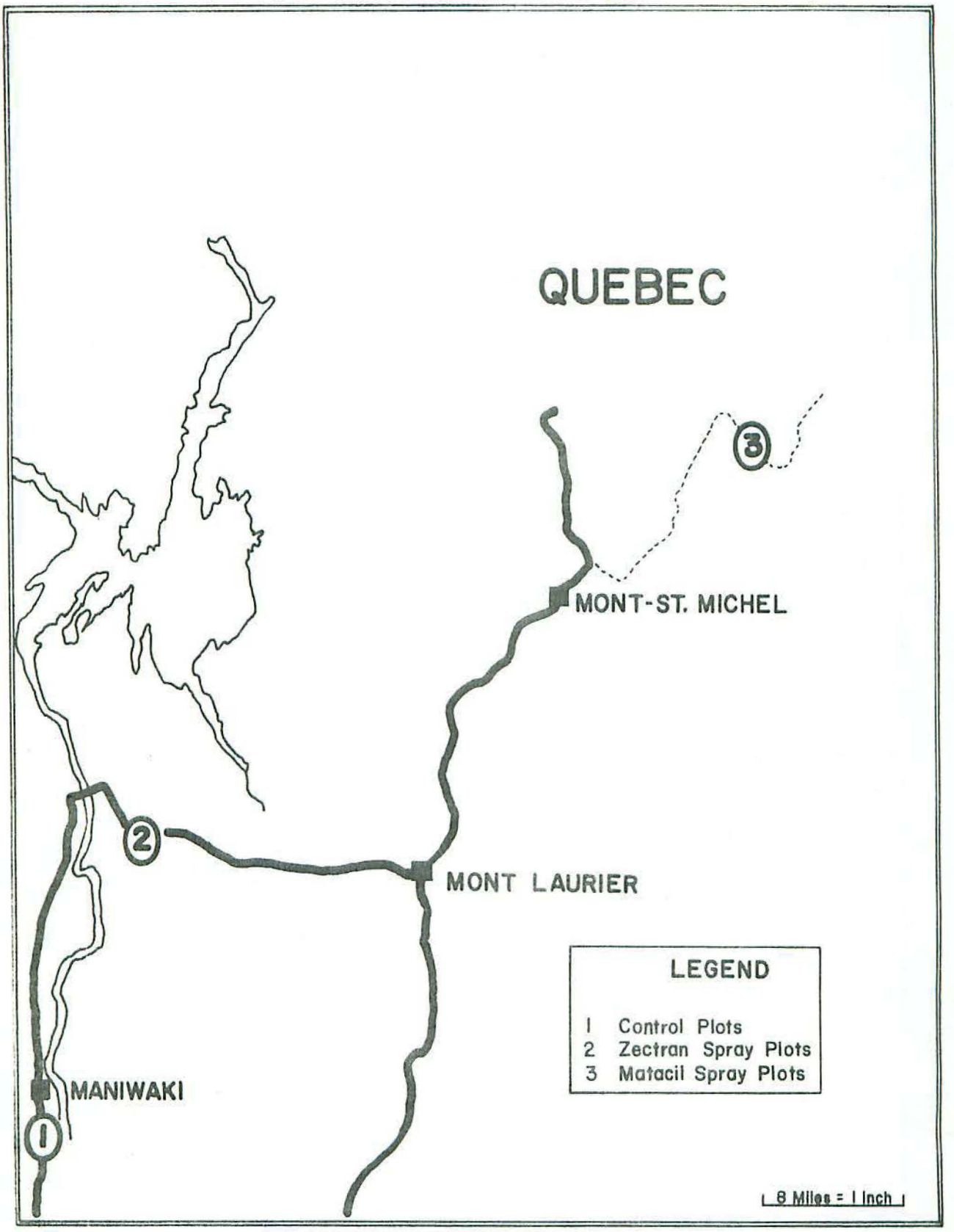

Figure 5. - Plot Locations for the Maniwaki-Mont Laurier area sprays, Quebec 1972.

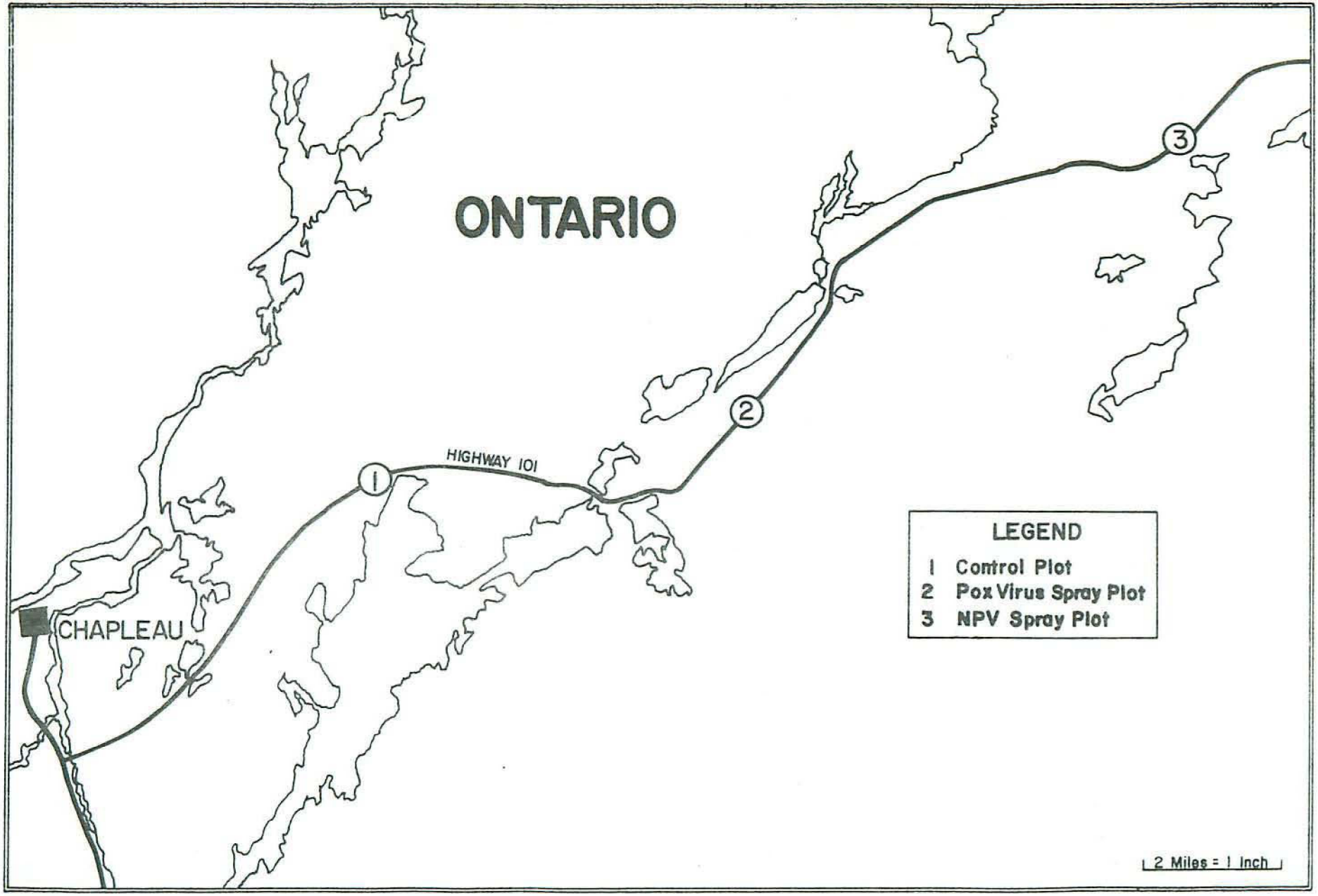

Figure 6 - Plot locations of Chapleau area sprays - Chapleau, Ontario - 1972.

APPENDIX

TABLE I

SMALL MAMMAL POPULATIONS FROM FIVE SNAPBACK TRAP LINES
MATACIL SPRAY PLOT - HARCOURT, NEW BRUNSWICK - JULY 1971

Plot No	Habitat	Numbers of Small Mammals Trapped					
		Microtus pennsylvanicus	Clethrionomys gapperi	Sorex spp	Napaeozapus insignis	Peromyscus maniculatus	Blarina brevicauda
1	meadow	45	0	0	0	0	0
2	forest	1	12	1	0	0	0
3	forest	2	2	2	0	1	0
4	forest	2	10	3	2	0	0
5	forest	0	4	0	1	0	0
Total		50	28	6	3	1	1

APPENDIX

TABLE 2

SEX AND AGE STRUCTURE OF SMALL MAMMALS TRAPPED ON MATACIL SPRAY PLOT - HARCOURT, NEW BRUNSWICK - JULY 1971

Species	Females			Males		
	Adults	Subadults	Juv	Adults	Subadults	Juv
M. pennsylvanicus	13	15	0	9	12	1
C. gapperi	5	3	0	15	5	0
Sorex spp.	4	0	0	2	0	0
B. brevicauda	0	0	0	1	0	0
P. maniculatus	0	0	0	1	0	0
N. insignis	1	0	0	2	0	0

APPENDIX

TABLE 3

SUSSEX AREA SONGBIRD POPULATIONS IN
PAIRS PER HUNDRED ACRES

	Populations						Difference		
	##215		##223		Cntrl		#215	#223	Cntrl
	--	++	--	++	--	++			
PICIDAE									
Yellow-shafted Flicker	1	0	1	0	1	0	- 1	-- 1	- 1
Yellow-bellied Sapsucker			1	0	1	0		- 1	- 1
TYRANNIDAE									
Yellow-bellied Flycatcher	0	5	5	5	0	10	5	0	10
Eastern Wood Peewee	0	5					5		
CORVIDAE									
Gray Jay	1	0					- 1		
PARIDAE									
Black-capped Chickadee	5	0			0	5	- 5		5
SITTIDAE									
Red-breasted Nuthatch			0	10				10	
TROGLODYTIDAE									
Winter Wren	5	0	5	5	5	0	- 5	0	- 5
MIMIDAE									
Catbird					5	0			- 5
TURDIDAE									
American Robin	25	30	40	20	35	10	5	-20	-25
Swainson's Thrush	0	15	0	15	0	25	15	15	25
SYLVIIDAE									
Golden-crowned Kinglet			5	0				- 5	
Ruby-crowned Kinglet	15	20	20	15	20	5	5	- 5	-15
VIREONIDAE									
Solitary Vireo			10	5				- 5	
PARULIDAE									
Black-and-white Warbler	5	20	5	15			15	10	
Tennessee Warbler	0	35	0	30	0	30	35	30	30
Nashville Warbler	0	5	10	0			5	-10	
Parula Warbler			0	10				10	
Magnolia Warbler	0	20	0	25	0	15	20	25	15
Cape May Warbler	0	10	5	10			10	5	
Black-throated Blue Warbler	0	0	15	0	0	5	0	-15	5
Myrtle Warbler	20	5	0	10	5	0	-15	10	- 5
Black-throated Green Warbler	0	10	0	10	5	10	10	10	5
Blackburnian Warbler	0	15					15		
Chestnut-sided Warbler	5	10					5		
Ovenbird	0	20	0	5	20	5	20	5	-15
Mourning Warbler	0	0	0	15	0	10	0	15	10
Yellowthroat	0	10	0	0	0	0	10	0	0
American Redstart	20	10	0	20	5	25	-10	20	20
ICTERIDAE									
Rusty Blackbird	0	0	3	0	6	0	0	- 3	- 6
FRINGILLIDAE									
Rose-breasted Grosbeak			5	0				- 5	
Evening Grosbeak	0	5	0	4	0	4	5	4	4
Purple Finch	5	0	10	0	5	5	- 5	-10	0
Slate-colored Junco	15	15	5	5	10	5	0	0	- 5
Chipping Sparrow	15	20	5	5	0	5	5	0	5
White-throated Sparrow	25	15	30	30	35	45	-10	0	10
Swamp Sparrow			5	0				- 5	

APPENDIX

TABLE

MANIWAKI AREA SONGBIRD POPULATIONS IN PAIRS PER HUNDRED ACRES

	Population										Difference				
	Cntrl ##1		Cntrl ##2		Zectran ##3		Zectran ##4		Matacil ##5		C1	C2	Z3	Z4	M5
	--	++	--	++	--	++	--	++	--	++					
TETRAEONIDAE															
Ruffed Grouse			0	5	5	0							- 5		
PICIDAE															
Yellow-bellied Sapsucker					1	0							- 1		
Hairy Woodpecker			3	0	1	0	1	0				- 3	- 1	- 1	
TYRANNIDAE															
Eastern Phoebe			0	5	5	0							5	- 5	
HIRUNDINIDAE															
Tree Swallow					5	0							- 5		
CORVIDAE															
Blue Jay	1	3	0	5	1	0					2	5	- 1		
PARIDAE															
Black-capped Chickadee	0	10	0	15	0	5	0	10			10	15	5	10	
SITTIDAE															
Red-breasted Nuthatch									5	0					- 5
TROGLODYTIDAE															
Winter Wren							5	5						0	
Long-billed Marsh Wren			0	5								5			
TURDIDAE															
American Robin	20	15	10	10	5	5	5	0			- 5	0	0	- 5	
Hermit Thrush	10	10	5	0	5	10					0	- 5	5		
Swainson's Thrush	10	5	5	0	5	0					- 5	- 5	- 5		
Veery	20	30	0	30	5	5	15	10			10	30	0	- 5	
BOMBYCILLIDAE															
Cedar Waxwing			3	0	5	0						- 3	- 5		
VIREONIDAE															
Solitary Vireo					5	0							- 5		
Red-eyed Vireo	10	0	25	40	10	5	40	10			-10	15	- 5	-30	
PARULIDAE															
Black-and-white Warbler	5	10	0	5	5	0	5	5			5	5	- 5	0	
Golden-winged Warbler	0	5									5	5			
Tennessee Warbler	5	0			5	0					- 5		- 5		
Nashville Warbler	15	15	5	0	30	5	10	0	10	25	0	- 5	-25	-10	15
Parula Warbler					0	5	5	0					5	- 5	
Yellow Warbler					10	5							- 5		
Magnolia Warbler	10	5	5	0	10	5	0	5	5	5	- 5	- 5	- 5	5	0
Black-throated Blue Warb.			0	10								10			
Myrtle Warbler	5	0			5	0	5	0			- 5		- 5	- 5	
Blackburnian Warbler			5	0	25	0	15	0				- 5	-25	-15	
Chestnut-sided Warbler	30	40	5	0	5	10			5	0	10	- 5	5		- 5
Bay-breasted Warbler	10	0									-10				
Blackpoll Warbler					5	5							0		
Pine Warbler							0	5						5	
Ovenbird	25	30	15	60	20	15	35	15			- 5	45	- 5	-20	
Mourning Warbler	5	5	0	5	5	0	5	0			0	5	- 5	- 5	
Yellowthroat	5	0			20	0					- 5		-20		
Canada Warbler			0	5	5	0						5	- 5		
American Redstart	5	0	5	0	5	0					- 5	- 5	- 5		
ICTERIDAE															
Redwinged Blackbird					2	5							3		
Brown-headed Cowbird					2	3							1		
THRAUPIDAE															
Scarlet Tanager					5	0							- 5		
FRINGILLIDAE															
Rose-breasted Grosbeak	10	5	0	15	5	0	10	0			- 5	15	- 5	-10	
Indigo Bunting	0	10									10				
Evening Grosbeak	1	0	5	0	6	0	3	0			- 1	- 5	- 6	- 3	
Purple Finch	5	0	25	0	10	5					- 5	-25	- 5		
American Goldfinch	0	5	0	5	0	1	0	1			5	5	1	1	
White-winged Crossbill					1	0							- 1		
Chipping Sparrow			5	0	5	0						- 5	- 5		
White-throated Sparrow	20	50	20	40	20	25	5	5	5	45	30	20	5	0	40
Song Sparrow	0	5					5	0			5		- 5		
Swamp Sparrow					0	10							10		

APPENDIX

TABLE 5

Juniper Area Songbird Populations in Pairs per Hundred Acres

	Populations						Difference		
	#457H		#457S		Cntrl		#457H	#457S	Cntrl
	--	++	--	++	--	++			
TETRAONIDAE									
Ruffed Grouse	0	5					5		
PICIDAE									
Yellow-shafted Flicker	0	1			1	0	1		- 1
Pileated Woodpecker					1	0			- 1
Yellow-bellied Sapsucker	3	0	1	0	4	0	- 3	- 1	- 4
Downy Woodpecker	0	2					2		
TYRANNIDAE									
Yellow-bellied Flycatcher			0	5				5	
Least Flycatcher	25	10	20	0	40	15	-15	-20	-25
Eastern Wood Pewee					0	5			5
CORVIDAE									
Gray Jay			1	3				2	
Blue Jay	3	0	1	2			- 3	1	
PARIDAE									
Black-capped Chickadee	5	0	10	5	5	5	- 5	- 5	0
SITTIDAE									
Red-breasted Nuthatch			10	5			0	- 5	
TROGLODYTIDAE									
Winter Wren	5	5	5	10	0	0	0	5	0
MIMIDAE									
Brown Thrasher	0	0	10	0	0	0	0	-10	0
TURDIDAE									
American Robin	35	0	10	25	15	5	-35	15	-10
Hermit Thrush	0	5			0	15	5		15
Swainson's Thrush	20	50	15	45	15	30	30	30	15
Gray-cheeked Thrush			0	5				5	
Veery					0	20			20
SYLVIIDAE									
Ruby-crowned Kinglet			0	10	15	10		10	5
VIREONIDAE									
Solitary Vireo	5	0	15	10	5	0	- 5	- 5	- 5
Red-eyed Vireo	5	20	5	0	15	15	15	- 5	0
PARULIDAE									
Black-and-white Warbler			15	5	30	10		-10	-20
Tennessee Warbler	15	0	55	25	20	0	-15	-30	-20
Nashville Warbler	5	0	25	25	25	10	- 5	0	-15
Parula Warbler	20	10	0	5	20	5	-10	5	-15
Yellow Warbler	0	5					5		
Magnolia Warbler	15	0	5	0	15	5	-15	- 5	-10
Cape May Warbler			10	5	5	0		- 5	- 5
Black-throated Blue Warbler	55	30			20	5	-25		-15
Myrtle Warbler	10	0	15	5	10	10	-10	-10	0
Black-throated Green Warbler	30	25	5	0	10	10	- 5	- 5	0
Blackburnian Warbler	5	0	20	5	15	0	- 5	-15	-15
Bay-breasted Warbler			0	10	0	25		10	25
Ovenbird	40	45	35	25	45	55	5	-10	10
Mourning Warbler	- 0	10					10		
Yellowthroat	5	15					10		
Wilson's Warbler	5	0					- 5		
Canada Warbler	15	25	20	5			10	-15	0
American Redstart	65	35			20	30	-30		10
ICTERIDAE									
Brown-headed Cowbird			1	0	5	0		- 1	- 5
FRINGILLIDAE									
Rose-breasted Grosbeak	20	25	5	5	10	10	5	0	0
Evening Grosbeak	9	13	25	3	0	1	4	-22	1
Purple Finch					5	5			0
Pine Grosbeak	0	6					6		
Pine Siskin			5	0				- 5	0
American Goldfinch					1	0			- 1
Slate-colored Junco	0	10	10	10	5	5	10	0	0
Chipping Sparrow	5	0	5	10	0	5	- 5	5	5
White-crowned Sparrow	10	5			5	0	- 5		- 5
White-throated Sparrow	25	20	10	20	25	30	- 5	10	5

APPENDIX

TABLE 6

Dunphy Area Songbird population in Pairs Per Hundred Acres

	Population						Difference		
	#125		Prcvl		Cntrl		#125	Prcvl	Cntrl
	--	++	--	++	--	++			
PICIDAE									
Yellow-shafted Flicker	1	1	4	5	1	0	0	1	- 1
Pileated Woodpecker	1	0	1	0	1	0	- 1	- 1	- 1
Yellow-bellied Sapsucker	5	1	8	6	4	0	- 4	- 2	- 4
Downy Woodpecker			0	1				1	
TYRANNIDAE									
Yellow-bellied Flycatcher	5	0			0	0	- 5		
Least Flycatcher	0	5	0	5	40	15	5	5	-25
Eastern Wood Peewee	0	5			0	5	5		5
HIRUNDINIDAE									
Tree Swallow			5	0				- 5	
CORVIDAE									
Gray Jay	2	0					- 2		
Blue Jay			1	1				0	
PARIDAE									
Black-capped Chickadee	5	10	5	5	5	5	5	0	0
Boreal Chickadee	0	0	5	0			0	- 5	
SITTIDAE									
Red-breasted Nuthatch	0	15	5	5			15	0	
CERTHIIDAE									
Brown Creeper	0	5					5		
TROGLODYTIDAE									
Winter Wren	10	10	5	5			0	0	
MIMIDAE									
Catbird	0	0	5	0			0	- 5	
TURDIDAE									
American Robin	0	5	20	20	15	5	5	0	-10
Hermit Thrush	10	5	15	5	0	15	- 5	-10	15
Swainson's Thrush	5	15	5	30	15	30	10	25	15
Veery	0	0	0	0	0	20			20
SYLVIIDAE									
Ruby-crowned Kinglet	20	10	10	5	15	10	-10	- 5	- 5
VIREONIDAE									
Solitary Vireo	15	5			5	0	-10		- 5
Red-eyed Vireo					15	5			0
PARULIDAE									
Black-and-white Warbler	5	0	5	0	30	10	- 5	- 5	-20
Tennessee Warbler	35	10	45	0	20	0	-25	-45	-20
Nashville Warbler	5	5	15	25	25	10	0	10	-15
Parula Warbler	20	0	25	0	20	5	-20	-25	-15
Yellow Warbler	10	0	5	0			-10	- 5	
Magnolia Warbler	5	5	15	25	15	5	0	10	-10
Cape May Warbler	5	0			5	0	- 5		- 5
Black-throated Blue Warbler					20	5			-15
Myrtle Warbler	10	20	15	5	10	10	10	-10	0
Black-throated Green Warbler	20	20			10	10	0		0
Blackburnian Warbler	5	5	5	0	15	0	0	- 5	-15
Chestnut-sided Warbler			0	5				5	
Bay-breasted Warbler					0	25			25
Ovenbird	15	35	20	15	45	55	20	- 5	10
Yellowthroat	0	15	5	10	0	0	15	5	0
Canada Warbler	0	5	0	5	0	0	5	5	0
American Redstart	0	0	0	0	20	30	0	0	10
ICTERIDAE									
Redwinged Blackbird	0	0	5	0	0	0	0	- 5	0
brown-headed Cowbird	0	0	0	0	5	0	0	0	- 5
FRINGILLIDAE									
Rose-breasted Grosbeak	10	5	10	5	10	10	- 5	- 5	0
Evening Grosbeak	0	0	1	0	0	1	0	- 1	1
Purple Finch	0	0	0	5	5	5	0	5	0
American Goldfinch					1	0			- 1
Slate-colored Junco	15	20	15	5	5	5	5	-10	0
Chipping Sparrow	0	5	10	15	0	5	5	5	5
White-crowned Sparrow					5	0			- 5
White-throated Sparrow	20	30	45	35	25	30	10	-10	5

APPENDIX

TABLE 7

BLISEVILLE AREA SONGBIRD POPULATIONS
IN PAIRS PER HUNDRED ACRES

	Population						Difference		
	##329		##334		Cntrl		#329	#334	Cntrl
	--	++	--	++	--	++			
TETRAEONIDAE									
Ruffed Grouse	1	0					- 1		
PICIDAE									
Yellow-shafted Flicker	3	0	7	1	3	0	- 3	- 6	- 3
Pileated Woodpecker	1	0	1	0	1	0	- 1	- 1	- 1
Yellow-bellied Sapsucker	3	0	3	0	7	3	- 3	- 3	- 4
Downy Woodpecker	3	0					- 3		
TYRANNIDAE									
Eastern Kingbird			5	0				- 5	
Yellow-bellied Flycatcher	0	5			0	5	5		5
Least Flycatcher	5	0	0	5	0	10	- 5	5	10
Eastern Wood Peewee					0	5			5
CORVIDAE									
Blue Jay	4	0	1	4	1	0	- 4	3	- 1
PARIDAE									
Black-capped Chickadee	5	0	5	10	5	0	- 5	5	- 5
Boreal Chickadee			10	0				-10	
SITTIDAE									
Red-breasted Nuthatch	0					0	10		- 5
TROGLODYTIDAE									
Winter Wren	5	5	5	5	5	5	0	0	0
TURDIDAE									
American Robin	20	10	15	5	15	10	-10	-10	- 5
Wood Thrush					10	0			-10
Hermit Thrush	10	0	25	10	10	15	-10	-15	- 5
Swainson's Thrush	0	5	0	5	0	15	5	5	15
Veery	15	30	5	5	10	15	15	0	5
SYLVIIDAE									
Golden-crowned Kinglet							0	0	0
Ruby-crowned Kinglet	10	0	20	10	15	0	-10	-10	-15
BOMBYCILLIDAE									
Cedar Waxwing			3	0				- 3	
VIREONIDAE									
Solitary Vireo	0	5	5	10	0	5	5	5	5
Red-eyed Vireo	5	20	5	5	5	5	15	0	0
PARULIDAE									
Black-and-white Warbler	25	10	35	20	20	5	-15	-15	-15
Tennessee Warbler			0	15	0	5		15	5
Nashville Warbler	5	0	5	35	15	15	- 5	30	0
Parula Warbler	10	10	20	0	20	15	0	-20	- 5
Yellow Warbler	10	0	5	0			-10	- 5	
Magnolia Warbler	0	5	0	5	0	5	5	5	5
Black-throated Blue Warbler					0	20			20
Myrtle Warbler	10	10	10	0	20	5	0	-10	-15
Black-throated Green Warbler	5	0			0	10	- 5		10
Chestnut-sided Warbler	5	0			5	10	- 5		5
Bay-breasted Warbler	0	10			0	10	10		10
Blackpoll Warbler	5	0					- 5		
Ovenbird	20	10	40	30	25	45	-10	-10	20
Mourning Warbler									
Yellowthroat	0	5	0	15	10	0	5	15	-10
Wilson's Warbler							0	0	0
Canada Warbler	0	0	0	15	0	15	0	15	15
American Redstart	10	15	0	0	0	10	5	0	10
ICTERIDAE									
Redwinged Blackbird			5	0				- 5	
Brown-headed Cowbird					3	0			- 3
FRINGILLIDAE									
Rose-breasted Grosbeak	0	5	5	15	5	0	5	10	- 5
Purple Finch	10	10	5	0	0	5	0	- 5	5
Slate-colored Junco	5	5	5	10	5	10	0	5	5
Chipping Sparrow	0	5	0	5	5	0	5	5	- 5
White-crowned Sparrow	10	0					-10		
White-throated Sparrow	25	30	45	45	30	15	5	0	-15

APPENDIX

TABLE 8

Small Mammals Population Census-Maniwaki Spray Plots 1972.

Plot	Clethrionomys gapperi				Peromyscus maniculatus				Tamias striatus				Napaeozapus insignis				Zapus hudsonius	Microtus pennsylvanicus	Tamiasciurus hudsonicus	Blarina brevicauda
	Male			Female	Male			Female	Male			Female	Male			Female	Female	Female	Female	Male
	A	SA	J	A SA J	A	SA	J	A SA J	A	SA	J	A SA J	A	SA	J	A SA J	A SA J	A SA J	A SA J	A SA J
Control Plot #1	5	0	0	1 0 0	1	0	0	0 0 0	1	-	-	- - -	-	-	-	- - -	- - -	- - -	- - -	- - -
Control Plot #2	3	0	0	1 0 0	0	0	0	1 0 0	1	-	-	- 1 -	-	-	-	- - -	- - -	- - -	- - -	- - -
Zectran Plot #3	11	3	1	5 3 3	3	1	0	5 0 0	-	-	-	- - -	1	-	-	1 - -	- - -	- - -	- - -	- - -
Zectran Plot #4	10	3	0	9 1 0	8	2	0	6 3 0	-	-	-	- - -	-	-	-	2 - -	- - -	1 - -	- 1 -	1 - -
Matacil Plot #5	7	0	0	4 1 1	1	3	1	4 2 0	-	-	-	- - -	2	-	-	- - -	- - -	- - -	- - -	- - -
Matacil Plot #6	6	2	2	8 0 1	4	3	0	2 3 0	2	-	-	- - -	-	-	-	- - -	- 1 -	- - -	- - -	- - -
TOTALS	91				53				5				6				1	1	1	1

APPENDIX
TABLE 9

CHAPLEAU AREA SONGBIRD POPULATIONS IN PAIRS PER HUNDRED ACRES

	Populations						Difference		
	Pox		NPV		Cntrl		Pox	NPV	Cntrl
	--	++	--	++	--	++			
TETRAEONIDAE									
Ruffed Grouse	5	5			5	0	0		- 5
PICIDAE									
Yellow-shafted Flicker			3	0	6	0		- 3	- 6
Pileated Woodpecker	1	0			3	0	- 1		- 3
Yellow-bellied Sapsucker	2	2	2	2	5	2	0	0	- 3
Hairy Woodpecker					2	0			- 2
Downy Woodpecker			1	0	1	1		- 1	0
TYRANNIDAE									
Yellow-bellied Flycatcher			0	5				5	
Least Flycatcher					0	5			5
Eastern Wood Peewee					5	0			- 5
CORVIDAE									
Gray Jay	2	0	1	1	2	0	- 2	0	- 2
Blue Jay	1	0	2	3			- 1	1	
PARIDAE									
Black-capped Chickadee	10	5	10	0	15	0	- 5	-10	-15
SITTIDAE									
Red-breasted Nuthatch	15	0	15	5	15	10	-15	-10	- 5
TROGLODYTIDAE									
Winter Wren	5	0	10	5	10	5	- 5	- 5	- 5
TURDIDAE									
American Robin	20	0	10	5	30	10	-20	- 5	-20
Hermit Thrush	0	5					5		
Swainson's Thrush	5	20	0	20	0	40	15	20	40
Gray-cheeked Thrush					5	0			- 5
SYLVIIDAE									
Ruby-crowned Kinglet	25	5	20	0	30	10	-20	-20	-20
BOMBYCILLIDAE									
Cedar Waxwing			1	1				0	
VIREONIDAE									
Solitary Vireo					5	0			- 5
Red-eyed Vireo	5	0	0	20	0	15	- 5	20	15
PARULIDAE									
Black-and-white Warbler			0	5	0	5		5	5
Tennessee Warbler	0	5	0	5	0	15	5	5	15
Nashville Warbler	25	15	25	10	25	5	-10	-15	-20
Parula Warbler			0	5	0	5		5	5
Magnolia Warbler			10	5	0	10		- 5	10
Myrtle Warbler	30	45	25	0	40	15	15	-25	25
Black-throated Green Warb.	0	10			0	10	10		10
Blackburnian Warbler	5	5			0	20	0		20
Chestnut-sided Warbler	0	10	0	35			10	35	
Bay-breasted Warbler	0	10					10		
Ovenbird	0	20	0	5	0	15	20	5	15
Mourning Warbler			0	5	0	5		5	5
Yellowthroat	0	5					5		
Canada Warbler	0	20	0	15	0	30	20	15	30
ICTERIDAE									
Common Crackle	0	1	1	0			1	- 1	
Brown-headed Cowbird	1	0	1	0			- 1	- 1	
FRINGILLIDAE									
Rose-breasted Grosbeak	5	0					- 5		
Evening Grosbeak	4	10	1	21	0	21	6	20	21
Slate-colored Junco	20	5			0	10	-15		10
Chipping Sparrow	15	10			15	15	- 5		0
White-throated Sparrow	45	25	55	0	50	35	-20	-55	-15

APPENDIX

TABLE 10

Petawa Area Songbird Popluation in Pairs per Hundred Acres

	Populations				Difference		
	Plot #1 Control	Plot #2 2 oz/ac	Plot #3 18oz/ac	Plot #4 18oz/ac	# 2 2oz	# 3 18oz	# 4 18oz
TETRAEONIDAE							
Ruffed Grouse	0	5	0	5	5	0	5
PICIDAE							
Yellow-shafted Flicker	5	3	0	0	- 2	- 5	- 5
Yellow-bellied Sapsucker	3	0	8	0	- 3	5	- 3
Hairy Woodpecker	0	0	0	3	0	0	3
TYPANNIDAE							
Yellow-bellied Flycatcher	10	0	0	0	-10	-10	-10
Eastern Phoebe	0	5	0	0	5	0	0
HIRUNDINIDAE							
Barn Swallow	0	0	3	0	0	3	0
CORVIDAE							
Blue Jay	3	3	0	3	0	- 3	0
PARIDAE							
Black-capped Chickadee	0	5	0	0	5	0	0
TURDIDAE							
American Robin	5	5	5	0	0	0	- 5
Hermit Thrush	5	10	0	0	5	- 5	- 5
Swainson's Thrush	0	0	5	10	0	5	10
Veery	10	20	0	0	10	-10	-10
SYLVIIDAE							
Golden-crowned Kinglet	5	0	0	0	- 5	- 5	- 5
Ruby-crowned Kinglet	15	0	0	0	-15	-15	-15
BOMBYCILLIDAE							
Cedar Waxwing	3	0	5	5	- 3	2	2
VIREONIDAE							
Red-eyed Vireo	0	0	15	5	0	15	5
PARULIDAE							
Black-and-white Warbler	0	0	5	5	0	5	5
Tennessee Warbler	10	0	0	0	-10	-10	-10
Nashville Warbler	0	5	10	10	5	10	10
Yellow Warbler	0	15	0	0	15	0	0
Myrtle Warbler	10	0	0	0	-10	-10	-10
Chestnut-sided Warbler	10	0	10	10	-10	0	0
Pine Warbler	0	0	5	0	0	5	0
Ovenbird	10	5	0	0	- 5	-10	-10
Yellowthroat	30	5	0	0	-25	-30	-30
Canada Warbler	20	0	0	0	-20	-20	-20
ICTERIDAE							
Redwinged Blackbird	3	15	0	0	12	- 3	- 3
FRINGILLIDAE							
Rose-breasted Grosbeak	0	25	0	0	25	0	0
Indigo Bunting	5	0	0	0	- 5	- 5	- 5
Purple Finch	5	0	5	5	- 5	0	0
American Goldfinch	5	0	0	0	- 5	- 5	- 5
White-winged Crossbill	5	0	0	0	- 5	- 5	- 5
Slate-colored Junco	5	0	0	5	- 5	- 5	0
Chipping Sparrow	5	0	0	5	- 5	- 5	0
White-throated Sparrow	55	45	5	15*	-10	-50	-40
Swamp Sparrow	20	35	0	0	15	-20	-20
Song Sparrow	10	0	5	5	-10	- 5	- 5

*Fledglings observed