IMPACT OF DOUBLE APPLICATIONS OF PERMETHRIN ON FOREST STREAMS AND PONDS

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ABSTRACT

Aquatic impact studies of the synthetic pyrethroid, Permethrin, applied to forest ponds and streams were conducted in 1978. Double applications of 17.5 g/ha Permethrin resulted in substantial reductions of aquatic invertebrate populations, with the effects of the second applications significant in further reducing populations to a point at which recovery of numbers was delayed for at least a month and a half. No incidents of fish mortality were documented, however, fish food organisms were affected to an extent that the diet of native slimy sculpin, *Cottus cognatus* Richardson, populations shifted from various aquatic insects to almost exclusively midge larvae for a postspray period of at least 45 days. Return to a normal diet was evident by four months after treatment. Water analysis results indicated that Permethrin residues never exceeded measured quantities of 2.6 ug/l and fell to below the limits of detection (0.25ug/l) within 12 hours in streams and 48 hours in ponds.

RÉSUMÉ

Des études de l'influence de la Permethrine pyréthroïde synthétique sur la faune aquatique des étangs et ruisseaux ont eu lieu en 1978. Une double application de Permethrine à raison de 17.5 g/ha diminua substantiellement les populations d'invertébrés aquatiques. Les effets de la deuxième application furent plus significatifs en ce qu'elle réduisit davantage les populations, à tel point que le rétablissement de leur nombre fut d'une durée d'au moins un mois et demi. On n'a toutefois observé aucune mortalité chez les poissons, bien que les organismes dont s'alimentent les poissons fussent affectés au point que l'alimentation des callionymes limoneux indigènes, *Cottus cognatus* Richardson, changea de divers insectes aquatiques qu'elle était, pour se limiter presque exclusivement aux larves de moucherons pendant au moins 45 jours après l'application. On a signalé un retour évident à une alimentation normale, quatre mois après le traitement. L'analyse de l'eau indiqua que les résidus de Permethrine n'excédèrent jamais les quantités mesurées de 2.6 mg/ℓ et tombèrent au-dessous des limites de détection (0.25 mg/ℓ) dans l'espace de 12 heures dans les ruisseaux et de 48 heures dans les étangs.

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INTRODUCTION

Research into the development of environmentally acceptable forest pest control methods has recently focused on the potential of a synthetic pyrethroid, Permethrin, as a chemical insecticide. The Forest Pest Management Institute (formerly Chemical Control Research Institute) has previously studied and reported on the effects of Permethrin applied at rates of between 35.0 and 140.0 g AI/ha to trout streams and lakes (Kingsbury 1976a and b, 1977). Spruce budworm, *Choristoneura fumiferana* (Clemens), efficacy tests conducted in 1977 indicated that multiple treatments of 17.5 g AI/ha Permethrin were effective in controlling budworm populations (DeBoo, pers. comm.).

In 1978, Chipman Inc. applied to the Department of Supply and Services and was granted funding through the unsolicited proposal program for research into the effects of double applications of 17.5 g AI/ha Permethrin. This involved studies of the environmental impact and fate of pesticide residues in terrestrial and aquatic ecosystems of an eastern Ontario forest block and in coldwater streams of the Gaspé Peninsula. This study of impact on forest ponds and streams was part of the program and was directed by the Environmental Impact Section of the Forest Pest Management Institute in cooperation with Chipman Inc.

SITE DESCRIPTION

Pond Studies

Impact studies on lentic organisms were carried out in Larose Forest, near Ottawa, Ontario. Several small semi-permanent ponds in a poorly drained spruce-pine, *Picea glauca* (Moench) Voss, *Pinus strobus* L., plantation were selected for study. The three treatment ponds (Fig. 1), approximately 1 km apart are surrounded by alders, *Alnus* sp., willows, *Salix* sp., and wetland grasses providing little or no canopy cover. Alder, spruce, maple, *Acer* sp., birch, *Betula* sp., and aspen, *Populus* sp., trees border the control pond providing 5 to 10% cover. All ponds are characterized by dark coloured water ranging in depth from 0.25 to 1.5 m. Bottom types consist of sand and silt heavily littered with detritus, organic debris, and aquatic vegetation.

Stream Studies

The treatment study streams are part of the watershed system draining the boreal, spruce-balsam forest lands of Temiscouata County, near Lac Temiscouata, Quebec (Fig. 2). North Baker Brook originates southwest of Lac Temiscouata and flows in a southeast direction to the Saint John River. The unsprayed headwater portion of North Baker Brook was used as a control station while the mid section of the stream was established as a treatment area. Little Baker Brook is one of the

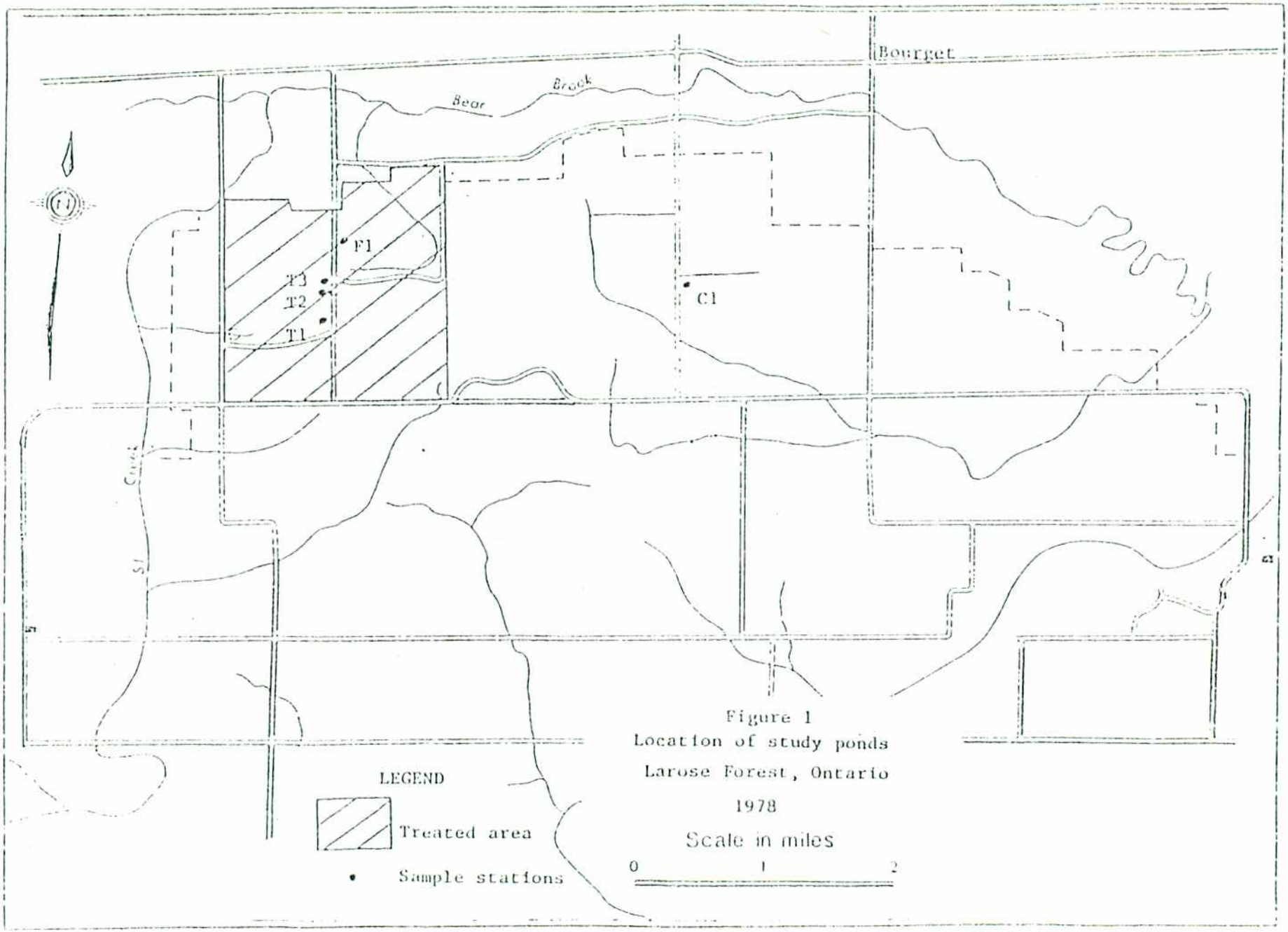

Figure 1
Location of study ponds
Larose Forest, Ontario
1978

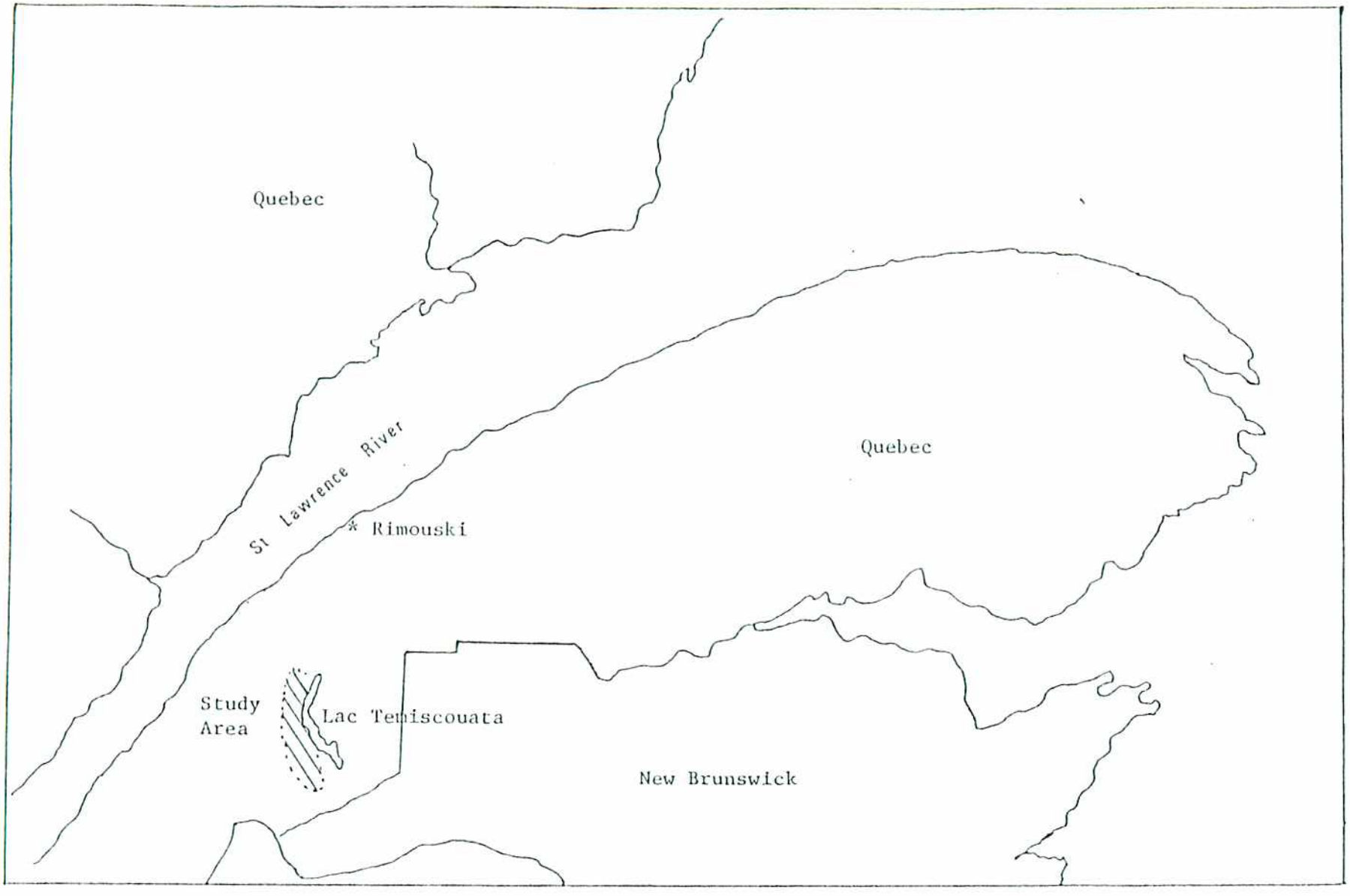

Figure 2

Location of Stream Study

Temiscouata County, Quebec

larger tributaries of this river system and intersects North Baker Brook approximately 4.0 km downstream from the North Baker station (Fig. 3). A treatment study area was selected on Little Baker Brook about 0.7 km upstream from the confluence. A supplementary station was chosen as Downstream Baker approximately 1.7 km below the North Baker and Little Baker junction.

Ruisseau de la Pointe au Sable is a much smaller river with no major tributaries and flows into the northeast corner of Lac Temiscouata (Fig. 4). A survey station was established on this stream approximately 0.5 km from the mouth. Table 1 summarizes the physical and descriptive features of each of these streams.

METHODS

Site Selection

The ponds and streams used in the study program were selected on the basis of sampling accessibility, public acceptability, and apparent capability of supporting viable populations of aquatic fauna. Other factors such as surrounding forest type, existing canopy, and suitability for aerial pesticide application were also considered.

Insecticide Application and Deposit

Two applications of the synthetic pyrethroid, Permethrin[1], at a dosage of 17.5 g AI/ha were made within a six day interval (31 May and 6 June 1978) to the spray plot in Larose Forest. Permethrin mixed with insecticide diluent 585 and automate "B" dye was delivered at the rate of 1.34 ℓ/ha by a Pawnee D aircraft fitted with model AU 3000 Micronair atomizers (Fig. 5). Sixty metre swaths were sprayed from a height of approximately 15 m above the forest canopy.

The study streams in Quebec were treated with double applications of 17.5 g AI/ha Permethrin[2] at five day intervals (13 June and 18 June, 16 June and 21 June 1978). The spray was emitted at the rate of 4.68 ℓ/ha from an AU 3000 Micronair system mounted on a Cessna 185 flying single swaths up the stream bed (Fig. 6). As a general rule, the spraying was initiated immediately downstream from the sample station and terminated approximately 5.0 km upstream.

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[1]Permethrin 50% oil concentrate, 500 g AI/ℓ, Chipman Inc.

[2]North Baker Brook, Ruisseau de la Pointe au Sable - Permethrin 50% oil concentrate 500 g AI/ℓ, Chipman Inc.
Little Baker Brook - Permethrin 300 g AI/ℓ solution, Shell Canada Ltd.

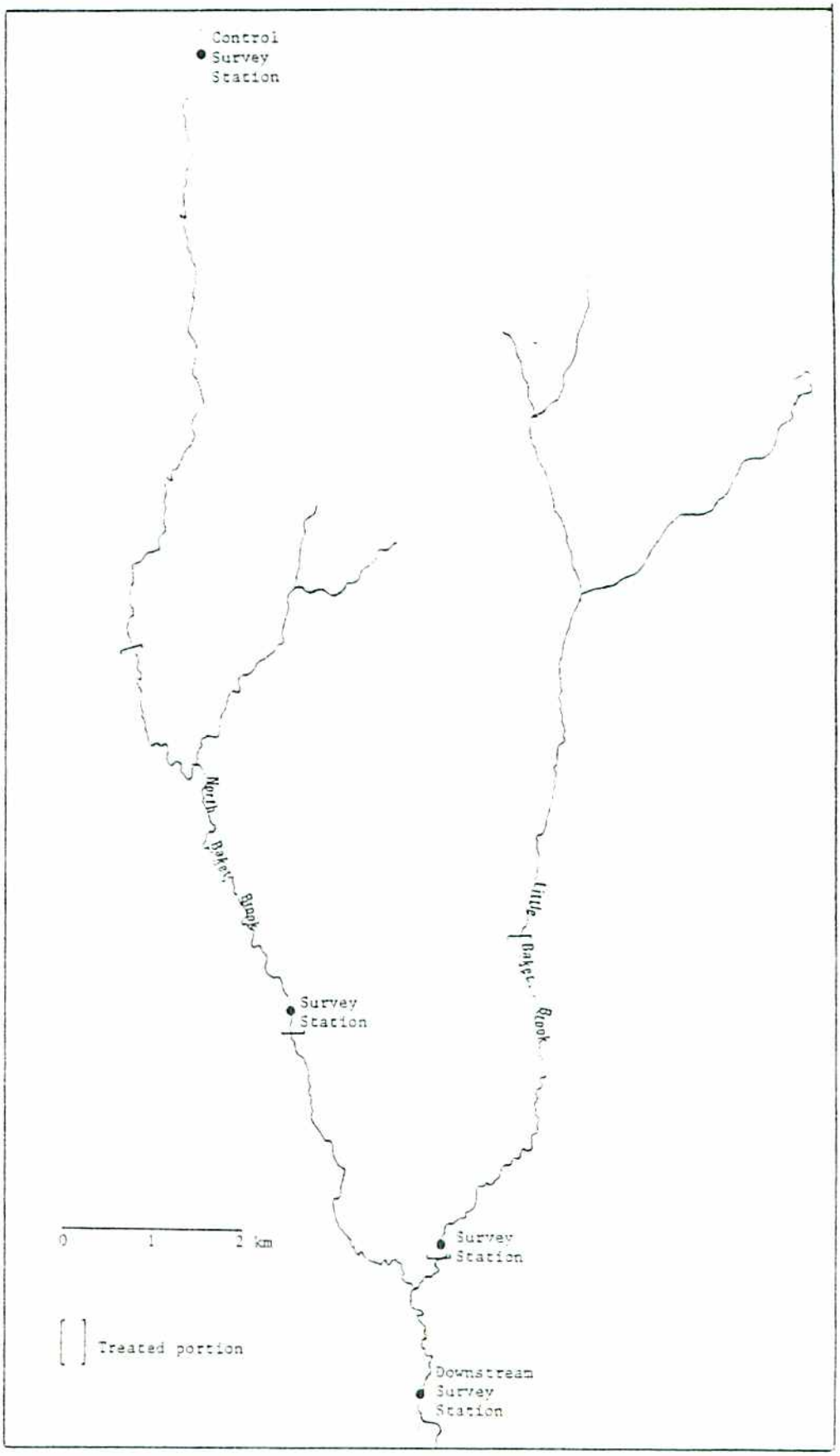


Figure 3
Sampling Stations
Temiscouata County, Quebec

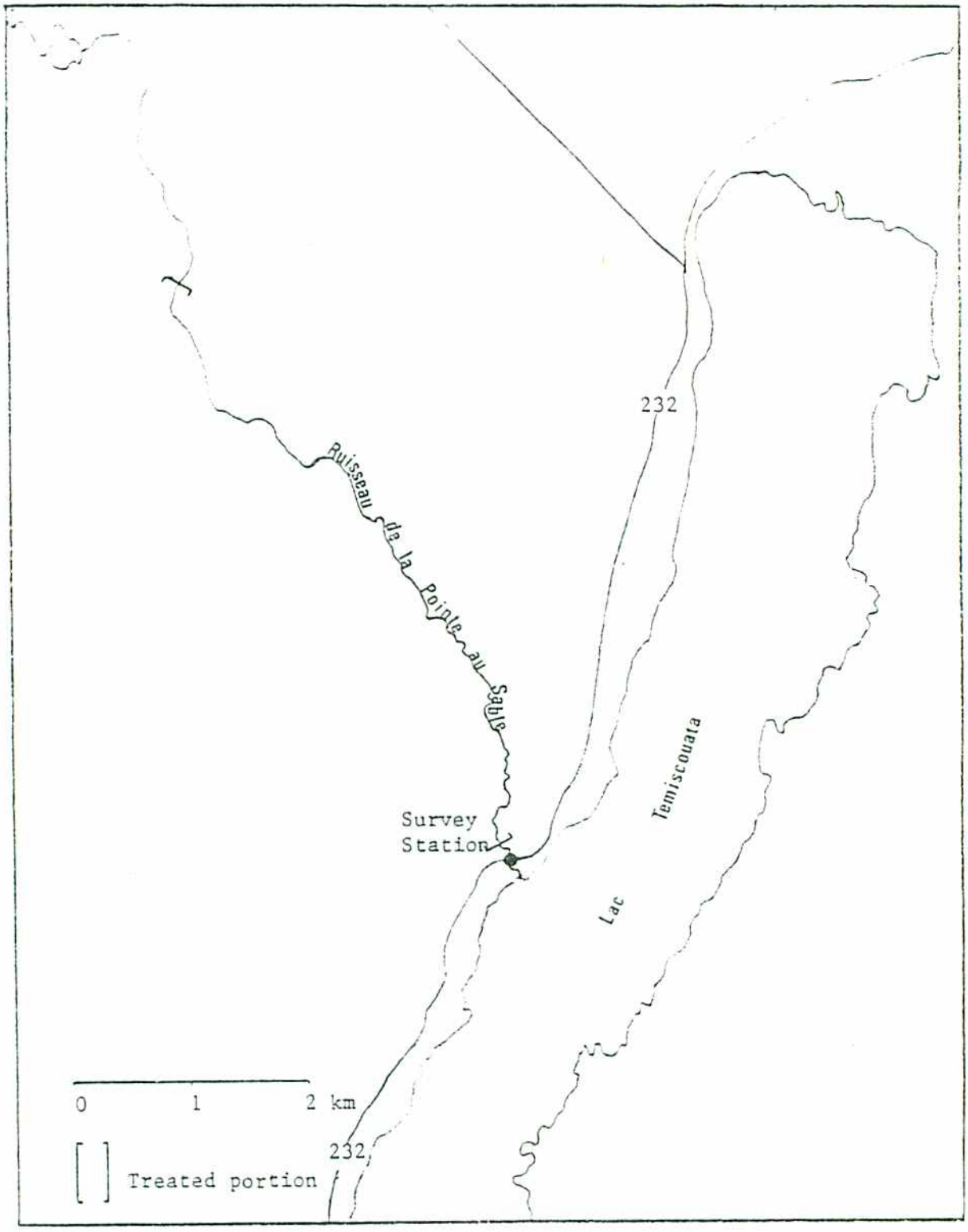


Figure 4
Sampling Station

Temiscouata County, Quebec

Table 1
Site description for study streams
Temiscouata County, Quebec
1978

Station	Approximate Width	Approximate Depth	Flow Description	Instream Cover	Shoreline Cover	Bottom Type	Surber Site
Control	2 - 5 m	10 - 50 cm	medium fast current frequent interspersion of riffles and pools	abundant - fallen trees and logs	30-90% canopy alder flanked by spruce, aspen, cedar	small stones, gravel, sand, silt deposits	Depth-approx. 12 cm Current- med. fast Bottom-gravel, small stones
North Baker	7 - 8 m	20 - 60 cm (pools up to 200 cm)	medium fast to fast current - few pools mainly riffles	available - logs, branches, boulders	10-20% canopy alder and willow flanked by cedar, spruce, and lowland hardwoods	boulders, rubble, gravel, few silt deposits	Depth-approx. 12-30 cm Current-medium to fast Bottom-gravel, small to large stones
Little Baker	4 - 8 m	20 - 70 cm	extensive medium fast to fast riffle areas- few pools	limited-logs, branches, boulders	20-30% canopy alder and willow	boulders, rubble, gravel-pools with sand and silt	Depth-approx. 30 cm Current-slow to medium Bottom-gravel, small to large stones
Downstream Baker	7 - 9 m	25 - 150 cm	mainly slow - small section of riffles	limited - logs, undercut banks	0-2% canopy alder, willow, marsh grasses	gravel, sand, clay	Depth-approx. 30 cm Current-slow to medium Bottom-gravel, sand, clay
Pointe au Sable	5 - 7 m	10 - 30 cm (pools up to 100 cm)	medium to medium fast current frequent riffles	limited - logs, boulders	0-30% canopy alder, poplar, spruce	boulders, rubble, gravel, sand, some heavily silted areas	Depth-approx. 15 cm Current-medium to medium fast Bottom-gravel, small to medium stones

Figure 5
Pawnee D aircraft applying Permethrin
to Larose Forest, Ontario

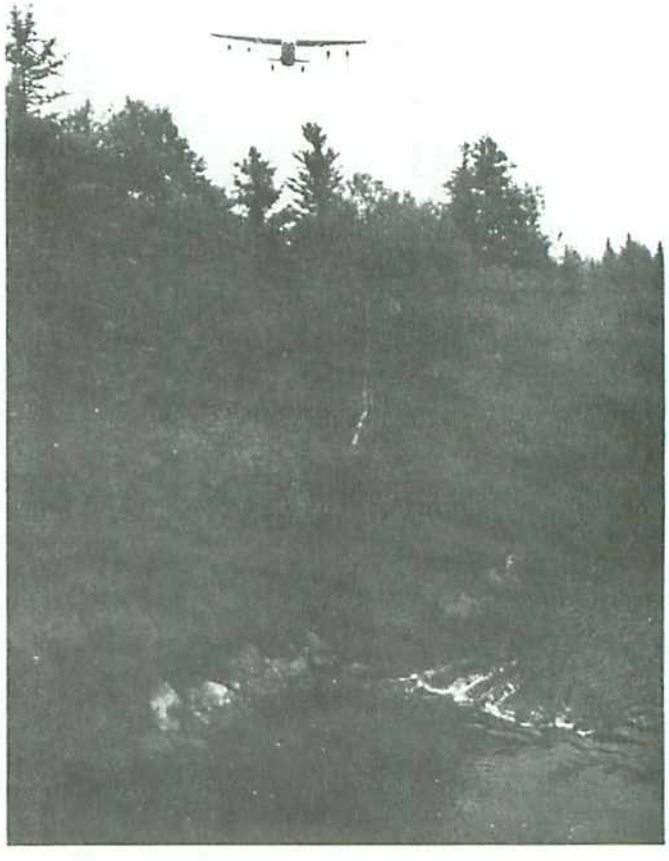


Figure 6
Cessna 185 aircraft applying Permethrin
to study stream, Temiscouata County, Quebec

Deposit was measured on double aluminum plates, one plate covered with a 100 cm^2 Kromekote paper card. The plates were placed at approximately 15 m intervals on floats or stakes in the water and along the banks. After the spray the deposit samplers were transported to the laboratory for volumetric deposit analysis. The aluminum plates were washed with 5 ml of absolute methanol and the amount of dye in the resulting solution was measured colourimetrically. Deposit on the Kromekote cards was determined using a spot-counting system (Hurtig et al. 1953).

Insecticide Residue Analysis

Samples of fish, stream bank foliage, surface water, and bottom sediment were taken periodically before and after the pesticide applications for analysis of Permethrin residue. In Larose Forest, fish were collected from a supplementary sample pond (F1, Fig. 1) within the treatment area. Water and bottom sediment were sampled from one treatment (T-2), the control, and the fish pond.

Water, foliage, and fish residue samples were taken periodically from each of the study streams in Quebec.

Insecticide residues were analyzed by the Technical Department of Chipman Inc. in Stoney Creek, Ontario. A representative 50 g sample of foliage was macerated in a blender containing 200 ml of 80%:20%, V:V, hexane:acetone. The ground material was filtered, and extracted three times with 150 ml distilled water and 25 ml of a 1 M sodium sulphate solution. The lower aqueous and emulsified material phases were discarded then each time. A 40 ml portion was drained off after extraction and evaporated to near dryness, and made up to a final volume of 10.0 ml. A 2.0 ml aliquot of this solution was put on a chromatographic column containing 2 g of Merckogel and washed with 25 to 35 ml of hexane to remove the impurities, followed by 15 ml of 2.5% diethyl-ether in hexane solution to elute the Permethrin. This volume was collected, reduced to near dryness on a rotary evaporator, redissolved in hexane, and then transferred to a 5 g activated florisil column for final washing with 25 to 35 ml of hexane. The Permethrin was then eluted with 50 ml of a 5% diethyl-ether in hexane solution. This eluate was collected and its volume reduced to 2.0 ml from which a 7.5 µl fraction was taken and injected in a gas chromatograph fitted with an electron capture detector. A concentration (ppm) was derived by comparison of its peak with a reference standard peak.

A representative 100 g sediment sample was ground, filtered, and extracted as per foliage. An 80 ml aliquot was collected from the extract and reduced to a volume of 10.0 ml. Of this, 2.0 ml were cleaned on a 10 g activated florisil column with 15 ml of hexane. The Permethrin was eluted with 175 ml of a 5% diethyl-ether in hexane solution. The volume of the eluate was then reduced to 2.0 ml from which a 7.5 µl portion was injected in the chromatograph.

Two litre water samples were extracted twice with 100 ml of hexane and rinsed with a further 25 ml of hexane. The solvent containing the extract and the rinsings was collected, consolidated, and reduced to a volume of 10.0 ml. From this, a 2.0 ml aliquot was cleaned on a Merckogel column with 10 ml of hexane. The Permethrin was eluted with 10 ml of a 2.5% diethyl-ether in hexane solution. This eluate was then collected and reduced to 2 ml from which a 7.5 µl fraction was sampled and injected in the gas chromatograph.

Twenty grams of whole fish were ground for 3 minutes in 40%:60%, V:V, acetone:hexane (150 ml) and granular anhydrous sodium sulphate (100 g), transferred to a Buchner funnel, and filtered through a No. 4 Whatman filter paper into a Erlenmeyer flask by suction. The filtered material was extracted a second time in 50 ml of extraction solvent, then re-extracted and filtered as above. Acetone (100 ml) and ethylether (100 ml) were used to rinse the blender container and then passed through the previously filtered material. The extract was transferred to a round bottomed flask and evaporated to dryness or until a film of oily extract remained.

The extract was re-dissolved in 20.0 ml ethyl acetate, from which a 10.0 ml aliquot was taken and transferred to a separatory funnel. This was partitioned with 50.0 ml acetonitrile saturated with hexane and 25.0 ml hexane, and set aside for 10 minutes to allow the phases to separate. The lower phase (acetonitrile) was transferred to a second separatory funnel and the hexane phase partitioned with 10.0 ml acetonitrile saturated with hexane. The two acetonitrile phases were combined and partitioned with 25.0 ml hexane, and left for 5 minutes to allow for separation. The hexane phase and any emulsified materials were discarded.

A 70 ml acetonitrile aliquot was drained off, transferred to a round bottomed flask, and evaporated to dryness with a rotary evaporator. The dry extract was re-dissolved with hexane and transferred quantitatively to a graduated centrifuge tube, resulting in a final volume of 10.0 ml. A 7.5 µl fraction of this solution was injected in the gas chromatograph for comparison with a reference peak.

Water Quality and Stream Flow Analysis

Water quality parameters were measured in the field before and after the Permethrin applications, using Hach model AL-36B and DR-EL/2 portable test kits. Water volumes were not determined in the study ponds, but relative depth measurements were made at each sampling time to provide an indication of changes in water levels.

Stream flow was calculated using the following formula:

width (m) x average depth (m) x current velocity (m/sec) = m^3/sec stream flow

Measurements were taken with a metre stick and either a Teledyne Gurley No. 625 Pygmy Current Meter or a Teledyne Gurley No. 665 Direct Reading Current Meter.

Biological Sampling

Zooplankton. Pre- and post-spray sampling of zooplankton populations was conducted in the study ponds using a 12 ℓ Schindler-Patalas plankton trap (Schindler, 1969). The samples were immediately preserved in formaldehyde and taken to the laboratory for subsequent counting and identification.

Drifting Organisms. Numbers of drifting invertebrates in the study streams were monitored with the use of drift nets before and after the spray applications. The nets, measuring 0.47 x 0.32 m, were positioned in the streams to collect drifting organisms from a column of water for a predetermined length of time (Figure 7). The nets were placed such that a water column was sampled from the surface to the stream bottom where possible, and from the surface to the net bottom where water levels exceeded the height of the net opening. The current velocity and the depth of the water at the net opening were measured and recorded with each sample (Fig. 8). The collected organisms were picked from the samples and preserved in 30% methanol to be counted and identified in the laboratory. The resulting numbers were then quantified and expressed as organisms per cubic metre of water using the following formula:

$$\frac{\text{number of organisms collected}}{\text{depth of water column sampled (m) x width of net opening (0.47 m) x current velocity (m/sec) x sample duration (sec)}}$$

Drift samples were taken twice daily, morning and evening, before and after the spray, and at more frequent intervals immediately following each treatment.

Bottom Dwelling Organisms. Bottom fauna populations were periodically assessed in each of the study areas with the use of a 0.093 m^2 Surber sampler (Surber, 1936). The pre- and post-spray samples collected from the Larose Forest ponds were preserved whole in 10% formaldehyde and later picked, counted, identified, and tabulated as number of organisms per sample.

Surber samples from the study streams were picked immediately and preserved in 30% methanol and subsequently counted, identified, and presented as mean number and standard deviation of four samples. Organisms collected from four randomly chosen rocks (approximately 20 cm in diameter) at each stream station were used to supplement the bottom fauna population study. The invertebrates were picked and documented in the same way as described for stream surber sampling.

Figure 7
Drift net being set in stream sampling station

Figure 8
Stream velocity measurement being taken at drift station

Non-target Insect Knockdown. Qualitative sampling of the non-target insect kill in the Larose Forest experimental spray area involved the collection, preservation, and identification of dead insects found floating on the surface of the ponds. Collections were made immediately following and for several days after the Permethrin applications.

Terrestrial insect knockdown was measured quantitatively with the drift nets set in the study streams. Terrestrial organisms were separated from the drift samples, counted, identified, and recorded as number of organisms per 10 m^2 of surface water flowing through the net, calculated as follows:

$$\frac{\text{number of organisms}}{\text{width of net opening (0.47 m) x currently velocity (m/sec) x sample duration (sec) x 10}}$$

Other Invertebrate Mortality. Supplementary invertebrate mortality studies in Larose Forest involved placing live organisms in fine mesh bags suspended just beneath the surface of the treatment and control ponds. The number of living organisms in each bag was tallyed at regular intervals before and after the pesticide application. The invertebrates used in this study included adult predacious diving beetles (Coleoptera: Dytiscidae), water boatmen (Hemiptera: Corixidae), whirligigs (Coleoptera: Gyrinidae), caddisfly larvae (Trichoptera), dragonfly nymphs (Odonata: Anisoptera), non-biting mosquito larvae (Diptera: Chaoborus), and water mites (Hydracarina).

Fish Diet and Mortality. Studies of fish mortality in Larose Forest were conducted in a manner similar to that described above for invertebrate mortality. Several species of fish including cyprinids (pearl dace, *Semotilus margarita* (Cope), golden shiners, *Notemigonus crysoleucas* (Mitchill), common shiners, *Notropid cornutus* (Kutland), central mud-minnows, *Umbra limi* (Kutland), and brown bullheads, *Ictalurus nebulosus* (Lesueur), as well as frog larvae, *Rana clamitans* (Latreille), were caught in a 50 ft seine and placed in screened plastic containers suspended in the treatment and control ponds. Prior to and at intervals following the Permethrin applications, the living organisms were counted and recorded.

Fish mortality studies as such were not included in the Quebec stream study program, however, direct observations on fish populations within the study streams were recorded.

Indigenous fish populations from each of the streams were sampled with the use of an electro-shocker for measurement, sexing, and diet analysis. Total length, fork length (when applicable), weight,

and sex were determined for each of a minimum sample of 10 fish using a measuring board, an Ohaus 1600 gram capacity balance, and dissecting tools. The stomach from each of the fish was extracted and preserved to be opened later and analyzed for content and volume. The slimy sculpin, *Cottus cognatus* (Richardson) was the main species collected for this study, although samples were occassionally supplemented with ling, *Lota lota* (Linnaeus), and brook trout, *Salvelinus fontinalis* (Mitchell).

RESULTS

Pond Studies

Water Quality. Most water quality parameters measured in the ponds fluctuated to some extent throughout the sampling period (Table 2). The inconsistencies appeared to be related to weather and seasonal changes with steadily increasing temperatures and decreasing water levels. Periodic water level measurements indicated a total drop of 56 cm of water in the control pond and a reduction of 18 cm in T2 pond, while T1 and T3 had completely dried up by the end of the three month sampling season.

Insecticide Deposit. Measurements of insecticide deposit from the first application show that the percent, mean density, and mean droplet diameter values of the deposit increased consistently from the southernmost to the northernmost pond (Table 3). The second application resulted in variable volumes and droplet densities but virtually identical droplet sizes were deposited in all four treatment ponds. Deposit volumes determined by the spot counting analysis varied from 0.16 to 2.44 l/ha (12.1 to 182.0% deposit) while the colourimetric analysis produced results ranging from 0.25 to 1.07 l/ha (18.7 to 79.9% deposit). Unusually high results were obtained from the spot counting method in instances where the aircraft passed directly over the deposit samplers resulting in a high density of large droplets deposited.

Insecticide Residues. Measured amounts of Permethrin in water samples from the treatment ponds never exceeded 2.66 µg/ℓ and did not persist beyond 48 hours (Table 4). The sample ponds contained 2.3 to 4.5 times greater amounts of pesticide following the first application than the level of residues found in the water after the second application. The pattern of insecticide degradation was similar after both sprays with no detectable amounts of Permethrin found in F1 after 12 hours and in T1 after 24 hours. No insecticide was detected in the water of the control ponds following either application.

Table 2
Water quality parameters in study ponds
Larose Forest, Ontario
1978

Sample Station	Date (1978)	Temperature °C	Dissolved O_2 mg/l	pH	Hardness mg/l $CaCO_3$	Alkalinity mg/l $CaCO_3$	Colour
Control	16 May	15	8	7.5	137	N/A	N/A
	22 May	19	11	10.0	140	35	75
	26 May	23	10	7.1	60	80	10
	30 May	26	10	7.2	110	10	60
	3 June	22	10	7.3	80	5	50
	9 June	20	8	7.5	60	10	50
	12 June	21	8	7.2	110	70	75
	20 June	21	7	8.0	160	70	100
	27 June	21	6	6.0	150	100	70
	5 July	24	7	N/A	170	10	N/A
T1*	17 May	14	5	6.0	51	N/A	N/A
	22 May	17	3	6.2	60	40	275
	26 May	21	5	6.2	60	30	335
	30 May	22	5	5.8	50	20	375
	3 June	19	6	6.2	50	30	325
	9 June	18	5	6.6	45	25	350
	13 June	19	8	6.8	40	10	250
	20 June	20	4	6.5	40	10	10
	27 June	21	3	6.0	40	20	10
T2*	17 May	14	8	5.0	51	N/A	N/A
	22 May	18	6	5.3	50	50	500
	26 May	21	5	4.9	50	40	475
	30 May	22	6	5.7	40	5	500
	3 June	19	10	5.5	50	5	500
	9 June	19	4	5.8	30	15	500
	13 June	18	7	6.0	40	5	500
	20 June	20	6	6.3	40	10	20
	27 June	20	4	6.0	40	10	10
	5 July	21	4	N/A	80	10	N/A
T3*	17 May	15	6	6.5	85	N/A	N/A
	22 May	18	8	5.2	90	45	350
	26 May	20	6	6.4	90	35	200
	30 May	23	4	6.2	60	15	225
	3 June	18	3	6.4	40	20	260
	9 June	16	3	6.3	35	25	280
	13 June	19	3	6.6	90	10	150
	20 June	19	5	6.6	100	50	175
	27 June	21	2	6.7	80	20	125

* treated with 17.5 g AI/ha Permethrin on 31 May and again on 6 June 1978

Table 3
Deposit analysis of 17.5 g AI/ha Permethrin applied at an emission rate of 1.34 l/ha to study ponds
Larose Forest, Ontario
1978

		Spot Counting Analysis		Colourimetric Analysis		Mean Density	Mean Droplet
		l/ha	% deposit	l/ha	% deposit	(Drops per cm^2)	Diameter Deposited(μ)
Control	First spray	0.0	0.0	0.0	0.0	0.0	----
	Second spray	0.004	0.3	0.0	0.0	0.7	42.4
T1*	First spray	0.16	12.1	0.25	18.7	17.2	49.7
	Second spray	0.25	18.8	0.29	21.6	7.18	82.7
T2*	First spray	0.26	19.5	0.37	27.6	24.7	52.7
	Second spray	2.43	181.3	0.87	64.9	68.7	83.1
T3*	First spray	0.59	43.8	0.64	47.8	33.7	61.1
	Second spray	0.70	52.3	0.43	32.1	23.3	82.0
F1*	First spray	2.02	150.4	0.86	64.2	55.4	77.2
	Second spray	2.44	182.0	1.07	79.9	70.4	82.8

* treated with 17.5 g AI/ha Permethrin on 31 May and again on 6 June 1978

Table 4
Permethrin residues in water from ponds
Larose Forest, Ontario
1978

Sample Period	Control	T1	F1
First Application			
2 hr	N.D.	2.5 ppb.	2.6 ppb.
12 hr	N.D.	0.70 ppb.	0.40 ppb.
24 hr	N.D.	0.25 ppb.	N.D.
48 hr	--	N.D.	N.D.
96 hr	N.D.	N.D.	N.D.
Second Application			
2 hr	N.D.	1.1 ppb.	0.58 ppb.
12 hr	N.D.	0.36 ppb.	0.27 ppb.
24 hr	N.D.	0.26 ppb.	N.D.
48 hr	N.D.	N.D.	N.D.
96 hr	N.D.	N.D.	N.D.
7 day	N.D.	N.D.	N.D.
14 day	--	N.D.	N.D.
21 day	--	N.D.	N.D.
28 day	--	N.D.	N.D.

Limite of detection = 0.25 ppb.

N.D. = nondetectable

Pesticide residues in bottom sediment samples taken from T2 pond did not exceed 0.040 µg/g but persisted at a concentration of 0.010 µg/g for at least 28 days (Table 5). Detectable amounts of Permethrin were found in the control pond bottom sediment samples after the second application.

Fish samples from the F1 pond indicated that Permethrin residues reached a peak concentration of 0.12 µg/g in the fish 2 hours after the first application and then fell to below the limit of detection within 12 hours (Table 6). The second application resulted in a second accumulation of pesticide in the fish (up to 0.08 µg/g) which remained fairly stable for the duration of the sampling period (28 days). The occurrence of Permethrin was also documented from several untreated control fish samples.

Zooplankton. Results from zooplankton sampling in Larose Forest showed drastically fluctuating populations but did not indicate an effect of the Permethrin applications. Although zooplankton in the treatment ponds were reduced following the pesticide applications, a similar occurrence was documented for the control pond (Appendix Tables 1-4).

Bottom Fauna. Bottom fauna sampling did not indicate a significant overall effect of the Permethrin applications on bottom dwelling invertebrates. Numbers in samples fluctuated to a large degree but generally corresponded to similar changes in the control pond (Appendix Tables 5-8). Evidence of an impact of the pesticide was apparent only amongst three bottom fauna groups. Trichoptera larvae disappeared from all three treatment ponds immediately after the second spray, while Culicidae larvae were reduced from a prespray average of 3.9/0.093 m^2 to a postspray average of 0.2/0.093 m^2. Chironomid numbers declined substantially in two of the treatment ponds following the second application, and while they remained virtually absent in one of the ponds, the population in the second pond reached and exceeded prespray levels within two weeks.

Non-target Insect Knockdown. Following the first application to the forest ponds, large numbers of dead water boatmen, predacious diving beetles, whirligig beetles, and adult dragonflies were found in some of the treatment ponds, mostly within 24 hours of the spray. Smaller numbers of dead insects were found after the second treatment but over a longer period of time. Visual counts indicated that surface insects (water striders, whirligig beetles) disappeared from the treatment ponds and did not return within the monitoring period although still present at the untreated control pond. Insects apparently affected to a lesser extent included dragonfly nymphs, giant water bugs (Hemiptera: Belestoma), and predacious diving beetle larvae.

Table 5
Permethrin residues in sediment from ponds
Larose Forest, Ontario
1978

Sample Period	Control	T2
First Application		
2 hr	N.D.	0.030 ppm
12 hr	N.D.	0.020 ppm
1 day	N.D.	0.040 ppm
2 day	N.D.	N.D.
4 day	N.D.	0.030 ppm
Second Application		
2 hr	0.016 ppm*	N.D.
12 hr	--	0.040 ppm
1 day	0.10 ppm*	0.010 ppm
2 day	N.D.	0.025 ppm
4 day	N.D.	N.D.
7 day	N.D.	0.025 ppm
14 day	N.D.	0.007 ppm
21 day	0.02 ppm*	0.010 ppm
28 day	N.D.	0.010 ppm

N.D. - nondetectable

Limit of detection - 0.005 ppm

*See page 37 for comments

Table 6
Permethrin residues in fish from ponds
Larose Forest, Ontario
1978

Sample Period	Control	F1
First Application		
1 day prespray	0.06 ppm*	--
0 day prespray	--	N.D.
2 hr	0.06 ppm*	0.12 ppm
12 hr	--	N.D.
1 day	N.D.	N.D.
2 day	--	N.D.
4 day	N.D.	N.D.
Second Application		
2 hr	N.D.	0.07 ppm
12 hr	--	0.08 ppm
1 day	N.D.	0.08 ppm
2 day	--	0.03 ppm
4 day	--	0.08 ppm
7 day	0.16 ppm*	0.06 ppm
14 day	N.D.	N.D.
21 day	N.D.	N.D.
28 day	1.10 ppm*	0.05 ppm

N.D. - nondetectable

Limit of detection - 0.01 ppm

*See page 37 for comments

Other Invertebrate Mortality. Studies of the effects of Permethrin on selected aquatic invertebrates exposed to the treatments in Larose Forest are documented and summarized in Table 7. Definite results were difficult to attain because of inadequate insect caging facilities, increasing water temperatures and decreasing water levels. However, the data imply that caddisfly larvae, water boatmen, adult predacious diving beetles, whirligigs, and non-biting mosquito larvae were fairly susceptible to the pesticide, with most mortalities amongst these groups occurring within 2 hours of the initial application. Water mites and dragonfly nymphs appeared more resistant and survived for longer periods of time.

Fish Mortality. Results from fish and amphibian mortality studies in the forest ponds indicate that the pesticide applications did not contribute to mortality of these organisms (Table 8). The few occurrences of fish mortality in the treatment ponds reflect similar losses in the control samples and may be attributed to factors other than those induced by the Permethrin applications. No observations of fish mortality among native fish populations were made in any of the ponds.

Stream Studies

Water Quality and Stream Flow. Water quality of the study streams appeared to be relatively stable (Table 9). Water chemistry parameters were found to be typical of those associated with coldwater stream types and appeared suitable for sustaining fish and invertebrate populations. Results from stream volume measurements, as outlined on Table 9, indicate that the total stream flows declined by a moderate extent over the sampling period.

Insecticide Deposit. Data from deposit measurements indicate substantial variation with spot counting analysis results ranging from 0.05 to 1.93 l/ha (1.0 to 41.3% emitted) and colourimetric analysis data showing from 0.10 to 2.77 l/ha (2.1 to 59.2% emitted) deposit (Table 10). Shoreline samplers consistently received less deposit than instream samplers (40 to 76% less), but both shoreline and instream types indicated comparable mean droplet sizes. Droplet sizes remained fairly consistent for each application with the exception of the second treatment of Little Baker. Other applications averaged mean deposited droplet diameters of 58.7 μ while the second application to Little Baker resulted in a mean deposited droplet diameter of 46.2 μ.

In all instances, deposit results from the colourimetric analysis method were higher (10 to 51%) than those obtained from the spot counting calculations.

Table 7

Summary of caged invertebrate mortality study results in Larose Forest, 1978

Invertebrates			No. in samples	Control % Mortality -0 AM	+2 hr	+12 hr	+24 hr	+48 hr	+96 hr	T1 -0 AM	+2 hr	+12 hr	+24 hr	+48 hr	+96 hr	No. in samples	T1 % Mortality -0 AM	+2 hr	+12 hr	+24 hr	+48 hr	+96 hr	No. in Samples	T2 % Mortality -0 AM	+2 hr	+12 hr	+24 hr	+48 hr	+96 hr	-0 AM	+2 hr	+12 hr	+24 hr	+48 hr	+96 hr
Acarloida	Hydracarina		14	0	0	7	7	7	57	57	57	57	57			3	0	0	0	66	66	100							7	0	29	71	86	86	86	86	86	86	86	100
Odonata	Anisoptera	nymphs	9	0	0	0	0	11	67	67	67					9	0	0	0	44	44	67							10	0	0	0	30	30	30	30	50	80	90	100
Trichoptera		larvae	10	0	0	100										10	0	100											6	0	100									
Hemiptera	Corixidae	adults	4	0	75	100										10	0	100											2	0	100									
Coleoptera	Dytiscidae	adults	10	0	0	0	0	0	40	40	40	40	70			7	0	0	86	100									6	0	100									
	Gyrinidae	adults	7	0	14	28	28	86	86	100						6	0	100											4	0	75	75	75	75	100					
Diptera	Chaoborus		5	0	40	100										6	0	100											11	0	73	100								

Table 8

Summary of caged fish mortality study results in Larose Forest, 1978

Fish and Amphibians	No. in Samples	Control % Mortality -0 AM	+2 hr	+12 hr	+24 hr	+48 hr	+96 hr	T1 -0 AM	+2 hr	+12 hr	+24 hr	No. in Samples	T1 % Mortality -0 AM	+2 hr	+12 hr	+24 hr	+48 hr	+96 hr	-0 AM	+2 hr	+12 hr	+24 hr	No. in Samples	T2 % Mortality -0 AM	+2 hr	+12 hr	+24 hr	+48 hr	+96 hr	-0 AM	+2 hr	+12 hr	+24 hr
Bullheads (*Ictalurus sp.*)	18	0	0	0	0	0	5	5	5	5		13	0	0	0	0	0	0	0	0	0	0						N/A					
Minnows (*Cyprinidae*)	12	0	0	0	0	0	17	17	17	17		22	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	5	10	10	10	10
Bullheads (*Ictalurus sp.*)	24	0	0	0	0	0	4	4	4	4		20	0	0	0	0	0	15	15	15	15	15						N/A					
Tadpoles (*Rana clamitans*)	19	0	0	0	0	0	0	0	0	0		10	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0

Table 9
Water quality parameters in study streams
Temiscouata County, Quebec
1978

Sample Station	Date (1978)	Temperature (°C)	Dissolved O_2 (mg/ℓ)	Hardness (gpg Ca CO_3*)	Alkalinity (gpg Ca CO_3)	pH	Volume m^3/sec
Control	10 June	9	9	5	1	7.5	0.098
	1 July	12	8	4	3	7.5	0.093
	1 August	16	8	7	5	7.5	0.024
	25 October	2	12	5	4	7.5	N/A
Pointe au Sable	10 June	12	10	4	4	8.0	0.332
	1 July	12	8	6	5	9.0	0.164
	1 August	14	10	10	9	8.5	0.036
	25 October	3	12	6	2	7.5	N/A
North Baker	10 June	10	10	5	4	7.5	0.886
	1 July	12	9	5	3	7.5	0.956
	1 August	14	9	8	5	8.0	0.250
	25 October	3	11	6	4	7.5	N/A
Little Baker	10 June	9	10	4	2	7.5	0.847
	1 July	12	9	4	2	7.5	1.280
	1 August	14	9	6	5	8	0.153
	25 October	1	12	5	3	6.5	N/A
Downstream Baker	16 June	N/A	10	4	2	7.5	N/A
	1 July	12	9	4	2	7.5	2.122
	1 August	15	11	7	4	8.0	0.281
	25 October	1	N/A	N/A	N/A	N/A	N/A

* grains per gallon calcium carbonate

Table 10
Deposit analysis of 17.5 g AI/ha Permethrin applied at an emission rate of 4.68 l/ha to study streams
Temiscouata County, Quebec
1978

	Spot Counting Analysis		Colourimetric Analysis		Mean Density	Mean Droplet
	l/ha	% deposit	l/ha	% deposit	(Drops per cm^2)	Diameter Deposited(μ)
Control	0.0	0.0	0.0	0.0	0.0	----
Pointe au Sable						
First spray instream	0.32	6.9	0.66	14.1	15.6	61.7
shoreline	0.1	2.3	0.25	5.3	9.0	52.5
Second spray instream	0.12	2.7	0.16	3.4	4.4	60.0
shoreline	0.05	1.0	0.10	2.1	2.8	63.0
North Baker						
First spray instream	1.93	41.3	2.77	59.2	104.5	60.0
shoreline	0.86	18.3	1.20	25.6	57.1	54.7
Second spray instream	1.23	26.3	1.37	29.2	58.1	61.2
shoreline	0.29	6.1	0.42	9.0	20.6	54.9
Little Baker						
First spray instream	1.71	36.4	2.33	49.9	92.7	61.3
shoreline	1.13	24.1	1.87	40.0	69.4	58.1
Second spray instream	0.44	9.4	0.57	12.1	25.0	49.8
shoreline	0.16	3.4	0.21	4.5	13.4	42.7

Insecticide Residues. The amounts of Permethrin measured in water samples taken from the treatment streams ranged from 0.23 to 1.8 ug/l and fell to below the limits of detection (0.2 ug/l) within 24 hours (Table 11). Unexplained insecticide residues were also measured in the 7 day and 96 hour postspray samples from the control station and Little Baker, respectively.

Results from stream bank foliage sampling indicate that the pesticide accumulation was minimal (generally less than 1.0 ppm) but persisted for at least 12 days after the second application (Table 12). Analysis of Permethrin residues in fish produced extremely variable results which are presented in Table 13.

Aquatic Invertebrates. The initial application of Permethrin to the three treatment streams resulted in a sharp increase in the number of drifting organisms (Fig. 9). The effect was apparent immediately following the spray and remained evident for a relatively short period (about 15 hours). Although the patterns of increase in each stream were similar, the numbers of organisms varied, with the magnitude of the drift increases correlated to the persistence of insecticide residues found in the streams (Table 11). These increases consisted mainly of baetid and heptagenid mayfly nymphs (Ephemeroptera: Baetidae and Heptageniidae), stonefly nymphs (Plecoptera), and caddisfly larvae (Trichoptera). Much smaller and shorter lasting increases were evident among blackfly larvae (Diptera: Simuliidae) and midge larvae (Diptera: Chironomidae). More detailed descriptions of drift increases and composition for each stream are included in the appendix (Tables 9-12).

The second Permethrin applications resulted in a second increase in drift, similar in duration to the first, but smaller in magnitude (6 to 22% of the total peak numbers recorded after the first application). The extent of the increases again correlated with the persistence of the insecticide residues in the streams. The second increases consisted mainly of stonefly nymphs which represented 20.1 to 44.3% of the total drift in different streams. Caddisfly larvae, which comprised a major portion of the first increases, were virtually absent from the drift following the second sprays. Table 14 summarizes the changes in numbers of the four most frequently occurring drift organisms. Drift net catches in the control stream remained relatively stable throughout the sampling period.

Data from bottom fauna sampling indicate that populations decreased significantly after the initial applications of pesticide. The second applications resulted in a further reduction of bottom dwelling organisms in all three streams (Figures 10 and 11). Results from Surber and rock sampling were similar and showed that the most significantly affected organisms were those that had demonstrated the greatest increases in drift. Heptagenid mayfly nymphs and caddisfly larvae were virtually eliminated from the stream bottoms while

Table 11
Permethrin residues in water from streams
Temiscouata County, Quebec
1978

Sample Period	Control	Pointe au Sable	North Baker	Little Baker	Downstream Baker
First Application					
½ hr	--	0.25 ppb	0.55 ppb	0.43 ppb	N.D.
2 hr	N.D.	N.D.	Trace	0.23 ppb	Trace
12 hr	--	N.D.	N.D.	N.D.	N.D.
24 hr	N.D.	N.D.	N.D.	N.D.	N.D.
48 hr	--	N.D.	--	N.D.	--
96 hr	N.D.	N.D.	--	--	--
Second Application					
½ hr	--	0.36 ppb	1.3 ppb	1.8 ppb	N.D.
2 hr	--	N.D.	Trace	0.67 ppb	N.D.
12 hr	--	N.D.	--	N.D.	--
24 hr	--	N.D.	--	N.D.	--
48 hr	--	N.D.	--	N.D.	--
96 hr	--	N.D.	--	0.60 ppb	--
7 day	0.26 ppb*	N.D.	--	--	--
14 day	--	N.D.	--	--	--

N.D. = Nondetectable
Trace - <0.25 ppb

Limit of detection - 0.2 ppb
*See page 39 for comments

Table 12
Permethrin residues in streamside alder foliage
Temiscouata County, Quebec
1978

Sample Period	Pointe au Sable	Little Baker
First Application		
0 hr	N.D.	N.D.
2 hr	0.52 ppm	1.08 ppm
1 day	0.44 ppm	0.94 ppm
2 day	0.41 ppm	0.69 ppm
4 day	1.07 ppm	0.56 ppm
Second Application		
2 hr	1.11 ppm	0.68 ppm
1 day	0.40 ppm	--
2 day	0.27 ppm	0.71 ppm
4 day	0.43 ppm	0.43 ppm
8 day	--	0.56 ppm
12 day	0.43 ppm	0.61 ppm

N.D. - Nondetectable
Limit of detection - 0.01 ppm

Table 13
Permethrin residues in fish from streams
Temiscouata County, Quebec
1978

Sample Period	Control	Pointe au Sable	North Baker	Little Baker
First Application				
8 day prespray	--	--	--	N.D.
7 day prespray	--	--	--	--
6 day prespray	--	--	0.12 ppm*	0.17 ppm*
3 day prespray	0.06 ppm*	--	--	--
2 day prespray	--	0.03 ppm*	--	--
1 day prespray	--	--	--	--
1 day postspray	--	0.03 ppm	--	--
2 day postspray	--	--	0.08 ppm	0.06 ppm
3 day postspray	0.03 ppm*	--	--	0.04 ppm
Second Application				
1 day postspray	--	--	--	--
2 day postspray	--	--	--	0.05 ppm
3 day postspray	--	--	--	--
4 day postspray	--	--	N.D.	--
6 day postspray	--	0.01 ppm	--	--
8 day postspray	--	--	--	--
10 day postspray	--	--	--	0.11 ppm

N.D. - nondetectable
Limit of detection - 0.01 ppm
*See page 39 for comments

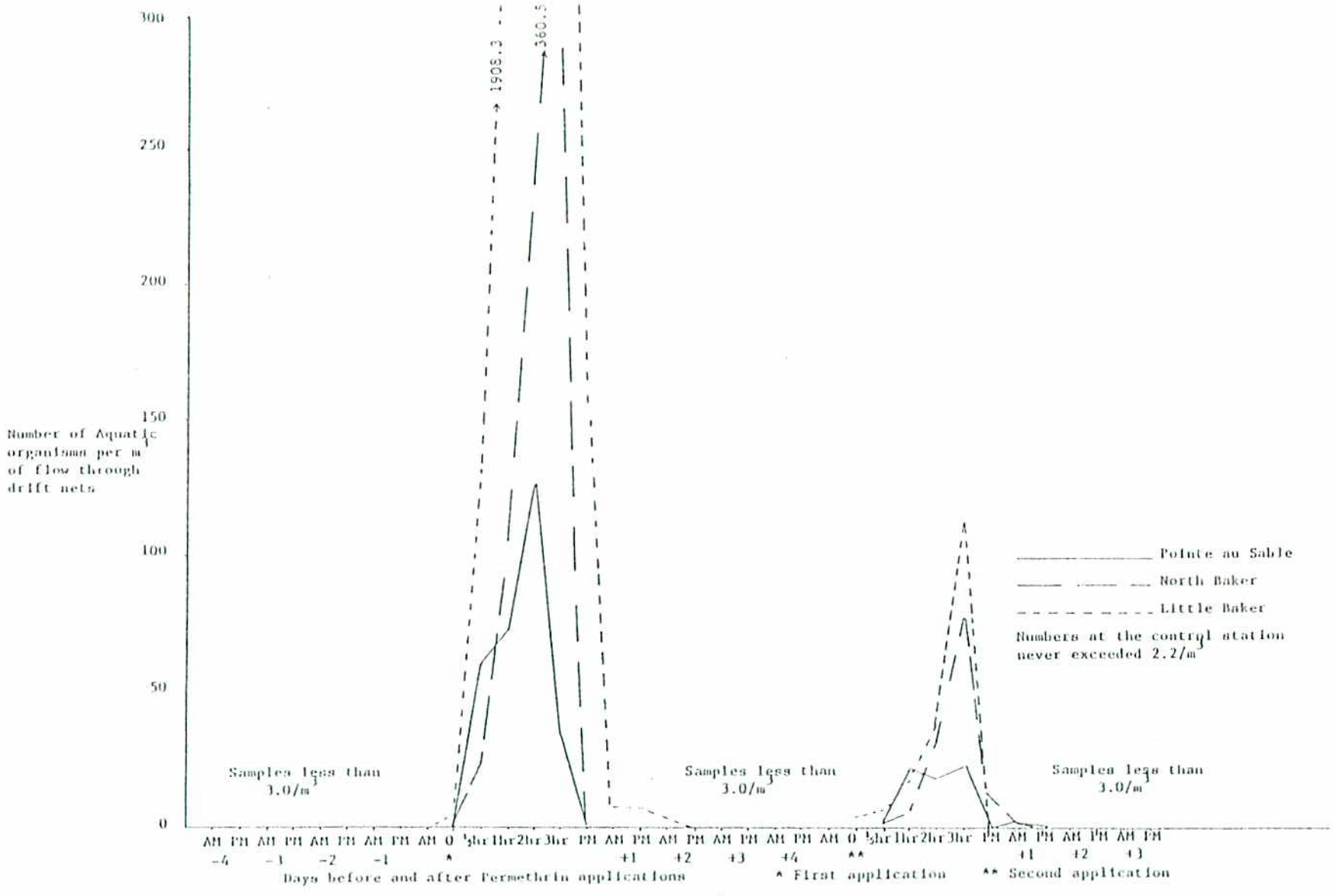


Figure 9 Aquatic organisms caught in drift nets set in study streams, Temiscouata County, Quebec, 9 June to 24 June, 1978

Table 14

Summary of selected aquatic invertebrates*
caught in drift nets set in study streams
Temiscouata County, Quebec
1978

Location	Heptageniidae no./m^3	Baetidae no./m^3	Plecoptera no./m^3	Trichoptera no./m^3
North Baker				
Prespray average	0.01	0.07	0.02	0.04
First postspray peak	16.8	164.4	51.8	60.8
Second postspray peak	4.5	6.5	35.4	1.2
Little Baker				
Prespray average	0.04	0.28	0.18	0.07
First postspray peak	172.0	470.0	1050.0	320.0
Second postspray peak	0.0	7.9	22.6	3.0
Pointe au Sable				
Prespray average	0.04	0.0	0.02	0.01
First postspray peak	67.0	36.0	25.5	4.2
Second postspray peak	7.0	6.6	8.7	0.3
Control				
Prespray average	0.00	0.13	0.01	0.00
First postspray average	0.00	0.05	0.01	0.01
Second postspray average	0.00	0.03	0.00	0.01

*Expressed as number per cubic metre of flow through net

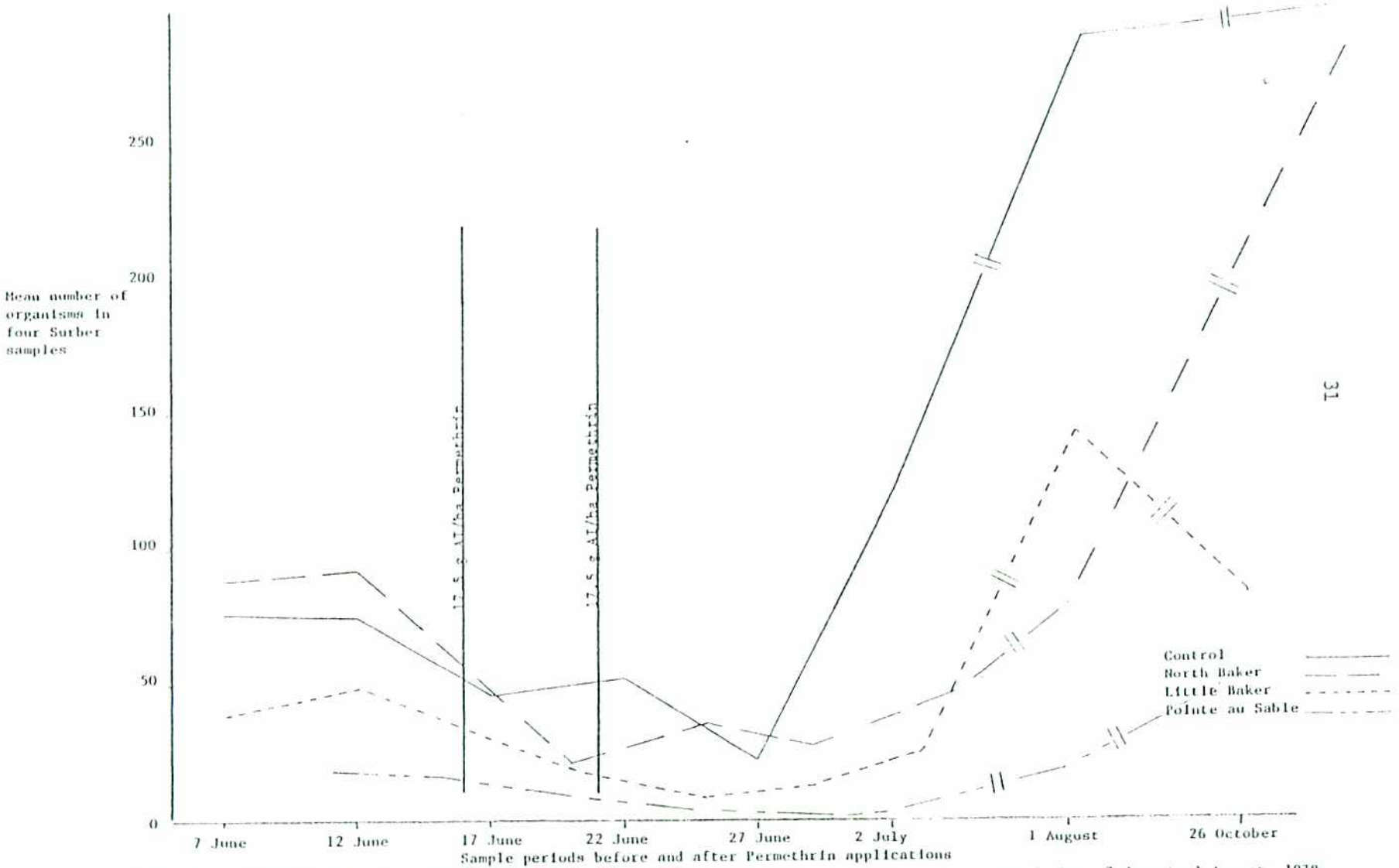


Fig. 10. Aquatic invertebrates collected in Surber samples from study streams, Temiscouata County, Quebec, 7 June to 1 August, 1978

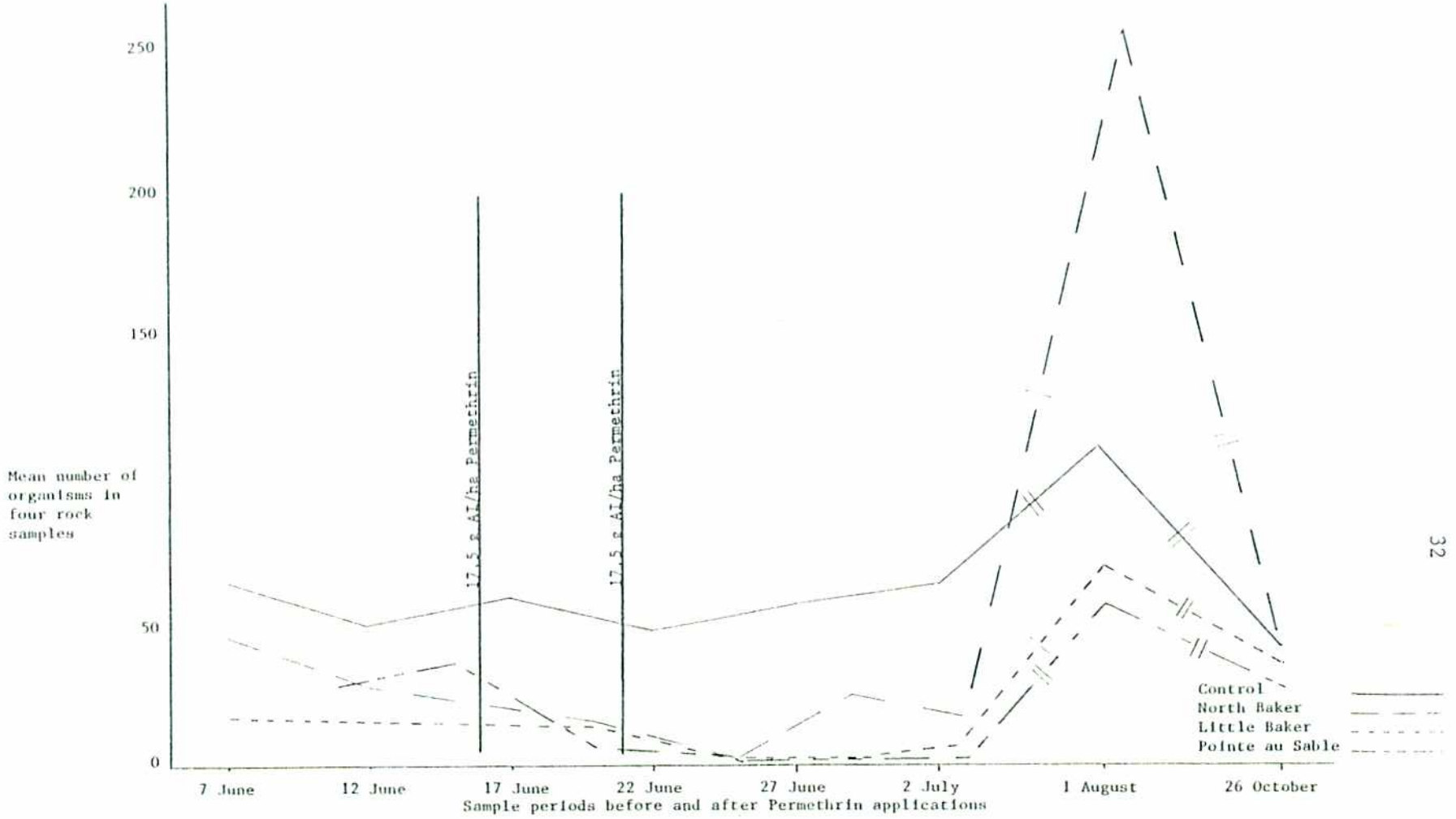


Fig. 11. Aquatic invertebrates collected from rocks taken from study streams, Temiscouata County, Quebec, 7 June to 1 August, 1978

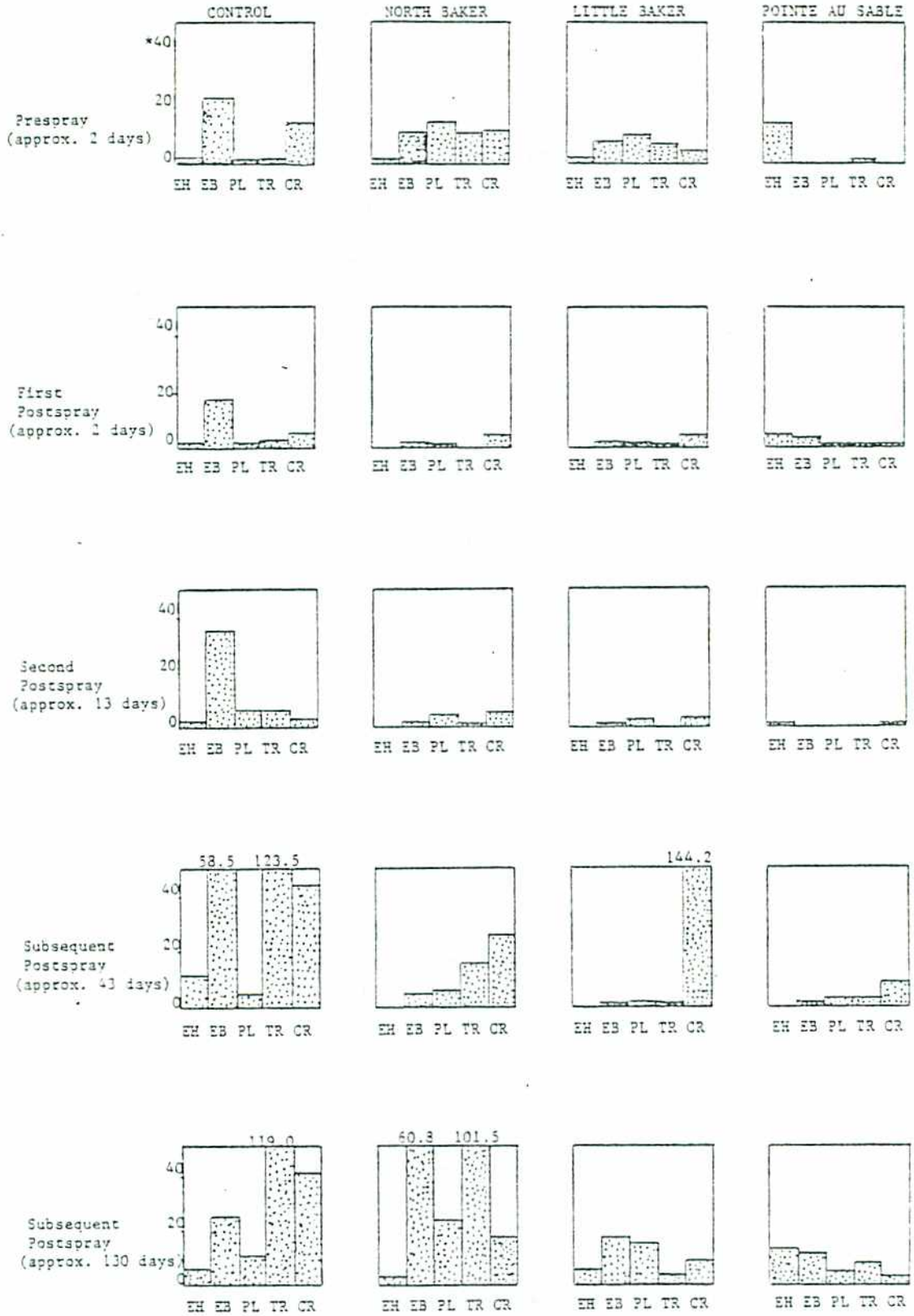
baetid mayfly nymphs, plecoptera nymphs, and midge larvae were reduced by 40 to 90% in most cases (Fig. 12). Complete sample results are listed in the appendix (Tables 13-20).

At the Downstream Baker station located 5.7 km below the North Baker station and 2.4 km from Little Baker, an increase in drifting organisms as well as a reduction in bottom fauna populations were documented following the first Permethrin applications (Appendix Table 21 and Table 22). The second applications did not substantially increase the drift numbers but did contribute to a further decline in bottom dwelling invertebrates in the untreated downstream area.

One and a half months after the treatment most of the affected organisms were showing significant trends toward recovery, with the exception of heptagenid mayfly nymphs which had not reappeared in any number in the streams despite steadily increasing populations at the control station. Midge larvae populations had exceeded prespray levels in all streams by early August reflecting a similar increase at the control. Subsequent sampling in mid-October indicated that bottom fauna populations had returned to or exceeded prespray and control levels (Fig. 12).

Non-target Insect Knockdown. Both Permethrin applications to the study streams resulted in substantial increases in the number of terrestrial organisms drifting on the stream surface (Fig. 13). These increases consisted largely of adult Diptera and Homoptera, as well as Hemiptera, Plecoptera, and Coleoptera adults. Knockdown persisted for 24 to 48 hours after each application (Appendix Tables 23-27).

Fish Diet and Mortality. No incidents of fish mortality were documented following the insecticide treatments, however, effects on fish food organisms were evident. Prior to the Permethrin applications, slimy sculpins in the streams were feeding on a variety of aquatic invertebrates of which heptagenid and baetid mayfly nymphs, stonefly nymphs, caddisfly larvae, and midge larvae were the most important (Appendix Tables 28-35). The increased number of drifting invertebrates directly following both applications was apparently utilized by the sculpins for opportunistic feeding, as the mean number per stomach, percent contribution to volume, and percent occurrence of the food organisms increased immediately subsequent to the treatments. However, as illustrated on Figure 14, the diet composition had become almost exclusively comprised of midge larvae one and a half months later. In one of the treatment streams the percent occurrence of empty stomachs in the sample fish increased from 17 to 20% to 40 to 60% during the postspray period, reflecting a reduction in available food. The results of supplementary fish samples including brook trout and ling showed a similar trend with initial heavy feeding on drifting organisms immediately after the spray followed by a subsequent decline in utilization of preferred food species (Appendix Tables 36-38).



EH - Ephemeroptera: Heptageniidae nymphs
EB - Ephemeroptera: Baetidae nymphs
PL - Plecoptera nymphs
TR - Trichoptera larvae
CR - Diptera: Chironomidae larvae
* Mean number of organisms in four Surber samples

Fig. 12. Populations of selected bottom dwelling invertebrates collected in Surber samples from study streams, Temiscouata County, Quebec, 7 June to 25 October, 1978

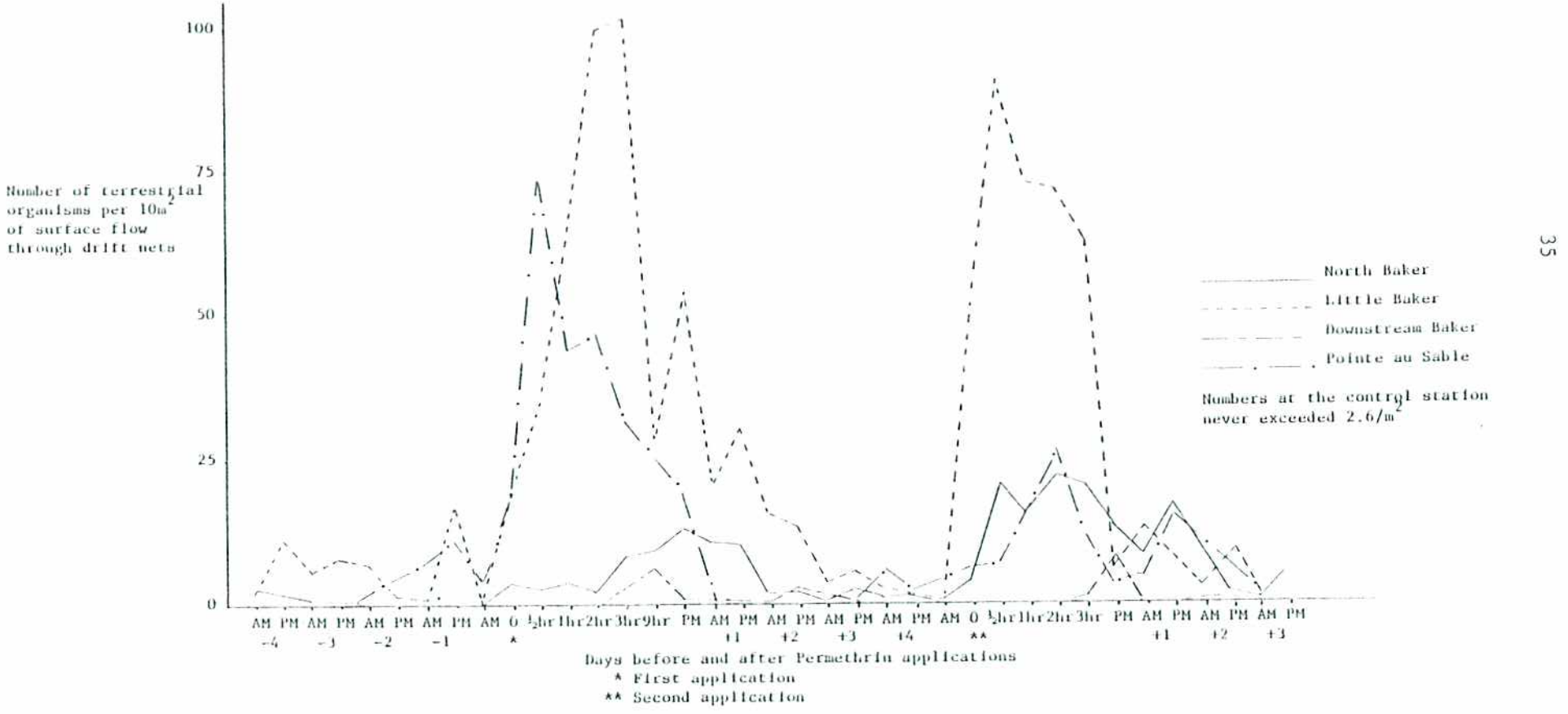
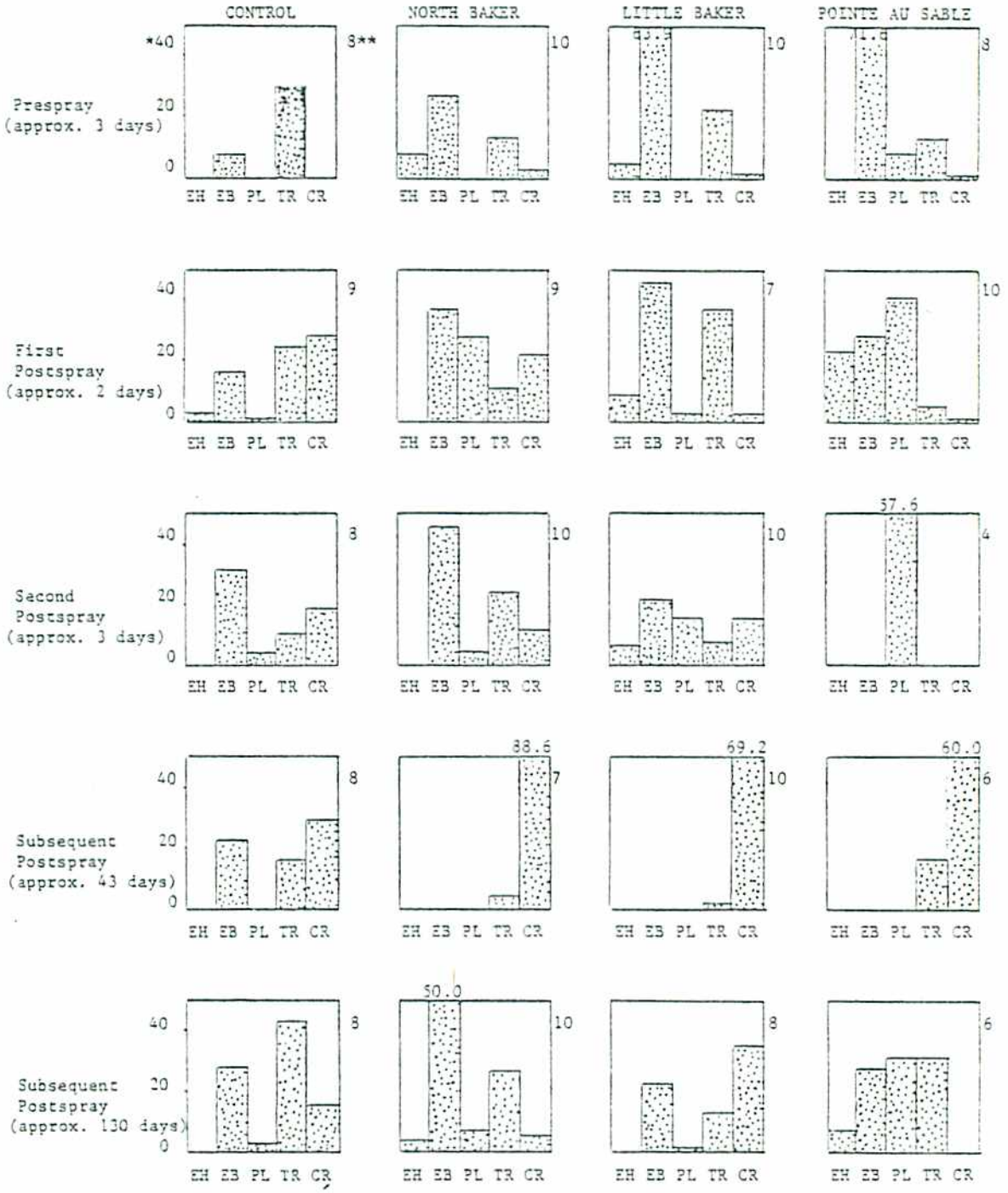


Fig. 13. Terrestrial organisms caught in drift nets set in study streams, Temiscouata County, Quebec, 9 June to 24 June, 1978



EH - Ephemeroptera: Heptageniidae nymphs
EB - Ephemeroptera: Baetidae nymphs
PL - Plecoptera nymphs
TR - Trichoptera larvae
CR - Diptera: Chironomidae larvae
* Mean percent contribution of food organism to volume
** Number of stomachs in sample containing food organisms

Fig. 14. Percent contribution of food organisms to diet of slimy sculpins taken from study streams, Temiscouata County, Quebec, 6 June to 25 October, 1978

Sampling of sculpin populations approximately four months after the treatment showed a return to a normal diet consisting of a variety of aquatic insects.

DISCUSSION AND CONCLUSIONS

Pond Studies

Insecticide Deposit. Deposition of the insecticide on the ponds varied to some extent but certain trends were evident. Measurements from the first application to Larose Forest indicate that the percent, density, and droplet size of the insecticide deposit increased as the distance from the centre of the observed flight path of the aircraft to the ponds decreased. The aircraft flew the spray line closest to all four treated ponds at an angle such that the distance from the centre of the flight path to the ponds increased as the plane moved north to south. This resulted in a progressively smaller deposit of emitted spray on the ponds located further south in the treated block.

The consistently higher deposit measurements documented for the second application correspond to recorded field observations stating that the aircraft passed directly over all the treated ponds. Variations in the deposit on individual ponds correlated well to the amount of surrounding canopy cover.

The unusually high deposit measurements obtained in some instances from spot counting analysis may have been because of the high droplet density on the sample cards and may not be reliable measurements of the actual volumetric deposit.

Insecticide Residues. Detectable amounts of Permethrin disappeared from the treatment ponds within 48 hours indicating that the persistence of the insecticide in standing water is relatively low. The accumulation of pesticide in fish and bottom sediment appears more stable. According to results from residue analyses, low levels of the insecticide in these samples persisted for the duration of the sampling period (28 days). The measurable quantities of Permethrin found in the control pond fish and bottom sediment were apparently due to contamination during collection, transportation, or analysis of the samples.

Effects of Insecticide on Invertebrates. Zooplankton populations displayed drastic fluctuations that were apparently not related to the insecticide applications as similar patterns were documented for the control pond.

Despite somewhat erratic results from pre and post-spray bottom fauna sampling, which may be attributed to inaccurate sampling techniques,

it is apparent that the Permethrin applications to the forest ponds were not overly detrimental to most benthic organisms. The second application to the ponds appeared significant in that the impact demonstrated by reduction in a few invertebrate groups became evident only following the second spray.

Both Permethrin applications resulted in substantial mortality of surface dwelling and terrestrial invertebrates. Certain groups were affected to an extent that they were eliminated from the treatment ponds for the duration of the monitoring period. Organisms that commonly inhabit surface and littoral sections of the ponds were affected to the greatest extent.

Mortalities amongst groups of selected aquatic invertebrates exposed to the treatments confirm indications from visual surface counts. Surface dwelling and littoral species, as well as caddisfly larvae, comprised the most sensitive groups used in the study, while water mites and dragonfly nymphs appeared less susceptible to the pesticide.

Effects of Insecticide on Fish. Recorded field observations and data from caged fish mortality studies indicate that the Permethrin applications did not result in fish mortalities.

Stream Studies

Insecticide Deposit. Deposit of insecticide from the treatments was variable, but comparable to results obtained from operational aerial pesticide application programs. The amount of deposition on the streams generally correlated to subsequent Permethrin residues found in the water, in that the streams with the greatest deposit contained the highest insecticide residue levels.

The lower deposit measurements from shoreline samples indicate that streamside foliage is effective in screening out a portion of the deposit and therefore less volume of emitted spray reaches the shoreline ground level than the amount deposited on an adjacent midstream water surface. Differences in deposited droplet diameters were not significant, suggesting that although streamside foliage effectively reduces total volume deposited, it does not eliminate specific droplet sizes.

Reduced droplet sizes deposited from the second treatment of Little Baker were apparently the result of the late morning application period. The Permethrin was applied at 1140 hours when the evaporation rate of the most volatile fraction of the spray formulation, the carrier diluent 585, was greatly increased because of higher air

temperature and lower relative humidity. The evaporation of the carrier diluent resulted in decreased droplet sizes deposited from this particular application. The smaller droplets in turn increased the occurrence of off target drifting, as evidenced by the lower droplet density and spray volume deposited on the second application than those documented from the initial treatment.

Insecticide Residues. The levels of Permethrin in the treated streams, which did not exceed 1.8 mg/l, were fairly unstable and disappeared within 2 to 12 hours. The insecticide residues measured in the 7 day and 96 hour postspray samples from the control station and Little Baker, respectively, were probably the result of mis-labelling or contamination of the samples.

Accumulations of pesticide in streamside foliage were generally minimal but more persistent, with detectable amounts still present 12 days after the second application. Fish residue analyses produced extremely variable results and do not appear to be reliable measurements of the actual pesticide accumulation. The discrepancies are apparently due to sample contamination during collection, transportation, and analysis of the fish.

Effects of Insecticide on Invertebrates. The Permethrin applications to the streams resulted in immediate and dramatic increases in the number of drifting organisms for a period of about 15 hours. Bottom fauna populations declined following the spray, with the second applications significant in further reducing the invertebrate numbers. These substantial increases in postspray invertebrate drift followed by significant reductions in bottom dwelling populations indicate that the impact of the insecticide was such that the recuperation and reestablishment of the affected organisms were not possible in the treated areas for at least 45 days. The effects of Permethrin were also documented below the treated sections of the streams. A reduction in bottom fauna at the downstream station indicates that residual insecticide from the upstream treated areas adversely affected the invertebrates in the lower section as well, even though water residue sample results from Downstream Baker showed a minimal or no trace of the pesticide. Lower drift numbers at the downstream station after the second treatment (Appendix Table 21) apparently resulted from a decrease in the number of invertebrates affected in the upstream portions.

Trends in re-establishment of invertebrate populations were evident by 45 days after treatment and a return to or above prespray levels was documented four months after the applications.

Increases in the number of terrestrial organisms drifting on stream surfaces were recorded following both pesticide treatments. The magnitude of the terrestrial insect knockdown in each stream correlates well with the existing stream cover. Since the pesticide was usually applied during early morning hours, insect flying activity was low and

therefore exposed insects inhabiting the peripheral foliage dropped to the ground or the water below when affected. The large increase in drifting terrestrial organisms at Little Baker reflects the comparatively dense foliage canopy characterisitic of this stream (Fig. 15).

Effects of Insecticide on Fish. Although no incidents of fish mortality were observed, the applications of Permethrin affected the diets of indigenous fish populations. Following initial opportunistic feeding on drifting invertebrates, the diet of native slimy sculpin populations shifted from various aquatic insects to almost exclusively midge larvae for a postspray period of at least 45 days. Bottom fauna sampling indicated that invertebrate populations had been significantly reduced during this period such that the most frequently selected fish food organisms would no longer be attainable and a greater dependence on the available species would result. A return to a normal diet was evident by four months after treatment.

GENERAL CONCLUSIONS

Water analysis results indicated that Permethrin residues never exceeded measured quantities of 2.6 mg/l and fell to below the limits of detection (0.25 mg/l) within 12 hours in streams and 48 hours in ponds. The magnitude and duration of increases in invertebrate drift correlated to the amount of insecticide residue in individual treatment streams.

Accumulations of pesticide in fish, foliage, and bottom sediment were not clearly defined but appeared to be fairly stable with measurable levels persisting throughout the monitoring period.

The applications of 17.5 g AI/ha Permethrin to forest ponds resulted in significant reductions of surface dwelling and littoral invertebrates but had limited effects on bottom fauna and zooplankton.

Immediate and dramatic increases in drifting organisms, followed by a substantial decline in bottom fauna populations, occurred in the treatment streams following both Permethrin applications. The second application was significant in further reducing populations to a point at which recovery of numbers was considerably slower than after the impact caused by a single application of this dosage (Kingsbury and Kreutzweiser, in press). The effects of both insecticide treatments persisted downstream from the treated portions for a distance of at least 2.4 km.

Although no incidents of fish mortality were documented, fish food organisms were affected to an extent that the diet of native slimy sculpin populations shifted from various aquatic insects to almost exclusively midge larvae for a postspray period of at least 45 days.

Figure 15
Little Baker Brook sampling station

The impact of Permethrin appeared limited to the season of application as invertebrate populations had returned to or exceeded prespray levels and a resumption of normal fish feeding activity was evident by four months after the treatments.

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APPENDICES

Table 1

Zooplankton populations*, untreated control pond
Larose Forest, Ontario
16 May to 4 July, 1978

Sample Period		16 May	22 May	26 May	30 May	3 June	9 June	12 June	20 June	27 June	4 July
Rotifera	Keratella	3	5	0	11	9	2	1	9	1	3
	Monostyla	34	49	0	13	23	0	7	4	1	3
	Asplanchna	19	8	0	12	15	2	10	22	8	3
	Others	12	16	0	2	9	4	5	8	4	4
	Subtotal	68	78	0	38	56	8	23	43	14	13
Cladocera	Daphnia	24	8	55	1	16	5	0	1	0	3
	Bosmina	0	1	0	0	2	0	1	0	0	0
	Chydorus	4	2	0	0	6	0	0	0	0	0
	Alona	6	9	0	9	25	3	1	12	2	2
	Subtotal	34	20	55	10	49	8	2	13	2	5
Ostracoda		8	0	0	1	0	2	0	2	0	1
Copepoda	Cyclopoida	63	26	20	42	823	33	22	35	24	15
	Immatures	347	24	335	310	317	974	85	40	222	16
	Subtotal	410	50	355	352	1140	1007	107	75	246	31
	TOTAL	520	148	410	401	1245	1025	132	133	262	50

* expressed as number of organisms per 24 l water sample

Table 2

Zooplankton populations*, T1 pond**
Larose Forest, Ontario
16 May to 27 June, 1978

Sample Period		16 May	22 May	26 May	30 May	3 June	9 June	12 June	20 June	27 June
Rotifera	Keratella	5	23	43	329	117	0	19	7	5
	Monostyla	3	6	7	3	13	0	2	2	5
	Asplanchna	166	8	8	31	44	0	4	3	38
	Others	3	2	4	0	0	0	0	1	2
	Subtotal	177	39	62	363	174	0	25	13	50
Cladocera	Daphnia	64	241	56	154	3	0	0	0	0
	Bosmina	0	0	0	0	0	0	1	0	0
	Simocephalus	31	0	0	0	0	0	0	0	0
	Scapholebeus	0	0	0	5	0	0	0	0	1
	Macrothrix	0	2	0	0	0	0	0	0	0
	Alona	0	0	0	0	0	0	0	1	0
	Polyphemus	54	8	0	0	0	0	0	0	0
	Subtotal	149	251	56	159	3	0	1	1	1
Ostracoda		1	45	30	11	17	0	2	3	0
Copepoda	Cyclopoida	408	790	161	119	76	5	25	2	28
	Immatures	359	89	23	85	118	5	105	9	117
	Subtotal	767	879	184	204	194	10	130	11	145
Malacostraca	Isopoda	0	0	1	0	0	0	0	0	0
	Amphipoda	0	0	1	0	0	0	0	0	0
	Subtotal	0	0	2	0	0	0	0	0	0
	TOTAL	1094	1214	334	737	388	10	158	28	196

* expressed as number of organisms per 24 l water sample
**treated with 17.5 g AI/ha Permethrin on 31 May and again on 6 June, 1978

Table 3

Zooplankton population*, T2 pond**
Larose Forest, Ontario
16 May to 4 July, 1978

Sample Period		16 May	22 May	26 May	30 May	3 June	9 June	12 June	20 June	27 June	4 July
Rotifera	Keratella	41	0	1	42	15	4	33	11	2	6
	Monostyla	35	2	0	27	9	0	6	0	1	0
	Asplanchna	16	0	0	31	12	4	36	7	33	8
	Others	7	6	4	10	6	29	4	0	0	8
	Subtotal	99	8	5	110	42	37	77	18	36	22
Tardigrada	Macrobiotus	0	0	0	1	0	0	0	0	0	0
Cladocera	Daphnia	1	1	1	3	0	0	0	0	0	0
	Scapholeberis	0	0	0	5	1	0	0	0	0	0
	Chydorus	25	2	5	17	4	1	3	0	2	0
	Polyphemus	0	0	0	1	0	0	0	0	0	0
	Subtotal	26	3	6	26	5	1	3	0	2	0
Ostracoda		8	0	0	2	3	0	3	0	0	0
Copepoda	Calanoida	3	0	0	0	0	0	0	0	0	0
	Cyclopoida	113	9	4	6	7	0	3	1	0	0
	Immatures	22	5	1	7	7	5	3	1	39	113
	Subtotal	138	14	5	13	14	5	6	2	39	113
Malacostraca	Amphipoda	1	0	1	0	1	0	0	0	0	0
	TOTAL	272	25	17	152	65	43	91	20	77	135

* expressed as number of organisms per 24 ℓ water sample
** treated with 17.5 g AI/ha Permethrin on 31 May and again on 6 June 1978

Table 4

Zooplankton populations*, T3 pond**
Larose Forest, Ontario
16 May to 27 June, 1978

Sample Period		16 May	22 May	26 May	30 May	3 June	9 June	12 June	20 June	27 June
Rotifera	Keratella	0	12	6	0	0	1	1	1	8
	Monostyla	0	0	0	0	0	0	0	0	2
	Ascomorphella	0	0	0	18	0	13	10	20	0
	Asplanchna	0	2	2	0	17	0	2	1	1
	Others	0	1	1	3	0	0	1	2	4
	Subtotal	0	15	9	21	17	14	14	24	15
Cladocera	Daphnia	0	5	1	7	0	0	0	2	6
	Simocephalus	0	0	2	12	10	0	0	0	0
	Chydorus	0	0	0	0	0	0	0	1	1
	Dunhevedia	0	2	0	0	0	0	0	0	0
	Alona	0	0	0	0	0	0	0	2	0
	Subtotal	0	7	3	19	10	0	0	5	7
Ostracoda		0	3	1	3	0	15	1	0	2
Copepoda	Cyclopoida	68	316	98	364	235	12	40	13	3
	Immatures	0	2	1	3	0	0	8	3	12
	Subtotal	68	318	99	367	235	12	48	16	15
	TOTAL	68	343	112	410	262	41	63	45	39

* expressed as number of organisms per 24 ℓ water sample
**treated with 17.5 g AI/ha Permethrin on 31 May and again on 6 June, 1978

Table 5

Bottom fauna populations*, untreated control pond
Ianoue Forest, Ontario
16 May to 4 July, 1978

Sample Period	16 May		22 May		25 May		30 May		3 June		9 June		12 June		20 June		27 June		4 July	
Ephemeroptera: Baetidae				1											1					
Odonata: Anisoptera: Libellulidae	1	1	1	2	1										1					
: Zygoptera: Coenagrionidae	2		1			1	1			1										
Hymenoptera				1																
Hemiptera: Corixidae				0				2							24			2	6	
Pleidae					3															
Trichoptera: larvae	1					1		4		1										
pupae										1										
Coleoptera: Haliplidae larvae													1				1	5		
adults			1		1	1									1		2			
Dytiscidae larvae								2							3					
adults					5	8														
Noteridae adults			2	1																
Gyrinidae adults				1																
Diptera: Chironomidae larvae	74	29	14	7	4	20	20	71		18		5	604		248	500	8			
pupae			1		1			2					2		3	4	1			
Meleidae larvae	1	1	1	1		4	2	1					2		1	1				
pupae													1							
Tabanidae larvae	5					5	4	2	1	1		5	1							
Tipulidae larvae								1												
Nematoda	1		1			6	12			6			7							
Oligochaeta	36	16		8	11	2	73	3	23			3	19		6	48				
Hirudinea		1																		
Gastropoda		2	1	2	2	1	2	5		1			4			5				
Pelecypoda									1	1	2	3	3							
Arachnida: Hydracarina			1	2	1	1										2				
TOTAL	121	55	23	30	32	41	114	9	111	30	3	16	673		243	567	15			

* expressed as number of organisms per 0.093 m^2

Table 6

Bottom fauna populations*, T1 pond**
Larose Forest, Ontario
17 May to 27 June, 1978

Sample Period	17 May		22 May		26 May		30 May		3 June		9 June		13 June		20 June		27 June	
Odonata Zygoptera Coenagrionidae nymphs	1							1						1				
Hemiptera Corixidae			1											2				
Trichoptera larvae			7	16		5		4	1	4	3							
Coleoptera Haliplidae adults	1																	
Dytiscidae larvae						1									1			
adults	1																	
Diptera Tipulidae larvae										1								
Culicidae larvae			4	1			22	16		1								
Chironomidae larvae	1														3			
pupae												2		6		1	47	23
Oligochaeta			7	2	1		5			6							1	
Gastropoda														10	1			2
Pelecypoda	1		1				6			4		1		4	2		3	6
Arachnida Hydracarina							1			10	1							
Crustaceae Isopoda	11		1	10			1			1								
TOTAL	16	-	21	29	6	1	39	18	27	3	1	3	0	23	7	1	51	31

no sample

* expressed as number of organisms per 0.093 m^2
**treated with 17.5 mg AI/ha Permethrin on 31 May and again on 6 June, 1978

Table 7

Bottom fauna populations*, T2 pond**
Larose Forest, Ontario
17 May to 4 July, 1978

Sample Period	17 May	22 May	26 May	30 May	3 June	9 June	13 June	20 June	27 June	4 July
Odonata: Anisoptera: Libellulidae nymphs	1			3					no sample	no sample
Hemiptera: Corixidae					1		1			
Trichoptera larvae	4			1	1	6				
pupae				1			1			
Coleoptera: Haliplidae adults		1								
Hydrophilidae pupae			1							
Chrysomelidae larvae				2		4				
Diptera: Tipulidae larvae						2				
Culicidae larvae		2	1	10	1	2				
Chironomidae larvae	18	8	43	6	13	2	15	3	1	
pupae							1			
Tabanidae larvae		1					1		1	
Oligochaeta	6		4		1		23	7		
Gastropoda								2	1	
Pelecypoda							7	2		
Crustacean Isopoda		1								
TOTAL	29	11	49	2	17	21	6	0	59	14	1	0	4	0	0	0	-	0	-

* expressed as number of organisms per 0.093 m^2
**treated with 17.5 g AI/ha Permethrin on 31 May and again on 6 June, 1978

Table 8

Bottom fauna populations*, T3 pond**
Larose Forest, Ontario
22 May to 27 June, 1978

Sample Period	17 May		22 May		26 May		30 May		3 June		9 June		13 June		20 June		27 June	
Trichoptera larvae					3		3											
pupae									1									
Coleoptera Chrysomelidae larvae							1				2							
Diptera Culicidae larvae							1											
Chironomidae larvae			4	71	1	1	41	9	6	6	6				64	75	1	5
pupae			1				2	1							1	1		
Heleidae larvae			3	6			2											
Muscidae pupae						1											1	
Unidentified larvae							1											
Nematoda			2	1												3		
Oligochaeta			1	109			7								48	23		
Hirudinea							2											
Gastropoda			4	1	5		14	4	5	17	11	11		2	1	1		
Pelecypoda			1	6	3		2	5	1		6	2		1	2			2
Arachnida Hydracarina							1											
TOTAL	-	-	18	194	12	2	77	19	12	24	26	13	0	3	116	103	2	7

* expressed as number of organisms per 0.093 m^2
**treated with 17.5 g AI/ha Permethrin on 31 May and again on 6 June, 1978

Table 9

Aquatic organisms* caught in drift nets set in the Untreated Control Stream, Temiscouata County, Quebec 9 June to 24 June and 1 August, 1978

Drift Date			9 June AM	9 June PM	10 June AM	10 June PM	11 June AM	11 June PM	12 June AM	12 June PM	13 June AM	13 June PM	14 June AM	14 June PM	15 June AM	15 June PM	16 June AM	16 June PM	17 June AM
Volume of flow through net (m^3)			81.6	66.0	61.0	47.1	50.4	53.6	46.3	22.3	21.6	22.9	41.1	38.1	36.8	55.9	58.4	23.1	22.4
Current velocity (m/sec)			0.67	0.79	0.73	0.61	0.64	0.64	0.58	0.58	0.58	0.55	0.98	0.91	0.88	0.67	0.70	0.58	0.58
Ephemeroptera	Heptageniidae											0.04			0.03				
	Baetidae		0.17		0.10	0.17	0.10	0.22	0.11	0.22	0.09	0.17	0.15	0.16	0.14	0.13		0.04	0.09
Plecoptera										0.04		0.04	0.07			0.02			0.04
Hemiptera	Gerridae					0.02											0.03		
	Macrovelliidae																		
Trichoptera					0.03						0.14		0.10	0.05			0.02		
Coleoptera	Haliplidae	**(L)							0.02			0.04							
		(A)			0.02					0.04	0.05								
	Elmidae	(L)	0.01	0.02	0.18	0.02							1.41	0.26	0.11	0.07			0.09
		(A)						0.06											
Diptera	Tipulidae														0.03	0.02			
	Dixidae		0.01				0.02						0.02						
	Simuliidae	(L)	0.11	0.08	0.02	0.06	0.08	0.11	0.15	0.13	0.23	0.13	0.05	0.16	0.16	0.30			0.11
		(P)													0.03				
	Chironomidae	(L)		0.05			0.02	0.02	0.02	0.04	0.05	0.13	0.10	0.08	0.14	0.07			0.04
		(P)						0.02	0.06					0.01	0.08				0.18
	Bezziidae									0.04									
	Athericidae							0.02		0.04					0.03				
Nematomorpha				0.01	0.01	0.02	0.02	0.02											
Nematoda																			
Oligochaeta															0.03				
Gastropoda																0.02			
Arachnida	Hydracarina		0.02	0.09	0.05	0.02	0.02	0.11	0.02	0.13	0.05	0.31	0.17	0.05		0.05			0.18
Ostracoda					0.02	0.15	0.10	0.28	0.11	0.13	0.05	0.13	0.05	0.08		0.05			0.22
Totals			0.31	0.27	0.45	0.46	0.36	0.91	0.49	0.81	0.66	0.99	2.12	0.87	0.78	0.71	0.05	0.04	0.97

*Expressed as organisms/m^3 of flow through net.

**(L) larvae
(P) pupae
(A) adults

Table 9 (cont'd)

Drift Date			17 June PM	18 June AM	18 June PM	19 June AM	19 June PM	20 June AM	20 June PM	21 June AM	21 June PM	22 June AM	22 June PM	23 June AM	23 June PM	24 June AM	24 June PM	3 August AM	3 August PM
Volume of flow through net (m^3)			48.8	43.1	41.2	53.4	39.0	50.8	40.6	40.6	32.3	15.3	22.9	33.0	35.6	14.6	68.6	11.5	18.2
Current velocity (m/sec)			0.61	0.55	0.52	0.64	0.49	0.61	0.49	0.49	0.73	0.37	0.55	0.40	0.43	0.37	0.55	0.21	0.18
Ephemeroptera	Heptageniidae							0.02				0.07					0.01		0.05
	Baetidae			0.05		0.04	0.13	0.02	0.12	0.10	0.59	0.07	0.09				0.03	0.09	
Plecoptera				0.02			0.01		0.02		0.03								
Hemiptera	Gerridae		0.02						0.01							0.07			0.11
	Macrovelliidae																	0.17	
Trichoptera			0.04		0.05			0.02			0.01			0.01				0.17	
Coleoptera	Haliplidae	(L)																	
		(A)					0.01						0.04						
	Elmidae	(L)		0.12		0.02	0.01				0.09		0.09		0.03				
		(A)									1.08				0.03				
Diptera	Tipulidae					0.02													
	Diidae																		
	Simuliidae	(L)		0.12	0.12	0.02	0.10	0.10		0.05	0.37					0.07			
		(P)														0.14		0.17	
	Chironomidae	(L)			0.05	0.07	0.21	0.06	0.02			0.11	0.11	0.06			0.01		
		(P)		0.05	0.05	0.04	0.05	0.04		0.05		0.07							
	Ucliidae																		
	Athericidae																		
Nematomorpha										0.02									
Nematoda												0.07			0.03				
Oligochaeta																			
Gastropoda																			
Arachnida	Hydracarina			0.09	0.07	0.07	0.08	0.02	0.05	0.10		0.13	0.04			0.07	0.03		
Ostracoda				0.02	0.16	0.02	0.13	0.10	0.02	0.15			0.04						
Totals			0.06	0.52	0.50	0.30	0.78	0.38	0.30	0.47	2.19	0.47	0.43	0.09	0.09	0.35	0.08	0.60	0.16

Table 10

Aquatic organisms* caught in drift nets set in
Ruisseau de la Pointe au Sable**, Temiscouata County, Quebec
9 June to 21 June and 2 August, 1978

Days before or after Permethrin application			-4 AM	-4 PM	-3 AM	-3 PM	-2 AM	-2 PM	-1 AM	-1 PM	-0 AM	+0 hr	+½ hr	+1 hr	+2 hr	+3 hr	+14 hr	+1 AM	+1 PM	+2 AM	+2 PM
Volume of flow through net (m^3)			39.5	56.7	45.4	61.2	41.3	44.1	39.2	30.2	27.8	27.8	27.8	5.5	5.5	5.5	2.2	37.8	62.6	67.1	67.1
Current velocity (m/sec)			0.52	0.67	0.49	0.58	0.49	0.55	0.49	0.40	0.52	0.52	0.52	0.52	0.52	0.52	0.43	0.61	0.79	0.79	0.79
Ephemeroptera	Ephemeridae																				0.01
	Heptageniidae		0.05	0.07		0.03	0.10	0.02			0.07		11.4	20.5	66.9	16.0		0.11	0.03	0.03	
	Baetidae												11.2	24.9	35.6	7.90	0.45	0.16	0.05	0.01	0.07
Plecoptera			0.03	0.04	0.02			0.02			0.11	0.07	25.5	18.7	12.4	4.36		0.13		0.07	0.06
Hemiptera	Gerridae											0.18	0.14								
	Veliidae											0.07									
	Hebridae												0.14		1.45						
	Saldidae								0.03												
Trichoptera		***(L)			0.02						0.04	0.04	4.17	1.45	3.64	0.73		0.03	0.02	0.10	0.01
		(P)																			
Coleoptera	Haliplidae									0.03		0.04	0.72								
	Dytiscidae											0.04				0.55					
	Hydrophilidae							0.02		0.06		0.04	0.43			0.55		0.03	0.03		
	Elmidae	(L)										0.04	0.14	0.18		3.27		1.35	0.86	0.28	0.04
		(A)	0.03	0.02		0.02	0.02					0.04	0.43	2.55	2.91	0.91		0.13			0.01
	Curculionidae											0.07									0.01
	Others																				0.01
Diptera	Tipulidae															0.18	0.45			0.01	0.03
	Culicidae												5.04	0.18	0.73				0.08		
	Simuliidae	(L)	0.08	0.02	0.07	0.10	0.15	0.11	0.05		0.07	0.07	0.14	3.45	4.36	0.73	0.45	0.06	0.14	0.01	0.03
	Chironomidae	(L)				0.02	0.02				0.04		0.86	1.09		0.73			0.11	0.04	0.04
		(P)				0.02								0.18				0.03		0.15	0.13
	Heleidae																			0.01	
Oligochaeta																			0.03	0.01	
Arachnida	Hydracarina					0.02		0.02			0.07	0.14				0.55					
Totals			0.19	0.15	0.11	0.21	0.29	0.19	0.08	0.09	0.40	0.84	60.3	73.2	128.0	35.6	1.35	2.03	1.35	0.72	0.45
Fish Fry																	0.03		0.24		

* Expressed as organisms per m^3 of flow through net.

** Treated with 17.5 g Permethrin/ha at 7:11 AM, 13 June, 1978 and at 4:43 AM, 18 June, 1978.

*** (L) larvae
(P) pupae
(A) adults

Table 10 (cont'd)

Days before or after Permethrin application			+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+0 hr (2nd spray)	+½ hr	+1 hr	+2 hr	+3 hr	+16 hr	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+45 AM	+45 PM
Volume of flow through net (m^3)			69.6	80.1	51.4	33.6	41.3	41.3	8.3	8.3	4.1	4.1	36.1	34.4	27.5	29.4	29.4	12.4	2.7	4.5
Current velocity (m/sec)			0.82	0.70	0.79	0.52	0.73	0.73	0.73	0.73	0.73	0.73	0.64	0.61	0.49	0.55	0.58	0.52	0.09	0.15
Ephemeroptera	Ephemeridae		0.01																	
	Heptagenidae		0.04	0.01	0.02	0.03				6.14	5.37	7.07	0.06		0.04					
	Baetidae		0.16	0.05	0.04	0.03	0.05	0.02	0.36	3.49	4.63	6.59		0.03	0.07					
Plecoptera			0.03	0.01	0.02			0.02	0.84	8.67	5.85	5.37	0.08	0.15	0.22	0.03	0.07			
Hemiptera	Gerridae									0.12										
	Veliidae																			
	Nebridae																			
	Saldidae		0.01																	
Trichoptera		(L)	0.04	0.01					0.12	0.24			0.03	0.03	0.04					
		(P)																		
Coleoptera	Haliplidae																			
	Dytiscidae										0.49	0.24								
	Hydrophilidae											0.49	0.12	0.12	0.11					0.22
	Elmidae	(L)	0.10								0.49	0.24	0.06	0.09	0.04					
		(A)	0.01		0.02					3.01		0.24	0.06		0.04	0.03	0.07			
	Curculionidae															0.03				
	Others					0.03									0.04	0.03				
Diptera	Tipulidae		0.01	0.02	0.02															
	Culicidae										0.24			0.03						
	Simuliidae	(L)						0.05	0.12			0.24					0.03			
	Chironomidae	(L)	0.04		0.02				0.12	0.24	1.71	1.46	0.06	3.26	0.11	0.03	0.07			2.44
		(P)	0.01		0.02													0.08		
	Heleidae								0.12											
Oligachaeta												0.24		0.09						
Arachnida	Hydracarina										0.24									
Totals			0.46	0.10	0.06	0.09	0.05	0.09	1.68	21.9	19.0	22.2	0.47	3.71	0.69	0.15	0.24	0.08	0.00	2.66
Fish Fry			0.56	0.12		0.12	0.24	0.07		0.12			0.06		0.07					

Table 11

Aquatic organisms* caught in drift nets in North Baker Brook**
Temiscouata County, Quebec
9 June to 24 June and 3 August, 1978

Days before or after 1st or 2nd Permethrin application			-7 AM	-7 PM	-6 AM	-6 PM	-5 AM	-5 PM	-4 AM	-4 PM	-3 AM	-3 PM	-2 AM	-2 PM	-1 AM	-1 PM	-0 AM	10 hr	½ hr	+1 hr	+2 hr	+3 hr	+9 hr	+15 hr	+1 AM	+1 PM	+2 AM	+2 PM
Volume of flow through net (m^3)			77.4	59.2	51.6	54.1	49.1	49.1	52.3	24.1	20.9	20.9	29.6	11.3	29.6	54.1	61.8	61.8	30.9	12.4	3.09	3.09	24.7	11.8	19.1	25.8	25.8	24.5
Current Velocity (m/sec)			0.61	0.70	0.61	0.64	0.58	0.58	0.64	0.61	0.55	0.55	0.70	0.67	0.70	0.64	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.70	0.61	0.64	0.61	0.58
Ephemeroptera	Heptageniidae		0.01								0.05	0.05							1.78	4.52	15.5	16.8	3.24	0.51		0.08	0.12	0.04
	Baetidae			0.08	0.02	0.02	0.02	0.02				0.10	0.17	0.26	0.14	0.07	0.08	0.08	11.7	56.4	164.4	150.0	46.6	1.52	0.36	0.12	0.19	
Plecoptera			0.04	0.02	0.04	0.02		0.02			0.05		0.07		0.03		0.02	0.08	1.94	12.6	11.0	51.8	7.12	1.27	0.47	0.19	0.12	0.12
Hemiptera	Corixidae																						21.7	1.69	0.57	0.16	0.16	0.04
	Gerridae																	0.08	0.10	0.32	0.32							
	Veliidae																	0.01										
Trichoptera			0.14	0.05	0.02		0.06	0.02			0.10		0.03	0.09		0.04		0.05	1.72	20.6	60.8	44.0						
Coleoptera	Dytiscidae	(A)													0.03		0.08	0.08	0.10	0.32					0.10	0.04	0.04	
	Elmidae	(L)	0.09	0.76	0.08						0.10						0.08	0.02	0.39	1.29	7.72	19.4	1.30	0.08		0.16	0.04	0.04
		(A)	0.02																0.03									
	Others														0.03													
Diptera	Tipulidae	(L)	0.01										0.03			0.02	0.02	0.02	0.10	0.97	1.29	6.47		0.25		0.04	0.04	
	Psychodidae	(L)																			1.29			0.08				
	Dixidae	(L)																	0.16									
	Simuliidae	(L)	0.04	0.14	0.12	0.02	0.06		0.06	0.08	0.38	0.05			0.10	0.07	0.03	0.18	1.97	3.55	18.1	8.41	2.59	0.25	0.05	0.08		
		(P)														0.02												
	Chironomidae	(L)	0.09	0.12	0.08	0.02	0.06	0.02	0.04	0.04	0.05		0.14	0.09			0.06	0.03	0.94	2.58	11.6	64.7	3.24	1.69	0.62	0.50	0.62	0.24
		(P)	0.05										0.01			0.02				0.64		1.29	0.32		0.05			0.08
	Blephariceridae	(L)							0.02																			
	Dixidae	(L)																						0.08				
	Others																		0.03									
Bryozoa					0.02			0.02						0.09						0.08	0.32				0.05			
Oligochaeta																												
Arachnida	Hydracarina				0.04	0.06	0.04		0.02	0.04		0.10	0.03	0.09	0.03	0.02			0.29	0.97	9.06	2.59	0.97		0.05	0.04		
Totals			0.50	1.16	0.41	0.13	0.24	0.10	0.13	0.16	0.72	0.29	0.51	0.62	0.37	0.26	0.37	0.65	21.2	104.9	301.6	360.5	82.1	7.46	2.33	1.59	1.32	0.57

* Expressed as organisms/m^3 of flow through net.

** Treated with 17.5 g Permethrin/ha at 4:30 AM on 16 June and again at 7:00 AM on 21 June, 1978.

(L) larvae
(P) pupae
(A) adults

Table 11 (cont'd)

Days before or after 1st or 2nd Permethrin application			+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+0 hr (2nd spray)	+½ hr	+1 hr	+2 hr	+3 hr	+14 hr	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+43 AM	+43 PM
Volume of flow through net (m^3)			24.5	49.1	24.5	23.3	49.1	4.91	4.91	4.91	4.91	4.91	23.3	28.3	23.3	25.8	51.6	46.4	36.4	12.0	36.8
Current Velocity (m/sec)			0.58	0.58	0.58	0.55	0.58	0.58	0.58	0.58	0.58	0.58	0.55	0.67	0.55	0.61	0.61	0.61	0.43	0.15	0.30
Ephemeroptera	Heptageniidae			0.04	0.04		0.04			0.20		4.48									
	Baetidae			0.04			0.04	0.20	0.20	0.61	4.48	6.52	2.06	0.07			0.06		0.08		
Plecoptera			0.04	0.10	0.04		0.04		0.41	1.02	3.15	35.4	2.32	0.39	0.21		0.02				
Hemiptera	Corixidae										0.41										
	Gerridae								0.20	0.41	1.63	1.22	0.26		0.17						
	Veliidae																				
Trichoptera			0.08	0.06			0.04		0.61	1.22	0.81	2.04	0.08	0.28	0.39		0.02	0.04	0.22		0.03
Coleoptera	Dytiscidae																				
	Elmidae	(L)	0.04				0.02							0.28	0.17				0.19		
		(A)		0.04	0.04				0.20	1.22	4.89	8.55	4.21	0.18	0.13		0.06		0.03		
	Others																0.04	0.02			
Diptera	Tipulidae		0.04	0.10		0.04	0.02			0.41	0.81	3.26	0.86	0.42	0.17		0.06				0.03
	Psychodidae			0.02											0.04		0.02				
	Dixidae																				
	Simuliidae	(L)	0.04							0.20	0.81	1.22									
		(P)																			
	Chironomidae	(L)	0.28	0.53	0.04	0.17	0.10		0.41	0.41	5.70	16.3	1.80	0.85	0.30		0.10			0.92	0.16
		(P)		0.04									0.17		0.13		0.04	0.02		0.08	0.05
	Rhagionidae																				
	Muscidae																				
	Others																				
Nematomorpha			0.04																		
Oligochaeta				0.02																	
Arachnida	Hydracarina			0.06							3.26	0.81		0.14	0.26				0.05		
Totals			0.57	1.06	0.16	0.21	0.30	0.20	2.04	5.70	31.0	79.8	11.7	2.61	1.97		0.41	0.09	0.58	1.00	0.27

SAMPLE LOST

* Expressed as organisms/m^3 of flow through net.

** Treated with 17.5 g Permethrin/ha at 4:30 AM on 16 June and again at 7:00 AM on 21 June, 1978.

(L) larvae
(P) pupae
(A) adults

Table 12

Aquatic organisms* caught in drift nets set in Little Baker Brook**, Temiscouata County, Quebec 9 June to 24 June and 3 August, 1978

Days before or after Fenvalerate application			-7 AM	-7 PM	-6 AM	-6 PM	-5 AM	-5 PM	-4 AM	-4 PM	-3 AM	-1 PM	-2 AM	-2 PM	-1 AM	-1 PM	-0 AM	10 hr	0½ hr	1 hr	2 hr	3 hr	19 hr	114 hr	1 AM
Volume of flow through net (m^3)			80.0	61.0	38.4	15.6	11.3	14.8	19.4	20.2	43.7	22.7	34.6	14.2	24.4	40.6	48.3	48.3	24.1	4.8	2.4	2.4	5.8	4.6	9.7
Current velocity (m/sec)			0.64	0.71	0.46	0.41	0.37	0.43	0.55	0.52	0.61	0.61	0.82	0.85	0.82	0.49	0.58	0.58	0.58	0.58	0.58	0.58	0.70	0.55	0.58
Ephemeroptera	Ephemeridae													0.49	0.04		0.02	0.02	2.66	46.7	171.7	123.3	24.2	9.35	
	Heptageniidae						0.03	0.03						1.24	0.07	0.10	0.02	0.22	43.5	470.0	413.3	295.8	53.1	14.4	1.65
	Baetidae		0.01	0.28	0.08		0.03	0.03		0.10		0.04	0.20												
Plecoptera				0.05		0.06						0.04		2.54	0.04		0.02	0.11	25.3	336.7	941.7	1050.0	140.0	80.4	4.11
Hemiptera	Notonectidae																	0.14	0.33					0.22	
	Veliidae																	0.04		0.21					
	Gerridae																								
	Unidentified								0.01																
Megaloptera	Corydalidae			0.02															0.12						0.11
Neuroptera															0.18		0.06								
Trichoptera		***(L)	0.06	0.03	0.01		0.11	0.01	0.03		0.02	0.09	0.03	0.42	0.04	0.05	0.05	0.31	31.0	320.0	221.7	121.0	35.9	24.6	0.82
		(P)	0.01															0.02							
Coleoptera	Haliplidae								0.05																
	Dytiscidae	(L)											0.03						0.33						
	Gyrinidae								0.03																0.10
	Hydrophilidae	(A)						0.14		0.20		0.09	0.03								1.67	0.83			0.21
	Elmidae	(L)	0.01	0.11	0.21	0.06						0.04	0.14	0.14	0.07			0.02	0.33				2.07	0.43	
		(A)	0.01	0.02		0.01	0.01	0.06					0.03	0.85	0.04	0.02		0.06	2.64	6.67	15.0	8.33	0.69		0.11
	Staphylinidae	(A)																						0.43	
Diptera	Tipulidae	(L)																							
		(P)		0.02									0.03					0.02	0.33		1.67		2.07		
	Blephariceridae	(L)											0.03		0.04										
	Dixidae	(L)															0.02	0.08	0.33		1.67	0.83			
	Simuliidae	(L)		0.02	0.10	0.06	0.16	0.06		0.05	0.02	0.04		0.28	0.18	0.12	0.02	1.74	20.3	35.0	33.3	30.0	9.66	3.04	
		(P)				0.01																			
	Chironomidae	(L)	0.01	0.08	0.03	0.03	0.03	0.09		0.05		0.04	0.20	1.41		0.10	0.02	0.12	4.67	56.7	101.7	163.3	32.4	32.0	1.03
		(P)		0.02		0.06	0.03		0.01					0.07		0.05					1.67	5.00	7.59	1.74	
	Heleidae	(P)											0.09		0.04							0.83			
	Athericidae	(L)																				3.33	0.69	0.87	
	Empididae	(L)					0.06									0.02						0.83	1.38	0.43	
		(L)																							
Turbellaria													0.03												
Nematomorpha				0.02	0.02	0.05	0.11	0.01																	
Nematoda																									
Oligochaeta													0.09		0.04										
Arachnida	Hydracarina			0.01		0.03				0.05		0.03	0.04	0.06			0.05			1.00	5.00	3.14	0.83	2.07	0.22	0.21
Fish														0.01											
Totals			0.16	0.70	0.55	0.42	0.51	0.46	0.20	0.60	0.09	0.43	1.01	9.45	0.77	0.52	0.23	3.19	133.1	1275.2	1908.3	1808.3	315.2	164.7	8.97

* Expressed as organisms/m^3 of flow through net.

** Treated with 17.5 g Fenvalerate/ha at 6:11 AM, 16 June, 1978, and again at 11:40 AM, 21 June, 1978.

*** (L) larvae
(P) pupae
(A) adults

Table 12 (cont'd)

Days before or after Permethrin application			+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+0 hr (2nd spray)	½ hr	+1 hr	+2 hr	+3 hr	+11 hr	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+43 AM	+43 PM
Volume of flow through net (m^3)			24.4	22.3	24.1	24.1	52.7	21.6	52.1	22.9	8.6	4.3	4.3	4.3	4.3	12.7	23.9	16.0	53.4	21.3	47.1	44.8	11.3	15.0
Current velocity (m/sec)			0.61	0.61	0.58	0.58	0.67	0.52	0.64	0.55	0.55	0.55	0.55	0.55	0.55	0.30	0.61	0.64	0.64	0.55	0.61	0.58	0.15	0.12
Ephemeroptera	Ephemeridae									0.04						0.08								
	Heptageniidae		0.25			0.04		0.05				0.23	0.23		1.63									
	Baetidae		1.89	0.27	0.12	0.46	0.13	0.09	0.10	0.22	0.11	0.93	1.40	2.56	7.91	1.26	0.13	0.06	0.04	0.09		0.02		
Plecoptera			4.22	1.88	0.08	0.50	0.40	0.17	0.17	0.74	1.28	1.16	8.84	22.6	65.1	0.47	0.42			0.33				
Hemiptera	Notonectidae																		0.02					
	Veliidae																							
	Gerridae											1.16	1.63	1.63										
	Unidentified																							
Megaloptera	Corydalidae																							
Neuroptera																0.08								
Trichoptera		(L)	0.49	0.90	0.12	0.25	0.13	0.14	0.06	0.04		0.23	1.40	1.16	1.02	0.24	0.13		0.04	0.14	0.06	0.07		
		(P)																						
Coleoptera	Haliplidae																							
	Dytiscidae	(L)												0.23										
	Gyrinidae														0.23									
	Hydrophilidae	(A)	0.04	0.04	0.04		0.04	0.05			0.11							0.12			0.02			0.13
	Elmidae	(L)	0.12	0.04	0.04			0.05		0.04		0.21		0.23	0.47	1.50					0.04			
		(A)	0.20	0.13	0.17	0.08	0.02		0.02	0.09	0.23		1.86	5.58	0.93		0.17	0.12		0.23		0.02		
	Staphylinidae	(A)				0.04					0.11	1.63			0.47	0.16		0.06	0.04		0.06			
Diptera	Tipulidae	(L)																						
		(P)	0.31		0.04		0.02	0.09							2.33				0.02					
	Blephariceridae	(L)																						
	Dixidae	(L)							0.02															
	Simuliidae	(L)	0.08	0.04	0.04	0.04		0.05			0.11											0.09		
		(P)																						
	Chironomidae	(L)	1.27	0.76	0.12	0.41	0.25	0.14	0.06	0.13	0.11	1.40	2.56	2.79	27.9		0.46	0.06	0.07	0.14	0.04	0.02		0.07
		(P)		0.04		0.04	0.06	0.05			0.11		0.23		1.86		0.04	0.06		0.05	0.06	0.02		
	Heleidae	(P)				0.04	0.04				0.11									0.05		0.02		
	Athericidae	(L)									0.11			0.93										
	Tipulidae	(L)		0.13	0.04	0.04			0.02	0.13				0.23	0.23	0.16	0.13	0.06	0.02	0.14	0.02			
Turbellaria																								
Nematomorpha																								
Nematoda																		0.06						
Oligochaeta																								
Arachnida	Hydracarina					0.04	0.06			0.04	0.11		0.70	0.23	0.23		0.04				0.02	0.02		
Fish																								
Totals			8.89	4.21	0.83	1.99	1.14	1.06	0.44	1.48	2.56	6.98	18.8	38.1	112.3	3.94	1.51	0.60	0.24	1.17	0.30	0.20	0.09	0.20

Table 13

Aquatic invertebrates* collected from rocks taken from the Untreated Control Stream, Temiscouata County, Quebec

7 June to 25 October, 1978

Sample Date			7 June	12 June	17 June	22 June	27 June	2 July	2 August	25 October
Ephemeroptera	Heptagenlidae		5.0 ± 5.2	1.5 ± 1.9	1.8 ± 1.0	1.2 ± 1.3	2.5 ± 3.8	6.2 ± 9.9	1.0 ± 0.8	4.2 ± 2.3
	Baetidae		13.8 ± 11.4	12.2 ± 14.7	14.0 ± 7.5	12.5 ± 19.8	15.8 ± 15.7	12.0 ± 16.7	6.5 ± 5.8	4.8 ± 2.1
Plecoptera			0.2 ± 0.5		1.0 ± 1.2		0.5 ± 1.0		1.2 ± 1.3	0.5 ± 1.0
Trichoptera		larvae	7.0 ± 4.5	1.2 ± 1.3	5.5 ± 5.5	0.8 ± 1.5	3.5 ± 2.6	2.0 ± 1.4	15.0 ± 18.1	16.5 ± 11.1
		pupae	5.8 ± 2.4	1.2 ± 1.3	7.2 ± 11.3	0.8 ± 1.0	4.2 ± 7.2	4.2 ± 6.7		
Coleoptera	Haliplidae	larvae							0.2 ± 0.5	
	Elmidae	larvae	1.2 ± 1.9	0.8 ± 1.0	0.8 ± 1.0	4.0 ± 6.2	2.2 ± 3.3	6.8 ± 6.1	2.5 ± 1.3	3.0 ± 6.0
		adults			2.2 ± 2.9	0.8 ± 1.0		5.2 ± 8.1		4.0 ± 6.1
Diptera	Tipulidae	larvae	4.5 ± 4.4	2.5 ± 2.9	2.8 ± 4.9	0.2 ± 0.5	0.5 ± 1.0	1.0 ± 1.4	3.5 ± 3.4	2.5 ± 1.3
		pupae	0.2 ± 0.5	0.5 ± 0.6		0.2 ± 0.5		0.8 ± 1.0		
	Simuliidae	larvae	7.2 ± 8.0	15.2 ± 30.5	2.8 ± 5.5	1.5 ± 3.0	2.0 ± 4.0	3.5 ± 7.0		0.5 ± 1.0
		pupae		0.5 ± 1.0						
	Chironomidae	larvae	17.8 ± 17.2	11.8 ± 2.6	20.0 ± 8.3	20.2 ± 16.9	18.8 ± 8.5	14.5 ± 9.3	76.0 ± 36.1	1.3 ± 1.9
		pupae	0.5 ± 1.0	0.8 ± 1.5		1.2 ± 1.3	0.8 ± 1.5	0.8 ± 1.5	1.5 ± 1.3	
	Heleidae					0.8 ± 1.0		0.8 ± 1.5		
	Athericidae		0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5	0.5 ± 1.0	1.0 ± 2.0		3.5 ± 4.0	0.8 ± 0.5
	Empididae								0.5 ± 1.0	0.5 ± 1.0
Nematoda								0.5 ± 0.6	0.2 ± 0.5	
Pelecypoda	Sphaeriidae						0.2 ± 0.5			
Arachnida	Hydracarina		1.0 ± 2.0	0.8 ± 1.5	0.8 ± 1.5	2.8 ± 2.9	4.5 ± 1.7	3.2 ± 1.0		0.2 ± 0.5
Totals			64.4 ± 48.8	49.2 ± 21.9	59.0 ± 26.3	47.5 ± 44.6	56.5 ± 20.2	61.5 ± 40.0	111.8 ± 44.6	39.0 ± 18.5

* Mean numbers and standard deviations of organisms collected from four rocks approximately 20 cm in diameter.

Table 14

Aquatic Invertebrates* collected from rocks taken from Ruisseau de la Pointe au Sable**
Temiscouata County, Quebec
8 June to 26 October, 1978

Date			8 June	12 June	17 June	22 June	27 June	2 July	1 August	26 October
Days before or after 1st spray (2nd spray)			-5	-1	+4 (-1)	+9 (+4)	+14 (+9)	+19 (+14)	+49 (+44)	+135 (+130)
Ephemeroptera	Heptageniidae		12.8 ± 9.8	23.5 ± 5.6	0.5 ± 1.0	0.2 ± 0.5	--	--	0.2 ± 0.5	1.8 ± 2.1
	Baetidae		--	--	--	--	--	--	--	0.5 ± 0.6
Plecoptera			--	0.5 ± 1.0	--	--	--	--	--	1.2 ± 1.9
Trichoptera		larvae	2.2 ± 1.7	5.2 ± 4.6	0.8 ± 1.0	0.2 ± 0.5	--	--	5.2 ± 5.6	14.8 ± 6.5
		pupae	1.8 ± 1.3	1.2 ± 1.5	1.2 ± 1.0	--	1.0 ± 0.8	0.2 ± 0.5	0.2 ± 0.5	2.0 ± 2.5
Coleoptera	Elmidae	larvae	0.2 ± 0.5	--	--	--	--	--	--	--
		adults	--	--	--	--	--	--	--	0.2 ± 0.5
	Heteroceridae	adults	0.2 ± 0.5	--	--	--	--	--	--	--
Diptera	Tipulidae	larvae	0.5 ± 0.6	1.0 ± 0.0	0.8 ± 1.5	--	--	--	--	0.5 ± 0.6
	Blepharoceridae	larvae	1.5 ± 1.9	1.8 ± 3.5	0.2 ± 0.5	--	--	--	--	--
	Simuliidae	larvae	7.0 ± 9.5	1.0 ± 0.8	2.5 ± 2.4	--	--	--	--	--
	Chironomidae	larvae	3.2 ± 1.7	1.8 ± 1.7	0.8 ± 1.0	0.2 ± 0.5	0.5 ± 0.6	3.2 ± 2.5	41.8 ± 30.7	4.0 ± 4.2
		pupae	--	--	--	--	--	--	1.2 ± 1.5	--
	Empididae	larvae	--	--	--	--	--	--	--	0.5 ± 1.0
Nematoda			--	0.2 ± 0.5	0.2 ± 0.5	--	--	--	--	--
Gastropoda			--	--	--	--	--	--	0.8 ± 1.5	--
Arachnida	Hydracarina		--	--	0.2 ± 0.5	0.5 ± 0.6	0.2 ± 0.5	0.2 ± 0.5	--	--
Totals			29.5 ± 11.4	36.2 ± 7.1	7.5 ± 1.3	1.2 ± 1.0	1.8 ± 1.0	3.8 ± 2.2	54.0 ± 39.9	25.5 ± 9.4

* Mean numbers and standard deviations of organisms collected from four rocks approximately 20 cm in diameter.

** Treated with 17.5 g/ha Permethrin on 13 June, 1978, and again on 18 June, 1978.

Table 15

Aquatic invertebrates* collected from rocks taken from North Baker Brook**
Temiscouata County, Quebec
7 June to 25 October, 1978

Date			7 June	12 June	20 June	25 June	29 June	3 July	1 August	25 October
Days before or after 1st spray (2nd spray)			-9	-4	+4 (-1)	+9 (+4)	+13 (+8)	+17 (+12)	+46 (+41)	+131 (+126)
Ephemeroptera	Heptagenitidae		1.5 ± 2.4	1.0 ± 1.2	--	--	--	--	--	5.8 ± 3.6
	Baetidae		0.5 ± 0.6	1.0 ± 1.4	1.5 ± 1.7	--	--	0.5 ± 0.6	4.0 ± 3.4	3.2 ± 3.3
Plecoptera			0.8 ± 1.0	0.5 ± 1.0	1.0 ± 0.8	--	--	0.2 ± 0.5	0.2 ± 0.5	2.2 ± 1.0
Trichoptera		larvae	3.2 ± 3.2	5.0 ± 2.4	0.8 ± 1.0	0.5 ± 0.6	1.0 ± 1.4	--	15.0 ± 14.9	8.2 ± 8.5
		pupae	1.2 ± 1.0	0.2 ± 0.5	0.5 ± 0.6	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5	--	0.8 ± 1.0
Coleoptera	Elmidae	larvae	--	--	--	--	--	--	1.8 ± 2.1	--
		adults	--	0.5 ± 0.6	0.8 ± 1.5	0.2 ± 0.5	0.2 ± 0.5	1.2 ± 1.2	--	--
Diptera	Tipulidae		2.5 ± 2.4	0.8 ± 0.5	0.8 ± 1.0	0.8 ± 0.5	4.0 ± 4.8	1.2 ± 1.0	0.5 ± 1.0	5.5 ± 4.9
	Simuliidae	larvae	2.5 ± 1.0	--	0.2 ± 0.5	--	0.2 ± 0.5	--	21.2 ± 23.4	--
		pupae	--	--	--	--	--	--	1.2 ± 2.5	--
	Chironomidae	larvae	30.5 ± 26.6	16.2 ± 16.8	10.0 ± 12.4	1.0 ± 1.4	16.0 ± 19.7	11.8 ± 5.4	204.2 ± 142.0	13.0 ± 7.6
		pupae	--	--	--	--	2.0 ± 3.4	0.2 ± 0.5	6.2 ± 4.1	--
	Heleidae		--	--	--	--	--	--	1.0 ± 0.8	--
	Athericidae		0.2 ± 0.5	0.5 ± 0.6	--	--	0.8 ± 0.5	--	0.2 ± 0.5	0.5 ± 1.0
Gastropoda			--	--	--	--	--	--	0.2 ± 0.5	--
Nematoda			--	--	--	--	--	--	0.2 ± 0.5	--
Arachnida	Hydracarina		2.0 ± 4.0	1.5 ± 1.7	0.2 ± 0.5	0.5 ± 0.6	0.2 ± 0.5	1.5 ± 1.9	0.2 ± 0.5	--
Totals			45.0 ± 35.6	27.2 ± 16.5	15.8 ± 12.6	3.2 ± 1.3	24.8 ± 29.1	17.0 ± 8.4	256.5 ± 186.1	39.2 ± 17.7

* Mean numbers and standard deviations of organisms collected from four rocks approximately 20 cm in diameter.

** Treated with 17.5 g/ha Permethrin on 16 June, 1978, and again on 21 June, 1978.

Table 16

Aquatic Invertebrates* collected from rocks
taken from Little Baker Brook**
Temiscouata County, Quebec
7 June to 25 October, 1978

Date			7 June	12 June	20 June	25 June	29 June	3 July	1 August	25 October
Days before or after 1st spray (2nd spray)			-9	-4	+4 (-1)	+9 (+4)	+13 (+8)	+17 (+12)	+46 (+41)	+131 (+126)
Ephemeroptera	Heptageniidae		1.5 ± 1.3	2.5 ± 2.4	0.2 ± 0.5	--	--	--	0.2 ± 0.5	1.8 ± 1.3
	Baetidae		1.8 ± 1.5	1.0 ± 1.4	0.5 ± 0.6	--	--	0.2 ± 0.5	0.2 ± 0.5	5.8 ± 4.1
Plecoptera			0.8 ± 1.0	--	--	--	--	--	0.2 ± 0.5	1.5 ± 1.9
Trichoptera		larvae	5.8 ± 4.0	4.0 ± 1.2	1.0 ± 2.0	0.2 ± 0.5	--	0.2 ± 0.5	1.2 ± 1.0	10.5 ± 7.0
		pupae	1.5 ± 1.7	1.8 ± 2.1	2.2 ± 1.7	1.8 ± 1.5	0.8 ± 0.5	0.8 ± 1.0	1.5 ± 1.9	1.5 ± 1.7
Coleoptera	Elmidae	larvae	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5	--	--	--	1.5 ± 1.3	0.2 ± 0.5
		adults	--	--	--	0.2 ± 0.5	--	--	--	--
Diptera	Tipulidae		--	--	--	--	--	--	--	0.5 ± 1.0
	Chironomidae	larvae	3.5 ± 2.4	2.0 ± 0.8	9.8 ± 8.8	0.2 ± 0.5	--	4.8 ± 4.3	59.2 ± 13.5	5.8 ± 7.0
		pupae	--	--	--	--	--	0.2 ± 0.5	1.2 ± 1.0	--
	Heleidae		--	--	--	--	0.5 ± 1.0	--	--	--
	Athericidae		--	--	--	--	--	--	--	0.5 ± 0.6
	Dolichopodidae		--	--	--	--	--	0.2 ± 0.5	--	--
	Empididae		1.8 ± 1.7	1.5 ± 1.9	0.2 ± 0.5	0.2 ± 0.5	--	0.8 ± 1.5	--	--
Turbellaria			--	0.2 ± 0.5	--	--	--	--	--	--
Gastropoda	Ancylidae		0.2 ± 0.5	--	0.2 ± 0.5	--	--	0.2 ± 0.5	--	--
Pelecypoda			--	--	--	--	--	--	--	1.2 ± 1.9
Arachnida	Hydracarina		0.5 ± 1.0	1.5 ± 2.4	1.0 ± 1.2	0.5 ± 0.6	0.8 ± 1.5	--	--	--
Oligochaeta			--	--	--	--	--	0.2 ± 0.5	--	--
Totals			17.5 ± 12.6	14.5 ± 5.1	15.5 ± 11.7	3.2 ± 1.7	2.0 ± 1.4	7.8 ± 6.4	65.5 ± 13.9	31.2 ± 19.7

* Mean numbers and standard deviations of organisms collected from four rocks approximately 20 cm in diameter.

** Treated with 17.5 g/ha Permethrin on 16 June, 1978, and again on 21 June, 1978.

Table 17

Bottom Fauna Populations*, Untreated Control Stream, Temiscouata County, Quebec

7 June to 25 October, 1978

Date			7 June	12 June	17 June	22 June	27 June	2 July	1 August	25 October
Ephemeroptera	Heptageniidae		1.0 ± 1.4	1.5 ± 1.3	2.2 ± 1.5	1.8 ± 2.1	0.8 ± 1.0	3.0 ± 0.8	10.5 ± 7.9	6.2 ± 6.7
	Baetidae		24.2 ± 13.6	22.0 ± 7.6	18.5 ± 1.9	15.5 ± 10.0	6.5 ± 7.0	34.5 ± 12.6	58.5 ± 37.9	24.0 ± 28.9
Odonata	Cordulegastridae		--	--	--	--	--	--	0.2 ± 0.5	1.2 ± 1.9
Plecoptera			4.5 ± 7.0	1.2 ± 1.5	2.0 ± 1.8	1.2 ± 1.0	1.0 ± 1.2	7.0 ± 3.7	5.5 ± 3.4	11.0 ± 11.4
Trichoptera		larvae	3.2 ± 1.5	3.5 ± 1.3	3.2 ± 2.7	7.2 ± 6.3	2.5 ± 2.6	6.8 ± 2.9	123.5 ± 125.4	119.0 ± 132.9
		pupae	1.0 ± 1.4	1.0 ± 0.8	1.0 ± 1.2	1.0 ± 1.4	0.5 ± 0.6	3.0 ± 2.2	0.2 ± 0.5	0.5 ± 0.6
Coleoptera	Hydrophilidae		--	--	--	--	--	--	0.2 ± 0.5	--
	Gyrinidae		--	--	--	--	--	--	--	0.2 ± 0.5
	Elmidae	larvae	16.0 ± 15.7	13.0 ± 9.4	4.5 ± 2.1	2.8 ± 2.2	3.8 ± 3.0	14.0 ± 4.2	22.8 ± 15.5	30.2 ± 17.2
		adults	10.0 ± 9.3	6.5 ± 3.5	5.7 ± 3.4	2.0 ± 1.4	1.8 ± 1.3	29.5 ± 27.5	13.5 ± 13.3	27.2 ± 35.0
Diptera	Chironomidae	larvae	7.7 ± 5.3	15.5 ± 23.1	4.2 ± 2.8	12.2 ± 19.2	0.5 ± 1.0	3.2 ± 2.2	44.2 ± 7.1	40.0 ± 53.6
		pupae	0.2 ± 0.5	1.0 ± 1.4	0.2 ± 0.5	2.0 ± 3.4	--	1.5 ± 2.4	2.2 ± 2.1	--
	Simuliidae	larvae	0.5 ± 1.0	1.0 ± 1.4	1.2 ± 2.5	--	0.8 ± 1.0	3.8 ± 5.7	--	--
		pupae	--	--	--	0.2 ± 0.5	--	--	--	--
	Tipulidae	larvae	3.2 ± 2.2	5.8 ± 2.9	2.5 ± 1.3	2.8 ± 3.6	1.8 ± 1.5	4.0 ± 1.2	4.2 ± 3.9	32.0 ± 23.7
		pupae	1.0 ± 0.8	0.8 ± 1.0	0.5 ± 0.6	1.2 ± 1.3	0.5 ± 1.0	--	--	--
	Athericidae		--	1.0 ± 1.4	--	1.0 ± 2.0	1.0 ± 0.8	1.0 ± 1.4	11.5 ± 3.0	10.8 ± 6.4
	Empididae		0.2 ± 0.5	--	--	--	--	--	--	--
	Heleidae		0.5 ± 1.0	1.8 ± 2.4	0.5 ± 1.0	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5	--	7.8 ± 10.4
Nematoda			0.5 ± 1.0	0.2 ± 0.5	--	0.2 ± 0.5	0.2 ± 0.5	0.5 ± 0.6	--	0.2 ± 0.5
Oligochaeta			1.0 ± 1.4	--	0.2 ± 0.5	0.5 ± 1.0	1.0 ± 1.2	4.5 ± 5.3	3.8 ± 3.9	3.5 ± 3.5
Gastropoda			0.2 ± 0.5	--	--	--	--	--	--	0.2 ± 0.5
Pelecypoda			--	--	--	--	--	--	--	0.8 ± 1.5
Hydracarina			3.0 ± 6.0	0.5 ± 0.6	--	--	--	5.0 ± 0.8	--	1.2 ± 1.9
Totals			78.2 ± 56.0	76.2 ± 22.3	46.8 ± 15.7	52.0 ± 40.9	22.8 ± 14.8	121.5 ± 34.8	301.0 ± 192.6	346.8 ± 224.2

* Mean numbers and standard deviations of organisms collected in four 0.093 m^2 Surber samples.

Table 18

Bottom fauna populations*, Ruisseau de la Pointe au Sable**, Temiscouata County, Quebec

8 June to 25 October, 1978

Date			8 June	12 June	17 June	22 June	27 June	2 July	1 August	25 October
Days before or after 1st spray (2nd spray)			-5	-1	+4 (-1)	+9 (+4)	+14 (+9)	+19 (+14)	+49 (+44)	+134 (+129)
Ephemeroptera	Heptageniidae		16.0 ± 9.5	14.2 ± 6.7	3.8 ± 2.2	0.5 ± 0.6	--	1.2 ± 1.2	0.2 ± 0.5	14.2 ± 4.8
	Baetidae		0.8 ± 1.0	0.2 ± 0.5	3.2 ± 2.8	0.2 ± 0.5	--	0.2 ± 0.5	0.8 ± 1.0	11.8 ± 4.3
Odonata	Gomphidae		--	--	--	0.2 ± 0.5	--	--	0.2 ± 0.5	--
Plecoptera			0.2 ± 0.5	0.2 ± 0.5	0.5 ± 0.6	0.5 ± 0.6	0.2 ± 0.5	0.2 ± 0.5	2.2 ± 1.9	2.5 ± 1.3
Trichoptera		larvae	0.8 ± 1.5	2.2 ± 1.0	0.5 ± 0.6	0.2 ± 0.5	--	--	2.2 ± 1.5	4.0 ± 3.9
		pupae	--	--	--	--	--	0.5 ± 1.0	--	0.5 ± 1.0
Coleoptera	Elmidae	larvae	--	--	0.2 ± 0.5	0.2 ± 0.5	--	1.0 ± 1.4	2.8 ± 3.0	6.0 ± 4.1
		adults	0.2 ± 0.5	--	0.2 ± 0.5	0.5 ± 0.6	--	0.5 ± 0.6	1.2 ± 1.5	1.5 ± 1.3
	Chrysomelidae		--	--	--	--	--	--	0.5 ± 1.0	--
	Hydroscaphidae		--	--	0.2 ± 0.5	--	--	--	--	--
Diptera	Tipulidae		0.5 ± 1.0	--	--	--	--	0.5 ± 1.0	1.0 ± 0.8	2.8 ± 1.0
	Simuliidae		0.2 ± 0.5	--	--	--	0.2 ± 0.5	--	--	--
	Chironomidae	larvae	0.5 ± 1.0	0.2 ± 0.5	0.8 ± 1.5	0.2 ± 0.5	0.2 ± 0.5	0.5 ± 1.0	9.2 ± 2.8	2.0 ± 1.4
		pupae	--	--	0.2 ± 0.5	--	--	0.2 ± 0.5	2.0 ± 2.7	--
	Heleidae		--	--	--	--	--	--	--	0.8 ± 1.5
	Athericidae		--	--	--	--	--	--	--	0.2 ± 0.5
Oligochaeta			--	--	--	--	--	0.2 ± 0.5	--	0.2 ± 0.5
Gastropoda			--	0.2 ± 0.5	--	--	--	--	--	--
Pelecypoda			--	--	--	--	--	--	--	0.8 ± 1.0
Totals			19.2 ± 8.8	17.5 ± 7.4	9.8 ± 2.6	2.8 ± 1.5	0.8 ± 0.5	5.2 ± 1.9	22.5 ± 7.0	47.2 ± 7.3

* Mean numbers and standard deviations of organisms collected in four 0.093 m^2 Surber samples.

** Treated with 17.5 g Permethrin/ha on 13 June, 1978, and again on 18 June, 1978.

Table 19

Benthos fauna populations*, North Baker Brook**,
Temiscouata County, Quebec
7 June to 25 October, 1978

Date			7 June	12 June	20 June	25 June	29 June	3 July	1 August	25 October
Days before or after 1st spray (2nd spray)			-9	-4	+4 (-1)	+9 (+4)	+13 (+8)	+17 (+12)	+46 (+41)	+131 (+126)
Ephemeroptera	Heptageniidae		8.8 ± 9.2	3.5 ± 2.6	0.2 ± 0.5	0.2 ± 0.5	--	--	--	2.5 ± 3.1
	Baetidae		17.0 ± 10.2	11.8 ± 9.5	2.8 ± 1.3	2.0 ± 1.6	0.2 ± 0.5	1.2 ± 1.3	5.5 ± 7.7	60.8 ± 29.6
Plecoptera			12.0 ± 15.8	14.5 ± 14.4	2.0 ± 1.4	6.0 ± 9.4	2.0 ± 2.7	4.5 ± 2.9	6.2 ± 9.3	22.8 ± 11.5
Hemiptera			--	--	--	--	--	--	--	0.2 ± 0.5
Trichoptera		larvae	21.8 ± 19.0	10.5 ± 8.7	0.2 ± 0.5	0.5 ± 1.0	--	0.8 ± 1.0	17.2 ± 23.2	101.5 ± 128.9
		pupae	3.0 ± 1.4	2.0 ± 2.8	0.2 ± 0.5	--	0.2 ± 0.5	--	--	0.5 ± 0.6
Coleoptera	Elmidae	larvae	4.2 ± 5.9	5.0 ± 7.3	2.5 ± 2.4	7.8 ± 8.4	6.0 ± 3.7	9.2 ± 5.6	9.2 ± 11.2	16.0 ± 23.7
		adults	11.0 ± 6.6	24.8 ± 24.2	4.5 ± 6.1	10.2 ± 6.8	15.0 ± 4.5	9.8 ± 8.7	2.2 ± 2.6	25.5 ± 10.3
	Unidentified		0.2 ± 0.5	--	--	--	--	--	--	--
Diptera	Tipulidae		1.2 ± 1.0	1.0 ± 0.8	0.2 ± 0.5	1.0 ± 0.8	0.8 ± 1.0	1.2 ± 1.0	1.0 ± 2.0	17.8 ± 8.8
	Simuliidae	larvae	2.2 ± 4.5	5.0 ± 8.1	--	--	--	0.2 ± 0.5	5.8 ± 8.5	--
		pupae	0.5 ± 1.0	--	--	--	--	--	--	--
	Chironomidae	larvae	6.5 ± 5.7	11.8 ± 11.6	4.5 ± 4.2	2.8 ± 3.1	2.5 ± 3.1	5.8 ± 3.0	25.5 ± 24.8	16.0 ± 14.3
		pupae	0.2 ± 0.5	--	0.2 ± 0.5	0.5 ± 1.0	0.5 ± 0.6	0.5 ± 0.6	2.5 ± 4.4	--
	Heleidae		--	--	0.5 ± 0.6	4.5 ± 9.0	0.2 ± 0.5	3.2 ± 2.2	0.8 ± 1.5	11.0 ± 7.5
	Athericidae		--	--	--	--	--	--	0.2 ± 0.5	3.8 ± 1.0
	Empididae	larvae	--	--	--	--	--	--	5.5 ± 8.3	--
		pupae	--	--	--	--	--	--	0.2 ± 0.5	--
	Unidentified		--	--	--	0.2 ± 0.5	--	0.5 ± 1.0	--	--
Nematomorpha			--	0.5 ± 0.6	1.8 ± 1.7	0.2 ± 0.5	--	0.5 ± 1.0	--	--
Oligochaeta			--	--	0.2 ± 0.5	--	--	--	0.8 ± 1.5	0.8 ± 1.0
Pelecypoda			--	--	0.2 ± 0.5	--	--	--	--	0.2 ± 0.5
Arachnida	Hydracarina		0.8 ± 1.5	--	--	0.2 ± 0.5	--	3.0 ± 3.6	--	0.2 ± 0.5
Decapoda			0.2 ± 0.5	0.2 ± 0.5	--	--	--	--	--	--
Totals			89.8 ± 61.0	90.5 ± 52.2	20.2 ± 15.4	36.2 ± 22.8	27.5 ± 10.7	40.5 ± 9.4	82.8 ± 79.9	342.2 ± 196.0

* Mean numbers and standard deviations of organisms collected in four 0.093 m^2 Surber samples.

** Treated with 17.5 g Permethrin/ha on 16 June, 1978, and again on 21 June, 1978.

Table 20

Bottom fauna populations*, Little Baker Brook**
Temiscouata County, Quebec
7 June to 25 October, 1978

Date			7 June	12 June	20 June	25 June	29 June	3 July	1 August	25 October
Days before or after 1st spray (2nd spray)			-9	-4	+4 (-1)	+9 (+4)	+13 (+8)	+17 (+12)	+46 (+41)	+131 (+126)
Ephemeroptera	Ephemeridae		--	--	0.2 ± 0.5	--	0.8 ± 1.5	--	0.2 ± 0.5	0.2 ± 0.5
	Heptageniidae		2.8 ± 2.5	2.2 ± 1.0	0.5 ± 0.6	--	--	--	0.5 ± 1.0	5.5 ± 4.1
	Baetidae		5.0 ± 1.8	8.8 ± 6.8	2.5 ± 1.7	0.5 ± 1.0	0.5 ± 0.6	1.2 ± 1.0	0.5 ± 0.6	18.8 ± 14.6
Odonata	Gomphidae		0.2 ± 0.5	--	--	--	--	--	--	--
	Cordulegastridae		--	--	--	--	--	--	0.2 ± 0.5	0.2 ± 0.5
Plecoptera			9.8 ± 2.8	10.0 ± 6.1	2.0 ± 1.8	1.0 ± 0.8	0.8 ± 0.5	3.2 ± 2.1	1.5 ± 1.3	16.0 ± 8.3
Trichoptera		larvae	6.0 ± 3.6	7.0 ± 3.9	1.5 ± 1.0	1.8 ± 2.1	1.2 ± 1.2	0.2 ± 0.5	1.0 ± 0.8	2.0 ± 1.4
		pupae	1.8 ± 2.4	4.5 ± 5.1	0.2 ± 0.5	--	0.2 ± 0.5	--	--	--
Megaloptera	Sialidae		--	--	--	--	--	--	1.2 ± 2.5	2.2 ± 1.7
Coleoptera	Elmidae	larvae	4.5 ± 2.6	5.2 ± 3.9	1.2 ± 0.5	1.5 ± 3.0	2.5 ± 3.0	10.0 ± 4.5	14.0 ± 11.9	19.5 ± 20.5
		adults	6.5 ± 3.1	3.5 ± 2.4	4.8 ± 3.6	1.5 ± 1.3	2.5 ± 2.6	3.5 ± 1.9	0.8 ± 1.5	0.5 ± 0.6
Diptera	Tipulidae		0.2 ± 0.5	1.0 ± 1.4	--	--	--	0.5 ± 0.6	2.0 ± 0.8	4.5 ± 4.4
	Simuliidae		--	0.2 ± 0.5	--	--	--	--	--	--
	Chironomidae	larvae	0.8 ± 1.0	4.5 ± 3.5	4.0 ± 2.7	2.0 ± 0.8	4.2 ± 3.2	3.0 ± 2.9	114.0 ± 71.9	9.2 ± 7.2
		pupae	0.2 ± 0.5	--	0.2 ± 0.5	--	--	0.2 ± 0.5	5.5 ± 7.7	--
	Heleidae	larvae	--	0.2 ± 0.5	0.5 ± 0.6	0.5 ± 1.0	0.2 ± 0.5	0.8 ± 1.0	0.2 ± 0.5	4.5 ± 2.4
		pupae	0.8 ± 1.5	--	--	--	--	--	--	--
	Bolitophopilidae	pupae	--	--	0.2 ± 0.5	--	--	--	--	--
	Athericidae		--	--	--	--	--	--	--	0.8 ± 1.5
	Tipulidae		0.2 ± 0.5	0.8 ± 1.0	0.2 ± 0.5	0.5 ± 0.6	0.2 ± 0.5	--	1.5 ± 1.1	0.2 ± 0.5
Nematoda			--	--	--	--	--	0.2 ± 0.5	1.0 ± 1.2	--
Oligochaeta			--	0.2 ± 0.5	--	--	--	0.8 ± 1.0	--	0.8 ± 1.5
Pelecypoda			--	--	--	--	--	--	--	1.2 ± 1.5
Arachnida	Hydracarina		--	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5	--	0.3 ± 0.5	--	--
Decapoda			0.2 ± 0.5	--	--	--	--	--	--	--
Totals			39.0 ± 7.9	48.5 ± 20.5	19.0 ± 7.9	9.5 ± 6.5	13.2 ± 5.6	24.5 ± 6.0	144.2 ± 93.1	86.2 ± 48.3

* Mean numbers and standard deviations of organisms collected in four 0.093 m^2 Surber samples.

** Treated with 17.5 g Permethrin/ha on 16 June, 1978, and again on 21 June, 1978.

Table 21

Aquatic organisms* caught in drift nets set at North Baker Brook Downstream Station**, Temiscouata County, Quebec
12 June to 24 June and 3 August, 1978

Days before or after Permethrin application			-4 AM	-4 PM	-3 AM	-3 PM	-2 AM	-2 PM	-1 AM	-1 PM	-0 AM	+1hr (NB) -½hr (LB)	+2½hr (NB) +1hr (LB)	+4½hr (NB) +3hr (LB)	+10hr (NB) +8½hr (LB)	+15½hr (NB) +14 hr (LB)	+1 AM	+1 PM	+2 AM	+2 PM
Volume of flow through net (m^3)			44.6	30.3	34.4	19.4	34.1	12.2	27.9	53.3	72.4	72.4	72.4	48.3	5.3	12.2	33.0	29.5	27.8	16.5
Current Velocity (m/sec)			0.46	0.37	0.40	0.34	0.82	0.73	0.67	0.64	0.58	0.58	0.58	0.58	0.64	0.49	0.43	0.40	0.40	0.43
Ephemeroptera	Ephemeridae													75.5	5.28	0.98				
	Heptageniidae													179.2	49.1	2.30	0.09	0.07		0.06
	Baetidae		0.07	0.10	0.30	0.05	0.03	0.25	0.07	0.02	0.07									
Plecoptera														102.0	154.0	3.93	0.18	0.03		
Hemiptera	Nebridae													0.33						
Megaloptera	Sialidae	***(L)													0.75					
	Corydalidae	(L)						0.08												
Trichoptera		(L)	0.17		1.13		0.56	0.25		0.13	0.08	0.06	0.04	77.5	74.7	1.89	0.42	0.10	0.11	
		(P)									0.01									
Coleoptera	Dytiscidae	(A)												0.33		0.08				
	Hydrophilidae	(L)												0.33						
		(A)																0.03	0.04	
	Elmidae	(L)					0.12	0.08	0.07		0.01									
		(A)					0.03							1.99		0.16	0.03	0.03		
	Others						0.06									0.08	0.03			
Diptera	Tipulidae	(L)			0.03										0.75	0.16				
		(P)					0.03													
	Simuliidae	(L)	0.02		0.15					0.02	0.01			0.66		0.08			0.04	
		(P)	0.02																	
	Chironomidae	(L)			0.06		0.82	0.08		0.04	0.01			8.28	21.9	0.08	0.06	0.03	0.11	0.12
		(P)					0.21							0.33	1.51					
	Belefdae	(L)																		
		(P)						0.08	0.07					0.33						
	Others						0.03								0.75					
Oligochaeta																				
Arachnida	Hydracarina		0.05	0.30	0.23									0.33			0.03		0.04	0.06
Totals			0.33	0.40	1.90	0.05	0.89	0.82	0.21	0.21	0.19	0.06	0.04	447.1	308.7	9.74	0.84	0.29	0.34	0.24

* Expressed as organisms/m^3 of flow through net.

** 2.4 Km downstream from Little Baker Brook (sprayed 17.5 g Permethrin/ha on 16 June, 1978, and again on 21 June, 1978) and 5.7 Km downstream from North Baker Brook (sprayed 17.5 g Permethrin/ha on 16 June, 1978, and again on 21 June, 1978).

*** (L) larvae
(P) pupae
(A) adults

(NB) Application to North Baker Brook
(LB) Application to Little Baker Brook

Table 21 (cont'd)

Days before or after Permethrin application			+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+1½hr (NB -3hr (LB)	+3½hr (NB) -1hr (LB)	+5½hr (NB) +1hr (LB)	+6½hr (NB) +2hr (LB)	+7½hr (NB) +3hr (LB)	+15hr (NB) +10½hr (LB)	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+4½ AM	+4½ PM
Volume of flow through net (m^3)			18.3	56.5	45.9	47.6	57.1	38.1	19.0	38.1	19.0	19.0	16.5	26.2	13.1	40.6	13.9	41.0	30.1	3.6	3.6
Current Velocity (m/sec)			0.46	0.49	0.40	0.40	0.46	0.46	0.46	0.46	0.46	0.46	0.43	0.37	0.37	0.49	0.37	0.40	0.40	0.03	0.03
Ephemeroptera	Ephemeridae				0.04								0.18								
	Heptageniidae												1.76								
	Baetidae			0.02		0.04		0.03			0.05	0.10	0.08	0.08		0.02					
Plecoptera			0.16	0.05	0.02	0.02	0.02				0.05	0.05	0.48								
Hemiptera	Nebiidae																				
Megaloptera	Sialidae	(L)																			
	Corydalidae	(L)																			
Trichoptera		(L)	0.05	0.07			0.02	0.03				0.10	0.18	0.04			0.07				
		(P)											0.24								
		(A)													0.08	0.02					
Coleoptera	Dytiscidae	(A)																			
	Hydrophilidae	(L)			0.04											0.02					
		(A)	0.05	0.02																	
	Elmidae	(L)		0.02				0.03	0.05	0.03			1.01	0.04			0.07				
		(A)		0.02																	
	Others									0.03											
Diptera	Tipulidae	(L)																			
		(P)																			
	Simuliidae	(L)																			
		(P)																			
	Chironomidae	(L)		0.05								0.05	0.12				0.07	0.02	0.07		
		(P)		0.04		0.02															0.56
	Heleidae	(L)			0.02																
		(P)																			
	Others																		0.01		0.56
Oligochaeta																0.02		0.07			
Arachnida	Hydracarina																				
Totals			0.26	0.29	0.12	0.08	0.04	0.09	0.05	0.06	0.10	0.30	3.97	0.16	0.08	0.08	0.21	0.09	0.10	0.00	1.12

Table 22

Bottom fauna populations*, North Baker Brook Downstream Station**,
Temiscouata County, Quebec
12 June to 1 August, 1978

Date			12 June	20 June	25 June	29 June	3 July	1 August
Days before or after 1st spray (2nd spray)			-4	+4 (-1)	+9 (+4)	+13 (+8)	+17 (+12)	+46 (+41)
Ephemeroptera	Ephemeridae		--	--	--	--	--	0.2 ± 0.5
	Heptagenlidae		0.2 ± 0.5	0.2 ± 0.5	--	--	--	0.2 ± 0.5
	Baetidae		5.0 ± 3.5	3.2 ± 4.3	3.2 ± 2.5	0.2 ± 0.5	2.2 ± 2.2	1.0 ± 0.8
Odonata	Gomphidae		--	--	--	--	--	0.2 ± 0.5
Plecoptera			1.0 ± 1.2	1.2 ± 1.3	2.5 ± 3.8	0.8 ± 1.0	4.8 ± 4.0	0.5 ± 0.6
Trichoptera		larvae	16.0 ± 13.6	4.8 ± 5.0	3.5 ± 3.3	1.0 ± 0.8	0.5 ± 0.6	4.0 ± 2.9
		pupae	--	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5	--	--
Coleoptera	Elmidae	larvae	2.0 ± 2.4	--	--	0.8 ± 0.9	3.5 ± 4.5	7.0 ± 2.7
		adults	1.2 ± 1.5	3.2 ± 3.0	3.5 ± 4.4	2.0 ± 1.8	0.5 ± 1.0	0.8 ± 1.5
	Hydrophilidae		0.5 ± 1.0	--	--	--	0.2 ± 0.5	--
	Psephenidae		--	0.2 ± 0.5	--	--	--	--
	Haliplidae		--	--	--	0.2 ± 0.5	--	--
	Hydroscaphidae		--	--	--	--	0.2 ± 0.5	--
Diptera	Tipulidae	larvae	0.2 ± 0.5	1.0 ± 1.4	0.5 ± 1.0	1.0 ± 0.8	1.5 ± 1.3	1.5 ± 1.3
		pupae	--	--	--	--	0.2 ± 0.5	1.8 ± 2.4
	Athericidae		--	--	--	0.2 ± 0.5	--	--
	Simulidae		0.2 ± 0.5	--	--	--	--	--
	Chironomidae	larvae	9.8 ± 3.5	0.2 ± 0.5	1.5 ± 1.3	1.8 ± 1.7	3.5 ± 4.5	82.8 ± 80.5
		pupae	0.2 ± 0.5	--	--	--	0.2 ± 0.5	1.5 ± 1.3
	Heleidae		--	--	--	1.2 ± 1.5	4.8 ± 5.0	3.0 ± 4.8
	Empididae	larvae	0.5 ± 0.6	--	--	--	--	--
		pupae	--	--	--	--	1.0 ± 2.0	--
	Unidentified		--	--	--	--	0.5 ± 0.6	--
Oligochaeta			0.8 ± 1.0	--	--	--	--	1.0 ± 1.2
Arachnida	Hydracarina		0.2 ± 0.5	0.2 ± 0.5	--	--	0.5 ± 0.6	--
Gastropoda			--	0.2 ± 0.5	--	--	--	0.2 ± 0.5
Totals			38.0 ± 18.5	15.0 ± 9.4	15.0 ± 9.0	9.5 ± 5.2	24.2 ± 11.3	105.8 ± 91.0

* Mean numbers and standard deviations of organisms collected in four 0.093 m^2 Surber samples.

** 2.4 Km downstream from Little Baker Brook (treated with 17.5 g Permethrin/ha on 16 June, 1978, and again on 21 June, 1978) and 5.7 Km downstream from North Baker Brook (treated with 17.5 g Permethrin/ha on 16 June, 1978, and again on 21 June, 1978).

Table 23

Terrestrial organisms* caught in drift nets set
in the untreated control stream
Temiscouata County, Quebec
9 June to 24 June and 3 August, 1978

Drift Date			9 June AM	9 June PM	10 June AM	10 June PM	11 June AM	11 June PM	12 June AM	12 June PM	13 June AM	13 June PM	14 June AM	14 June PM	15 June AM	15 June PM	16 June AM	16 June PM	17 June AM	17 June PM	18 June AM
Water surface sampled (m^2)			277.6	218.7	201.9	168.2	176.7	176.7	159.8	79.9	79.9	75.7	134.6	126.2	122.0	185.1	193.5	79.9	79.9	168.2	151.4
Collembola							0.06		0.06				0.07		0.08						
Ephemeroptera		adults		0.18						0.12		0.13	0.07	0.08		0.11		0.12		1.19	
Plecoptera		adults																			
Neuroptera			0.04					0.06													
Trichoptera		adults														0.05				0.06	0.07
Lepidoptera		larvae																			
Hymenoptera			0.04					0.11	0.06	0.12			0.07						0.25		0.13
Coleoptera	Staphylinidae									0.12			0.07								
	Unidentified																				
Diptera		adults	0.11	0.27		0.65	0.23	0.17	0.31	1.00		0.39	0.15		0.16		0.10	0.50	0.88	0.24	0.26
Arachnida	Araneida				0.05		0.11	0.06			0.12				0.08				0.38		
Totals			0.19	0.45	0.05	0.65	0.40	0.40	0.43	1.36	0.12	0.52	0.43	0.08	0.32	0.16	0.10	0.62	1.51	1.49	0.46

* Expressed as organisms/10 m^2 of stream surface flowing through net.

Table 23 (cont'd)

Drift Date			18 June PM	19 June AM	19 June PM	20 June AM	20 June PM	21 June AM	21 June PM	22 June AM	22 June PM	23 June AM	23 June PM	24 June AM	24 June PM	3 August AM	3 August PM
Water surface sampled (m^2)			143.0	176.7	134.6	168.2	134.6	134.6	201.9	50.5	75.7	109.4	117.8	50.5	227.1	88.3	75.7
Collembola										0.20							
Ephemeroptera		adults			0.37		1.85										0.13
Plecoptera		adults														0.11	
Realptera																	0.13
Trichoptera		adults							0.05								
Lepidoptera		larvae														0.23	
Hymenoptera						0.06	0.07	0.07	0.15	0.20	0.13						
Coleoptera	Staphylinidae															0.11	
	Unidentified											0.09		0.20			
Diptera		adults	0.28	0.23	1.04	0.06	0.67	0.37	0.59	0.78	0.92	0.09		0.39	0.04	0.45	1.58
Arachnida	Araneida			0.06		0.06											
Totals			0.28	0.29	1.41	0.18	2.59	0.44	0.79	1.18	1.05	0.18	0.00	0.59	0.04	0.90	1.84

Table 24

Terrestrial organisms* caught in drift nets set in Ruisseau de la Pointe au Sable**
Temiscouata County, Quebec
9 June to 21 June and 1 August, 1978

Days before or after 1st or 2nd Permethrin application			-4 AM	-4 PM	-3 AM	-3 PM	-2 AM	-2 PM	-1 AM	-1 PM	-0 AM	+0 hr	+½ hr	+1 hr	+2 hr	+3 hr	+14 hr	+1 AM	+1 PM
Water Surface Sampled (m^2)			219.2	283.6	206.3	245.0	206.3	232.1	206.3	167.6	146.1	146.1	146.1	29.2	29.2	29.2	12.0	171.9	223.5
Collembola						0.04	0.05									0.34			
Ephemeroptera		adults				0.04		0.09	0.05			0.27				1.71	0.83		
Plecoptera		adults		0.04				0.04				0.41	3.29		1.37	1.71			
Homoptera		nymphs						0.09					6.30	2.40					
		adults							0.10	1.25	0.07	0.14	1.10	5.14		7.53	3.33	0.06	0.09
Homoptera												0.14	1.37	1.71	2.74		0.83		
Trichoptera		adults				0.08		0.13	0.05	0.12		0.14	1.37	0.68		1.37			
Lepidoptera	Unidentified	larvae			0.15									0.68	1.37	1.01	0.83		0.04
	Unidentified	adults		0.04	0.05				0.05				0.24						
Hymenoptera		larvae											0.55			0.34			
		adults	0.05		0.53	0.12	0.10	0.47	0.39	0.06	0.14		3.01	2.40	8.22	1.37		0.06	
Coleoptera		adults						0.09	0.05	0.24	0.14	0.48	1.92	0.34	0.34		0.83		
Diptera		adults	0.18	0.08	1.50	1.88	0.58	3.81	6.64	8.53	4.11	18.0	52.8	31.2	31.5	15.4	10.8	0.87	0.18
Arachnida	Araneida				0.05			0.09	0.10	0.06		0.27	1.64	0.34	1.37	0.68	1.67		
Totals			0.23	0.16	2.28	1.16	0.73	4.83	7.43	10.26	4.46	19.8	73.6	44.9	46.9	31.5	19.1	0.99	0.31

* Expressed as organisms/10 m^2 of stream surface flowing through net.

** Treated with 17.5 g/ha Permethrin at 7:11 AM on 13 June and again at 4:43 AM on 18 June, 1978.

Table 24 (cont'd)

Days before or after 1st or 2nd Permethrin application			+2 AM	+2 PM	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+0 hr (2nd spray)	+5 hr	+1 hr	+2 hr	+3 hr	+16 hr	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+45 AM	+45 PM
Water Surface Sampled (m^2)			223.5	223.5	232.1	296.5	223.5	146.1	206.3	206.3	41.3	41.3	20.6	20.6	180.5	171.9	137.5	154.7	161.3	73.1	38.7	64.5
Collembola							0.13		0.19				0.49						0.06			
Ephemeroptera		adults				0.07	0.04				0.24		5.34		0.44	0.47	0.58					
Plecoptera		adults				0.03			0.05				0.49		0.11	0.35	1.09		0.06			
Hemiptera		nymphs			0.04		0.04					0.73	9.22	5.34	1.61	1.80	1.96	8.21	1.04	20.5		0.47
		adults	0.13	0.09		0.10	0.85	2.19	0.39	0.29		0.24					2.47					
Homoptera																						
Trichoptera		adults	0.04		0.04			0.07	0.15	0.19	0.48	0.73	1.46		0.06		0.15			0.14		0.16
Lepidoptera	Unidentified	larvae	0.18	0.04	0.04	0.13	0.27		0.15	0.05					0.06			0.06	0.06			0.16
	Unidentified	adults						0.14														
Hymenoptera		larvae										0.48	0.97		0.06		0.07		0.18	0.14		0.16
		adults					0.18	0.14	0.05									0.06	0.18	0.14		0.31
Coleoptera		adults	0.09	0.09		0.07	0.18	0.27		0.15	0.48	0.73										
Diptera		adults	0.31	1.12	0.13	0.67	4.47		0.82	5.91	6.30	13.3	7.77	6.31	2.22	2.44	8.28	3.17	5.45	10.9	0.78	27.1
Arachnida	Araneida			0.09			0.13	0.14	0.05	0.10	0.24		0.49			0.06			0.06			0.16
Totals			0.75	1.43	1.32	1.07	6.29	2.95	1.85	6.69	7.74	16.2	26.2	11.6	4.56	5.12	14.6	11.5	7.09	31.8	0.78	28.5

Table 25

Terrestrial organisms* caught in drift nets set
in North Baker Brook**
Temiscouata County, Quebec
9 June to 24 June and 3 August, 1978

Days before or after 1st or 2nd Permethrin application	-7 AM	-7 PM	-6 AM	-6 PM	-5 AM	-5 PM	-4 AM	-4 PM	-3 AM	-3 PM	-2 AM	-2 PM	-1 AM	-1 PM	-0 AM	+0 hr	+½ hr	+1 hr	+2 hr	+3 hr	+9 hr	+15 hr	+1 AM	+1 PM
Water Surface Sampled (m^2)	258.0	197.4	172.0	180.5	163.6	163.6	180.5	86.6	77.6	77.6	98.7	32.8	98.7	180.5	205.9	205.9	102.9	41.2	10.3	10.3	82.3	19.5	68.8	86.0
Collembola	0.12	0.15									0.10				0.05	1.36	0.48	0.97		3.88				
Ephemeroptera	0.04														0.05	0.05	0.10					1.26	0.14	6.05
Plecoptera	0.04								0.13							1.60	0.39					0.51	0.29	0.12
Homoptera	0.04																		0.97	2.91	2.92	1.26	0.29	
Trichoptera	0.04																0.10							0.12
Lepidoptera																						1.01	0.29	0.70
Hymenoptera						0.12	2.82	0.23		0.26					0.05	0.10					0.97	2.28	5.23	1.05
Coleoptera	0.04					0.18	0.11		0.13					0.06			0.10							
Diptera	0.23	0.25		0.44	0.30			1.40	0.64	0.64	0.10	0.26		0.33	0.30	1.46	1.36	2.91	1.94	1.94	5.83	6.08	4.36	2.21
Arachnida Arenetida			0.06		0.06				0.13							0.15	0.29						0.14	
Totals	0.56	0.40	0.06	0.44	0.37	0.30	2.94	1.63	1.03	0.90	0.20	0.26	0.00	0.39	0.24	4.21	2.82	3.88	2.91	8.74	9.72	12.4	10.8	10.2

* Expressed as organisms/10 m^2 of stream surface flowing through net.

** Treated with 17.5 g/ha Permethrin at 4:30 AM on 16 June and again at 7:00 AM on 21 June, 1978.

Table 25 (cont'd)

Days before or after 1st or 2nd Permethrin application	+2 AM	+2 PM	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+0 hr (2nd spray)	+½ hr	+1 hr	+2 hr	+3 hr	+14 hr	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+43 AM	+43 PM
Water Surface Sampled (m^2)	86.0	81.8	81.8	163.6	81.8	77.6	163.6	16.4	16.4	16.4	16.4	16.4	77.6	94.5	77.6	86.0	172.0	172.0	121.3	63.4	126.9
Collembola								0.61	1.22	0.61				0.21	0.39	SAMPLE LOST		0.12	0.16		
Ephemeroptera		0.37		0.86		0.39				0.61									0.08		0.24
Plecoptera	0.12		0.12				0.12			0.61				0.10							0.08
Homoptera	0.12			0.12						0.61				0.53	0.39		0.06		0.08		0.08
Trichoptera					0.12	0.13	0.12			0.61			0.13	0.10	0.13						
Lepidoptera	0.23										1.22		0.39	0.10					0.25		
Hymenoptera	0.35	0.37		0.12	0.12		0.06	2.44		0.61		3.66	1.03	0.63	3.09		0.12	0.17	1.48		0.08
Coleoptera				0.18				0.61		2.44	1.22	1.22	0.52	0.21	1.55		0.12	0.06	0.41		0.16
Diptera	0.81	1.10	0.73	2.08	0.86	1.29	0.24	1.22	18.9	9.76	17.1	15.8	10.8	6.14	11.5		1.51	0.64	2.88	0.63	6.07
Arachnida Araneida									0.61		2.44		0.26	0.32	0.52						
Totals	1.74	1.83	0.86	3.36	1.10	1.80	0.55	4.88	20.7	15.8	22.0	20.7	13.1	8.36	17.5		1.80	0.99	5.36	0.63	6.70

Table 26

Terrestrial organisms* caught in drift nets set in Little Baker Brook**
Temiscouata County, Quebec
9 June to 24 June and 3 August, 1978

Days before or after 1st or 2nd Fenvalerate application		-7 AM	-7 PM	-6 AM	-6 PM	-5 AM	-5 PM	-4 AM	-4 PM	-3 AM	-3 PM	-2 AM	-2 PM	-1 AM	-1 PM	-0 AM	+0 hr	+½ hr	+1 hr	+2 hr	+3 hr	+9 hr	+14 hr	+1 AM
Water Surface Sampled (m^2)		265.0	202.0	127.0	118.0	191.0	118.0	151.0	72.0	168.0	84.0	114.0	42.0	91.0	135.0	160.0	160.0	80.0	16.0	8.0	8.0	19.0	15.0	12.0
Collembola			0.08	0.05	0.24	0.16	0.20	0.08					0.43		0.22		4.19	1.00		5.00		2.11		0.31
Ephemeroptera			0.08					0.08	0.33		0.12	1.43	0.09	0.43	0.22					5.00	5.00	2.11	8.00	
Plecoptera										0.06		0.09			0.15		1.12	6.00	10.0				2.00	
Anoptera																				5.50				
Thysanoptera								0.17	0.07		0.35	0.09												0.62
Hemiptera						0.08		0.42	0.20	0.14		0.24	0.09			0.06	0.12	5.00	20.0	35.0	52.5	14.2	9.33	0.62
Homoptera															0.07						2.50			
Neuroptera																	0.19				2.50		1.33	0.62
Trichoptera			0.15			0.08	0.10	0.08			0.06		0.09								2.50		5.33	
Lepidoptera	Larvae							0.16	0.07			0.12			0.07				1.25					2.50
Hymenoptera			0.07					0.08						0.11						5.00	10.0		4.00	
Coleoptera			0.07		0.08			0.25	0.07	0.14	0.06		0.15		0.22		0.44	1.00	5.00	5.00		2.11	1.33	0.94
Diptera			1.06	0.45	0.55	10.4	4.75	7.46	1.99	11.1	5.06	5.48	4.91	1.06	0.33	16.1		10.6	22.0	25.0	35.0	32.5	8.42	22.7	16.6
Nematoda																								
Oligochaeta																								
Arachnida	Arachnida										0.12				0.07		0.88		5.00	5.00	2.50		0.67	
Isopoda																					2.50			
Totals			1.51	0.50	0.87	10.7	5.05	8.78	2.21	11.3	5.48	7.62	5.71	1.92	0.66	16.9	0.06	19.29	35.0	66.2	100.0	102.5	29.5	54.7	22.2

* Expressed as organisms/10 m^2 of stream surface flowing through net.

** Treated with 17.5 g/ha Fenvalerate at 6:11 AM on 16 June and again at 11:40 AM on 21 June, 1978.

Table 26 (cont'd)

Days before or after 1st or 2nd Permethrin application		+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+0 hr (2nd spray)	+½ hr	+1 hr	+2 hr	+3 hr	+11 hr	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+43 AM	+43 PM
Water Surface Sampled (m^2)		84.0	84.0	80.0	80.0	185.0	72.0	177.0	76.0	30.0	15.0	15.0	15.0	15.0	42.0	84.0	53.0	177.0	76.0	168.0	160.0	63.0	50.0
Collembola		0.36	0.24	0.37	0.25	0.11	0.28			0.33		0.67	2.00			0.12		0.05	0.39	0.06			
Ephemeroptera		11.7	0.24	1.00	0.12	0.49		0.17		0.67					0.24		2.26	0.05			0.50		
Plecoptera		1.43	0.12	0.25		0.11				0.33	4.00	3.33	0.67	1.33		0.12							
Anoplura														0.67									
Thysanoptera														0.67									
Hemiptera		0.12	0.12											14.0		0.12			0.39				
Homoptera		1.67	1.19	1.00	0.50	0.43		0.06	0.13	2.00	4.67	9.33	14.0	6.00	0.71	1.43	0.19	0.34	0.13	0.12	0.50	0.16	
Neuroptera		0.48		0.37						0.67		4.00	4.67										0.20
Trichoptera		0.36			0.25		0.14		0.13	2.00	8.00	4.00	4.00	2.67	0.48		0.38	0.11	0.26				0.20
Lepidoptera																							0.20
	larvae	0.84									0.67		0.67	1.33	0.24	0.60		0.06	0.26				
Hymenoptera		1.07				0.16				2.33	8.00	5.33	9.33	4.67		0.71			0.13	0.12	0.06	0.32	
Coleoptera		0.36	0.36	0.25	0.12	0.38	0.14			0.67	2.00	4.00	1.33	2.00		0.83	0.19	0.34	0.06	0.12	0.19		0.20
Diptera		12.7	13.1	9.87	3.37	4.27	2.22	1.64	1.05	40.3	62.0	41.3	32.0	29.3	4.29	9.17	4.15	2.32	5.92	1.55	4.25	0.48	
Nematoda							0.14																
Oligochaeta							0.14																
Arachnida	Acarina	0.24	0.12	0.38	0.25				0.13	2.33	2.00	1.33	3.33	0.67	0.24	0.36	0.38	0.06	1.18	0.06			
Isopoda																							
Totals		31.3	15.5	14.5	4.86	5.95	3.06	1.87	1.44	51.6	91.3	73.3	72.0	63.3	6.20	13.5	7.55	3.33	9.32	2.01	5.50	0.96	0.80

Table 27

Terrestrial organisms* caught in drift nets set in North Baker Brook Downstream Station**
Temiscouata County, Quebec
12 June to 24 June and 3 August, 1978

Days before or after 1st or 2nd Permethrin application			-4 AM	-4 PM	-3 AM	-3 PM	-2 AM	-2 PM	-1 AM	-1 PM	-0 AM	+1 hr (NB) -½ hr (LB)	+2½ hr (NB) +1 hr (LB)	+4½ hr (NB) +3 hr (LB)	+10 hr (NB) +8½ hr (LB)	+13½ hr (NB) +14 hr (LB)	+1 AM	+1 PM	+2 AM	+7 PM
Water Surface Sampled			189.0	151.0	164.0	93.0	116.0	60.0	93.0	177.0	240.0	240.0	240.0	180.0	18.0	60.0	118.0	109.0	109.0	52.0
Collembola					0.06		0.26			0.06				0.89						
Ephemeroptera		adults																		
Plecoptera		adults					0.09													
Hemiptera							0.09						0.04				0.08			
Homoptera			0.26	0.66			0.09		0.11						6.67		0.42	0.28	0.46	0.51
Trichoptera		adults																		0.17
Lepidoptera		larvae adults			0.06								0.04			0.50			0.18	
Hymenoptera			0.05					0.25		0.06								0.18	0.09	0.17
Coleoptera	Staphylinidae		0.05			0.11										0.25		0.09		0.17
	Unidentified			0.07	0.06		0.79				0.04									
Diptera		adults	0.37	0.80	0.98	0.22	0.44	0.50		0.34				1.78		0.75	0.68	0.56	0.46	2.20
Arachida	Araneida		0.05	0.07																
Totals			0.78	1.60	1.16	0.33	1.76	0.75	0.11	0.46	0.04	0	0.08	2.67	6.67	1.50	1.18	1.11	1.19	3.22

* Expressed as organisms/10 m^2 of stream surface flowing through net.

** 2.4 Km downstream from Little Baker Brook (sprayed 17.5 g/ha Permethrin on 16 June and again on 21 June, 1978) and 5.7 Km downstream from North Baker Brook (sprayed 17.5 g/ha Permethrin on 16 June and again on 21 June, 1978).

(NB) Application to North Baker Brook
(LB) Application to Little Baker Brook

Table 27 (cont'd)

Days before or after 1st or 2nd Permethrin application			+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+1⅓ hr (NB) −3 hr (LB)	+3⅔ hr (NB) −1 hr (LB)	+5⅔ hr (NB) +1 hr (LB)	+6⅔ hr (NB) +2 hr (LB)	+7⅓ hr (NB) +3 hr (LB)	+15 hr (NB) +10½ hr (LB)	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM	+43 AM	+43 PM
Water Surface Sampled			63.0	202.0	164.0	164.0	189.0	126.0	63.0	126.0	63.0	63.0	59.0	101.0	50.0	135.0	50.0	164.0	109.0	12.0	12.0
Collembola																					
Ephemeroptera		adults				0.06					0.16			0.10	0.20						
Plecoptera		adults								0.08											
Hemiptera												0.16	0.34			0.07	0.20				
Homoptera			0.16	0.15		0.06		0.08		0.08		0.48	0.51			0.21	0.40	0.06			
Trichoptera		adults	0.16										0.85								
Lepidoptera		larvae adults		0.05											0.20		0.20				
Hymenoptera			0.16							0.08		0.32	0.17	0.10		0.07					
Coleoptera	Staphylinidae			0.05	0.12				0.16					0.20					0.12		
	Unidentified		0.48													0.07	0.20				
Diptera		adults	0.96	0.40	0.30	0.79				0.16	0.16	0.96	5.76	0.20	0.40	0.14	1.40	0.43		0.83	1.67
Arachnida	Araneida												0.17					0.12			
Totals			1.92	0.65	0.42	0.91	0	0.08	0.16	0.40	0.32	1.92	7.80	0.60	0.80	0.56	2.40	0.73	0	0.83	1.67

Table 28

Slimy sculpin stomach contents, untreated control station, Tenkarcoata County, Quebec
9 June to 26 October, 1978

Sample Date	Percent Occurrence						Mean Percent Contribution to Volume						Mean Basket of Organisms Per Stomach				
	9 June	18 June	24 June	30 June	2 August	26 October	9 June	18 June	24 June	30 June	2 August	26 October	9 June	18 June	24 June	30 June	2 August	26 October
No Food Present	20	10	20	30	20	20												
Aquatic Insects																		
Burrowing mayfly nymphs	30	--	--	--	--	10	21.3	--	--	--	--	8.8	2.0	--	--	--	--	1.0
Heptagenid mayfly nymphs	--	10	--	--	--	--	--	4.4	--	--	--	--	--	2.0	--	--	--	--
Baetid mayfly nymphs	20	30	60	30	20	50	8.8	16.0	35.9	40.0	22.5	27.6	1.0	3.0	2.7	1.7	2.5	2.2
Dragonfly nymphs	10	--	--	--	--	--	11.3	--	--	--	--	--	1.0	--	--	--	--	--
Stonefly nymphs	--	10	10	20	--	20	--	1.1	6.0	15.7	--	3.5	--	1.0	2.0	1.0	--	1.5
Fishfly larvae	--	10	--	--	--	--	--	0.1	--	--	--	--	--	1.0	--	--	--	--
Caddisfly larvae	40	50	40	20	40	70	30.0	23.7	10.4	17.1	17.0	42.5	1.0	1.4	1.8	2.5	4.0	2.6
Aquatic Coleoptera larvae	--	--	10	20	--	--	--	--	1.2	5.7	--	--	--	--	2.0	2.0	--	--
Aquatic Coleoptera adults	10	20	10	--	--	--	13.8	2.8	15.0	--	--	--	1.0	1.5	3.0	--	--	--
Crane fly larvae	--	--	--	--	10	10	--	--	--	--	0.6	2.0	--	--	--	--	1.0	1.7
Blackfly larvae	--	--	--	10	--	--	--	--	--	2.9	--	--	--	--	--	1.0	--	--
Chironomid larvae	--	60	60	30	50	60	--	29.2	19.6	7.4	29.8	15.6	--	1.7	11.7	9.0	7.6	2.0
Culicoides larvae	10	--	--	--	20	--	5.0	--	--	--	7.6	--	1.0	--	--	--	2.0	--
Aquatic Diptera larvae	--	--	--	--	10	--	--	--	--	--	8.8	--	--	--	--	--	1.0	--
Other Aquatic Invertebrates																		
Oligochaeta	10	10	10	--	--	--	1.0	10.9	10.0	--	--	--	1.0	2.0	1.0	--	--	--
Hydracarina	--	--	--	--	10	--	--	--	--	--	5.0	--	--	--	--	--	1.0	--
Terrestrial Arthropods																		
Terrestrial Homoptera	--	--	--	--	10	--	--	--	--	--	8.8	--	--	--	--	--	1.0	--
Terrestrial Lepidoptera larvae	--	10	--	--	--	--	--	7.7	--	--	--	--	--	4.0	--	--	--	--
Terrestrial Diptera larvae	--	--	--	10	--	--	--	--	--	11.1	--	--	--	--	--	1.7	--	--
Terrestrial Diptera adults	--	10	--	--	--	--	--	5.1	--	--	--	--	--	1.0	--	--	--	--

Table 29

Slimy sculpin stomach contents,
Ruisseau de la Pointe au Sable*, Temiscouata County, Quebec
11 June to 25 October, 1978

Sample Date	Percent Occurrence					Mean Percent Contribution to Volume					Mean Number of Organisms Per Stomach				
	11 June	14 June	25 June	3 August	25 October	11 June	14 June	25 June	3 August	25 October	11 June	14 June	25 June	3 August	25 October
No Food Present	20	17	60	40	40										
Aquatic Insects															
Heptagenid mayfly nymphs	10	42	--	--	10	0.6	22.6	--	--	8.3	1.0	4.4	--	--	2.0
Baetid mayfly nymphs	70	67	--	--	30	71.6	27.3	--	--	28.3	1.7	3.3	--	--	2.0
Stonefly nymphs	20	58	20	--	40	9.4	40.2	56.7	--	30.8	3.0	3.8	1.0	--	2.0
Caddisfly larvae	20	17	--	20	30	12.0	4.5	--	18.3	30.8	1.0	3.0	--	2.0	1.0
Caddisfly pupae	--	--	10	--	--	--	--	33.0	--	--	--	--	1.0	--	--
Aquatic Coleoptera adults	--	--	10	--	--	--	--	10.0	--	--	--	--	1.0	--	--
Aquatic Coleoptera larvae	--	8	--	--	--	--	1.0	--	--	--	--	1.0	--	--	--
Cranefly larvae	20	8	--	10	10	11.6	1.5	--	6.7	1.1	2.0	1.0	--	1.0	1.0
Mosquito larvae	10	8	--	10	--	0.1	0.3	--	1.7	--	1.0	2.0	--	3.0	--
Chironomid larvae	30	25	--	50	10	0.9	1.2	--	60.0	0.3	1.0	2.0	--	3.8	1.0
Unidentified Diptera larvae	10	--	--	10	--	0.1	--	--	13.3	--	1.0	--	--	2.0	--
Other Aquatic Invertebrates															
Oligochaetes	10	8	--	--	--	6.1	1.5	--	--	--	1.0	1.0	--	--	--

* Treated with 17.5 g Permethrin/ha on
13 June and again on 18 June, 1978.

Table 30

Slimy sculpin stomach contents, North Baker Brook*,
Temiscouata County, Quebec
10 June to 25 October, 1978

Sample Date	Percent Occurrence						Mean Percent Contribution to Volume						Mean Number of Organisms Per Stomach					
	10 June	18 June	21 June	30 June	1 August	25 October	10 June	18 June	21 June	30 June	1 August	25 October	10 June	18 June	21 June	30 June	1 August	25 October
No Food Present	17	10	0	20	10	0												
Aquatic Insects																		
Burrowing mayfly nymphs	25	--	--	10	--	--	20.3	--	--	1.9	--	--	1.3	--	--	1.0	--	--
Heptagenid mayfly nymphs	8	--	--	--	--	20	9.0	--	--	--	--	4.2	1.0	--	--	--	--	1.5
Baetid mayfly nymphs	25	50	70	20	--	90	27.8	37.0	45.4	1.5	--	50.0	7.3	4.2	6.9	1.0	--	4.2
Stonefly nymphs	--	20	20	30	--	40	--	29.4	6.5	5.9	--	6.3	--	2.1	2.0	1.7	--	2.5
Hydropsychid larvae	--	--	--	10	--	--	--	--	--	0.5	--	--	--	--	--	1.0	--	--
Caddisfly larvae	33	50	70	40	10	60	12.6	10.9	24.3	14.4	4.3	27.1	2.0	2.6	1.6	1.9	1.0	5.7
Aquatic Coleoptera adults	--	--	10	10	--	--	--	--	1.5	0.5	--	--	--	--	1.0	2.0	--	--
Aquatic Coleoptera larvae	17	20	--	10	--	--	7.0	0.7	--	0.3	--	--	1.5	1.0	--	1.0	--	--
Crane fly larvae	--	10	20	--	--	40	--	0.1	0.6	--	--	6.7	--	1.0	1.5	--	--	2.0
Mosquito larvae	8	--	--	--	20	--	0.5	--	--	--	3.6	--	1.0	--	--	--	2.5	--
Blackfly larvae	--	--	10	--	--	--	--	--	0.1	--	--	--	--	--	1.0	--	--	--
Chironomid larvae	67	90	90	40	70	50	3.8	21.7	11.7	0.9	88.6	5.7	2.0	6.1	3.3	3.5	4.6	1.8
Unidentified Diptera larvae	--	--	--	10	10	--	--	--	--	0.1	3.6	--	--	--	--	1.0	1.0	--
Other Aquatic Invertebrates																		
Oligochaetes	--	--	--	70	--	--	--	--	--	73.3	--	--	--	--	--	4.0	--	--
Crayfish	--	--	10	--	--	--	--	--	9.9	--	--	--	--	--	1.0	--	--	--
Terrestrial Arthropods																		
Terrestrial Lepidoptera larvae	8	--	--	10	--	--	10.0	--	--	0.9	--	--	2.0	--	--	1.0	--	--
Terrestrial Diptera adults	8	--	--	--	--	--	9.0	--	--	--	--	--	1.0	--	--	--	--	--

* Treated with 17.5 g Permethrin/ha on 16 June
and again on 21 June, 1978.

Table 31

Slimy sculpin stomach contents, Little Baker Brook*,
Temiscouata County, Quebec
10 June to 25 October, 1978

Sample Date	Percent Occurrence						Mean Percent Contribution to Volume						Mean Number of Organisms Per Stomach					
	10 June	18,19 June	23 June	1 July	1 August	25 October	10 June	18,19 June	23 June	1 July	1 August	25 October	10 June	18,19 June	23 June	1 July	1 August	25 October
No Food Present	0	46	0	20	0	20												
Aquatic Insects																		
Burrowing mayfly nymphs	--	--	60	50	20	20	--	--	24.5	55.9	19.8	21.2	--	--	2.2	1.8	2.0	1.0
Heptagenid mayfly nymphs	10	15	10	--	--	--	5.4	9.0	7.3	--	--	--	2.0	1.5	1.0	--	--	--
Baetid mayfly nymphs	100	39	70	--	--	50	63.9	46.8	21.0	--	--	22.5	2.9	4.8	1.7	--	--	1.6
Stonefly nymphs	--	15	60	20	--	10	--	2.8	15.8	6.0	--	1.2	--	1.0	3.7	2.0	--	2.0
Caddisfly larvae	40	31	30	10	10	10	21.5	36.7	8.8	4.4	2.0	12.5	2.0	2.8	1.3	2.6	1.0	2.0
Aquatic Coleoptera larvae	--	15	--	--	10	--	--	2.6	--	--	9.0	--	--	1.0	--	--	1.0	--
Crane fly larvae	--	--	10	--	--	10	--	--	6.8	--	--	7.5	--	--	1.0	--	--	1.0
Chironomid larvae	60	31	80	40	100	50	1.2	2.0	15.9	30.2	69.2	35.0	1.4	1.3	2.5	5.5	7.3	2.0
Terrestrial Arthropods																		
Adult Caddisflies	10	--	--	--	--	--	8.0	--	--	--	--	--	1.0	--	--	--	--	--
Terrestrial Diptera adults	--	--	10	10	--	--	--	--	0.1	2.5	--	--	--	--	1.0	1.0	--	--
Terrestrial Diptera larvae	--	--	--	10	--	--	--	--	--	1.0	--	--	--	--	--	1.0	--	--

* Treated with 17.5 g Fenesthelin/ha on
16 June and again on 21 June, 1978.

Table 32

Brook trout sampled for stomach analysis from untreated control station Temiscouata County, Quebec 9 June to 26 October, 1978

	9,10 June	18 June	24 June	30 June	2 August	26 October
No. of fish sampled	10	10	10	10	10	10
Mean total length (mm)	89.7	58.1	95.4	95.8	78.9	73.2
Range	38 - 117	34 - 127	21 - 132	85 - 105	61 - 104	67 - 91
Mean Fork Length (mm)	8.54	55.5	90.3	91.8	54.8	69.8
Range	37 - 111	32 - 122	49 - 125	81 - 100	58 - 100	64 - 86
Mean Weight (gm)	8.65	5.06	10.92	11.71	6.28	3.27
Range	0.7 - 16.2	1.2 - 22.2	1.2 - 21.7	7.5 - 14.4	2.6 - 11.3	2.2 - 6.5
Mean Volume of Stomach Contents (ml)	0.20	0.09	0.20	0.23	0.25	0.11
Range	0 - 0.5	<0.1 - 0.1	<0.1 - 0.6	<0.1 - 0.5	<0.1 - 0.5	<0.1 - 0.1

Sculpins sampled for stomach analysis from untreated control station Temiscouata County, Quebec 9 June to 26 October, 1978

	9 June	18 June	24 June	30 June	2 August	26 October
No. of fish sampled	10	10	10	10	10	10
Mean total length (mm)	73.1	79.7	71.8	60.2	61.3	64.3
Range	57 - 93	62 - 95	51 - 87	46 - 87	48 - 100	56 - 81
Mean Fork Length (mm)	--	--	--	--	--	--
Range	--	--	--	--	--	--
Mean Weight (gm)	5.66	8.71	4.28	4.26	3.43	2.58
Range	2.7 - 12.8	5.4 - 12.7	1.3 - 7.1	2.1 - 6.8	1.6 - 12.6	1.5 - 6.1
Mean Volume of Stomach Contents (ml)	0.24	0.12	0.03	0.02	0.04	0.06
Range	0 - 1.8	0 - 0.7	0 - 0.1	0 - 0.1	0 - 0.1	0 - 0.1

Table 33

Sculpins sampled for stomach analysis
from Ruisseau de la Pointe au Sable*
Temiscouata County, Quebec
11 June to 25 October, 1978

	11 June	14 June	25 June	3 August	25 October
No. of fish sampled	10	12	10	10	10
Mean total length (mm)	59.3	55.3	52.8	57.9	59.1
Range	49 - 75	42 - 80	46 - 62	52 - 66	51 - 73
Mean weight (g)	1.88	2.15	2.27	2.24	1.97
Range	1.2 - 4.0	0.8 - 7.2	1.8 - 3.1	1.6 - 3.0	1.1 - 3.8
Mean volume of stomach contents (ml)	0.06	0.08	0.01	0.02	0.03
Range	0 - 0.3	0 - 0.2	0 - < 0.1	0 - 0.1	0 - 0.1

* Treated with 17.5 g/ha Permethrin on
13 June and again on 18 June, 1978.

Table 34

	Brook trout sampled for stomach analysis from North Baker Brook* Temiscouata County, Quebec 10 June to 1 August, 1978			Sculpins sampled for stomach analysis from North Baker Brook* Temiscouata County, Quebec 10 June to 25 October, 1978					
	10 June	1,2 July	1 August	10 June	18 June	23 June	30 June	1 August	25 October
No. of fish sampled	4	2	2	12	10	10	10	10	10
Mean total length (mm)	117.3	107.0	111.5	66.6	64.5	74.1	70.0	74.3	64.0
Range	113 - 126	90 - 124	63 - 160	42 - 93	49 - 84	57 - 94	55 - 93	53 - 103	48 - 91
Mean fork length (mm)	111.8	104.0	108.0	--	--	--	--	--	--
Range	108 - 120	87 - 121	61 - 155	--	--	--	--	--	--
Mean weight (g)	15.28	15.80	24.15	4.62	5.72	5.30	6.76	4.73	3.53
Range	11.8 - 19.0	8.4 - 23.2	7.9 - 45.4	1.1 - 10.2	3.1 - 3.9	4.1 - 13.8	3.4 - 12.6	1.8 - 12.1	0.8 - 9.8
Mean volume of stomach contents (ml)	0.30	0.40	0.35	0.11	0.11	0.29	0.42	0.02	0.07
Range	0.2 - 0.4	0.3 - 0.5	<0.1 - 0.6	<0.1 - 0.3	0 - 0.2	<0.1 - 0.6	0 - 1.2	0 - <0.1	0.1 - 0.2

* Treated with 17.5 g/ha Permethrin on 16 June and again on 21 June, 1978.

Table 35

Sculpins sampled for stomach analysis from Little Baker Brook*
Temiscouata County, Quebec
10 June to 25 October, 1978

	10 June	18,19 June	23 June	1 July	1 August	25 October
No. of fish sampled	10	13	10	10	10	10
Mean total length (mm)	56.5	58.4	60.1	56.2	64.3	62.8
Range	45 - 95	42 - 30	45 - 90	45 - 80	47 - 101	50 - 75
Mean weight (g)	4.08	3.56	6.05	2.56	3.77	2.46
Range	2.5 - 13.9	1.9 - 6.5	3.8 - 11.4	1.3 - 7.5	1.3 - 14.3	1.1 - 4.4
Mean volume of stomach contents (ml)	0.05	0.04	0.09	0.03	0.02	0.06
Range	<0.1 - 0.1	0 - 0.1	<0.1 - 0.3	0 - 0.1	< 0.1	0 - 0.2

Ling sampled for stomach analysis from Little Baker Brook*
Temiscouata County, Quebec
10 June to 25 October, 1978

	10 June	18 June	25 October
No. of fish sampled	5	3	2
Mean total length (mm)	136.4	161.3	204.5
Range	108 - 165	138 - 179	200 - 209
Mean weight (g)	30.68	27.03	32.75
Range	10.9 - 32.1	18.1 - 32.1	29.5 - 36.0
Mean volume of stomach contents (ml)	0.16	0.83	0.20
Range	0 - 0.4	0.6 - 1.1	0.1 - 0.4

* Treated with 17.5 g/ha Permethrin on 16 June and again on 21 June, 1978.

Table 36

Brook trout stomach contents, untreated control station,
Ivatewauta County, Quebec
9 June to 26 October, 1978

Sample Date	Percent Occurrence						Mean Percent Contribution to Volume						Mean Number of Organisms Per Stomach					
	9,10 June	18 June	24 June	30 June	2 August	26 October	9,10 June	18 June	24 June	30 June	2 August	26 October	9,10 June	18 June	24 June	30 June	2 August	26 October
No Food Present	0	0	10	0	0	0												
Aquatic Insects																		
Burrowing mayfly nymphs	20	--	10	--	--	--	5.5	--	0.4	--	--	--	1.5	--	2.0	--	--	--
Heptagenid mayfly nymphs	20	--	--	10	--	20	2.5	--	--	0.5	--	0.8	1.5	--	--	1.0	--	1.5
Baetid mayfly nymphs	100	60	80	60	50	60	29.5	16.3	10.4	3.7	8.6	11.0	2.7	4.0	3.1	2.5	2.5	3.7
Ephemerellid mayfly nymphs	10	--	--	--	--	10	2.0	--	--	--	--	9.0	1.0	--	--	--	--	1.0
Stonefly nymphs	60	20	40	40	40	30	6.4	2.5	2.0	7.1	2.8	4.5	2.1	2.5	2.0	1.3	1.1	1.3
Aquatic Dryopterids	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydropsychids	--	--	10	--	10	--	--	--	1.1	--	0.1	--	--	--	1.0	--	1.0	--
Rhyacophilid larvae	--	--	--	10	--	--	--	--	--	0.5	--	--	--	--	--	1.0	2.0	--
Caddisfly larvae	90	50	60	70	40	90	10.9	4.8	6.4	17.5	2.8	40.2	1.8	2.2	3.2	10.9	1.8	4.2
Caddisfly pupae	20	--	--	--	--	10	3.5	--	--	--	--	2.0	1.5	--	--	--	--	1.0
Aquatic Coleoptera larvae	20	--	--	20	10	10	0.9	--	--	0.4	0.5	0.2	1.5	--	--	1.5	--	1.0
Aquatic Coleoptera adults	10	10	40	30	40	10	0.5	4.0	8.6	0.9	3.6	0.6	1.0	1.0	3.8	1.3	1.3	2.0
Crane fly larvae	40	30	30	50	20	10	2.7	0.5	2.0	6.9	13.0	10.0	1.8	1.7	1.6	2.0	2.5	1.0
Crane fly pupae	20	--	--	--	--	--	1.5	--	--	--	--	--	10	--	--	--	--	--
Blackfly larvae	70	60	20	20	--	--	4.4	7.7	0.5	0.5	--	--	1.4	3.7	1.5	2.0	--	--
Blackfly pupae	10	--	--	--	--	--	0.2	--	--	--	--	--	1.0	--	--	--	--	--
Chironomid larvae	60	90	80	70	80	40	3.1	4.4	5.3	6.5	3.1	1.2	1.3	3.8	4.6	12.7	3.1	2.2
Chironomid pupae	--	--	20	20	30	--	--	--	0.2	0.3	0.7	--	--	--	1.0	3.0	1.0	--
Ceratopogonid larvae	20	--	--	10	--	--	0.2	--	--	0.1	--	--	1.5	--	--	1.0	--	--
Ceratopogonid pupae	10	--	10	--	--	--	0.9	--	0.2	--	--	--	1.0	--	1.0	--	--	--
Empidid larvae	20	--	10	10	--	10	1.7	--	0.6	2.0	--	0.4	1.5	--	1.0	1.0	--	2.0
Simuliid larvae	10	--	--	--	--	--	0.2	--	--	--	--	--	1.0	--	--	--	--	--
Tipulid fly larvae	--	--	--	10	--	--	--	--	--	6.5	--	--	--	--	--	1.0	--	--
Other Aquatic Invertebrates																		
Nematodes	30	20	--	20	40	--	0.3	0.2	--	0.2	0.5	--	4.0	3.0	--	4.5	1.3	--
Oligochaetes	10	--	--	10	10	40	5.0	--	--	0.5	0.3	2.0	1.0	--	--	1.0	1.0	1.0
Fingernail Clam	--	--	--	--	--	10	--	--	--	--	--	0.3	--	--	--	--	--	1.0
Sphaeriidae	20	10	30	40	10	10	1.9	0.1	0.6	0.5	0.1	0.1	1.5	6.0	1.3	1.3	1.0	1.0
Terrestrial Arthropods																		
Sowbug	--	--	--	--	--	10	--	--	--	--	--	1.0	--	--	--	--	--	1.0
Spiders	--	20	30	--	20	20	--	2.1	0.4	--	1.2	1.5	--	1.5	1.0	--	1.0	1.0
Millipedes	--	--	10	10	--	--	--	--	0.4	0.1	--	--	--	--	1.0	1.0	--	--
Springtails	--	--	--	10	--	--	--	--	--	0.1	--	--	--	--	--	1.0	--	--
Adult mayflies	10	20	30	30	10	--	0.5	4.5	2.3	4.7	4.0	--	1.0	1.0	2.0	3.0	1.0	--
Grasshoppers	--	--	10	--	--	--	--	--	2.0	--	--	--	--	--	1.0	--	--	--
Adult stoneflies	--	10	10	--	10	--	--	0.5	2.2	--	3.5	--	--	1.0	1.0	--	1.3	--
Terrestrial Dryopterids	--	30	30	20	20	--	--	7.9	3.2	1.7	4.0	--	--	1.0	1.7	1.5	2.0	--
Terrestrial Hemiptera	10	30	30	10	30	30	0.5	3.8	1.3	0.1	1.7	4.5	2.0	2.0	4.3	1.0	2.0	2.3
Terrestrial Homoptera	10	10	20	20	20	--	1.0	0.5	0.9	3.5	2.4	--	1.0	1.0	1.0	2.0	1.5	--
Adult caddisflies	10	10	20	20	--	--	2.5	7.6	11.0	1.2	--	--	2.0	1.0	2.5	1.0	--	--
Terrestrial Lepidoptera larvae	30	30	50	20	--	--	--	0.1	--	--	--	--	--	1.0	--	--	--	--
Terrestrial Hymenoptera larvae	--	10	--	--	--	--	--	0.2	5.4	0.5	1.4	--	--	1.0	2.0	1.0	1.0	--
Terrestrial Hymenoptera adults	--	10	40	10	30	--	--	--	3.1	4.8	--	--	1.5	--	1.0	1.0	--	--
Terrestrial Coleoptera adults	40	--	20	20	--	--	11.5	--	1.0	15.9	0.5	--	--	5.5	2.0	3.3	1.0	--
Terrestrial Diptera larvae	--	20	10	30	20	--	--	7.5	1.0	15.9	0.5	--	1.0	2.2	2.9	1.9	10.4	1.0
Terrestrial Diptera adults	20	60	70	70	90	60	0.2	21.8	6.3	11.0	60.2	6.0						

Table 37

Brook trout stomach contents, North Baker Brook and Little Baker Brook* (combined), Temiscouata County, Quebec
10 June to 1 August, 1978

Sample Date	Percent Occurrence				Mean Percent Contribution to Volume				Mean Number of Organisms per Stomach			
	10 June	23 June	1,2 July	1 August	10 June	23 June	1,2 July	1 August	10 June	23 June	1,2 July	1 August
No Food Present	0	0	0	0								
Aquatic Insects												
Heptagenid mayfly nymphs	25	--	--	--	3.8	--	--	--	1.0	--	--	--
Baetid mayfly nymphs	75	50	100	--	32.5	1.0	19.0	--	4.0	1.0	2.5	--
Stonefly nymphs	25	100	50	--	12.5	57.5	0.5	--	1.0	12.5	2.0	--
Fishfly larvae	--	--	50	--	--	--	10.0	--	--	--	2.0	--
Caddisfly larvae	75	100	--	50	20.8	15.0	--	2.5	4.7	3.5	--	1.0
Aquatic Coleoptera adults	--	--	50	100	--	--	1.5	4.5	--	--	1.0	1.0
Cranefly larvae	25	50	50	--	0.3	3.5	22.5	--	1.0	2.0	3.0	--
Blackfly larvae	25	--	--	--	0.3	--	--	--	1.0	--	--	--
Chironomid larvae	50	50	50	50	1.0	0.5	1.0	2.5	1.5	1.0	1.0	2.5
Chironomid pupae	--	--	--	50	--	--	--	1.0	--	--	--	1.0
Dancefly larvae	--	--	--	50	--	--	--	1.5	--	--	--	1.0
Other Aquatic Invertebrates												
Nematodes	25	--	100	100	0.3	--	2.0	1.0	1.0	--	10.0	5.5
Oligochaetes	25	--	--	--	15.0	--	--	--	1.0	--	--	--
Leeches	--	--	50	--	--	--	0.5	--	--	--	1.0	--
Terrestrial Arthropods												
Terrestrial Hemiptera	--	--	--	100	--	--	--	8.5	--	--	--	1.0
Adult Caddisfly	--	--	50	50	--	--	36.5	8.0	--	--	5.0	1.0
Terrestrial Lepidoptera	25	--	50	--	2.0	--	0.5	--	1.0	--	1.0	--
Terrestrial Coleoptera adults	25	50	--	50	10.0	17.5	--	16.5	1.0	4.0	--	1.0
Terrestrial Diptera adults	--	50	50	100	--	2.5	5.0	54.0	--	--	3.0	4.5
Terrestrial Diptera larvae	25	--	50	--	2.0	--	1.0	--	2.0	1.0	1.0	--
Spider	--	50	--	--	--	2.5	--	--	--	1.0	--	--

* Treated with 17.5 g Permethrin/ha on 16 June, 1978, and again on 21 June, 1978.

Table 38

Ling stomach contents, Little Baker Brook*,
Temiscouata County, Quebec
10 June to 25 October, 1978

Sample Date	Percent Occurrence			Mean Percent Contribution to Volume			Mean Number of Organisms Per Stomach		
	10 June	18 June	25 October	10 June	18 June	25 October	10 June	18 June	25 October
No Food Present	20	0	0						
Aquatic Insects									
Burrowing mayfly nymphs	10	--	--	15.0	--	--	1.0	--	--
Heptageniid mayfly nymphs	20	67	--	0.5	4.0	--	1.0	1.5	--
Baetid mayfly nymphs	40	100	100	16.8	49.0	40.0	4.0	66.3	6.5
Stonefly nymphs	40	100	50	35.0	10.0	25.0	4.0	10.3	6.0
Caddisfly larvae	40	100	50	7.5	34.3	35.0	1.5	13.0	4.0
Cranefly larvae	--	33	--	--	0.3	--	--	4.0	--
Blackfly larvae	--	33	--	--	0.7	--	--	2.0	--
Chironomid larvae	40	100	--	25.3	1.7	--	1.0	4.7	--

* Treated with 17.5 g Permethrin/ha on
16 June, 1978, and again on 21 June, 1978.