STUDIES OF THE ENVIRONMENTAL IMPACT OF THE 1974 SPRUCE BUDWORM CONTROL OPERATION IN QUEBEC

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ABSTRACT

The impact of several insecticides on various components of forest ecosystems was studied during operational spraying against spruce budworm *Choristoneura fumiferana* Clem. in Western Quebec in 1974. Dosage rates for the insecticides emitted were 52 g/ha (3/4 oz/acre) for MATACIL® and ZECTRAN®, 280 g/ha (4 oz/acre) for *Bacillus thuringiensis* (B.t.) and 140 g/ha (2 oz/acre) for fenitrothion. Particular emphasis was placed upon monitoring the effects of these insecticides on populations of small forest songbirds, small mammals, honey bees and components of aquatic ecosystems. At these dosage rates, measurable environmental impact was minimal. Tennessee warbler, *Vermivora peregrina* (Wilson) populations were lightly affected by fenitrothion as were those of black and white warbler *Mniotila varia* (Linnaeus). Double applications using fenitrothion followed by ZECTRAN® slightly depressed populations of solitary vireo, *Vireo solitarius* (Wilson) after the fenitrothion treatment. In areas treated with MATACIL® there was an apparent reduction in populations of ruby-crowned kinglets *Regulus calendula* (Linnaeus) and several species of warblers (Family Parulidae). There is no evidence of impact upon the small mammal component present in the treatment areas. Honey bees were not affected by an early application of fenitrothion and were only slightly affected by the second treatment. Colonies treated with ZECTRAN® were only lightly affected. Few effects were found on aquatic insect populations within the insecticide treated areas. MATACIL® selectively affected stonefly nymph (Plecoptera) populations.

ABRÉGÉ

L'impact de plusieurs insecticides sur différents constituants de l'écosystème forestier a été étudié lors du programme d'arrosage pour le contrôle de la tordeuse des bourgeons d'épinette (*Choristoneura fumiferana* Clem.) dans l'ouest du Québec, en 1974. Les doses d'insecticides pulvérisés ont été de 52g/ha (3/4 on/acre) pour le MATACIL® et le ZECTRAN®, 280 g/ha (4 on/acre) pour le *Bacillus thuringiensis* (B.t.) et 140 g/ha (2 on/acre) pour le fénitrothion. Les efforts de surveillance ont été concentrés sur l'effet de ces insecticides sur les petits oiseaux chanteurs, les petits mammifères, les abeilles domestiques et les invertébrés aquatiques. Aux concentrations utilisées, l'impact des insecticides sur l'environnement a été minimal. Les populations de la fauvette obscure, *Vermivora peregrina* (Wilson) ont été légèrement affectées par le fénitrothion de même que celles de la fauvette noire et blanche, *Mniotila varia* (Linnaeus). L'application de fénitrothion, suivie d'une application de ZECTRAN®, a légèrement réduit les populations du viréo à tête bleue, *Vireo solitarius*. Dans les régions traitées au MATACIL®, il y a eu une diminution apparente dans les populations du roitelet à couronne rubis, *Regulus calendula* (Linnaeus) et de plusieurs espèces de fauvettes (famille Parulidae). Aucun impact apparent n'a pu être décelé sur les petits mammifères dans les régions traitées. Les abeilles n'ont pas été affectées par la première application de fénitrothion et n'ont été que légèrement affectées par la deuxième pulvérisation. Les colonies traitées au ZECTRAN® n'ont été que très légèrement affectées. Quelques effets ont pu être décelés sur les populations d'insectes aquatiques. Le MATACIL® a sélectivement affecté les populations de perles (PLECOPTERA).

INTRODUCTION

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In 1974, 6.3 million acres of Quebec forests were treated with insecticides to protect them from severe defoliation by spruce budworm *Choristoneura fumiferana* Clem. During the planning of this operation it was decided to conduct an active environmental monitoring program to determine the effect of the treatments on non-target organisms. Responsibility for this aspect of the operation was assigned to the Quebec Service des Recherches Biologiques. The Environmental Impact Section of the Chemical Control Research Institute (C.C.R.I.) was asked to advise and assist in setting up and conducting a suitable monitoring program. This group has considerable experience and expertise in monitoring and research programs designed to study the hazards of forest insect control practices to non-target organisms.

The studies reported in this paper were conducted by personnel from both the Service des Recherches Biologiques and C.C.R.I. In future years personnel from the Service des Recherches Biologiques will take on responsibility for the field monitoring program under the supervision of M. Raymond Sarrazin. The environmental impact section from C.C.R.I. headed by Dr C.H. Buckner will continue to work closely with the Service des Recherches Biologiques group in an advisory capacity, through the conducting of research and accident investigation programs and by evaluating the technique and results of monitoring studies.

BIRDS

B.B. McLeod, R. Sarrazin, R. Ouellet, J.M. Bergeron

The spring of 1974 was somewhat delayed and many species of birds, particularly the warblers (family *Parulidae*) had not reached the forest pest control areas by the time the first treatments were applied between May 11 and 16th. The second treatments were applied in the early part of June when most migrants had returned and were firmly established in breeding territories. Treatment blocks 258, 259 and 261 received double applications of fenitrothion, firstly on May 15-16 and then June 6-7. Bird census plots on treatment block 260 received a single application on June 6. A double application of MATACIL® was applied to block 327 on June 4 and June 15. Limited pre-spray data were collected from plots 1 and 4; plot 3 was monitored during the late application only.

Treatment blocks in the Mont Tremblant Park area received an application of fenitrothion on May 20 followed in approximately three weeks by an application of ZECTRAN® on June 7.

The untreated plot in the Lac Chaud area served as the control for the fenitrothion and fenitrothion-ZECTRAN® treatments and an untreated plot near Parent served as the control for the MATACIL® operation.

METHODS

Population census of small forest birds were conducted using methods similar to those described by Kendeigh 1944, Buckner and Turnock 1965. Populations were assessed by traversing the 8 hectare (20 acre)

plots along parallel lines marked 40 metre (132 feet) apart and recording all singing and sighted birds on a plot map. Observations were continued on succeeding days until approximately five days after treatment. Post-spray population data are compared to the pre-spray census and untreated control data and the populations expressed as numbers of birds per 40 hectares (100 acres). Immediately after each application a thorough plot search was made to recover any sick or dead birds as a result of the treatment. Any specimens collected were immediately frozen and returned to the laboratory for chemical analysis.

RESULTS

Fenitrothion, double application: Bird populations on the control plot and plots which received double applications of fenitrothion are presented in Tables I to VIII. Groups of birds such as the grouse (family Tetraonidae), woodpeckers (Picidae), flycatchers (Tyrannidae) and chickadees (Paridae) were not affected by either application. Winter wrens were not recorded on plot 258 after the first application but were not affected by the later spray. Populations of thrushes (Turdidae) and kinglets (Sylviidae) were not affected by either treatment nor were the jays (Corvidae) or vireos (Vireonidae).

Black and white warbler *Mniotilia varia* (Linnaeus) populations declined on plots 258 and 261 as a result of the second application. Tennessee warblers, *Vermivora peregrina* (Wilson) were considerably reduced during the second application while the nashville warblers *Vermivora ruficopilla* (Wilson) showed light declines. The populations of the other species of warblers showed slight variations, none of which could be attributed to the applications of fenitrothion.

Slate-coloured junco populations declined on the untreated control as well as the treatment plots in the early application but remained relatively constant during the second application. All other species in the family Fringillidae were not adversely affected.

Fenitrothion, single late application: Plot 260 (Table IX) received a single application of insecticide on the evening of June 6 (same as No. 258). Population of black and white warblers were lightly affected for two days after treatment (either recovered or replaced) while tennessee warblers were also reduced as on plots 259 and 261. Slight fluctuations of daily populations recorded for the remaining species cannot be related to the application of fenitrothion.

Fenitrothion-ZECTRAN® : Plot 121A was treated with fenitrothion on May 20 when very little hardwood foliage had flushed thus leaving the avifauna present in a more exposed habitat than later treatments. Many species had not as yet migrated into the area due to the lateness of the spring while others roamed the area in small flocks not having set up breeding territories. (Tables X, XI and XII).

Low populations of ruffed grouse, *Bonasa umbellus* (Linnaeus) were not affected by the early application while such groups as the woodpeckers (family Picidae), flycatchers (family Tyrannidae) and the blackbirds, orioles etc. (family Icteridae) were recorded as very scattered or in territories too large to monitor.

Lower crown or ground foraging groups such as the thrushes (family Turdidae) and the winter wren, *Troglodytes troglodytes* (Linnaeus) and

ovenbird, *Seiurus aurocapillus* (Linnaeus) remained unaffected as did such open habitat species as the chipping sparrow, *Spizella passerina* (Bechstein) and song sparrow *Melospiza melodia* (Wilson). The solitary vireo, *Vireo solitarius* (Wilson) showed a decline on plot 121A-1.

Many species normally found in this area were not recorded at all during the first treatment census while others show a rapid build-up as a result of the late spring and delayed spring migration. Treatment plots were searched after the application but no dead or sick birds were found or observed. The Lac Chaud untreated plot (Table XIII) served as the control for the first treatment.

ZECTRAN® was applied to these plots on 7 June when all the hardwoods had leafed out and most bird species had established breeding and foraging territories (Tables XIV, XV and XVI). Some slight population changes are noted, especially on treatment block 121A-1 where some species of warblers (family Parulidae) showed a slight decline. Comparisons with data obtained from the untreated control (Table XVII) and with trends of species of similar size and habitat indicate population variations were caused by factors other than the application of pesticides.

MATACIL®: All plots in the Parent area were located in rather similar typical spruce-fir forests with the untreated control having a larger component of jack pine (*Pinus banksiana* Lamb).

Several groups of birds such as the woodpeckers (family Picidae), the chickadees (family Paridae) and grouse (family Tetraonidae) were found either in very low numbers or their territories were too large to monitor. The winter wren was recorded only on the treatment plots and was not affected by the first treatment but ruby-crowned kinglet *Regulus calendula*

(Linnaeus) numbers were reduced on treatment plots 1 (Table XVIII) and 4 (Table XIX) while remaining almost stable on the untreated control (Table XX). The family Parulidae suffered slight losses in species especially in plot 1 where populations of black-throated green warblers, *Dendroica virens* (Gmelin) and the mourning warbler *Oporornis philadelphia* (Wilson) were not recorded after the treatment.

Evening grosbeaks, *Hesperiphona vespertina* (Cooper) were not found on plot 4 after the first application, however this species has been recorded as vacating insecticide treated areas for suitable unsprayed habitat (Bent 1968). Numbers of slate-coloured juncos *Junco hyemalis* (Linnaeus) were slightly reduced on both treatment plots and the swamp sparrows, *Melospiza georgiana* (Latham) also showed a decline on plot 4.

It would appear from the data collected from the second application (Tables XXI, XXII, XXIII and XXIV), that many of the species, especially the warblers, did not find suitable breeding territories in the untreated control area. Populations of nashville, *Vermivora ruficapilla* (Wilson) and magnolia *Dendroica magnolia* (Wilson) warblers, declined on both treatment plots 3 and 4. Ruby-crowned kinglet populations showed declines in all areas including the control area indicating the spreading out of numbers and establishing breeding territories. Winter wren populations showed a reduction on treatment plot 4 but all other species were unaffected by the second application.

Bird kill reports: Reports of mortality to small forest songbird populations in the vicinity of budworm control operations were investigated by the Chemical Control Research Institute emergency investigations team. Dead birds were collected, the affected areas monitored for insecticide residues

and chemical analysis of sample materials obtained. In one case, death was attributed to excessive amounts of calcium chloride (probably ingested while birds were gravelling at roadsides). All other mortality reports were attributed to starvation amongst early migrants of the warbler and kinglet groups due to the lateness of the spring delaying insect emergence.

Table I

Populations of Small Forest Songbirds
Lac Chaud Control Plot
La Macaza Area Quebec
1974

Family	Species	Pre-spray treatment 1						Post-spray treatment 1					
		-5	-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Tetraonidae	Ruffed Grouse	0	3	6	18	24	10	24	6	6	12	12	10
Scolopacidae	American Woodcock	0	0	0	0	0	0	0	0	0	0	0	0
Picidae	Yellow-shafted Flicker	6	12	30	6	12	13	12	15	18	15	12	14
	Yellow-bellied Sapsucker	0	0	51	30	48	26	30	18	27	36	36	29
	Hairy Woodpecker	3	0	9	6	27	9	6	6	3	3	9	5
	Downy Woodpecker	0	0	18	15	21	11	9	12	15	12	0	10
Tyrannidae	Eastern Phoebe	0	0	0	0	6	1	6	9	12	0	0	5
	Least Flycatcher	0	0	0	24	24	10	6	12	12	18	36	17
	Eastern Wood Pewee	0	0	0	0	0	0	0	0	0	0	0	0
Hirundinidae	Tree Swallow	0	0	18	15	18	10	6	12	12	12	12	11
	Barn Swallow	0	0	6	6	12	5	0	0	0	6	0	1
Corvidae	Blue Jay	0	0	6	3	0	2	0	3	6	3	0	2
	Common Raven	3	0	0	0	0	1	0	0	0	0	0	0
	Common Crow	6	0	0	0	0	1	0	0	0	0	0	0
Paridae	Black-capped Chickadee	23	0	27	24	42	23	27	30	27	30	36	30
	Boreal Chickadee	0	0	3	0	6	2	0	0	0	0	0	0
Sittidae	Red-breasted Nuthatch	6	0	12	9	9	7	18	9	12	0	12	10
Certhiidae	Brown Creeper	0	0	3	15	6	5	15	6	6	0	0	5

Table I (Cont'd)

Family	Species	Pre-spray treatment 1						Post-spray treatment 1					
		-5	-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave
Troglodytidae	Winter Wren	24	24	36	48	69	40	54	39	30	12	42	35
Mimidae	Brown Thrasher	0	0	0	6	0	1	0	0	0	0	0	0
Turdidae	American Robin	0	3	21	21	21	13	21	6	6	3	9	9
	Wood Thrush	0	0	6	0	6	2	0	0	3	0	0	1
	Hermit Thrush	0	0	3	3	24	6	12	9	9	14	6	10
	Swainson's Thrush	0	0	0	0	0	0	0	0	0	3	3	1
	Veery	0	0	3	6	3	2	15	6	12	9	9	10
Sylviidae	Golden-crowned Kinglet	6	6	0	12	8	6	12	0	0	0	0	2
	Ruby-crowned Kinglet	18	6	69	60	18	34	30	6	6	45	45	26
Vireonidae	Solitary Vireo	0	0	6	0	6	2	6	0	0	6	0	2
	Red-eyed Vireo	0	0	0	0	0	0	0	0	0	0	0	0
	Philadelphia Vireo	0	0	0	0	0	0	0	0	0	0	0	0
	Warbling Vireo	0	0	0	0	0	0	0	0	0	0	0	0
Parulidae	Black and White Warbler	0	0	0	12	6	5	15	18	18	24	36	22
	Tennessee Warbler	0	0	3	3	0	1	9	0	0	0	0	2
	Nashville Warbler	0	0	0	6	0	1	12	6	6	6	24	11
	Yellow Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Magnolia Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Cape May Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Black-throated Blue Warbler	0	0	6	0	18	5	21	18	18	18	36	22
	Myrtle Warbler	0	0	21	36	6	13	18	6	12	0	0	7
	Black-throated Green Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Blackburnian Warbler	0	0	0	18	0	4	0	0	0	0	0	0
	Chestnut-sided Warbler	0	0	0	6	0	1	6	0	0	0	0	1
	Bay-breasted Warbler	0	0	0	6	0	1	0	0	0	0	0	0

Table I (Cont'd)

Family	Species	Pre-spray treatment 1						Post-spray treatment 1					
		-5	-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Parulidae (Cont'd)	Blackpoll Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Prairie Warbler	0	0	12	0	0	2	0	0	0	0	0	0
	Ovenbird	0	0	6	30	72	22	66	33	39	48	30	43
	Northern Waterthrush	0	0	0	0	0	0	0	0	0	0	0	0
	Mourning Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Yellowthroat	0	0	0	6	0	1	0	0	0	0	0	0
	Canada Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	American Redstart	0	0	0	0	0	0	0	0	0	0	0	0
Icteridae	Red-winged Blackbird	0	6	6	0	0	2	0	0	0	0	0	0
	Baltimore Oriole	0	0	6	0	0	1	0	6	6	0	0	2
	Common Grackle	3	0	0	0	0	1	0	0	0	0	0	0
	Brown-headed Cowbird	0	6	30	0	15	10	6	0	0	0	6	2
Fringillidae	Rose-breasted Grosbeak	0	0	0	30	18	10	12	12	12	12	12	12
	Evening Grosbeak	9	21	6	6	12	10	15	0	0	6	6	5
	Purple Finch	12	0	0	24	36	14	36	48	48	39	51	44
	American Goldfinch	0	0	0	6	0	1	0	0	0	0	0	0
	Slate-coloured Junco	12	9	21	12	6	12	12	0	0	0	0	0
	Chipping Sparrow	0	0	0	12	6	4	0	0	0	0	0	0
	White-crowned Sparrow	0	0	6	6	0	2	0	0	0	0	0	0
	White-throated Sparrow	33	24	126	126	111	84	87	63	69	81	78	76
	Song Sparrow	6	6	6	12	12	8	12	6	12	6	12	9
Unidentified	Species	15	3	0	0	0	4	0	0	0	0	0	0
Totals		185	129	588	684	716	460	636	420	462	480	570	514

Table II

Populations of Small Forest Songbirds
Fenitrothion Treatment Plot 258
Lac Saguay Area, Quebec
1974

Family	Species	Pre-spray treatment 1						Post-spray treatment 1					
		-5	-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Tetraonidae	Ruffed Grouse	0	0	3	0	0	1	3	0	0	0	0	1
Scolopacidae	American Woodcock	3	0	0	0	0	1	0	0	3	0	0	1
Columbidae	Mourning Dove	0	0	0	0	6	1	0	0	0	0	0	0
Apodidae	Chimney Swift	0	0	0	0	3	1	0	0	0	0	3	1
Alcedinidae	Belted Kingfisher	0	0	6	0	0	1	0	0	0	0	0	0
Picidae	Yellow-shafted Flicker	0	0	0	18	3	4	6	6	6	3	3	5
	Yellow-bellied Sapsucker	36	0	6	12	6	12	12	0	6	6	0	5
	Downy Woodpecker	0	0	0	12	15	5	0	12	12	12	12	10
	Hairy Woodpecker	0	0	0	12	0	2	0	0	0	0	0	0
Tyrannidae	Eastern Kingbird	0	0	0	0	3	1	0	0	0	0	0	0
	Least Flycatcher	0	0	0	0	12	2	0	0	21	0	6	5
Hirundinidae	Tree Swallow	0	0	0	0	0	0	0	0	0	0	3	1
	Cliff Swallow	0	0	0	3	0	1	0	0	0	0	0	1
Corvidae	Blue Jay	0	0	9	18	12	8	9	0	9	3	3	5
	Common Raven	0	0	0	0	0	0	6	0	0	0	0	1
	Common Crow	0	0	0	6	0	1	0	0	0	0	3	1
Paridae	Black-capped Chickadee	21	0	15	18	9	0	12	0	9	3	0	5
Sittidae	Red-breasted Nuthatch	0	0	0	0	6	1	0	0	0	0	0	0

Table II (Cont'd)

Family	Species	Pre-spray treatment 1						Post-spray treatment 1					
		-5	-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Certhiidae	Brown Creeper	0	0	3	6	6	3	0	0	0	0	0	0
Troglodytidae	Winter Wren	6	0	18	18	0	8	0	0	0	0	0	0
Mimidae	Catbird	0	0	0	0	3	1	0	0	0	0	0	0
	Brown Thrasher	0	0	0	0	0	0	3	0	0	0	0	1
Turdidae	American Robin	21	27	39	24	36	29	12	12	36	15	24	20
	Wood Thrush	0	0	0	0	0	0	0	3	6	0	0	2
	Hermit Thrush	12	0	6	12	21	10	3	24	21	6	3	11
	Veery	0	0	0	0	0	0	0	0	0	3	0	1
Sylviidae	Golden-crowned Kinglet	6	0	12	15	6	8	0	0	12	6	0	4
	Ruby-crowned Kinglet	57	12	39	87	54	50	72	21	36	15	27	29
Vireonidae	Solitary Vireo	0	0	3	3	6	2	12	0	0	0	3	3
Parulidae	Black and White Warbler	0	0	3	0	6	2	0	0	0	0	0	0
	Tennessee Warbler	0	0	0	0	3	1	0	0	0	0	0	0
	Nashville Warbler	0	0	0	6	6	2	0	0	0	0	6	1
	Magnolia Warbler	0	0	0	0	9	2	0	0	0	0	6	1
	Cape May Warbler	0	0	0	0	0	0	0	0	6	0	0	1
	Black-throated Blue Warbler	0	0	0	6	6	2	0	0	12	12	12	7
	Myrtle Warbler	15	0	9	0	12	7	9	0	12	0	0	4
	Black-throated Green Warbler	0	0	0	0	0	0	6	0	6	0	0	2
	Blackburnian Warbler	0	0	0	0	0	0	0	0	0	0	6	1
	Chestnut-sided Warbler	0	0	3	0	0	1	0	0	0	0	0	0
	Bay-breasted Warbler	0	0	0	0	6	1	0	0	0	0	0	0
	Ovenbird	0	0	30	52	66	30	33	36	60	30	48	41

Table II(Cont'd)

Family	Species	Pre-spray treatment 1						Post-spray treatment 1					
		-5	-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Icteridae	Common Grackle	3	0	0	0	0	1	3	0	0	0	0	1
	Brown-headed Cowbird	6	0	12	0	18	7	0	0	9	12	12	7
Fringillidae	Rose-breasted Grosbeak	0	0	0	0	9	2	84	18	30	12	18	32
	Evening Grosbeak	18	12	54	9	15	22	30	6	24	30	27	23
	Purple Finch	6	0	0	18	15	8	3	6	30	12	6	11
	Slate-coloured Junco	12	0	12	33	30	17	6	0	12	6	12	7
	Chipping Sparrow	0	0	0	6	6	2	0	0	0	0	3	1
	White-crowned Sparrow	6	0	6	0	0	2	0	0	0	0	6	1
	White-throated Sparrow	72	48	72	76	102	74	36	51	36	18	24	33
	Song Sparrow	24	9	27	21	24	21	18	0	0	12	12	8
Unidentified	Species	0	0	3	0	30	7	0	12	24	18	6	12
Totals		324	108	390	491	570	377	378	207	438	234	294	235

Table III

Populations of Small Forest Songbirds
Fenitrothion Treatment Block 259
Lac Allard Area, Quebec
1974

Family	Species	Pre-spray treatment 1					Post-spray treatment 1					
		-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave
Tetraonidae	Ruffed Grouse	0	0	0	3	1	0	0	0	0	6	1
Apodidae	Chimney Swift	0	0	0	0	0	0	0	0	0	0	0
Alcedinidae	Belted Kingfisher	0	0	0	6	2	0	0	0	12	6	4
Picidae	Yellow-shafted Flicker	12	0	9	12	8	6	21	0	6	0	7
	Yellow-bellied Sapsucker	6	6	0	3	4	0	9	0	6	0	3
	Downy Woodpecker	0	0	0	0	0	0	0	3	0	6	2
	Black-backed Three-toed Woodpecker	0	0	0	0	0	0	0	0	0	0	0
Tyrannidae	Eastern Kingbird	0	0	0	0	0	0	0	0	0	0	0
	Great-crested Flycatcher	0	0	0	0	0	0	0	0	0	0	0
	Least Flycatcher	0	0	0	0	0	0	6	0	0	0	0
	Olive-sided Flycatcher	0	0	0	0	0	3	0	0	0	0	1
Hirundinidae	Tree Swallow	0	0	12	0	3	0	24	65	0	0	18
Corvidae	Blue Jay	6	0	15	3	6	6	0	0	0	12	4
	Common Crow	0	0	0	0	0	0	0	0	0	0	0
Paridae	Black-capped Chickadee	15	24	24	21	21	6	0	12	12	18	10
	Boreal Chickadee	0	0	0	0	0	0	0	0	0	0	0
Sittidae	Red-breasted Nuthatch	0	0	0	0	0	0	0	0	3	3	1
Certhiidae	Brown Creeper	0	0	0	0	0	0	0	0	3	0	1

Table III (Cont'd)

Family	Species	Pre-spray treatment 1					Post-spray treatment 1					
		-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Troglodytidae	Winter Wren	0	12	12	24	12	12	12	18	24	18	17
Turdidae	American Robin	6	12	18	18	14	6	3	12	6	6	7
	Wood Thrush	0	0	0	0	0	0	0	0	0	6	1
	Hermit Thrush	0	0	0	0	0	0	0	18	6	6	6
	Swainson's Thrush	12	18	18	0	12	0	0	0	0	0	0
	Veery	0	0	0	0	0	0	0	0	3	0	1
Sylviidae	Golden-crowned Kinglet	3	0	3	0	2	6	0	0	0	6	2
	Ruby-crowned Kinglet	45	24	51	48	42	47	27	12	6	21	23
Bombycillidae	Cedar Waxwing	0	0	0	0	0	0	0	0	0	0	0
Vireonidae	Solitary Vireo	0	0	0	0	0	24	6	0	0	0	6
	Red-eyed Vireo	0	0	0	0	0	0	0	0	0	0	0
	Philadelphia Vireo	0	0	0	0	0	0	0	0	0	0	0
Parulidae	Black and white Warbler	0	0	0	0	0	3	0	0	6	6	3
	Tennessee Warbler	0	0	0	0	0	0	0	0	0	0	0
	Nashville Warbler	0	0	18	6	6	0	18	0	72	48	28
	Parula Warbler	0	0	0	0	0	0	0	0	0	0	0
	Magnolia Warbler	0	0	0	0	0	0	0	0	0	0	0
	Cape May Warbler	0	0	0	0	0	0	0	6	0	0	1
	Black-throated Blue Warbler	0	0	0	0	0	0	0	0	0	0	0
	Myrtle Warbler	0	0	0	0	0	0	0	42	24	15	16
	Black-throated Green Warbler	0	0	0	0	0	0	0	0	0	0	0
	Blackburnian Warbler	0	0	0	0	0	18	0	0	0	0	4
	Chestnut-sided Warbler	0	0	0	0	0	0	0	0	0	0	0
	Bay-breasted Warbler	0	0	0	0	0	0	0	0	6	0	1
	Blackpoll Warbler	0	0	0	0	0	0	0	0	0	0	0
	Ovenbird	0	0	0	6	2	6	6	24	6	24	13
	Northern Waterthrush	0	0	0	0	0	0	6	0	6	0	2
	Yellowthroat	0	0	0	0	0	0	6	24	12	24	13

Table III (Cont'd)

Family	Species	Pre-spray treatment 1					Post-spray treatment 1					
		-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
	Canada Warbler	0	0	0	0	0	0	0	0	0	0	0
	American Redstart	0	0	0	0	0	0	0	0	0	0	0
Icteridae	Red-winged Blackbird	18	18	15	42	23	18	36	30	21	18	25
	Baltimore Oriole	0	0	0	0	0	0	0	0	0	0	0
	Common Grackle	0	3	3	0	2	0	0	0	0	0	0
	Brown-headed Cowbird	0	0	6	0	2	6	0	0	0	0	1
Fringillidae	Rose-breasted Grosbeak	0	0	0	0	0	6	12	6	6	6	7
	Evening Grosbeak	18	75	0	30	31	12	6	6	12	51	17
	Purple Finch	6	6	12	12	9	6	6	6	6	12	7
	American Goldfinch	0	0	0	0	0	0	0	0	0	0	0
	Slate-coloured Junco	0	0	0	0	0	0	0	0	0	3	1
	White-throated Sparrow	27	42	30	33	33	9	51	39	51	36	37
	Swamp Sparrow	0	0	0	24	6	18	33	18	6	33	22
	Song Sparrow	0	0	9	6	4	0	0	6	0	3	2
Unidentified	Species	0	0	0	0	0	3	0	3	0	3	2
Totals		165	237	255	297	239	221	228	350	321	396	315

Table IV

Populations of Small Forest Songbirds
Fenitrothion Treatment Block 261
La Macaza Area, Quebec
1974

Family	Species	Pre-spray treatment 1						Post-spray treatment 1					
		-5	-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Tetraonidae	Ruffed Grouse	6	6	6	6	6	6	6	6	6	6	6	6
Scolopacidae	American Woodcock	0	0	0	0	0	0	0	0	0	0	0	0
Caprimulgidae	Common Nighthawk	0	0	0	0	0	0	0	0	0	0	0	0
Alcedinidae	Belted Kingfisher	0	0	0	0	6	1	0	3	0	0	0	1
Picidae	Yellow-shafted Flicker	0	6	6	0	6	4	0	6	0	12	0	4
	Yellow-bellied Sapsucker	0	0	0	0	0	0	0	6	0	0	0	1
	Hairy Woodpecker	0	0	0	0	0	0	0	0	0	0	3	1
	Downy Woodpecker	0	0	0	0	0	0	0	6	0	0	6	2
Tyrannidae	Eastern Phoebe	0	0	0	0	0	0	0	0	0	0	0	0
	Least Flycatcher	0	0	0	0	6	1	6	0	6	0	6	4
	Eastern Wood Pewee	0	0	0	0	0	0	0	0	0	0	0	0
	Olive-sided Flycatcher	0	0	0	0	6	1	0	0	0	0	0	0
Corvidae	Blue Jay	0	0	0	0	6	1	0	0	6	6	6	4
	Common Raven	0	0	0	0	0	0	0	0	0	0	0	0
	Common Crow	0	0	3	6	0	2	3	0	0	0	0	1
Paridae	Black-capped Chickadee	6	30	6	0	12	11	0	18	24	24	30	19
Troglodytidae	Winter Wren	12	6	24	6	6	11	12	12	18	12	6	12

Table IV (Cont'd)

Family	Species	Pre-spray treatment 1						Post-spray treatment 1					
		-5	-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Mimidae	Catbird	0	0	0	0	0	0	6	0	0	0	0	1
	Brown Thrasher	0	0	0	0	0	0	0	0	0	0	0	0
Turdidae	American Robin	6	12	12	0	0	6	6	6	12	6	21	10
	Wood Thrush	0	0	0	0	6	1	6	6	6	12	0	6
	Hermit Thrush	0	0	0	0	6	1	0	12	12	6	0	6
	Swainson's Thrush	0	0	0	0	0	0	0	0	0	0	0	0
	Veery	0	0	0	0	0	0	0	12	6	18	24	12
Sylviidae	Ruby-crowned Kinglet	18	18	48	36	42	32	18	12	30	30	18	22
Vireonidae	Solitary Vireo	0	0	0	0	0	0	0	0	0	0	0	0
	Red-eyed Vireo	6	6	0	0	6	4	6	12	6	6	6	7
Parulidae	Black and White Warbler	0	0	0	6	18	5	6	0	24	18	6	11
	Tennessee Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Nashville Warbler	0	0	0	6	12	4	30	54	48	54	54	48
	Yellow Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Magnolia Warbler	0	0	0	0	0	0	0	6	0	0	6	2
	Cape May Warbler	0	0	0	0	0	0	0	0	0	6	6	2
	Black-throated Blue Warbler	0	0	0	0	0	0	0	0	0	0	6	1
	Myrtle Warbler	0	0	0	0	0	0	0	6	6	0	6	4
	Black-throated Green Warbler	0	0	0	0	6	1	0	6	6	6	6	5
	Blackburnian Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Chestnut-sided Warbler	0	0	0	0	0	0	0	6	0	0	0	1
	Bay-breasted Warbler	0	0	0	0	0	0	0	0	0	0	0	0

Table IV (Cont'd)

Family	Species	Pre-spray treatment 1						Post-spray treatment 1					
		-5	-4	-3	-2	-1	Daily ave.	+0	+1	+2	+3	+4	Daily ave.
Parulidae (Cont'd)	Blackpoll Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Ovenbird	0	0	0	0	36	7	18	42	36	48	36	36
	Mourning Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Yellowthroat	0	0	0	0	0	0	0	0	0	6	6	2
	Canada Warbler	0	0	0	0	0	0	0	0	6	0	0	1
	American Redstart	0	0	0	0	0	0	0	0	0	0	0	0
Fringillidae	Red-breasted Grosbeak	0	0	0	0	0	0	18	24	24	12	30	22
	Evening Grosbeak	0	0	0	0	0	0	0	0	6	0	30	7
	Vesper Sparrow	0	0	0	0	0	0	0	0	0	0	0	0
	Slate-coloured Junco	24	33	42	36	60	39	6	6	0	0	0	2
	Chipping Sparrow	0	0	0	0	0	0	0	0	6	6	6	4
	White-throated Sparrow	111	108	69	81	120	98	120	78	84	90	69	88
	Fox Sparrow	6	0	0	0	0	1	0	0	0	0	0	0
	Song Sparrow	12	24	18	12	6	14	12	12	18	12	24	16
Unidentified	Species	0	0	0	0	0	0	0	0	0	0	0	0
Totals		207	249	240	195	360	250	258	357	222	384	423	329

Table V

Populations of Small Forest Songbirds
Lac Chaud Control Plot
La Macaza Area, Quebec
1974

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-5	-4	-3	-2	-1	Daily ave.	+ 1	+ 2	+ 3	+ 4	+ 5	Daily ave.
Tetraonidae	Ruffed Grouse	0	0	6	0	0	1	0	3	0	0	0	1
Scolopacidae	American Woodcock	0	0	0	0	0	0	0	0	0	0	3	1
Picidae	Yellow-shafted Flicker	6	0	6	0	6	4	3	0	0	0	0	1
	Yellow-bellied Sapsucker	0	6	0	0	0	1	0	0	0	0	0	0
	Hairy Woodpecker	0	0	0	0	6	1	0	0	0	0	0	0
	Downy Woodpecker	0	0	0	6	0	1	0	0	0	0	0	0
Tyrannidae	Eastern Phoebe	0	0	0	0	0	0	0	0	0	0	0	0
	Least Flycatcher	66	42	60	54	48	54	72	66	48	54	42	56
	Eastern Wood Pewee	0	0	0	0	0	0	0	12	6	12	12	5
Hirundinidae	Tree Swallow	0	0	0	0	0	0	0	0	0	0	0	0
	Barn Swallow	0	0	0	0	0	0	0	0	0	0	0	0
Corvidae	Blue Jay	12	0	12	0	0	5	12	6	6	6	6	7
	Common Crow	0	0	0	0	0	0	0	0	0	0	0	0
	Common Raven	0	0	0	0	0	0	0	0	0	0	0	0
Paridae	Black-capped Chickadee	12	27	0	9	27	15	36	6	18	0	0	12
	Boreal Chickadee	0	0	0	0	0	0	0	0	0	0	0	0
Sittidae	Red-breasted Nuthatch	0	0	0	0	0	0	3	0	0	0	0	1
Certhiidae	Brown Creeper	0	0	0	0	0	0	0	0	0	0	0	0
Troglodytidae	Winter Wren	18	18	18	24	24	20	6	30	30	12	6	17

Table V (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-5	-4	-3	-2	-1	Daily ave.	+ 1	+ 2	+ 3	+ 4	+ 5	Daily ave.
Mimidae	Brown Thrasher	0	0	0	0	0	0	0	0	0	0	0	0
Turdidae	American Robin	24	24	9	9	21	17	12	33	12	24	6	17
	Wood Thrush	0	6	0	6	6	4	0	6	0	0	0	1
	Hermit Thrush	0	6	12	6	0	5	0	6	0	12	0	4
	Swainson's Thrush	0	0	0	0	0	0	0	0	0	0	0	0
	Veery	36	24	12	6	6	17	21	36	21	12	18	22
Sylviidae	Golden-crowned Kinglet	0	0	0	0	0	0	0	0	0	0	0	0
	Ruby-crowned Kinglet	36	24	12	6	6	17	0	0	6	0	0	1
Vireonidae	Solitary Vireo	0	0	6	0	0	1	0	0	0	0	0	0
	Red-eyed Vireo	0	0	0	0	0	0	24	24	36	54	24	32
	Philadelphia Vireo	0	0	0	0	0	0	0	0	0	0	6	1
	Warbling Vireo	0	0	0	0	6	1	0	0	0	0	0	0
Parulidae	Black and White Warbler	6	0	18	6	12	8	6	18	18	36	30	22
	Tennessee Warbler	0	0	0	6	0	1	0	6	0	0	0	1
	Nashville Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Yellow Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Magnolia Warbler	6	0	0	0	0	1	0	0	0	0	0	0
	Cape May Warbler	6	6	0	0	6	4	6	0	0	0	0	1
	Black-throated Blue Warbler	48	42	42	0	42	35	54	18	54	48	36	42
	Myrtle Warbler	6	0	0	0	0	1	0	0	0	0	0	0
	Black-throated Green Warbler	24	30	30	30	18	26	12	12	18	6	18	13
	Blackburnian Warbler	6	0	0	0	12	4	24	18	6	0	0	10
	Chestnut-sided Warbler	114	96	90	84	78	92	96	54	66	60	30	61
	Bay-breasted Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Blackpoll Warbler	0	0	0	12	6	4	36	24	12	12	0	17
	Prairie Warbler	0	0	12	0	0	2	0	0	0	0	0	0
	Ovenbird	108	66	60	45	90	74	72	54	48	48	30	50
	Northern Waterthrush	0	0	0	0	0	0	6	0	0	0	0	1

Table V (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-5	-4	-3	-2	-1	Daily ave.	+ 1	+ 2	+ 3	+ 4	+ 5	Daily ave.
Parulidae (Cont'd)	Mourning Warbler	6	0	6	18	0	6	0	6	0	18	24	10
	Yellowthroat	0	0	0	0	0	0	0	6	0	0	0	1
	Canada Warbler	6	6	12	12	18	11	6	6	18	0	6	7
	American Redstart	18	12	24	15	9	16	12	15	21	18	24	18
Icteridae	Red-winged Blackbird	0	0	0	0	0	0	0	0	0	0	6	1
	Baltimore Oriole	0	0	0	0	0	0	0	0	0	0	0	0
	Common Grackle	0	6	0	0	0	1	0	0	0	0	0	0
	Brown-headed Cowbird	0	6	0	9	12	5	6	0	0	0	0	1
Fringillidae	Rose-breasted Grosbeak	30	60	30	24	24	34	24	27	18	6	12	17
	Evening Grosbeak	12	0	24	24	6	13	6	6	6	0	0	4
	Purple Finch	6	6	27	12	12	13	6	0	0	0	0	1
	American Goldfinch	0	0	6	0	0	1	0	0	0	0	0	0
	Slate-coloured Junco	0	0	0	0	0	0	0	0	6	0	0	1
	Chipping Sparrow	0	0	0	0	0	0	0	0	0	0	0	0
	White-crowned Sparrow	0	0	0	0	0	0	0	0	0	0	0	0
	White-throated Sparrow	39	48	36	42	36	40	48	24	24	30	12	28
Unidentified	Species	0	0	6	0	0	1	0	0	0	0	6	1
Totals		645	561	582	465	531	567	609	522	498	468	357	491

Table VI

Populations of Small Forest Songbirds
Fenitrothion Treatment Plot 258
Lac Saguay Area, Quebec
1974

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-6	-5	-4	-3	-2	Daily ave.	+ 1	+ 2	+ 3	+ 4	Daily ave.	
Tetraonidae	Ruffed Grouse	0	0	0	6	3	2	3	6	0	0	2	
Apodidae	Chimney Swift	0	0	0	0	0	0	0	0	0	3	1	
Trochilidae	Ruby-throated Hummingbird	0	3	3	0	0	1	0	0	0	0	0	
Picidae	Yellow-shafted Woodpecker	6	0	0	3	0	2	0	0	0	0	0	
	Yellow-bellied Sapsucker	0	0	0	0	0	0	6	3	0	0	2	
	Hairy Woodpecker	6	0	0	0	0	1	0	0	0	0	0	
Tyrannidae	Least Flycatcher	12	12	18	30	18	18	12	12	12	18	14	
	Eastern Wood Pewee	0	0	0	0	0	0	0	12	12	12	9	
Hirundinidae	Barn Swallow	0	0	0	0	0	0	0	0	3	0	1	
Corvidae	Blue Jay	3	6	3	12	0	5	0	0	0	6	2	
Paridae	Black-capped Chickadee	12	6	0	9	0	5	6	0	0	6	3	
Sittidae	Red-breasted Nuthatch	6	6	0	6	6	5	0	6	0	0	2	
Troglodytidae	Winter Wren	6	0	0	0	0	1	6	6	0	0	3	
Turdidae	American Robin	15	27	15	18	21	19	9	9	0	6	6	
	Wood Thrush	6	0	0	6	18	6	6	12	0	18	9	
	Hermit Thrush	0	0	0	6	0	1	0	0	0	3	1	
	Swainson's Thrush	0	0	0	3	3	1	0	0	0	0	0	

Table VI (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-6	-5	-4	-3	-2	Daily ave.	+ 1	+ 2	+ 3	+ 4	Daily ave.	
Turdidae (Cont'd)	Veery	21	3	21	21	12	12	15	42	12	47	29	
Sylviidae	Ruby-crowned Kinglet	0	0	0	0	6	1	0	24	0	0	6	
Bombycillidae	Cedar Waxwing	0	0	0	0	0	0	0	3	6	0	2	
Vireonidae	Red-eyed Vireo	0	0	0	6	36	8	24	24	18	30	24	
Parulidae	Black and White Warbler	0	6	18	12	6	8	0	0	0	6	2	
	Tennessee Warbler	0	0	0	0	0	0	0	0	0	6	2	
	Nashville Warbler	6	0	6	12	6	6	0	3	0	6	2	
	Parula Warbler	0	0	0	0	0	0	6	0	12	12	8	
	Magnolia Warbler	12	0	12	3	18	9	0	0	12	30	11	
	Cape May Warbler	18	18	18	6	18	16	12	6	0	12	8	
	Black-throated Blue Warbler	18	45	18	24	12	23	12	18	18	36	21	
	Myrtle Warbler	21	15	6	9	6	11	0	6	0	0	2	
	Black-throated Green Warbler	24	12	0	0	0	7	6	12	12	18	9	
	Blackburnian Warbler	0	0	0	0	0	0	0	0	0	24	6	
	Chestnut-sided Warbler	30	30	18	18	30	25	39	30	18	42	32	
	Bay-breasted Warbler	18	6	0	0	3	5	0	0	0	0	0	
	Blackpoll Warbler	3	0	0	0	0	1	0	0	0	0	0	
	Ovenbird	51	57	48	66	72	59	84	90	54	66	74	
	Northern Waterthrush	0	0	0	0	0	0	0	0	6	0	2	
	Mourning Warbler	0	0	0	0	6	1	18	12	0	0	8	
	Yellowthroat	0	6	0	9	0	3	6	21	6	0	8	
	Canada Warbler	0	0	0	6	6	2	0	12	0	0	3	
	American Redstart	24	18	0	0	0	8	12	9	6	3	8	
Icteridae	Baltimore Oriole	6	6	0	0	0	2	0	0	0	0	0	
	Brown-headed Cowbird	24	12	24	18	12	18	12	6	6	6	8	

Table VI (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2				
		-6	-5	-4	-3	-2	Daily ave.	+ 1	+ 2	+ 3	+ 4	Daily ave.
Fringillidae	Rose-breasted Grosbeak	36	27	6	24	6	20	9	18	6	15	12
	Evening Grosbeak	12	3	0	18	3	7	18	9	3	6	9
	Purple Finch	0	0	0	6	0	1	0	6	0	6	3
	American Goldfinch	0	0	0	0	0	0	6	9	0	6	4
	Chipping Sparrow	0	0	0	0	0	0	6	6	0	12	6
	White-throated Sparrow	18	9	27	24	21	20	3	12	9	39	16
	Song Sparrow	27	18	18	9	18	18	6	6	6	12	8
Unidentified	Species	6	18	3	9	0	7	6	6	0	9	5
Totals		447	369	282	399	366	378	348	456	237	521	391

Table VII

Populations of Small Forest Songbirds
Fenitrothion Treatment Block 259
Lac Allard Area, Quebec
1974

Family	Species	Pre-spray treatment 2						Post-spray treatment 2				
		-8	-7	-5	-4	-3	Daily ave.	+ 1	+ 2	+ 4	+ 5	Daily ave.
Tetraonidae	Ruffed Grouse	0	0	6	0	0	1	0	6	0	0	2
Apopidae	Chimney Swift	0	0	15	6	6	5	6	6	6	18	9
Alcedinidae	Belted Kingfisher	0	0	0	0	0	0	0	0	0	0	0
Picidae	Yellow-shafted Woodpecker	0	0	0	6	0	1	0	12	9	0	5
	Yellow-bellied Sapsucker	0	6	0	0	0	1	0	18	0	0	5
	Downy Woodpecker	0	0	0	0	0	0	0	0	0	0	0
	Black-backed Three-Toed Woodpecker	0	0	0	0	0	0	0	6	0	0	2
Tyrannidae	Eastern Kingbird	0	0	0	3	0	1	0	6	0	0	2
	Great-Crested Flycatcher	0	0	0	0	6	1	6	12	0	0	5
	Least Flycatcher	24	0	3	0	0	5	0	6	0	0	2
	Olive-sided Flycatcher	0	0	0	0	0	0	6	0	0	0	2
Hirundinidae	Tree Swallow	0	6	0	3	0	2	0	0	0	0	0
Corvidae	Blue Jay	0	0	0	0	0	0	9	12	9	12	10
	Common Crow	0	0	0	6	0	1	0	0	0	0	0
Paridae	Black-capped Chickadee	0	6	12	0	3	4	3	6	6	12	7
	Boreal Chickadee	0	0	0	0	3	1	0	0	0	0	0
Sittidae	Red-breasted Nuthatch	0	0	6	6	0	2	0	3	0	0	1
Certhiidae	Brown Creeper	0	0	0	0	0	0	0	0	0	0	0

Table VII (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2				
		-8	-7	-5	-4	-3	Daily ave.	+ 1	+ 2	+ 4	+ 5	Daily ave.
Troglodytidae	Winter Wren	0	18	12	0	18	10	18	12	0	24	14
Turdidae	American Robin	15	6	3	0	0	5	12	18	6	12	12
	Wood Thrush	0	0	6	6	6	4	0	0	0	0	0
	Hermit Thrush	0	0	0	0	0	0	0	0	0	0	0
	Swainson's Thrush	0	0	6	0	0	1	0	12	6	0	5
	Veery	12	18	21	18	6	15	6	12	6	0	6
Sylviidae	Golden-crowned Kinglet	0	0	0	0	0	0	6	18	0	0	6
	Ruby-crowned Kinglet	45	10	39	36	30	32	48	30	24	36	35
Bombycillidae	Cedar Waxwing	0	0	0	0	0	0	6	0	6	6	5
Vireonidae	Solitary Vireo	0	0	0	0	0	0	0	0	0	0	0
	Red-eyed Vireo	0	0	0	6	0	1	0	6	6	12	6
	Philadelphia Vireo	0	0	0	0	0	0	6	6	0	0	3
Parulidae	Black and white Warbler	6	0	0	0	0	1	0	12	0	0	3
	Tennessee Warbler	30	54	36	42	60	44	42	30	18	18	27
	Nashville Warbler	12	24	30	12	42	24	60	42	6	12	26
	Parula Warbler	0	0	0	0	0	0	0	0	0	12	3
	Magnolia Warbler	0	18	12	0	15	9	24	42	6	12	21
	Cape May Warbler	45	15	24	12	54	30	36	72	18	12	35
	Black-throated Blue Warbler	0	0	0	0	0	0	0	0	6	0	2
	Myrtle Warbler	66	12	12	12	6	22	21	15	0	0	9
	Black-throated Green Warbler	0	0	0	0	12	2	12	6	0	0	5
	Blackburnian Warbler	0	3	0	0	6	2	0	12	0	0	3
	Chestnut-sided Warbler	0	6	12	12	12	8	6	6	15	18	11
	Bay-breasted Warbler	6	18	6	12	60	20	30	54	0	0	21
	Blackpoll Warbler	0	0	0	0	6	1	0	0	0	0	0
	Ovenbird	6	18	12	18	18	14	18	30	18	32	25
	Northern Waterthrush	0	12	18	18	18	13	12	6	12	6	9

Table VII (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2				
		-8	-7	-5	-4	-3	Daily ave.	+ 1	+ 2	+ 4	+ 5	Daily ave.
Parulidae (Cont'd)	Yellowthroat	0	12	27	12	24	15	24	18	12	15	17
	Canada Warbler	0	6	0	6	18	6	0	12	0	3	4
	American Redstart	0	0	6	0	0	1	0	0	0	0	0
Icteridae	Red-winged Blackbird	12	15	42	30	21	24	30	36	12	48	32
	Baltimore Oriole	0	0	0	0	0	0	0	0	0	6	2
	Common Grackle	0	0	3	0	0	1	0	0	3	0	1
	Brown-headed Cowbird	3	0	0	12	12	5	0	6	0	0	2
Fringillidae	Rose-breasted Grosbeak	12	18	12	9	18	14	24	24	12	12	18
	Evening Grosbeak	21	18	12	15	15	16	12	18	6	18	14
	Purple Finch	0	0	6	0	6	2	30	27	0	18	19
	American Goldfinch	0	0	12	0	0	2	0	0	0	0	0
	Slate-coloured Junco	0	0	0	0	0	0	6	6	0	0	3
	White-throated Sparrow	24	0	15	18	18	15	30	18	27	27	26
	Swamp Sparrow	18	33	15	24	24	23	12	12	0	6	8
	Song Sparrow	0	0	0	24	12	7	12	24	6	6	12
Unidentified	Species	0	0	0	3	0	1	12	6	0	0	5
Totals		357	352	441	381	555	417	585	741	261	413	500

Table VIII

Populations of Small Forest Songbirds
Fenitrothion Treatment Block 261
La Macaza Area, Quebec.
1974

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-5	-4	-3	-2	-1	Daily ave.	+0	+1	+2	+3	+4	Daily ave.
Tetraonidae	Ruffed Grouse	6	3	0	0	0	2	3	0	0	0	0	1
Scolopacidae	American Woodcock	3	0	0	0	0	1	0	0	0	0	0	0
Caprimulgidae	Common Nighthawk	0	0	0	0	0	0	6	0	0	0	0	1
Alcedinidae	Belted Kingfisher	0	0	0	0	0	0	0	0	0	3	0	1
Picidae	Yellow-shafted Flicker	0	0	0	0	0	0	0	0	0	0	0	0
	Yellow-bellied Sapsucker	0	0	0	0	0	0	0	0	6	0	0	1
	Hairy Woodpecker	0	0	0	0	0	0	0	0	0	0	0	0
	Downy Woodpecker	0	0	0	0	0	0	0	0	0	0	0	0
Tyrannidae	Eastern Phoebe	6	6	6	6	6	6	0	6	6	6	0	4
	Least Flycatcher	6	18	18	30	24	19	6	24	0	18	24	14
	Eastern Wood Pewee	0	0	0	0	6	1	0	6	6	6	6	4
	Olive-sided Flycatcher	0	0	0	0	0	0	0	0	0	0	0	0
Corvidae	Blue Jay	0	0	0	0	0	0	0	0	0	0	0	0
	Common Raven	0	3	0	0	0	1	0	0	0	0	0	0
	Common Crow	0	0	0	0	0	0	0	0	0	0	0	0
Paridae	Black-capped Chickadee	0	0	12	6	0	4	0	0	0	0	0	0
Troglodytidae	Winter Wren	6	0	0	0	0	1	0	0	0	6	0	1

Table VIII (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-5	-4	-3	-2	-1	Daily ave	+0	+1	+2	+3	+4	Daily ave.
Mimidae	Catbird	6	0	0	6	6	4	6	18	0	0	6	6
	Brown Thrasher	0	0	0	0	0	0	0	0	0	0	0	0
Turdidae	American Robin	24	6	0	6	0	7	12	0	6	6	12	7
	Wood Thrush	0	18	12	6	6	8	0	6	6	6	6	5
	Hermit Thrush	6	12	6	0	0	5	12	6	0	0	0	4
	Swainson's Thrush	0	6	0	0	0	1	0	0	6	6	6	4
	Veery	42	24	54	24	18	32	54	24	36	54	42	42
Sylviidae	Ruby-crowned Kinglet	0	0	0	0	0	0	0	0	0	0	0	0
Vireonidae	Solitary Vireo	6	12	24	12	30	17	6	12	18	18	6	12
	Red-eyed Vireo	18	6	6	12	12	11	12	18	36	24	18	22
Parulidae	Black and White Warbler	18	24	18	18	6	17	6	6	6	12	6	7
	Tennessee Warbler	72	54	24	12	12	35	0	0	0	0	0	0
	Nashville Warbler	36	18	30	12	12	22	18	6	6	12	0	8
	Yellow Warbler	0	6	0	0	0	1	0	0	0	0	0	0
	Magnolia Warbler	6	6	0	6	0	4	0	0	0	0	0	0
	Cape May Warbler	0	0	0	0	0	0	6	0	0	0	0	1
	Black-throated Blue Warbler	0	6	12	30	24	14	0	6	18	12	12	10
	Myrtle Warbler	6	6	0	6	0	4	0	0	0	0	0	0
	Black-throated Green Warbler	0	0	0	0	0	0	0	6	0	0	0	1
	Blackburnian Warbler	0	0	6	0	0	1	0	0	0	0	0	0
	Chestnut-sided Warbler	66	48	42	66	72	59	42	66	36	54	36	47
	Bay-breasted Warbler	0	0	0	6	0	1	0	0	0	0	0	0
	Blackpoll Warbler	6	0	24	0	0	6	0	0	0	0	0	0

Table VIII (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-5	-4	-3	-2	-1	Daily ave.	+0	+1	+2	+3	+4	Daily ave.
Parulidae (Cont'd)	Ovenbird	30	48	24	24	36	32	24	24	36	24	30	28
	Mourning Warbler	24	24	30	24	24	25	24	30	30	12	18	50
	Yellowthroat	0	12	6	6	6	6	6	6	0	6	0	4
	Canada Warbler	0	0	6	0	6	2	0	6	0	6	12	5
	American Redstart	36	60	24	30	54	41	6	54	60	72	24	43
Fringillidae	Rose-breasted Grosbeak	24	6	24	12	24	18	0	12	24	6	0	8
	Evening Grosbeak	6	6	0	0	6	4	0	6	0	0	15	4
	Vesper Sparrow	6	0	0	0	6	2	0	0	0	0	0	0
	Slate-coloured Junco	0	0	0	0	0	0	0	0	0	0	0	0
	Chipping Sparrow	6	0	0	6	0	2	6	0	6	6	18	7
	White-throated Sparrow	60	24	30	30	27	34	18	12	21	24	18	19
	Fox Sparrow	0	0	0	0	0	0	0	0	0	0	0	0
	Song Sparrow	18	12	6	12	18	13	12	6	6	24	24	14
Unidentified	Species	0	0	0	6	0	1	0	0	6	6	0	2
Totals		549	474	444	414	441	464	285	366	381	429	339	360

Table IX

Populations of Small Forest Songbirds
Fenitrothion Treatment Block 260
La Macaza Area, Quebec.
1974

Family	Species	Pre-spray						Post-spray					
		-4	-3	-2	-1	-0	Daily ave.	+ 1	+ 2	+ 3	+ 4	+ 5	Daily ave.
Tetraonidae	Ruffed Grouse	0	0	3	0	0	1	0	0	0	0	0	0
Trochilidae	Ruby-throated Hummingbird	3	0	0	0	0	1	0	0	0	0	0	0
Picidae	Yellow-shafted Flicker	6	0	0	0	0	1	6	0	0	6	0	2
	Yellow-bellied Sapsucker	0	0	0	0	0	0	6	0	0	0	0	1
	Hairy Woodpecker	0	0	0	0	6	1	0	0	0	0	0	0
Tyrannidae	Yellow-bellied Flycatcher	0	0	0	0	0	0	6	0	0	0	0	1
	Least Flycatcher	6	12	0	6	12	7	6	6	12	6	24	11
	Eastern Wood Pewee	0	0	0	6	0	1	0	0	0	0	0	0
	Olive-sided Flycatcher	6	0	0	0	0	1	0	0	0	6	0	1
Hirundinidae	Tree Swallow	0	0	0	0	0	0	0	0	0	0	6	1
Corvidae	Blue Jay	0	18	12	6	15	10	24	12	0	0	18	11
	Common Crow	3	0	0	0	9	2	0	0	0	0	0	0
Paridae	Black-capped Chickadee	18	0	6	6	12	8	6	0	6	0	0	2
Sittidae	Red-breasted Nuthatch	6	0	6	0	0	2	0	0	0	0	0	0
Troglodytidae	Winter Wren	6	6	12	6	6	7	6	0	6	6	6	5
Mimidae	Catbird	0	6	0	0	0	1	0	0	0	0	0	0

Table IX (Cont'd)

Family	Species	-4	-3	-2	-1	-0	Daily ave.	+ 1	+ 2	+ 3	+ 4	+ 5	Daily ave.
Turdidae	American Robin	0	6	6	0	6	4	12	6	6	0	0	5
	Wood Thrush	0	0	0	0	0	0	0	0	6	0	0	1
	Hermit Thrush	0	0	6	12	6	5	6	12	6	6	6	7
	Veery	12	24	12	36	42	25	36	18	42	24	0	24
Sylviidae	Ruby-crowned Kinglet	36	24	30	24	30	29	18	18	12	12	18	16
Vireonidae	Solitary Vireo	0	6	6	6	6	5	6	6	6	0	0	4
	Red-eyed Vireo	0	0	0	0	0	0	0	0	0	6	6	2
Parulidae	Black and white Warbler	6	12	18	0	6	8	0	0	6	12	0	4
	Tennessee Warbler	96	96	114	114	120	108	42	54	60	66	36	52
	Nashville Warbler	12	12	12	6	18	12	24	18	24	18	30	23
	Magnolia Warbler	6	6	0	0	0	2	0	0	0	0	0	0
	Cape May Warbler	6	0	0	48	24	16	30	18	24	18	48	28
	Black-throated Warbler	0	0	0	0	0	0	0	0	0	0	6	1
	Blackburnian Warbler	6	0	0	0	0	1	0	0	0	6	0	1
	Chestnut-sided Warbler	12	30	30	30	18	24	18	30	18	18	18	20
	Bay-breasted Warbler	18	6	0	0	6	6	0	0	0	0	0	0
	Blackpoll Warbler	0	0	0	6	0	1	0	0	0	0	0	0
	Ovenbird	24	42	18	24	24	26	30	12	36	18	30	25
	Mourning Warbler	0	0	0	12	6	4	0	0	0	6	6	2
	Yellowthroat	6	6	6	0	12	6	0	6	6	6	6	5
	Canada Warbler	6	0	12	18	6	8	6	0	6	6	12	6
	American Redstart	30	66	30	54	30	42	30	30	36	30	24	30
Icteridae	Brown-headed Cowbird	6	0	0	0	0	1	6	0	0	0	0	1
Fringillidae	Rose-breasted Grosbeak	6	6	0	6	6	5	6	0	0	0	0	1
	Evening Grosbeak	0	9	6	12	6	7	12	18	12	12	24	16
	Purple Finch	6	0	0	0	6	2	0	12	0	6	0	4
	Slate-coloured Junco	0	0	6	0	0	1	0	0	0	0	0	0
	White-throated Sparrow	24	18	24	24	24	23	30	24	18	27	24	19
	Swamp Sparrow	0	0	0	0	0	0	0	0	12	0	0	2
Totals		372	411	375	462	462	416	372	324	360	321	342	344

Table X

Populations of Small Forest Songbirds
Fenitrothion-ZECTRAN ® Treatment Block 121A-1
Mont Tremblant Park Quebec
1974

Family	Species	Pre-spray treatment 1				Post spray treatment 1 (Fenitrothion)					
		-3	-2	-1	Daily ave.	+0	+1	+2	+3	+4	Daily ave.
Tetraonidae	Ruffed Grouse	6	0	6	4	6	6	0	6	6	5
Scolopacidae	American Woodcock	6	0	0	2	0	0	0	0	0	0
Trochilidae	Ruby-throated Hummingbird	3	0	6	3	0	0	6	6	9	4
Alcedinidae	Belted Kingfisher	3	0	0	1	0	0	0	0	0	0
Picidae	Yellow-shafted Flicker	0	6	9	5	0	0	0	0	0	0
	Pileated Woodpecker	6	0	0	2	0	0	0	0	0	0
	Yellow-bellied Sapsucker	6	0	0	2	0	0	0	0	0	0
Paridae	Black-capped Chickadee	9	0	0	3	6	12	9	3	0	6
	Boreal Chickadee	3	0	0	1	0	0	0	0	0	0
Sittidae	Red-breasted Nuthatch	6	0	0	2	0	6	0	0	6	2
Certhiidae	Brown Creeper	0	0	6	2	0	0	0	0	0	0
Troglodytidae	Winter Wren	12	18	18	16	12	12	6	0	12	8
Turdidae	American Robin	15	27	30	24	15	42	18	18	24	23
	Wood Thrush	12	6	0	6	6	6	6	3	3	3
Sylviidae	Golden-crowned Kinglet	6	0	0	2	0	0	0	0	0	0
	Ruby-crowned Kinglet	18	4	18	14	12	18	18	18	12	

Table X (Cont'd)

Family	Species	Pre-spray treatment 1				Post-spray treatment 1 (Fenitrothion)					
		-3	-2	-1	Daily ave.	+0	+1	+2	+3	+4	Daily ave.
Vireonidae	Solitary Vireo	18	30	12	20	6	12	0	0	6	5
Parulidae	Black and White Warbler	6	0	18	8	0	12	6	6	0	5
	Nashville Warbler	6	0	0	2	6	0	0	6	6	4
	Parula Warbler	0	0	0	0	0	0	0	0	6	1
	Cape May Warbler	0	0	0	0	0	0	0	12	0	2
	Black-throated Blue Warbler	0	0	0	0	0	0	6	6	6	4
	Myrtle Warbler	0	12	6	6	6	24	12	12	12	13
	Bay-breasted Warbler	0	0	0	0	0	0	0	0	12	2
	Ovenbird	6	24	18	16	12	15	18	24	24	17
Icteridae	Brown-headed Cowbird	6	0	6	4	0	6	6	3	6	4
Fringillidae	Rose-breasted Grosbeak	12	6	0	6	0	0	6	12	12	5
	Evening Grosbeak	45	27	36	36	39	54	18	30	18	32
	Purple Finch	12	6	12	10	30	12	30	6	18	19
	Chipping Sparrow	0	0	6	2	6	6	0	0	0	2
	White-crowned Sparrow	0	0	0	0	0	0	0	6	0	1
	White-throated Sparrow	48	30	24	24	27	42	12	12	24	23
	Totals :	270	196	231	232	189	285	177	189	222	212

Table XI

Populations of Small Forest Songbirds
Fenitrothion-ZECTRAN® Treatment Block 121A-2
Mont Tremblant Park, Quebec
1974

Family	Species	Pre-spray treatment 1				Post-spray treatment 1 (Fenitrothion)					
		-4	-3	-2	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Picidae	Yellow-shafted Flicker	0	0	0	0	0	8	0	0	0	2
	Yellow-bellied Sapsucker	0	8	8	5	4	8	8	4	4	6
	Hairy Woodpecker	0	0	0	0	0	0	0	0	4	1
Hirundimae	Bank Swallow	0	0	0	0	24	24	8	0	16	14
Corvidae	Blue Jay	0	12	4	5	0	4	0	0	8	2
	Common Crow	0	0	0	0	0	0	0	4	0	1
Paridae	Black-capped Chickadee	0	0	0	0	0	0	0	4	4	2
	Boreal Chickadee	0	0	0	0	24	24	8	0	16	14
Sittidae	Red-breasted Nuthatch	0	0	0	0	8	0	0	16	8	6
Troglodytidae	Winter Wren	8	0	0	3	0	0	8	8	0	3
Turdidae	American Robin	4	28	12	13	8	8	8	16	4	9
	Wood Thrush	0	8	0	3	0	0	0	8	4	2
	Swainson's Thrush	0	0	4	1	0	0	0	0	0	0
Sylviidae	Ruby-crowned Kinglet	0	12	16	9	0	20	16	0	16	10
Vireonidae	Solitary Vireo	0	0	16	5	8	0	0	0	0	2
Parulidae	Black and White Warbler	0	12	0	4	0	0	0	0	16	3
	Nashville Warbler	0	0	8	3	0	8	0	0	12	8

Table XI (Cont'd)

Family	Species	Pre-spray treatment 1				Post-spray treatment 1 (Fenitrothion)					
		-4	-3	-2	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Parulidae (Cont'd)	Magnolia Warbler	0	0	0	0	0	0	0	0	8	2
	Cape May Warbler	0	0	0	0	0	8	16	0	16	8
	Black-throated Blue Warbler	0	0	0	0	0	0	0	0	8	2
	Myrtle Warbler	8	8	16	10	16	16	16	8	16	14
	Bay-breasted Warbler	0	0	0	0	0	0	0	8	52	12
	Ovenbird	0	0	0	0	0	0	8	16	8	6
Icteridae	Brown-headed Cowbird	0	0	0	0	0	8	0	0	12	4
Fringillidae	Rose-breasted Grosbeak	0	8	0	3	0	8	0	0	0	2
	Evening Grosbeak	8	16	8	10	4	16	28	44	0	18
	Purple Finch	8	24	32	21	8	32	16	8	32	19
	Slate-coloured Junco	16	16	16	16	8	8	4	0	4	5
	Chipping Sparrow	0	8	8	5	8	8	28	8	0	10
	White-throated Sparrow	28	40	20	29	20	16	0	48	8	18
Totals		80	200	168	149	140	224	172	200	296	206

Table XII

Populations of Small Forest Songbirds
Fenitrothion-ZECTRAN® Treatment Block 121A-3
Mont Tremblant, Park Quebec
1974

Family	Species	Pre-spray treatment 1					Post-spray treatment 1 (Fenitrothion)					
		-4	-3	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Tetraonidae	Ruffed Grouse	0	6	6	0	3	6	6	6	0	15	7
Trochilidae	Ruby-throated Hummingbird	0	0	0	0	0	0	0	0	3	0	1
Picidae	Yellow-shafted Flicker	0	0	0	6	2	0	0	0	0	6	1
	Yellow-bellied Sapsucker	0	0	0	0	0	0	3	6	6	0	4
	Hairy Woodpecker	0	0	0	0	0	0	0	0	0	6	1
Corvidae	Gray Jay	0	0	0	0	0	0	0	0	3	3	1
	Blue Jay	0	3	9	0	3	0	0	0	0	0	0
	Common Crow	0	0	3	0	1	3	0	0	3	0	1
Paridae	Black-capped Chickadee	3	0	0	0	1	0	0	12	0	6	3
Sittidae	Red-breasted Nuthatch	6	0	0	0	2	0	0	6	6	6	4
Certhiidae	Brown Creeper	6	3	6	0	4	0	0	0	0	0	0
Troglodytidae	Winter Wren	6	6	6	0	5	6	6	12	12	12	10
Turdidae	American Robin	0	0	6	0	1	6	0	6	0	9	4
	Wood Thrush	0	0	0	0	0	0	0	0	0	6	1
	Hermit Thrush	6	3	6	0	4	0	3	0	0	0	1
Sylviidae	Ruby-crowned Kinglet	12	0	6	6	6	18	6	18	6	6	11
Vireonidae	Solitary Vireo	6	12	12	6	9	6	0	12	0	15	7
	Red-eyed Vireo	0	0	0	0	0	6	0	0	0	0	1

Table XII (Cont'd)

Family	Species	Pre-spray treatment 1					Post-spray treatment 1 (Fenitrothion)					
		-4	-3	-2	-1	Daily ave.	+ 0	+1	+2	+3	+4	Daily ave.
Parulidae	Black-and-White Warbler	12	18	12	0	10	0	6	6	12	12	7
	Nashville Warbler	0	0	6	0	1	6	18	6	6	24	12
	Parula Warbler	0	0	0	0	0	6	0	18	0	6	6
	Magnolia Warbler	0	0	0	0	0	0	0	0	0	12	2
	Cape May Warbler	0	0	0	0	0	0	0	12	0	0	2
	Black-throated Blue Warbler	0	0	12	0	3	12	12	27	6	30	17
	Myrtle Warbler	0	6	0	0	1	18	12	18	6	15	14
	Black-throated Green Warbler	0	0	0	0	0	0	0	12	0	0	2
	Blackburnian Warbler	0	0	0	0	0	0	0	6	6	12	5
	Chestnut-sided Warbler	0	0	0	0	0	0	0	0	0	6	1
	Bay-breasted Warbler	0	0	0	0	0	0	0	0	12	24	7
	Ovenbird	18	18	12	0	12	12	6	36	24	24	20
Icteridae	Brown-headed Cowbird	0	0	0	0	0	6	0	0	0	3	2
Fringillidae	Rose-breasted Grosbeak	0	0	0	0	0	6	0	0	0	0	0
	Evening Grosbeak	3	27	3	0	8	27	21	27	12	15	20
	Purple Finch	6	12	30	6	11	24	24	30	0	6	17
	Slate-coloured Junco	0	30	0	0	8	6	6	15	0	12	8
	Chipping Sparrow	0	0	0	0	0	12	6	0	0	0	2
	White-crowned Sparrow	0	0	0	0	0	0	0	0	0	6	1
	White-throated Sparrow	12	42	18	3	15	18	15	24	6	18	16
Totals		96	186	153	27	116	204	150	315	129	315	223

Table XIII

Populations of Small Forest Songbirds
Lac Chaud Control Plot (for plots 121A-1, 121A-2, 121A-3)
La Macaza Area, Quebec.
1974

Family	Species	Pre-spray					Post-spray				
		16th - 3	17 -2	18 -1	19 -0	Daily ave.	20 + 1	21 + 2	22 + 3	23 + 4	Daily ave.
Tetraonidae	Ruffed Grouse	24	24	6	6	15	12	12	6	6	9
Scolopacidae	American Woodcock	0	0	0	0	0	0	0	0	0	0
Picidae	Yellow-shafted Flicker	12	12	15	18	14	15	12	12	9	12
	Yellow-bellied Sapsucker	48	30	18	27	31	36	36	42	30	36
	Hairy Woodpecker	21	6	6	3	9	3	9	6	3	5
	Downy Woodpecker	18	9	12	15	14	12	0	0	0	3
Tyrannidae	Eastern Phoebe	6	6	9	12	8	0	0	9	0	2
	Least Flycatcher	24	6	12	12	14	18	36	66	36	39
	Eastern Wood Pewee	0	0	0	0	0	0	0	0	0	0
Hirundinidae	Tree Swallow	18	6	12	12	12	12	12	24	12	15
	Bank Swallow	12	0	0	0	3	6	0	9	0	4
Corvidae	Blue Jay	3	0	3	6	3	3	0	0	6	2
	Common Raven	0	0	0	0	0	0	0	0	0	0
	Common Crow	0	0	0	0	0	0	0	0	0	0
Paridae	Black-capped Chickadee	42	27	30	27	32	30	36	15	36	29
	Boreal Chickadee	6	0	0	0	2	0	0	0	0	0
Sittidae	Red-breasted Nuthatch	9	18	9	12	12	0	12	9	0	5

Table XIII (Cont'd)

Family	Species	Pre-spray 16th -3	17 -2	18 -1	19 -0	Daily ave.	Post-spray 20 + 1	21 + 2	22 + 3	23 + 4	Daily ave.
Certhiidae	Brown Creeper	6	15	6	6	8	0	0	6	0	2
Troglodytidae	Winter Wren	66	54	39	30	47	12	42	30	42	32
Mimidae	Brown Thrasher	0	0	0	0	0	0	0	0	0	0
Turdidae	American Robin	15	21	6	6	12	3	9	9	3	6
	Wood Thrush	6	0	0	3	2	0	0	0	0	0
	Hermit Thrush	21	12	9	9	13	12	6	0	12	8
	Swainson's Thrush	0	0	0	0	0	3	3	0	0	2
	Veery	3	15	6	12	9	9	9	6	15	10
Sylviidae	Golden-crowned Kinglet	18	12	0	0	8	0	0	0	0	0
	Ruby-crowned Kinglet	81	30	6	6	31	45	45	18	18	32
Vireonidae	Solitary Vireo	6	6	0	0	3	6	0	6	12	6
	Red-eyed Vireo	0	0	0	0	0	0	0	0	0	0
	Philadelphia Vireo	0	0	0	0	0	0	0	0	0	0
	Warbling Vireo	0	0	0	0	0	0	0	0	0	0
Parulidae	Black and white Warbler	6	15	18	18	14	24	36	18	30	27
	Tennessee Warbler	0	9	0	0	2	0	0	0	0	0
	Nashville Warbler	0	12	6	6	6	6	24	12	12	14
	Yellow Warbler	0	0	0	0	0	0	0	0	0	0
	Magnolia Warbler	0	0	0	0	0	0	0	0	0	0
	Cape May Warbler	0	0	0	0	0	0	0	0	0	0
	Black-throated Blue Warbler	0	21	18	18	14	18	36	48	36	35
	Myrtle Warbler	6	18	6	12	11	0	0	0	0	0
	Black-throated Green Warbler	0	0	0	0	0	0	0	6	0	2

Table XIII (Cont'd)

Family	Species	Pre-spray 16th -3	17 -2	18 -1	19 -1	Daily ave.	Post-spray 20 + 1	21 + 2	22 + 3	23 + 4	Daily ave.
Parulidae (Cont'd)	Blackburnian Warbler	18	0	0	0	5	0	0	0	0	0
	Chestnut-sided Warbler	0	6	0	0	2	0	0	12	18	8
	Bay-breasted Warbler	0	0	0	0	0	0	0	0	0	0
	Blackpoll Warbler	0	0	0	0	0	0	0	0	0	0
	Prairie Warbler	0	0	0	0	0	0	0	0	0	0
	Ovenbird	72	66	33	39	53	48	30	42	42	41
	Northern Waterthrush	0	0	0	0	0	0	0	0	0	0
	Mourning Warbler	0	0	0	0	0	0	0	0	0	0
	Yellowthroat	0	0	0	0	0	0	0	0	0	0
	Canada Warbler	0	0	0	0	0	0	0	0	0	0
	American Redstart	0	0	0	0	0	0	0	0	0	0
Icteridae	Red-winged Blackbird	0	0	0	0	0	0	0	6	6	3
	Baltimore Oriole	0	0	6	6	3	0	0	0	0	0
	Brown-headed Cowbird	15	6	0	0	5	0	6	0	0	2
Fringillidae	Rose-breasted Grosbeak	12	12	12	12	12	12	12	27	18	17
	Evening Grosbeak	12	15	0	0	7	6	6	12	12	9
	Purple Finch	30	36	48	48	41	39	51	42	30	41
	American Goldfinch	0	0	0	0	0	0	0	0	0	0
	Slate-coloured Junco	6	12	0	0	5	0	0	0	0	0
	Chipping Sparrow	6	0	0	0	2	0	0	12	6	5
	White-crowned Sparrow	0	0	0	0	0	0	0	0	6	2
	White-throated Sparrow	105	87	63	69	81	81	78	84	78	80
	Song Sparrow	12	12	6	12	11	6	12	12	18	12
Unidentified	Species	6	0	0	0	2	0	0	6	6	3
	Totals :	771	636	420	462	572	477	498	612	558	536

Table XIV

Populations of Small Forest Songbirds
Fenitrothion-ZECTRAN® Treatment Block 121A-1
Mont Tremblant Park Quebec
1974

Family	Species	Pre-spray treatment 2						Post-spray treatment 2 (ZECTRAN®)					
		-9	-8	-7	-5	-2	Daily ave.	+0	+1	+2	+3	+4	Daily ave.
Tetranonidae	Ruffed Grouse	0	0	0	6	6	2	6	0	6	0	0	2
Scolopacidae	American Woodcock	0	6	0	0	6	2	0	6	0	0	0	1
Trochilidae	Ruby-throated Hummingbird	6	6	0	12	0	5	0	0	0	0	6	1
Alcedinidae	Belted Kingfisher	0	0	0	0	0	0	0	0	0	12	0	2
Picidae	Yellow-bellied Sapsucker	0	0	6	0	0	1	6	0	12	0	0	4
	Hairy Woodpecker	0	0	0	0	0	0	0	6	0	0	0	1
Tyrannidae	Least Flycatcher	0	0	6	0	0	1	0	0	0	0	0	0
Paridae	Black-capped Chickadee	0	0	0	0	6	1	6	0	0	0	0	1
Sittidae	Red-breasted Nuthatch	0	6	0	0	0	1	0	6	0	6	0	2
Certhiidae	Brown Creeper	0	0	6	6	0	2	0	0	6	0	0	1
Troglodytidae	Winter Wren	12	12	6	12	6	10	6	6	12	6	6	7
Turdidae	American Robin	12	30	24	18	18	20	18	0	18	12	6	11
	Wood Thrush	18	6	6	12	12	11	12	0	6	12	6	7
	Swainson's Thrush	0	6	0	0	0	1	0	0	0	6	0	1
Sylviidae	Golden-crowned Kinglet	0	0	0	0	6	1	0	0	0	6	6	2
	Ruby-crowned Kinglet	0	0	0	0	6	1	12	18	12	18	12	14
Vireonidae	Solitary Vireo	0	0	12	12	12	7	12	6	12	6	6	8

Table XIV (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2 (ZECTRAN®)					
		-9	-8	-7	-5	-2	Daily ave.	+0	+1	+2	+3	+4	Daily ave.
Vireonidae (Cont'd)	Red-eyed Vireo	0	0	0	0	0	0	12	6	0	12	12	8
Parulidae	Black and white Warbler	0	0	0	0	0	0	0	0	0	6	12	4
	Tennessee Warbler	0	0	0	0	18	4	0	0	0	0	0	0
	Nashville Warbler	0	0	6	6	0	2	0	0	0	0	0	0
	Magnolia Warbler	0	0	18	12	6	7	12	18	18	24	12	17
	Cape May Warbler	0	0	24	12	6	8	12	18	18	18	12	17
	Black-throated Blue Warbler	0	0	0	12	0	2	12	12	6	6	6	8
	Myrtle Warbler	6	6	6	6	0	5	0	6	0	12	18	7
	Black-throated Green Warbler	0	6	6	6	12	6	0	0	0	0	0	0
	Blackburnian Warbler	0	0	0	18	18	7	18	12	12	6	18	13
	Chestnut-sided Warbler							0	6	6	12	12	7
	Bay-breasted Warbler	0	0	12	24	12	10	30	30	18	24	36	28
	Ovenbird	24	12	18	30	24	22	30	18	18	30	18	23
	Northern Waterthrush	6	0	0	6	0	2	0	0	0	0	0	0
	Mourning Warbler	0	0	0	0	0	0	6	0	6	0	0	2
	Yellowthroat	0	0	6	0	0	1	0	0	0	6	0	1
	American Redstart	0	0	12	12	12	7	6	18	0	0	0	5
Icteridae	Common Grackle	0	18	0	0	0	4	18	0	0	0	0	4
	Brown-headed Cowbird	6	0	0	0	6	2	6	0	0	0	0	1
Fringillidae	Rose-breasted Grosbeak	6	24	6	18	0	8	12	15	27	18	18	18
	Evening Grosbeak	0	3	12	6	6	5	0	0	6	0	0	1
	Purple Finch	12	18	24	6	12	14	12	6	12	12	12	11
	American Goldfinch	0	0	0	0	0	0	6	0	0	0	0	1
	Slate-coloured Junco	0	0	0	0	0	0	6	0	12	6	0	5
	Chipping Sparrow	0	0	12	12	0	5	12	6	0	0	6	5
	White-crowned sparrow	0	0	6	0	0	1	0	0	0	0	0	0
	White-throated sparrow	12	18	0	30	12	14	18	0	18	18	12	13
Totals		120	177	234	288	222	208	306	219	261	294	252	266

Table XV

Populations of Small Forest Songbirds
Fenitrothion-ZECTRAN® Treatment Block 121A-2
Mont Tremblant Park, Quebec
1974

Family	Species	Pre-spray treatment 2						Post-spray treatment 2 (ZECTRAN®)					
		-7	-6	-5	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Picidae	Yellow-shafted Flicker	8	0	0	0	0	2	0	0	0	0	0	0
	Yellow-bellied Sapsucker	4	4	4	0	8	4	4	4	4	8	0	5
	Hairy Woodpecker	0	0	0	0	0	0	4	0	0	0	0	1
Tyrannidae	Crested Flycatcher	0	0	0	0	0	0	0	0	0	8	0	2
Hirundinidae	Bank Swallow	24	0	12	8	0	9	8	8	0	0	8	5
Corvidae	Gray Jay	0	0	0	16	0	3	0	0	0	12	0	2
	Blue Jay	0	0	0	12	4	3	0	4	4	4	4	3
	Common Raven	0	8	0	4	0	2	0	4	0	0	0	1
	Common Crow	0	0	4	0	4	2	4	8	0	0	8	4
Paridae	Black-capped Chickadee	0	0	4	0	4	2	0	4	0	0	0	1
Sittidae	Red-breasted Nuthatch	16	8	8	8	0	8	8	0	8	8	0	5
Certhiidae	Brown Creeper	0	8	0	0	0	2	0	0	0	0	0	0
Troglodytidae	Winter Wren	0	8	8	8	0	5	0	8	0	0	0	2
Turdidae	American Robin	8	8	16	0	4	7	0	4	0	8	4	3
	Wood Thrush	0	8	0	0	0	2	8	0	8	0	0	3
	Swainson's Thrush	16	16	4	8	16	12	12	8	0	8	0	6
	Veery	0	0	0	0	0	0	0	8	4	0	0	2

Table XV (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2 (ZECTRAN®)					
		-7	-6	-5	-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Sylviidae	Ruby-crowned Kinglet	0	24	24	0	8	11	0	8	16	0	0	5
Bombycillidae	Cedar Waxwing	0	0	0	0	0	0	0	0	0	16	12	6
Vireonidae	Solitary Vireo	16	24	0	0	0	8	0	0	0	16	0	3
	Red-eyed Vireo	0	0	0	0	8	2	0	0	0	0	0	0
Parulidae	Black and White Warbler	8	0	16	0	0	5	0	16	0	0	16	6
	Nashville Warbler	24	16	4	0	8	10	0	0	0	8	8	3
	Magnolia Warbler	16	16	24	16	8	16	8	24	24	32	8	19
	Cape May Warbler	24	16	16	8	24	18	0	0	16	16	16	10
	Black-throated Blue Warbler	0	0	0	0	0	0	8	0	0	0	0	2
	Myrtle Warbler	16	24	16	8	0	13	16	16	16	16	8	14
	Black-throated Green Warbler	0	0	0	0	8	2	16	8	8	0	0	6
	Blackburnian Warbler	0	8	16	24	0	10	8	8	16	0	16	10
	Chestnut-sided Warbler	16	16	32	8	8	16	8	16	0	24	16	13
	Bay-breasted Warbler	24	16	24	8	0	14	0	0	0	0	0	0
	Ovenbird	8	8	16	8	24	13	24	8	16	16	8	15
	Mourning Warbler	0	0	0	0	0	0	8	16	16	24	8	15
	Yellowthroat	0	8	0	0	0	0	0	0	0	8	0	2
Icteridae	Brown-headed Cowbird	0	8	8	8	0	5	0	0	0	0	8	2
Fringillidae	Rose-breasted Grosbeak	4	20	0	0	8	6	0	0	0	8	0	2
	Evening Grosbeak	0	0	0	0	4	1	0	0	0	4	0	1
	Purple Finch	8	16	24	16	0	13	8	8	0	0	8	5
	American Goldfinch	0	0	8	0	0	2	8	8	0	0	0	3
	Slate-coloured Junco	0	0	0	0	8	2	8	0	16	0	8	6
	Chipping Sparrow	8	0	0	16	8	6	8	8	8	8	8	8
	White-throated Sparrow	48	24	24	32	16	29	16	20	8	0	8	10
Totals		288	312	312	216	180	261	192	224	188	252	180	207

Table XVI

Populations of Small Forest Songbirds
Fenitrothion-ZECTRAN® Treatment Block 121A-3
Mont Tremblant Park, Quebec
1974

Family	Species	Pre-spray treatment 2						Post-spray treatment 2 (ZECTRAN®)					
		-8	-7	-5	-3	-2	Daily ave.	+ 0	+1	+2	+3	+4	Daily ave.
Tetraonidae	Ruffed Grouse	12	12	0	6	6	7	0	6	6	0	0	2
Scolopacidae	American Woodcock	6	0	0	0	0	1	0	0	0	0	0	0
Trochilidae	Ruby-throated Hummingbird	12	0	0	0	0	2	0	0	0	0	0	0
Picidae	Yellow-bellied Sapsucker	0	0	0	6	0	1	6	0	0	0	0	1
	Hairy Woodpecker	0	0	6	0	0	1	6	6	0	0	0	2
Tyrannidae	Great-crested Flycatcher	0	0	0	0	0	0	0	0	0	0	6	1
Corvidae	Blue Jay	0	0	6	0	0	1	0	0	6	0	0	1
	Common Crow	0	0	0	0	6	1	0	0	12	6	0	4
Paridae	Black-capped Chickadee	0	6	12	6	6	6	6	12	6	0	0	5
Sittidae	Red-breasted Nuthatch	0	6	6	0	0	2	0	0	6	0	0	1
Certhiidae	Brown Creeper	0	0	6	0	0	1	0	0	6	6	0	2
Troglodytidae	Winter Wren	0	6	0	0	6	2	6	6	6	6	0	5
Turdidae	American Robin	0	6	0	0	0	1	0	0	0	0	0	0
	Hermit Thrush	18	6	6	0	0	6	6	0	6	0	0	2
	Swainson's Thrush	18	12	0	0	12	8	0	0	12	6	6	5

Table XVI (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2 (ZECTRAN®)					
		-8	-7	-5	-3	-2	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Sylviidae	Golden-crowned Kinglet	0	6	6	0	0	2	6	0	0	0	0	1
	Ruby-crowned Kinglet	6	6	6	6	6	6	0	6	0	0	0	1
Vireonidae	Solitary Vireo	6	12	0	6	0	5	12	6	6	6	12	8
	Red-breasted Vireo	0	6	6	0	12	5	12	6	24	6	6	11
Parulidae	Black and White Warbler	6	18	12	6	12	11	18	0	6	0	6	6
	Nashville Warbler	6	12	12	0	0	6	18	6	18	18	24	17
	Parula Warbler	0	12	24	6	12	11	18	6	6	6	6	8
	Magnolia Warbler	0	12	12	18	18	12	12	6	18	6	18	12
	Cape May Warbler	0	0	0	0	12	2	6	0	0	0	6	2
	Black-throated Blue Warbler	0	24	0	12	18	11	18	18	6	6	12	12
	Myrtle Warbler	0	6	0	0	0	1	12	0	0	0	0	2
	Black-throated Green Warbler	0	0	24	0	6	6	12	6	24	12	12	13
	Blackburnian Warbler	0	24	24	12	24	17	24	30	36	42	48	36
	Chestnut-sided Warbler	0	12	12	12	12	10	24	12	12	12	18	16
	Bay-breasted Warbler	0	30	6	6	6	10	18	6	18	6	12	12
	Ovenbird	30	36	36	24	24	30	24	24	30	24	36	28
	Mourning Warbler	0	0	0	0	0	0	0	0	0	6	6	2
	Yellowthroat	0	6	0	0	0	1	0	0	0	0	0	0
	Mourning Warbler	0	0	0	0	0	0	0	0	0	6	6	2
	Canada Warbler	0	0	0	6	6	2	6	6	0	0	0	2
	American Redstart	0	0	0	0	0	0	0	12	6	0	0	4
Icteridae	Brown-headed Cowbird	0	0	0	0	0	0	0	0	6	0	0	1
Fringillidae	Rose-breasted Grosbeak	0	0	0	0	0	0	12	12	6	0	12	8
	Evening Grosbeak	0	0	0	0	0	0	0	0	0	6	0	1

Table XVI (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2 (ZECTRAN®)					
		-8	-7	-5	-3	-2	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Fringillidae (Cont'd)	Purple Finch	24	24	18	6	0	14	0	12	6	0	0	4
	American Goldfinch	0	0	0	0	0	0	0	6	0	0	0	2
	Slate-coloured Junco	0	0	6	0	6	2	6	0	0	0	0	2
	White-throated Sparrow	18	30	18	12	24	20	12	12	6	0	6	7
	Chipping Sparrow	0	6	6	0	0	2	0	0	6	0	0	2
Totals		162	336	270	150	234	230	300	222	300	186	258	253

Table XVII

Populations of Small Forest Songbirds
Lac Chaud Control Plots
La Macaza Area, Quebec.
1974

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-5	-4	-3	-2	-1	Daily ave.	+ 1	+ 2	+ 3	+ 4	+ 5	Daily ave.
Tetraonidae	Ruffed Grouse	0	0	6	0	0	1	0	3	0	0	0	1
Scolopacidae	American Woodcock	0	0	0	0	0	0	0	0	0	0	3	1
Picidae	Yellow-shafted Flicker	6	0	6	0	6	4	3	0	0	0	0	1
	Yellow-bellied Sapsucker	0	6	0	0	0	1	0	0	0	0	0	0
	Hairy Woodpecker	0	0	0	0	6	1	0	0	0	0	0	0
	Downy Woodpecker	0	0	0	6	0	1	0	0	0	0	0	0
Tyrannidae	Eastern Phoebe	0	0	0	0	0	0	0	0	0	0	0	0
	Least Flycatcher	66	42	60	54	48	54	72	66	48	54	42	56
	Eastern Wood Pewee	0	0	0	0	0	0	0	12	6	12	12	5
Hirundinidae	Tree Swallow	0	0	0	0	0	0	0	0	0	0	0	0
	Barn Swallow	0	0	0	0	0	0	0	0	0	0	0	0
Corvidae	Blue Jay	12	0	12	0	0	5	12	6	6	6	6	7
	Common Crow	0	0	0	0	0	0	0	0	0	0	0	0
	Common Raven	0	0	0	0	0	0	0	0	0	0	0	0
Paridae	Black-capped Chickadee	12	27	0	9	27	15	36	6	18	0	0	12
	Boreal Chickadee	0	0	0	0	0	0	0	0	0	0	0	0
Sittidae	Red-breasted Nuthatch	0	0	0	0	0	0	3	0	0	0	0	1
Certhiidae	Brown Creeper	0	0	0	0	0	0	0	0	0	0	0	0

Table XVII (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-5	-4	-3	-2	-1	Daily ave.	+ 1	+ 2	+ 3	+ 4	+ 5	Daily ave.
Troglodytidae	Winter Wren	18	18	18	24	24	20	6	30	30	12	6	17
Mimidae	Brown Thrasher	0	0	0	0	0	0	0	0	0	0	0	0
Turdidae	American Robin	24	24	9	9	21	17	12	33	12	24	6	17
	Wood Thrush	0	6	0	6	6	4	0	6	0	0	0	1
	Hermit Thrush	0	6	12	6	0	5	0	6	0	12	0	4
	Swainson's Thrush	0	0	0	0	0	0	0	0	0	0	0	0
	Veery	36	24	12	6	6	17	21	36	21	12	18	22
Sylviidae	Golden-crowned Kinglet	0	0	0	0	0	0	0	0	0	0	0	0
	Ruby-crowned Kinglet	36	24	12	6	6	17	0	0	6	0	0	1
Vireonidae	Solitary Vireo	0	0	6	0	0	1	0	0	0	0	0	0
	Red-eyed Vireo	0	0	0	0	0	0	24	24	36	54	24	32
	Philadelphia Vireo	0	0	0	0	0	0	0	0	0	0	6	1
	Warbling Vireo	0	0	0	0	6	1	0	0	0	0	0	0
Parulidae	Black and white Warbler	6	0	18	6	12	8	6	18	18	36	30	22
	Tennessee Warbler	0	0	0	6	0	1	0	6	0	0	0	1
	Nashville Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Magnolia Warbler	6	0	0	0	0	1	0	0	0	0	0	0
	Cape May Warbler	6	6	0	0	6	4	6	0	0	0	0	1
	Black-throated Blue Warbler	48	42	42	0	42	35	54	18	54	48	36	42
	Myrtle Warbler	6	0	0	0	0	1	0	0	0	0	0	0
	Black-throated Green Warbler	24	30	30	30	18	26	12	12	18	6	18	13
	Blackburnian Warbler	6	0	0	0	12	4	24	18	6	0	0	10
	Chestnut-sided Warbler	114	96	90	84	78	92	96	54	66	60	30	61

Table XVII (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-5	-4	-3	-2	-1	Daily ave.	+ 1	+ 2	+ 3	+ 4	+ 5	Daily ave.
Parulidae (Cont'd)	Bay-breasted Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Blackpoll Warbler	0	0	0	12	6	4	36	24	12	12	0	17
	Prairie Warbler	0	0	12	0	0	2	0	0	0	0	0	0
	Ovenbird	108	66	60	45	90	74	72	54	48	48	30	50
	Northern Waterthrush	0	0	0	0	0	0	6	0	0	0	0	1
	Mourning Warbler	6	0	6	18	0	6	0	6	0	18	24	10
	Yellowthroat	0	0	0	0	0	0	0	6	0	0	0	1
	Canada WArbler	6	6	12	12	18	11	6	6	18	0	6	7
	American Redstart	18	12	24	15	9	16	12	15	21	18	24	18
Icteridae	Red-winged Blackbird	0	0	0	0	0	0	0	0	0	0	6	1
	Baltimore Oriole	0	0	0	0	0	0	0	0	0	0	0	0
	Common Grackle	0	6	0	0	0	1	0	0	0	0	0	0
	Brown-headed Cowbird	0	6	0	9	12	5	6	0	0	0	0	1
Fringillidae	Rose-breasted Grosbeak	30	60	30	24	24	34	24	27	18	6	12	17
	Evening Grosbeak	12	0	24	24	6	13	6	6	6	0	0	4
	Purple Finch	6	6	27	12	12	13	6	0	0	0	0	1
	American Goldfinch	0	0	6	0	0	1	0	0	0	0	0	0
	Slate-coloured Junco	0	0	0	0	0	0	0	0	6	0	0	1
	Chipping Sparrow	0	0	0	0	0	0	0	0	0	0	0	0
	White-crowned Sparrow	0	0	0	0	0	0	0	0	0	0	0	0
	White-throated Sparrow	39	48	36	42	36	40	48	24	24	30	12	28
Unidentified	Species	0	0	6	0	0	1	0	0	0	0	6	1
Totals		645	561	582	465	531	567	609	522	498	468	357	491

Table XVIII

Population of Small Forest Songbirds Monitored
on MATACIL® Treatment Plot 1
Parent Quebec
1974

Family	Species	Pre-spray treatment 1			Post-spray treatment 1					
		-2	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Tetraonidae	Ruffed Grouse	0	12	6	6	6	12	6	6	7
Alcedinidae	Belted Kingfisher	0	12	6	0	0	0	0	0	0
Picidae	Yellow-shafted Flicker	0	15	8	0	0	6	6	6	4
	Yellow-bellied Sapsucker	0	12	9	0	18	0	0	0	4
Tyrannidae	Eastern Phoebe	0	0	0	0	0	0	0	0	0
	Least Flycatcher	6	30	18	30	54	66	36	42	46
Paridae	Black-capped Chickadee	0	0	0	0	0	0	0	0	0
Sittidae	Red-breasted Nuthatch	12	12	12	0	0	0	0	0	0
Troglodytidae	Winter Wren	6	42	24	39	12	48	36	33	34
Turdidae	American Robin	15	9	12	15	12	18	30	24	20
	Hermit Thrush	6	6	6	6	12	60	66	60	29
	Swainson's Thrush	6	0	3	0	30	60	12	6	22
	Veery	0	0	0	30	72	36	42	42	44
Sylviidae	Ruby-crowned Kinglet	18	30	24	0	12	0	48	12	14
	Golden-crowned Kinglet	0	0	0	12	0	0	0	0	2
Vireonidae	Solitary Vireo	0	12	6	0	12	0	0	0	2

Table XVIII (Cont'd)

Family	Species	Pre-spray treatment 1			Post-spray treatment 1					
		-2	-1	Daily ave	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Vireonidae (Cont'd)	Red-eyed Vireo	0	6	3	0	0	0	0	0	0
Parulidae	Black and White Warbler	0	6	3	0	0	0	0	0	0
	Nashville Warbler	6	18	12	78	42	54	30	48	50
	Magnolia Warbler	0	0	0	24	48	60	18	0	30
	Cape-May Warbler	0	0	0	0	0	0	18	0	4
	Black-throated Blue Warbler	6	18	12	18	0	0	6	0	5
	Myrtle Warbler	0	0	0	0	18	6	0	0	5
	Black-throated Green Warbler	6	18	12	0	0	0	0	0	0
	Blackburnian Warbler	0	0	0	0	0	0	0	0	0
	Chestnut-sided Warbler	18	72	45	60	60	60	102	78	72
	Bay-breasted Warbler	0	0	0	0	0	0	24	24	10
	Ovenbird	18	48	33	66	30	30	54	36	43
	Mourning Warbler	0	18	9	0	0	0	0	0	0
	Yellowthroat	6	0	3	0	0	0	0	0	0
	Canada Warbler	0	24	12	12	18	24	24	18	19
	American Redstart	6	63	35	45	66	42	18	36	41
Icteridae	Red-winged Blackbird	0	0	0	6	0	0	0	0	1
Fringillidae	Evening Grosbeak	0	0	0	0	6	6	0	0	2
	Purple Finch	0	6	3	0	0	0	0	0	0
	Slate-coloured Junco	0	6	3	0	0	0	0	0	0
	White-throated Sparrow	24	114	69	120	114	108	126	72	108
Totals		165	597	381	567	642	636	702	543	618

Table XIX

Populations of Small Forest Songbirds
on MATACIL® Treatment Plot 4
Parent Quebec
1974

Family	Species	Pre-spray treatment 1				Post-spray treatment 1					
		-2	-1	-0	Daily ave.	+ 1	+ 2	+ 3	+ 4	+ 5	Daily ave.
Trochilidae	Ruby-throated Hummingbird	0	0	0	0	0	3	0	0	0	1
Picidae	Yellow-bellied Sapsucker	12	6	18	12	0	0	0	0	0	0
Tyrannidae	Least Flycatcher	0	0	0	0	0	6	6	0	6	4
	Olive-sided Flycatcher	0	0	0	0	6	0	0	0	0	1
Corvidae	Blue Jay	0	0	3	1	0	0	0	0	0	0
	Gray Jay	0	0	0	0	6	0	0	0	0	1
Paridae	Black-capped Chickadee	6	0	0	2	0	0	0	0	0	0
Sittidae	Red-breasted Nuthatch	0	0	0	0	12	12	6	6	0	7
Troglodytidae	Winter Wren	18	0	0	6	24	30	30	24	30	32
Turdidae	Hermit Thrush	6	6	6	6	24	12	12	18	18	17
	Swainson's Thrush	0	0	0	0	6	12	0	12	42	14
	Veery	0	6	6	3	0	0	0	0	18	5
Sylviidae	Ruby-crowned Kinglet	54	55	114	78	48	48	51	84	54	57
Vireonidae	Red-eyed Vireo	6	0	0	2	0	0	0	0	0	0
	Solitary Vireo	0	0	6	2	0	0	0	0	0	0

Table XIX (Cont'd)

Family	Species	Pre-spray treatment 1				Post-spray treatment 1					
		-2	-1	-0	Daily ave.	+ 1	+ 2	+ 3	+ 4	+ 5	Daily ave.
Parulidae	Tennessee Warbler	0	60	72	44	108	66	66	14	42	59
	Nashville Warbler	0	48	42	30	78	30	66	48	30	50
	Magnolia Warbler	6	18	12	12	0	12	18	24	12	13
	Black-throated Green Warbler	0	0	0	0	0	0	6	18	12	7
	Chestnut-sided Warbler	0	0	6	2	6	6	6	0	18	7
	Cape May Warbler	0	66	78	48	78	54	84	54	12	56
	Bay-breasted Warbler	0	6	12	6	12	12	36	18	60	28
	Yellowthroat	0	0	0	0	24	0	0	6	18	11
Icteridae	Rusty Blackbird	0	0	6	2	0	0	0	0	0	0
	Brown-headed Cowbird	0	6	0	2	0	0	0	0	0	0
Fringillidae	Evening Grosbeak	0	15	21	12	0	0	0	0	0	0
	Slate-coloured Junco	0	0	6	2	0	0	0	0	12	2
	White-throated Sparrow	57	84	96	79	128	48	72	60	90	80
	Swamp Sparrow	0	18	12	10	0	6	6	6	6	5
Unidentified	Species	0	0	0	0	6	3	9	9	0	3
Totals		165	351	516	344	566	360	474	401	480	456

Table XX

Populations of Small Forest Songbirds
on MATACIL ® Control Plot
Parent Quebec
1974

Family	Species	Pre-spray treatment 1	Post-spray treatment 1					
		- 1	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Caprimulgidae	Common Nighthawk	9	0	0	0	0	0	0
Alcedinidae	Belted Kingfisher	0	0	0	0	0	0	0
Picidae	Yellow-shafted Flicker	12	0	0	0	0	0	0
	Yellow-bellied Sapsucker	0	0	0	0	0	0	0
Tyrannidae	Eastern Kingbird	0	0	6	0	6	0	2
	Eastern Phoebe	0	0	0	0	0	12	2
	Least Flycatcher	0	0	6	0	0	6	2
	Olive-sided Flycatcher	0	0	0	0	0	0	0
Hirundinidae	Tree Swallow	0	6	6	0	0	6	4
Corvidae	Gray Jay	0	0	6	12	0	12	6
Sittidae	Red-breasted Nuthatch	0	6	0	6	0	0	2
Troglodytidae	Winter Wren	0	0	0	0	0	0	0
Turdidae	American Robin	9	0	6	15	0	3	5
	Hermit Thrush	48	36	42	24	6	18	25
	Swainson's Thrush	0	0	0	3	12	0	3
	Veery	6	0	0	0	0	0	0
Sylviidae	Ruby-crowned Kinglet	36	18	24	36	60	18	31
Bombycillidae	Cedar Waxwing	0	0	0	0	0	0	0

Table XX (Cont'd)

Family	Species	Pre-spray treatment 1	Post-spray treatment 1					
		- 1	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Vireonidae	Solitary Vireo	0	0	0	6	6	0	2
	Red-eyed Vireo	0	0	0	0	0	0	0
Parulidae	Black and White Warbler	0	0	0	0	0	0	0
	Tennessee Warbler	0	0	12	6	12	0	6
	Nashville Warbler	0	6	36	24	18	0	17
	Yellow Warbler	0	6	0	0	0	0	1
	Magnolia Warbler	6	0	0	0	12	6	4
	Myrtle Warbler	6	12	0	0	0	0	2
	Chestnut-sided Warbler	0	0	0	0	0	0	0
	Bay-breasted Warbler	0	0	0	0	0	0	0
	Ovenbird	0	0	6	0	0	0	1
Icteridae	Red-winged Blackbird	12	12	6	24	24	6	14
	Rust Blackbird	0	0	0	0	0	0	0
	Common Grackle	0	0	24	15	3	12	11
Fringillidae	Evening Grosbeak	0	0	0	12	6	6	5
	American Goldfinch	0	0	0	0	0	0	0
	Slate-coloured Junco	12	18	6	15	57	36	26
	White-throated Sparrow	30	54	84	45	51	36	54
	Swamp Sparrow	0	0	0	0	0	0	0
Unidentified	Species	6	0	0	6	0	0	1
Totals		192	180	282	255	273	183	234

Table XXI

Population of Small Forest Songbirds Monitored
on MATACIL ® Treatment Plot 1
Parent Quebec
1974

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-6	-5	-4	-3	-2	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Tetraonidae	Ruffed Grouse	6	6	6	6	6	6	0	6	6	6	6	
Alcedinidae	Belted Kingfisher	0	0	0	0	0	0	0	0	0	0	0	0
Picidae	Yellow-shafted Flicker	6	6	6	12	12	8	0	3	0	0	30	7
	Yellow-bellied Sapsucker	0	0	0	6	0	1	0	18	3	12	0	7
Tyrannidae	Eastern Phoebe	0	6	0	0	0	1	0	0	0	0	0	0
	Least Flycatcher	30	18	24	18	18	22	24	24	12	30	30	24
Paridae	Black-capped Chickadee	0	0	0	0	0	0	6	0	0	0	0	1
Sittidae	Red-breasted Nuthatch	0	0	0	0	0	0	6	0	0	0	0	1
Troglodytidae	Winter Wren	42	24	18	24	36	29	12	30	12	30	12	19
Turdidae	American Robin	21	24	0	18	12	15	3	24	12	66	33	28
	Hermit Thrush	54	12	24	6	12	22	0	6	18	24	30	16
	Swainson's Thrush	6	6	18	12	12	11	30	30	36	18	42	31
	Veery	30	30	48	30	60	40	0	30	36	42	42	30
Sylviidae	Golden-crowned Kinglet	0	0	0	0	0	0	6	0	0	0	0	1
	Ruby-crowned Kinglet	0	66	54	42	84	49	18	30	24	24	24	24
Vireonidae	Solitary Vireo	0	0	0	0	0	0	0	0	0	0	0	0
	Red-eyed Vireo	0	0	0	0	0	0	60	48	78	108	120	83

Table XXI (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-6	-5	-4	-3	-2	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Parulidae	Black and White Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Nashville Warbler	36	36	0	24	18	23	18	24	0	24	18	17
	Magnolia Warbler	12	0	0	0	18	6	6	24	18	42	24	23
	Cape May Warbler	6	24	0	0	0	6	6	0	24	24	36	18
	Black-throated Blue Warbler	0	0	0	0	0	0	30	0	0	0	0	6
	Myrtle Warbler	0	0	0	0	0	0	0	6	0	0	0	1
	Black-throated Green Warbler	0	0	0	0	0	0	6	0	0	0	0	1
	Blackburnian Warbler	0	0	0	0	0	0	18	0	0	0	0	4
	Chestnut-sided Warbler	90	84	48	24	42	58	18	54	24	48	54	40
	Bay-breasted Warbler	6	0	0	0	6	2	18	36	12	18	42	25
	Ovenbird	30	42	30	18	54	35	48	24	30	42	30	35
	Mourning Warbler	6	0	0	0	0	1	24	0	0	0	0	5
	Yellowthroat	0	0	0	0	0	0	0	0	0	0	0	0
	Canada Warbler	0	0	0	0	0	0	24	0	6	0	0	6
	American Redstart	36	24	12	36	12	24	18	12	0	18	12	12
Icteridae	Red-winged Blackbird	0	0	0	0	0	0	0	0	0	0	0	0
Fringillidae	Evening Grosbeak	0	0	0	0	0	0	0	0	0	0	0	0
	Purple Finch	0	0	0	0	0	0	12	0	0	0	0	0
	Slate-coloured Junco	6	0	0	0	0	0	0	0	0	0	0	0
	White-throated Sparrow	60	60	72	72	126	78	18	60	84	120	90	74
Totals		477	468	360	336	528	433	429	489	435	969	675	545

Table XXII

Populations of Small Forest Songbirds
on MATACIL® Treatment Plot 3
Parent Quebec
1974

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-6	-5	-4	-3	-2	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Tetraonidae	Spruce Grouse	0	0	0	0	0	0	0	0	0	0	0	1
Caprimulgidae	Common Nighthawk	0	0	0	6	0	1	0	0	0	6	0	1
Picidae	Yellow-shafted Flicker	3	12	0	12	6	6	6	0	6	6	0	4
	Yellow-bellied Sapsucker	0	3	0	9	6	4	0	0	0	0	0	0
Tyrannidae	Eastern Phoebe	18	0	6	0	6	6	0	6	0	6	0	2
	Least Flycatcher	0	6	6	6	0	4	6	0	0	0	12	4
Paridae	Boreal Chickadee	0	0	0	0	0	0	0	6	0	0	0	1
Sittidae	Red-breasted Nuthatch	0	0	0	6	0	1	0	0	0	0	0	0
Troglodytidae	Winter Wren	6	48	12	12	0	16	12	6	0	18	0	7
Turdidae	American Robin	0	3	0	0	0	1	0	0	0	0	0	0
	Hermit Thrush	24	12	12	0	12	12	18	24	24	0	12	16
	Swainson's Thrush	12	6	30	6	12	11	0	12	54	6	12	17
	Veery	0	0	0	0	0	0	0	0	0	0	0	0
Sylviidae	Ruby-crowned Kinglet	42	30	42	54	24	38	42	30	42	30	48	38
Vireonidae	Solitary Vireo	0	0	0	0	0	0	0	0	0	0	6	1
Parulidae	Tennessee Warbler	18	42	78	42	78	52	150	135	126	138	84	127
	Nashville Warbler	36	48	36	42	30	38	12	0	18	30	18	16
	Magnolia Warbler	33	18	42	30	30	31	0	0	48	18	36	20
	Cape-May Warbler	12	0	12	36	6	13	0	6	12	0	72	18
	Myrtle Warbler	0	0	0	0	0	0	12	0	0	0	6	4

Table XXII (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-6	-5	-4	-3	-2	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Parulidae (Cont'd)	Black-throated Green Warbler	12	0	0	0	0	2	0	0	0	0	0	0
	Chestnut-sided Warbler	0	12	0	0	0	2	0	0	0	0	0	0
	Bay-breasted Warbler	42	24	24	18	6	23	0	12	24	24	18	16
	Ovenbird	6	0	6	0	0	2	0	0	0	0	0	0
	Yellowthroat	0	0	6	12	0	4	0	0	0	6	18	5
	Canada Warbler	0	0	0	0	0	0	6	0	0	0	0	1
	American Redstart	0	0	0	0	0	0	0	0	6	0	0	1
Fringillidae	Purple Finch	0	0	0	0	6	1	0	0	0	0	0	0
	American Goldfinch	0	0	0	0	6	1	0	0	0	0	0	0
	Slate-coloured Junco	36	6	12	6	12	14	42	18	0	21	6	17
	White-throated Sparrow	66	90	78	90	78	73	87	87	72	105	84	87
	Song Sparrow	0	0	0	0	0	0	6	0	0	0	0	1
Unidentified	Species	6	0	0	6	6	4	0	0	0	0	0	0
Totals		372	360	402	393	324	370	405	342	432	414	438	406

Table XXIII

Populations of Small Forest Songbirds
on MATACIL® Treatment Plot 4
Parent Quebec
1974

Family	Species	Pre-spray treatment 2					Post-spray treatment 2				
		-5	-3	-1	-0	Daily ave.	+ 1	+ 2	+ 3	+ 4	Daily ave.
Picidae	Yellow-shafted Flicker	6	0	0	0	2	18	0	0	0	5
	Yellow-bellied Sapsucker	0	0	6	6	3	0	0	0	0	0
Tyrannidae	Least Flycatcher	0	0	0	6	2	0	6	0	0	2
	Olive-sided Flycatcher	6	0	0	0	2	0	0	0	0	0
Troglodytidae	Winter Wren	30	30	24	45	32	18	18	0	18	14
Turdidae	American Robin	0	0	0	6	2	0	0	0	0	0
	Hermit Thrush	6	6	18	12	11	6	18	24	12	17
	Swainson's Thrush	48	30	18	30	32	60	48	18	36	41
	Veery	0	0	0	18	5	0	0	18	0	5
Sylviidae	Ruby-crowned Kinglet	66	54	30	78	57	42	30	42	24	35
Vireonidae	Red-eyed Vireo	12	0	0	0	3	0	0	6	6	3
	Solitary Vireo	6	0	0	0	2	0	0	0	0	0
Parulidae	Tennessee Warbler	66	78	126	84	89	128	150	96	150	131
	Nashville Warbler	6	36	60	66	47	12	12	42	12	24
	Magnolia Warbler	24	12	66	36	36	18	24	12	30	21
	Myrtle Warbler	6	0	0	0	2	0	0	0	0	0
	Black-throated Green Warbler	6	0	0	0	2	0	0	0	0	0
	Black-throated Blue Warbler	0	0	6	0	2	0	0	0	0	0

Table XXIII (Cont'd)

Family	Species	Pre-spray treatment 2					Post-spray treatment 2				
		-5	-3	-1	-0	Daily ave.	+ 1	+ 2	+ 3	+ 4	Daily ave.
Parulidae (Cont'd)	Chestnut-sided Warbler	0	0	0	6	2	0	0	0	0	0
	Bay-breasted Warbler	42	18	18	6	21	48	24	72	66	53
	Cape May Warbler	24	6	12	60	26	30	24	42	0	24
	Yellowthroat	24	24	24	0	18	18	12	36	12	20
	American Redstart	0	0	0	24	6	0	0	0	0	0
Icteridae	Red-winged Blackbird	0	0	0	0	0	0	0	0	6	2
Fringillidae	Purple Finch	0	6	0	0	2	6	0	0	0	2
	Slate-coloured Junco	24	24	15	0	16	12	6	12	6	14
	White-throated Sparrow	102	30	84	180	99	72	42	84	24	56
Unidentified	Species	12	0	12	0	6	0	0	0	0	0
Totals		516	354	519	663	513	488	414	504	402	452

Table XXIV

Populations of Small Forest Songbirds
on MATACIL ® Control Plot
Parent Quebec
1974

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		- 6	- 5	- 4	- 3	- 1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Caprimulgidae	Common Nighthawk	0	0	0	0	0	0	6	0	0	3	0	2
Alcedinidae	Belted Kingfisher	0	0	0	0	6	1	0	0	0	0	0	0
Picidae	Yellow-shafted Flicker	0	0	0	0	0	0	0	0	0	0	0	0
	Yellow-bellied Sapsucker	0	6	0	0	0	1	0	0	0	0	0	0
Tyrannidae	Eastern Kingbird	0	0	0	0	0	0	0	0	0	0	0	0
	Eastern Phoebe	0	6	0	18	6	6	0	0	0	6	6	2
	Least Flycatcher	0	0	0	6	6	2	0	0	0	0	0	0
	Olive-sided Flycatcher	0	6	6	6	0	4	0	0	0	0	0	0
Hirundinidae	Tree Swallow	0	0	0	0	0	0	0	0	0	6	0	1
Corvidae	Gray Jay	6	0	0	0	6	2	0	0	0	0	0	0
Sittidae	Red-breasted Nuthatch	0	0	12	6	18	7	0	0	0	0	0	0
Troglodytidae	Winter Wren	0	0	0	0	6	1	0	0	0	0	0	0
Turdidae	American Robin	12	6	0	6	6	6	0	9	0	0	0	2
	Hermit Thrush	24	12	27	18	30	22	48	21	48	24	0	28
	Swainson's Thrush	15	12	24	24	24	20	54	24	18	54	30	36
	Veery	0	6	0	0	0	1	0	0	0	0	0	0
Sylviidae	Ruby-crowned Kinglet	66	66	54	78	66	66	6	18	36	30	24	23
Bombycillidae	Cedar Waxwing	0	0	0	15	9	5	0	0	0	0	0	0

Table XXIV (Cont'd)

Family	Species	Pre-spray treatment 2						Post-spray treatment 2					
		-6	-5	-4	-3	-1	Daily ave.	+ 0	+ 1	+ 2	+ 3	+ 4	Daily ave.
Vireonidae	Solitary Vireo	0	0	0	18	6	5	0	0	0	0	0	0
	Red-eyed Vireo	0	0	0	0	0	0	6	6	6	12	12	8
Parulidae	Black and White Warbler	6	0	0	6	6	4	0	0	0	0	0	0
	Tennessee Warbler	0	0	0	0	0	0	0	0	12	12	0	5
	Nashville Warbler	0	0	0	0	0	0	0	18	6	6	24	11
	Yellow Warbler	0	0	0	0	0	0	0	0	0	0	0	0
	Magnolia Warbler	0	0	0	0	0	0	0	6	0	6	6	4
	Myrtle Warbler	3	6	0	0	0	2	0	0	0	0	0	0
	Chestnut-sided Warbler	6	6	0	0	0	2	0	0	0	0	0	0
	Bay-breasted Warbler	0	0	0	0	0	0	0	6	0	0	0	1
	Ovenbird	0	0	0	6	0	1	0	0	0	0	0	0
Icteridae	Red-winged Blackbird	6	6	18	6	12	10	0	6	18	18	12	11
	Rusty Blackbird	0	12	6	30	6	11	0	0	0	0	0	0
	Common Grackle	0	0	0	0	0	0	0	0	9	3	0	2
Fringillidae	Evening Grosbeak	6	6	0	30	0	8	0	0	0	0	0	0
	American Goldfinch	0	6	6	0	0	2	0	0	0	0	0	0
	Slate-coloured Junco	15	51	6	24	36	26	6	12	36	6	12	14
	White-throated Sparrow	84	90	72	90	66	80	48	78	60	36	30	50
	Swamp Sparrow	0	6	0	0	0	1	0	0	0	0	0	0
Unidentified	Species	3	3	0	3	3	2	0	0	0	0	0	0
Totals		252	312	231	390	318	301	174	204	249	222	156	201

SMALL MAMMALS

R. Sarrazin, B.B. McLeod

Small mammal populations were censused from four areas in Western Quebec in 1974. Single and double applications of fenitrothion were monitored as well as a double application of MATACIL® and a combined treatment of fenitrothion followed by ZECTRAN®. Trapping took place in early August approximately 6 weeks after the final application to ensure that litters being carried by the females at the time of treatment had time to leave the nest and become available for trapping as sub-adults. An untreated plot in the Lac Chaud area served as a control for both the fenitrothion and combination applications.

METHODS

Eighty meter (90 yard) center lines were established and marked at 9 meter (10 yard) intervals. Five snap-back traps were located at 1 meter (1 yard) intervals perpendicular to the center line at each marker, resulting in a 80 x 40 meter trap line containing 50 traps. Each line was trapped for three consecutive nights. Small mammal specimens collected were identified, sex, age and breeding condition determined and the adult females preserved and returned to the laboratory for examination for embryos or placental scars.

RESULTS

Fenitrothion: Treatment block 260 received a single application of fenitrothion while blocks 258-259 received a double application. The red-back vole, *Clethrionomys gapperi* (Vigors) was the most frequently

trapped mammal followed by the woodland jumping mouse *Napaeozapus insignis* (Miller) and the deer mouse *Peromyscus maniculatus* (Wagner). Relatively low populations were encountered on all treatment blocks.

A total of 16 mammals representing 7 species were taken from the untreated plot (Table XXV). Eight of these animals were either juvenile or sub-adults and 2 females were either pregnant or contained placental scars indicating an uninterrupted breeding cycle of several weeks. Sixteen animals representing 3 species were collected from treatment block 260 (Table XXVI), which received a single application of insecticide. Juvenile and sub-adult animals were also trapped and 5 out of 5 adult females were either pregnant or contained placental scars. Treatment blocks 258 and 259 were subjected to a double application of fenitrothion. A total of 37 specimens belonging to 5 species were trapped (Table XXVII). Nineteen juvenile and sub-adult animals were taken while 8 out of the 10 female adults were either pregnant or contained placental scars.

The variation in numbers of species and specimens collected is a result of habitat selected for trapping rather than a result of the application of fenitrothion. Juvenile, sub-adult and adult female animals carrying embryos or placental scars indicate the normal breeding cycle had not been unduly disrupted by the application of fenitrothion.

Table XXV

Small Mammal Population Census
Untreated Control Plot
Lac Chaud, Quebec
August 1974

Species	Males				Females						
							Adults				
	Juv	Sub. ad.	Adult	Total	Juv	Sub. ad.	Pregnant	Not Pregnant	Placental Scars	Total	Total
Blarina brevicauda	1	0	1	2	0	0	0	0	0	0	2
Napaeozapus insignis	0	0	1	1	0	3	0	0	0	3	4
Peromyscus maniculatus	0	0	1	1	0	0	1	0	0	1	2
Clethrionomys gapperi	0	0	2	2	0	1	0	0	1	2	4
Microtus pennsylvanicus	0	1	0	1	1	0	0	1	0	2	3
Tamias striatus	0	1	0	1	0	0	0	0	0	0	1
Total	1	2	5	8	1	4	1	1	1	8	16

Table XXVI

Small Mammal Population Census
Fenitrothion Treatment Block 260 (Single Application)
La Macaza Quebec
August 1974

	Males				Females						
							Adults				
Species	Juv	Sub ad	Adult	Total	Juv	Sub ad	Pregnant	Not Pregnant	Placental Scars	Total	Total
Napaeozapus insignis	0	0	0	0	0	4	0	0	0	4	4
Peromyscus maniculatus	0	0	0	0	0	0	0	0	1	1	1
Clethrionomys gapperi	1	0	5	6	1	0	2	0	2	5	11
Total	1	0	5	6	1	4	2	0	3	10	16

Table XXVII

Small Mammal Population Census
Fenitrothion Treatment Blocks 258-259 (Double Application)
Lac Saguay Area, Quebec
August 1974

Species	Males				Females						
							Adults				
	Juv	Sub Ad	Adult	Total	Juv	Sub Ad	Pregnant	Not Pregnant	Placental Scars	Total	Total
Blarina brevicauda	0	1	2	3	0	1	0	1	0	2	5
Napaeozapus insignis	1	0	0	1	2	0	0	0	0	2	3
Peromyscus maniculatus	0	0	3	3	0	0	1	0	1	2	5
Clethrionomys gapperi	4	3	2	9	7	0	2	1	4	14	23
Microtus pennsylvanicus	0	0	1	1	0	0	0	0	0	0	1
Total	5	4	8	17	9	1	3	2	5	20	37

MATACIL®: Very low populations were encountered on both the untreated control (Table XXVIII) and treatment block 327 (Table XXIX). Two out of the 7 animals taken from the treatment block were either juvenile or sub-adults and the single adult female trapped was pregnant. One out of the 2 animals trapped on the untreated control was a juvenile while the other was a pregnant female. While populations were very low in the Parent area, the data suggests that it is a reflection of a natural population level rather than a result of the application of MATACIL®.

Fenitrothion-ZECTRAN®: Treatment block 121A in Mont Tremblant Park received an early application of fenitrothion followed in about 3 weeks by an application of ZECTRAN®. A total of 22 small mammals representing 4 species were trapped (Table XXX). The untreated plot at Lac Chaud (Table XXV) served as the control. Six of the animals were either juveniles or sub-adults and 4 out of the 7 adult females were either pregnant or contained placental scars. Again, the numbers of small mammals collected were small, however, when the representative age classes and breeding condition of adult females is compared to the untreated control the data suggests the application of insecticides in this area did not adversely affect small mammal populations.

Table XXVIII

Small Mammal Population Census
Untreated Control Plot
Parent, Quebec
August 1974

Species	Males				Females						
							Adults				
	Juv	Sub Ad	Adult	Total	Juv	Sub Ad	Pregnant	Not Pregnant	Placental Scars	Total	Total
Zapus hudsonius	0	0	0	0	1	0	0	0	0	1	1
Microtus pennsylvanicus	0	0	0	0	0	0	1	0	0	1	1
Total	0	0	0	0	1	0	1	0	0	2	2

Table XXIX

Small Mammal Population Census
MATACIL® Treatment Plot 327
Parent, Quebec
August 1974

	Males				Females						
							Adults				
Species	Juv	Sub Ad	Adult	Total	Juv	Sub Ad	Pregnant	Not Pregnant	Placental Scars	Total	Total
Napaeoapus insignis	0	1	1	2	0	1	0	0	0	1	3
Peromyscus maniculatus	0	0	1	1	0	0	1	0	0	1	2
Tamias striatus	0	0	2	2	0	0	0	0	0	0	2
Total	0	1	4	5	0	1	1	0	0	2	7

Table XXX

Small Mammal Population Census
Fenitrothion-ZECTRAN® Treatment Block 121A
Mont Tremblant Park, Quebec
August 1974

	Males				Females						
							Adults				
Species	Juv	Sub Adult	Adult	Total	Juv	Sub Adult	Pregnant	Not Pregnant	Placental Scars	Total	Total
Peromyscus maniculatus	1	0	4	5	3	0	0	1	2	6	11
Clethrionomys gapperi	1	0	5	6	0	0	1	1	1	3	9
Napaeozapus insignis	0	1	0	1	0	0	0	0	0	0	1
Zapus hudsonius	0	0	0	0	0	0	0	1	0	1	1
Total	2	1	9	12	3	0	1	3	3	10	22

HONEY BEES

B.B. McLeod and K.L. Mortensen

Colonies of domestic honeybees *Apis mellifera* L. were placed on three treatment blocks in order to assess the impact of forest pest control upon pollinators of forest flora. Single early and late treatments of fenitrothion as well as a single treatment of ZECTRAN® were monitored.

METHODS

Colonies of honey bees were made up at the Chemical Control Research Institute headquarters apiary. Each colony contained 3 lbs. of newly imported bees with mated queen. The colonies were transported to the treatment areas about 1 week prior to the application of the insecticide and fitted with monitoring apparatus to measure activity at the hive entrance, pollen collected, weight of hives and numbers of dead bees at the colony. Brood and queens were checked periodically throughout the census period. All colonies were returned to the headquarters apiary about 6 days after treatment to prevent predation by bears or vandalism by humans.

RESULTS

Fenitrothion, Mont Tremblant, early treatment: The first treatment of fenitrothion was applied at 0600 hours, 18 May. Foliage of deciduous trees and shrubs had just flushed and there was little in bloom in the area. Insecticide deposit around the bee colonies averaged 4.3 gm active ingredient/hectare (0.06 oz AI/acre). The data collected from the various monitoring

devices indicated that the colonies were not damaged by the treatment (Table XXXI).

Table XXXI

Measurements taken of activity of honey bees located on a Fenitrothion treatment and control plot
Mont Tremblant Park, Quebec
1974
(Average of colonies)

No of days from treatment	Control				Mont Tremblant - Fenitrothion			
	Adult Activity	Adult Mortality	Pollen Weight (gms)	Hive Weight (lbs)	Adult Activity	Adult Mortality	Pollen Weight (gms)	Hive Weight (lbs)
-2	17,664	4.0	94.6		4,348	4.8	0	29.1
-1	20,736	5.0	30.2	45.2	8,154	3.5	0	30.1
+0	22,656	4.0	20.6		19,277	4.8	10.3	29.1
+1	15,872	3.0	8.8		22,195	5.4	12.0	28.6
+2	27,264	8.0	22.3		32,494	5.1	23.2	29.1
+3	20,864	6.0	24.4	45.7	11,827	5.5	10.2	28.8
+4	41,216	5.0	36.1		63,603	5.1	30.9	28.9
+5	5,504	5.0	8.2		5,452	1.9	0	29.3

Fenitrothion, La Macaza area, late treatment: The late treatment using fenitrothion took place at 2000 hours, 6 June. Average insecticide deposit in the bee yard as measured by Kromecote cards was 11.6 gm AI/hectare (0.17 oz AI/acre). A slight increase in the mortality of adult bees resulted (Table XXXII) but no other significant damage occurred. Examination of the hives showed no damage to the queen or new brood and honey production appeared normal at the end of the season.

Table XXXII

Measurements taken of activity of honey bee colonies located on a Fenitrothion treatment and control plot
La Macaza area, Quebec
1974
(Average of colonies)

No of days from treatment	Control plot				La Macaza area, Fenitrothion			
	Adult Activity	Adult Mortality	Pollen Weight (gms)	Hive Weight (lbs)	Adult Activity	Adult Mortality	Pollen Weight (gms)	Hive Weight (lbs)
-2	57,600	4.0	34.6		56,666	3.6	18.8	31.9
-1	110,336	2.0	14.6		164,736	2.7	47.8	--
-0	61,952	1.0	31.2		61,530	3.7	24.0	31.5
+1	91,776	3.0	21.8	56.0	175,795	50.7	12.5	30.4
+2	61,824	2.0	22.3		101,030	11.7	8.3	30.6
+3	75,648	2.0	39.2		171,430	0.3	14.2	30.4
+4	153,344	4.0	57.2		177,050	0.7	5.6	31.0
+5	12,544	6.0	11.3		18,547	3.7	15.5	30.4

ZECTRAN®: The insecticide deposit throughout the bee yard averaged 21.5 gm AI/hectare (0.31 oz AI/acre). A slight increase in adult mortality occurred on the day after treatment (Table XXXIII). All other factors measured remained normal. Examination of the hives showed no damage to brood or queens and the hive weights increased slightly.

Table XXXIII

Measurements taken of the activity of honey bee colonies located on a ZECTRAN® treatment and control plot
Mont Tremblant, Quebec
1974
(Average of colonies)

	Control				ZECTRAN® treatment			
No of days from treatment	Adult Activity	Adult Mortality	Pollen Weight (gms)	Hive Weight (lbs)	Adult Activity	Adult Mortality	Pollen Weight (gms)	Hive Weight (lbs)
-2	57,600	4.0	34.6	-	78,080	10.6	29.1	31.2
-1	110,336	2.0	14.6	-	134,348	6.8	69.0	31.4
+0	61,952	1.0	31.2	-	193,177	3.6	32.2	31.8
+1	91,776	3.0	21.8	56.0	190,950	16.8	43.6	30.2
+2	61,824	2.0	22.3	-	96,665	6.2	47.4	31.8
+3	75,648	2.0	39.2	-	126,745	4.2	62.0	31.8
+4	153,344	4.0	57.2	-	146,432	2.2	22.7	32.4
+5	12,544	6.0	11.3	56.3	35,251	12.2	2.2	32.4

AQUATIC FAUNA

P.D. Kingsbury and R. Sarrazin

Monitoring of the impact on aquatic systems of the 1974 spruce budworm control program in Quebec was limited to an evaluation of the effect of each of the insecticides used upon bottom fauna populations in streams within the respective treatment areas. At least one stream was monitored in each of the areas treated with B.t., ZECTRAN®, fenitrothion, fenitrothion-ZECTRAN® and MATACIL®.

METHODS

Bottom fauna populations within a stretch of stream were measured before and after each insecticide application by taking a series of 0.1 sq. meter (foot square) Surber samples (Surber, 1936). The benthic invertebrates and substrate from each sample was preserved immediately with formaldehyde. Data was collected on the nature of the current and bottom type of each area sampled as well as general descriptions, water temperatures and water chemistry data for each stream.

Benthic organisms were separated from the substrate in the lab by elutriation in a "bubbler" (Kingsbury and Beveridge, in preparation) and then identified to Order or Family and counted.

RESULTS

Control

The control stream flowed into the north end of Lac Chaud and was within 50 kilometers (thirty miles) of all the treatment streams sampled. It was fast flowing and relatively shallow (average depth 30 cm) with a hard

bottom of rocks, gravel and sand (Fig. 2). Water temperatures in this stream increased steadily over the sampling period in a similar manner to that shown in the treatment streams. Basic water chemistry parameters of the control stream were also quite similar to those of the treatment streams (Table XXXIV).

Bottom fauna populations at the control stream are presented in Table XXXV. Most aquatic insect groups showed progressive increases in their populations over the first three sampling periods and then a decrease in numbers by the final sampling period. This decrease coincided with the rapid increase in water temperature between the final sampling periods and probably represents the loss of individuals whose development was stimulated by increased water temperatures and which subsequently emerged as adult flying insects. The most notable exception to this pattern was midge larvae (Diptera: Chronomidae) populations which fluctuated erratically over the sampling period.

Numerous fish eggs were found in many samples and these developed and hatched over the treatment period as indicated by the presence of larval fish in the final series of samples.

B.t.

Bottom fauna populations were monitored in a stream which flowed through a 1,600 hectare (4,000 acre) block treated with 7.13 Billion International Units per hectare (3.25 Billion International Units per acre) of the biological insecticide *Bacillus thuringiensis*. The section of the stream sampled was fast flowing and very shallow (average depth 15 cm) with a bottom of boulders and stones interspersed with hard packed gravel and coarse sand (Fig. 3).

Populations of aquatic insects remained fairly constant or increased at this station over the treatment period with the exception of caddisfly larvae (Trichoptera) populations (Table XXXVI) which decreased. Caddisfly larvae populations showed a similar decrease at the control station over this period.

Fish eggs present in the B.t. stream developed normally and many larval fish were found in the samples taken six days after treatment.

ZECTRAN®:

Two applications of 52 g ZECTRAN®/hectare (3/4 oz/acre) were made on treatment block 121B. Bottom fauna populations were monitored in a very fast flowing, relatively shallow (average depth 30 cm) stream flowing through this plot (Fig. 4). The bottom was hard packed and consisted of large stones covering coarse sand mixed with a considerable amount of organic debris. Bottom fauna populations in this stream were relatively constant for all groups of benthic invertebrates over the treatment period (Table XXXVII) and no evidence of impact is apparent.

Fenitrothion:

Two streams were monitored which received successive applications of 140 g/ha of fenitrothion (2 oz/acre) three weeks apart. The stream flowing through block 258 was fast flowing, narrow and relatively shallow (average depth 30 cm) with a hard packed bottom of gravel, stones and sand (Fig. 5). The stream flowing through block 261 was somewhat slower flowing, wider and deeper (average depth 60 cm) with a pure sand bottom littered with sticks and organic debris.

Bottom fauna populations in these two streams are presented in

Tables XXXVIII and XXXIX. Mayfly nymph (Ephemeroptera) populations declined in both of the treatment streams as did caddisfly (Trichoptera) populations at block 261. Both of these groups declined at the control stream over this period but to a lesser extent. The results from block 261 may reflect the uneven distribution of these groups over the sand bottom due to their association with deadfalls and pockets of organic debris. This is suggested by the large standard deviations associated with the means numbers of these groups present.

Fish eggs present in the stream on block 258 developed and hatched normally over the treatment period.

Fenitrothion-ZECTRAN®:

Treatment block 121A received an application of 140 g fenitrothion /ha (2 oz/acre) followed three weeks later by 52 g ZECTRAN® /ha (3/4 oz/acre). The stream flowing through this block was moderate in flow and very shallow (average depth 15 cm) with a bottom of gravel, stones and coarse sand (Fig. 6).

There are no indications of impact on the benthic populations of this stream except for the virtual disappearance of sand-fly larvae (Diptera: Heleidae) following the ZECTRAN® treatment (Table XL). Sand-fly larvae were not found in any of the control samples. Their disappearance around the time of the ZECTRAN® application may have been due to their emergence as adults over this period brought on by the increase in water temperature.

MATACIL®:

MATACIL® (52 g AI/ha) was applied to the northern-most treatment blocks and because of slower development of the budworm at these latitudes, block 327B where the aquatic monitoring was conducted, was not treated until

June 4th with a second application on June 15th. Development of stream insects was also retarded so a separate control stream was sampled to relate to the MATACIL® treatment streams. No pre-treatment bottom samples were taken because of the late arrival of the sampling team, but series of samples were collected from the treatment and control streams right after the first insecticide application and again before and after the second application. All three streams were narrow (1 to 2 meter) and relatively deep (average depths 30 cm to 75 cm) but the control stream was slower flowing and consequently had a siltier bottom than the treated streams.

Over the treatment period bottom fauna populations increased in the two treated streams whereas they remained relatively constant in the control stream (Tables XLI, XLII and XLIII). These increases were primarily due to increases in midge larvae (Diptera: Chironomidae) populations at Plot 3 and midge larvae, oligochaete and fingernail clam (Mollusca: Sphaeriidae) populations at Plot 4. Stoneflies (Plecoptera) disappeared completely from Plot 3 samples and decreased at Plot 4 after the second MATACIL® application. Stonefly populations in the control stream were very low throughout the treatment period. Blackfly larvae (Diptera: Simuliidae) populations also decreased in the two treatment streams after the second MATACIL® application but the number of pupae present indicate this may have been due to the emergence of adult blackflies from the streams. Blackfly larvae populations in the control stream fluctuated erratically but on the whole decreased over the treatment period. Throughout the sampling period no dead or distressed fish or aquatic insects were observed in the treatment plots.

DISCUSSION

B.t.

Previous studies on Moresby Island, British Columbia in 1960 (Todd and Jackson, 1961) and in Algonquin Park, Ontario in 1973 (Buckner et al, 1974) have revealed no adverse effects of B.t. on aquatic fauna. The results from the 1974 spray in Quebec supports the evidence that B.t. has no noticeable effects on aquatic invertebrates.

ZECTRAN®

Studies in New Brunswick on the effects of applications of up to 560 g/ha ZECTRAN® (½ lb/acre) on bottom fauna populations have revealed no impact attributable to ZECTRAN® spraying (MacDonald and Penny, 1967, 1969). A ZECTRAN® application in Idaho in 1966 also had no effects on benthic aquatic insect numbers but caused a considerable increase in the numbers of some families of insect drifting downstream (Gibson and Chapman, 1972). Groups affected in this way included mayfly nymphs of the family Heptageniidae, caddisfly larvae of the families Phryganeidae, Rhyacophilidae and Timnephilidae, and diptera larva of the family Blephariceridae.

The results from the ZECTRAN® treatment blocks indicate that this insecticide had no measurable effect on aquatic invertebrate populations. ZECTRAN® has been shown to disappear completely from river water in two weeks under laboratory conditions (Eichelberger and Lichtenberg, 1971) so long term effects of this insecticide on aquatic systems are unlikely.

Fig. 1 DC6B being loaded with insecticide

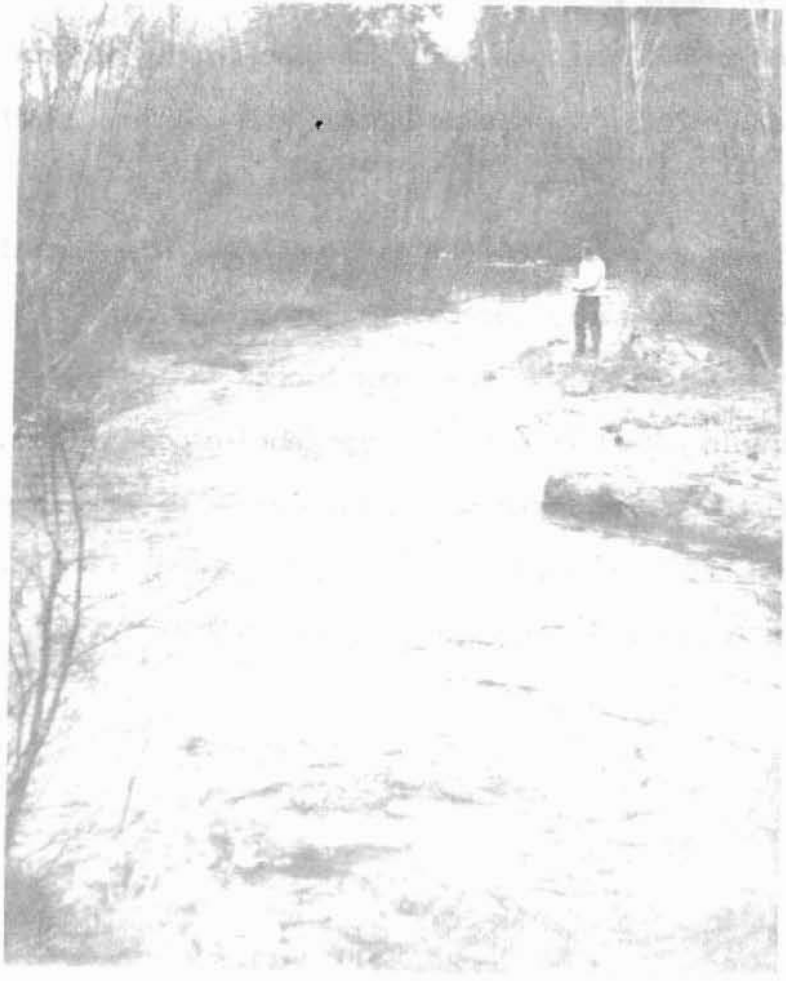

Fig. 2 Control stream, Lac Chaud, Quebec

Table XXXIV

Water Chemistry Parameters of Treatment and Control Streams in Quebec, May 16 and 17, 1974.

Stream	Date sampled	Temp. (°C)	O_2 (ppm)	pH	Alkalinity (gpg $CaCO_3$) Phenolphthalein	Alkalinity (gpg $CaCO_3$) Total	Hardness (gpg $CaCO_3$)
Lac Chaud Control	May 16	8	12	6.2	0	1	2
ZECTRAN® Block 121A	May 17	6	12	6.0	0	1	2
Fenitrothion -ZECTRAN® Block 121B	May 17	8	11	6.6	0	1	2
Fenitrothion Block 258	May 16	9	12	6.5	0	1	2
Fenitrothion Block 261	May 16	7	11	7.0	0	2	3

Table XXXV

Stream Bottom Fauna Populations, Lac Chaud Control Stream,

as Mean Numbers and Standard Deviations of Organisms/0.1 sq. m.

Lac Chaud, Quebec, May 11 to June 10, 1974

Number of days before or after treatment of:	Fenitrothion block 258	-4	+1	+14	+26 (+4 second treatment)
	Fenitrothion block 261	-5	0	+13	+25 (+3 second treatment)
	ZECTRAN® block 121A & B	-8	-3	+10	+22 (+3 second treatment)
	B.t. block	--	--	-6	+6
Number of samples		5	5	5	5
Water temperature		5°C	8°C	10°C	21°C
Ephemeroptera		7.4 ± 6.7	21.0 ± 13.3	34.4 ± 18.4	15.8 ± 7.7
Odonata		---	0.6 ± 0.9	0.2 ± 0.7	---
Plecoptera		2.4 ± 2.3	5.2 ± 4.1	9.2 ± 4.5	5.4 ± 1.1
Megaloptera		---	0.2 ± 0.7	---	---
Trichoptera		2.6 ± 2.5	16.0 ± 10.6	11.2 ± 6.6	4.8 ± 2.2
Lepidoptera		---	---	---	0.2 ± 0.7
Coleoptera		0.2 ± 0.7	0.8 ± 0.8	3.6 ± 2.9	4.2 ± 4.3
Diptera-Tipulidae		1.2 ± 0.8	3.6 ± 3.6	0.8 ± 0.8	0.6 ± 1.3
Diptera-Chironomidae		4.4 ± 4.2	17.6 ± 20.7	1.6 ± 1.1	12.2 ± 7.9
Diptera-Simuliidae		0.2 ± 0.7	1.2 ± 1.3	11.6 ± 14.1	5.4 ± 2.4
Diptera-Rhagionidae		0.4 ± 0.4	---	0.8 ± 0.4	0.4 ± 0.4
Nematoda		---	---	0.2 ± 0.7	---
Platyhelminthes		0.4 ± 0.9	---	0.6 ± 0.9	0.4 ± 0.4
Oligochaeta		0.4 ± 0.4	0.2 ± 0.7	1.6 ± 2.1	1.0 ± 1.4
Mollusca-Sphaeriidae		0.4 ± 0.2	0.2 ± 0.7	0.6 ± 0.9	0.8 ± 1.3
Mollusca-Gastropoda		0.2 ± 0.7	0.2 ± 0.7	0.2 ± 0.7	0.4 ± 0.4
Total		20.2 ±11.3	66.8 ± 38.7	76.6 ± 35.6	51.6 ± 18.3

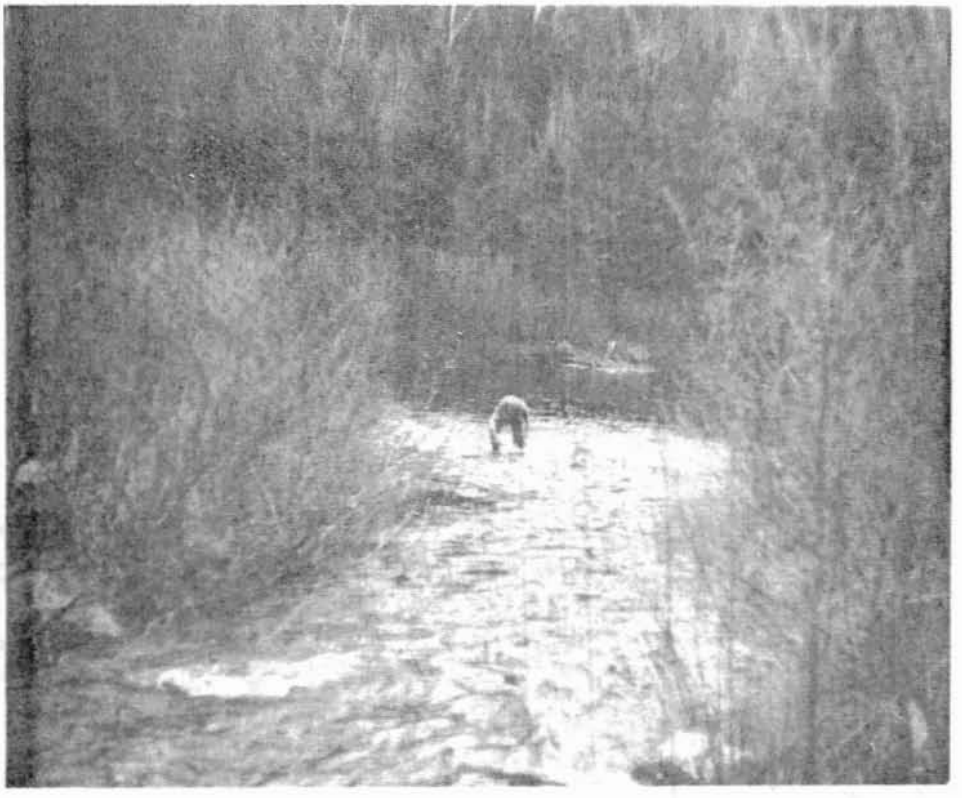

Fig. 3 B.t. spray block stream

Fig. 4 ZECTRAN® spray block 121B stream

Table XXXVI

Stream Bottom Fauna Populations, B.t. Spray Block,

as Mean Numbers and Standard Deviations of Organisms/0.1 sq. m.

Lac Chaud, Quebec. May 29 to June 10, 1974.

Number of days before or after treatment	- 6	+ 6
Number of samples	5	5
Water temperature	12°C	21°C
Ephemeroptera	44.6 ± 24.3	53.4 ± 17.6
Odonata	0.4 ± 0.4	0.4 ± 0.4
Plecoptera	9.4 ± 6.6	17.0 ± 16.9
Megaloptera	0.2 ± 0.7	0.2 ± 0.7
Trichoptera	20.2 ± 22.2	11.8 ± 10.1
Coleoptera	21.6 ± 15.2	22.8 ± 11.8
Diptera-Tipulidae	2.2 ± 3.3	0.6 ± 0.9
Diptera-Chironomidae	14.2 ± 9.7	42.4 ± 19.4
Diptera-Heleidae	0.2 ± 0.7	---
Diptera-Simuliidae	4.6 ± 2.6	19.8 ± 42.6
Diptera-Rhagionidae	0.8 ± 1.3	---
Platyhelminthes	1.2 ± 0.8	0.2 ± 0.7
Nematoda	---	0.4 ± 0.4
Oligochaeta	0.6 ± 0.9	3.6 ± 6.4
Hydracarina	0.2 ± 0.7	0.2 ± 0.7
Mollusca- Sphaeriidae	0.4 ± 0.9	5.0 ± 11.2
Mollusca-Gastropoda	0.8 ± 0.8	0.4 ± 0.4
Total	121.6 ± 74.4	178.2 ± 70.1

Table XXXVII

Stream Bottom Fauna Populations, ZECTRAN® Spray Block 121B

as Mean Numbers and Standard Deviations of Organisms/0.1 sq. m.

Mt. Tremblant Park, Quebec, May 17 to June 10, 1974.

Number of days before or after treatment	- 2	+ 9	+ 23 (+ 3 second treatment)
Number of samples	5	5	5
Water temperature	8°C	10°C	22°C
Ephemeroptera	31.8 ± 11.9	48.4 ± 20.9	46.8 ± 8.9
Odonata	0.2 ± 0.7	---	---
Plecoptera	9.4 ± 6.2	5.6 ± 2.9	7.8 ± 5.6
Megaloptera	0.2 ± 0.7	0.2 ± 0.7	0.6 ± 0.9
Trichoptera	14.4 ± 6.1	7.4 ± 2.5	9.4 ± 7.5
Coleoptera	8.2 ± 4.2	11.6 ± 2.4	19.2 ± 11.7
Diptera - Tipulidae	1.0 ± 1.0	0.2 ± 0.7	1.0 ± 1.0
Diptera - Chironomidae	9.8 ± 7.3	7.8 ± 4.1	23.2 ± 15.2
Diptera - Heleidae	1.8 ± 2.5	1.0 ± 1.7	0.4 ± 0.9
Diptera - Simuliidae	0.2 ± 0.7	1.0 ± 1.0	0.6 ± 0.9
Diptera - Blepharoceridae	0.2 ± 0.7	0.2 ± 0.7	0.2 ± 0.7
Nematoda	---	1.4 ± 1.1	3.8 ± 4.2
Oligochaeta	1.8 ± 1.5	1.0 ± 1.0	0.4 ± 0.4
Mollusca - Sphaeriidae	0.4 ± 0.9	0.2 ± 0.7	0.4 ± 0.9
Total	79.4 ± 25.8	86.0 ± 24.1	113.8 ± 35.7

Fig. 5 Fenitrothion spray block 258 stream.

stream

Table XXXVIII

Stream Bottom Fauna Populations, Fenitrothion Spray Block 258,

as Mean Numbers and Standard Deviations of Organisms/ 0.1 sq. m.

Lac Saguay, Quebec, May 11 to June 11, 1974.

Number of days before or after treatment	-4	+1	+13	+27 (+5 second treatment)
Number of samples	4	5	5	5
Water temperature	8°C	9°C	11°C	15°C
Ephemeroptera	8.5 ± 10.7	13.0 ± 7.4	9.6 ± 6.2	5.0 ± 4.5
Plecoptera	3.5 ± 6.4	2.4 ± 2.3	3.8 ± 2.5	5.0 ± 4.2
Trichoptera	1.8 ± 2.2	2.2 ± 1.8	3.4 ± 1.7	1.4 ± 0.5
Lepidoptera	---	0.4 ± 0.5	---	---
Coleoptera	2.5 ± 1.7	10.6 ± 9.7	12.6 ± 6.6	8.8 ± 6.6
Diptera-Tipulidae	1.2 ± 1.9	2.0 ± 1.9	1.0 ± 0.7	0.2 ± 0.4
Diptera-Chironomidae	1.0 ± 1.4	2.0 ± 2.9	1.2 ± 1.3	1.6 ± 3.6
Diptera-Simuliidae	1.8 ± 2.2	0.4 ± 0.5	0.2 ± 0.4	0.6 ± 1.3
Diptera-Rhagionidae	---	---	---	0.2 ± 0.4
Nematoda	---	---	---	0.2 ± 0.4
Oligochaeta	0.2 ± 0.5	0.2 ± 0.4	0.6 ± 0.9	0.6 ± 0.9
Hydracarina	---	---	---	0.2 ± 0.4
Mollusca-Sphaeriidae	---	0.4 ± 0.9	---	---
Mollusca-Gastropoda	---	---	0.4 ± 0.5	0.2 ± 0.4
Total	20.5 ± 24.4	33.6 ± 8.9	32.8 ± 12.7	24.0 ± 18.1

Table XXXVIV

Stream Bottom Fauna Populations, Fenitrothion Spray Block 261,

as Mean Numbers and Standard Deviations of Organisms/ 0.1 sq. m.

Lac David, Quebec, May 11 to June 11, 1974

Number of days before or after treatment	-5	0	+12	+26 (+4 second treatment)
Number of samples	3	5	5	5
Water temperature	6°C	7°C	13.5°C	17°C
Ephemeroptera	12.3 ± 19.6	0.8 ± 1.8	2.4 ± 3.0	2.2 ± 2.2
Odonata	1.0 ± 1.7	0.2 ± 0.4	0.2 ± 0.4	1.0 ± 1.2
Plecoptera	---	0.6 ± 0.5	0.4 ± 0.5	0.2 ± 0.4
Trichoptera	4.7 ± 8.1	1.8 ± 1.5	0.4 ± 0.9	1.0 ± 1.2
Coleoptera	0.7 ± 0.6	---	2.0 ± 2.3	---
Diptera-Tipulidae	1.0 ± 1.0	0.8 ± 1.3	2.6 ± 1.9	1.8 ± 2.4
Diptera-Chironomidae	7.7 ± 8.6	11.8 ± 2.8	15.4 ± 13.4	15.0 ± 15.0
Diptera-Heleidae	---	0.4 ± 0.9	---	---
Diptera-Simuliidae	1.3 ± 2.3	0.6 ± 0.5	1.8 ± 1.3	8.2 ± 7.6
Diptera-Rhagionidae	0.7 ± 1.1	---	0.2 ± 0.4	1.2 ± 2.7
Nematoda	---	---	0.6 ± 0.9	0.6 ± 0.5
Oligochaeta	0.3 ± 0.6	2.2 ± 2.9	17.0 ± 16.1	12.0 ± 7.9
Hydracarina	0.3 ± 0.6	---	---	0.2 ± 0.4
Amphipoda	---	0.2 ± 0.4	---	---
Mollusca-Sphaeriidae	4.3 ± 2.5	72.4 ± 71.2	82.2 ± 45.7	54.4 ± 42.2
Mollusca-Gastropoda	---	0.2 ± 0.4	---	0.2 ± 0.4
Total	34.3 ± 42.2	92.0 ± 70.6	125.2 ± 50.2	98.0 ± 50.2

Table XL

Stream Bottom Fauna Populations, Fenitrothion-ZECTRAN® Spray Block 121A,

as Mean Numbers and Standard Deviations of Organisms/0.1 sq. m.

Mt. Tremblant Park, Quebec, May 17 to June 10, 1974.

Number of days before or after treatment	- 2	+ 9	+ 23 (+3 second treatment)
Number of samples	5	5	5
Water temperature	6°C	10°C	19°C
Ephemeroptera	0.4 ± 0.5	0.2 ± 0.4	———
Plecoptera	3.4 ± 3.8	18.4 ± 14.9	42.0 ± 51.2
Trichoptera	2.4 ± 1.9	2.6 ± 1.5	1.4 ± 0.9
Lepidoptera	0.2 ± 0.4	———	0.4 ± 0.5
Coleoptera	0.4 ± 0.5	0.2 ± 0.4	0.8 ± 1.1
Diptera - Tipulidae	1.4 ± 1.5	1.2 ± 1.3	1.8 ± 1.6
Diptera - Chironomidae	3.2 ± 2.3	5.0 ± 4.1	11.2 ± 9.6
Diptera - Heleidae	1.4 ± 1.7	5.0 ± 5.1	0.2 ± 0.4
Diptera - Simuliidae	1.0 ± 1.0	2.4 ± 1.9	52.6 ± 67.4
Diptera - Rhagionidae	———	———	0.4 ± 0.5
Nematoda	0.4 ± 0.5	1.0 ± 1.2	1.4 ± 1.5
Oligochaeta	2.2 ± 1.6	8.8 ± 8.0	3.4 ± 3.3
Mollusca - Sphaeriidae	———	0.2 ± 0.4	———
Total	16.4 ± 8.6	45.0 ± 16.0	115.6 ± 120.6

Table XLI

Stream Bottom Fauna Populations at Plot 3, MATACIL® Spray Block 327B

as Mean Numbers and Standard Deviations of Organisms/0.1 sq. m.

Parent, Quebec, June 6 to June 18, 1974.

Number of days before or after treatment	+ 2	+ 8	+ 14 (+ 3 second treatment)
Number of samples	3	4	4
Water temperature	10°C	12°C	10°C
Trichoptera	4.0 ± 3.0	14.2 ± 7.9	9.8 ± 6.5
Ephemeroptera	0.3 ± 0.6	0.5 ± 1.0	--
Plecoptera	6.0 ± 6.1	19.0 ± 20.9	--
Coleoptera	--	0.2 ± 0.6	--
Diptera-Chironomidae	29.3 ± 32.3	159.0 ± 48.2	245.8 ± 152.1
Diptera-Simuliidae	15.7 ± 6.1	30.8 ± 33.8	0.5 ± 0.6
Other Diptera	1.7 ± 2.1	2.5 ± 3.0	4.0 ± 5.4
Nematoda	1.7 ± 2.9	1.5 ± 1.9	3.2 ± 2.5
Oligochaeta	19.7 ± 12.5	30.0 ± 41.4	20.5 ± 13.8
Hydracarina	--	4.2 ± 2.5	2.5 ± 3.0
Sphaeriidae	0.3 ± 0.6	2.8 ± 3.6	7.0 ± 3.6
Total	78.7 ± 44.7	264.8 ± 127.9	293.2 ± 180.0

Table XLII

Stream Bottom Fauna Populations at Plot 4, MATACIL® Spray Block 327B

as Mean Numbers and Standard Deviations of Organisms/0.1 sq. m.

Parent, Quebec, June 6 to June 18, 1974.

Number of days before or after treatment	+ 2	+ 8	+ 14 (+ 3 second treatment)
Number of samples	4	4	4
Water temperature	12°C	10°C	7°C
Trichoptera	0.8 ± 1.0	17.0 ± 20.6	17.5 ± 18.1
Plecoptera	1.2 ± 0.5	1.5 ± 1.7	0.2 ± 0.5
Neuroptera	--	0.2 ± 0.5	---
Diptera-Chironomidae	8.0 ± 3.8	69.5 ± 39.6	45.0 ± 66.7
Diptera-Simuliidae	3.5 ± 3.0	1.5 ± 1.7	0.5 ± 1.0
Other Diptera	0.8 ± 0.5	0.5 ± 1.0	0.5 ± 1.0
Nematoda	1.0 ± 1.4	2.2 ± 0.5	0.5 ± 1.0
Oligochaeta	4.5 ± 4.6	63.0 ± 10.0	64.5 ± 56.9
Sphaeriidae	1.0 ± 0.8	13.2 ± 10.3	77.5 ± 46.6
Total	20.8 ± 6.6	168.8 ± 65.7	207.0 ± 135.4

Table XLIII

Stream Bottom Fauna Populations at the Untreated Check Plot, MATACIL® Spray Area, as Mean Numbers and Standard Deviations of Organisms/0.1 sq. m.

Parent, Quebec, June 5 to June 19, 1974.

Number of days before or after treatment	+ 1	+ 9	+ 15 (+4 second treatment)
Number of samples	4	4	4
Water temperature	11°C	11°C	9°C
Trichoptera	1.5 ± 1.3	0.2 ± 0.5	1.0 ± 1.4
Ephemeroptera	1.8 ± 2.4	--	0.2 ± 0.5
Plecoptera	--	0.5 ± 1.0	0.2 ± 0.5
Coleoptera	2.5 ± 1.8	0.2 ± 0.5	--
Hemiptera	0.2 ± 0.5	--	--
Diptera-Chironomidae	6.2 ± 4.4	4.0 ± 2.8	4.8 ± 3.3
Diptera-Simuliidae	17.8 ± 15.6	0.8 ± 1.0	9.5 ± 8.7
Other Diptera	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5
Oligochaeta	0.5 ± 1.0	13.0 ± 9.9	16.2 ± 13.1
Sphaeriidae	0.2 ± 0.5	--	--
Total	31.0 ± 21.7	19.0 ± 11.3	32.2 ± 23.0

Fenitrothion:

A great number of studies have been done in Canada on the effects of fenitrothion on aquatic organisms (Kingsbury, 1975). These have generally shown that fenitrothion significantly reduces aquatic insect populations at high rates of application (420 to 560 gm/ha) but has relatively little impact at the lower dosages presently applied in large scale applications (140 or 210 gm/ha). Large increases in numbers of drifting aquatic insects have been measured following fenitrothion applications at these lower dosages, but this has not caused measurable depletion of benthic populations (Eidt, 1975). Stonefly nymphs in particular and mayfly nymphs to a lesser extent appear to be the aquatic insect groups most susceptible to fenitrothion poisoning.

The results from the fenitrothion blocks show that some impact on mayfly nymph and caddisfly larvae populations may have occurred in some of the fenitrothion treated streams. However, the lack of effect on generally sensitive stonefly nymph populations suggests that the reductions in mayfly nymph and caddisfly larvae populations may not have been caused by the fenitrothion treatments.

MATACIL®:

The impact of aerial applications of MATACIL® on aquatic fauna has been previously studied during small scale applications in New Brunswick in 1970 and 1971 (G.H. Penney 1971a, 1971b). Two consecutive applications of 88 g MATACIL®/hectare (1¼ oz/acre) in 1970 had no effect on caged salmon parr or aquatic insect populations in a stream within the treatment plot. A single application of 88 g MATACIL®/hectare the following year significantly reduced stonefly populations in the two streams studied but

had little effect on other aquatic insect orders.

The results from the MATACIL® treatment blocks show that the large scale MATACIL® applications in Quebec in 1974 had similar effects on the aquatic systems studied. No significant impact on overall aquatic insect populations occurred but stoneflies were selectively affected. Under static conditions in the laboratory relatively high concentrations of MATACIL® have been shown to disappear completely from river water in less than four weeks (Eichelberger and Lichtenberg, 1971), so no long term effects of MATACIL® on aquatic systems would be expected.

CONCLUSIONS

C.H. Buckner and R. Sarrazin

The data compiled from the areas of western Quebec monitored during the spruce budworm control operations of 1974, indicate overall bird loses to be minimal. Those areas treated with fenitrothion suffered slight mortality to some species of the family Parulidae, particularly the tennessee and to a less extent black and white warblers.

In areas treated with applications of fenitrothion followed by ZECTRAN®, a slight reduction in solitary vireo populations occurred after the fenitrothion treatment.

MATACIL® apparently slightly reduced populations of ruby-crowned kinglets, black-throated green, nashville, magnolia and mourning warblers. Minor reductions in numbers of swamp sparrows and slate-coloured juncos were noted. Early migrating insectivorous species such as the warblers, suffered some losses due to starvation when the late spring delayed insect activity.

Low populations of small mammals were encountered in all treatment block and control blocks. A normal age class distribution was found in the trapped sample and many of the females were carrying embryos or placental scars. There is no evidence in the animals collected that the small mammal populations were affected by any of the insecticide treatments monitored.

Colonies of honey bees located on the fenitrothion treatment blocks were not affected by the early application and only slightly affected by the late treatment. Colonies treated with ZECTRAN® were only

very lightly affected. Neither brood nor queens were affected by this series of chemical treatments and the honey yield appeared normal.

None of the insecticides applied in Quebec in 1974 was found to have seriously affected bottom fauna populations or the development and hatching of fish eggs in any of the streams studied. MATACIL® selectively reduced stonefly nymph populations. Reductions in mayfly nymph and caddisfly larvae populations within the fenitrothion treated streams appear not to have been caused by the insecticide treatments. No evidence of impact was found in streams exposed to B.t. or ZECTRAN® treatments.

In summary, the impact studies presented in this report found that environmental damage attributable to the 1974 spruce budworm control operations in Quebec was slight and limited to narrow range effects of some of the treatments on specific bird species and orders of aquatic insects.

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