A PRELIMINARY REPORT ON THE EFFECTS OF A SPLIT APPLICATION OF RELDAN® ON AQUATIC AND TERRESTRIAL ECOSYSTEMS

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1. INTRODUCTION

Studies were conducted by the Environmental Impact Section of the Forest Pest Management Institute in Quebec in 1977 (Kingsbury, 1979), and again in 1979 (Kingsbury and Holmes 1980), to assess the effects of aerial applications of the candidate forestry insecticide RELDAN® (chlorpyrifos-methyl) on aquatic ecosystems. Further studies were carried out in New Brunswick in 1980 and were expanded to include effects on forest songbirds and terrestrial arthropods. A preliminary analysis of the results of the 1980 study is presented in this report.

2. SITE DESCRIPTION

Environmental impact studies were conducted in a 400 ha spray block located approximately 8.4 km southeast of the town of Allardville in Gloucester County, New Brunswick (Figure 1). The nearest operational spray blocks were located about 10.5 km to the southwest and 7.0 km to the south, and the nearest experimental block was 1.7 km to the southwest.

Terrestrial impact studies were conducted along a gravel fire road which transected the southeastern end of the spray block (Figure 2). Vegetation survey points were located at 120 m intervals along this transect, 60 m on either side of the road. The predominant species present and their relative abundance at these survey points were presumed to be fairly indicative of the vegetative complex of this portion of the block as a whole (Table 1).

A control bird transect was located approximately 3 km further east on the same road (Figure 1). Vegetation was surveyed in the same manner as described for the treatment block (Table 1). The control area for the terrestrial invertebrate knockdown study was located about 500 m south of Highway 360, 7.7 km east of Allardville (Figure 1).

Within the spray block, aquatic impact studies were conducted in North Brook, a small headwater trout stream approximately 2-4 m wide and 15-50 cm deep, with a moderate current and rock and gravel bottom (Figures 1 and 2). Discharge measurements taken on 8 June and 15 June were 0.08 and 0.07 m^3/sec respectively.

Two streams, Bass and Little Brooks, were used as controls for the aquatic studies (Figure 1). Bass Brook is 2-4 m wide, 10-40 cm deep, and has a moderate current and rocky bottom. Discharges on 8 June and 15 June were 0.12 and 0.14 m^3/sec respectively. Little Brook is 3-5 m wide, 15-60 cm deep, and has a moderate current and rock and gravel bottom. Discharge on 8 June was 0.13 m^3/sec.

Water quality parameters were measured periodically in North and Bass Brooks using a Hach Kit, Model AL-36B and are summarized in Table 2.

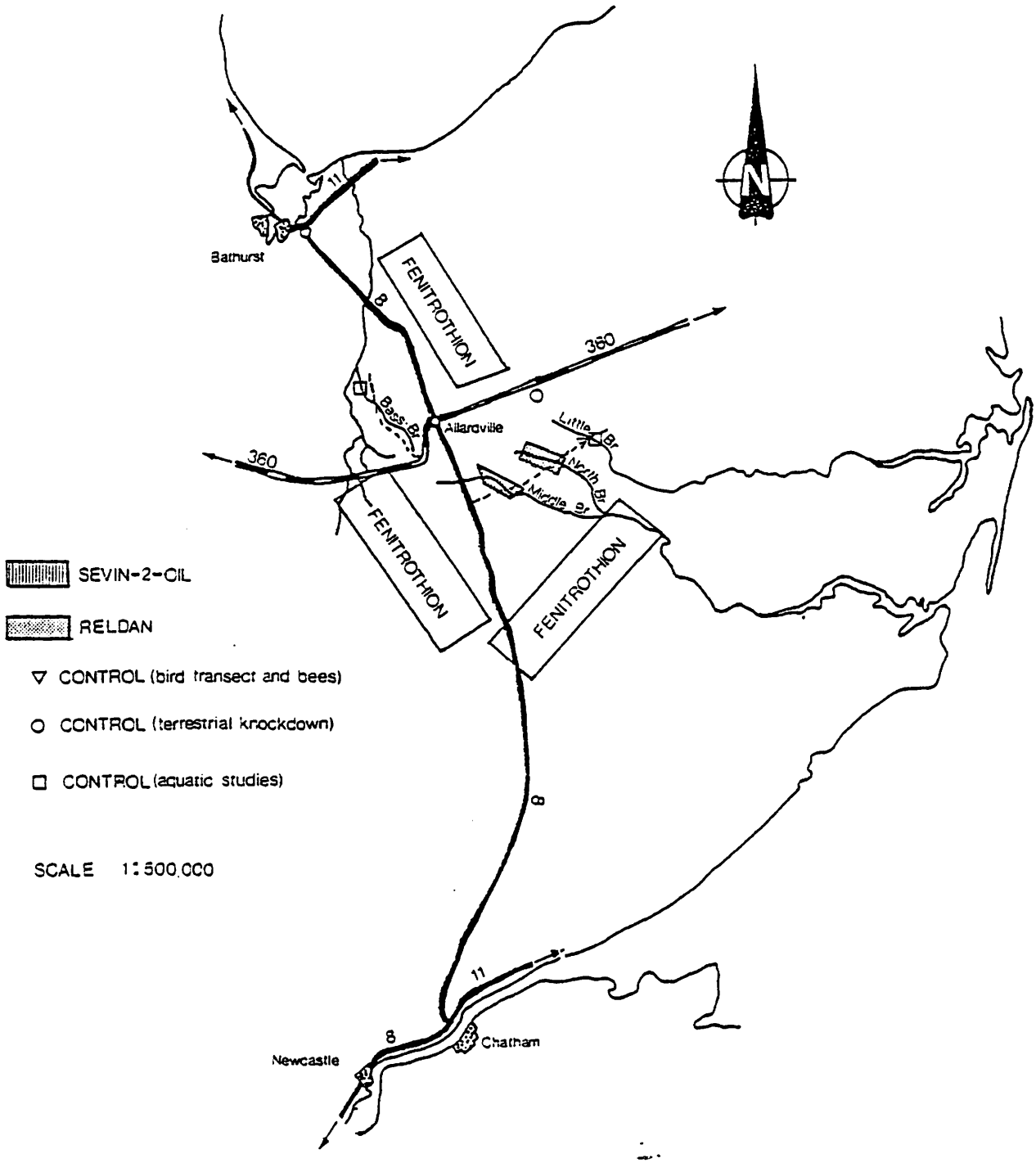

Figure 1. Location of spray blocks.

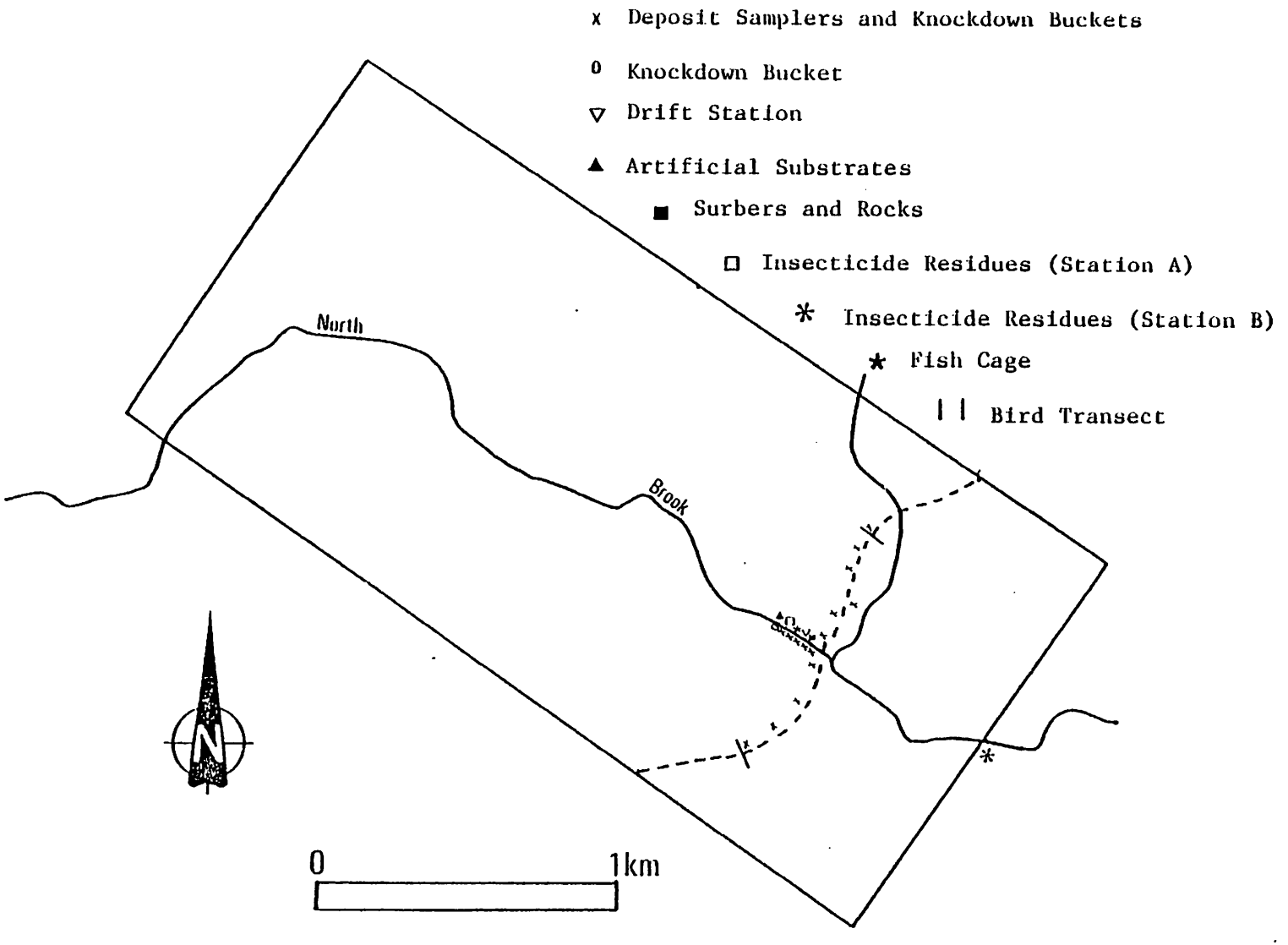

Figure 2. Location of sampling stations.

Table 1. Relative abundance of predominant plant species in the treatment block and control area.

TREATMENT

Overstory			Understory		
	Major Species	Percent		Major Species	Percent
Red maple	*Acer rubrum* L.	39.6	Red maple	*Acer rubrum* L.	21.7
White spruce	*Picea glauca* (Moench) Voss.	38.3	Balsam fir	*Abies balsamea* (L.) Mill.	17.1
Beech	*Fagus grandifolia* Ehrh.	15.8	Striped maple	*Acer pensylvanicum* L.	13.6
White birch	*Betula papyrifera* Marsh.	2.8	American basswood	*Tilia americana* L.	9.4
Cedar	*Thuja occidentalis* L.	1.4	White spruce	*Picea glauca* (Moench) Voss.	7.5
Balsam fir	*Abies balsamea* (L.) Mill.	1.0	Beech	*Fagus grandifolia* Ehrh.	7.2
White pine	*Pinus strobus* L.	0.7	Mountain maple	*Acer spicatum* Lam.	7.2
Mountain maple	*Acer spicatum* Lam.	0.3	Smooth alder	*Alnus serrulata* (Ait.) Willd.	4.0
			Speckled alder	*Alnus rugosa* (Du Roi) Spreng.	2.5
			Willow	*Salix* L.	1.8
Percent cover of overstory = 43.0			Percent cover of understory = 46.0		

CONTROL

Overstory			Understory		
	Major Species	Percent		Major Species	Percent
Red maple	*Acer rubrum* L.	32.7	Balsam fir	*Abies balsamea* (L.) Mill.	43.9
White birch	*Betula papyrifera* Marsh.	18.0	Red maple	*Acer rubrum* L.	11.3
Black spruce	*Picea mariana* (Mill.) BSP	15.4	Black spruce	*Picea mariana* (Mill.) BSP	11.1
White spruce	*Picea glauca* (Moench) Voss.	14.5	White birch	*Betula papyrifera* Marsh.	10.0
White pine	*Pinus strobus* L.	7.7	White spruce	*Picea glauca* (Moench) Voss.	9.1
Yellow birch	*Betula lutea* Michx.	7.3	Rhodora	*Rhodora canadense* (L.) Torr.	4.7
Beech	*Fagus grandifolia* Ehrh.	1.8	Pin cherry	*Prunus pensylvanica* L.	2.3
Balsam fir	*Abies balsamea* (L.) Mill.	1.3	Yellow birch	*Betula lutea* Michx.	1.0
Pin cherry	*Prunus pensylvanica* (L.) Mill.	0.7	Speckled alder	*Alnus rugosa* (Du Roi) Spreng.	1.0
Hemlock	*Tsuga canadensis* (L.) Carr.	0.6	Spiraea	*Spiraea sp.*	0.7
Percent cover of overstory = 36.5			Percent cover of understory = 48.1		

Table 2. Water quality parameters in study streams, Gloucester County, New Brunswick, 31 May - 1 August 1980.

Sampling Station		Date	Temperature (°C)	pH	Dissolved O_2 (mg/ℓ)	Hardness (gpg $CaCO_3$)	Alkalinity (gpg $CaCO_3$)
North Brook		31/5/80	8.0	6.5	11		
		21/6/80	10.0	8.0	10	4	
		27/6/80	14.0	7.0	9	3	
		1/8/80	13.0	6.5	10	2	1
Bass Brook	Control	31/5/80	8.5	7.5	11		
		21/6/80	12.0	7.0	9	6	
		26/6/80	14.5	7.5	9	4	
		1/8/80	16.0	7.0	7	3	1

3. SPRAY APPLICATION

RELDAN® was applied twice, with a six day interval between applications, at a rate of 0.070 kg/ha active ingredient in 1.46 ℓ/ha of oil solution. A small amount of Automate B dye was added to facilitate deposit assessment. The actual spray mixture consisted of:

RELDAN® (XRC-0057)[1]	65.9ℓ	9.7% by volume
Insecticide diluent 585[2]	601.9ℓ	88.3% by volume
Automate B dye[3]	13.6ℓ	2.0% by volume

Application was by a Cessna Agtruck equipped with four AU3000 Micronair® atomizers. Spraying commenced at 2015 ADT on 11 June 1980 with the plane making its initial pass along the northeast edge of the block. Subsequent swaths were made along parallel lines 60 metres apart, progressing toward the southwest edge of the block. The last pass of the first application was at 2119 ADT. The second application began at 0546 ADT and was complete by 0653 ADT on 17 June 1980. The same basic flight pattern was followed. Meteorological conditions at the time of the spray applications are summarized below:

	First application	Second application
Temperature (°C)	10.4	9.8
Relative Humidity (%)	52.4	95.8
Wind Speed (km/hr)	3-6	0-3
Wind Direction	WSW	NW
Cloud Cover (%)	80	10

4. SAMPLING METHODS

Methods used for deposit assessment and biological sampling were similar to those described by Holmes et al. (1981).

5. RESULTS AND DISCUSSION

Deposit

Deposit results are summarized in Table 3. Deposit along the road was very similar for both applications. At the aquatic sampling station

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[1]Dow Chemical of Canada, Ltd., Sarnia, Ontario.
[2]Shell Canada Ltd., Toronto, Ontario.
[3]Morton Williams Ltd., Ajax, Ontario.

Table 3. Deposit assessment summary for the RELDAN treatment block*, sprayed 11 and 17 June 1980 Gloucester County, New Brunswick.

					Colorimetry		Spot Counting	
			No. of deposit samplers	Mean drop density drops/cm^2	Mean volume deposited ℓ/ha	Mean % of emitted volume recovered	Mean volume deposited ℓ/ha	Mean % of emitted volume recovered
RELDAN®	First application	Instream	6	12.43	0.23	15.8	0.38	26.0
		Stream bank	6	7.24	0.15	10.3	0.19	13.0
		Road	10	11.00	0.14	9.6	0.34	23.3
	Second application	Instream	6	16.57	0.51	34.9	1.00	68.5
		Stream bank	6	7.21	0.18	12.3	0.38	26.0
		Road	10	9.08	0.14	9.6	0.28	19.2
CONTROL	First application		1	0.81	0.04	2.7	0.02	1.4
	Second application		1	0.15	0.04	2.7	<0.01	< 0.1

*spray emission rate of 1.46 ℓ/ha

however, a heavier deposit was received from the second application than from the first, with deposit on instream samplers almost three times that on stream bank samplers. Some drift of spray products was measured following each application at the extreme western end of the control bird transect.

Deposit values obtained by spot counting were significantly higher than those obtained by colourimetry. This differs from what has been reported by Holmes (1979), Kingsbury and McLeod (1979) and Kingsbury et al. (1980), but agrees with the results of Millikin and Mortenson (1980a and b). As explained by Kingsbury et al. (1980), colourimetry probably gives a truer indication of actual volume deposited.

Insecticide Residues

Chlorpyrifos-methyl residues in water and fish tissue were determined by the Analytical Chemistry Section of the Forest Pest Management Institute using methodologies described by (Szeto and Sundaram, 1981 MS).

Water

The results of analyses of stream water samples from Station A (Figure 2) demonstrate a rapid disappearance of chlorpyrifos-methyl residues from flowing water (Table 4). The highest residues measured at this station were 88 ppb, ½ hour after the first application, and 212 ppb, 5 minutes after the second application. These decreased to non-detectable levels (<0.025 ppb) within 42.5 hours and 99 hours of the first and second applications, respectively. Residues in stream water samples collected just below the downstream edge of the spray block (Station B) peaked slightly later and at a much lower level (2.24 ppb and 12.30 ppb, 3 hours after the first and second applications, respectively), but persisted for about the same length of time.

In general, residues were higher, and persisted longer, after the second application than after the first. This is consistent with the finding that deposit at the aquatic sampling station was approximately 2-3 times heavier for the second spray (Table 3).

Fish

Residues of chlorpyrifos-methyl were detected in brook trout and slimy sculpin tissues within a few days of each insecticide application, but by 9 days after the second application had declined to a trace (<3.0 ppb) (Tables 5 and 6). Residues were generally higher in brook trout than in sculpins. The fact that residues were detected in brook trout ranging from 11.4 to 46.4 ppb, and in slimy sculpins ranging from 5.2 to 18.2 ppb, even though residues in water at the time were either at trace levels (<0.05 ppb) or lower, suggests that this insecticide has a fairly high potential for concentration in fish tissues.

Table 4. Chlorpyrifos-methyl residues in stream water following a split application of RELDAN®

	Station A		Station B	
	Time after application	Chlorpyrifos-methyl (ppb)	Time after application	Chlorpyrifos-methyl (ppb)
First Application	5 min	5.50	11 min	0.49
	0.5 h	88.00	0.5 h	0.98
	1 h	7.96	1 h	0.95
	1.5 h	1.73	1.5 h	1.08
	2 h	1.05	2 h	1.68
	2.5 h	0.87	2.5 h	1.63
	3 h	1.01	3 h	2.24
	9.5 h	0.60	9 h	0.54
	18.5 h	0.14	18 h	0.15
	42.5 h	N.D.	42.5 h	Trace
	62.5 h	N.D.	62 h	N.D.
	85.5 h	N.D.	85.5 h	N.D.
	110.5 h	N.D.	110 h	N.D.
Second Application	5 min	212.00	10 min	0.47
	0.5 h	21.60	0.5 h	4.21
	1 h	2.34	1 h	3.54
	1.5 h	4.80	1.5 h	3.74
	2 h	3.30	2 h	6.41
	3 h	3.16	3 h	12.30
	4 h	2.26	4 h	3.70
	6 h	1.42	6 h	1.42
	29 h	0.16	28.75 h	0.08
	50.5 h	0.06	50 h	0.05
	75 h	Trace	75.5 h	Trace
	99 h	N.D.	98.8 h	N.D.
	123.5 h	N.D.	123.3 h	N.D.
	147.5 h	N.D.	147.3 h	N.D.
	171.5 h	N.D.	172.3 h	N.D.
	195.5 h	N.D.	192.5 h	N.D.
	219.5 h	N.D.	219 h	N.D.
	241 h	N.D.	240.5 h	N.D.

N.D. = not detectable (<0.025 ppb)
Trace = <0.05 ppb

Table 5. Residues of chlorpyrifos-methyl in brook trout tissues following a split application of RELDAN®

Date	Number of fish analysed	Total length (mm)** $\bar{X}$, Range	Body weight (g)** $\bar{X}$, Range	Chlorpyrifos-methyl (ppb) $\bar{X}$, Range
13 June	4	124, 120-127	17.1, 14.0-18.8	34.3, 21.6-46.4
20 June	4	129, 127-130	19.4, 17.4-20.9	29.1, 11.4-41.1
26 June	4	129, 124-134	22.1, 18.3-25.4	Trace
3 August	4	128, 125-132	19.4, 15.5-23.3	N.D.

*application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980
**tail lengths and body weights were measured after fish had been frozen and thawed
Trace = <3.0 ppb
N.D. = not detectable (<1.5 ppb)

Table 6. Residues of chlorpyrifos-methyl in slimy sculpin tissues following a split application of RELDAN®*

Date	Number of fish analysed	Total length (mm)** $\bar{X}$, Range	Body weight (g)** $\bar{X}$, Range	Chlorpyrifos-methyl (ppb) $\bar{X}$, Range
13 June	6	72, 64-80	3.7, 2.2- 5.7	10.1, 4.2-18.2
20 June	6	70, 64-81	3.6, 2.9- 5.4	8.8, 5.2-12.6
26 June	10	58, 51-77	2.2, 1.5- 4.1	Trace
3 August	10	58, 47-69	2.0, 1.0- 3.1	N.D.

*application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980
**tail lengths and body weights were measured after fish had been frozen and thawed
Trace = <3.0 ppb
N.D. = not detectable (<1.5 ppb)

Terrestrial Studies

Terrestrial Invertebrate Knockdown

Knockdown of terrestrial invertebrates from balsam fir and alder (stream bank cover) occurred immediately after application. Numbers did not return to normal until 2 and 3 days after the first and second applications respectively (Figures 3 and 4). Increased numbers collected on the last day of sampling were not pesticide-related, as similar increases were observed at the control site. Effects were more pronounced following the first application than the second, even though deposit along the road was similar for both sprays, and significantly higher along the stream for the second spray. The first application was an evening spray, however, and warmer temperatures may have resulted in increased insect activity, and consequently increased exposure to the insecticide.

Knockdown from balsam fir was composed primarily of small flying Diptera (mainly Chironomidae, Sciaridae, and Mycetophilidae) (Appendix I, Table 1), although a slight effect on Hymenoptera and Coleoptera: Staphylinidae was also noted. A large number of Diptera were collected 6 days before the first application from the balsam fir treatment buckets. These were mostly live Sciaridae taken from one bucket located in a swampy area, however, while those found after treatment were dead. Very few invertebrates were collected from the control buckets (Appendix I, Table 2). Post-spray samples taken along the treatment stream contained slightly higher numbers of Diptera (Sciaridae, Chironomidae, and Pharidae), Araneida, Plecoptera and parasitic Hymenoptera (Appendix I, Table 3). Increases in the number of Staphylinidae collected were well within natural increases exhibited on control (Appendix I, Table 4). There was no observed knock-down of Lepidoptera larvae associated with either treatment.

Birds

Pre-spray populations were estimated to be 172 birds of 34 species on treatment and 176 birds of 30 species on control (Appendix II, Tables 2 and 3). The 10 June census was excluded from the data compilation as adverse weather conditions (light rain and cold temperatures) resulted in abnormally low numbers of birds being censused on that date. The treatment population remained stable throughout the study with an overall increase in activity during both post-spray time periods, a trend which was more pronounced than on control. There were no missing family groups following treatment, and no significant reductions in any one family (Figure 5). There was also a slight increase in diversity (Appendix II, Table 2).

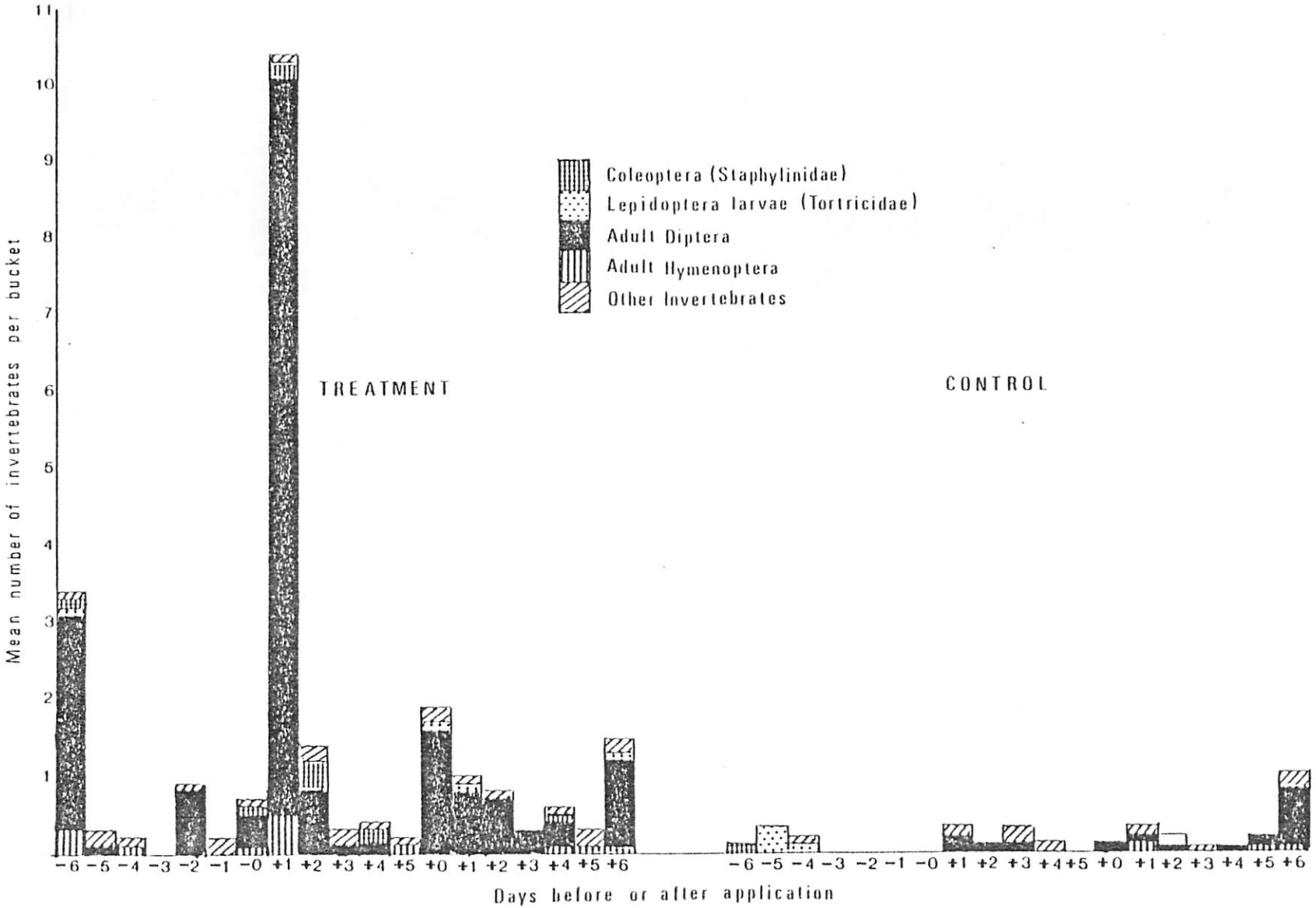

Figure 3. Terrestrial invertebrates collected from buckets placed under Balsam fir.

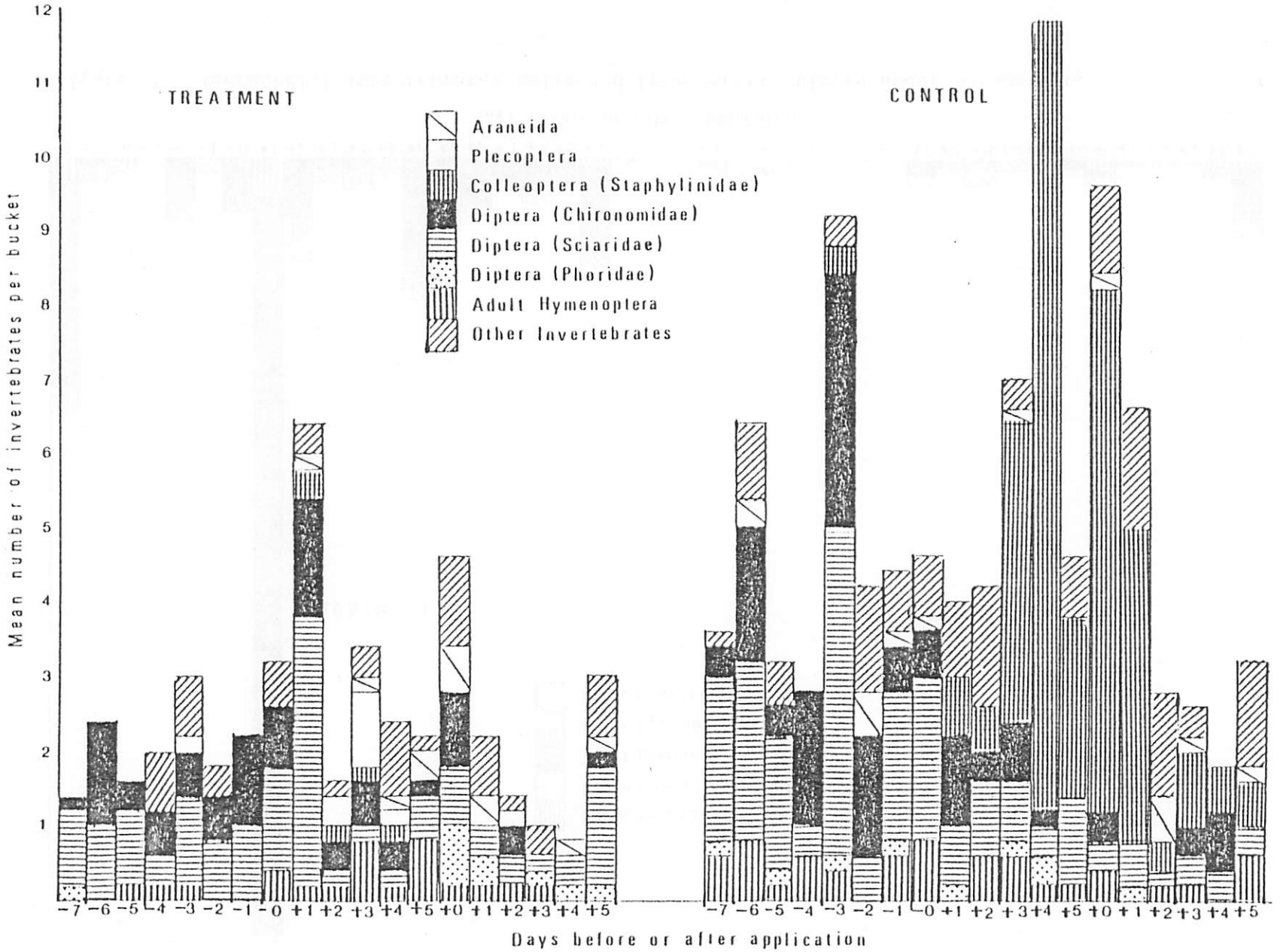

Figure 4. Terrestrial invertebrates collected from buckets placed under typical stream cover.

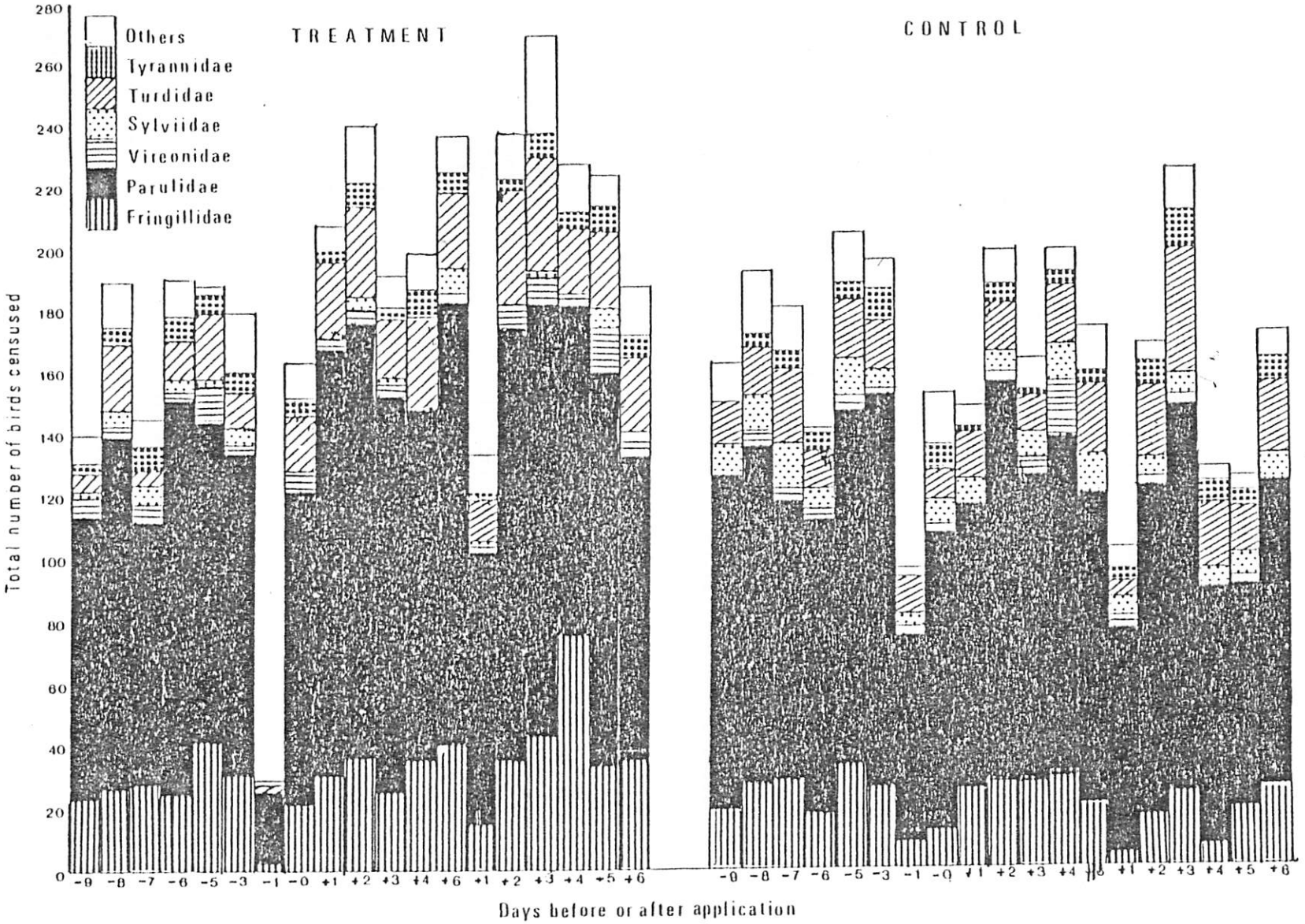

Figure 5. Activity trends of major families of forest songbirds in treatment and control areas.

Territory analyses of selected species occupying niches of varying exposure to the insecticide (Appendix III, Figures 1-12), indicated that the number of territories established during the pre-spray time period, and the average number of days these territories were observed to be occupied, remained fairly constant or were similar to trends exhibited in the control area (Table 7). Where a reduction in the number of territories was observed on treatment but not on control (e.g., least flycatcher, baybreasted warbler, Tennessee warbler), post-spray sightings were usually too infrequent to constitute a territory (minimum of 2 days required). In these cases 'single records' confirmed the male's presence in the vicinity of the territory (Appendix III, Figures 5 and 7). For the least flycatcher, although no sighting was made in one of three territories after the second application, the two remaining territories were unaltered, suggesting that there was no adverse effect on the population as a whole (Appendix III, Figure 1). Although territory reductions of the ruby-crowned kinglet were noted on both treatment and control, the reduction was greater on treatment, and shifting of territories from the pre-spray locations occurred, while control territories were stationary (Appendix III, Figure 2). A similar situation was observed with the yellow-rumped warbler, for which territorial shifting from pre-spray locations was more pronounced on the treatment block (Appendix III, Figure 9). Overall, there was no evidence of territorial abandonment by shrub or canopy feeders, two groups which are, by virtue of their feeding niches, potentially highly exposed to insecticide applications.

Aquatic Studies

Drift

The first insecticide application appears to have had little or no effect on aquatic invertebrate drift (Figure 6). Although small increases in the drift rates of Diptera: Simuliidae and Chironomidae, Ephemeroptera: Baetidae, Trichoptera: Brachycentridae and Coleoptera: Elmidae were noted in the treatment stream following the first application, at least some of these increases can be attributed to the normal diurnal variation in drift, since similar increases were also noted for Simuliidae, Baetidae and Elmidae in the control stream (Appendix IV, Tables 1 and 2). This diurnal variation in drift is found at all times of the year and is related to the light and dark periods, usually with a peak shortly after the dark begins (Hynes, 1972).

Significant increases in drift were noted for several taxa following the second application (Figure 6; Appendix IV, Table 1). Simuliidae and Chironomidae appeared to be most affected with increases in drift up to 50 X and 40 X their pre-spray morning averages of 0.25 and 0.07 organisms/m^3 respectively. Smaller increases were noted for Plecoptera (18 X), Baetidae (5 X), Brachycentridae (4 X), Diptera: Tipulidae and Hemiptera: Gerridae. No similar increases were noted in the control stream (Figure 6; Appendix IV, Table 2).

Table 7. Changes in the number of territories and the average number of days each territory was occupied.

	Control		Treatment	
	Number of territories	Average number of days	Number of territories	Average number of days
Feeds in flight				
Least flycatcher	+1	S*	-1	-1
Canopy feeders				
Ruby-crowned kinglet	-2	S	-2	-1
Solitary vireo	-2	-4	S	-1
Blackburnian warbler	S	-1	S	S
Baybreasted warbler	-1	-2	-2	+1
Rose-breasted grosbeak	S	-3	+1	S
Shrub feeders				
Tennessee warbler	-1	S	-2	S
Magnolia warbler	S	-1	+7	-1
Yellow-rumped warbler	S	-1	S	-1
Ground feeders				
Hermit thrush	-3	+1	S	+1
Ovenbird	-3	S	+1	-2
White-throated sparrow	-1	-2	+1	S
Total Change	S	-13	+3	-5

*S: same

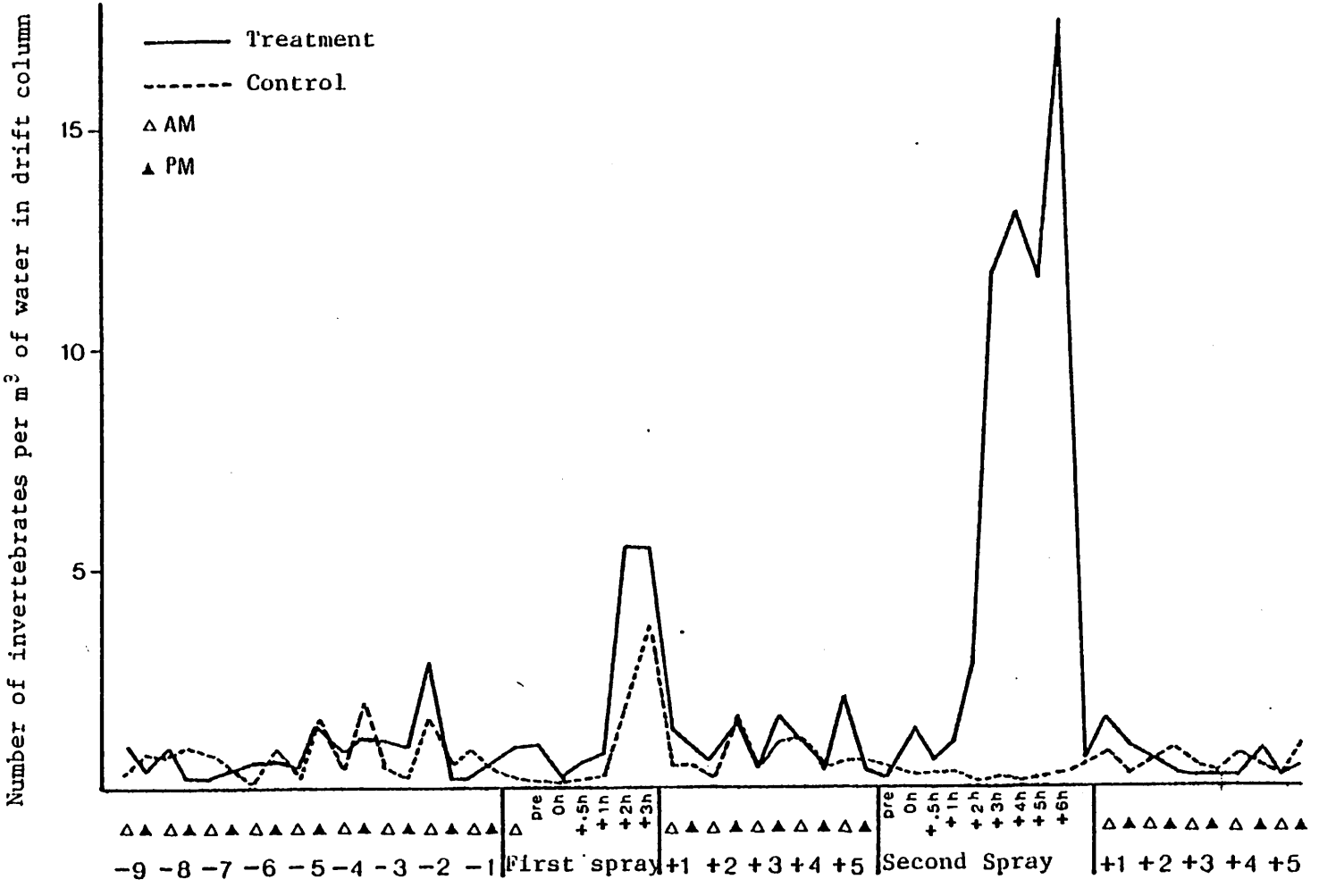

Figure 6. Aquatic invertebrates collected in drift net sets

Muirhead-Thompson (1978a,b) has studied the lethal and behavioral effects of chlorpyrifos-methyl on a range of stream macro-invertebrates in the laboratory under simulated stream conditions. He found that nymphs of the mayfly *Baetis* (Ephemeroptera: Baetidae) were readily activated by the insecticide, leading to detachment and downstream drift, while activation and drift of *Simulium* (Diptera: Simuliidae) larvae appeared to be delayed. These observations were confirmed in the present study where peak drifts of Baetidae were recorded immediately after application, but not until 6 hours later for Simuliidae. On the other hand, although Muirhead-Thompson's experiments with *Brachycentrus* (Trichoptera: Brachycentridae) showed little sign of activation, with the majority of exposed larvae dying in situ, in the present study Brachycentridae were observed to drift in response to the insecticide treatment. Muirhead-Thompson has also shown that, in the laboratory at least, *Simulium* are more tolerant to chlorpyrifos-methyl than are *Baetis*. Nevertheless, in our field studies, Simuliidae exhibited a greater response to the insecticide, in terms of increased drift, than did Baetidae.

Knockdown of terrestrial organisms (adult Diptera) into the treatment stream following the first application was slight (Figure 7; Appendix IV, Table 3). Knockdown was somewhat greater after the second application, with adult Diptera, Collembola, adult Hymenoptera and possibly Homoptera, the groups most affected. No similar increases in drift were noted in the control stream (Figure 7, Appendix IV, Table 4).

Artificial Substrates

No significant reductions in numbers were noted in any taxa in samples collected from the treatment stream immediately after the two insecticide applications (Appendix IV, Table 5). Over this same period, Trichoptera: Hydroptilidae, adult Elmidae, Chironomidae and Diptera: Empididae all significantly increased in abundance. By the time of the +51 (+45) day post-spray sample, (i.e., 51 days after the first spray and 45 days after the second spray) numbers of Hydracarina and Brachycentridae were significantly reduced in the treatment stream, while numbers of Ephemeroptera: Heptageniidae and Leptophlebiidae, Megaloptera: Sialidae, Trichoptera pupae, Elmidae larvae, Diptera: Tipulidae, Heleidae and Chironomidae were all significantly increased. Similar trends were observed for Hydracarina, Heptageniidae, Leptophlebiidae, Elmidae larvae, Tipulidae and Heleidae in the control stream (Appendix IV, Table 6). The net effect of all of these individual increases and decreases in abundance on total standing crop is seen in Figure 8.

Surber Samples

Brachycentridae numbers gradually declined over the course of the study in the treatment stream, from a high in the pre-spray samples to a low in August (Appendix IV, Table 7), a pattern similar to that seen in artificial substrates. Heleidae and Trichoptera: Odontoceridae numbers were also reduced in the treatment stream towards the end of the study. None of these taxa were represented in significant numbers at any time in Surber samples from the control stream (Appendix IV, Table 8). Apart from these three

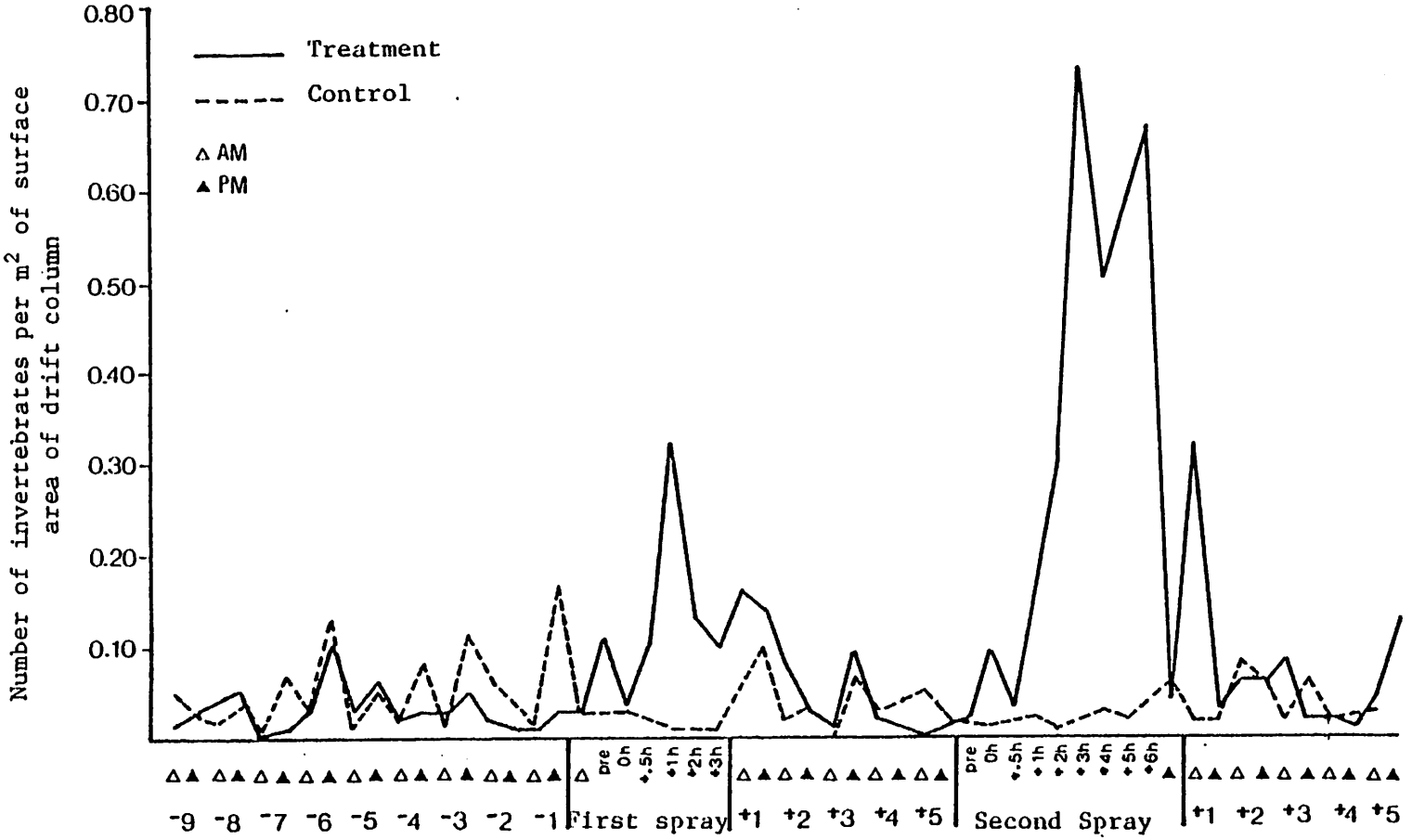

Figure 7. Terrestrial invertebrates collected in drift net sets

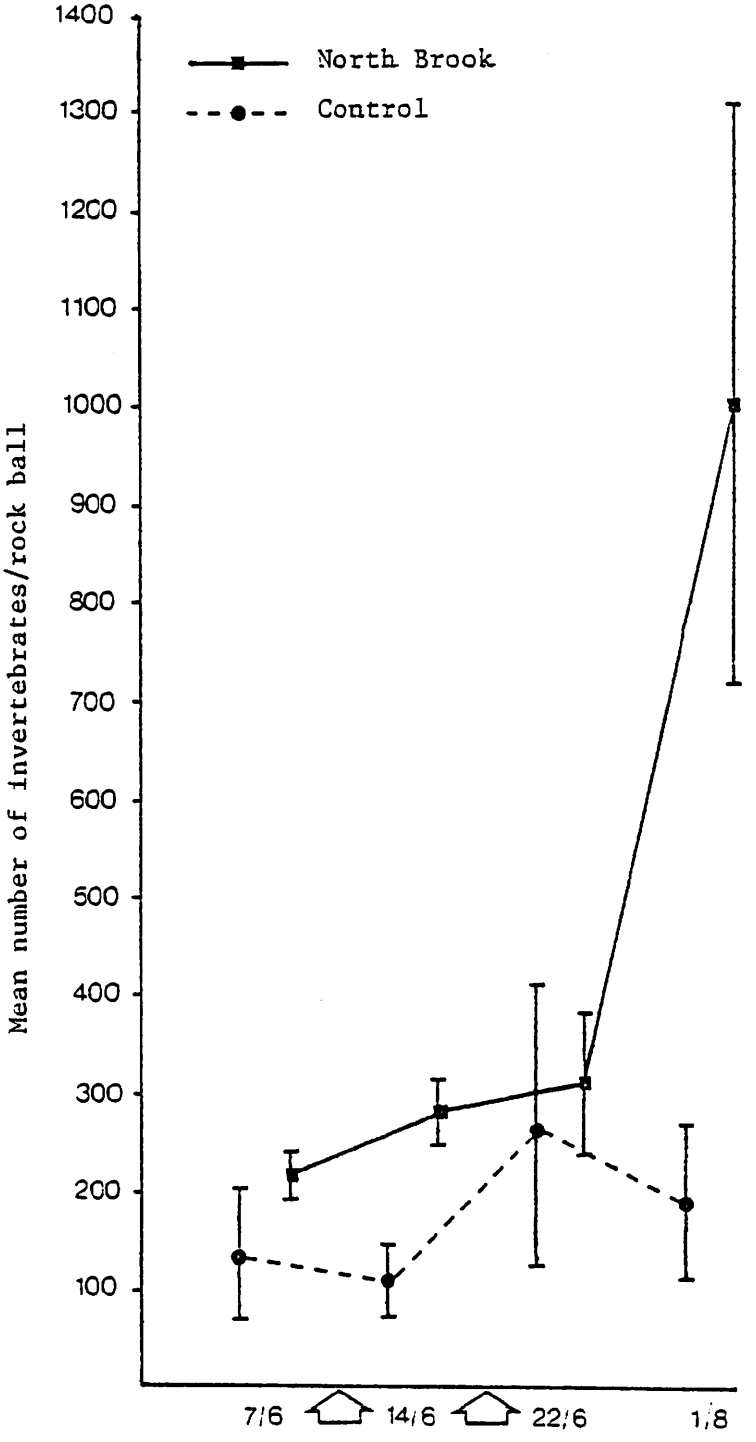

Figure 8. Mean numbers of aquatic invertebrates collected from artificial substrates.

examples, patterns of seasonal change in abundance of aquatic invertebrates were generally quite similar in the treatment and control streams (Figure 9; Appendix IV, Tables 7 and 8).

Rock Samples

Because of the extreme variability inherent in this type of sampling, it is impossible to tell whether the insecticide applications had any significant effect on individual aquatic invertebrate populations. Total standing crop was not reduced, however, (Figure 10; Appendix IV, Table 9).

Numbers of Baetidae and Chironomidae increased very significantly in the +51 (+45) day post-spray sample from the treatment stream (Appendix IV, Table 9). Increases were also noted at this time for Baetidae and Chironomidae in the control stream, but these were of much smaller magnitude (Appendix IV, Table 10).

Caged Fish

No mortality of caged fish was observed in either the treatment or control stream up to 10 days after the second insecticide application. In all, fish were caged for a total of 22 days without food and this was reflected in their very poor condition at the end of the study. Fulton's coefficients of condition (K) ranged from 0.80 to 0.99 (mean 0.90) for the 25 brook trout, *Salvelinus fontinalis*, caged in North Brook, from 0.96 to 1.12 (mean 1.04) for the 5 Atlantic salmon, *Salmo salar*, caged in North Brook, and from 0.63 to 1.06 (mean 0.91) for the 25 brook trout caged in the control stream (Little Brook). Brook trout sampled for stomach content analysis at this time had condition coefficients ranging from 1.06 to 1.39 (mean 1.23) for North Brook, and from 1.09 to 1.34 (mean 1.20) for the control stream (Little Brook).

Fish Diets

Detailed changes in brook trout and slimy sculpin *Cottus cognatus*, diets are summarized in Figures 11 to 15 and Appendix V Tables 1 to 10, and only general trends will be described in the following text.

Brook Trout

Throughout the study period, Ephemeroptera nymphs and Trichoptera larvae were important food items in the diets of North Brook brook trout, ranging between 52.1 and 68.7 percent of the total volume of food organisms consumed. Several other aquatic invertebrate taxa, including Plecoptera, Coleoptera and five families of Diptera, were consumed in lesser amounts. Terrestrial arthropods were not a particularly important food source for brook trout at the time of the first two samples, but increased in importance as the season progressed.

In terms of the volume of food eaten by North Brook brook trout, two points are worth mentioning:

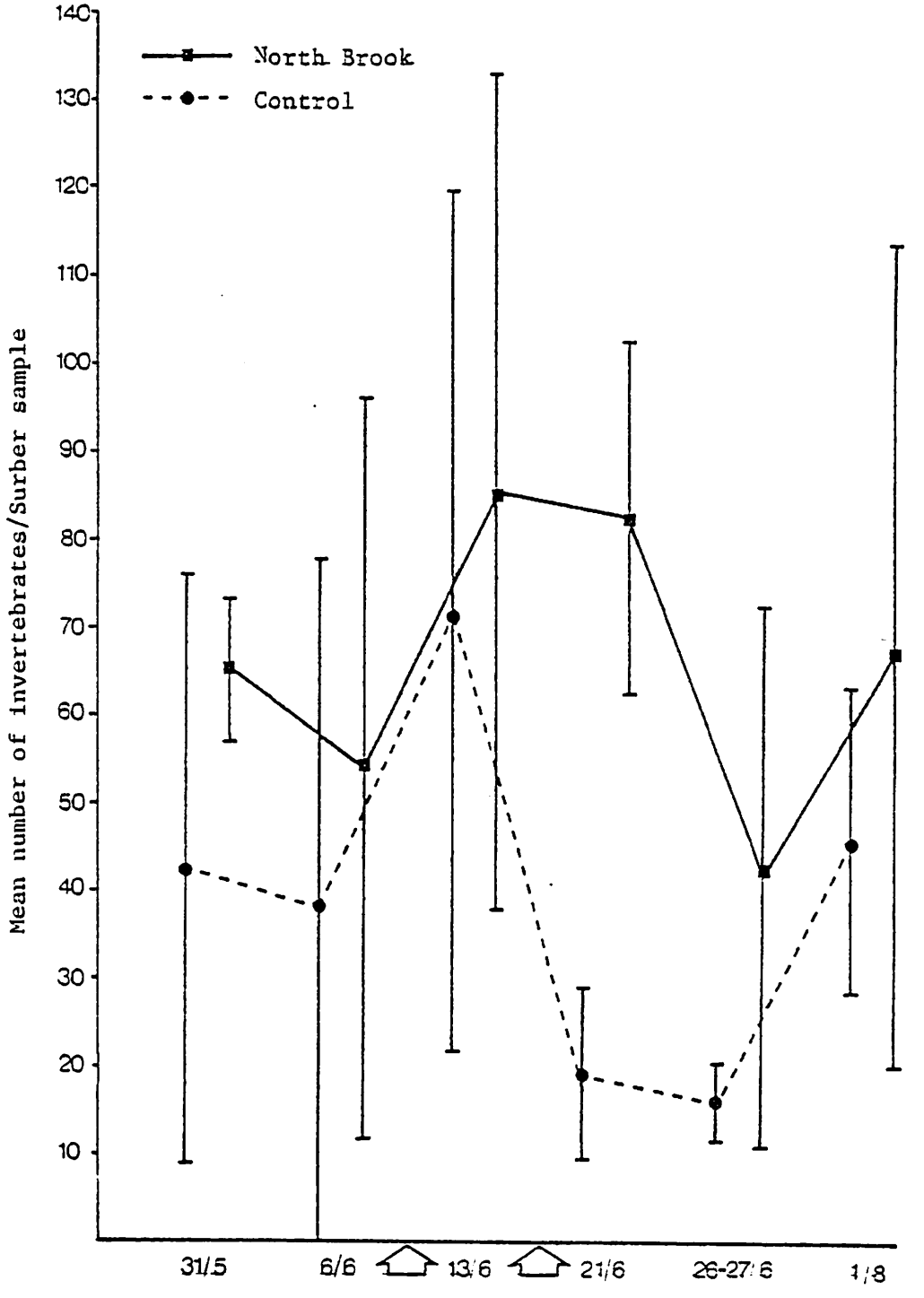

Figure 9. Mean numbers of aquatic invertebrates collected in Surber samples.

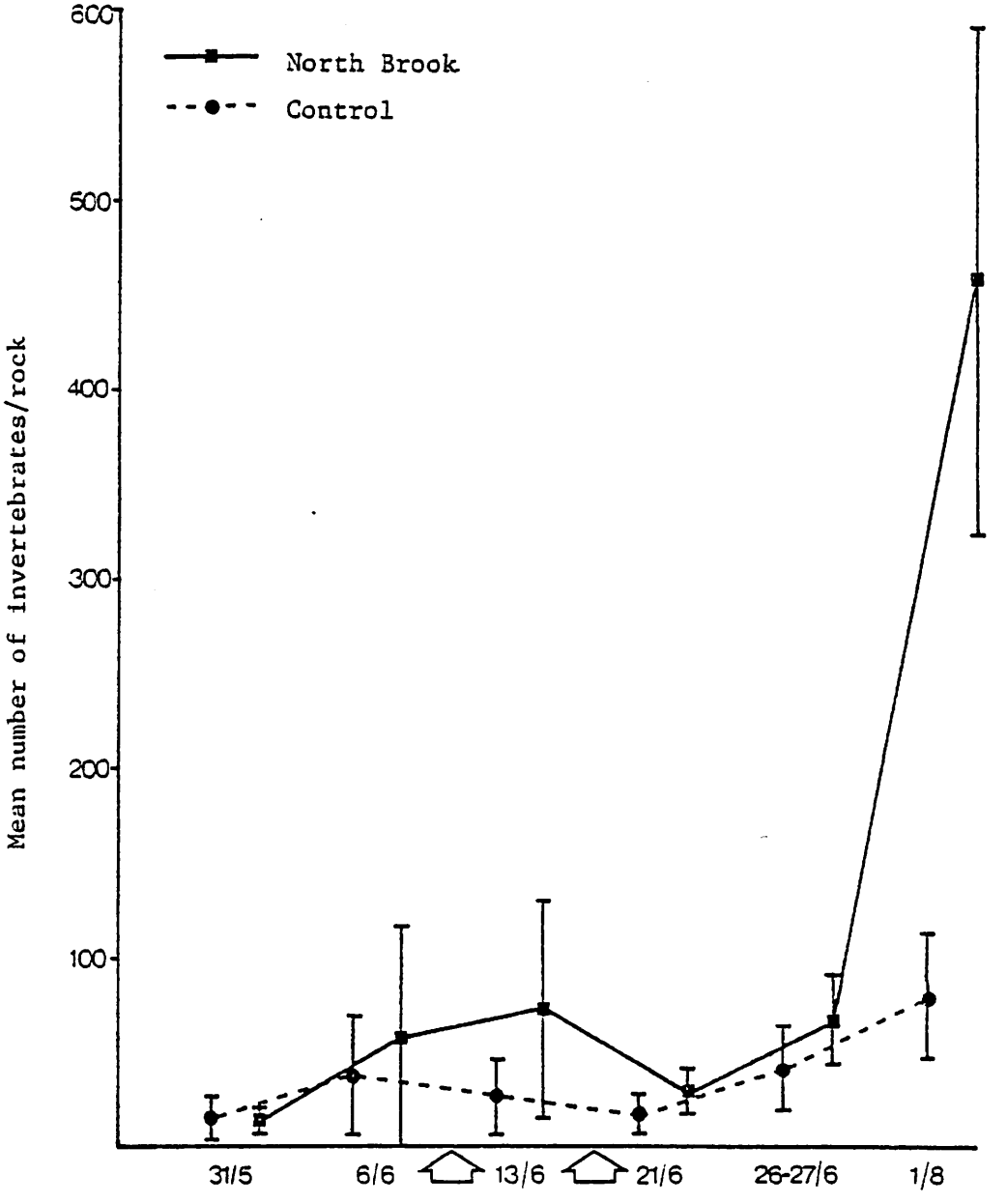

Figure 10. Mean numbers of aquatic invertebrates collected from rocks.

TREATMENT

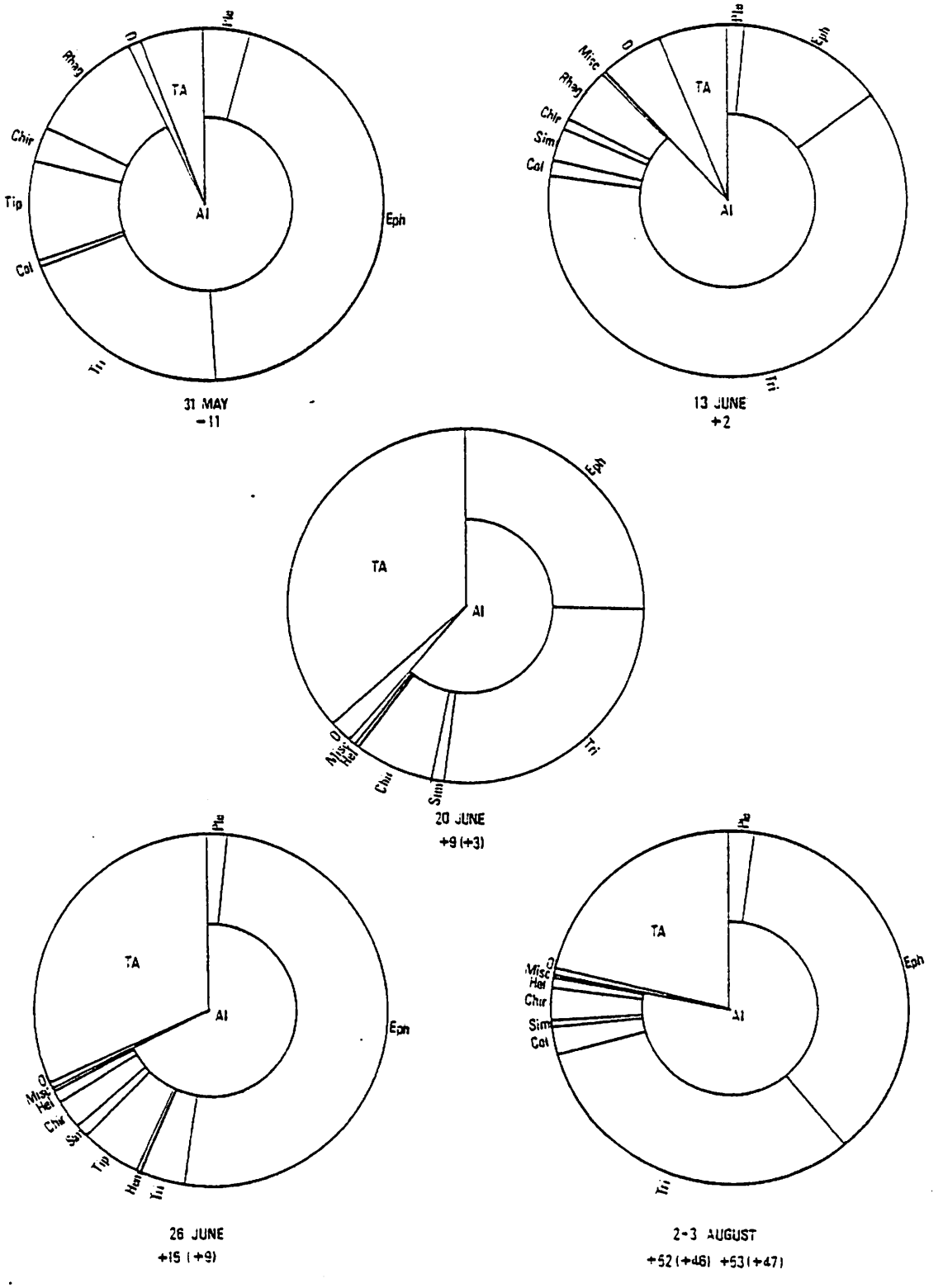

Figure 11. Dietary changes in brook trout sampled from North Brook (abbreviations are explained in Table 8).

CONTROL

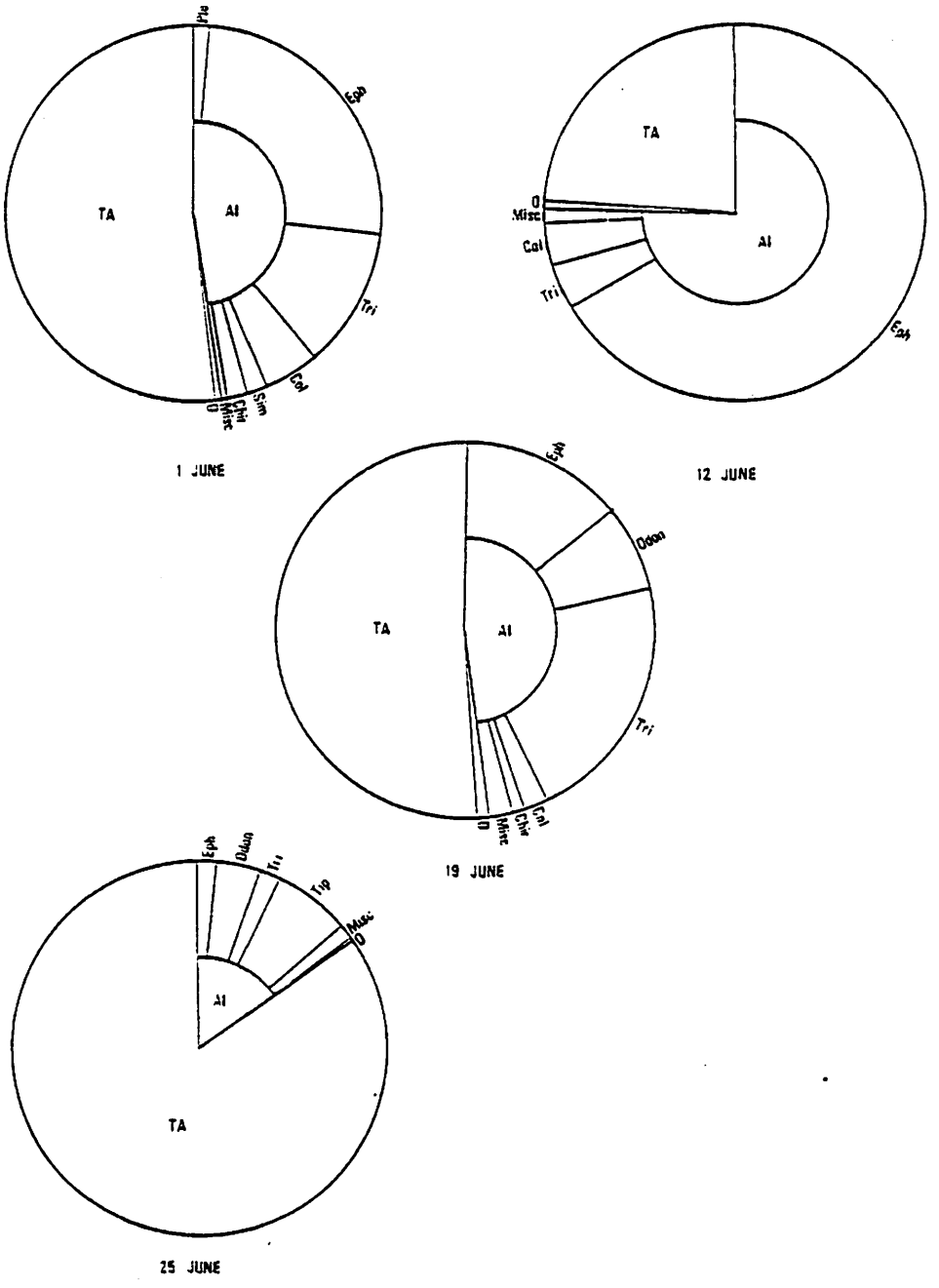

Figure 12. Dietary changes in brook trout sampled from Bass Brook (abbreviations are explained in Table 8).

CONTROL

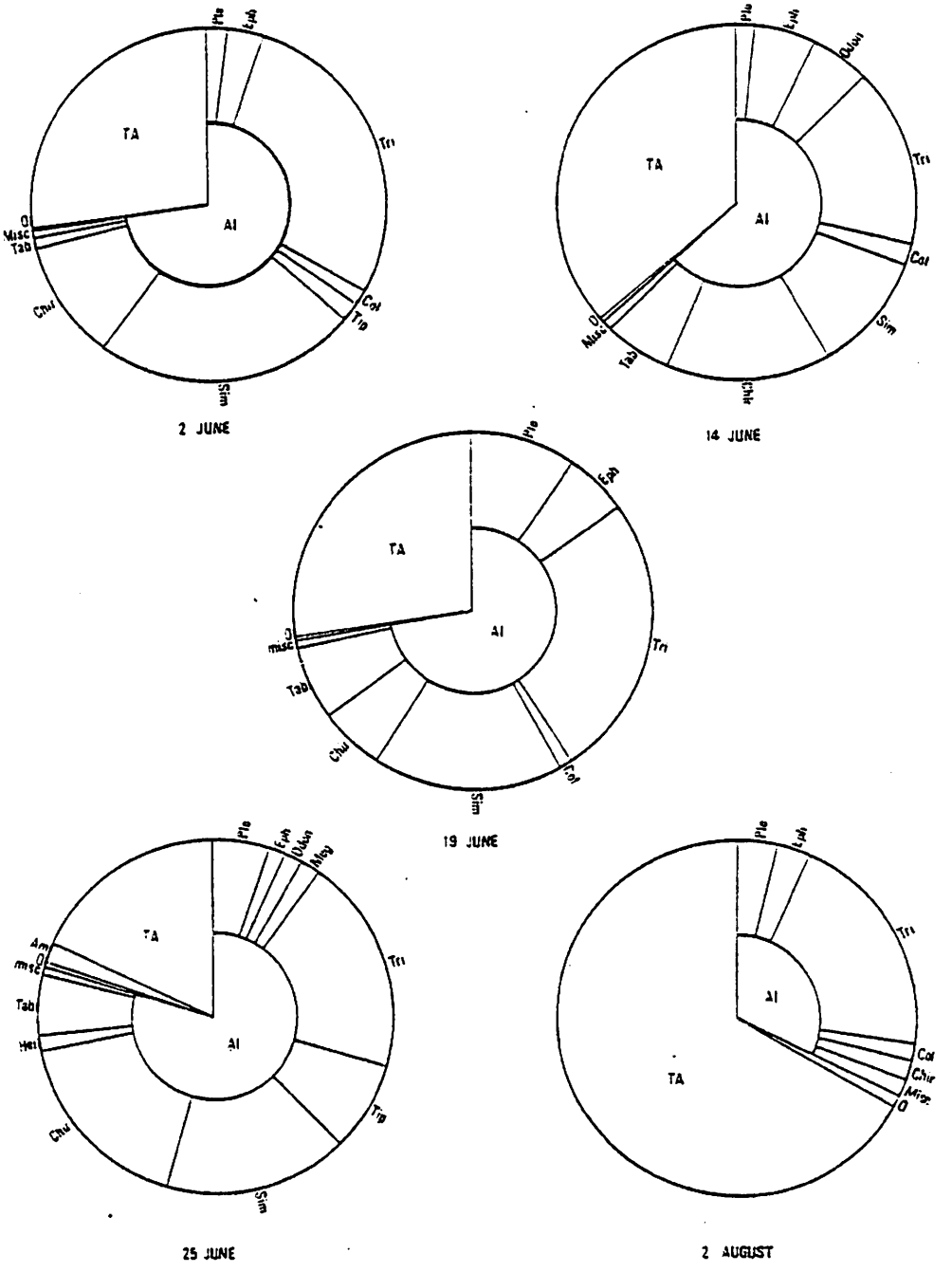

Figure 13. Dietary changes in brook trout sampled from Little Brook (abbreviations are explained in Table 8).

TREATMENT

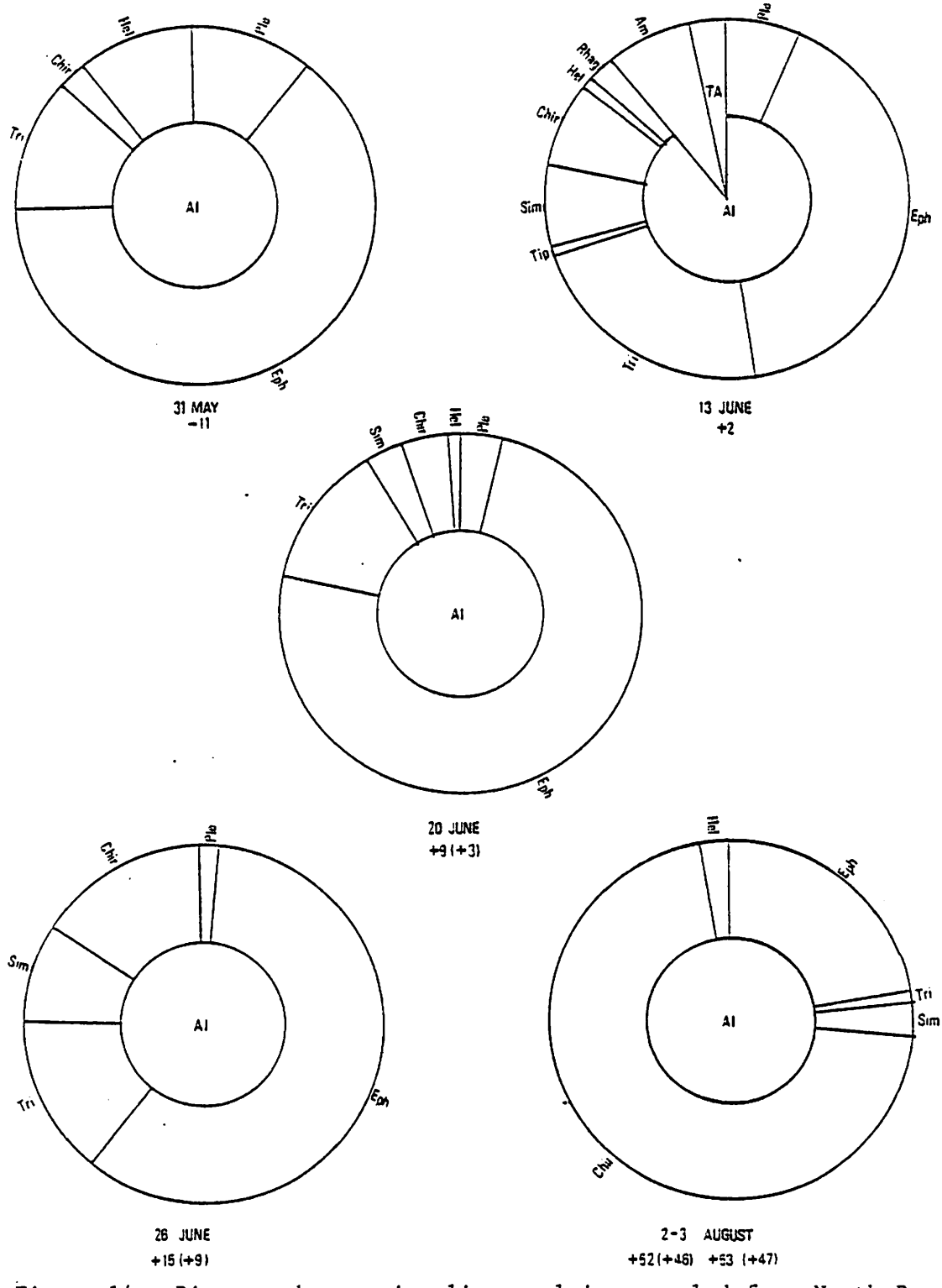

Figure 14. Dietary changes in slimy sculpins sampled from North Brook (abbreviations are explained in Table 8).

CONTROL

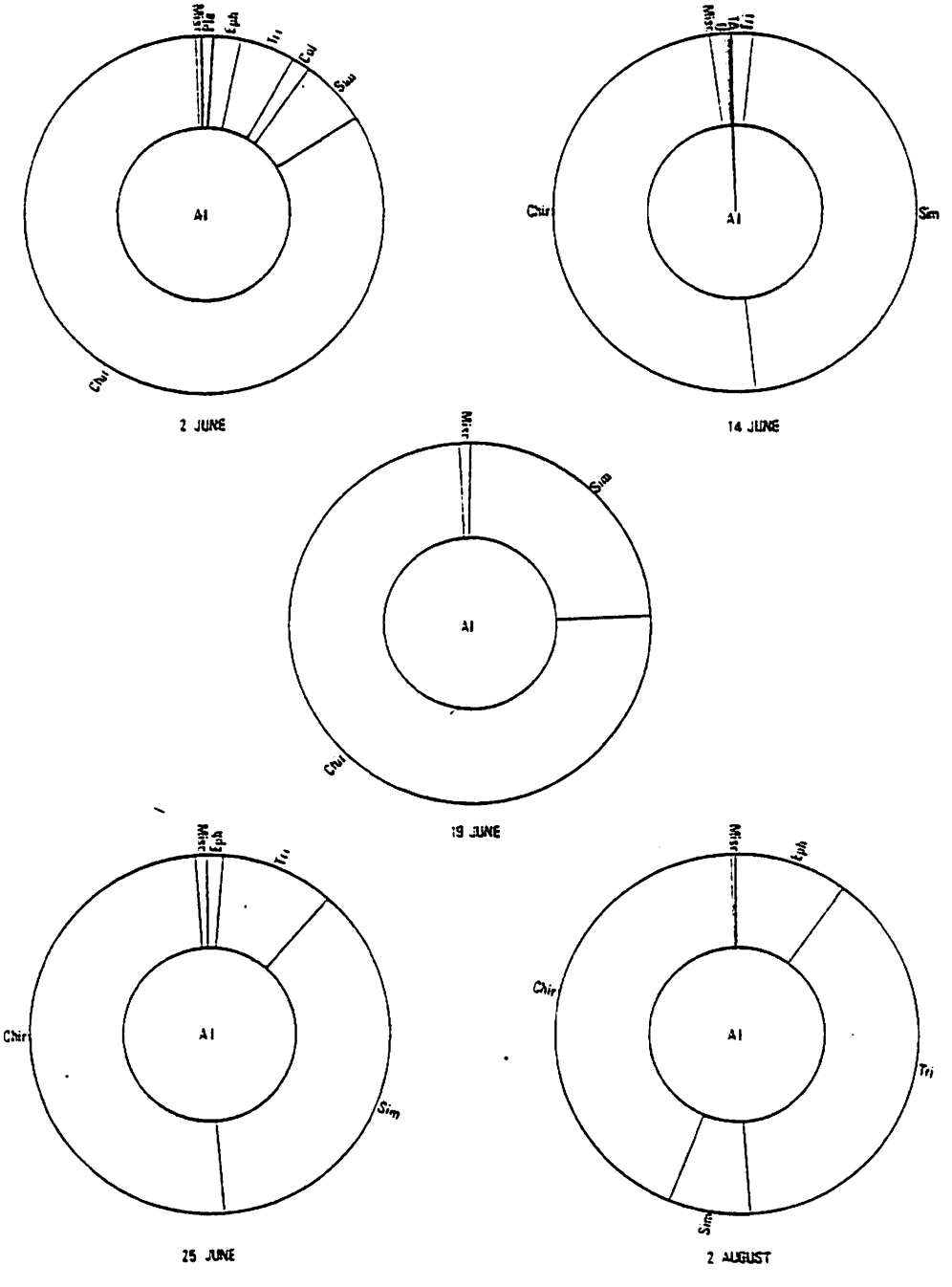

Figure 15. Dietary changes in slimy sculpins sampled from Little Brook (abbreviations are explained in Table 8).

Table 8. Codes used to represent various food items in the diets of brook trout and slimy sculpins from the treatment and control streams.

TA	terrestrial arthropods
AI	aquatic insects
Ple	Plecoptera
Eph	Ephemeroptera
Odon	Odonata
Hem	Hemiptera
Meg	Megaloptera
Tri	Trichoptera
Col	Coleoptera
Tip	Diptera: Tipulidae
Sim	Diptera: Simuliidae
Chir	Diptera: Chironomidae
Hel	Diptera: Heleidae
Tab	Diptera: Tabanidae
Misc	Miscellaneous
O	other aquatic invertebrates
Am	Amphibian eggs

1) the least amount of food was eaten on 20 June, 3 days after the second insecticide application. This is the same sample in which terrestrial arthropods became an important food source.

2) the greatest amount of food was eaten on 26 June. Several brook trout stomachs contained large numbers of emerging mayfly nymphs on this date.

Ephemeroptera and Trichoptera were also important food items in the diets of Bass Brook brook trout up to 19 June (35.0 to 72.1 percent of the total volume of food organisms consumed). Terrestrial arthropods increased significantly in importance in the 25 June sample however, with a corresponding reduction in importance of aquatic invertebrates in general, and Ephemeroptera and Trichoptera in particular.

Up to 25 June, Little Brook brook trout were feeding on a variety of aquatic and terrestrial invertebrates, with aquatic invertebrates making up between 63.8 and 79.8 percent of the total volume of food organisms consumed. Terrestrial arthropods increased significantly in importance in the 2 August sample, however. Aquatic invertebrates, particularly Simuliidae and Chironomidae, but not Trichoptera, were reduced in importance at this time.

Slimy Sculpins

Ephemeroptera and Trichoptera were the two most important food items in the diets of North Brook slimy sculpins between 31 May and 26 June (63.5 to 87.7 percent of the total volume of food organisms consumed). Plecoptera, Simuliidae, Chironomidae and Heleidae were also eaten in significant amounts. Chironomidae increased in importance in the 2-3 August sample to make up 71.0 percent of the total volume of food organisms consumed. In this sample, Ephemeroptera and Trichoptera were significantly reduced in importance, while Plecoptera and Heleidae disappeared from the diet altogether.

Chironomidae and Simuliidae were the most important food items in the diets of Little Brook sculpins between 2 and 25 June. Trichoptera were important in the 25 June sample as well however, and by 2 August contributed 38.7 percent to the total volume of food organisms consumed.

Condition Coefficients

Condition coeffficients for brook trout sampled from the treated stream (North Brook) and the two control streams (Bass and Little Brooks) were in the same general range (Figure 16), suggesting that the insecticide applications did not have any significant effect on the general well-being of brook trout populations.

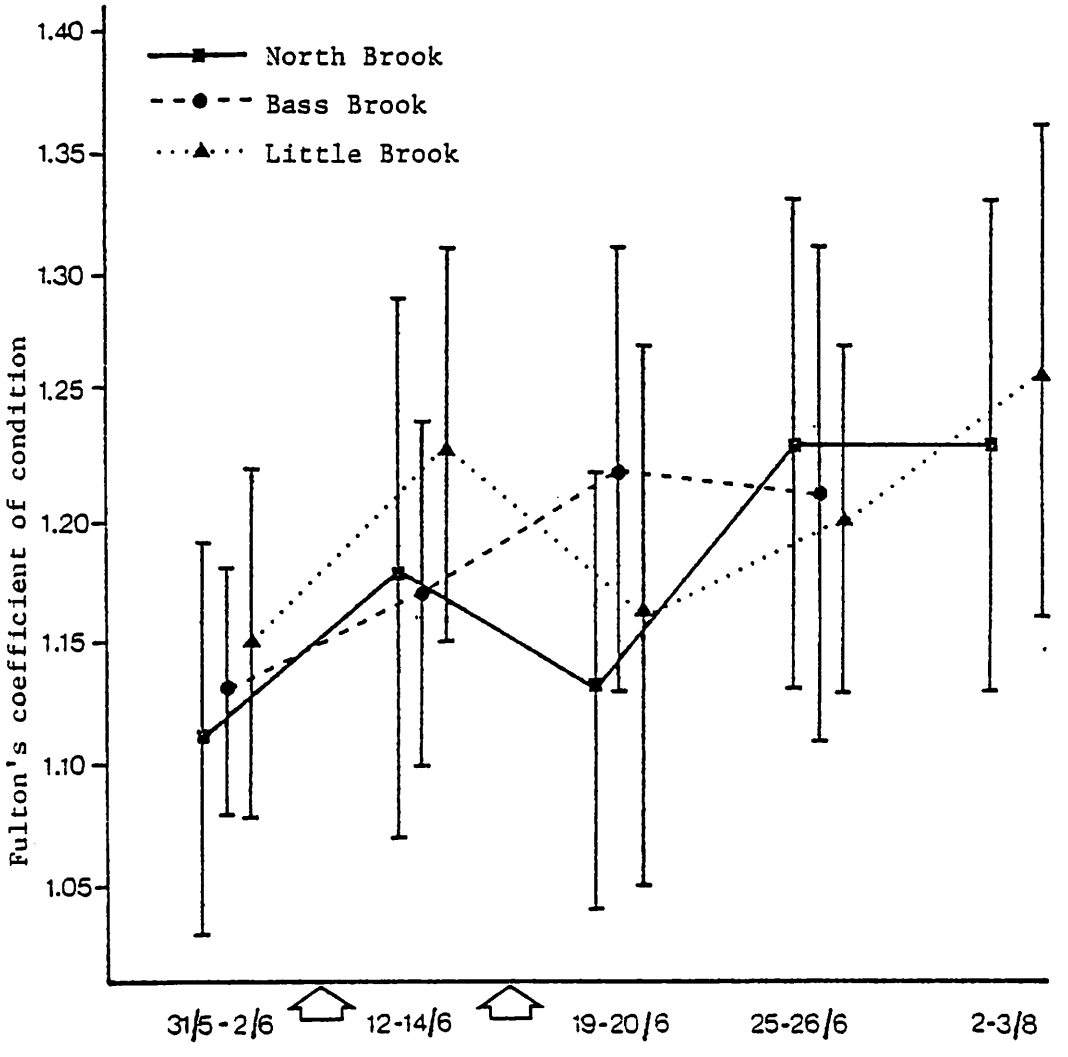

Figure 16. Condition coefficients of brook trout from the treatment and control streams.

7. SUMMARY AND CONCLUSIONS

1) Knockdown of terrestrial invertebrates was slight, involving primarily small flying Diptera, but also Hymenoptera, Araneida and Plecoptera. Effects of the first spray were more pronounced, presumably due to warmer temperatures and increased insect activity.

2) The population of forest songbirds in the treatment block remained stable throughout the study period, with little evidence of territorial disruption as a result of the insecticide applications.

3) Peak levels of chlorpyrifos-methyl in stream water were 88 ppb, ½ hour after the first application, and 212 ppb, 5 minutes after the second application. These decreased to non-detectable levels (<0.025 ppb) within 42.5 hours and 99 hours of application, respectively. Residues of chlorpyrifos-methyl were detected in fish tissues within a few days of each application.

4) Although the first application appeared to have little or no effect on aquatic invertebrate drift, a 19 X increase in drift was noted for the second application. Simuliidae and Chironomidae were the groups most affected, with smaller increases noted for Plecoptera, Baetidae, Brachycentridae, Tipulidae and Gerridae. No significant depletions were noted in the benthos.

5) Brook trout and slimy sculpin diets and condition coefficients were not significantly altered as a result of the insecticide applications.

6) There was no mortality of caged brook trout and Atlantic salmon parr held in the treatment stream up to 10 days after the second application.

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APPENDIX I

Terrestrial invertebrate knockdown in treated and control areas Gloucester County, New Brunswick.

Table 1. Terrestrial invertebrate knockdown from balsam fir, Treatment Block, Gloucester County, New Brunswick, 5 - 23 June 1980.

Days before or after application* of 0.070 kg AI/ha RELDAN®	Prespray								Postspray I								Postspray II							
	-6	-5	-4	-3	-2	-1	-0	Avg.	+1	+2	+3	+4	+5	Avg.	+0	+1	+2	+3	+4	+5	+6	Avg.
Pseudoscorpionida																					.1	.01 ± .04
Araneida		.1				.1	.1	.04 ± .05	.1		.1		.1	.06 ± .05						.2	.1	.04 ± .08
Chilopoda						.1		.01 ± .04														
Homoptera																						
Aphididae																			.1			.01 ± .04
Other	.1							.01 ± .04														
Coleoptera																						
Carabidae adults										.1				.02 ± .04								
Staphylinidae adults	.1						.1	.03 ± .05	.2	.4		.2		.16 ± .17					.1			.01 ± .04
Scarabaeidae adults															.1							.01 ± .04
Elateridae		.1			.1			.03 ± .05		.1				.02 ± .04								
Lampyridae adults			.1					.01 ± .04			.1			.02 ± .04								
Unidentified larvae											.1			.02 ± .04								
Lepidoptera																						
Tortricidae larvae															.1	.1					.1	.04 ± .05
Noctuidae larvae	.1							.01 ± .04								.1						.01 ± .04
Diptera																						
Tipulidae adults																.1						.01 ± .04
Psychodidae adults									.3					.06 ± .13								
Chironomidae adults									3.0					.6 ± 1.34	.4		.3				.2	.13 ± .17
Bibionidae adults																	.1					.01 ± .04
Mycetophilidae adults									1.2					.24 ± .54			.1					.01 ± .04
Sciaridae adults	2.6	.1		.7		.3		.53 ± .95	3.8	.4				.84 ± 1.66	.6	.5		.2	.1		.6	.29 ± .27
Cecidomyiidae adults									.1					.02 ± .04							.2	.03 ± .08
Rhagionidae adults										.2				.04 ± .09					.1			.01 ± .04
Empididae adults															.2	.1			.1			.06 ± .08
Other adults	.2			.1		.1		.06 ± .08	1.2	.2	.1	.1		.32 ± .50	.4	.1	.2	.1			.1	.13 ± .14
Unidentified larvae															.1		.1					.03 ± .05
Hymenoptera																						
Formicidae adults			.1				.1	.03 ± .05												.1		.01 ± .04
Other adults	.3							.04 ± .11	.5				.1	.12 ± .22					.1		.1	.03 ± .05
Unidentified larvae												.1		.02 ± .04								
Total terrestrial invertebrates	3.4	.3	.2	0	.9	.2	.7	.81 ± 1.2	10.4	1.4	.3	.4	.2	2.54 ± 4.42	1.9	1.0	.8	.3	.6	.3	1.5	.91 ± .60

*Application from 2021 to 2116 ADT on 11 June and again from 0550 to 0644 ADT on 17 June 1980.

Table 2. Terrestrial invertebrate knockdown from balsam fir, Untreated control, Gloucester County, New Brunswick, 5 - 23 June 1980.

Days before or after application* of 0.070 kg AI/ha RELDAN®	Prespray								Postspray I								Postspray II							
	-6	-5	-4	-3	-2	-1	-0	Avg.	+1	+2	+3	+4	+5	Avg.	+0	+1	+2	+3	+4	+5	+6	Avg.
Aranelda									.1					.02 ± .04		.1						.01 ± .04
Homoptera																					.1	.01 ± .04
Coleoptera																						
Carabidae adults																	.1				.1	.03 ± .05
Staphylinidae adults	.1							.01 ± .04														
Scarabaeidae adults											.1	.1		.04 ± .05								
Elateridae adults			.1					.01 ± .04										.1				.01 ± .04
Other adults											.1			.02 ± .04								
Lepidoptera																						
Tortricidae larvae		.3	.1					.06 ± .11														
Diptera																						
Tipulidae adults											.1			.02 ± .04								
Bibionidae adults															.1							.01 ± .04
Sciaridae adults									.2					.04 ± .09			.1			.1	.4	.09 ± .15
Cecidomyiidae adults																.1						.01 ± .04
Phoridae adults																					.1	.01 ± .04
Other adults										.1				.02 ± .04					.1		.2	.04 ± .08
Hymenoptera																						
Formicidae adults																				.1	.1	.03 ± .05
Other adults																.1						.01 ± .04
Total terrestrial invertebrates	.1	.3	.2	0	0	0	0	.09 ± .12	.3	.1	.3	.1	0	.16 ± .13	.1	.3	.2	.1	.1	.2	1.0	.29 ± .32

*application from 2015 to 2119 ADT on 11 June and again from 0546 to 0653 ADT on 17 June 1980.

Table 3. Terrestrial invertebrate knockdown, Treatment stream, Gloucester County, New Brunswick, 4-22 June 1980.

Days before or after application[a] of 0.070 kg AI/ha RELDAN®	Prespray								Avg.	Postspray I					Avg.	Postspray II						Avg.
	-7	-6	-5	-4	-3	-2	-1	-0		+1	+2	+3	+4	+5		+0	+1	+2	+3	+4	+5	
Acari																				0.4		.07 ± .16
Araneida										0.2		0.2	0.2	0.4	.40 ± .35	0.6	0.4	0.2		0.2	0.2	.57 ± .73
Plecoptera					0.2				.03 ± .07		0.4	1.0	0.2		.32 ± .41							
Psocoptera										0.2					.04 ± .09							
Hemiptera																						
Tingidae																			0.2			.03 ± .08
Others													0.2		.04 ± .09							
Homoptera																						
Cicadellidae																0.2						.03 ± .08
Psyllidae					0.2				.03 ± .07											0.2		.03 ± .08
Others						0.2			.03 ± .07			0.2	0.2		.08 ± .11	0.2	0.2					.07 ± .10
Coleoptera																						
Carabidae adults																	0.4					.07 ± .16
Staphylinidae adults										0.4	0.2	0.2	0.2		.56 ± .82							
Others					0.2				.03 ± .07													
Lepidoptera																						
Tortricidae larvae						.02			.03 ± .07							0.2						.03 ± .08
Unidentified larvae								0.2	.03 ± .07				0.2		.04 ± .09							
Diptera																						
Chironomidae adults	.2	1.4	0.4	0.6	0.6	0.6	1.2	0.8	.73 ± .40	1.6	0.4	0.6	0.4	0.2	.64 ± .55	1.0		0.4			0.2	.43 ± .46
Mycetophilidae adults												0.2			.04 ± .09	0.2						.03 ± .08
Sciaridae adults	1.0	1.0	1.0	0.4	1.2	0.8	1.0	1.4	.98 ± .29	3.6	0.2	0.2	0.2	0.6	2.04 ± 2.66	0.8	0.4	0.4	0.2	0.4	1.6	.63 ± .51
Cecidomyiidae adults				0.2				0.2	.05 ± .09				0.2	0.2	.08 ± .11	0.4					0.2	.10 ± .17
Phoridae adults	0.2								.03 ± .07							0.8	0.4		0.2	0.2	0.2	.30 ± .28
Other adults				0.6	0.4			0.2	.15 ± .23	0.2	0.2		0.2		.12 ± .11		0.2	0.2	0.2			.10 ± .11
Hymenoptera																						
Braconidae adults																			0.2			.03 ± .08
Ichneumonidae adults			0.2					0.4	.08 ± .15					0.6	.12 ± .27	0.2	0.2					.07 ± .10
Chalcidoidea adults				0.2	0.2				.05 ± .09		0.2	0.6	0.2	0.2	.24 ± .20			0.2				.03 ± .08
Formicidae adults										0.2		0.2			.08 ± .11							
Total terrestrial invertebrates	1.4	2.4	1.6	2.0	3.0	1.8	2.2	3.2	2.2 ± .64	6.4	1.6	3.4	2.4	2.2	3.2 ± 1.9	4.6	2.2	1.4	1.0	0.8	3.0	2.2 ± 1.4

[a]application at 2033 ADT on 11 June and again at 0606 ADT on 17 June 1980.

Table 4. Terrestrial invertebrate knockdown, Untreated control stream, Gloucester County, New Brunswick, 4 - 22 June, 1980.

Days before or after application* of 0.070 kg AI/ha RELDAN®	Prespray									Postspray I							Postspray II							
	-7	-6	-5	-4	-3	-2	-1	-0	Avg.	+1	+2	+3	+4	+5	Avg.		+0	+1	+2	+3	+4	+5	Avg.	
Acari			0.2						.03 ± .07		0.4				.08 ± .18			0.4		0.2		0.6	.20 ± .25	
Araneida		0.4				0.6	0.2	0.2	.17 ± .18			0.2			.04 ± .09		0.2		0.6	0.2		0.2	.20 ± .22	
Chilopoda		0.2							.03 ± .07															
Collembola						0.8			.10 ± .28	0.2					.04 ± .09									
Ephemeroptera					0.2				.03 ± .07															
Homoptera																								
Aphididae		0.2							.03 .07					0.2	.04 ± .09									
Coleoptera																								
Carabidae adults			0.2		0.2				.05 ± .09					0.2	.04 ± .09		0.2						.03 ± .08	
Staphylinidae adults					0.4				.05 ± .14	0.8	0.6	4.0	10.6	2.4	3.68 ± 4.11		7.0	4.2	0.4	1.0	0.6	0.6	2.30 ± 2.71	
Elateridae adults		0.2					0.2		.05 ± .09															
Other adults								0.2	.03 ± .07		0.2	0.2			.08 ± .11			0.2	0.2			0.4	.13 ± .16	
Lepidoptera																								
Tortricidae larvae											0.2				.04 ± .09			0.2	0.2			0.2	.10 ± .11	
Diptera																								
Tipulidae adults						0.2		0.2	.05 ± .09	0.2					.04 ± .09		0.4		0.4				.13 ± .21	
Chironomidae adults	0.4	1.8	0.4	1.8	3.4	1.6	0.6	0.6	1.3 ± 1.07	1.2	0.4	0.8	0.2		.52 ± .48		0.4			0.4	0.8		.27 ± .33	
Bibionidae larvae											0.2				.04 ± .09									
Sciaridae adults	2.2	2.4	1.8	0.4	4.4	0.6	2.0	2.2	2.0 ± 1.2	0.8	1.0	0.8	0.4	1.2	.84 ± .30		0.4	0.6	0.2	0.4	0.4	0.4	.40 ± .13	
Cecidomyiidae adults		0.4	0.2			0.4	0.2		.15 ± .18	0.2				0.2	.08 ± .11		0.4	0.6	0.2				.20 ± .25	
Phoridae adults	0.2		0.2		0.2		0.2		.10 ± .11	0.2		0.2	0.4		.16 ± .17			0.2					.03 ± .08	
Other adults	0.2						0.4	0.4	.13 ± .18	0.4	0.6	0.2		0.2	.28 ± .23		0.2	0.2	0.4	0.2		0.2	.20 ± .13	
Hymenoptera																								
Ichneumonoidea	0.2								.03 ± .07		0.2				.04 ± .09									
Ichneumonidae adults		0.4					0.4	0.4	.15 ± .21		0.2	0.2		0.2	.12 ± .11				0.2	0.2		0.2	.10 ± .11	
Braconidae adults				0.2	0.2			0.2	.08 ± .10								0.2						.03 ± .08	
Chalcidoidea adults	0.4	0.4	0.2	0.4	0.2		0.2		.20 ± .15		0.2	0.4	0.2		.16 ± .17		0.2					0.2	.07 ± .10	
Formicidae adults								0.2	.03 ± .07															
Other adults																						0.2	.03 ± .08	
Total terrestrial invertebrates	3.6	6.4	3.2	2.8	9.2	4.2	4.4	4.6	4.8 ± 2.1	4.0	4.2	7.0	11.8	4.6	6.3 ± 3.3		9.6	6.6	2.8	2.6	1.8	3.2	4.4 ± 3.0	

*Application at 2033 ADT on 11 June and again at 0606 ADT on 17 June 1980.

APPENDIX II

Population structure of bird communities on treatment and control plots. Gloucester County, New Brunswick.

Table 1. Common and Scientific names of bird species censused.

Scientific name	Common name
ACCIPITRIDAE	
Buteo platypterus	Broad-winged hawk
TETRAONIDAE	
Bonasa umbellus	Ruffed grouse
CUCULIDAE	
Coccyzus erythropthalmus	Black-billed Cuckoo
APODIDAE	
Chaetura pelagica	Chimney swift
TROCHILIDAE	
Archilochus colubris	Ruby-throated hummingbird
ALCEDINIDAE	
Megaceryle alcyon	Belted kingfisher
PICIDAE	
Colaptes auratus	Common flicker
Dryocopus pileatus	Pileated woodpecker
Sphyrapicus varius	Yellow-bellied sapsucker
Dendrocopos villosus	Hairy woodpecker
TYRANNIDAE	
Myiarchus crinitus	Great-crested flycatcher
Empidonax flaviventris	Yellow-bellied flycatcher
Empidonax traillii	Alder flycatcher
Empidonax minimus	Least flycather
Contopus virens	Eastern wood pewee
Nuttallornis borealis	Olive-sided flycatcher
CORVIDAE	
Perisoreus canadensis	Gray jay
Cyanocitta cristata	Blue jay
Corvus corax	Common raven
Corvus brachyrhnchos	Common crow
PARIDAE	
Parus atricapillus	Black-capped chickadee
Parus hudsonicus	Boreal chickadee
SITTIDAE	
Sitta carolinensis	White-breasted nuthatch
Sitta canadensis	Red-breasted nuthatch
TROGLODYTIDAE	
Troglodytes troglodytes	Winter wren
TURDIDAE	
Turdus migratorius	American robin
Hylocichla guttata	Hermit thrush
Hylocichla ustulata	Swainson's thrush
Hylocichla fuscescens	Veery
SYLVIIDAE	
Regulus satrapa	Golden-crowned kinglet
Regulus calendula	Ruby-crowned kinglet
BOMBYCILLIDAE	
Bombycilla cedrorum	Cedar waxwing
VIREONIDAE	
Vireo solitarius	Solitary vireo
Vireo olivaceus	Red-eyed vireo
PARULIDAE	
Mniotilta varia	Black-and-white warbler
Vermivora peregrina	Tennessee warbler
Vermivora ruficapilla	Nashville warbler
Parula americana	Parula warbler
Dendroica petechia	Yellow warbler
Dendroica magnolia	Magnolia warbler
Dendroica tigrina	Cape May warbler
Dendroica caerulescens	Black-throated blue warbler
Dendroica coronata	Yellow-rumped warbler
Dendroica virens	Black-throated green warbler
Dendroica fusca	Blackburnian warbler
Dendroica pensylvanica	Chestnut-sided warbler
Dendroica castanea	Bay-breasted warbler
Dendroica striata	Blackpoll warbler
Seiurus aurocapillus	Ovenbird
Seiurus noveboracensis	Northern waterthrush
Oporornis philadelphia	Mourning warbler
Geothlypis trichas	Common yellowthroat
Wilsonia pusilla	Wilson's warbler
Wilsonia canadensis	Canada warbler
Setophaga ruticilla	American Redstart
ICTERIDAE	
Quiscalus quiscula	Common grackle
Molothrus ater	Crown-headed cowbird
THRAUPIDAE	
Piranga olivacea	Scarlet tanager
FRINGILLIDAE	
Richmondena cardinalis	Cardinal
Pheuticus ludovicianus	Rose-breasted grosbeak
Hesperiphona vespertina	Evening grosbeak
Carpodacus purpureus	Purple finch
Pinicola enucleator	Pine grosbeak
Spinus tristis	American goldfinch
Junco hyemalis	Dark-eyed junco
Spizella passerina	Chipping sparrow
Zonotrichia albicollis	White-throated sparrow
Melospiza lincolnii	Lincoln's sparrow

Table 2
Forest bird population census
Reldan Treatment Block
Allardville, New Brunswick
2-23 June, 1980

Family	Species	Prespray June 2 -9	June 3 -8	June 4 -7	June 5 -6	June 6 -5	June 8 -3	June 10 -1	June 11 -0	Avg.	Postspray 1 June 12 +1	June 13 +2	June 14 +3	June 15 +4	June 17 +6	Avg.	Postspray 2 June 18 +1	June 19 +2	June 20 +3	June 21 +4	June 22 +5	June 23 +6	Avg.
Tetraonidae	Ruffed Grouse	0	2	0	2	0	2	0	0	0.8	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
Cuculidae	Black-billed Cuckoo	0	0	0	0	0	0	0	0	0.0	0	0	0	2	0	0.4	0	0	0	0	0	0	0.0
Apodidae	Chimney Swift	0	0	0	0	0	2	0	0	0.3	0	0	0	0	0	0.0	0	4	4	2	0	2	2.0
Trochilidae	Ruby-throated Hummingbird	0	0	1	1	0	3	0	1	0.8	0	1	1	2	1	1.0	1	0	0	0	0	0	0.2
Alcedinidae	Belted Kingfisher	0	1	1	1	0	1	0	0	0.5	1	1	1	1	0	0.8	1	1	1	1	2	1	1.2
Picidae	Common Flicker	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0	0	0	0	1	0	0	0.2
	Pileated Woodpecker	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0	1	0	1	0	0	1	0.5
	Yellow-bellied Sapsucker	3	3	2	1	0	1	0	2	1.5	2	1	0	2	0	1.0	0	1	5	2	2	2	2.0
Tyrannidae	Great-crested Flycatcher	1	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
	Yellow-bellied Flycatcher	0	0	0	0	0	0	0	0	0.0	0	0	0	0	2	0.4	0	2	4	2	0	0	1.3
	Least Flycatcher	2	4	6	6	4	2	0	6	3.8	2	6	2	4	2	3.2	0	2	2	2	4	4	2.3
	Eastern Wood Pewee	0	0	0	0	2	2	0	0	0.5	0	0	0	2	2	0.8	0	0	0	0	0	2	0.3
	Olive-sided Flycatcher	0	2	2	2	0	2	0	0	1.0	1	2	2	2	0	1.4	1	0	2	1	4	1	1.5
Corvidae	Gray Jay	1	0	0	1	0	0	0	0	0.3	0	1	0	0	0	0.2	1	0	1	0	0	0	0.3
	Blue Jay	0	0	0	0	0	0	0	0	0.0	1	1	0	0	0	0.4	0	0	3	0	0	0	0.5
	Common Crow	1	0	0	0	0	0	0	1	0.3	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
Paridae	Black-capped Chickadee	0	1	0	2	0	2	0	0	0.6	0	3	0	1	2	1.2	1	3	1	2	0	0	1.2
	Boreal Chickadee	0	1	1	0	1	2	0	4	1.1	1	3	0	0	0	0.8	0	1	2	0	0	0	0.5
Sittidae	White-breasted Nuthatch	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0	0	0	0	2	0	0	0.3
	Red-breasted Nuthatch	0	0	0	0	0	0	0	0	0.0	0	0	0	2	4	1.2	0	0	2	0	0	0	0.3
Troglodytidae	Winter Wren	4	6	2	0	2	4	2	2	2.8	4	4	8	2	2	4.0	2	4	2	0	2	4	2.3
Turdidae	American Robin	3	7	1	6	7	3	2	11	5.0	4	9	7	1	2	4.6	0	5	1	2	5	3	2.7
	Hermit Thrush	0	5	3	1	0	0	0	0	1.1	1	3	0	0	3	1.4	4	4	4	0	3	4	3.2
	Swainson's Thrush	1	6	1	1	8	3	0	3	2.9	11	12	7	23	15	13.6	5	18	23	15	14	13	14.7
	Veery	2	3	0	4	6	6	0	4	3.1	5	5	5	6	5	5.2	4	9	9	4	3	4	5.5
Sylvidae	Golden-crowned Kinglet	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0	0	0	0	0	2	0	0.3
	Ruby-crowned Kinglet	2	6	6	4	2	4	0	0	3.0	0	4	2	0	8	2.8	2	0	2	0	4	0	1.3
Bombycillidae	Cedar Waxwing	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0	0	0	0	3	0	0	0.5
Vireonidae	Solitary Vireo	6	2	6	4	12	4	0	6	5.0	4	4	4	0	2	2.8	2	6	8	4	10	6	6.0
	Red-eyed Vireo	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0	0	2	0	0	4	2	1.3

(cont'd)

Table 2
Forest bird population census
Reldan Treatment Block
Allardville, New Brunswick
2-23 June, 1980 (concl)

Family	Species	Prespray June 2 -9	June 3 -8	June 4 -7	June 5 -6	June 6 -5	June 8 -3	June 10 -1	June 11 -0	Avg.	Postspray 1 June 12 +1	June 13 +2	June 14 +3	June 15 +4	June 17 +6	Avg.	Postspray 2 June 18 +1	June 19 +2	June 20 +3	June 21 +4	June 22 +5	June 23 +6	Avg.
Parulidae	Black-and-white Warbler	0	0	0	0	0	0	0	0	0.0	2	2	0	0	2	1.2	0	0	2	0	0	2	0.7
	Tennessee Warbler	4	4	6	4	10	4	2	6	5.0	4	8	4	6	6	5.6	4	8	6	4	2	2	4.3
	Nashville Warbler	0	0	1	1	0	0	0	2	0.5	0	0	2	0	2	0.8	0	4	2	0	2	0	1.3
	Parula Warbler	6	10	4	11	12	6	0	6	6.9	4	11	8	4	20	9.4	7	4	2	2	6	6	4.5
	Yellow Warbler	0	0	0	1	0	0	0	0	0.1	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
	Magnolia Warbler	8	6	2	3	5	6	8	12	6.3	20	12	12	14	17	15.0	4	26	8	10	20	16	14.0
	Cape May Warbler	6	12	14	8	9	6	0	4	7.4	6	4	10	2	2	4.8	10	12	12	20	18	10	13.7
	Black-throated Blue Warbler	2	2	6	8	4	12	0	8	5.3	12	12	6	12	14	11.2	6	10	16	10	6	8	9.3
	Yellow-rumped Warbler	4	4	0	6	2	2	0	2	2.5	0	2	2	0	4	1.6	0	0	2	2	8	2	2.3
	Black-throated Green Warbler	4	6	2	6	4	2	0	0	3.0	4	2	2	6	2	3.2	4	0	0	2	0	2	1.3
	Blackburnian Warbler	4	10	4	13	12	6	0	2	6.4	6	12	4	6	6	6.8	2	10	10	6	8	10	7.7
	Chestnut-sided Warbler	4	10	2	6	6	8	0	16	6.5	14	18	8	8	14	12.4	4	8	16	8	8	4	8.0
	Bay-breasted Warbler	10	6	4	6	2	10	4	8	6.3	12	10	6	16	4	9.6	6	8	14	8	6	6	8.0
	Blackpoll Warbler	0	2	2	4	2	4	0	2	2.0	4	2	2	0	0	1.6	0	2	0	2	0	2	1.0
	Ovenbird	12	8	12	12	10	8	6	8	9.5	16	8	14	10	10	11.6	12	12	12	6	8	4	9.0
	Northern Waterthrush	4	4	4	2	2	0	0	4	2.5	0	2	4	2	0	1.6	4	2	4	4	2	2	3.0
	Mourning Warbler	0	4	2	6	4	4	0	2	2.8	2	2	6	2	2	2.8	4	4	4	6	8	6	5.3
	Yellowthroat	3	6	4	7	4	4	3	2	4.1	8	2	0	3	4	3.4	0	9	2	1	0	1	2.2
	Wilson's Warbler	0	2	2	2	0	2	0	0	1.0	2	0	4	0	0	1.2	0	0	0	0	2	0	0.3
	Canada Warbler	10	10	12	10	4	6	0	8	7.5	6	12	8	10	8	8.8	8	6	10	4	8	4	6.7
	American Redstart	10	9	2	13	12	14	0	10	8.8	16	20	26	13	27	20.4	13	15	18	12	16	11	14.2
Thraupidae	Scarlet Tanager	0	0	0	4	0	0	0	0	0.5	2	4	0	0	2	1.6	4	0	10	2	4	6	4.3
Fringillidae	Rose-breasted Grosbeak	9	9	2	8	19	11	0	2	7.5	6	4	6	8	15	7.8	2	10	10	7	3	11	7.2
	Evening Grosbeak	0	0	2	0	1	2	0	1	0.8	1	0	0	0	2	0.6	1	5	2	32	1	0	6.8
	Purple Finch	0	0	6	0	0	0	0	4	1.3	2	2	0	6	2	2.4	4	2	4	4	3	2	3.2
	Pine Grosbeak	0	2	0	2	2	2	2	4	1.8	0	0	2	0	0	0.4	0	0	0	0	2	0	0.3
	Dark-eyed Junco	0	0	0	1	0	0	0	0	0.1	0	4	2	2	0	1.6	0	2	2	0	0	0	0.7
	Chipping Sparrow	0	2	0	0	0	0	0	0	0.3	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
	White-throated Sparrow	14	13	17	11	19	16	0	10	12.5	21	26	15	19	21	20.4	7	16	25	32	24	22	21.0
Unidentified Birds		1	0	2	0	0	2	0	1	0.8	1	0	0	0	1	0.4	3	1	0	1	0	0	0.8
Total Birds		141	190	146	191	189	180	29	164	153.8	208	241	192	199	237	215.4	134	238	270	228	224	188	213.7
# of Species		29	36	35	39	30	38	8	33	31.0	35	39	32	32	36	34.8	33	36	42	37	37	36	36.8

Table 3
Forest bird population census
Untreated Control Block
Allardville, New Brunswick
2-23 June, 1980

Family	Species	Prespray									Postspray 1						Postspray 2						
		June 2	June 3	June 4	June 5	June 6	June 8	June 10	June 11		June 12	June 13	June 14	June 15	June 17		June 18	June 19	June 20	June 21	June 22	June 23	
		-9	-8	-7	-6	-5	-3	-1	-0	Avg.	+1	+2	+3	+4	+6	Avg.	+1	+2	+3	+4	+5	+6	Avg.
Accipitridae	Broad-winged Hawk	0	0	0	0	0	1	0	0	0.1	1	0	0	0	0	0.2	0	0	0	0	0	0	0.0
Tetraonidae	Ruffed Grouse	1	0	0	0	1	1	0	0	0.4	1	0	0	0	1	0.4	0	0	0	0	0	0	0.0
Apodidae	Chimney Swift	0	0	0	0	0	1	0	0	0.1	0	0	2	0	0	0.4	0	0	1	0	0	1	0.3
Trochilidae	Ruby-throated Hummingbird	1	1	1	0	1	1	0	0	0.6	0	0	0	0	0	0.0	0	0	1	0	0	0	0.2
Picidae	Common Flicker	0	2	1	0	1	1	0	2	0.9	2	3	2	0	1	1.6	0	0	1	0	2	1	0.7
	Yellow-bellied Sapsucker	2	2	3	1	1	1	0	1	1.4	1	2	1	2	3	1.8	0	1	1	2	2	1	1.2
	Hairy Woodpecker	0	0	0	0	0	0	0	1	0.1	1	0	0	0	0	0.2	0	0	0	0	0	0	0.0
Tyrannidae	Yellow-bellied Flycatcher	0	0	0	0	1	0	0	0	0.1	0	2	0	2	0	0.8	0	0	0	0	0	0	0.0
	Alder Flycatcher	0	0	2	0	0	0	0	0	0.3	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
	Least Flycatcher	0	4	4	4	2	6	0	8	3.5	2	2	2	2	4	2.4	2	8	12	6	4	6	6.3
	Eastern Wood Pewee	0	0	0	0	0	4	0	0	0.5	0	0	0	0	0	0.0	2	0	0	0	0	0	0.3
	Olive-sided Flycatcher	0	0	0	0	2	0	0	0	0.3	0	2	0	0	0	0.4	0	0	0	0	0	2	0.3
Corvidae	Gray Jay	0	5	0	0	1	0	0	5	1.4	0	0	0	0	0	0.0	0	4	0	0	0	0	0.7
	Blue Jay	1	1	3	0	5	1	0	2	1.6	0	1	1	1	1	0.8	2	0	2	0	2	3	1.5
	Common Raven	0	0	2	0	1	0	0	0	0.4	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
Paridae	Black-capped Chickadee	1	1	0	1	1	1	1	0	0.8	0	2	0	1	1	0.8	1	0	0	0	0	0	0.2
	Boreal Chickadee	3	0	1	1	0	1	1	0	0.9	0	0	0	0	2	0.4	0	0	0	2	0	0	0.3
Sittidae	Red-breasted Nuthatch	0	0	0	0	0	0	0	2	0.3	0	0	2	2	4	1.6	4	0	2	0	0	0	1.0
Troglodytidae	Winter Wren	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0	0	0	0	0	0	2	0.3
Turdidae	American Robin	3	0	6	2	3	2	2	0	2.3	1	1	5	10	6	4.6	3	7	7	6	4	8	5.8
	Hermit Thrush	4	8	10	4	7	4	4	2	5.4	6	4	0	4	6	4.0	0	4	7	6	0	4	3.5
	Swainson's Thrush	7	8	8	7	9	10	5	8	7.8	8	10	7	15	11	10.2	2	13	26	10	11	11	12.2
	Veery	0	0	0	0	0	0	1	0	0.1	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
Sylviidae	Ruby-crowned Kinglet	10	12	15	10	12	8	4	8	9.9	8	8	8	12	13	9.8	6	6	8	6	8	10	7.3
Bombycillidae	Cedar Waxwing	1	0	2	0	0	0	0	2	0.6	1	0	1	1	1	0.8	0	0	0	1	0	0	0.2
Vireonidae	Solitary Vireo	0	4	4	2	6	2	2	2	2.8	0	2	6	4	0	2.4	2	2	2	0	2	0	1.3
	Red-eyed Vireo	0	0	0	0	0	0	0	0	0.0	0	0	0	4	0	0.8	2	0	0	0	0	0	0.3

(cont'd)

Table 3
Forest bird population census
Untreated Control Block
Allardville, New Brunswick
2-23 June, 1980 (concl)

Family	Species	Prespray June 2 -9	June 3 -8	June 4 -7	June 5 -6	June 6 -5	June 8 -3	June 10 -1	June 11 -0	Avg.	Postspray 1 June 12 +1	June 13 +2	June 14 +3	June 15 +4	June 17 +6	Avg.	Postspray 2 June 18 +1	June 19 +2	June 20 +3	June 21 +4	June 22 +5	June 23 +6	Avg.
Parulidae	Black-and-white Warbler	4	6	0	2	6	7	2	2	3.6	4	8	6	4	6	5.6	0	2	8	6	0	6	3.7
	Tennessee Warbler	10	11	10	12	12	14	10	12	11.4	12	18	14	14	20	15.6	12	16	12	12	4	18	12.3
	Nashville Warbler	0	0	0	0	2	6	0	2	1.3	2	2	2	4	0	2.0	2	2	2	2	2	0	1.7
	Parula Warbler	4	8	8	0	0	4	2	2	3.5	2	0	0	4	2	1.6	0	0	6	4	0	4	2.3
	Magnolia Warbler	22	26	20	27	28	22	17	28	23.8	24	36	18	25	26	25.8	10	24	32	24	22	24	22.7
	Black-throated Blue Warbler	2	6	2	2	0	4	0	2	2.3	0	4	4	0	2	2.0	2	0	2	4	2	2	2.0
	Yellow-rumped Warbler	6	6	6	4	2	2	2	4	4.0	8	8	9	7	4	7.2	2	7	6	0	4	4	3.8
	Black-throated Green Warbler	8	8	4	6	8	12	4	4	6.8	4	10	6	6	6	6.4	6	8	6	6	2	2	5.0
	Blackburnian Warbler	6	8	8	2	9	8	4	8	6.6	6	3	4	12	2	5.4	8	6	8	4	10	8	7.3
	Chestnut-sided Warbler	0	0	0	0	0	0	0	0	0.0	0	0	0	0	0	0.0	2	0	0	0	0	0	0.3
	Bay-breasted Warbler	18	14	16	14	24	18	10	14	16.0	14	17	14	18	10	14.6	14	14	24	8	8	18	14.3
	Blackpoll Warbler	0	0	0	2	0	0	0	0	0.3	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
	Ovenbird	16	11	6	14	14	18	12	14	13.1	16	18	14	12	12	14.4	8	16	10	8	12	12	11.0
	Northern Waterthrush	2	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
	Common Yellowthroat	8	6	10	4	9	8	4	4	6.6	0	6	4	2	8	4.0	4	6	6	4	6	0	4.3
	Canada Warbler	2	0	0	0	0	2	0	0	0.5	0	0	2	0	0	0.4	0	2	4	0	0	0	1.0
	American Redstart	0	0	0	2	0	0	0	0	0.3	0	0	2	2	2	1.2	2	4	0	0	0	0	1.0
Icteridae	Common Grackle	0	0	0	0	0	0	0	2	0.3	0	1	1	0	0	0.4	0	0	0	0	0	0	0.0
	Brown-headed Cowbird	0	2	0	0	0	0	0	0	0.3	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
Thraupidae	Scarlet Tanager	0	0	0	0	0	0	1	0	0.1	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
Fringillidae	Cardinal	0	0	0	0	0	0	0	2	0.3	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
	Rose-breasted Grosbeak	5	8	4	6	8	6	0	2	4.9	4	7	0	8	2	4.2	0	2	10	0	0	4	2.7
	Evening Grosbeak	0	0	0	2	2	2	0	0	0.8	4	0	0	0	1	1.0	0	2	0	0	4	2	1.3
	Purple Finch	2	0	0	0	0	2	0	0	0.5	0	0	0	0	0	0.0	0	0	0	0	0	0	0.0
	Pine Grosbeak	0	0	2	2	0	0	0	0	0.5	2	2	2	2	6	2.8	0	0	2	4	0	2	1.3
	American Goldfinch	0	0	1	1	3	0	0	0	0.6	0	1	0	0	0	0.2	0	0	1	0	0	0	0.2
	Dark-eyed Junco	2	6	7	6	4	4	3	2	4.3	5	2	8	9	3	5.4	0	4	2	2	6	6	3.3
	White-throated Sparrow	10	13	12	2	14	10	5	6	9.0	10	13	17	10	8	11.6	4	8	8	1	8	11	6.7
	Lincoln's Sparrow	0	0	2	0	2	2	0	0	0.8	0	2	0	0	0	0.4	0	0	0	0	0	0	0.0
Unidentified Birds		2	5	1	0	4	0	0	0	1.5	0	2	0	0	0	0.4	0	0	6	0	0	0	1.0
Total Birds		163	192	181	142	205	196	96	153	166.0	149	199	164	199	174	177.0	102	168	225	128	125	172	153.3

APPENDIX III

Breeding territories of selected bird species occupying niches of varying exposure to the insecticide. Gloucester County, New Brunswick.

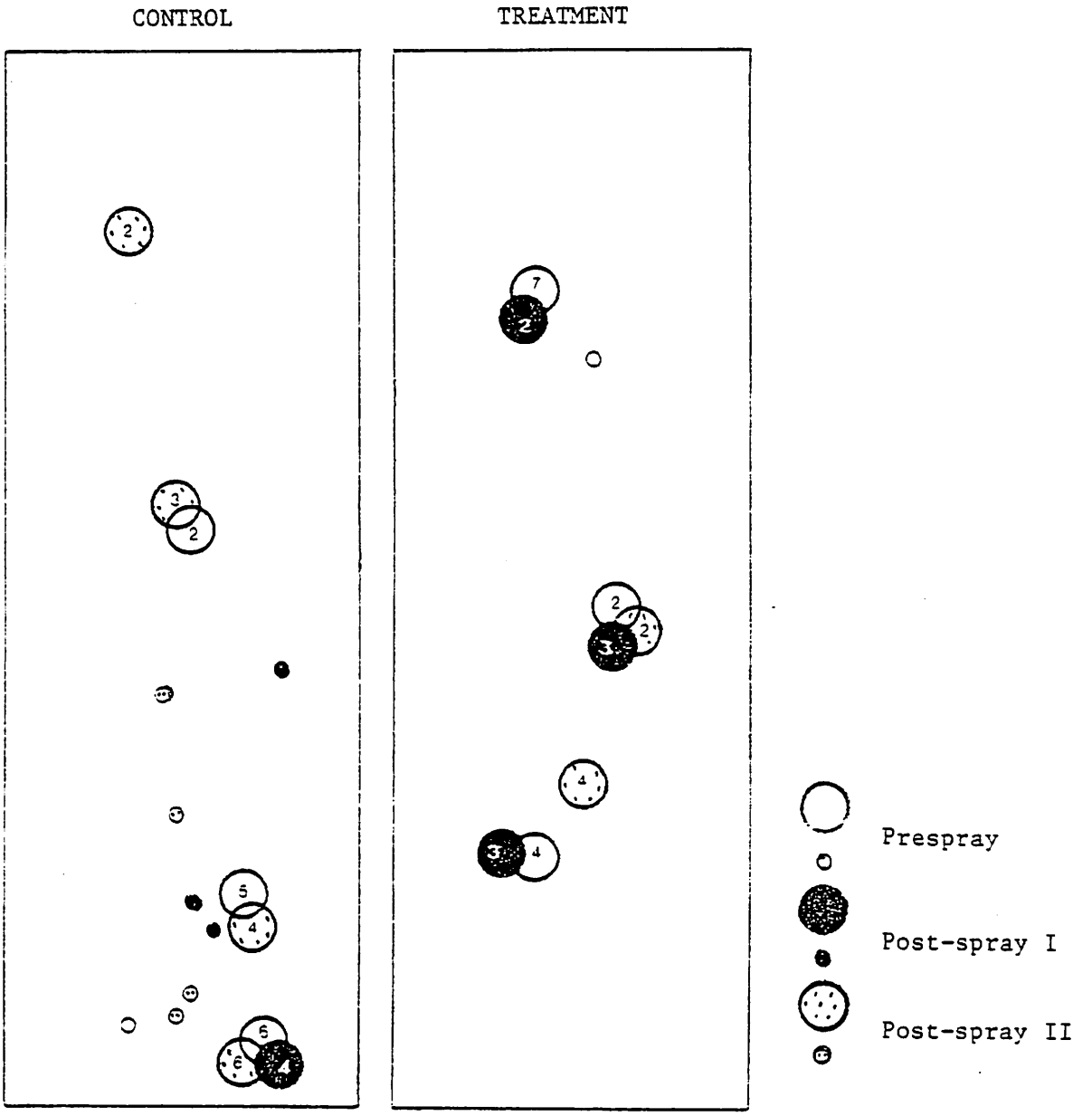

Figure 1. Breeding territories of the Least Flycatcher. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

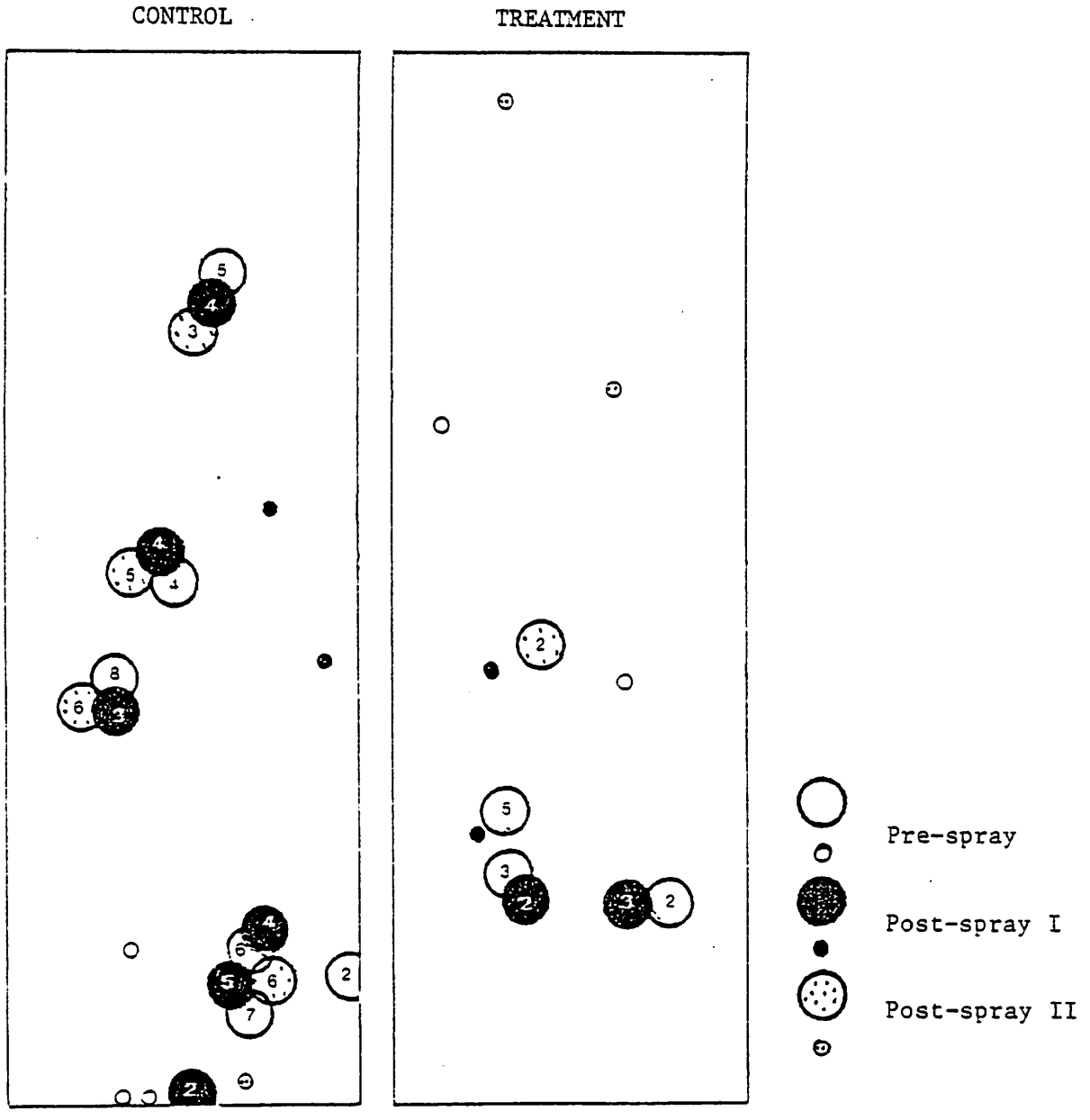

Figure 2. Breeding territories of the Ruby-crowned kinglet. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

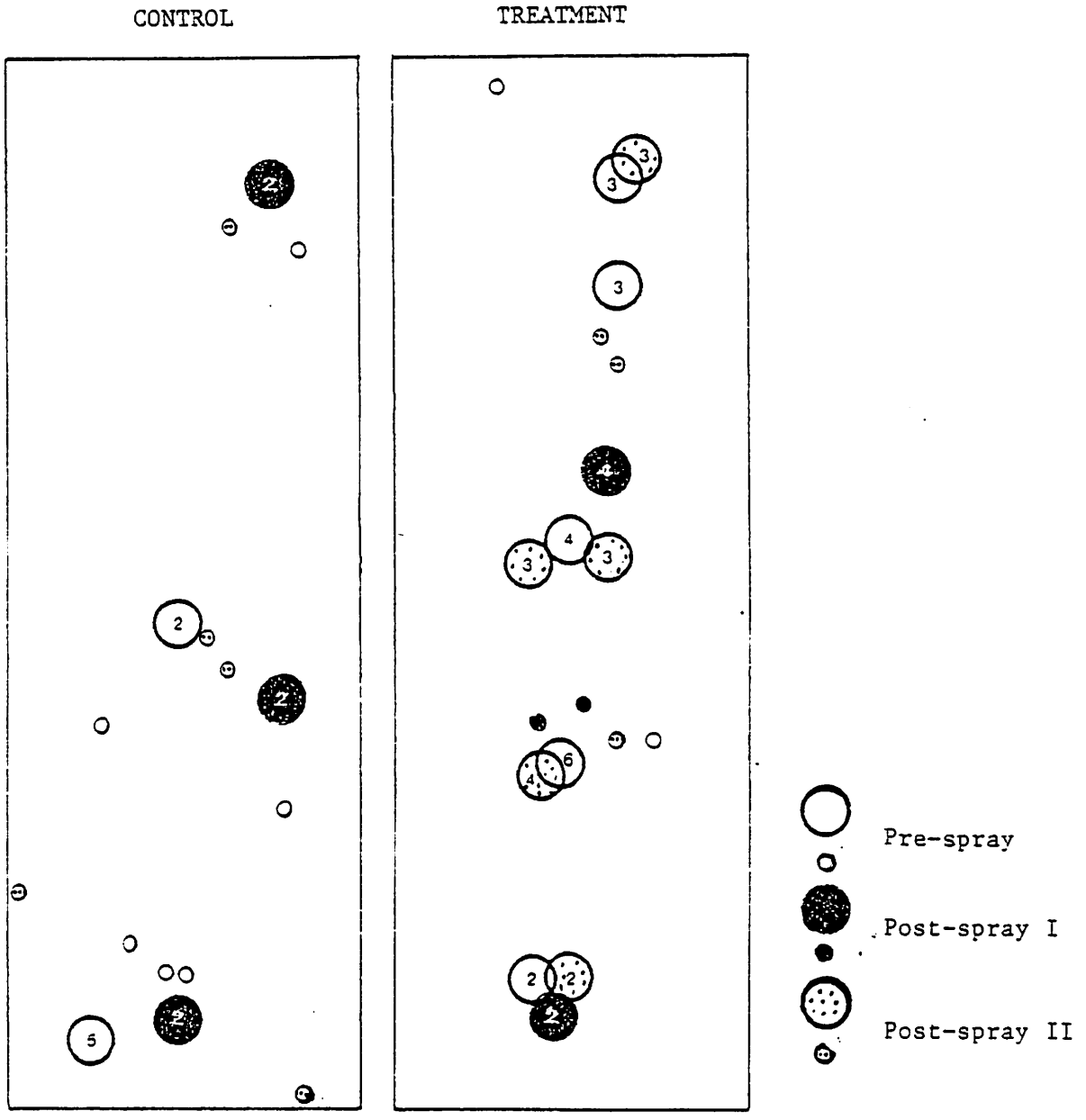

Figure 3. Breeding territories of the Solitary vireo. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

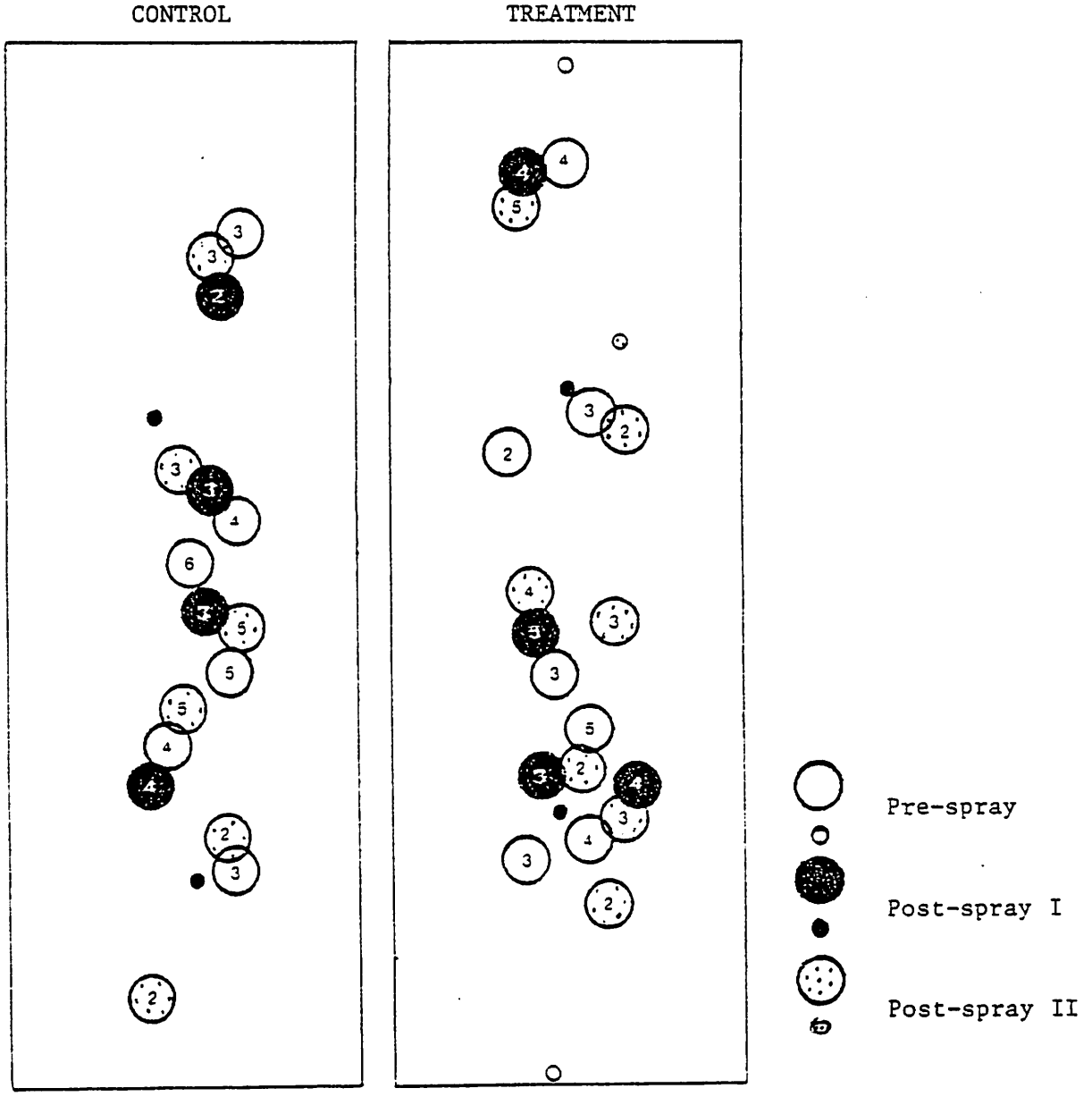

Figure 4. Breeding territories of the Blackburnian warbler. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

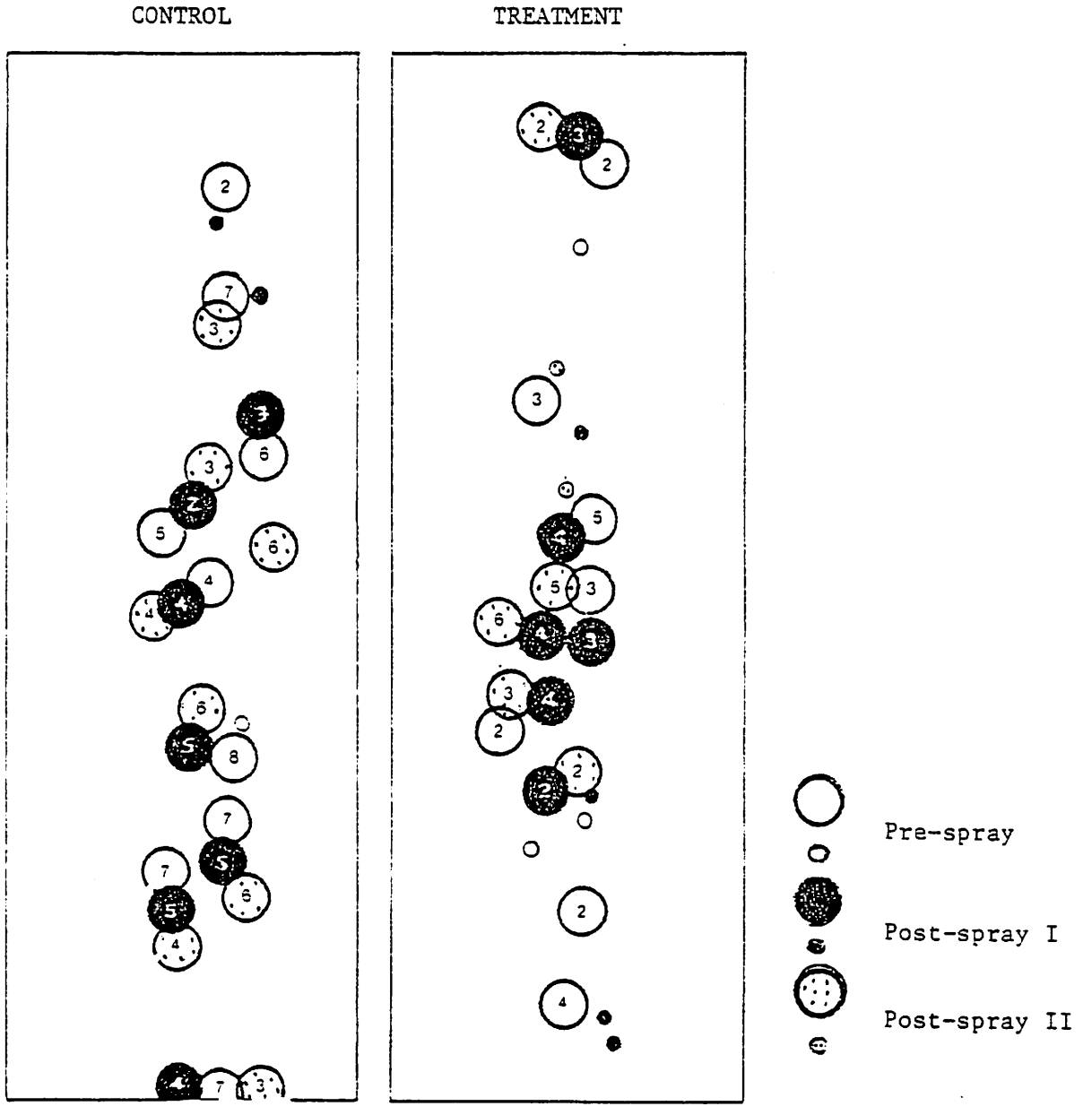

Figure 5. Breeding territories of the Baybreasted warbler. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

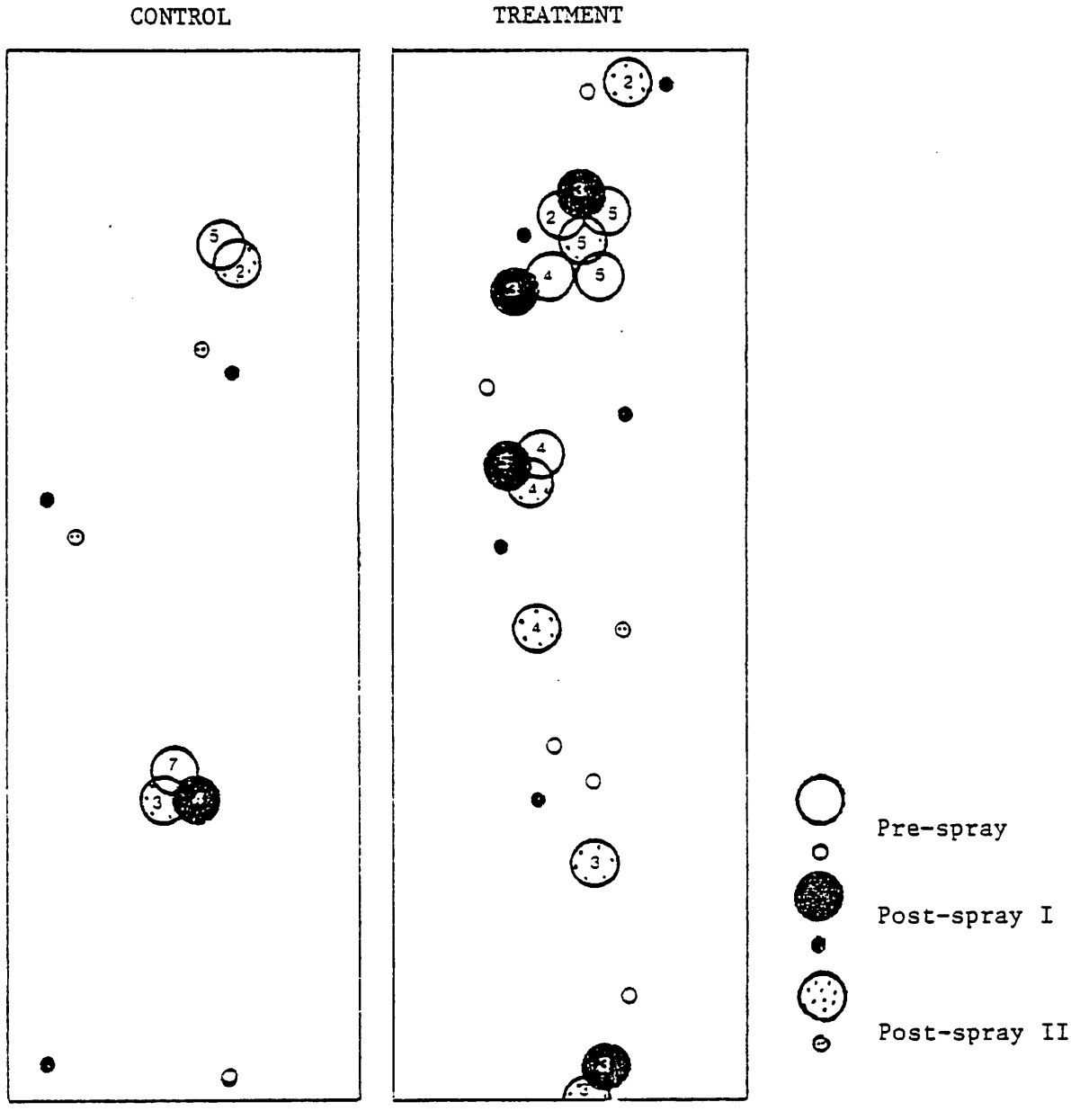

Figure 6. Breeding territories of the Rose-breasted grosbeak. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

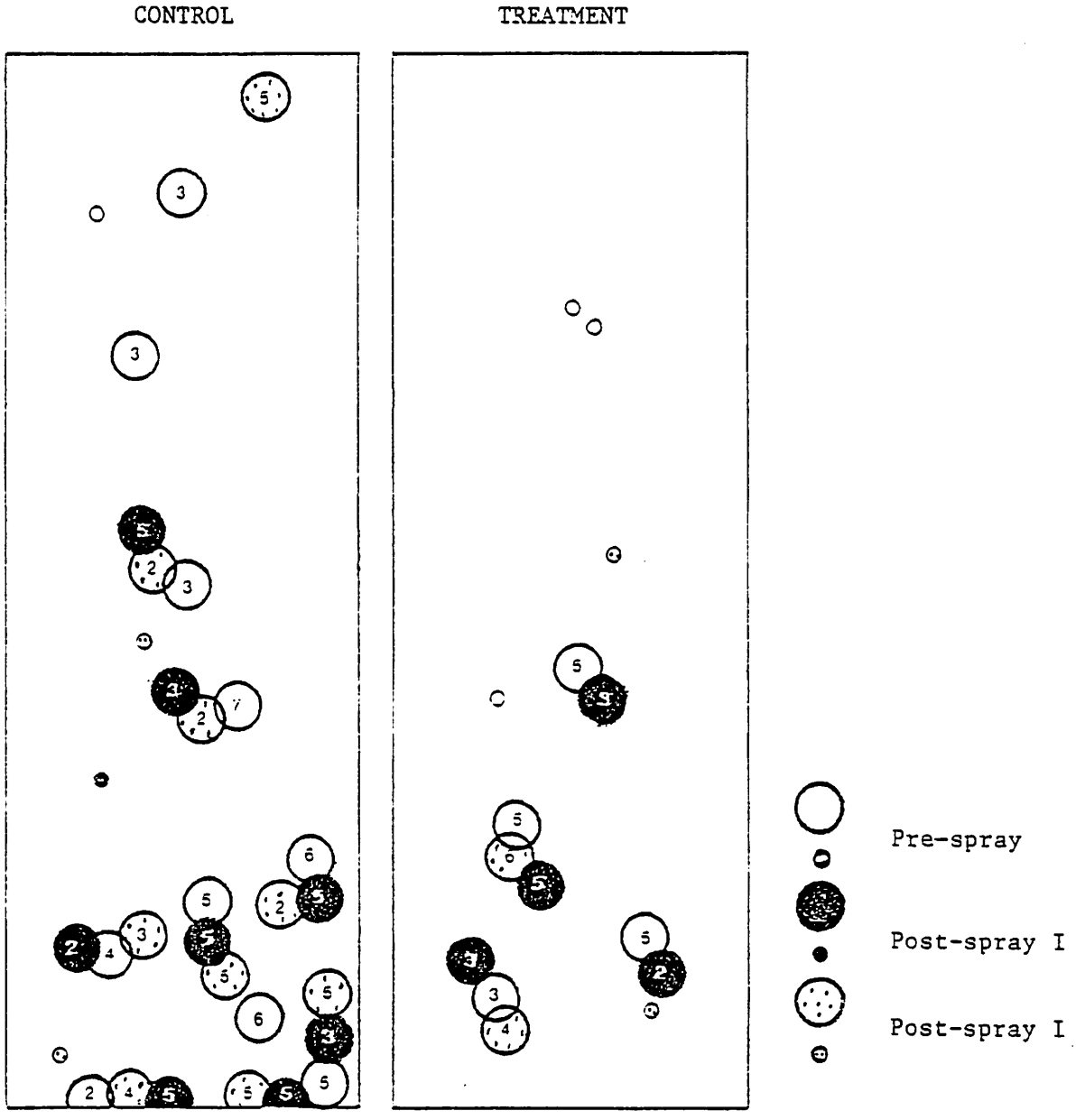

Figure 7. Breeding territories of the Tennessee warbler. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

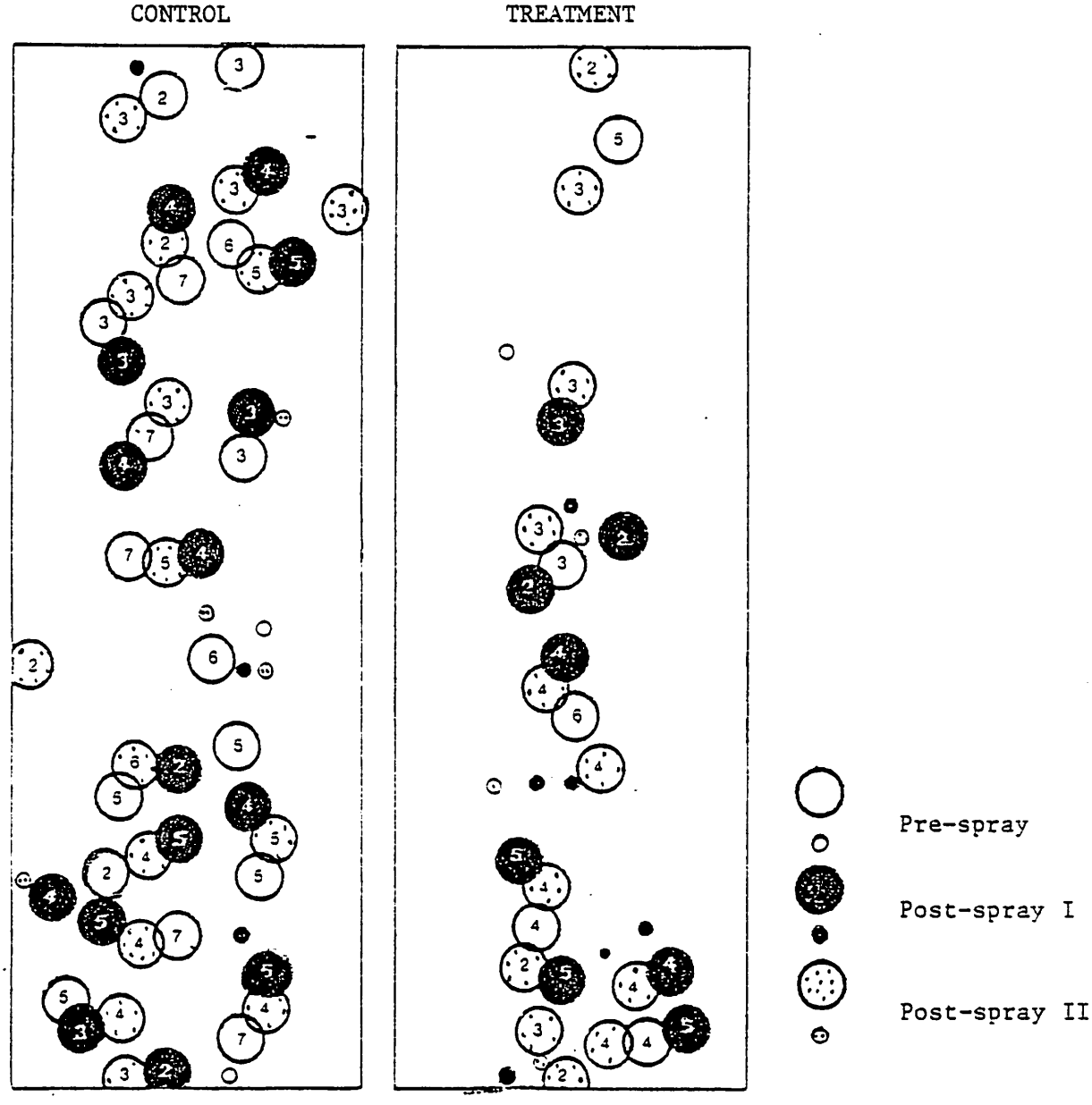

Figure 8. Breeding territories of the Magnolia warbler. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

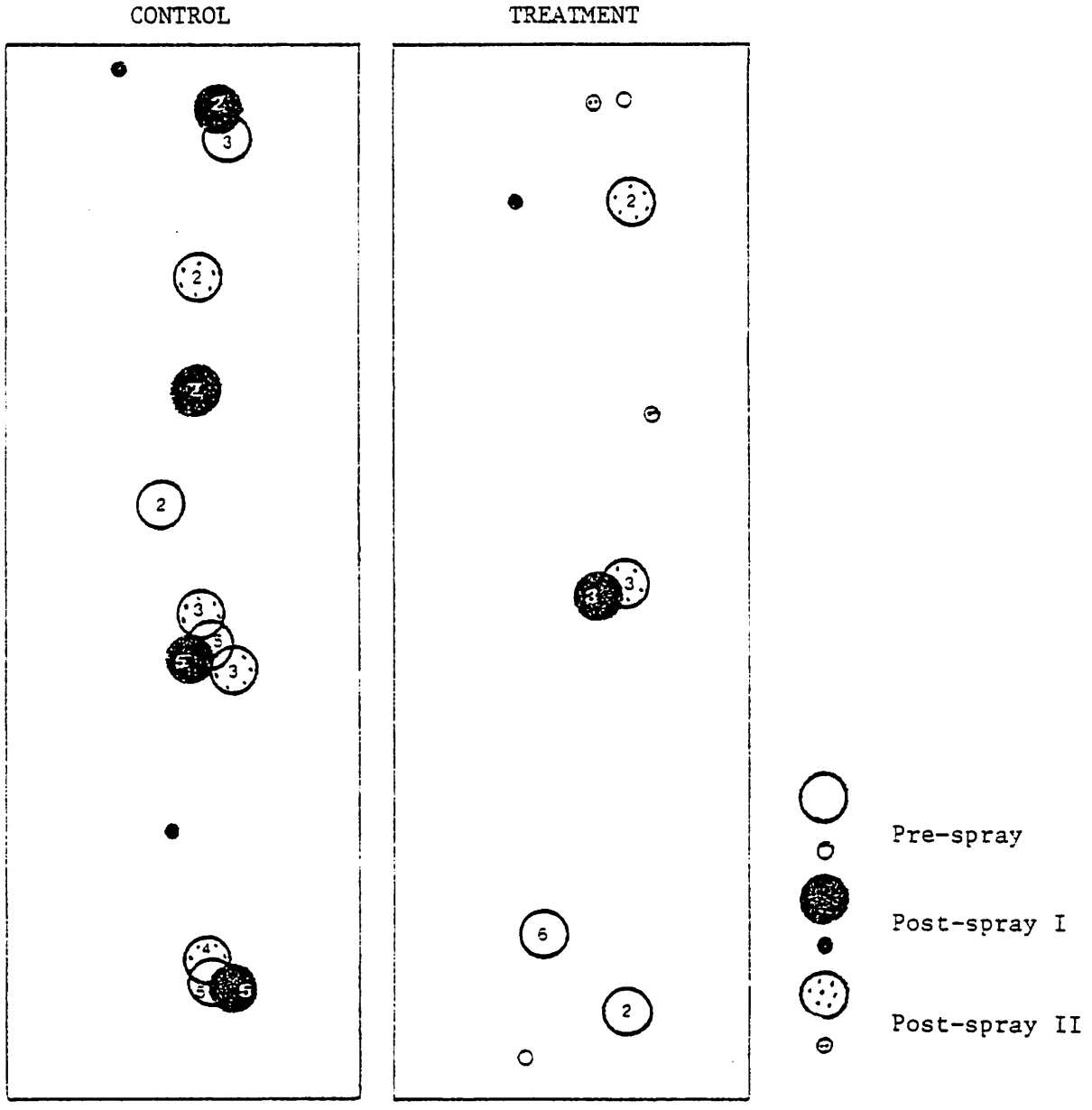

Figure 9. Breeding territories of the Yellow-rumped warbler. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

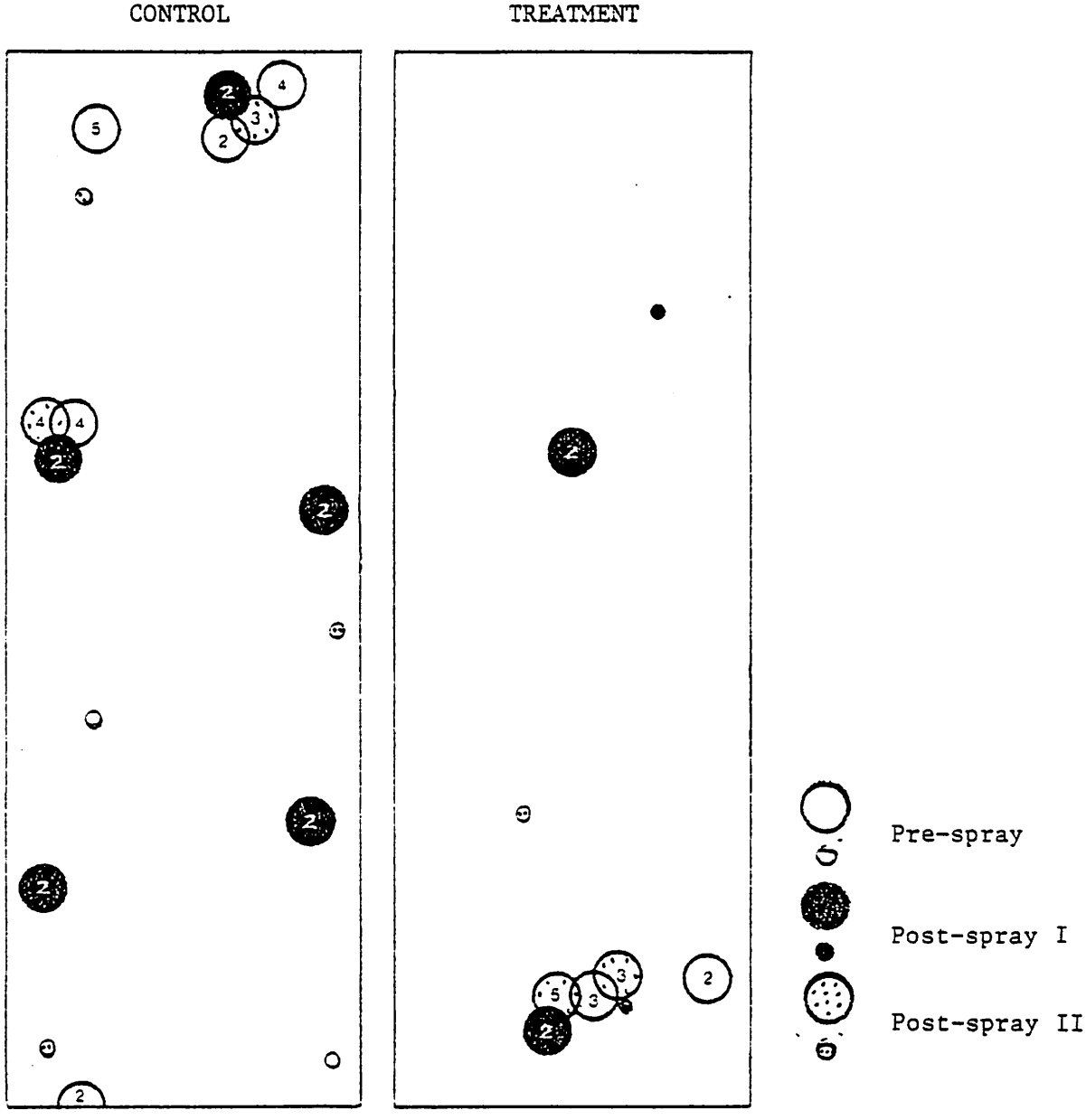

Figure 10. Breeding territories of the Hermit thrush. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

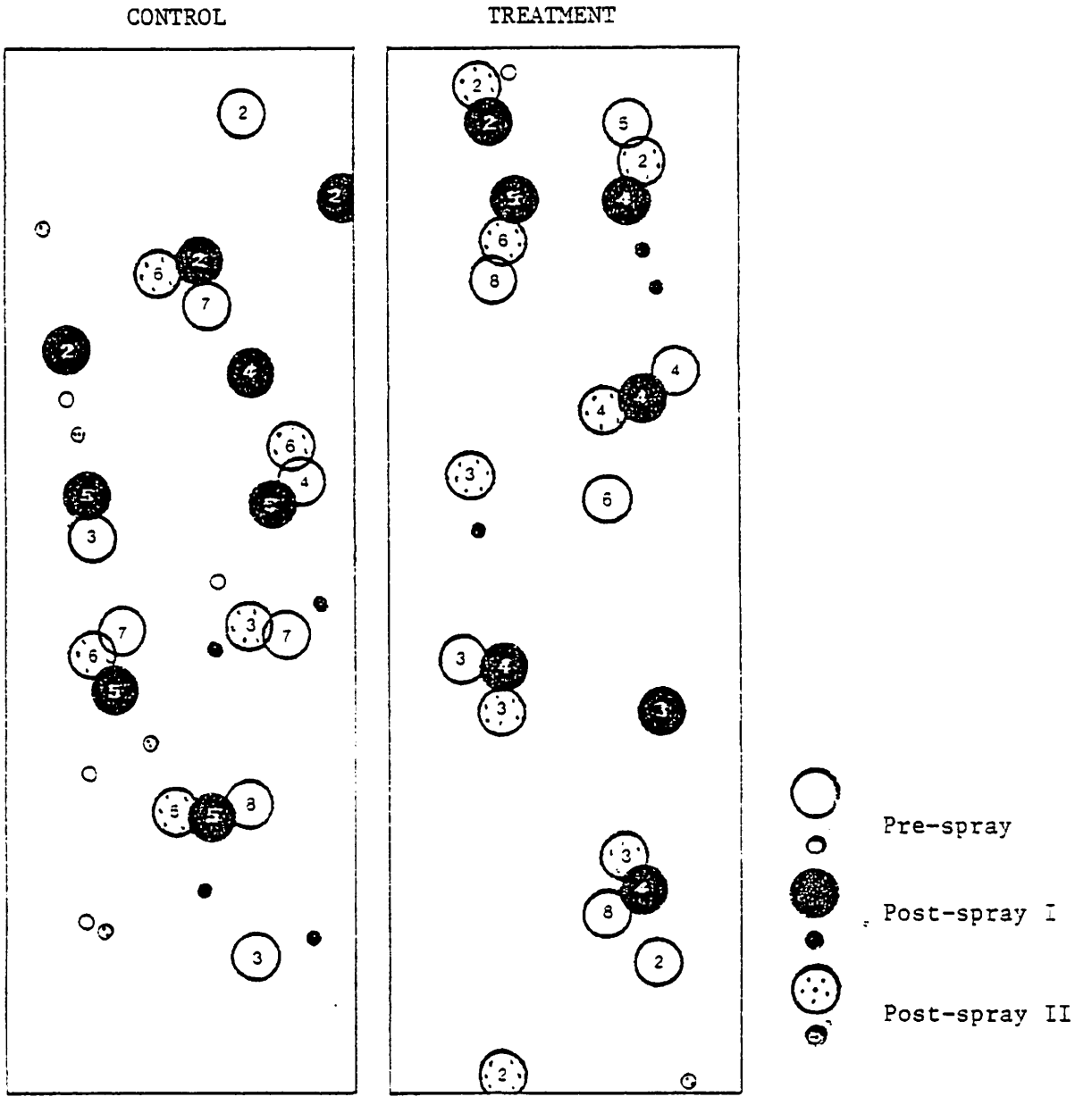

Figure 11. Breeding territories of the Ovenbird. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

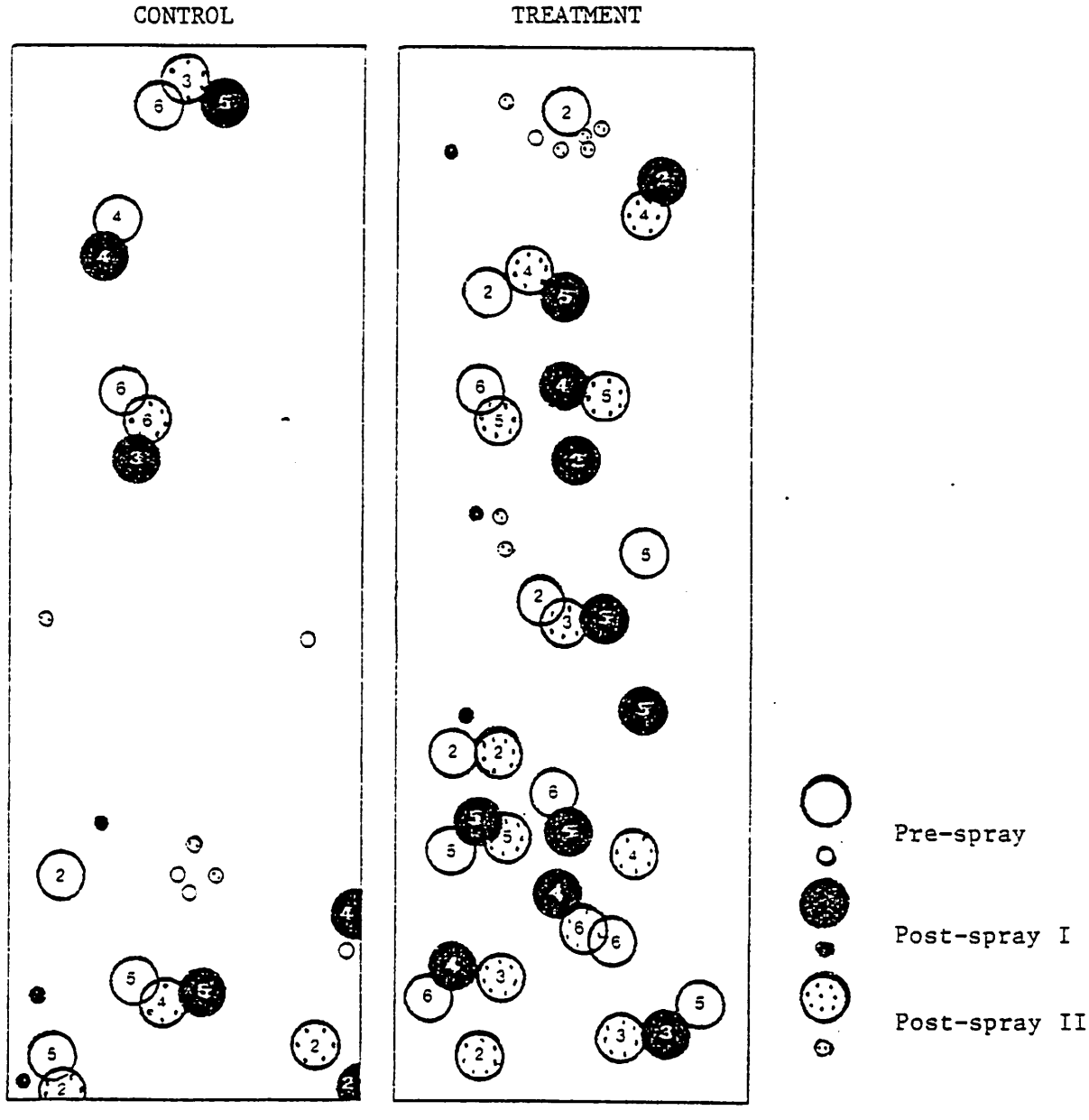

Figure 12. Breeding territories of the White-throated sparrow. Large circles represent nesting territories and small circles represent single records. Numbers within circles represent number of days recorded in territory.

APPENDIX IV

Aquatic and terrestrial invertebrates collected in drift net sets and by Surber, rock and artificial substrate sampling in the treatment and control streams. Gloucester County, New Brunswick.

Table 1. Aquatic organisms caught in drift net sets*, North Brook Treatment Station, Gloucester County, New Brunswick, 2 - 22 June 1980.

Days before or after application of 0.070 kg AI/ha RELDAN®**		-9		-8		-7		-6		-5		-4		-3		-2		-1	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Depth (cm)		19.0	15.0	11.5	15.0	16.0	11.0	10.0	11.0	11.5	12.0	14.0	12.0	12.0	13.0	19.0	16.0	14.0	17.0
Current speed (m/sec)		0.55	0.43	0.46	0.46	0.43	0.40	0.40	0.40	0.43	0.34	0.37	0.34	0.37	0.30	0.40	0.40	0.43	0.43
Volume of Drift Column (m^3)		44.20	27.28	22.38	29.19	29.10	18.61	16.92	18.61	20.92	17.26	21.91	17.26	18.78	16.50	32.15	27.07	25.46	30.92
Nematoda								0.06											
Ostracoda		0.05	0.07		0.03				0.05	0.05	0.35	0.05	0.17						0.06
Hydracarina		0.18	0.18	0.04	0.14	0.03	0.05	0.06	0.11	0.14	0.29	0.05	0.35	0.27	0.30	0.25	0.04		0.06
Plecoptera	N	0.05					0.05								0.06	0.12			0.03
Ephemeroptera																			
Baetidae	N	0.45			0.03	0.03	0.05	0.06				0.14			0.12	0.25	0.04		
Heptageniidae	N												0.12			0.03			
Leptophlebiidae	N																		
Ephemerellidae	N	0.11		0.04		0.03						0.14	0.06	0.11	0.24	0.06			0.03
Hemiptera																			
Gerridae	N																		
	A																		
Megaloptera																			
Sialidae				0.09					0.05										
Trichoptera																			
Brachycentridae	L	0.05	0.04	0.27		0.07		0.06		0.05	0.12	0.23	0.06	0.11	0.06	0.31	0.04		
Hydroptilidae	L														0.06				
Limnephilidae	L	0.09		0.09				0.12		0.05	0.06		0.12	0.11		0.90			0.03
Odontoceridae	L																		
Polycentropodidae	L																		
Rhyacophilidae	L																		
Unidentified	L																		
Unidentified	P																		
Coleoptera																			
Hydrophilidae	A																		
Elmidae	L						0.05	0.06		0.05						0.03	0.04		
	A						0.05							0.11					
Unidentified	A																		
Diptera																			
Tipulidae	L																		
Psychodidae																			
Simuliidae	L	0.02		0.27	0.07	0.03		0.12	0.27		0.06	0.14	0.17	0.43	0.12	0.84	0.04		0.23
Chironomidae	L	0.05	0.04	0.13			0.05		0.11	0.10	0.17	0.05	0.06	0.05		0.09	0.04	0.12	0.10
	P																		
Heleidae	L																		
	P																		
Rhagionidae	L												0.06						
Total Aquatic Invertebrates		1.04	0.33	0.94	0.27	0.21	0.32	0.53	0.59	0.43	1.04	0.78	1.16	1.17	0.97	2.89	0.22	0.12	0.55

*expressed as number of organisms per m^3 of water in drift column

**application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

N = nymph

A = adult

L = larvae

P = pupae

Table 1. Aquatic organisms caught in drift net sets*, North Brook Treatment Station, Gloucester County, New Brunswick, 2 - 22 June 1980. (Continued)

Days before or after application of 0.070 kg AI/ha RELDAN®**		Spray Day AM	Pre	0 hr	½ hr	+1 hr	+2 hr	+3 hr	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+5 PM
Depth (cm)		14.0	14.0	13.0	13.0	14.0	14.0	14.0	13.0	14.0	14.0	12.0	12.5	12.0	13.5	14.5	15.5	20.0
Current speed (m/sec)		0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.24	0.30	0.34	0.34	0.30	0.21	0.24	0.27	0.27
Volume of Drift Column (m^3)		21.91	21.91	20.35	20.35	21.91	21.91	21.91	20.35	14.21	17.77	17.26	17.98	15.23	13.32	14.72	17.70	22.84
Nematoda											0.06				0.15			
Ostracoda										0.07		0.41		0.66	0.15	0.20	0.06	0.18
Hydracarina				0.10	0.29				0.05	0.07	0.06	0.17		0.07		0.07	0.23	0.04
Plecoptera	N					0.05	0.14	0.14		0.14						0.07		
Ephemeroptera																		
Baetidae	N	0.05	0.14			0.32	0.41	0.50	0.59	0.14	0.06	0.06			0.08	0.07		
Heptageniidae	N		0.05					0.05										
Leptophlebiidae	N																	
Ephemerellidae	N	0.18					0.23	0.18	0.05	0.07		0.06						0.09
Hemiptera																		
Gerridae	N																	
	A																	
Megaloptera																		
Sialidae															0.08			
Trichoptera																		
Brachycentridae	L		0.18				0.46	0.41	0.10		0.06		0.06				0.11	
Hydroptilidae	L																0.06	
Limnephilidae	L													0.07	0.15		0.11	
Odontoceridae	L																	
Polycentropodidae	L																	
Rhyacophilidae	L							0.14	0.05									
Unidentified	L				0.05													
Unidentified	P							0.05										
Coleoptera																		
Hydrophilidae	A																	
Elmidae	L																	
	A						0.14	0.09						0.20				
Unidentified	A													0.07				
Diptera																		
Tipulidae	L				0.05													
Psychodidae					0.05													
Simuliidae	L	0.64	0.55	0.10	0.05	0.41	3.93	3.29	0.44	0.35	0.17	0.70	0.28	0.60	0.30		1.36	0.09
Chironomidae	L	0.09	0.09		0.05		0.18	0.46	0.10	0.14	0.17		0.11	0.13		0.07	0.17	0.04
	P																	
Heleidae	L																	
	P																	
Rhagionidae	L							0.09										
Total Aquatic Invertebrates		0.96	1.00	0.20	0.54	0.78	5.48	5.39	1.38	0.99	0.56	1.39	0.44	1.77	0.90	0.48	2.09	0.44

*expressed as number of organisms per m^3 of water in drift column

**application of 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

N = nymph
L = larvae
A = adult
P = pupae

Table 1. Aquatic organisms caught in drift net sets*, North Brook Treatment Station, Gloucester County, New Brunswick, 2 - 22 June 1980. (Concluded)

Days before or after application of 0.070 kg AI/ha RELDAN**		Spray Day										+1		+2		+3		+4		+5	
		Pre	0 hr	+½ hr	+1 hr	+2 hr	+3 hr	+4 hr	+5 hr	+6 hr	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Depth (cm)		16.0	13.0	13.0	13.0	13.5	13.0	13.0	13.0	13.0	13.0	12.0	13.5	14.5	13.5	12.0	14.5	16.5	14.0	14.5	12.0
Current speed (m/sec)		0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.27	0.27	0.30	0.27	0.24	0.24	0.40	0.40	0.34
Volume of Drift Column (m^3)		20.30	16.50	16.50	16.50	19.04	16.50	16.50	16.50	16.50	16.50	15.23	17.13	16.56	19.04	13.71	14.72	16.75	23.69	24.53	17.26
Nematoda													0.06								
Ostracoda									0.18	0.06			0.29	0.18	0.05				0.04	0.08	0.12
Hydracarina		0.20	0.18	0.30	0.12	0.11	0.06	0.06	0.06				0.06	0.12			0.07		0.04	0.08	
Plecoptera	N		0.12				0.36	0.18	0.18	0.30		0.07						0.06			0.06
Ephemeroptera																					
Baetidae	N		0.55		0.06		0.12	0.24	0.36	0.42		0.33			0.05				0.21		
Heptageniidae	N								0.06												
Leptophlebiidae	N		0.06				0.06														
Ephemerellidae	N		0.12				0.18					0.20			0.05	0.07		0.06	0.08		0.12
Hemiptera																					
Gerridae	N			0.18		0.11	0.12	0.06	0.12												
	A																	0.12			
Megaloptera																		0.12	0.17		0.06
Sialidae																					
Trichoptera																					
Brachycentridae	L		0.18				0.12	0.48	0.42	0.61		0.13	0.12	0.06			0.07				
Hydroptilidae	L	0.05										0.07	0.06	0.06			0.07				
Limnephilidae	L							0.06			0.06	0.13			0.05				0.04		
Odontoceridae	L							0.06													
Polycentropodidae	L							0.06					0.06								
Rhyacophilidae	L																				
Unidentified	L																				
Unidentified	P																				
Coleoptera																					
Hydrophilidae	A										0.06										
Elmidae	L				0.06						0.30								0.08	0.04	
	A															0.07					
Unidentified	A																				
Diptera																					
Tipulidae	L						0.06	0.12	0.24	0.24			0.12								
Psychodidae																					
Simuliidae	L		0.06		0.55	2.68	9.33	11.52	9.52	12.55	0.12	0.53		0.24	0.11	0.07			0.13		
Chironomidae	L			0.12	0.24	0.26	1.09	0.06	0.24	2.91	0.24	0.13	0.23				0.07			0.04	0.06
	P									0.30											
Heleidae	L							0.06													
	P																				0.06
Rhagionidae	L						0.06														
Total Aquatic Invertebrates		0.25	1.27	0.61	1.03	3.15	11.58	12.97	11.39	17.39	0.79	1.58	0.99	0.66	0.32	0.22	0.27	0.24	0.80	0.24	0.46

*expressed as number of organisms per m^3 of water in drift column

**application of 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

N = nymph

A = adult

L = larvae

P = pupae

Table 2. Aquatic organisms caught in drift net sets*, Bass Brook Control Station, Gloucester County, New Brunswick, 2 - 22 June 1980.

Days before or after application of 0.070 kg AI/ha BELDAN**		-9		-8		-7		-6		-5		-4		-3		-2		-1	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Depth (cm)		19.0	15.0	22.0	20.0	19.0	19.5	20.0	19.0	19.0	17.0	18.0	18.0	16.5	18.0	22.0	20.0	21.0	19.5
Current speed (m/sec)		0.40	0.37	0.34	0.34	0.37	0.34	0.37	0.37	0.34	0.37	0.34	0.34	0.37	0.34	0.34	0.37	0.37	0.34
Volume of Drift Column (m^3)		32.15	33.48	31.64	28.76	29.74	28.04	31.30	29.74	27.33	26.61	25.89	25.89	25.82	25.89	31.64	31.30	32.87	28.04
Nematoda							0.04		0.03										0.04
Ostracoda			0.66	0.25	0.59	0.13	0.11		0.81		1.50	0.04	1.35	0.23	0.12	0.41	0.29	0.09	0.32
Hydracarina		0.06	0.03	0.03	0.17	0.07				0.04	0.04	0.08	0.27	0.15	0.04	0.13		0.06	
Plecoptera	N	0.03				0.10	0.04			0.04			0.12			0.06			
Ephemeroptera																			
Baetidae	N	0.06		0.03		0.13							0.12			0.06		0.03	0.04
Heptageniidae	N				0.03														
Leptophlebiidae	N					0.03													
Ephemerellidae	N																		
Ephemeridae	N																		
Unidentified	N																		
Hemiptera																			
Gerridae																			
Megaloptera																			
Sialidae	L																		
Trichoptera																			
Leptoceridae	L																		
Limnephilidae	L	0.03		0.03	0.03		0.11	0.03								0.03			
Polycentropodidae	L																		
Unidentified	L	0.03																0.03	
	P																		
Coleoptera																			
Dytiscidae	A																		
Elmidae	L	0.06		0.03		0.03	0.04					0.04				0.09		0.06	
	A	0.02												0.08		0.06	0.03	0.03	
Diptera																			
Colicidae	L																0.13		
Simuliidae	L	0.06	0.06	0.28	0.14	0.24	0.11	0.03	0.07	0.15		0.19	0.12	0.12	0.12	0.60	0.10	0.58	0.04
	P					0.03				0.04					0.04				
Chironomidae	L			0.09					0.03	0.04	0.08	0.15	0.04		0.04	0.09			
Rhagionidae	L															0.03		0.03	
Gastropoda																	0.03		
Total Aquatic Invertebrates		0.37	0.75	0.76	0.97	0.77	0.43	0.06	0.94	0.29	1.62	0.50	2.01	0.58	0.35	1.58	0.58	0.91	0.43

* expressed as number of organisms per m^3 of water in drift column
**application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

N = nymphs
L = larvae
P = pupae
A = adults

Table 2. Aquatic organisms caught in drift net sets*, Bass Brook Control Station, Gloucester County, New Brunswick, 2 - 22 June 1980. (Continued)

Days before or after application of 0.070 kg AI/ha RELDAN®**		Spray Day AM	2030	2130	2230	2330	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+5 PM
Depth (cm)		20.0	19.5	19.5	19.5	19.5	18.0	17.5	17.5	16.0	15.5	16.0	16.0	17.0	16.0	19.0
Current speed (m/sec)		0.34	0.34	0.34	0.34	0.34	0.30	0.30	0.27	0.30	0.27	0.27	0.27	0.30	0.30	0.34
Volume of Drift Column (m^3)		31.30	28.04	28.04	28.04	28.04	22.84	22.21	19.99	20.30	17.70	18.27	18.27	21.57	20.30	27.33
Nematoda																
Ostracoda							0.09	0.27	0.05	1.03	0.23	0.60	0.33	0.23	0.25	0.22
Hydracarina			0.04			0.07	0.04	0.09		0.10	0.11	0.05	0.11	0.05	0.05	0.15
Plecoptera	N				0.11							0.11		0.09	0.05	
Ephemeroptera																
Baetidae	N			0.04	0.14	0.32	0.04	0.05		0.05		0.11	0.27	0.05	0.05	0.04
Heptageniidae	N															
Leptophlebiidae	N															
Ephemerellidae	N									0.05						
Ephemeridae	N					0.03										
Unidentified	N							0.05								
Hemiptera																
Gerridae											0.06					
Megaloptera																
Sialidae	L															
Trichoptera																
Leptoceridae	L												0.05			
Limnephilidae	L				0.03											
Polycentropodidae	L															
Unidentified	L															
	P					0.03										
Coleoptera																
Dytiscidae	A									0.05						
Elmidae	L		0.04		0.07	0.07	0.04	0.05			0.06		0.05			
	A	0.03		0.07	0.25	0.75				0.10					0.05	0.04
Diptera																
Culicidae	L															
Simuliidae	L	0.13	0.07	0.25	1.43	2.39	0.31	0.05	0.15	0.05	0.06	0.16	0.22	0.05	0.30	0.18
	P															
Chironomidae	L	0.10			0.11	0.14	0.04	0.05	0.05				0.11			
Rhagionidae	L									0.05						
Gastropoda																
Total Aquatic Invertebrates		0.26	0.14	0.36	2.14	3.82	0.57	0.59	0.25	1.48	0.51	1.04	1.15	0.46	0.74	0.62

*expressed as number of organisms per m^3 of water in drift column
**application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

N = nymphs
L = larvae
P = pupae
A = adults

Table 2. Aquatic organisms caught in drift net sets*, Bass Brook Control Station, Gloucester County, New Brunswick, 2 - 22 June 1980. (Concluded)

Days before or after application of 0.070 kg AI/ha RELDAN**		Spray Day 0600	0700	0800	0900	1000	1100	PM	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+5 PM
Depth (cm)		16.0	16.0	16.0	16.0	16.0	16.0	15.5	16.0	16.5	18.0	15.0	16.0	17.0	17.5	16.0	16.0	15.0
Current speed (m/sec)		0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.30	0.30	0.30	0.30	0.30	0.34	0.30	0.30	0.34	0.30
Volume of Drift Column (m^3)		23.01	23.01	23.01	23.01	23.01	23.01	22.29	20.30	20.94	22.84	19.04	20.30	24.45	22.21	20.30	23.01	19.04
Nematoda																		
Ostracoda								0.36	0.30	0.14	0.13	0.58	0.15	0.16	0.41	0.05	0.09	0.26
Hydracarina		0.04		0.04	0.09		0.04	0.04	0.05	0.05	0.18		0.05	0.08	0.05		0.13	0.05
Plecoptera	N		0.09			0.04		0.09	0.05		0.04	0.05	0.05	0.04		0.05	0.04	0.11
Ephemeroptera																		
Baetidae	N		0.04	0.09	0.04	0.04	0.04		0.05	0.05	0.13	0.05	0.10	0.04	0.05			
Heptagenlidae	N																	
Leptophlebiidae	N																	
Ephemerellidae	N															0.10		
Ephemeridae	N																	
Unidentified	N																	
Hemiptera																		
Gerridae																		
Megaloptera																		
Sialidae	L																0.04	
Trichoptera																		
Leptoceridae	L																	
Limnephilidae	L																	
Polycentropodidae	L				0.04													
Unidentified	L																	
	P																	
Coleoptera																		
Dytiscidae	A																	
Elmidae	L		0.04						0.05				0.05		0.09	0.05		0.05
	A							0.04			0.04	0.05		0.08	0.05	0.05		0.05
Diptera																		
Colicidae	L																	
Simuliidae	L	0.22	0.13		0.04	0.04	0.09		0.25	0.05	0.09	0.16	0.15		0.14	0.10	0.09	0.26
	P					0.04												
Chironomidae	L	0.04	0.04				0.04		0.05							0.05		0.21
Rhagionidae	L																	0.05
Gastropoda																		
Total Aquatic Invertebrates		0.30	0.35	0.13	0.22	0.17	0.22	0.54	0.79	0.29	0.61	0.89	0.54	0.41	0.77	0.44	0.39	1.05

*expressed as number of organisms per m^3 of water in drift column
**application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

N = nymphs
L = larvae
P = pupae
A = adults

Table 3. Terrestrial organisms caught in drift net sets*, North Brook Treatment Station, Gloucester County, New Brunswick, 2 - 22 June 1980.

Days before or after application of 0.070 kg AI/ha RELDAN®**		-9		-8		-7		-6		-5		-4		-3		-2		-1	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Current speed (m/sec)		0.55	0.43	0.46	0.46	0.43	0.40	0.40	0.40	0.43	0.34	0.37	0.34	0.37	0.30	0.40	0.40	0.43	0.43
Surface Area of Drift Column (m^2)		232.65	181.89	194.58	194.58	181.89	169.20	169.20	169.20	181.89	143.82	156.51	143.82	156.51	126.90	169.20	169.20	181.89	181.89
Arachida																			
Collembola			0.02	0.03	0.05			0.01	0.07	0.02	0.04	0.01	0.01	0.02	0.01	0.01	0.01		0.02
Ephemeroptera	A		0.01					0.01						0.01					
Plecoptera	A																		
Psocoptera	A																		
Hemiptera		0.01							0.01										
Homoptera																			
Coleoptera	L																		
	A														0.01				
Trichoptera	A						0.01												
Lepidoptera	L																		
Diptera	A		0.01		0.01		0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02			0.01	
Hymenoptera	A			0.01					0.01		0.01		0.01		0.02	0.01			0.01
Total Terrestrial Invertebrates		0.01	0.03	0.04	0.05	0.00	0.01	0.03	0.10	0.03	0.06	0.02	0.03	0.03	0.05	0.02	0.01	0.01	0.03

*expressed as number of organisms per m^2 of surface area of drift column
**Application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

A = adult
L = larvae

Table 3. Terrestrial organisms caught in drift net sets*, North Brook Treatment Station, Gloucester County, New Brunswick, 2 - 22 June 1980. (Continued)

Days before or after application of 0.070 kg AI/ha REI.DAN®**		Spray Day AM	Pre	+0hr	+½ hr	+1 hr	+2 hr	+3 hr	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+5 PM
Current speed (m/sec)		0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.24	0.30	0.34	0.34	0.30	0.21	0.24	0.27	0.27
Surface Area of Drift Column (m^2)		156.51	156.51	156.51	156.51	156.51	156.51	156.51	156.51	101.52	126.90	143.82	143.82	126.90	88.83	101.52	114.21	114.21
Annelida			0.02		0.01			0.01	0.01									
Collembola					0.03	0.05	0.02		0.08	0.07	0.04							0.01
Ephemeroptera	A																	
Plecoptera	A						0.01	0.01										
Psocoptera	A																	
Hemiptera																		
Homoptera			0.01								0.01	0.01		0.01				
Coleoptera	L.																	
	A								0.01									
Trichoptera	A	0.01				0.01			0.01	0.01								
Lepidoptera	L.																	
Diptera	A	0.03	0.08		0.06	0.26	0.10	0.08	0.04	0.05	0.02	0.01	0.01	0.07	0.02	0.01		
Hymenoptera	A			0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.01				
Total Terrestrial Invertebrates		0.03	0.11	0.04	0.10	0.32	0.13	0.10	0.16	0.14	0.08	0.03	0.01	0.09	0.02	0.01	0.00	0.01

*expressed as number of organisms per m^2 of surface area of drift column
**application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

A - adult
L - larvae

Table 3. Terrestrial organisms caught in drift net sets*, North Brook Treatment Station, Gloucester County, New Brunswick, 2 - 22 June 1980. (Concluded)

Days before or after application of 0.070 kg AI/ha RELDAN[AA]		Spray Day Pre	0hr	+½ hr	+1 hr	+2 hr	+3 hr	+4 hr	+5 hr	+6 hr	PM	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+5 PM
Current speed (m/sec)		0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.27	0.27	0.30	0.27	0.24	0.24	0.40	0.40	0.34
Surface Area of Drift Column (m^2)		126.90	126.90	126.90	126.90	126.90	126.90	126.90	126.90	126.90	126.90	126.90	114.21	114.21	126.90	114.21	101.52	101.63	169.20	169.20	143.82
Annelida								0.02	0.02	0.01		0.01								0.01	0.01
Collembola		0.02	0.06	0.02	0.16	0.11	0.30	0.10	0.09	0.18		0.08	0.02	0.03	0.01	0.03		0.01		0.01	0.03
Ephemeroptera	A								0.01												0.01
Plecoptera	A					0.01				0.02											
Psocoptera	A									0.02											
Hemiptera							0.01	0.01							0.01						
Homoptera							0.01		0.03	0.06		0.02									
Coleoptera	L																				
	A							0.01	0.01	0.02			0.01		0.02		0.01				
Trichoptera	A		0.01																	0.01	0.01
Lepidoptera	L								0.02												0.01
Diptera	A		0.02	0.02	0.02	0.18	0.40	0.36	0.34	0.31	0.03	0.19	0.03	0.04	0.03	0.05	0.01	0.01	0.01	0.01	0.05
Hymenoptera	A					0.01	0.02	0.01	0.08	0.06	0.01	0.02									0.01
Total Terrestrial Invertebrates		0.02	0.09	0.03	0.17	0.31	0.73	0.50	0.58	0.67	0.04	0.32	0.05	0.06	0.06	0.08	0.02	0.02	0.01	0.04	0.11

*expressed as number of organisms per m^2 of surface area of drift column
**application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

A = adult
L = larvae

Table 4. Terrestrial organisms caught in drift net sets, Bass Brook Control Station, Gloucester County, New Brunswick, 2 - 22 June 1980.

Days before or after application of 0.070 kg AI/ha BELDAN**		-9		-8		-7		-6		-5		-4		-3		-2		-1	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Current speed (m/sec)		0.40	0.37	0.34	0.34	0.37	0.34	0.37	0.37	0.34	0.37	0.34	0.34	0.37	0.34	0.34	0.37	0.37	0.34
Surface Area of Drift Column (m^2)		169.20	156.51	143.82	143.82	156.51	143.82	156.51	156.51	143.82	156.51	143.82	143.82	156.51	143.82	143.82	156.51	156.51	143.82
Arachnida					0.01				0.01										
Chilopoda																			
Collembola				0.01		0.01	0.05			0.01		0.01			0.01		0.01		
Ephemeroptera	A												0.01						
Homoptera									0.01										
Coleoptera	A																		
Trichoptera	A	0.01			0.01			0.01						0.01				0.01	
Lepdioptera	L	0.01									0.01								
Diptera	L															0.01			
	A	0.04	0.03	0.01	0.03		0.02	0.02	0.12		0.04	0.01	0.08	0.01	0.09	0.06	0.03		0.17
Hymenoptera	A														0.01		0.01		
Total Terrestrial Invertebrates		0.05	0.03	0.02	0.04	0.01	0.07	0.03	0.13	0.01	0.05	0.02	0.08	0.01	0.11	0.07	0.04	0.01	0.17

*expressed as number of organisms per m^2 of surface area of drift column
**application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

A = adults
L = larvae

Table 4. Terrestrial organisms caught in drift net sets, Bass Brook Control Station, Gloucester County, New Brunswick, 2 - 22 June 1980. (Continued)

Days before or after application of 0.070 kg AI/ha RELDAN****		Spray Day AM	2030	2130	2230	2330	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+5 PM
Current speed (m/sec)		0.34	0.34	0.34	0.34	0.34	0.30	0.30	0.27	0.30	0.27	0.27	0.27	0.30	0.30	0.34
Surface Area of Drift Column (m^2)		156.51	143.82	143.82	143.82	143.82	126.90	126.90	114.21	126.90	114.21	114.21	114.21	126.90	126.90	143.82
Arenicola		0.01		0.01												
Chilopoda																
Collembola									0.01					0.01	0.02	
Ephemeroptera	A							0.01							0.02	
Homoptera			0.01													
Coleoptera	A															
Trichoptera	A						0.01									
Lepidoptera	L							0.01								
Diptera	L															
	A	0.02	0.02	0.01	0.01		0.04	0.08	0.01	0.03		0.06	0.03	0.03	0.02	0.01
Hymenoptera	A		0.01			0.01		0.01				0.01				0.01
Total Terrestrial Invertebrates		0.03	0.03	0.01	0.01	0.01	0.05	0.10	0.02	0.03	0.00	0.07	0.03	0.04	0.05	0.02

*expressed as number of organisms per m^2 of surface area of drift column
**application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

A = adults
L = larvae

Table 4. Terrestrial organisms caught in drift net sets, Bass Brook Control Station, Gloucester County, New Brunswick, 2 - 22 June 1980. (Concluded)

Days before or after application of 0.070 kg AI/ha RELDAN**		Spray Day 0600	0700	0800	0900	1000	1100	PM	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+5 PM
Current speed (m/sec)		0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.30	0.30	0.30	0.30	0.30	0.34	0.30	0.30	0.34	0.30
Surface Area of Drift Column (m^2)		143.82	143.82	143.82	143.82	143.82	143.82	143.82	126.90	126.90	126.90	126.90	126.90	143.82	126.90	126.90	143.82	126.90
Araneida											0.02				0.01			
Chilpoda																		
Collembola		0.01	0.01	0.01	0.01			0.01			0.01							
Ephemeroptera	A													0.01				
Homoptera																		
Coleoptera	A							0.01										
Trichoptera	A											0.01						
Lepidoptera	L.																	
Diptera	L.																	
	A	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.02	0.02	0.06	0.06	0.02	0.06	0.02	0.02	0.01	0.01
Hymenoptera	A						0.01						0.01				0.01	
Total Terrestrial Invertebrates		0.01	0.02	0.01	0.02	0.01	0.02	0.06	0.02	0.02	0.08	0.06	0.02	0.06	0.02	0.02	0.03	0.01

*expressed as number of organisms per m^2 of surface area of drift column
**Application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

A = adults
L = larvae

Table 5. Aquatic invertebrates collected from artificial substrates*, North Brook Treatment Station, Gloucester County, New Brunswick, 7 June - 1 August 1980.

Days before or after first (second) application of 0.070 kg AI/ha RELDAN®**		-4	+3	+11(+5)	+51(+45)
Turbellaria		-	-	0.2	0.6
Nematoda		-	0.2	0.6	-
Nematomorpha		-	0.4	-	-
Oligochaeta		-	-	-	8.4a
Hydracarina		14.4	12.0	17.2	2.0a
Plecoptera	N	52.8a	50.4a	80.8ab	100.6b
Ephemeroptera					
Baetidae	N	19.8	6.2	11.8	10.6
Heptageniidae	N	-	0.8	0.2	4.2a
Leptophlebiidae	N	7.2ab	6.2a	14.6b	81.2c
Ephemerellidae	N	30.8ab	24.0a	36.0ab	50.6b
Odonata					
Gomphidae	N	-	-	-	0.2
Megaloptera					
Sialidae	L	-	-	-	1.2a
Trichoptera					
Brachycentridae	L	8.0a	4.4ab	4.2ab	0.6b
Glossosomatidae	L	0.2	-	-	-
Hydropsychidae	L	0.4	-	-	-
Hydroptilidae	L	1.8a	4.4ab	11.6b	1.6a
Lepidostomatidae	L	1.0	-	-	0.4
Limnephilidae	L	1.0	2.2	0.4	0.4
Odontoceridae	L	1.2	-	0.6	-
Philopotamidae	L	-	-	-	0.2
Polycentropodidae	L	0.2	0.2	-	-
Unidentified	L	-	-	-	0.6
	P	0.2	-	0.6	21.8a
Coleoptera					
Elmidae	L	0.2	0.6	-	5.6a
	A	-	1.6a	4.8b	1.0a
Chrysomelidae	A	0.2	-	-	-
Diptera					
Tipulidae	L	0.8	1.2	1.6	7.4a
Psychodidae	L	0.2	-	-	-
Simuliidae	L	1.2	1.6	1.6	6.2
	P	0.6	0.6	-	0.2
Chironomidae	L	63.8	149.6a	111.0a	608.8b
	P	0.4	-	3.4a	16.4b
Heleidae	L	6.4	10.8	4.4	43.0a
Rhagionidae	L	4.2	4.2	5.8	7.4
Empididae	L	0.2	0.4	1.4a	-
	P	-	-	-	0.2
Pelecypoda		-	-	-	33.6
Total aquatic invertebrates		217.2a	282.0ab	312.8b	1015.0c

*mean numbers of organisms collected from five artificial substrates
numbers followed by the same character are not significantly different at the 5% significance level (a Student-Newman-Keuls test was used after transforming the data to log (x + 1.0))

**application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

N = nymphs
A = adults
L = larvae
P = pupae

Table 6
Aquatic invertebrates collected from artificial substrates*,
Bass Brook Control Station,
Gloucester County, New Brunswick
7 June - 1 August 1980

Days before or after first (second) application of 0.280 kg AI/ha SEVIN-4-OIL**			-4	-3	+11 (+3)	+51 (+43)
Turbellaria			-	-	1.0	1.4
Nematoda			-	-	-	0.2
Oligochaeta			-	-	-	0.2
Hydracarina			1.0 a	3.8 a	7.0 a	0.2
Plecoptera			36.2 a	15.0 a	31.0	12.8 a
Ephemeroptera	Baetidae	nymphs	13.0	7.0	9.2	7.6
	Heptageniidae	nymphs	-	-	-	1.4 a
	Leptophlebiidae	nymphs	1.2	1.2	2.4	7.2 a
	Ephemerellidae	nymphs	2.6	3.6	10.4 a	1.2
Odonata	Cordulegastridae	nymphs	-	-	0.2	-
Trichoptera	Hydropsychidae	larvae	-	-	-	6.4 a
	Hydroptilidae	larvae	0.2	1.0	1.4	-
	Lepidostomatidae	larvae	-	-	0.2	-
	Limnephilidae	larvae	0.2	-	-	0.2
	Odontoceridae	larvae	0.2	-	0.4	-
	Philopotamidae	larvae	-	-	1.4	3.6
	Polycentropodidae	larvae	0.6	-	-	0.2
	Psychomyiidae	larvae	-	-	-	0.4
	Rhyacophilidae	larvae	-	0.2	0.4	-
	Unidentified	larvae	-	-	-	0.2
		pupae	-	-	-	0.4
Coleoptera	Elmidae	larvae	6.0	9.6	9.6	21.4 a
		adults	38.4	48.0	62.4	58.2
Diptera	Tipulidae	larvae	1.6	1.4	1.2	7.0 a
	Simuliidae	larvae	4.0	3.6	7.4	0.6
		pupae	1.2 a	0.2 ab	0.4 ab	- b
	Chironomidae	larvae	24.8 a	14.2 a	120.0 b	29.2 ab
		pupae	0.8	0.6	0.6	3.6 a
	Heleidae	larvae	0.2	0.2	1.0	4.0 a
	Rhagionidae	larvae	0.8	0.6	1.0	3.4
	Empididae	larvae	0.2	-	0.2	-
Gastropoda			0.4	-	-	-
Pelecypoda			0.4	0.2	-	9.6
Total Aquatic Invertebrates			134.0	110.4	268.8	191.6

*mean numbers of organisms collected from five artificial substrates
numbers followed by the same character are not significantly different at the 5% significance level (a Student-Newman-Keuls test was used after transforming the data to log (x + 1.0))

**application at 0631 ADT on 11 June 1980 and again at 0819 ADT on 17 June 1980

Table 7. Aquatic invertebrates collected in Surber samples*, North Brook Treatment Station, Gloucester County, New Brunswick, 31 May - 1 August 1980.

Days before or after first (second) application of 0.070 kg AI/ha RELDAN®**		-11	-5	+2	+10(+4)	+16(+10)	+51(+45)
Nematomorpha		-	0.25	-	-	0.25	-
Oligochaeta		-	0.50	0.50	-	0.25	0.50
Hydracarina		1.50	-	1.00	0.75	1.25	-
Plecoptera	N	2.25	2.50	4.00	1.50	0.25	0.50
Ephemeroptera							
Baetidae	N	0.50	2.75	5.75	0.50	0.25	6.50
Heptageniidae	N	3.00ab	2.50ab	2.25ab	7.25b	- a	3.00b
Leptophlebiidae	N	1.50	0.25	0.50	1.50	0.50	0.75
Ephemerellidae	N	14.25ab	12.50ab	23.50ab	40.00a	18.50ab	7.75b
Ephemeridae	N	0.25	-	-	-	-	-
Odonata							
Cordulegastridae	N	-	-	-	-	0.25	-
Trichoptera							
Brachycentridae	L	11.50	17.00	10.00	7.25	2.25	1.75
Glossosomatidae	L	-	0.50	0.50	-	-	1.00
Hydropsychidae	L	0.25	0.25	-	0.25	-	0.25
Hydroptilidae	L	-	0.25	5.75	0.75	2.50	0.50
Lepidostomatidae	L	1.50	-	-	-	-	0.50
Limnephilidae	L	2.00	1.00	3.25	1.00	2.25	5.75
Odontoceridae	L	0.50	0.75	1.25	-	-	-
Polycentropodidae	L	-	-	-	-	-	0.25
Psychomyiidae	L	-	-	-	-	-	0.25
Rhyacophilidae	L	-	0.25	-	-	-	-
Unidentified	L	0.25	-	0.25	-	0.25	-
	P	0.75	2.75	1.75	2.00	3.00	5.25
Lepidoptera	L	0.50	-	-	-	-	-
Coleoptera							
Elmidae	L	1.25	1.75	1.75	1.00	4.25	6.75
	A	1.75	1.25	2.50	5.50	2.75	3.00
Diptera							
Tipulidae	L	2.75	1.00	1.50	1.00	0.50	0.50
Simuliidae	L	-	0.75	0.50	8.50	0.25	3.25
	P	0.25	-	0.50	0.75	-	0.25
Chironomidae	L	6.50	2.25	13.75	2.00	1.00	8.25
	P	0.50	-	0.50	-	-	3.00a
Deleidae	L	7.50a	1.25	2.00	0.75	-	0.50
Tabanidae	L	-	-	0.25	-	-	-
Rhagionidae	L	4.00a	1.50ab	1.75ab	- b	1.00ab	4.00a
Empididae	L	-	-	-	-	-	0.25
Pelecypoda		0.25	-	-	-	-	2.50
Total aquatic invertebrates		65.25	53.75	85.25	82.25	41.50	66.75

*mean numbers of organisms collected in four Surber samples
numbers followed by the same character are not significantly different at the 5% significance level (a Student-Newman-Keuls test was used after transforming the data to log (x + 1.0))

**application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

N = nymphs
A = adults
L = larvae
P = pupae

Table 8. Aquatic invertebrates collected in Surber samples*, Bass Brook Control Station, Gloucester County, New Brunswick, 31 May - 1 August 1980.

Days before or after first (second) application of 0.280 kg AI/ha SEVIN-2-OIL®AA			-11	-5	+2	+10 (+4)	+15 (+9)	+51 (+45)
Turbellaria			0.25	0.25	-	-	-	-
Nematoda			0.25	-	1.00	-	-	0.25
Oligochaeta			-	-	0.75	0.25	0.25	0.25
Hydracarina			-	1.25	-	0.25	-	-
Plecoptera		nymphs	1.50	0.75	2.50	2.75	1.00	0.50
Ephemeroptera	Baetidae	nymphs	9.25 a	2.25 ab	2.75 ab	- b	- b	0.25 b
	Heptagenitidae	nymphs	3.25	0.25	2.75	1.25	0.75	1.75
	Leptophlebiidae	nymphs	-	-	0.25	0.25	0.75	0.50
	Ephemerellidae	nymphs	4.50 ab	4.25 a	15.50 b	2.00 a	1.75 a	2.25 a
	Unidentified	nymphs	-	-	-	-	0.50	-
Odonata	Cordulegastridae	nymphs	0.25	0.25	0.25	-	0.25	-
	Gomphidae	nymphs	0.25	-	0.25	-	0.25	-
Trichoptera	Brachycentridae	larvae	-	-	0.25	-	-	0.50
	Glossosomatidae	larvae	-	-	-	-	-	0.50
	Hydropsychidae	larvae	0.75	-	0.75	0.25	-	0.25
	Hydroptilidae	larvae	0.25	-	0.25	-	0.25	-
	Leptoceridae	larvae	-	-	0.50	-	-	-
	Limnephilidae	larvae	0.75	0.75	0.50	-	0.50	1.00
	Polycentropodidae	larvae	0.25	-	-	0.50	-	-
	Rhyacophilidae	larvae	0.50	0.25	0.25	1.25	-	-
	Unidentified	larvae	-	-	0.25	-	-	-
		pupae	0.75	2.00	1.50	0.50	0.50	0.75
Lepidoptera		larvae	-	-	-	0.25	-	-
Coleoptera	Elmidae	larvae	4.25 ab	5.00 ab	10.25 b	0.75 a	2.50 ab	12.75 b
		adults	10.00	17.50	23.00	8.00	2.75	19.50
Diptera	Tipulidae	larvae	1.75	1.00	3.50	0.25	1.00	1.25
	Simuliidae	larvae	2.50	0.25	1.25	0.25	0.75	-
		pupae	0.50	0.25	0.25	-	-	-
	Chironomidae	larvae	-	1.50	2.00	0.50	2.00	2.00
		pupae	-	-	0.25	-	-	-
	Rhagionidae	larvae	0.50	0.50	-	-	0.25	0.75
Pelecypoda			-	-	-	-	-	0.50
Total Aquatic Invertebrates			42.25	38.25	70.75	19.25	16.00	45.50

*mean numbers of organisms collected in four Surber samples numbers followed by the same character are not significantly different at the 5% significance level (a Student-Newman Keuls test was used after transforming the data to log (x + 1.0)

**application at 0631 ADT on 11 June 1980 and again at 0819 ADT on 17 June 1980

Table 9. Aquatic invertebrates collected from rocks*, North Brook Treatment Station, Gloucester County, New Brunswick, 31 May - 1 August, 1980.

Days before or after first (second) application of 0.070 kg AI/ha RELDAN®**		-11	-5	+2	+10(+4)	+16(+10)	+51(+45)
Nematoda		-	-	-	-	-	0.25
Nematomorpha		-	-	-	-	0.25	-
Hirudinea		-	-	-	0.25	-	-
Hydracarina		3.00	4.75	8.25	6.00	3.25	0.50
Plecoptera	N	-	0.75	1.00	1.00	0.50	0.50
Ephemeroptera							
Baetidae	N	-	3.00a	-	-	-	129.75b
Heptageniidae	N	0.25	4.25	2.00	-	0.50	3.00
Leptophlebiidae	N	-	0.50	-	0.25	0.25	2.00
Ephemerellidae	N	1.00	4.25	1.25	3.00	3.50	7.50
Trichoptera							
Brachycentridae	L	0.25a	6.00b	0.50ab	- a	1.00 ab	2.25ab
Glossosomatidae	L	-	0.50	-	-	-	-
Hydroptilidae	L	0.50	-	1.00	1.75	2.25	0.75
Lepidostomatidae	L	0.25	-	1.50	0.25	0.25	-
Limnephilidae	L	- a	- a	2.75b	4.00b	1.25ab	2.50b
Philopotamidae	L	-	0.25	-	-	-	-
Polycentropodidae	L	-	-	-	-	-	0.50
Rhyacophilidae	L	-	0.25	-	-	-	-
Unidentified	P	0.25	0.50	1.00	1.25	0.50	4.25
Coleoptera							
Elmidae	L	0.25	0.50	0.25	-	-	1.50
	A	-	0.50	0.75	-	-	0.50
Diptera							
Tipulidae	L	1.00	0.75	1.50	-	-	2.25
Simuliidae	L	0.25a	21.25ab	2.75ab	- a	12.75ab	29.75b
	P	-	-	-	-	0.25	0.25
Chironomidae	L	7.25	9.75	45.50a	9.50	39.50a	264.50b
	P	-	-	0.25	-	0.25	3.75a
Heleidae	L	-	0.75	1.25	0.25	0.25	0.50
Rhagionidae	L	-	0.50	1.50	0.75	-	0.25
Empididae	L	-	0.25	0.75	0.25	0.75	-
	P	-	-	-	0.25	-	-
Total aquatic invertebrates		14.25a	59.25ab	73.75b	28.75ab	67.25b	457.00c

*mean numbers of organisms collected from four rocks
numbers followed by the same character are not significantly different at the 5% significance level (a Student-Newman-Keuls test was used after transforming the data to log (x + 1.0))

**application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

N = nymphs
A = adults
L = larvae
P = pupae

Table 10
Aquatic Invertebrates collected from rocks*,
Bass Brook Control Station,
Gloucester County, New Brunswick
31 May - 1 August 1980

Days before or after first (second) application of 0.280 kg AI/ha SEVIN-2-OIL®AA			-11	-5	+2	+10 (14)	+15 (+9)	+51 (45)
Nematoda			-	-	-	0.25	-	-
Oligochaeta			-	-	-	-	-	0.75
Hydracarina			0.75	3.00	1.00	1.25	5.75 a	-
Plecoptera		nympha	- a	0.50 ab	0.50 ab	1.00 ab	2.75 b	0.75 ab
Ephemeroptera	Baetidae	nympha	0.50	0.50	1.50	1.25	2.00	13.25 a
	Heptageniidae	nympha	0.50	-	0.50	-	0.25	-
	Leptophlebiidae	nympha	-	0.25	-	-	0.75	0.25
	Ephemerellidae	nympha	1.00	1.25	-	0.25	4.25	1.00
Trichoptera	Brachycentridae	larvae	0.25	-	-	-	-	4.00
	Hydropsychidae	larvae	-	-	-	-	-	0.50
	Hydroptilidae	larvae	-	0.50	0.75	-	-	-
	Lepidostomatidae	larvae	-	-	-	0.50	-	-
	Limnephilidae	larvae	-	0.50	1.00	0.25	0.25	-
	Odontoceridae	larvae	-	0.75	-	-	-	-
	Polycentropodidae	larvae	-	0.25	-	-	0.25	-
	Rhyacophilidae	larvae	-	0.50	-	-	-	1.25
	Unidentified	larvae	0.25	-	-	-	-	-
		pupae	-	1.00	-	0.25	0.25	0.25
Lepidoptera		larvae	-	-	-	-	-	0.25
Coleoptera	Elmidae	larvae	0.25	6.00	1.50	0.50	1.75	22.75 a
		adults	1.00	3.00	2.75	0.25	3.00	4.75
Diptera	Tipulidae	larvae	-	0.75	-	-	-	-
	Simuliidae	larvae	0.25	0.75	0.50	-	-	-
	Chironomidae	larvae	10.00	19.00	15.25	11.75	19.25	28.00
		pupae	0.50	0.50	0.50	-	-	0.25
	Heleidae	larvae	-	0.25	0.25	0.25	-	-
	Rhagionidae	larvae	-	-	-	-	-	0.75
	Empididae	larvae	-	-	0.25	-	-	-
Total Aquatic Invertebrates			15.25 a	39.25 ab	26.25 ab	17.75 ab	40.50 ab	80.00 b

*Mean numbers of organisms collected from four rocks
numbers followed by the same character are not significantly different at the 5% significance level (a Student-Newman-Keuls test was used after transforming the data to log $(x + 1.0)$)

**Application at 0631 ADT on 11 June 1980 and again at 0819 ADT on 17 June 1980

APPENDIX V

Stomach content analyses for brook trout and slimy sculpins collected from the treatment and control streams Gloucester County, New Brunswick.

Table 1. Brook trout sampled for stomach content analysis, North Brook Treatment, Gloucester County, New Brunswick.

Date	31 May	13 June	20 June	26 June	2-3 August
Number of fish sampled	10	10	10	11	10
Mean fork length (mm))	117.50	119.50	114.60	125.73	114.80
Range	95-157	111-138	87-133	113-153	89-144
Mean weight (g)	18.76	20.58	17.50	24.75	19.37
Range	10.4-39.0	14.5-33.6	7.6-25.2	16.5-43.2	8.9-37.1
Mean volume of stomach contents (ml)	0.41	0.79	0.32	2.26	0.35
Range	<0.1-1.2	0.1-1.7	0-0.8	0.7-5.8	<0.1-0.9
Mean (volume of stomach contents/body weight)	0.022	0.037	0.017	0.086	0.022
Range	0.003-0.077	0.007-0.068	0-0.039	0.039-0.134	0.007-0.078
Fulton's coefficient of condition (K)*	1.11	1.18	1.13	1.23	1.23
Range	1.01-1.22	1.00-1.32	0.99-1.30	1.06-1.39	1.09-1.39

*$K = w/\ell^3 \times 10^5$ where w = weight (g)
ℓ = fork length (mm)

Table 2. Sculpins sampled for stomach content analysis, North Brook Treatment, Gloucester County, New Brunswick.

Date	31 May–1 June	13 June	20 June	26 June	2–3 Aug.
Number of fish sampled	10	12	10	10	10
Mean total length (mm)	76.40	63.08	64.40	57.80	56.00
Range	55–118	48–80	50–81	53–75	43–65
Mean weight (g)	5.08	3.33	3.77	2.67	2.37
Range	1.9–13.9	1.6–6.5	1.7–7.0	2.0–5.1	1.0–3.3
Mean volume of stomach contents (ml)	0.11	0.18	0.10	0.08	0.05
Range	<0.1–0.5	<0.1–1.0	0–0.2	<0.1–0.2	0–<0.1

Table 3. Brook trout sampled for stomach content analysis, Bass Brook Control, Gloucester County, New Brunswick.

Date	1 June	12 June	19 June	25 June
Number of fish sampled	15	11	12	13
Mean fork length (mm)	90.80	98.82	97.42	103.54
Range	60-135	71-122	72-137	73-165
Mean weight (g)	10.15	12.28	12.28	15.39
Range	2.4-28.4	3.9-20.2	5.0-27.4	4.8-52.5
Mean volume of stomach contents (ml)	0.33	0.86	0.41	0.65
Range	0.1-1.1	0.2-2.6	0.1-1.1	0.1-4.0
Mean (volume of stomach contents/body weight)	0.034	0.075	0.40	0.034
Range	0.021-0.052	0.025-0.160	0.011-0.090	0.012-0.076
Fulton's coefficient of condition (K)*	1.13	1.17	1.22	1.21
Range	1.02-1.23	1.06-1.27	1.07-1.40	1.07-1.39

*$K = w/\ell^3 \times 10^5$ where w = weight (g)
ℓ = fork length (mm)

Table 4. Brook trout sampled for stomach content analysis, Little Brook Control, Gloucester County, New Brunswick.

Date	2 June	14 June	19 June	25 June	2 Aug.
Number of fish sampled	10	10	11	11	10
Mean fork length (mm)	124.10	135.10	129.45	115.36	122.30
Range	93-169	107-185	93-168	85-150	89-153
Mean weight (g)	22.90	32.65	28.93	19.70	25.08
Range	9.9-50.4	16.2-76.3	7.8-58.9	7.6.-42.3	10.1-43.9
Mean volume of stomach contents (ml)	1.24	1.16	0.96	1.09	0.86
Range	<0.1-4.5	0.5-2.1	<0.1-2.8	0.2-2.6	0.1-2.7
Mean (volume of stomach contents/body weight)	0.050	0.043	0.033	0.054	0.46
Range	0.002-0.095	0.011-0.093	0.005-0.066	0.013-0.097	0.010-0.223
Fulton's coefficient of condition (K)*	1.15	1.23	1.16	1.20	1.26
Range	1.04-1.23	1.10-1.32	0.97-1.31	1.09-1.34	1.13-1.43

*$K = w/\ell^3 \times 10^5$ where w = weight (g)
ℓ = fork length (mm)

Table 5. Sculpins sampled for stomach content analysis, Little Brook Control, Gloucester County, New Brunswick.

Date	2 June	14 June	19 June	25 June	2 August
Number of fish sampled	10	12	10	10	10
Mean total length (mm)	63.10	65.08	66.40	71.50	60.20
Range	50-80	50-93	50-82	56-87	55-68
Mean weight (g)	2.39	3.50	3.71	5.14	3.52
Range	1.1-4.2	1.9-7.7	1.8-7.1	2.9-8.5	2.4-5.5
Mean volume of stomach contents (ml)	0.15	0.11	0.13	0.13	0.08
Range	<0.1-0.4	0-0.2	<0.1-0.3	<0.1-0.5	<0.1-0.2
Mean (volume of stomach contents/ body weight)	0.06	0.03	0.03	0.03	0.02
Range	0.02-0.16	0-0.06	0.01-0.06	0.01-0.10	0.01-0.06

Table 6. Stomach contents of brook trout, North Brook Treatment, Gloucester County, New Brunswick.

		Percent Occurrence					Mean Percent Contribution to Volume					Mean Number of Organisms per Stomach				
Sample date		31 May	13 June	20 June	26 June	2-3 August	31 May	13 June	20 June	26 June	2-3 August	31 May	13 June	20 June	26 June	2-3 August
No food present		0	0	10	0	0										
Aquatic insects																
Plecoptera	N	50	50	10	82	10	4.3	1.5	0.2	1.8	2.2	2.2	1.6	2.0	3.0	3.0
Ephemeroptera																
Heptageniidae	N	30	30	-	55	-	1.6	0.8	-	1.3	-	1.7	1.0	-	1.2	-
Ephemeridae	N	50	10	40	73	20	26.5	0.5	16.4	31.0	4.5	4.4	1.0	1.5	8.8	1.5
Other	N	60	80	60	100	90	16.8	12.0	8.9	18.2	32.0	3.3	4.5	1.3	11.8	27.4
Trichoptera	L	70	100	70	82	90	20.4	62.4	26.7	3.9	30.2	3.1	11.3	3.6	2.8	3.7
	P	-	-	10	27	10	-	-	0.1	0.4	2.0	-	-	1.0	1.3	1.0
Hemiptera																
Hydrometridae		-	-	-	9	-	-	-	-	0.1	-	-	-	-	1.0	-
Gerridae		-	-	-	9	-	-	-	-	0.2	-	-	-	-	2.0	-
Coleoptera	L	-	-	-	-	10	-	-	-	-	0.2	-	-	-	-	1.0
	P	-	-	-	-	10	-	-	-	-	0.2	-	-	-	-	1.0
	A	10	20	10	9	10	0.5	1.5	0.2	0.1	2.2	1.0	1.5	1.0	1.0	1.0
Diptera																
Tipulidae	L	30	10	-	64	10	9.0	0.1	-	5.7	0.1	1.3	1.0	-	1.7	1.0
Simuliidae	L	10	70	30	64	30	0.1	2.9	0.9	1.1	0.6	1.0	4.9	1.0	3.3	1.0
	P	-	-	10	9	-	-	-	0.2	0.1	-	-	-	1.0	1.0	-
Chironomidae	L	80	60	40	91	90	3.0	1.0	0.6	2.6	3.0	2.1	3.3	1.3	11.3	4.0
	P	-	-	10	18	-	-	-	6.7	0.1	-	-	-	3.0	2.0	-
Heleidae	L	-	20	30	36	30	-	0.2	0.4	0.4	0.9	-	1.0	1.0	2.3	1.7
	P	-	-	-	36	-	-	-	-	0.7	-	-	-	-	2.5	-
Rhagionidae	L	20	60	10	9	10	11.0	5.3	0.2	0.1	0.1	3.5	1.8	1.0	1.0	1.0
Other aquatic invertebrates																
Hydracarina		30	60	30	36	50	1.0	4.1	1.0	0.5	0.6	1.0	2.5	1.3	1.8	1.0
Gastropoda		-	10	20	-	-	-	1.5	1.1	-	-	-	3.0	1.5	-	-
Pelecypoda		-	10	-	-	-	-	0.1	-	-	-	-	1.0	-	-	-
Terrestrial arthropods																
Arachnida		-	10	10	55	40	-	0.2	0.4	0.7	5.8	-	1.0	1.0	1.3	2.0
Collembola		-	10	10	-	-	-	0.8	1.1	-	-	-	13.0	3.0	-	-
Hemiptera		-	20	20	27	20	-	0.2	1.8	0.5	0.3	-	1.0	2.0	1.3	1.0
Homoptera		-	20	30	18	30	-	0.4	1.7	0.2	0.4	-	1.5	1.0	1.5	1.7
Coleoptera	L	20	10	10	9	-	3.5	0.5	1.4	0.1	-	2.0	1.0	1.0	1.0	-
	A	10	20	10	55	30	2.3	0.7	0.2	2.9	2.4	1.0	1.0	3.0	1.2	1.0
Trichoptera	A	-	-	-	36	-	-	-	-	0.5	-	-	-	-	1.3	-
Lepidoptera	L	-	-	10	27	-	-	-	1.6	0.9	-	-	-	1.0	2.3	-
Diptera	A	-	20	60	91	90	-	2.6	17.6	23.7	12.0	-	2.5	4.8	18.0	4.6
Hymenoptera																
Formicidae		-	20	50	9	-	-	0.4	10.6	0.4	-	-	1.0	2.8	1.0	-
Other	A	-	20	-	55	10	-	0.3	-	1.7	0.3	-	1.0	-	2.0	2.0

Application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980

N = nymphs
A = adults
L = larvae
P = pupae

Table 7. Stomach contents of slimy sculpins, North Brook Treatment, Gloucester County New Brunswick.

		Percent Occurrence					Mean Percent Contribution to Volume					Mean Number of Organisms per Stomach				
Sample date		31 May	13 June	20 June	26 June	2-3 August	31 May	13 June	20 June	26 June	2-3 August	31 May	13 June	20 June	26 June	2-3 August
No food present		0	0	10	0	10										
Aquatic insects																
Plecoptera	N	20	33	60	30	-	11.0	6.7	3.6	1.7	-	1.0	1.5	1.7	1.0	-
Ephemeroptera																
Heptageniidae	N	-	8	-	-	40	-	0.1	-	-	3.4	-	1.0	-	-	1.0
Ephemeridae	N	40	8	30	-	-	36.0	3.7	16.1	-	-	3.3	3.0	2.7	-	-
Other	N	50	75	90	70	60	28.0	37.2	58.6	59.4	18.9	1.4	3.0	2.2	2.0	5.0
Trichoptera	L	20	58	60	30	10	12.0	22.5	13.0	14.5	1.1	2.0	2.7	1.5	3.0	2.0
Diptera																
Tipulidae	L	-	25	-	-	-	-	0.8	-	-	-	-	1.7	-	-	-
Simuliidae	L	-	42	30	20	30	-	7.3	2.2	11.2	3.0	-	6.0	1.7	4.0	3.7
	P	-	-	10	10	-	-	-	1.1	0.5	-	-	-	2.0	1.0	-
Chironomidae	L	20	75	70	70	90	2.5	7.6	4.1	12.7	71.0	2.5	8.4	6.0	4.1	26.2
	P	-	-	10	-	-	-	-	0.1	-	-	-	-	1.0	-	-
Heleidae	L	20	50	40	-	50	10.5	1.0	0.9	-	2.6	1.0	1.2	1.5	-	1.6
Rhagionidae	L	-	17	-	-	-	-	2.5	-	-	-	-	1.5	-	-	-
Terrestrial arthropods																
Diptera	A	-	8	-	-	-	-	3.3	-	-	-	-	1.0	-	-	-
Amphibian eggs		-	8	-	-	-	-	7.5	-	-	-					

Application at 2033 ADT on 11 June 1980 and again at 0606 ADT on 17 June 1980.

N = nymphs
A = adults
L = larvae
P = pupae

Table 8. Stomach contents of brook trout, Bass Brook Control, Gloucester County, New Brunswick.

Sample date		Percent Occurrence				Mean Percent Contribution to Volume				Mean Number of Organisms per Stomach			
		1 June	12 June	19 June	25 June	1 June	12 June	19 June	25 June	1 June	12 June	19 June	25 June
No food present		0	0	0	0								
Aquatic insects													
Plecoptera	N	47	18	42	23	1.5	0.2	0.9	0.3	2.1	1.0	1.2	1.3
Ephemeroptera													
Heptagenitidae	N	-	9	-	-	-	0.1	-	-	-	2.0	-	-
Ephemeridae	N	20	18	-	-	0.4	0.3	-	-	1.0	1.0	-	-
Other	N	93	100	75	23	24.9	66.1	13.8	1.8	4.4	82.4	3.1	3.9
Odonata													
Anisoptera	N	-	-	8	8	-	-	7.4	3.8	-	-	4.0	1.0
Trichoptera	L	73	73	75	38	12.0	5.6	17.2	1.8	5.1	3.1	3.0	2.8
	P	-	-	8	-	-	-	4.0	-	-	-	4.0	-
Coleoptera	L	47	18	8	-	4.3	0.3	0.2	-	3.0	1.5	2.0	-
	A	33	64	50	-	0.5	1.8	1.9	-	1.2	1.7	1.7	-
Diptera													
Tipulidae	L	7	9	-	15	0.1	0.1	-	6.6	1.0	1.0	-	2.0
Simuliidae	L	60	36	33	8	1.5	0.4	0.8	0.3	2.7	1.0	2.0	1.0
	P	20	-	-	8	0.3	-	-	0.2	3.7	-	-	2.0
Chironomidae	L	100	45	50	23	1.7	0.5	0.9	0.2	3.8	1.8	2.2	1.7
	P	7	9	8	-	0.1	0.1	0.1	-	2.0	1.0	1.0	-
Heleidae	L	40	9	17	23	0.4	0.1	0.2	0.3	1.3	1.0	1.5	1.3
Other aquatic invertebrates													
Hydracarina		33	64	58	23	0.3	0.6	0.6	0.2	1.2	1.6	1.6	1.7
Gastropoda		13	-	17	-	0.1	-	0.4	-	1.0	-	1.5	-
Terrestrial arthropods													
Arachnida		20	36	42	38	0.5	0.5	0.8	0.7	1.7	2.0	1.4	1.4
Collembola		7	9	-	15	0.1	0.1	-	0.2	2.0	1.0	-	1.0
Ephemeroptera	A	20	-	8	-	2.5	-	0.1	-	2.7	-	0.1	-
Plecoptera	A	7	9	-	-	0.8	0.5	-	-	2.0	7.0	-	-
Hemiptera		7	-	8	23	0.1	-	0.2	1.1	1.0	-	1.0	1.3
Homoptera		20	9	8	23	0.2	0.1	0.1	0.8	1.0	1.0	2.0	2.7
Coleoptera	L	7	9	-	-	0.1	0.5	-	-	2.0	1.0	-	-
	A	40	27	33	69	1.1	0.4	0.6	17.8	1.7	1.0	1.3	20.1
Trichoptera	A	20	36	-	-	0.3	0.6	-	-	1.0	1.5	-	-
Lepidoptera	L	13	9	25	85	0.1	0.2	4.5	16.2	1.0	1.0	1.3	18.9
Diptera	A	100	91	100	100	46.0	20.4	39.6	45.6	53.8	41.4	12.5	22.5
Hymenoptera													
Formicidae		7	9	58	54	0.1	0.3	5.5	1.8	1.0	4.0	1.0	1.7
Other	A	7	45	-	31	0.1	0.5	-	0.4	1.0	1.2	-	1.5

N = nymphs
A = adults
L = larvae
P = pupae

Table 9. Stomach contents of brook trout, Little Brook Control, Gloucester County, New Brunswick.

Sample date		Percent Occurrence					Mean Percent Contribution to Volume					Mean Number of Organisms per Stomach				
		2 June	14 June	19 June	25 June	2 August	2 June	14 June	19 June	25 June	2 August	2 June	14 June	19 June	25 June	2 August
No food present		0	0	0	0	0										
Aquatic Insects																
Plecoptera	N	30	80	44	82	20	1.9	1.7	9.6	5.1	1.7	11.0	4.1	1.1	15.0	2.4
Ephemeroptera																
Heptageniidae	N	-	10	9	9	20	-	0.1	0.1	0.1	0.5	-	1.0	1.0	1.0	1.5
Ephemeridae	N	20	20	9	9	-	1.8	1.1	1.6	0.5	-	1.5	1.0	1.0	1.0	-
Other	N	50	100	55	55	70	1.5	4.3	4.0	0.8	2.5	3.4	4.8	1.7	2.2	1.6
Odonata																
Anisoptera	N	-	10	-	9	-	-	5.3	-	1.4	-	-	3.0	-	1.0	-
Megaloptera																
Sialidae	L	-	-	-	9	-	-	-	-	1.0	-	-	-	-	10.0	-
Trichoptera	L	100	100	91	73	100	28.0	15.3	25.4	19.2	19.6	7.1	7.2	5.4	8.1	3.0
	P	-	20	9	9	10	-	0.8	0.1	0.2	1.0	-	1.0	1.0	1.0	4.0
Coleoptera																
Psephenidae	L	10	-	-	-	-	0.1	-	-	-	-	1.0	-	-	-	-
Other	L	-	-	9	9	-	-	-	0.1	0.1	-	-	-	1.0	1.0	-
	P	10	10	9	-	-	0.5	1.0	0.5	-	-	1.0	1.0	2.0	-	-
	A	30	40	18	9	20	0.8	1.0	0.5	0.4	1.5	1.7	1.3	1.0	1.0	1.5
Diptera																
Tipulidae	L	20	-	-	36	20	1.7	-	-	5.0	0.2	1.5	-	-	1.3	1.0
	P	-	-	9	9	-	-	-	0.1	2.3	-	-	-	1.0	1.0	-
Simuliidae	L	90	90	73	91	40	22.9	10.0	17.0	15.0	0.7	59.7	22.6	103.6	28.3	1.5
	P	10	10	9	45	-	0.8	0.1	0.1	1.7	-	3.0	1.0	5.0	3.6	-
Chironomidae	L	90	100	82	100	60	9.6	14.4	5.6	13.4	1.3	25.4	32.1	19.1	29.0	3.3
	P	30	20	18	18	10	1.5	0.3	0.7	0.2	0.1	12.0	2.0	1.5	1.5	1.0
Tabanidae	L	10	20	9	64	10	0.1	0.2	0.1	1.5	0.1	1.0	1.0	1.0	2.9	1.0
	P	-	50	-	-	-	-	0.7	-	-	-	-	2.6	-	-	-
Stratiomyidae	L	10	-	-	-	-	0.5	-	-	-	-	1.0	-	-	-	-
Scatophagidae	L	10	40	9	9	10	1.0	4.1	6.8	5.5	0.5	1.0	1.5	1.0	4.0	1.0
Blephariceridae	L	10	-	-	-	-	0.3	-	-	-	-	1.0	-	-	-	-
Empididae	L	-	20	-	18	-	-	0.2	-	0.2	-	-	1.0	-	1.0	-
Other aquatic invertebrates																
Hydracarina		20	40	27	36	30	0.2	0.4	0.2	0.4	0.7	1.5	2.0	1.7	1.0	1.0
Gastropoda		-	-	9	-	10	-	-	0.1	-	0.4	-	-	1.0	-	1.0
Terrestrial arthropods																
Arachnida		20	60	36	27	90	0.7	2.1	0.3	0.6	10.5	2.0	1.8	1.0	1.3	2.2
Collembola		-	10	9	9	10	-	0.1	0.1	0.1	0.1	-	2.0	1.0	2.0	1.0
Ephemeroptera	A	-	-	-	-	20	-	-	-	-	1.3	-	-	-	-	2.5
Plecoptera	A	-	-	-	-	10	-	-	-	-	1.4	-	-	-	-	3.0
Hemiptera		10	20	-	18	30	0.3	0.2	-	0.3	1.4	1.0	1.0	-	1.0	2.3
Homoptera		-	20	9	-	40	-	0.6	0.1	-	1.3	-	2.5	1.0	-	3.5
Coleoptera		-	-	-	-	50	-	-	-	-	3.2	-	-	-	-	1.2
	L	-	-	-	-	-	-	2.0	-	-	-		2.0	-	-	-
	P	-	10	-	-	-	-	0.1	-	-	-		1.0	-	-	-
	A	30	50	55	55	70	1.0	4.0	1.8	2.0	6.0	1.7	4.2	1.3	3.1	1.9
Trichoptera	A	-	10	-	-	20	-	0.1	-	-	4.7	-	1.0	-	-	6.0
Lepidoptera	L	30	30	-	-	5	1.2	0.9	-	-	2.9	1.7	1.3	-	-	1.4
	A	-	-	-	-	10	-	-	-	-	1.0	-	-	-	-	3.0
Diptera	L	-	20	36	9	10	-	8.0	6.3	0.2	0.7		50.5	24.8	1.0	1.0
	A	60	100	73	73	100	16.4	17.1	14.7	9.5	29.8	11.5	17.1	12.5	11.8	13.1
Hymenoptera																
Formicidae		60	60	9	18	20	7.1	1.2	0.2	0.5	2.0	1.0	1.0	1.0	1.0	1.5
Other	A	10	20	-	9	20	0.1	0.7	-	0.1	0.5	1.0	1.0	-	2.0	1.5
Amphibian eggs		-	-	-	9		-	-	-	1.8						

N = nymphs
A = adults
L = larvae
P = pupae

Table 10. Stomach contents of slimy sculpins, Little Brook Control, Gloucester County, New Brunswick.

		Percent Occurrence					Mean Percent Contribution to Volume					Mean Number of Organisms per Stomach				
Sample date		2 June	14 June	19 June	25 June	2 August	2 June	14 June	19 June	25 June	2 August	2 June	14 June	19 June	25 June	2 August
No food present		0	8	0	0	0										
Aquatic insects																
Plecoptera	N	30	25	10	30	20	1.0	0.5	0.1	0.5	0.3	1.3	2.7	1.0	1.3	1.0
Ephemeroptera																
Heptageniidae	N	-	-	-	-	10	-	-	-	-	0.1	-	-	-	-	1.0
Other	N	10	42	-	30	60	2.5	0.5	-	1.4	10.0	1.0	1.4	-	3.0	3.8
Trichoptera	L	50	33	20	70	60	4.9	1.9	0.8	10.2	38.7	1.2	2.3	1.5	2.1	3.0
Coleoptera	L	-	8	-	-	-	-	0.1	-	-	-	-	1.0	-	-	-
	A	10	8	-	-	-	1.5	0.1	-	-	-	3.0	1.0	-	-	-
Diptera																
Tipulidae	L	10	-	-	10	-	0.1	-	-	0.5	-	1.0	-	-	3.0	-
Simuliidae	L	70	83	80	60	50	6.1	46.1	24.0	36.6	7.1	7.0	43.8	21.9	66.8	1.4
	P	-	17	10	10	10	-	0.2	0.2	0.4	0.1	-	1.0	2.0	2.0	1.0
Chironomidae	L	100	92	100	100	100	83.4	49.5	74.9	50.4	43.7	50.4	36.1	62.2	19.7	28.0
	P	10	8	-	-	-	0.1	0.4	-	-	-	1.0	2.0	-	-	-
Heleidae	L	10	-	-	-	-	0.1	-	-	-	-	1.0	-	-	-	-
	P	-	17	-	-	-	-	0.2	-	-	-	-	1.5	-	-	-
Rhagionidae	L	10	8	-	-	-	0.2	0.1	-	-	-	1.0	1.0	-	-	-
Empididae	L	10	8	-	-	-	0.1	0.1	-	-	-	1.0	1.0	-	-	-
Other aquatic invertebrates																
Gastropoda		-	8	-	-	-	-	0.3	-	-	-	-	2.0	-	-	-
Terrestrial arthropods																
Ephemeroptera	A	-	8	-	-	-	-	0.1	-	-	-	-	1.0	-	-	-

N = nymphs
A = adults
L = larvae
P = pupae