

THE EFFECTS OF PERMETHRIN ON THE INVERTEBRATE FAUNA
OF A QUEBEC FOREST

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ABSTRACT

Both a single and double application of 17.5 g AI/ha permethrin resulted in catastrophic drift of aquatic invertebrates and substantial depletion of benthos in streams within the application blocks and up to 2 km downstream. Despite massive disturbances of benthos, repopulation of bottom fauna was evident within 2 1/2 months and was virtually complete at the taxonomic level studied within 3 1/2 months. Terrestrial arthropods demonstrated a light to moderate pesticide-induced knockdown from stream bank foliage and forest canopy for up to 48 hours after each application. There was no measurable impact on the activity of ground dwelling invertebrates or small mammals. Permethrin residues attained peak levels of 1.35 µg/L in standing water and 1.94 µg/L in flowing water and persisted at low concentrations for up to 96 hours post-spray. Accumulations of residual permethrin were negligible in sediment, but were higher and more persistent in forest litter. Four 400 ha blocks in Kamouraska County in the Lower St. Lawrence Region of Quebec were treated with 17.5 g AI/ha permethrin emitted in 1.46 L/ha. Two blocks received a single application and two blocks received two treatments at nine or ten day intervals.

RESUME

Une application simple et une application double de perméthrine à la dose de 17.5 g d'ingrédient actif/ha se sont traduites, dans les cours d'eau qui se trouvaient à l'intérieur des blocs d'application et jusqu'à 2 km en aval, par une dérive massive des invertébrés aquatiques et un appauvrissement important du benthos, malgré lequel on a observé le rétablissement de la faune benthique après moins de 2½ mois, pratiquement complet après moins de 3½ mois, au niveau taxonomique étudié. Les arthropodes de la végétation rivulaire et du couvert forestier ont subi un effet de choc léger à modéré, qui a duré jusqu'à 48 heures après chaque application. Il n'y a eu aucune répercussion mesurable sur les invertébrés au sol ou sur les petits mammifères. Les concentrations de perméthrine ont atteint un maximum de 1.35 µg/L dans les eaux dormantes et de 1.94 µg/L dans les eaux courantes, et sont restées faibles jusqu'à 96 heures après l'application. Leur accumulation dans les sédiments a été négligeable, mais elle a été plus forte et plus durable dans la litière de la forêt. On a traité quatre blocs de 400 ha, dans Kamouraska, dans le Bas-Saint-Laurent avec 17.5 g/ha de perméthrine, à raison de 1.46 L/ha. Deux blocs ont reçu une seule application; les deux autres, deux traitements, à neuf ou dix jours d'intervalle.

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INTRODUCTION

Experimental applications of permethrin, a synthetic pyrethroid insecticide were included as a part of the 1980 spruce budworm control program of the Quebec Service d'Entomologie et de Pathologie. The provincial program was designed to determine the efficacy of single and double 17.5 g AI/ha permethrin applications on the spruce budworm. In addition to provincial monitoring of the application's efficacy, the Forest Pest Management Institute assessed the environmental impact and persistence of the pesticide in streams and adjacent forested areas of the experimental treatment blocks. Additional support and analytical services were provided by Chipman Inc.

SITE DESCRIPTION

The four 400 hectare experimental blocks were located in Kamouraska County in the Lower St. Lawrence Region in Quebec, 60 km southwest of Riviere du Loup. Blocks were grouped in pairs, with blocks 301 and 302 located approximately 9 km southwest of blocks 303 and 304. All four areas were comprised of a mixed boreal forest type, predominantly black spruce, *Picea mariana*, and balsam fir, *Abies balsamea*, with sections of trembling aspen, *Populus tremuloides*, balsam poplar, *Populus balsamifera*, white birch, *Betula papyrifera*, pin cherry, *Prunus pensylvanica*, and speckled alder, *Alnus rugosa*.

An untreated control area was established adjacent to a section of Riviere du Loup approximately 7 km east of blocks 301 and 302. The control was characteristic of a more upland boreal forest type than that of the treatment blocks, but with a similar composition of black spruce, balsam fir, white birch, balsam poplar, and white cedar, *Thuja occidentalis*.

In three of the four blocks, aquatic sampling stations were established on portions of streams flowing through the treated areas. Riviere St. Denis flowed in a westerly direction through block 301 and was sampled on the western perimeter of the block and at a site 7 km downstream (Fig. 1). Riviere Manie flowed through a section of block 304 and then northward through the entire length of block 303. Aquatic sampling stations were located 3 km below 303, on the downstream perimeter of the double application block 303 itself, and in the single application block 304 (Fig.2). Block 304 was located immediately upstream from block 303 and in effect contributed pesticide to the lower sections of Riviere Manie equivalent to an extended spray area during the initial application.

A sampling site approximately 1.5 km upstream from block 304 on Riviere Manie was used as an upstream control, while a portion of Riviere du Loup 7 km east of blocks 301 and 302 served as a second control.

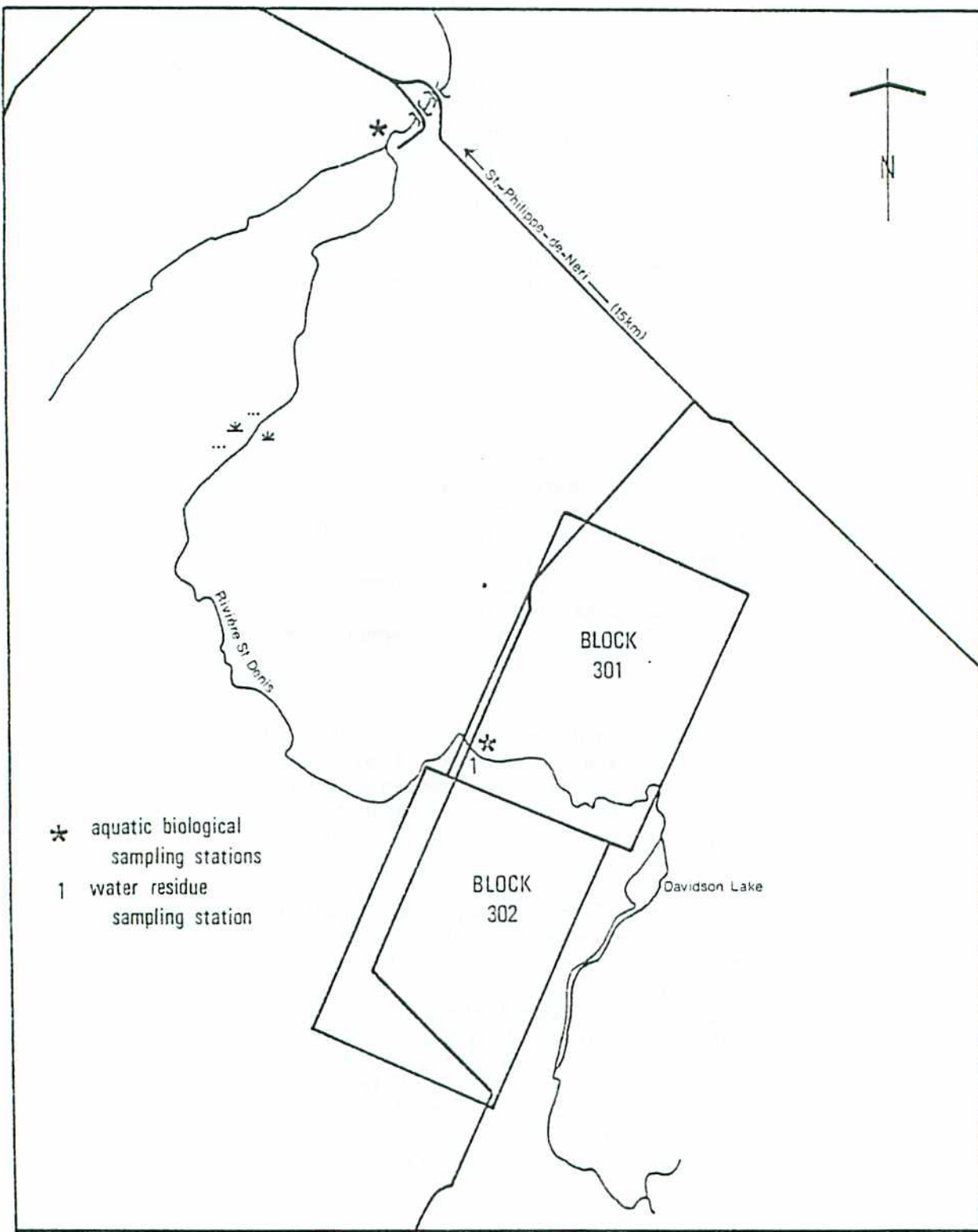


Figure 1 Permethrin application blocks on Riviere St. Denis, Kamouraska County, Quebec, 1980

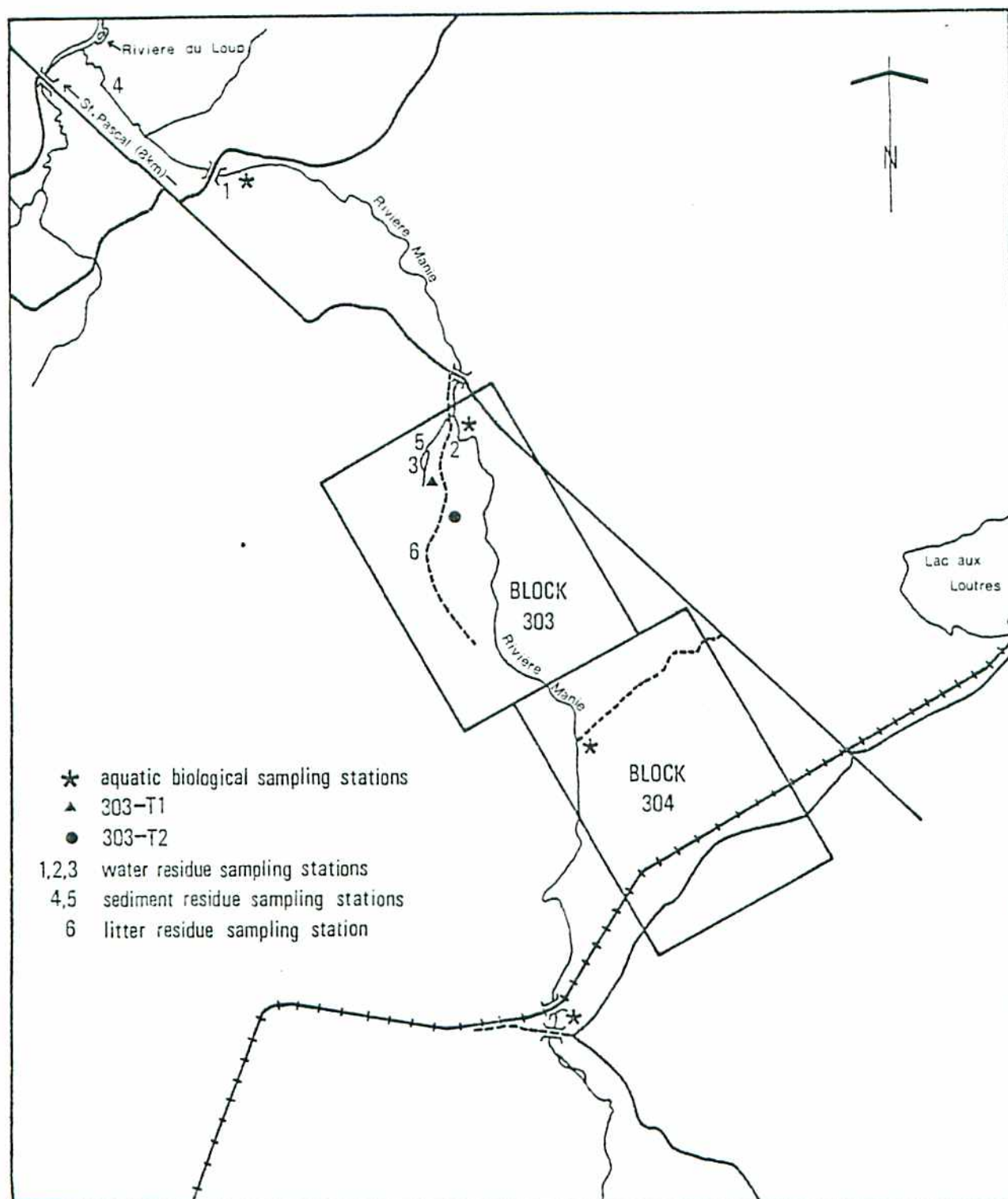


Figure 2 Permethrin application blocks on Riviere Manie, Kamouraska County, Quebec, 1980

Table 1 summarizes the descriptive features of each stream site, and Figures 3 and 4 illustrate characteristic portions of Riviere St. Denis and Riviere Manie.

METHODS

Insecticide Application and Deposit

A Pawnee D aircraft equipped with boom sprayers applied the 17.5 g AI/ha permethrin¹ (mixed with insecticide diluent 585 and 1% automate B dye) at an emission rate of 1.46 L/ha. Two single application (blocks 304, 301) were treated on 6 and 7 June 1980, while two double application blocks (303, 302) received successive treatments on 6 and 15 June, and 7 and 17 June 1980, respectively.

Deposit from the applications was collected on 100 cm² Kromekote paper cards and quantified using a spot-counting system described by Hurtig et al. (1953). For instream deposit analysis, 5 cards were placed on midstream stakes approximately 10 m apart and 20 to 40 cm above the surface the water. Shoreline cards were placed at the same intervals on adjacent stream banks of each sample site. Instream and shoreline deposit was measured in blocks 301, 303, and 304 and at a downstream station on Rivie Manie located 3 km below block 303.

Deposit cards were set in the terrestrial invertebrate sampling areas of the double application block 303. A Kromekote card was placed on the ground beside each of 10 knockdown collection samplers in 303-T1 and beside each of 10 pitfall traps in 303-T2 (Fig. 2). The overhead canopy above the deposit cards was recorded and is presented with the deposit assessment results.

Deposit analysis was also made at sediment and litter residue sampling stations. Five Kromekote cards were set on stakes approximately 10 m apart and 40 cm above the surface of the water body from which sediment samples were taken in the double application block (303). Deposit cards were also placed on the ground beside five litter sampling sites on the forest floor of block 303.

Insecticide Residue Analysis

Permethrin residues in water sediment, and forest litter were analyzed by the chemistry section of Chipman Inc. Sixteen replicate

¹Permethrin 50% oil concentrate, 50 g AI/L, Chipman Inc.

Table 1
Site description for aquatic sampling stations
Kamouraska County, Quebec, 1980

Station	Treatment	Approx. width	Approx. depth	Flow description	Instream cover	Shoreline cover	Bottom Type
St. Denis 301	17.5 g AI/ha permethrin on 7 June 1981 at 0700 to 0720 hrs	3-5 m	25-60 cm	moderate to moderately fast - frequent riffles occasional pools	5-5% cover - boulders, fallen logs	10-50% canopy white birch, spruce, alder	rubble, boulders limited gravel
St. Denis Downstream	7 km below single application block 301	5-7 m	25-70 cm	moderately fast to fast - mostly riffles, few pools	3-5% cover - boulders, fallen logs	20-70% canopy alder, spruce poplar	rubble, boulders limited gravel
Haute 303	17.5 g AI/ha permethrin on 6 and 15 June, 1981 at 0455 to 0528 hr and 1430 to 1500 hrs	7-10 m	30-90 cm	mainly fast - riffles, very few pools	5% cover - boulders	0-10% canopy alder, poplar, spruce, balsam fir	rubble, boulders limited gravel
Haute 304	17.5 g AI/ha permethrin on 6 June 1981 at 0647 to 0716 hrs	5-7 m	30-150 cm	slow to moderate	5-10% cover - boulders, logs	0-10% canopy - alder, balsam fir	rubble, boulders gravel
Haute Downstream	3 km below double application block 303	8-12 m	30 - 60 cm	fast - riffles, no pools	5% cover - boulders	0 -10% canopy alder, willow, spruce, balsam fir, poplar	rubble, boulders sparse gravel
Haute Upstream	upstream control 1.5 km above block 304	7-10 m	30 - 80 cm	moderate to fast frequent riffles, very few pools	5-15% cover - boulders, logs, undercut banks	0-10% canopy - alder, willow, spruce, balsam fir, poplar	rubble, boulders gravel
Control	untreated section of Riviere du Loup	8-12 m	20-50 cm	moderate to fast frequent riffles, very few pools	2-5% cover - boulders, logs, undercut banks	0-25% canopy - alder, poplar, spruce, white birch, cedar	rubble, gravel, few boulders

Figure 3 Riviere St. Denis,
Kamouraska County,
Quebec, 1980

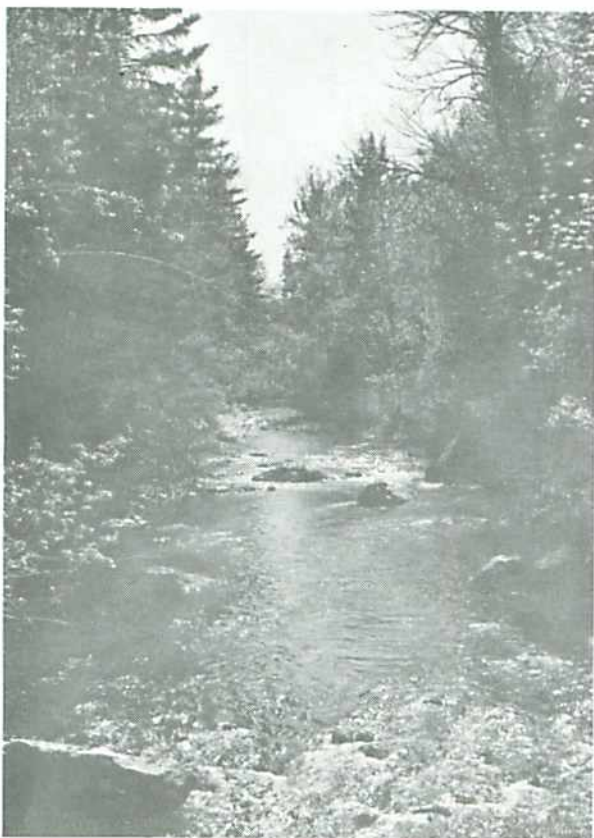
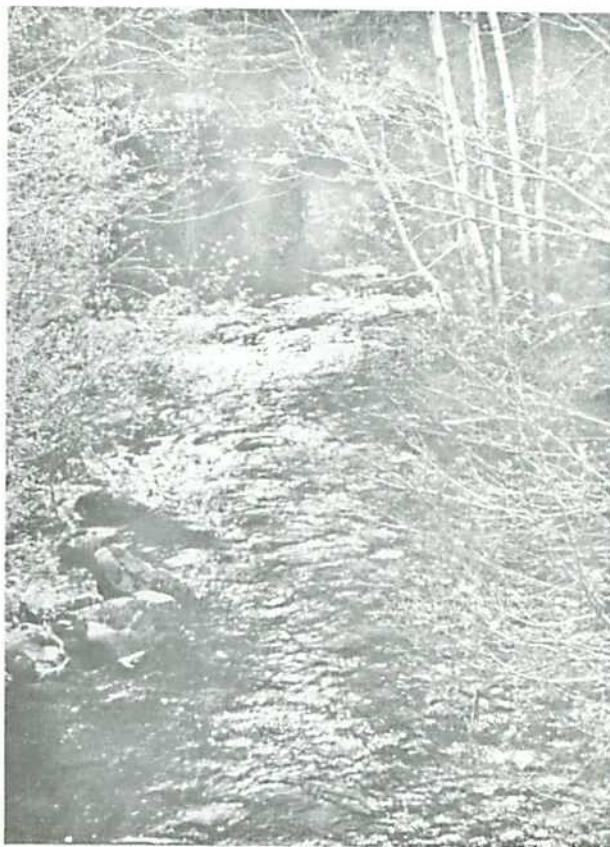


Figure 4 Riviere Manie,
Kamouraska County,
Quebec, 1980

water samples were processed by the Analytical Chemistry group at the Forest Pest Management Institute to confirm the results obtained.

Water samples were collected from Riviere Manie within and 3 km below the double application block 303, from a small pond in block 303, and from Riviere St. Denis in the single application block 301 (Figures 1 and 2). Two to five replicate samples were taken at 10 m intervals from the residue stations. Each sample was collected in two one litre amber glass bottles held approximately 10 cm below the surface of the water. Fifty ml of the collected water were decanted from each bottle and replaced with hexane (distilled in glass). The bottles were securely capped, shaken vigorously, and transported to the field lab for extraction. Water samples were field extracted as soon after collection as possible (usually within 12 hours) with a total of 700 ml of distilled hexane. This was later evaporated to dryness, dissolved in 10 ml of hexane and analyzed directly by electron capture on a Tracor 550 gas chromatograph. The detection limit was 0.01 $\mu\text{g/L}$ (ppb).

Sediment samples from the pond and outlet stream in double application block 303 and from Riviere Manie approximately 5 km below the double block were collected with an aluminum cup-shaped dipper (5 cm dia. x 6.4 cm length) immersed on edge into the sediment to a depth of 2.5 cm (half diameter). The dipper was advanced slowly until filled with sediment which was then placed in a 750 ml screw cap jar and frozen. Five such samples were collected from an area of two square metres at each site and combined as one sample.

Litter samples from the double application block were collected by cutting 30 cm x 30 cm sections of forest floor litter to a depth of 2.5 cm using a conventional garden trowel. Five of these sections were cut from a area of 10 square metres and combined as one sample at each site. The litter samples were then placed in polyethylene bags and frozen for subsequent analysis.

For determination of residual permethrin levels in stream sediment and forest litter, 50 g of a composite sample were extracted with 200 ml of acetone:hexane (2:8) in the presence of anhydrous sodium sulfate in a Sorval Omni-Mixer. The extract was vacuum filtered and washed with water to remove the acetone. The hexane was then dried with anhydrous sodium sulfate and an aliquot equivalent to 25 g of sample was evaporated to dryness on a rotary evaporator. The residue was redissolved in 10 ml of hexane and a 2 ml aliquot was cleaned on a Florisil column. The eluant fraction containing permethrin was concentrated, then rediluted to 10 ml and analyzed on the gas chromatograph. Permethrin residues in stream sediment were measured to a detection limit of 0.007 $\mu\text{g/g}$ (ppm) while the detection limit for permethrin in forest litter samples was 0.003 $\mu\text{g/g}$ (ppm).

Water Quality Assessment

Water quality parameters including dissolved oxygen, pH, alkalinity, hardness, and temperature were measured at pre- and post-spray intervals at each sampling station using a Hach model AL-36B portable field test kit.

Aquatic Biological Sampling

Drifting invertebrates. Drifting invertebrates were monitored before and after the permethrin applications with drift nets set in Riviere Manie Upstream Control (1.5 km above block 304), single application block 304, double application block 303, and Downstream (3 km below block 303) stations, as well as in Riviere St. Denis single application block 301, a 7 km downstream station (Figures 1 and 2) and in an untreated control station on Riviere du Loup. Nets, measuring 0.47 x 0.32 m with a No. 54 (363 μ) mesh collection bag, were positioned in the streams to collect drifting organisms from a column of water for a predetermined length of time. 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 when water levels exceeded the height of the net opening. Drift samples were taken twice daily, morning and evening, before and after the spray, and at more frequent intervals immediately following each treatment. Current velocity (measured with a Teledyne Gurley No.625 Pygmy Current Meter) and depth of the water at the net opening were recorded with each sample taken. All aquatic invertebrates collected were sorted from the net contents, preserved in 70% methanol, and subsequently counted, identified and quantified as organisms per cubic metre of water using the following formula:

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

In addition to the drift monitoring at each station, a drift profile was conducted on Riviere Manie in which drift samples from the upstream control, the single block 304, the double block 303, and the 3 km downstream station were collected simultaneously. This was in an attempt to compare the drift composition of each location at that specific time. Several drift profiles were taken before and after the permethrin applications.

Benthic invertebrates. Prior to and at intervals following the permethrin applications, bottom fauna populations were assessed with a

0.093 m² Surber net (Surber 1936) at each stream station immediately below the drift site. The pre- and post-spray samples were sorted, preserved in 70% methanol and later counted, identified, and presented as mean number and standard deviation of four samples. Organisms were also collected from four randomly selected rocks (approximately 15 cm in diameter) in the streambed at each station to provide additional data on the bottom fauna population. The invertebrates were sorted and enumerated in the manner described for stream Surber sampling.

Caged invertebrates. Plecoptera nymphs (Perlidae) were exposed to both applications in Riviere Manie 303 in small tubular holding cages. The cages were constructed of 30 cm lengths of 10 cm diameter ABS tubing, screened at both ends and fitted with a hinged top section. A series of polyethylene baffles were placed inside the cages to provide current eddies for the invertebrates (Fig. 5). A sample of 10 nymphs was placed in the stream prior to the first application and checked for post-spray mortality and sub-lethal effects including behavioral changes. Two days before the second application, a new sample of 25 plecopterans was placed in the stream. Observations of post-application mortality and behavior of the nymphs were again recorded.

Terrestrial Biological Sampling

Arboreal and flying invertebrates. Terrestrial insect knockdown over the treatment streams was measured quantitatively with the drift nets. Terrestrial organisms were separated from the drift samples, counted, identified and recorded as number of organisms per 10 m² of surface water flowing through the net, calculated as follows:

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

Plastic sampling buckets measuring 39 x 32 x 15 cm were used to collect and quantitatively assess the knockdown of non-target arboreal and flying invertebrates in the double application block 303. Twenty samplers were placed under specified trees (10 under balsam fir and 10 under pin cherry) in 303-T1, and 10 samplers were randomly placed under a peripheral stand of balsam fir in 303-T2. The invertebrates were collected each evening prior to and following both applications, counted, identified, and presented as the number of organisms per sampler for both areas. Similar sample procedures were used in the control area.

Ground dwelling invertebrates. The level of activity of ground dwelling invertebrates in 303-T2 and control areas was monitored for three

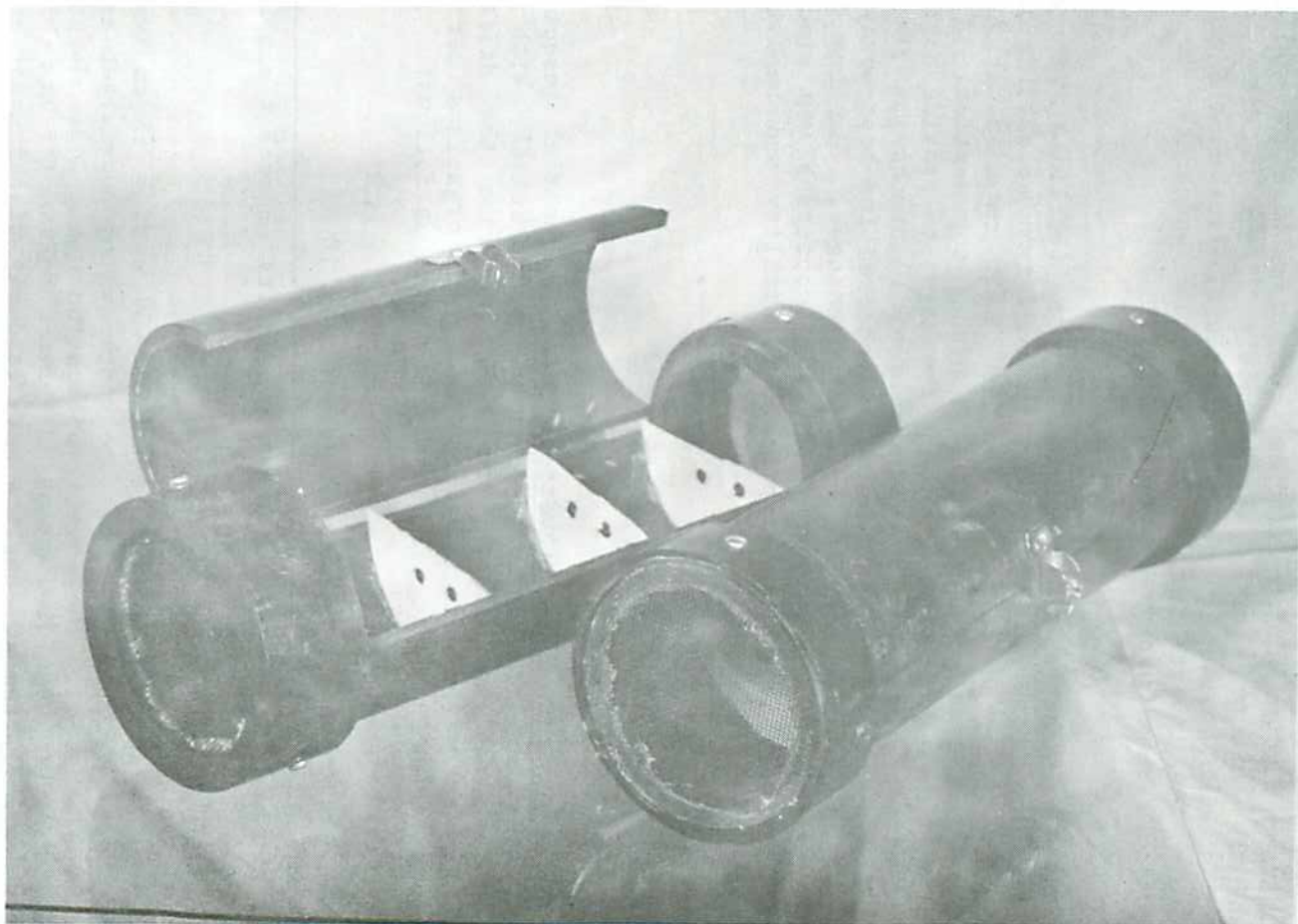


Figure 5 Invertebrate cages used for exposing Plecoptera nymphs to permethrin applications, Kamouraska County, Quebec, 1980

five-day periods during the sampling season with the use of pitfall traps. The traps consisted of plastic containers measuring 12 x 12 x 10 cm set in the forest litter such that the edges of the containers were flush with the surface of the litter. A small amount of a weak detergent solution was added to the traps to act as a killing agent preventing the escape of trapped organisms. Twenty traps were placed at 5 m intervals on an arbitrarily selected compass transect through 303-T2 of the double application block and the control area. The containers were emptied every evening of the sampling period, although damage caused by porcupines prevented the collection of some of the pitfalls on several occasions. All invertebrates were preserved in 70% methanol, counted, identified and presented as the number of organisms per sampler. Only those invertebrates in the Coleoptera, Phalangida, Acari, Araneida and Collembola taxonomic groups were included as indicators of ground dwelling invertebrate activity, as other invertebrates collected were of arboreal origin or adult flying insects.

Small mammals. Small mammals were collected in the double application block site 303-T2 and the control area prior to and two months after the permethrin applications to assess relative changes in age class structure and reproductive success in the small mammal complex. Snapback kill traps, 300 in 303-T2 and 200 in the control, were baited with a mixture of rolled oats and peanut butter and set three per station on a series of transects. All animals were preserved in 10% formalin and returned to the laboratory for identification, aging, sexing, and determination of breeding condition.

RESULTS

Insecticide Deposit

Results of pesticide deposit obtained from the double application block 303 represent measurements taken from the initial application only, since logistical problems prevented deposit analysis of the second application. The amount of emitted formulation deposited on sample cards ranged from 2.74 to 145.20%, with instream and open canopy samples receiving substantially greater deposit than shoreline and heavily canopied areas (Table 2). Although droplet densities did not exceed 10/cm², the mean diameters of the droplets deposited were approximately 1.5 to 2 times larger than those measured from previous experimental permethrin applications (Kingsbury and Kreutzweiser 1979, 1980, Kingsbury and Zylstra 1982).

Three kilometers below the double application block 303 at Manie Downstream, a deposit measurement of 0.004 L/ha (0.27% of the emitted volume) was recorded following the initial spray. No indications of deposit were found at the St. Denis Downstream station 7 km below the single application block 301.

Table 2

Deposit analysis of 17.5 g AI/ha permethrin applied
at an emission rate of 1.46 l/ha to treatment blocks*
Kamouraska County, Quebec, 1980.

	Spot Counting Analysis		Mean Density (Drops per cm ²)	Mean Droplet Diameter Deposited (μ)
	l/ha	% deposit		
Riviere Manie 304 instream	0.33 ± 0.32	22.60	2.67	138.2 ± 13.4
shoreline	0.08 ± 0.03	5.48	1.11	105.8 ± 4.9
303 instream	1.00 ± 0.24	68.49	4.21	140.0 ± 8.8
shoreline	0.73 ± 0.50	50.00	4.08	130.3 ± 15.6
Downstream instream	0.004 ± 0.002	0.27	0.18	63.2 ± 5.6
Riviere St. Denis 301 instream	2.12 ± 2.05	145.20	9.07	125.8 ± 41.8
shoreline	0.57 ± 0.16	39.04	5.13	107.2 ± 14.8
Downstream instream	0	0	-	-
Terrestrial sampling area				
303-1	0.20 ± 0.08	13.70	2.04	116.4 ± 7.3
303-2 (canopy)	0.12 ± 0.09	8.22	0.68	147.3 ± 15.4
303-2 (no canopy)	0.86 ± 0.28	58.90	3.18	161.5 ± 10.8
Sediment residue sampling area	0.64 ± 0.07	43.84	5.55	121.9 ± 2.1
Litter residue sampling area	0.04 ± 0.03	2.74	0.41	111.9 ± 15.9

*results from double application block (303) obtained from initial application only.

** one standard deviation

Insecticide Residue Analysis

Differences in values of permethrin residues in water samples analyzed by Chipman Inc. and the Forest Pest Management Institute were, for the most part, minor (Table 3). More than half of the 16 replicated samples produced differences of 0.02 $\mu\text{g/L}$ or less. Three samples varied by 0.03 to 0.04 $\mu\text{g/L}$, three by 0.08 to 0.13 $\mu\text{g/L}$, and a single sample resulted in the maximum difference of 0.27 $\mu\text{g/L}$.

The mean values of pesticide residue calculated from several replicate water samples taken at each interval have been presented in Table 4. Concentrations of residual permethrin in standing water ranged from 0.03 to 1.35 $\mu\text{g/L}$ and persisted at a mean level of 0.14 $\mu\text{g/L}$ for at least 96 hours after the initial application and at 0.06 $\mu\text{g/L}$ for at least 48 hours following the second application to block 303. Residue levels in the single application stream (St. Denis 301) peaked at 1.30 $\mu\text{g/L}$ one-half hour after the application and remained at 0.31 $\mu\text{g/L}$ for at least 24 hours post-spray. Samples from the double application stream (Manie 303) indicate residue levels ranged from 0.05 to 1.84 $\mu\text{g/L}$ with the exception of two anomalous samples containing 13.77 and 86.21 $\mu\text{g/L}$ permethrin. When tested against the four respective replicates the high concentrations of these samples are statistically improbable ($p < 0.005$) and have therefore been excluded from the calculation of mean values (outliers test described by Dixon and Massey 1969). Permethrin concentrations in the water persisted at mean levels of 0.15 $\mu\text{g/L}$ for at least 96 hours and 0.03 $\mu\text{g/L}$ for at least 48 hours after the first and second applications respectively. Pesticide residue levels measured at the Manie Downstream station varied from 0.03 $\mu\text{g/L}$ to 0.91 $\mu\text{g/L}$ with one sample (6 hours post-second application) containing 29.38 $\mu\text{g/L}$. This sample was identified as an outlier ($P < 0.005$) (Dixon and Massey 1969) and has been excluded from the analysis of mean concentrations. Residues persisted at a mean level of 0.03 $\mu\text{g/L}$ 24 hours after the initial application and at 0.04 $\mu\text{g/L}$ 12 hours after the second application. Actual concentration values for each water sample collected are included in Appendix Tables A-1 to A-3.

Measurements of permethrin residues in sediment collected from a pond and its outflow streams in block 303 varied widely after the two applications from non-detectable levels to 0.095 $\mu\text{g/g}$, but appeared to stabilize at a relatively high mean concentration of 0.012 $\mu\text{g/g}$ 59 days after the applications (Table 5). Accumulation of residual permethrin in stream sediment collected from a section of Riviere Manie approximately 4.5 km downstream from block 303 was minimal. Only 2 of a total of 24 samples taken contained measurable amounts of pesticide. Appendix table A-4 contains complete results of sediment analyses.

Permethrin residue levels in forest litter from block 303 increased substantially following the second application (Table 5). Mean concentrations ranged from 0.001 $\mu\text{g/g}$ to 0.053 $\mu\text{g/g}$ but were reduced to

Table 3
 Comparison of 16 replicate water samples
 analyzed by Chipman Inc. and the
 Forest Pest Management Institute

Permethrin concentration in water $\mu\text{g/L}$ analyzed by Chipman Inc.	Permethrin concentration in water ($\mu\text{g/L}$) analyzed by FPMI	Difference ($\mu\text{g/L}$)
0.57	0.57	0.00
1.81	1.54	0.27
1.74	1.51	0.13
0.64	0.61	0.03
0.55	0.51	0.04
0.08	0.07	0.01
0.05	0.05	0.00
0.07	0.10*	0.02
1.52	1.51	0.01
0.13	0.12	0.01
0.15	0.14	0.01
1.51	1.62	0.10
N.D.	0.02	0.02
0.63	0.71	0.08
0.71	0.67	0.04
N.D.	N.D.	0.00

N.D. - non-detectable

Chipman Inc. limit of detection 0.01 $\mu\text{g/L}$

FPMI limit of detection 0.02 $\mu\text{g/L}$

* insufficient sample for exact quantification

Table 4
 Permethrin residues ($\mu\text{g}/\ell$) in water samples
 taken from treatment areas Kamouraska County,
 Quebec, 1980.

Sampling Regime	Manie 303	Manie Downstream	Pond 303	St. Denis 301
Number of replicate samples	5	5	2	3
Pre-spray	N.D.	-	N.D.	-
First application				
$\frac{1}{2}$ hr post-spray	- ^{**}	-	-	1.30 \pm 0.60
1 $\frac{1}{2}$ hr	0.62 \pm 0.07	0.28 \pm 0.15	0.10 \pm 0.00	-
6 hr	0.43 \pm 0.13	0.59 \pm 0.20	0.62 \pm 0.01	0.64 \pm 0.25
12 hr	0.13 \pm 0.09	0.25 \pm 0.25	0.14 \pm 0.01	0.32 \pm 0.04
24 hr	0.11 \pm 0.11*	0.03 \pm 0.02	0.13 \pm 0.04	0.31 \pm 0.01
96 hr	0.15 \pm 0.10	-	0.14 \pm 0.16	-
Second application				
1 hr post-spray	1.58 \pm 0.24*	-	0.23 \pm 0.10	
1 $\frac{1}{2}$ hr	-	0.09 \pm 0.06	-	
6 hr	0.24 \pm 0.22	0.08 \pm 0.01*	0.77 \pm 0.10	
12 hr	0.15 \pm 0.06	0.04 \pm 0.02	0.84 \pm 0.73	
24 hr	0.55 \pm 0.59	-	0.12 \pm 0.01	
48 hr	0.03 \pm 0.03	-	0.06 \pm 0.01	

" - " indicates no sample taken

N.D. - none detected

Limit of detection 0.01 $\mu\text{g}/\ell$ (ppb)

* means calculated from four replicates only - anomalous samples ($p < 0.01$) have been excluded.

** one standard deviation

Table 5

Permethrin residues ($\mu\text{g/g}$) in sediment
and litter samples from treatment area
Kamouraska County, Quebec, 1980.

Sampling Regime	Sediment		Litter Block 303
	Manie 303 (pond and outlet)	Manie Downstream	
Number of replicate samples	7	5	5
Pre-spray	N.D.	-	N.D.
First application			
1 day post-spray	-	-	0.001 \pm 0.002
4 days	-	-	0.004 \pm 0.006
Second application			
1 day post-spray	0.004 \pm 0.008	-	0.030 \pm 0.014
4 days	0.004 \pm 0.008		0.053 \pm 0.073
6 days	-	0.002 \pm 0.005**	-
8 days	0.015 \pm 0.035*	N.D.	0.039 \pm 0.056
26 days	0.006 \pm 0.009	0.012 \pm 0.028**	0.016 \pm 0.012
59 days	0.012 \pm 0.009	N.D.	N.D.

" - " indicates no sample taken

N.D. - none detected

Limit of detection 0.003 $\mu\text{g/g}$ (ppm)

* increased mean and large variance introduced by one of seven samples with value 47 times greater than the other six.

** increased mean and large variance resulted from single sample since four of five samples contained no detectable levels.

- presented as mean and one standard deviation

non-detectable levels by the end of the 59 day sampling period. Results from analysis of forest litter samples are presented in Appendix Table A-5.

Water Quality Assessment

The results of water quality analyses have been presented in Table 6 and indicate conditions typical of boreal forest fast-water streams. Temperatures fluctuated according to weather conditions, dissolved oxygen levels approached saturation, pH was neutral and CaCO_3 content was generally stable.

Aquatic Biological Sampling

Drifting invertebrates. Following the single permethrin application to block 301, the number of drifting invertebrates at the Riviere St. Denis station increased from a pre-spray average of 1.36 organisms per m^3 to a half-hour post-spray maximum of 1555.6/ m^3 (Fig. 6). Ephemeroptera nymphs, Simuliidae larvae, Plecoptera nymphs, Chironomidae larvae and Trichoptera larvae comprised the major portion of the drift increases. Twelve hours after the application these increases were substantially reduced although elevated drift levels remained evident for 48 hours (Appendix Table A-6). There were no indications of an impact related increase in the number of drifting aquatic invertebrates at the St. Denis Downstream station 7 km below block 301 (Appendix Table A-7). A series of drift samples collected from Riviere Manie 304 on the day of the single application to block 304 demonstrated a definite but much smaller drift increase attaining a peak level of 87.2 aquatic invertebrates per m^3 (Appendix Table A-8).

Both permethrin applications to block 303 resulted in substantial increases in the number of drifting invertebrates at the Manie 303 station (Fig. 6). From a pre-spray average of 2.48 per m^3 , the number of drifting invertebrates increased to a peak level of 2598.1 per m^3 one hour after the initial application. Numbers had declined to 102.6/ m^3 by 12 hours post-spray but did not reach levels similar to pre-spray values for up to 84 hours. The drift increases were comprised almost entirely of Ephemeroptera, Trichoptera, Simuliidae, Plecoptera, and Chironomidae (Appendix Table A-9).

The second application to Manie 303 produced a second increase in drifting invertebrates but of a lesser magnitude and duration (Fig. 6). A peak level of 657.4 organisms per m^3 was attained two hours after the application, but numbers diminished to an average of 1.36 per m^3 within 36 hours (Appendix Table A-9). Ephemeroptera nymphs again comprised the major portion of the drift, followed by Plecoptera, Chironomidae, and Trichop-

Table 5
Basic water quality parameters measured in treatment
and control streams
Kamouraska County, Quebec, 1980

Station	Date 1980	Temp. °C		Oxygen mg/l	pH	Alkalinity mg/l CaCO ₃	Hardness mg/l CaCO ₃	Weather
		Air	Water					
Control	21 May	24	13	9	7.5	51.3	51.3	Clear
	25 May	14	9	10	7.5	34.2	58.4	Mostly cloudy
	30 May	24	14	9	7.5	34.2	34.2	Clear
	2 June	14	12	-	7.5	17.1	34.2	Overcast
	10 June	8	9	10	7.5	17.1	34.2	Overcast
	20 June	22	16	8	7.5	17.1	51.3	Partly cloudy
	24 Sept.	11	8	10	7.5	34.2	51.3	Clear
St. Denis 301	21 May	22	14	10	7.0	51.3	51.3	Clear
	25 May	11	9	9	7.5	17.1	34.2	Mostly cloudy
	30 May	26	19	9	7.5	51.3	34.2	Clear
	2 June	14	15	-	7.5	51.3	34.2	Overcast
	11 June	9	9	9	7.5	17.1	34.2	Overcast
	21 June	10	14	9	7.5	17.1	34.2	Heavy rain
	24 Sept.	10	8	9	7.0	17.1	51.3	Clear
St. Denis Downstream	22 May	14	12	11	7.5	17.1	51.3	Partly cloudy
	25 May	11	11	10	7.5	34.2	51.3	Mostly cloudy
	27 May	10	10	9	7.5	34.2	51.3	Light rain
	2 June	12	11	10	7.5	17.1	34.2	Overcast
	11 June	10	9	11	7.5	17.1	34.2	Overcast
	21 June	10	14	9	7.5	17.1	51.3	Heavy rain
	24 Sept.	8	8	11	7.0	17.1	51.3	Clear
Manie Upstream	22 May	17	14	9	7.5	34.2	51.3	Not recorded
	26 May	11	10	10	7.5	17.1	34.2	Light rain
	31 May	19	15	10	7.5	17.1	34.2	Overcast
	1 June	15	12	-	7.5	51.3	51.3	Moderate rain
	11 June	9	10	8	7.5	17.1	34.2	Overcast
	18 June	15	13	10	7.5	17.1	51.3	Overcast
	24 Sept.	2	9	10	7.5	17.1	34.2	Clear
Manie 304	23 May	19	11	11	7.5	17.1	34.2	Partly cloudy
	26 May	12	10	9	7.5	17.1	34.2	Light rain
	31 May	22	16	10	7.5	34.2	51.3	Overcast
	1 June	15	12	-	7.5	34.2	34.2	Moderate rain
	10 June	12	13	8	7.5	17.1	51.3	Overcast
	20 June	23	17	10	7.5	17.1	34.2	Partly cloudy
Manie 303	21 May	24	14	10	7.5	17.1	34.2	Clear
	24 May	18	14	11	7.5	17.1	34.2	Partly cloudy
	28 May	13	12	8	7.5	34.2	34.2	Overcast
	1 June	15	13	9	7.5	58.4	51.3	Moderate rain
	11 June	9	10	10	7.5	17.1	34.2	Overcast
	18 June	17	14	8	7.5	17.1	34.2	Overcast
Manie Downstream	20 May	18	13	9	7.5	17.1	34.2	Clear
	24 May	20	14	9	7.5	17.1	34.2	Partly cloudy
	27 May	10	10	10	7.5	34.2	51.3	Light rain
	1 June	17	15	9	7.5	17.1	34.2	Moderate rain
	11 June	9	9	10	7.5	17.1	34.2	Overcast
	18 June	15	13	9	7.5	34.2	34.2	Overcast
24 Sept.	6	9	10	7.5	51.3	51.3	Clear	

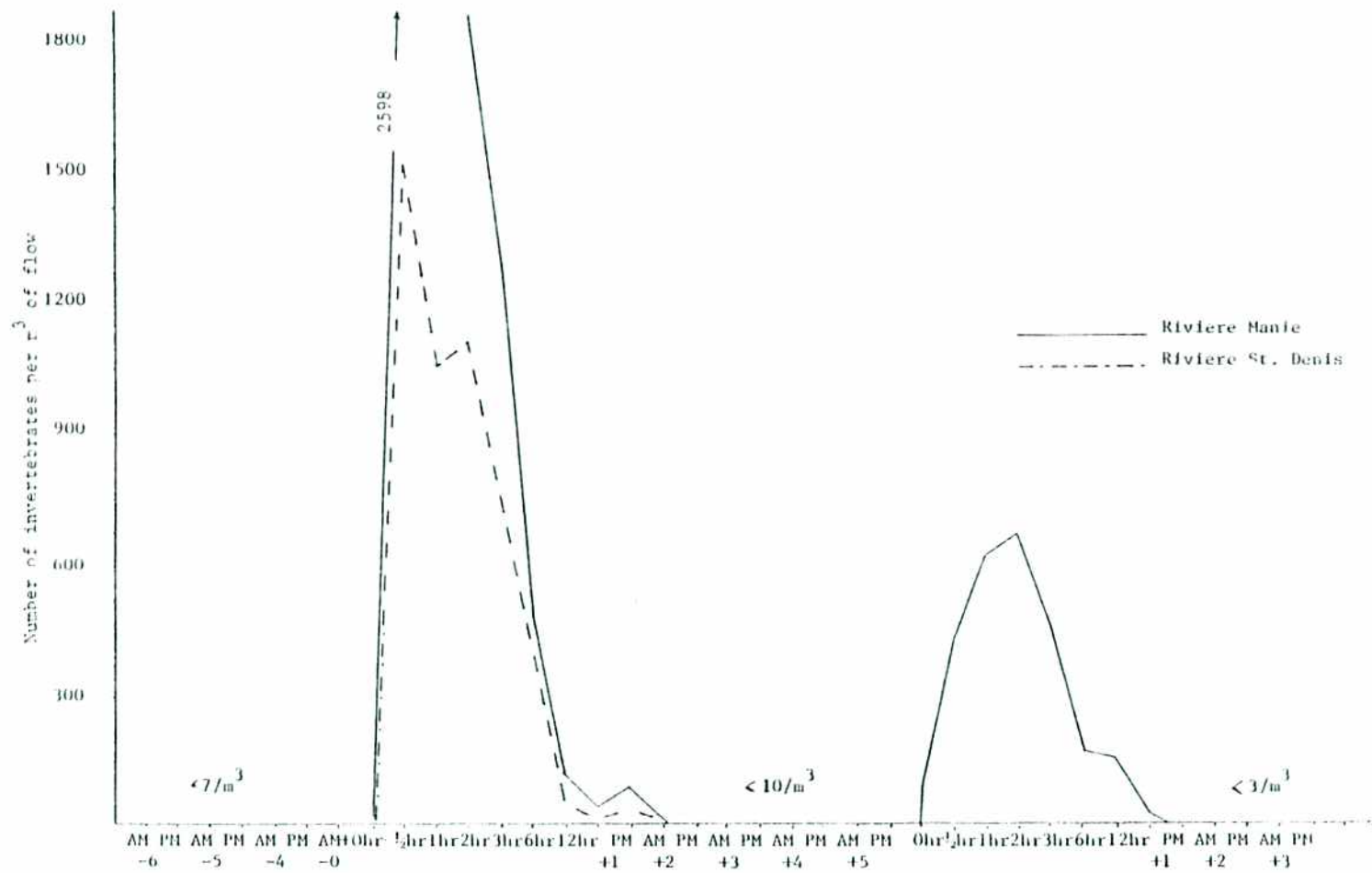


Figure 6 Aquatic invertebrates collected from drift nets set in Riviere St. Denis (single application) and Riviere Manie (double application), Kamouraska County, Quebec, 1980

tera. Although Simuliidae larvae represented a significant fraction of the drift increases after the first application, they were virtually absent from the second post-spray increases.

At the Manie Downstream station 3 km below block 303, a sharp increase in the number of drifting invertebrates was evident within one hour of the initial application to the block and reached a peak of 1051.6 organisms per m^3 by three hours post-spray. The drift composition was similar to that sampled from Manie 303 but did not persist for as long. Drifting invertebrates returned to a level comparable to pre-spray samples within 36 hours (Appendix Table A-10). Following the second application to block 303, a resulting increase in the number of drifting invertebrates at Manie Downstream was not evident until seven hours after the spray. The numbers peaked at 149.8 per m^3 11 hours post-spray and subsequently diminished to pre-spray levels within 36 hours. The invertebrate taxa comprising the drift increases were comparable to those collected in the Manie 303 post-second spray samples.

Total numbers of drifting invertebrates in both the Manie Upstream and Riviere du Loup control stations did not exceed 2.68 organisms per m^3 at any sampling time, and usually ranged from 0.33 to 1.10 per m^3 (Appendix Tables A-11 and A-12).

Table 7 summarizes the numbers of aquatic invertebrates collected from drift profile sampling in Riviere Manie. The number of drifting invertebrates varied considerably between stations and sample dates but demonstrated an apparent reduction in the treatment areas. Eight days after the second application to block 303, aquatic invertebrates at the upstream control drifted in numbers similar to prespray levels, while at Manie 304, 303, and Downstream numbers had decreased from those in the pre-spray samples. Conversely, a drift profile taken at the end of the season (24 September) showed a diminished level of invertebrate drift at the upstream control but an increase in drift at Manie 303 and Downstream.

Benthic invertebrates. Taxonomic and quantitative analyses of the stream bottom fauna from each sampling station are presented in Appendix Tables A-13 to A-26. Although a wide variety of invertebrate taxa was represented in the samples, Ephemeroptera nymphs comprised the largest proportion of the benthic invertebrates in all sample areas and demonstrated the most apparent indications of pesticide effects. Surber sampling in Riviere St. Denis in the single application block 301 showed a significant reduction (75%) in ephemeropterans, while benthic invertebrates collected from rocks were virtually eliminated following the application (Figures 7 and 8). The benthic samples remained at low levels for at least 32 days but showed a trend toward numerical recovery by the 74 day post-spray sample. By the end of the season (109 days post-spray) bottom fauna populations were comparable to those of the Riviere du Loup control station. No pesticide-induced reductions of

Table 7
 Aquatic invertebrates* collected from drift profile
 sampling in Riviere Manie, Kamouraska County, Quebec,
 26 May to 24 September, 1980

	Manie Upstream	Manie 304	Manie 303	Manie Downstream
26 May - 11 day pre-spray AM drift	2.08	1.28	7.22	3.02
4 June - 2 day pre-spray PM drift	0.68	4.96	3.75	1.04
23 June - 8 day post-spray AM drift	0.89	0.27	0.76	0.66
PM drift	2.27	0.91	1.14	0.47
24 Sept. - 101 day post-spray PM drift	0.56	-	3.19	1.11

* expressed as total aquatic invertebrates per m³ of flow through drift nets.

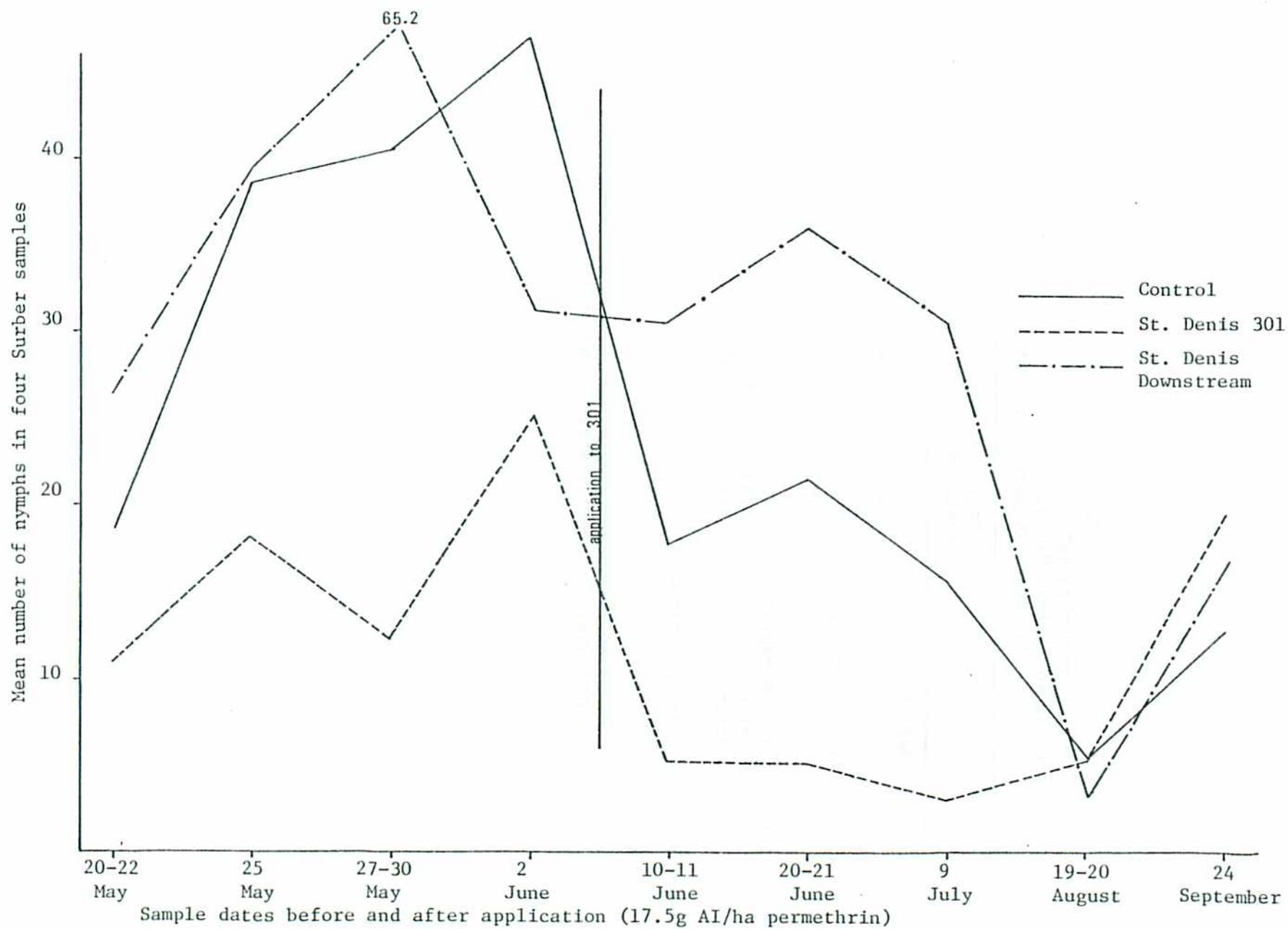


Figure 7 Mayfly nymphs collected in Surber samples taken from Riviere St. Denis and the untreated control section of Riviere du Loup, Kamouraska County, Quebec, 20 May to 24 September 1980

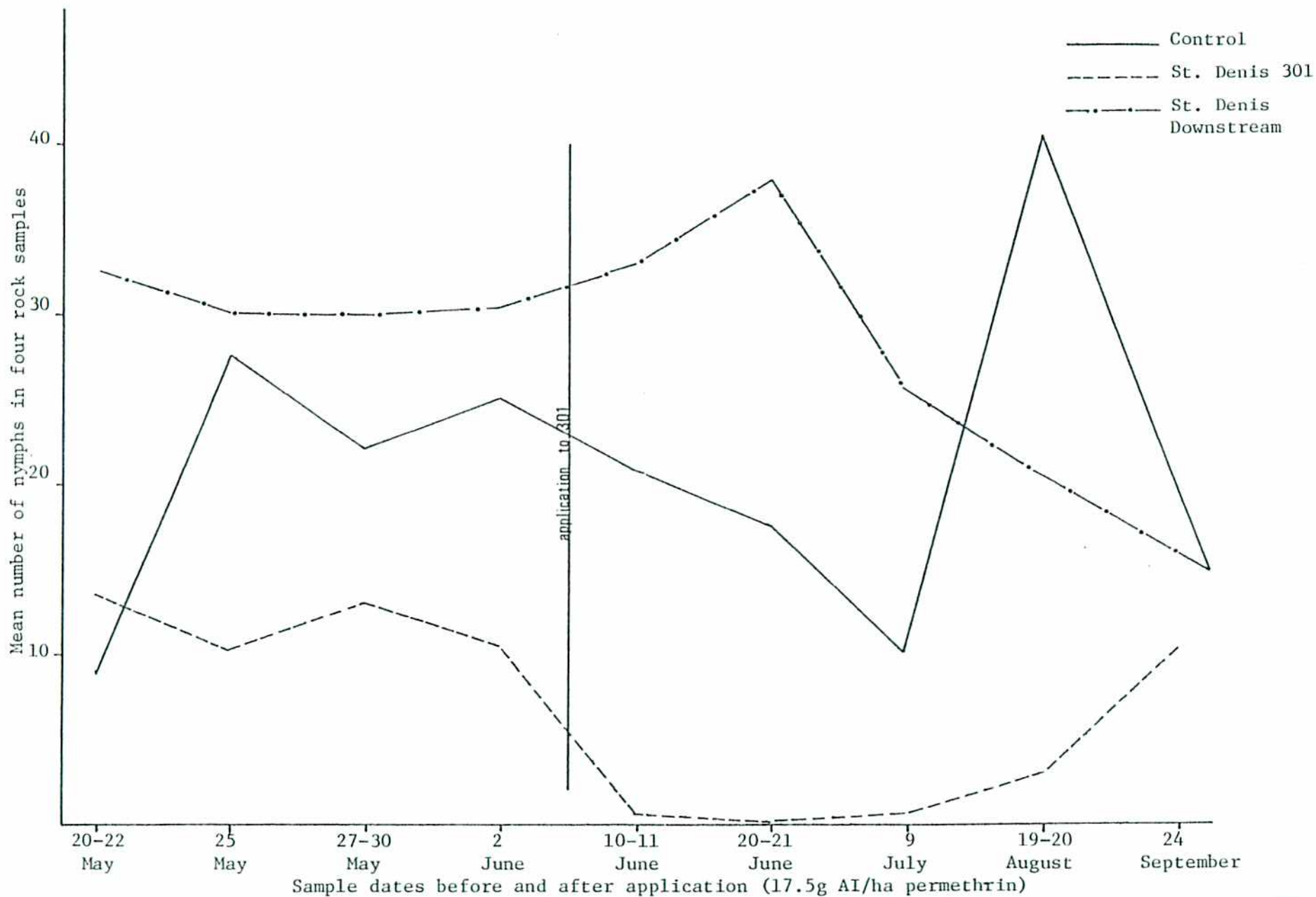


Figure 8 Mayfly nymphs collected from four rocks taken from Riviere St. Denis and the untreated control section of Riviere du Loup, Kamouraska County, Quebec, 20 May to 24 September 1980

benthic invertebrates were evident at the St. Denis Downstream station 7 km below the treatment block.

The single permethrin application to block 304 did not result in pesticide related benthic reductions at the Manie 304 station. The numbers of Ephemeroptera and other invertebrates present followed a pattern similar to that at the upstream control station.

Total benthos at Manie 303 declined in numbers after the double application to block 303. Ephemeropteran nymphs were substantially reduced in benthic samples after the first spray and almost eliminated following the second application (Figs. 9 and 10). At the Manie Downstream station 3 km below the double block, ephemeropterans were reduced by about 90% after the initial application and remained suppressed at that level for approximately 30 days after the second application to block 303. Substantial numerical recovery of benthic invertebrate populations at the taxonomic level studied was apparent within 69 days and was virtually complete by the 101 day post-spray sampling at the Riviere Manie 303 and Downstream stations.

Seasonal fluctuations in benthos at both the Manie Upstream and Riviere du Loup control stations demonstrated a mid- to late-May peak density of Ephemeroptera nymphs followed by an early to mid-June decline and a subsequent late season increase.

Surber and rock samples collected from all stations except Manie 304 one year after the permethrin applications (24 May 1981) contained a variety of invertebrates comparable to or greater than the pre-spray benthic samples from the previous year (Appendix Tables 27 and 28).

Caged invertebrates. Visual observations of caged Plecoptera nymphs subjected to the permethrin applications in block 303 demonstrated both lethal and sub-lethal effects of the pesticide on that particular invertebrate group. The recorded observations have been summarized in Table 8.

Terrestrial Biological Sampling

Arboreal and flying invertebrates. The density of terrestrial invertebrates collected in drift nets set in St. Denis 301 increased after the single permethrin application to block 301. From a pre-spray average of 0.36 invertebrates per 10 m² of surface water, the terrestrial invertebrate drift attained a half-hour post-spray peak of 16.57 per 10 m², and did not return to pre-spray levels for 72 hours. The increases in drift were comprised almost entirely of adult Diptera,

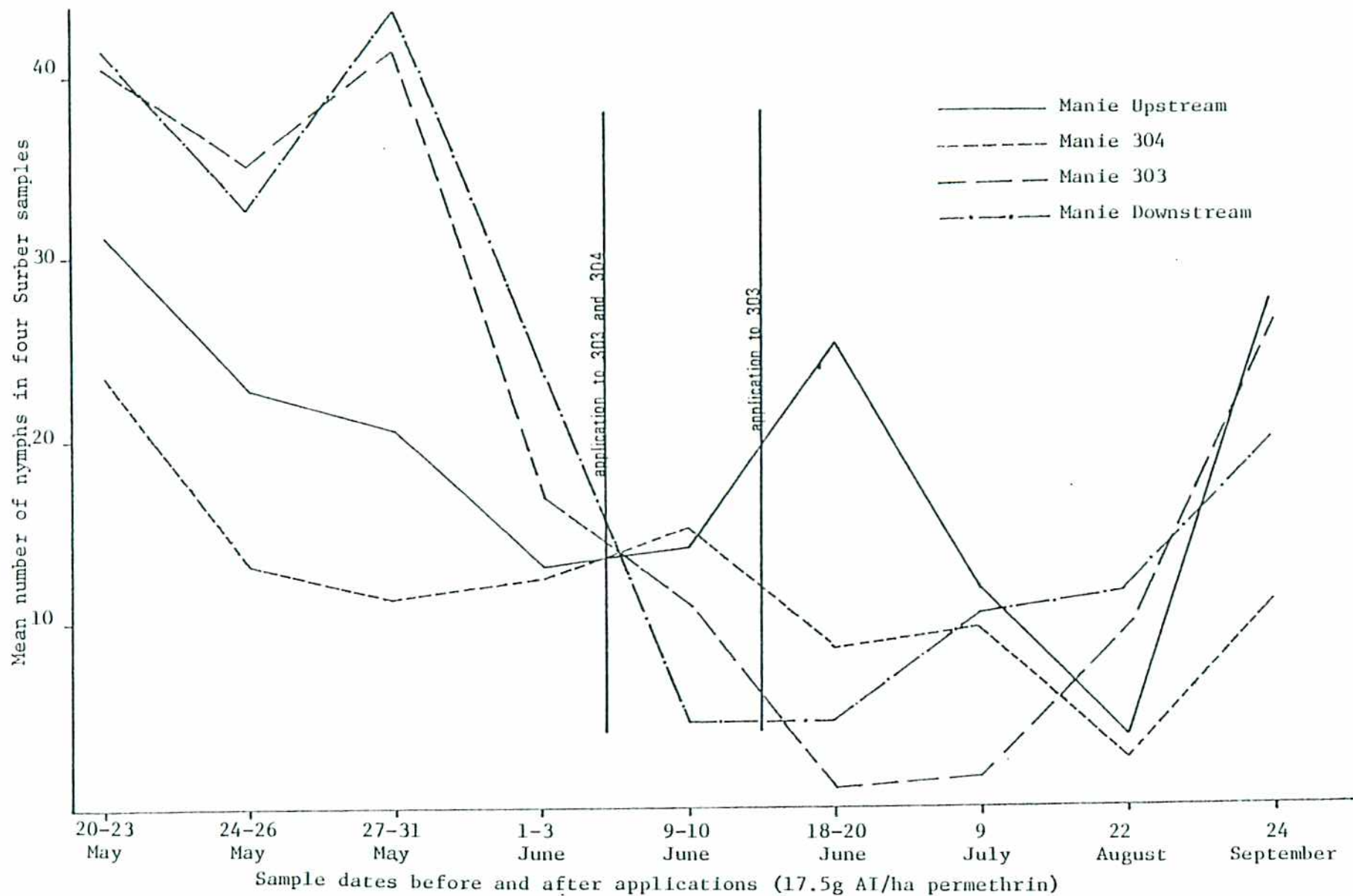


Figure 9 Mayfly nymphs collected in Surber samples from Riviere Manie, Kamouraska County, Quebec, 20 May to 24 September 1980

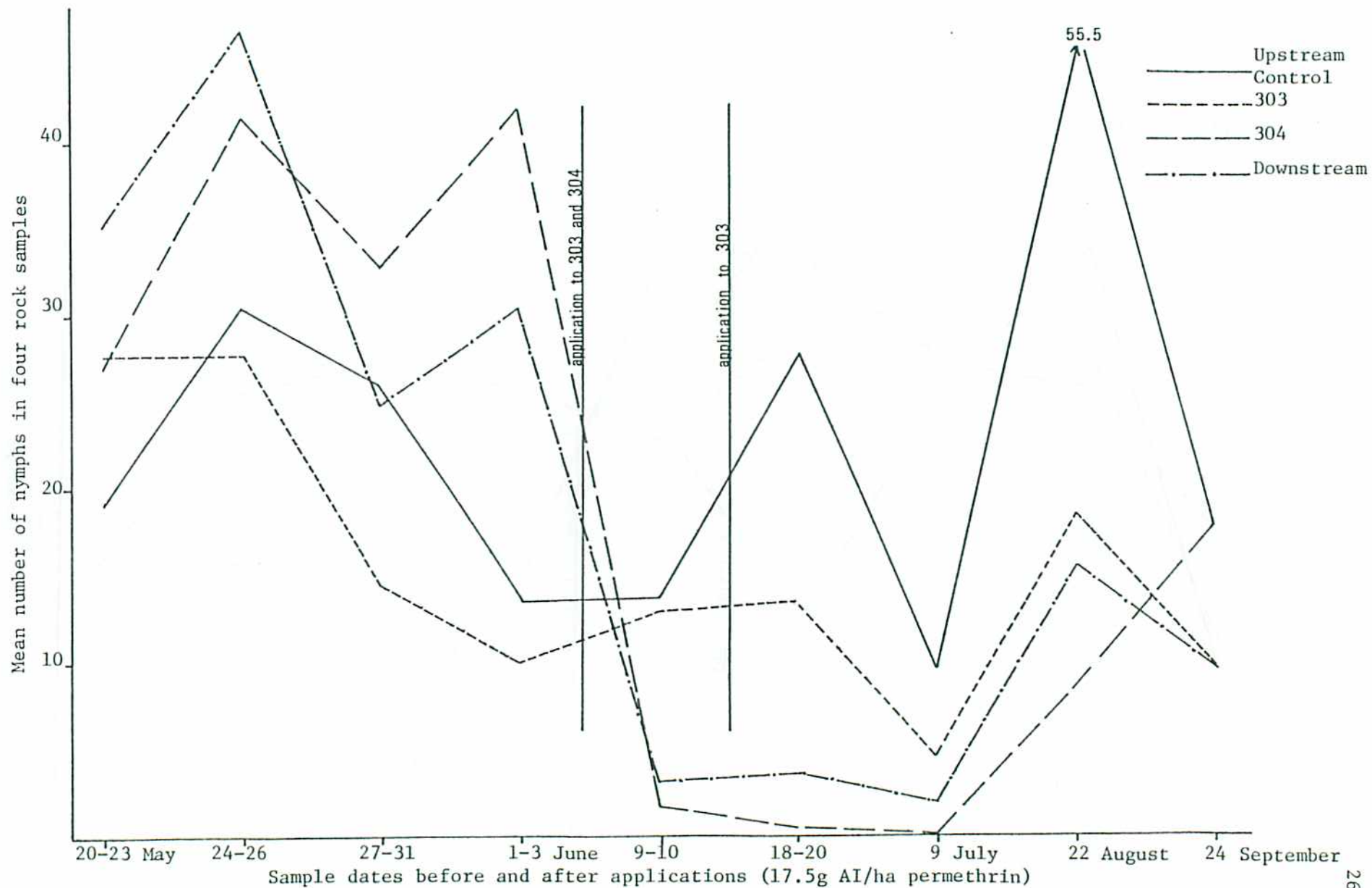


Figure 10 Mayfly nymphs collected from rocks taken from Riviere Manie, Kamouraska County, Quebec, 20 May to 24 September 1980

Table 3
 Visual observations of caged Plecoptera nymphs exposed to
 Permethrin applications in Manie 303
 Kamouraska County, Quebec, 1980

Time of observations	Comments
First application - 10 nymphs	
10 hours post-spray	10 alive but severely stressed - little response to touch stimuli - not able to maintain upright position
36 hours post-spray	4 dead, 5 alive and normal, 1 partially distressed - poor response to touch stimulus
60 hours post-spray	6 alive and normal
84 hours post-spray	6 alive and normal
108 hours post-spray	6 alive and normal
Second application - 25 nymphs	
3 hours post-spray	25 alive but severely stressed - little response to touch stimuli - not able to swim or maintain upright position
8 hours post-spray	25 alive but severely stressed - similar to above
24 hours post-spray	1 dead, 6 alive and recuperating with immediate response to touch stimuli and able to swim, 18 alive but severely stressed
48 hours post-spray	2 dead, 6 alive but severely stressed, 16 alive and normal
72 hours post-spray	3 dead, 2 alive and partially stressed, 17 alive and normal

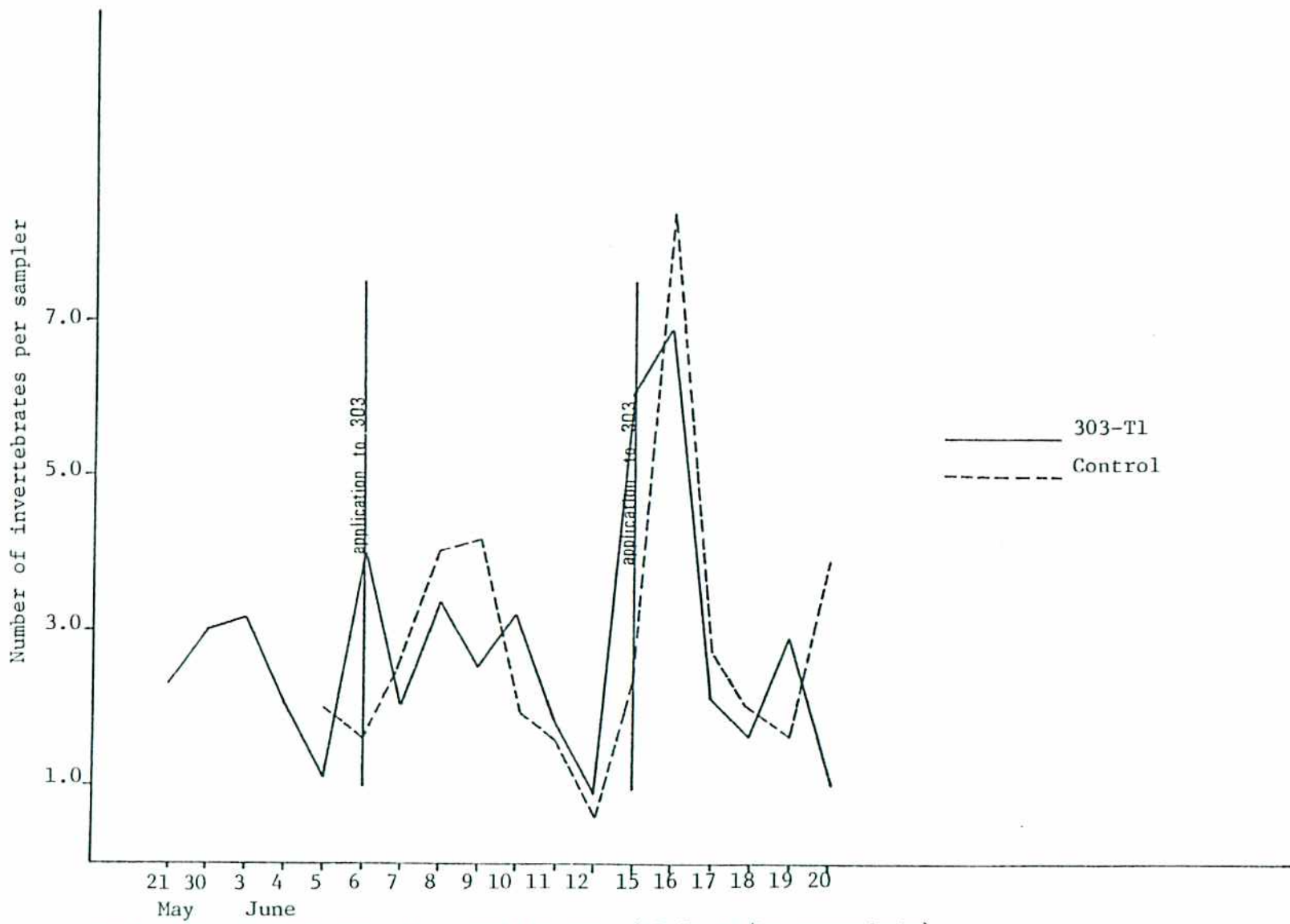
followed by Homoptera and adult Plecoptera (Appendix Table A-29). Seven kilometers below block 301 the number of drifting terrestrial invertebrates at St. Denis Downstream increased from a mean pre-spray level of 1.59 per 10 m² to a one hour post-spray peak of 12.40 per 10 m² but did not persist at elevated levels beyond 12 hours. Adult dipterans comprised most of the terrestrial invertebrate drift at St. Denis Downstream (Appendix Table A-30).

The single application to block 304 resulted in a substantial increase in the number of terrestrial arthropods drifting at Manie 304 with a 6 hour post-spray maximum of 163.80 per 10 m². As indicated in Appendix Table A-31 adult Diptera again contributed the greatest proportion of the drift, comprising 75 to 94% of the total number of terrestrial invertebrates collected.

Terrestrial arthropods drifting in Manie 303 increased noticeably after the first application to peak levels ranging from 12.8 to 20.1 per 10 m² at 2, 6, 12, and 24 hours post-spray. The second application also resulted in increased terrestrial invertebrate drift with maximum numbers of 12.60, 17.34, and 11.82 per 10 m² at ½, 6, and 24 hours after the spray. A similar pattern occurred 3 km below block 303 at Manie Downstream after the initial application with drifting terrestrial arthropods attaining three and seven hour post-spray peak levels of 20.9 and 10.2 per 10 m². Little indication of a pesticide-induced increase in the numbers of drifting terrestrial invertebrates was found at Manie Downstream following the second application to block 303. All of the terrestrial invertebrate drift samples collected from both Manie 303 and Downstream consisted primarily of Diptera adults (Appendix Table A-32 and A-33).

Although drifting terrestrial arthropods in the Manie Upstream control remained at a comparatively low level (the highest number collected was 3.91 per 10 m² and 80% of the samples were below 2.0), the terrestrial invertebrate drift results from the Riviere du Loup control were somewhat more erratic. Numbers varied from 0 to 21.8 invertebrates per 10 m² (Appendix Tables A-34 and A-35).

The permethrin applications to block 303 resulted in moderate increases in the number of arboreal and flying arthropods collected in the two terrestrial invertebrate knockdown sampling areas 303-T1 and 303-T2 (Figures 11 and 12). In three of the four instances the increases were limited to the day of application and did not persist beyond 24 hours, while the number of arthropods collected in 303-T1 following the second application continued to increase 24 hours after the spray. Increases of similar magnitude in the number of arboreal and flying invertebrates were collected in the control area as well but did not coincide with the permethrin treatments (Figures 11 and 12). Flying insects, mainly dipterans, as well as spruce budworm, hymenopterans,



Sample dates before and after applications (17.5g AI/ha permethrin)
 Figure 11 Terrestrial invertebrate knockdown from foliage in double application block 303,
 Kamouraska County, Quebec, 27 May to 20 June 1980

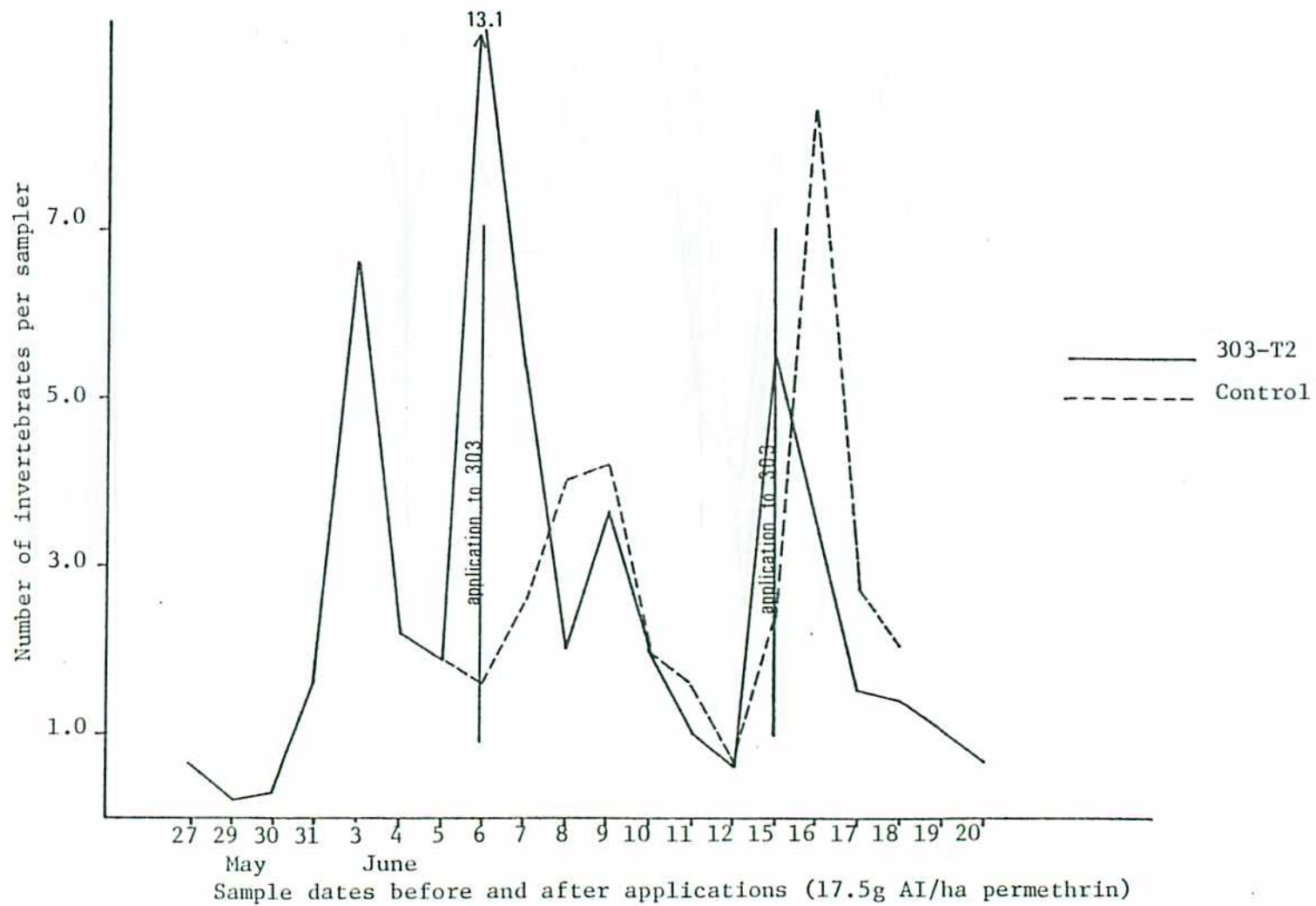


Figure 12 Terrestrial invertebrate knockdown from foliage in double application block 303, Kamouraska County, Quebec, 27 May to 20 June 1980

beetles, and spiders comprised the major portion of collected invertebrates in both the treated and control areas (Appendix Tables A36 to A38).

Ground dwelling invertebrates. Results from pitfall trapping, used as a means of determining a level of ground dwelling invertebrate activity, are summarized in Table 9. The number of arthropods collected in the traps tended to increase later in the season and generally exhibited a similar pattern in the treatment and control areas (Fig. 13).

Small mammals. Sampling of small mammals in both treatment and control areas did not produce numbers sufficient to determine a level of impact. Although the number of captures almost doubled during the late summer post-spray sampling period, the total number of animals trapped during the program was quite low, with an animal per trap-night success ratio of 0.004 and 0.014 in the control area and 0.007 and 0.024 in the treatment block (Tables 10 and 11). Approximately 40% of the animals captured from both areas in August were young of the year.

DISCUSSION AND CONCLUSIONS

Insecticide Deposit

The amount of emitted formulation deposited on the Kromekote cards varied in relation to the extent of the overhead canopy. Instream and open area samplers consistently received greater deposit than shoreline and heavily canopied sample cards. The mean diameters of the droplets deposited in all areas greatly exceeded those from previous and concurrent experimental permethrin applications (Kingsbury and Kreutzweiser 1979, 1980, Kingsbury and Zylstra 1982) and resulted in a relatively high percent deposit despite a low density of droplets per cm^2 . The deposit measurement from St. Denis 301 that was 45% higher than the volume emitted probably resulted from a flight line overlap of the application aircraft.

Since the Kromekote cards at Manie Downstream were located 3 km below block 303 the deposit measurements at the downstream station represented aerial drift of the pesticide. Although the actual amount of pesticide measured at the station was minimal (0.27% of the emitted volume) it indicates that aerial drift in that direction did occur and significant aerial contamination of the stream outside the block boundary was possible.

Insecticide Residues

Levels of residual permethrin measured in standing and flowing water within the treatment blocks were comparable to those reported from

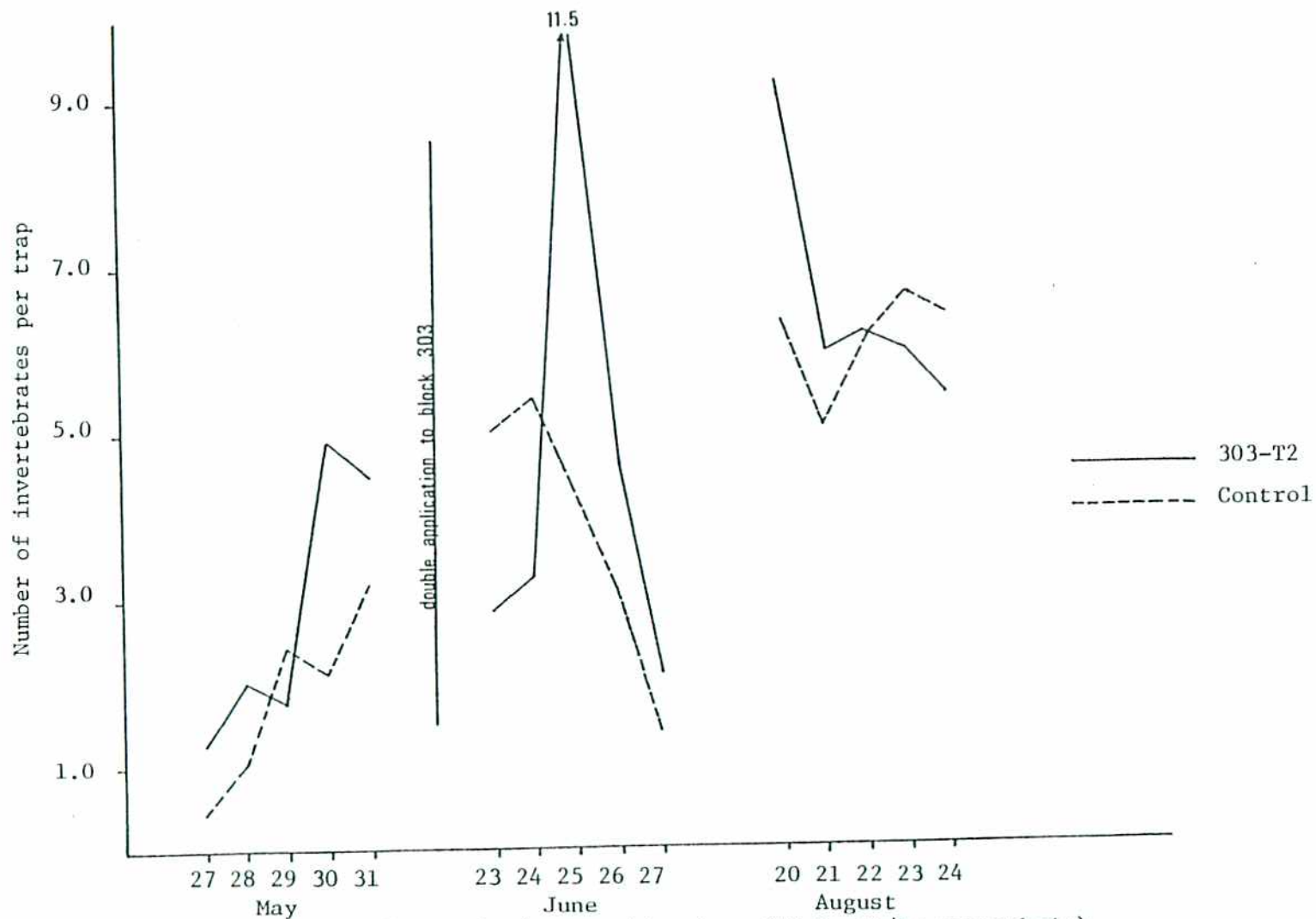
Table 9

Summary of pitfall trapping results expressed in organisms per sampler
for ground dwelling invertebrates in treatment* and control areas
Kamouraska County, Quebec, 27 May to 24 August 1980.

	MAY					TOTAL	MEAN	S.D.**	JUNE					TOTAL	MEAN	S.D.	AUGUST					TOTAL	MEAN	S.D.			
	27	28	29	30	31				23	24	25	26	27				20	21	22	23	24						
TREATMENT BLOCK																											
Coleoptera																											
Carabidae	0.25	0.30	0.35	0.35	0.40	1.65	0.33	0.06	0.61	0.35	0.78	0.65	0.25	2.64	0.53	0.22	0.40	0.14	0.11	0.10	0.10	0.85	0.17	0.13			
Curculionidae	0.05					0.05	0.01	0.02									0.14			0.05	0.19	0.04	0.06				
Elateridae																											
Staphylinidae	0.01	0.15		0.10	0.10	0.36	0.07	0.06	0.44	0.10	0.33	0.15	0.13	1.15	0.23	0.15	0.60	0.14	0.33	0.55	0.65	2.27	0.45	0.21			
Unidentified			0.05	0.05	0.05	0.15	0.03	0.03	0.06	0.05	0.06			0.12	0.03	0.03											
Phalangida				0.05		0.05	0.01	0.02	0.17	0.15	0.78	0.40	0.31	1.81	0.36	0.26	0.60				0.05	0.65	0.13	0.26			
Acarid	0.10	0.10	0.40	0.70	0.10	1.40	0.28	0.27	0.06		2.28	0.25	0.06	2.65	0.53	0.10	1.60	0.57	0.39	0.10	0.85	3.51	0.70	0.57			
Araneida	0.65	1.20	0.90	3.60	2.85	9.20	1.84	1.31	1.50	2.35	5.17	1.50	0.75	11.27	2.25	1.73	2.00	1.85	1.06	1.00	0.90	6.81	1.36	0.52			
Collembola	0.15	0.25		0.05	0.95	1.40	0.28	0.39	0.11	0.25	2.10	1.60	0.56	4.62	0.92	0.88	4.00	3.00	4.28	4.10	2.90	18.28	3.66	0.65			
TOTALS	1.21	2.00	1.70	4.90	4.45	14.26			2.84	3.25	11.50	4.55	2.06	24.26			9.20	5.84	6.17	5.90	5.45	32.56					
CONTROL BLOCK																											
Coleoptera																											
Carabidae	0.20	0.10	0.30	0.40		1.00	0.20	0.16	0.80	0.70	0.50	0.30	0.20	2.50	0.50	0.25	0.40			0.40	0.30	1.10	0.22	0.20			
Curculionidae																											
Elateridae					0.80	0.80	0.16	0.36	0.10		0.10			0.20	0.04	0.05											
Staphylinidae				0.10	0.30	0.40	0.08	0.13	1.10	1.20	0.60	0.10		3.00	0.60	0.55	0.70	0.30	0.50	0.70	2.20	0.58	0.18				
Unidentified					0.10	0.10	0.02	0.05			0.10	0.30	0.10	0.50	0.10	0.12											
Phalangida			0.20			0.20	0.04	0.09	0.10	0.30	0.30	0.70	0.50	1.90	0.38	0.23	0.40	0.10	0.10	0.50	0.70	1.70	0.36	0.26			
Acarid			0.10	0.10	0.10	0.30	0.06	0.05									0.30	0.10	0.30	0.30	1.00	0.20	0.14				
Araneida	0.20	0.70	1.80	1.40	1.80	5.90	1.18	0.71	2.70	2.80	1.60	1.60	0.50	9.20	1.84	0.94	1.20	0.40	1.70	0.60	1.00	4.90	0.98	0.51			
Collembola		0.20		0.10	0.10	0.40	0.08	0.08	0.20	0.40	0.40		0.10	1.10	0.22	0.18	4.40	3.30	3.70	4.30	3.70	19.40	3.88	0.46			
TOTALS	0.40	1.00	2.40	2.10	3.20	9.10			5.00	5.40	3.60	3.00	1.40	18.40			6.30	5.00	6.10	6.60	6.40	30.30					

*Block 303 treated with 17.5 g AI/ha permethrin at 0455 to 0528 hrs on 6 June and again at 1430 to 1500 hrs on 15 June 1980.

**Standard deviation



Sample dates before and after applications (17.5g AI/ha permethrin)
 Figure 13 Terrestrial invertebrates collected from pitfall traps set in double application block 303, Kamouraska County, Quebec, 27 May to 24 August 1980

Table 10

Small mammals captured in untreated
control block.
Kamouraska County, Quebec 1980.

Date	Species	MALES		FEMALES				Total animals
		adult	sub-adult	sub-adult	adult			
					not pregnant	Pregnant		
						embryo	scars	
23-31 May	<i>Sorex cinereus</i>					7	0	1
	<i>Clethrionomys gapperi</i>	2				4	2	3
	<i>Napaeozapus insignis</i>	4						4
	TOTALS	6	0	0	0	2		8
20-24 August	<i>Sorex cinereus</i>		3					3
	<i>Blarina brevicauda</i>		1					1
	<i>Clethrionomys gapperi</i>	2	2		2			6
	<i>Zapus hudsonius</i>				1			1
	<i>Napaeozapus insignis</i>	1			2			3
	TOTALS	3	6	0	5	0		14

Table 11

Small mammals captured in double
application block 303*
Kamouraska County, Quebec 1980.

Date	Species	MALES		FEMALES				Total animals
		adult	sub-adult	adult				
				sub-adult	not pregnant	Pregnant		
						embryo	scars	
23-31 May	<i>Sorex cinereus</i>	2	0	0	2	2	13	5
	<i>Peromyscus maniculatus</i>	3	0	0	0	9	2	5
	<i>Clethrionomys gapperi</i>	5	1	0	0	13	1	9
	TOTALS	10	1	0	2	6		19
20-24 August	<i>Sorex cinereus</i>	6	2	4	3		13	15
	<i>Peromyscus maniculatus</i>	3	1	3	1		6	8
	<i>Clethrionomys gapperi</i>	2	3	1		11		8
	<i>Synaptomys cooperi</i>	1						1
	<i>Zapus hudsonius</i>				1			1
	<i>Napaeozapus insignis</i>	1		1	1			3
	TOTALS	13	6	9	6	2		36

*block 303 treated with 17.5 g AI/ha permethrin at 0455 to 0528 hrs on 6 June and again at 1430 to 1500 hrs on 15 June 1980.

previous (Kingsbury and Kreutzweiser 1979, 1980) and concurrent (Wood 1982) experimental permethrin applications, but persisted at slightly higher concentrations for a longer period of time. Residue concentrations in water did not attain non-detectable levels in any of the areas by the end of the sampling period. However, water samples previously reported as containing no detectable concentrations of permethrin may have in fact fallen within the range of detection now possible since the limit of detection has been reduced from 0.2 $\mu\text{g/L}$ in 1979 and 0.05 $\mu\text{g/L}$ in 1980 to 0.01 $\mu\text{g/L}$ in the present study.

After the initial application to block 303, pesticide residues in water at the 3 km downstream station approached those measured within the block itself. This substantiates indications from deposit measurements that aerial drift of the pesticide may have contaminated portions of the stream below the block since it has been previously demonstrated that residual permethrin is rapidly diluted downstream from an application area (Kingsbury and Kreutzweiser 1980, Wood 1982).

Among the replicated water samples collected from the streams several contained extremely high concentrations of permethrin. When tested against the other respective replicates (outliers test for detection of extremes described by Dixon and Massey 1969) these values are statistically improbable ($p < 0.005$) and have been excluded from the calculation of means. Because of the inherent adsorptive qualities of permethrin (Sharom and Solomon 1981a), the pesticide is readily adsorbed to various collection and analytical equipment and the likelihood of samples being contaminated during the analytical process is considerable (pers. comm. Ian Hill, ICI Ltd). Consequently, these abnormally high values probably represent permethrin contamination from handling, and not actual residue concentrations from the sampling sites.

Permethrin residues in sediment samples from a pond and outlet stream in block 303 were generally less than those reported by Kingsbury and Kreutzweiser (1979) but comparable to the levels found in subsequent permethrin trials (Kingsbury and Kreutzweiser 1980, Wood 1982). Approximately 4.5 km downstream from block 303, the accumulation of residual permethrin in stream sediment was minimal with only 2 of 20 samples containing measurable quantities of pesticide. The apparent minimal accumulation of permethrin in sediments is a reflection of the relatively low residues in the water. Sharom and Solomon (1981b) and Rawn (1981) have demonstrated that permethrin is readily adsorbed to exposed sediments, but since the limit of detection for sediment analysis in the present study (0.003 $\mu\text{g/g}$) was almost three times higher than the maximum water residue sample, substantial accumulations of residual permethrin in sediment would have to occur before detectable levels were attained.

The second application to block 303 appeared to contribute significantly to the level of pesticide residues in forest litter. Mean

concentrations persisted at 0.016 $\mu\text{g/g}$ for at least 26 days post-spray but had diminished to non-detectable levels by the end of 59 days. Previous experimental permethrin applications resulted in similar or slightly higher litter residues but with a persistence extending beyond the sampling period (Kingsbury and Kreutweiser 1980, Wood 1982).

Aquatic Invertebrates

The single permethrin application to block 301 resulted in a massive disturbance of benthic invertebrates in Riviere St. Denis. A dramatic increase in the number of drifting invertebrates, followed by a substantial reduction in bottom fauna populations, was evident within the block immediately following the application. There were no indications of an impact on aquatic organisms at the St. Denis Downstream station although Kingsbury and Kreutweiser (1980b) and Eidt and Weaver (1982) have reported increases in invertebrate drift 7.6 and 4.2 km, respectively, downstream from a treated block. A portion of Riviere St. Denis between block 301 and the Downstream station included several areas of slow water where beaver dams blocked the flow and may have prevented the downstream transport of drifting invertebrates or residual permethrin.

The single permethrin application to block 304 resulted in a much less pronounced level of impact to aquatic organisms than the application to block 301. The comparatively lesser pesticide impact in Manie 304 concurs with recorded observations and measurements of a significantly lighter deposit and a shorter section of stream treated.

Massive increases in the number of drifting invertebrates and a severe depletion of benthic organisms occurred in Manie 303 after the initial application to the block. The second application resulted in a second disturbance of aquatic invertebrates but of a lesser magnitude. Bottom fauna sampling during the interval between the two applications indicated that a great proportion of the benthos had been removed by the first application and consequently a smaller residual population responded to the second spray. The permethrin application to block 304 (located immediately upstream from block 303 and treated within two hours of the first application to block 303) may have contributed to the post-first spray benthos disturbances measured at Manie 303. However, because of the small section of stream treated, the light insecticide deposit, and the comparatively minor impact on aquatic invertebrates at Manie 304, it is likely that the block 304 application had little contributory effect on benthic organisms at Manie 303.

Within one hour after the first application to block 303, a sharp increase in the number of drifting aquatic invertebrates was evident at Manie Downstream, 3 km below the block. The entire portion of Riviere Manie between block 303 and the Downstream station was consistently fast

water with an estimated velocity of 0.50 m/sec (based on several current velocity measurements taken in "typical" sections). Residual permethrin or drifting organisms from the application block would consequently require a minimum of two hours to be transported the 3 km distance. The virtually immediate post-spray drift increases at Manie Downstream confirmed indications from deposit and residue analyses that substantial aerial drift contamination occurred along the section of stream between the application block and the Downstream station. The subsequent decline in bottom fauna gave further evidence of toxic concentrations of permethrin occurring at that station.

After the second application to block 303, a similar though much reduced increase in drifting invertebrates occurred at Manie Downstream, but did not become evident until seven hours post-spray. Although deposit measurements were not taken, field observations, residue analyses, and the delayed downstream effects indicate significant aerial drift contamination did not occur outside block 303 following the second application.

From water residue analyses and bottom fauna sampling at Manie Downstream after the second application to block 303, it was apparent that permethrin concentrations at the downstream station were much lower than those found after the initial spray. The residual pesticide may not have been sufficient to induce drift but to cause disorientation and spasmodic behaviour of invertebrates actively entering the drift such that voluntary re-establishment on the stream bottom was not possible. The seven hour and subsequent post-spray drift increases (2200 hrs to 0500 hrs) corresponded to the time when behavioral invertebrate drift is normally sharply increased. The diel periodicity of invertebrate drift described by Waters (1972), Muller (1974), Elliott (1970), and Coady (1978), and supported by unpublished data collected by the Forest Pest Management Institute from an in progress study of Icewater Creek, Ontario, indicates that active drifting of aquatic invertebrates is greatly increased shortly after nightfall. In this instance, the normal diel drift peaks may have been exaggerated by toxic concentrations of permethrin affecting the benthic invertebrates after they had actively entered the drift. Permethrin may have been present in the water column in concentrations sufficient to subsequently produce involuntary and prolonged drift. Eidt (1975) postulated a similar occurrence following a fenitrothion application to a New Brunswick stream.

The seven hour lag time between the application to the block and an increase in downstream drift may represent the period of time required for affected organisms in the drift to reach the Downstream station. Previous discussion has inferred that the estimated time required for a unit of stream to travel the 3 km distance was approximately two hours, but this may not necessarily apply to the downstream transport of drifting invertebrates. Because of swimming and saltatory

behaviour, the translocation of benthic invertebrates may be considerably slower than the actual water velocity.

Substantial increases in invertebrate drift at various distances downstream from an experimental permethrin treatment have been previously documented. Kingsbury and Kreutzweiser (1979, 1980b) and Eidt and Weaver (1982) have reported pesticide induced drift up to 7 km below a 17.5 g AI/ha permethrin treated area, either as a result of toxic concentrations of residual pesticide being transported to that point or long distance drifting of affected organisms from the upstream treatments. Elliott (1971), Waters (1972), and Townsend and Hildrew (1976) have clearly demonstrated that behavioral, mechanically induced, and even dead invertebrate drift rarely exceeds 50 m and is usually less than 10 m, but these authors did not attempt to convey their conclusions to a pesticide impact. Flannagan et al. (1979) described incidents of drift increases as far as 400 km downstream from a methoxychlor injection site but determined that the drift was coincident with the arrival of the insecticide. In previous (Kingsbury and Kreutzweiser 1979, 1980a) and concomitant (Wood 1982) experimental applications it has been demonstrated that because of the inherent adsorptive qualities of permethrin, the pesticide concentrations are rapidly diluted downstream from the application site, especially below the confluence with a major untreated tributary. This infers that downstream invertebrate drift following a permethrin application at the present experimental dosage rate (17.5 g AI/ha) may not be induced by residual or a transported "slug" of pesticide affecting *in situ* benthic organisms, but may be comprised of drifting invertebrates from upstream treated areas.

Muirhead-Thomson (1978a,b) discussed the importance of non-lethal concentrations of pesticide resulting in detachment and downstream drift of certain aquatic invertebrates. Results from the present study demonstrated that the majority of Plecoptera nymphs exposed to the applications in submerged holding cages did not die but did exhibit severe stress and disorientation for a period of up to 48 hours, followed by an apparently complete recuperation. Similar observations have been reported by Kingsbury (1976) and Eidt and Weaver (1982). Following the permethrin applications to Manie 303, St. Denis 301, and to a New Brunswick salmon nursery stream in a concurrent study (Eidt and Weaver 1982), masses of drifting invertebrates were visually apparent, and many individuals both in the streams and in the collected samples displayed a cyclic behavioral pattern of bursts of spasmodic swimming followed by a few seconds of disoriented drifting. At an arbitrarily selected site on Riviere du Loup 6.5 km downstream from Manie 303 and 1.0 km below the confluence with Riviere Manie, a drift sample was collected five hours after the first application to block 303 and contained an abnormally high number of drifting invertebrates (219 in a two minute sample compared to one in a two minute sample collected immediately above the confluence with Riviere Manie). During the collection of the sample below the confluence, a large number of benthic invertebrates (mainly ephemeropterans) was observed drifting in the manner described above, displaying an erratic swimming behavior. This spasmodic

behavioral response to permethrin intoxication may induce aquatic invertebrate drift for much greater distances than normally occurs.

Since aquatic invertebrate drift as a natural phenomenon is generally considered an intentional activity in response to intra-specific competition and the maintenance of optimum population levels (Waters 1972, Muller 1974, Dimond 1967, and Townsend and Hildrew 1976), a depletion in bottom fauna populations should result in a diminished rate of active or behavioral drift. A marked reduction in benthic invertebrates at Manie 303 and Downstream after the permethrin applications was clearly evident, but a pesticide induced decrease in the drift complex at these stations was not as definitive. Drift profile sampling on Riviere Manie eight days after the applications produced variable numbers but did indicate that while drifting invertebrates in the control increased during that period, those in the treatment areas had decreased. By the end of the season the numbers of drifting invertebrates in Manie 303 and Downstream exceeded those of the control, giving evidence of substantial recovery.

Despite catastrophic drifts and severely depleted benthos in all treated stations except Manie 304, repopulation of bottom fauna was evident within 2½ months and was virtually complete at the taxonomic level studied within 3½ months. One year post-spray sampling indicated that invertebrate numbers had returned to or exceeded the late May pre-spray levels of the previous year. Rapid repopulation of benthic invertebrates following a severe pesticide impact has been reported by Kingsbury and Kreutzweiser (1979, 1980b), Kreutzweiser et al. (1982), Fredeen (1975), van Frankenhuyzen (1979), and Wallace et al. (1973). In previous experimental permethrin treatments it was demonstrated that the double applications were "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 1979). In the present study, however, the massive disturbance and subsequent recovery of bottom fauna in the single application block 301 were comparable to the benthic invertebrate response in the double application block 303. The extent of the impact on the benthos of the single block is probably a reflection of the unusually high deposit and resulting insecticide residues measured at that station.

The magnitude and duration of the drift increases as a reflection of the level of impact on benthic invertebrates were similar to those in previous permethrin applications reported by Kingsbury and Kreutzweiser (1979, 1982b) and Eidt and Weaver (1982). The drift composition was apparently density related with the invertebrate groups demonstrating the greatest impact being those that were most abundant in benthic samples.

Terrestrial Invertebrates

The number of terrestrial arthropods collected in drift nets was substantially increased after each permethrin application. Although aquatic invertebrates responded almost immediately to the applications, the knockdown of arboreal and flying invertebrates on to the stream surfaces continued to occur up to 48 hours after the applications and tended to reach peak level between 6 and 24 hours post-spray. This delay in knock-down response suggests significant mortality induced by ingestion of or contact with residual permethrin rather than a contact with actual suspended or deposited spray droplets during the application.

A similar increase in the number of terrestrial arthropods collected in samplers placed under foliage of block 303 occurred after both applications. In three of the four instances the increases were limited to the day of application and did not persist beyond 24 hours. The number of arthropods collected in 303-T1 following the second application continued to increase 24 hours after the spray but reflected a similar occurrence in the control area and may have been the result of heavy rainfall from the previous night. The knockdown of terrestrial invertebrates following experimental permethrin applications has been described by Kingsbury and Kreutzweiser (1979, 1980a), Kingsbury and McLeod (1979), and Kreutzweiser (1982).

Results from pitfall trapping did not indicate a measurable impact on the activity of ground dwelling invertebrates. The slightly decreased numbers between the end of the pre-spray and the beginning of the post-spray sampling periods in the treatment block may suggest a reduced level of activity but the extent of the decrease and the resurgence of numbers two days later reduce the likelihood of an indication of impact.

Small Mammals

The similar trends in trapping success and age class structure on the treatment and control plots suggest a lack of effects of the permethrin applications on the small mammal complex, but the low numbers encountered preclude definite conclusions.

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APPENDICES

Table A-1
 Permethrin residues ($\mu\text{g/L}$) in water collected
 from block 301,*
 Kamouraska County, Quebec, 1980

Sampling time Interval	Riviere St. Denis		
	Sampling Site		
	3027	3028	3029
<u>Post-spray</u>			
½ hr	1.94	1.20	0.76
6	0.91	0.60	0.42
12	0.43	0.36	0.35
24	0.32	0.31	0.31

Limit of detection 0.01 $\mu\text{g/L}$ (ppb)

Recovery 95%

* treated with 17.5 g AI/ha permethrin at 0700 to 0720 hrs on 7 June 1980

Table A-2
 Permethrin residues ($\mu\text{g/L}$ in water collected in block 303*,
 Kamouraska County, Quebec, 1980

Sampling time interval	Riviere Manie					Pond	
	Sampling Site					Sampling Site	
	3005	3006	3007	3008	3009	3010	3011
Pre-spray	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
<u>Post-spray</u>							
1 hr	0.57	0.54	0.64	0.63	0.71	0.10	0.10
6	0.30	0.30	0.55	0.43	0.56	0.62	0.61
12	0.08	0.11	0.08	0.28	0.08	0.14	0.13
25	0.07	0.05	0.05	13.77	0.27	0.16	0.10
96	0.27	0.08	0.07	0.24	0.10	0.25	0.03
<u>Post-spray</u>							
1 hr	1.81	1.74	1.52	86.21	1.27	0.30	0.16
6	0.15	0.13	0.13	0.15	0.63	0.84	0.70
12	0.06	0.16	0.15	0.23	0.14	1.35	0.32
24	0.28	0.20	1.52	0.05	0.68	0.11	0.12
48	N.D.	0.05	N.D.	0.05	0.06	0.07	0.05

N.D. = None detected

Limit of detection 0.01 $\mu\text{g/L}$ (ppb)

Recovery 95%

* treated with 17.5 g AI/ha permethrin at 0455 to 0528 hrs on 6 June
 and again at 1430 to 1500 hrs on 15 June 1980.

Table A-3
 Permethrin residues ($\mu\text{g/L}$) in water collected 3 km downstream
 from Block 303*, Kamouraska County, Queec, 1980

Sampling time interval	Riviere Manie -downstream from Block 303				
	Sampling Site				
	3022	3023	3024	3025	3026
<u>Post-spray</u>					
1 hrs	0.53	0.16	0.20	0.9	0.33
6	0.91	0.54	0.53	0.37	0.61
12	0.65	0.08	0.10	0.34	0.07
24	N.D.	0.06	0.03	0.04	0.04
<u>Post-spray</u>					
1 hrs	0.07	0.05	0.07	0.19	0.07
6	29.28	0.09	0.07	0.07	0.07
12	0.08	0.03	0.04	0.04	0.03

N.D. = None detected

Limit of detection 0.01 $\mu\text{g/L}$ (ppb)

Recovery 95%

* block 303 treated with 17.5 g AI/h permethrin at 0455 to 0528
 hrs on 6 June and again at 1430 to 1500 hrs on 15 June 1980.

Table A-4
 Permethrin residues ($\mu\text{g/g}$) in aquatic sediment collected from
 within and downstream from block 303*, Kamouraska County,
 Quebec, 1980.

Within Block 303							
Sampling time interval	Sampling Site in pond and outlet stream						
	3012	3013	3014	3015	3016	3030	3031
<u>Pre-spray</u>	N.D.	N.D.	N.D.	N.D.	N.D.	-	-
<u>Post-spray</u>							
1 day	N.D.	N.D.	N.D.	N.D.	.022	-	-
4	0.012	N.D.	N.D.	N.D.	.019	N.D.	N.D.
8	N.D.	N.D.	N.F.	N.D.	.095	N.D.	.013
26	.005	N.D.	N.D.	N.D.	N.D.	.022	.012
59	.009	.011	.029	.009	.012	.014	N.D.

Riviere Manie - 5 km downstream from Block 303					
Sampling time interval	Sampling site				
	3032	3033	3034	3035	3036
<u>Post-spray</u>					
6 days	N.D.	N.D.	N.D.	.012	N.D.
8	N.D.	N.D.	N.D.	N.D.	N.D.
26	N.D.	.062	N.D.	N.D.	N.D.
59	N.D.	N.D.	N.D.	N.D.	N.D.

N.D. = None detected

- = Sample not available

Recovery 115%

Limit of detection $0.003 \mu\text{g/g}$ (ppm)

* treated with 17.5 g AI/ha permethrin at 0455 to
 0528 hr on 6 June and again at 1430 to 1500 hrs
 on 15 June 1980.

Table A-5
 Permethrin residues ($\mu\text{g/g}$) in forest litter collected in
 block 303*, Kamouraska County, Quebec, 1980.

Sampling time interval	Sampling Site				
	3017	3018	3019	3020	3021
<u>Pre-spray</u>	N.D.	N.D.	N.D.	N.D.	N.D.
<u>Post-spray</u> 1 day	N.D.	N.D.	.004	N.D.	N.D.
4	N.D.	N.D.	.014	.008	N.D.
<u>Post-spray</u> 1 day	.017	.026	.052	.035	.022
4	.034	.183	.021	.019	.006
8	.138	.018	.024	.011	.006
26	.023	.028	.006	.022	N.D.
59	N.D.	N.D.	N.D.	N.D.	N.D.

N.D. = None detected

Limit of detection 0.003 $\mu\text{g/g}$ (ppm)

Recovery 80%

* treated with 17.5 g AI/ha permethrin at 0455 to 0528 hrs on
 6 June and again at 1430 to 1500 hrs on 15 June 1980.

Table A-6

Aquatic invertebrates* collected in drift net sets set in Riviere St. Denis 301**
 Kamouraska County, Quebec
 27 May to 10 June 1980

Days before or after permethrin application	-11 AM	-11 PM	-8 AM	-8 PM	-6 AM	-6 PM	-5 AM	-5 PM	-0 AM	+0hr ***	+1hr ***
Volume of drift column (m ³)	26.05	26.05	24.19	19.54	19.54	23.34	19.54	21.32	16.92	8.88	1.59
Current Velocity (m/sec)	0.33	0.33	0.33	0.33	0.33	0.36	0.33	0.36	0.30	0.30	0.30
Ephemeroptera: Total nymphs	0.19	0.12	0.08	0.10	0.10	0.43	0.10	0.14	0.65	321.7	727.2
Baetidae	0.04	0.04	0.08	-	0.10	0.17	0.10	0.05	0.24	315.1	520.1
Ephemerellidae	0.08	0.08	-	0.10	-	0.21	-	0.09	0.35	1.80	69.2
Heptageniidae	0.04	-	-	-	-	-	-	-	0.06	3.60	56.2
Leptophlebiidae	0.04	-	-	-	-	0.04	-	-	0.06	1.24	81.7
Odonata	-	-	-	-	-	-	-	-	-	-	-
Gomphoceridae	-	-	-	-	-	-	-	-	-	-	-
Libellulidae	-	-	-	-	-	-	-	-	-	-	-
Zygoptera	-	-	-	-	-	-	-	0.05	0.06	39.4	213.0
Hemiptera	-	-	-	-	-	-	-	-	-	-	-
Gerridae	-	-	-	-	-	-	-	-	-	-	-
Veliidae	-	-	-	-	-	-	-	-	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-	-
Corydalidae	-	-	-	-	-	-	-	-	-	-	-
Stalidae	-	-	-	-	-	-	-	-	-	-	-
Trichoptera: Total larvae	0.00	0.00	0.00	0.00	0.00	0.04	0.0	0.00	0.00	27.0	47.9
Brachycentridae	-	-	-	-	-	-	-	-	-	5.29	6.51
Glossosomatidae	-	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	-	-	-	-	-	-	-	-	-	0.11x	0.59x
Hydropsyllidae	-	-	-	-	-	-	-	-	-	0.68x	2.96x
Leptoceridae	-	-	-	-	-	0.04	-	-	-	-	-
Limnephilidae	-	-	-	-	-	-	-	-	-	-	-
Philoctamidae	-	-	-	-	-	-	-	-	-	19.4	37.9
Polycentropodidae	-	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	0.34x	-
Lepidostomatidae	-	-	-	-	-	-	-	-	-	-	-
Gleocoptera	-	-	-	-	-	-	-	-	-	-	-
Elmidae adults	-	-	-	-	-	-	-	-	-	1.13x	6.51x
larvae	-	-	-	-	-	-	-	-	0.06	0.11x	1.78x
Hydrophilidae adult	-	-	-	-	-	-	-	-	-	-	-
Noteridae	-	-	-	-	-	-	-	-	-	-	-
Staphylinidae larvae	-	-	-	-	-	-	-	-	-	-	-
Unidentified larvae	-	-	-	-	-	-	-	-	-	-	-
Diptera: Total	2.11	1.07	0.41	0.46	0.51	0.56	1.48	0.61	2.48	224.3	558.6
Chironomidae larvae	0.04	-	-	-	0.05	-	-	0.09	0.35	10.7	69.2
pupae	-	-	-	-	-	-	-	0.05	0.06	-	12.4
Culicidae larvae	-	-	-	-	-	-	-	-	-	-	-
Empididae larvae	-	-	-	-	-	-	-	-	-	-	-
Psychodidae larvae	-	-	-	-	-	-	-	-	-	-	-
Simuliidae larvae	2.07	1.07	0.41	0.46	0.46	0.56	1.48	0.47	2.07	213.6	470.4
Ticulidae larvae	-	-	-	-	-	-	-	-	-	-	-
Athericidae larvae	-	-	-	-	-	-	-	-	-	-	0.59x
Heleidae pupae	-	-	-	-	-	-	-	-	-	-	-
Oligochaeta	-	-	0.04	-	-	-	-	-	-	-	-
Nematomorpha	-	-	-	-	-	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-	-
Hydracarina	-	0.04	0.04	-	-	-	-	0.09	-	-	0.59x
Crustacea	-	-	-	-	-	-	-	-	-	-	-
Decapoda	-	-	-	-	-	-	-	-	-	-	-
Ostracoda	-	-	0.12	-	-	0.04	-	0.09	-	-	-
Total	2.30	1.23	0.66	0.56	0.61	1.07	1.59	0.98	3.25	613.7	1555.6

* expressed as organisms per m³ of flow through drift net.

** located in block 301 treated with 17.5 g Alpha permethrin at 0700 to 0720 hrs on 7 June 1980.

*** numbers extrapolated from subsample except where actual count is indicated by "x".

Table A-6 (concluded)

Aquatic invertebrates* collected in drift net sets set in Rivière St. Denis 301**
 Kamouraska County, Québec
 27 May to 10 June 1980

Days before or after permethrin application	+1hr ***	+2hr ***	+3hr ***	+4hr ***	+12hr	+1 AM	+1 PM ***	+2 AM	+2 PM	+3 AM	+3 PM
Volume of drift column (m ³)	1.59	1.59	1.50	1.38	1.35	16.07	25.29	15.26	28.34	26.45	23.61
Current Velocity (m/sec)	0.30	0.30	0.30	0.30	0.30	0.30	0.39	0.43	0.67	0.67	0.67
Ephemeroptera: Total nymphs	508.3	557.4	328.1	159.8	11.0	1.31	28.2	5.04	0.95	1.13	0.47
Baetidae	181.7	52.7	11.2	3.25	0.28	0.37	0.04x	0.44	0.04	-	0.04
Ephemerellidae	207.1	350.9	238.1	119.2	6.76	0.37	26.4	1.77	0.53	0.57	0.17
Heptageniidae	50.3	31.4	26.3	9.17	2.54	0.31	1.66	0.25	0.04	0.11	0.08
Leptophlebiidae	69.2	112.4	52.5	28.1	1.41	0.25	0.08x	2.59	0.35	0.45	0.17
Odonata	-	-	-	-	-	-	-	-	-	-	-
Calopterygidae	-	-	-	0.59x	-	0.06	0.04x	0.19	-	-	-
Plecoptera	232.0	213.0	218.12	125.4	11.0	1.18	14.7	7.38	1.20	1.02	0.13
Hemiptera	-	-	-	-	-	-	-	-	-	-	-
Gerridae	-	-	-	-	-	0.06	-	-	-	-	-
Veliidae	-	-	-	-	-	-	0.04x	0.06	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-	-
Corydalidae	-	-	0.62x	0.30x	-	-	0.04x	-	-	0.04	-
Stalidae	-	-	0.52x	-	-	-	-	-	-	-	-
Trichoptera: Total larvae	41.4	27.8	5.00	63.3	3.94	0.25	0.55	0.88	0.14	0.34	0.13
Brachycentridae	-	-	-	-	-	-	-	-	-	-	-
Glossosomatidae	0.59x	6.51	0.62x	31.7	0.56	-	-	-	-	-	-
Hydropsychidae	1.18x	0.59x	0.62x	3.25	0.56	-	0.16x	-	-	-	0.04
Hydroptilidae	1.18x	4.73x	0.62x	6.21	-	0.06	0.24x	0.38	3.04	0.11	0.04
Leptoceridae	-	-	-	-	-	-	-	-	-	-	-
Limnephilidae	-	-	-	-	-	-	-	0.13	-	-	-
Philopotamidae	37.3	11.8x	2.50x	21.9	-	-	0.16x	0.06	-	0.15	-
Polycentropodidae	-	0.59x	-	-	2.82	0.19	-	-	-	-	-
Rhyacophilidae	1.18x	3.55x	0.62x	0.30x	-	-	-	0.32	0.11	-	0.04
Lepidostomatidae	-	-	-	-	-	-	-	-	-	0.08	-
Coleoptera	-	-	-	-	-	-	-	-	-	-	-
Elmidae adults	1.18x	1.78x	3.12x	0.59x	0.28	-	0.24x	-	0.04	0.11	-
Larvae	0.59x	4.14x	1.25x	0.30x	-	-	1.78	1.89	0.14	0.04	0.04
Hydrophilidae adult	-	-	-	-	-	-	-	0.13	-	-	-
Noteridae	-	-	-	-	-	-	-	0.13	-	-	-
Staphylinidae larvae	-	-	-	-	-	-	0.16x	-	-	-	-
Unidentified larvae	-	-	-	-	-	-	-	0.06	0.04	-	-
Diptera: Total	271.0	316.6	198.75	106.8	33.0	4.11	1.90	4.98	1.09	0.91	0.21
Chironomidae larvae	81.7	81.1	66.2	3.25	2.82	0.68	0.67x	2.27	0.60	0.38	0.08
pupae	1.18x	24.85	-	-	0.56	-	0.59x	0.32	0.14	0.15	-
Culicidae larvae	-	-	-	-	-	0.06	-	-	-	-	-
Empididae larvae	-	1.78x	-	3.25	-	-	0.12x	-	-	-	-
Psychodidae larvae	-	-	-	-	-	-	-	0.13	0.04	-	-
Simuliidae larvae	188.2	206.5	132.50	94.1	29.6	3.30	0.43	1.32	0.32	0.23	0.08
Tipulidae larvae	-	1.78x	-	6.21	-	0.06	0.08x	0.16	-	0.11	0.04
Athericidae larvae	-	-	-	-	-	-	-	-	-	0.04	-
Hilidae pupae	-	-	-	-	-	-	-	0.19	-	-	-
Oligochaeta	-	-	-	-	-	-	-	-	-	-	-
Nematomorpha	-	-	-	-	-	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-	-
Hydracarina	-	0.59x	-	3.25	-	-	0.12x	0.06	-	-	-
Crustacea	-	-	-	-	-	-	-	-	-	-	-
Decapoda	-	-	0.62x	-	-	-	-	-	-	-	-
Ostracoda	-	-	-	-	-	-	-	0.25	-	-	-
Total	1054.4	1121.3	756.25	460.4	59.2	6.97	47.8	21.1	3.60	3.59	0.97

* expressed as organisms per m³ of flow through drift net.

** located in block 301 treated with 17.5 g AI/ha permethrin at 0700 to 0720 hrs on 7 June 1980.

*** numbers extrapolated from subsample except where actual count is indicated by "x".

Table A-7

Aquatic Invertebrates* caught in drift nets set in St. Denis Damstream**
 Kamouraska County, Quebec
 27 May to 10 June 1980

Volume of Drift column (m ³)	24.11	24.11	24.11	15.23	22.84	19.28	27.91	20.30	11.16	11.16	11.16	4.46	4.46	7.94	20.75	43.31	54.14	32.93	33.21	30.87	30.87
Current velocity (m/sec)	0.45	0.45	0.45	0.36	0.45	0.36	0.45	0.36	0.36	0.36	0.36	0.36	0.36	0.64	0.64	0.64	0.64	0.73	0.76	0.73	0.73
Days before or after permethrin application	-11	-11	-8	-8	-6	-6	-5	-5	+1	+2	+3	+4	+6	+9	+12	+1	+1	+2	+2	+3	+3
	AM	PM	AM	PM	AM	PM	AM	PM	hr	hr	hr	hr	hr	hr	hr	AM	PM	AM	PM	AM	PM
Ephemeroptera: Total nymphs	1.49	0.54	0.33	0.66	0.22	0.88	0.14	0.20	0.54	0.72	0.54	0.22	0.67	0.13	0.39	0.25	0.13	0.24	0.75	0.26	0.45
Baetidae	0.41	0.21	0.29	0.33	0.18	0.41	0.14	0.10	0.36	0.18	0.09	-	0.22	-	0.14	0.16	0.04	0.15	0.45	0.03	0.06
Ephemerellidae	0.46	0.12	0.04	0.26	0.04	0.26	-	0.10	0.09	0.45	0.18	-	0.22	0.13	0.24	0.07	0.05	0.06	0.15	0.10	0.29
Hydropsychidae	0.12	0.08	-	0.07	-	0.10	-	-	0.09	0.09	0.09	-	-	-	-	0.02	0.02	-	-	0.03	0.03
Leptophlebiidae	0.50	0.12	-	-	-	0.10	-	-	-	0.18	0.22	0.22	-	-	-	-	0.02	0.03	0.15	0.10	0.06
Plecoptera	0.04	-	-	-	-	0.05	-	-	-	-	-	-	-	-	-	-	-	0.03	-	-	0.06
Trichoptera: Total larvae	0.12	0.04	0.0	0.0	0.0	0.05	0.04	0.05	0.0	0.0	0.18	0.0	0.0	0.0	0.05	0.02	0.0	0.09	0.12	0.13	0.13
Glossosomatidae	-	-	-	-	-	-	-	-	-	-	0.09	-	-	-	-	-	-	-	-	-	-
Hydropsychidae	0.04	0.04	-	-	-	-	0.04	-	-	-	-	-	-	-	-	-	-	-	-	0.03	0.03
Hydropsilidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-	-	-	-	-
Leptoceridae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	-	-	-	-
Ptilopotamidae	0.04	-	-	-	-	-	-	0.05	-	-	-	-	-	-	-	-	-	-	-	-	0.10
Polycentropodidae	-	-	-	-	-	-	-	-	-	0.09	-	-	-	-	-	-	-	0.09	0.12	0.10	-
Rhyacophilidae	0.04	-	-	-	-	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pupae	-	0.08	-	-	-	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dytiscidae larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-	-
Elmidae adult	-	-	-	-	-	-	-	-	0.18	-	-	-	-	-	-	-	-	0.03	-	-	-
larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.27	0.42	0.39	0.10
Haliplidae adult	-	0.04	-	-	-	-	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-	-
Noteridae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-	-	-	-
Unidentified larvae	-	-	-	-	0.04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diptera: Total	0.58	1.0	0.12	0.66	0.57	1.24	0.07	0.15	1.25	0.54	1.16	0.90	1.79	0.13	0.58	0.46	0.41	0.52	0.87	0.78	0.55
Blephariceridae larvae	-	-	-	-	0.04	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-	-	-
Chironomidae larvae	0.08	0.17	0.08	0.13	0.04	0.16	0.04	0.05	0.18	0.09	0.18	-	0.90	0.13	0.19	0.05	0.05	0.18	0.39	0.10	0.23
pupae	0.08	0.12	-	0.07	-	0.05	0.04	-	0.18	0.18	0.27	-	-	-	-	0.07	-	0.06	0.09	0.06	0.10
Belontiidae pupae	-	-	-	-	-	0.05	-	-	-	-	-	-	-	-	-	-	0.28	0.03	0.06	0.03	-
Stenobothridae larvae	0.41	0.71	0.04	0.46	0.48	0.99	-	0.10	0.90	0.27	0.63	0.90	0.90	-	0.34	0.35	0.07	0.18	0.30	0.49	0.23

Cont Insect

Table A-7 (concluded)

Apatite Invertebrates* caught in drift nets set in St. Denis Damstream**
 Kamouraska County, Quebec
 27 May to 10 June 1980

Volume of Drift column (m ³)	24.11	24.11	24.11	15.23	22.84	19.28	27.91	20.30	11.16	11.16	11.16	4.46	4.46	7.94	20.75	43.31	54.14	32.93	33.21	30.87	30.87	
Current velocity (m/sec)	0.45	0.45	0.45	0.36	0.45	0.36	0.45	0.36	0.45	0.36	0.36	0.36	0.36	0.36	0.36	0.64	0.64	0.64	0.76	0.73	0.73	
Days before or after permethrin application	-11	-11	-8	-8	-6	-6	-5	-5	+1	+2	+3	+4	+6	+9	+12	+1	+1	+2	+2	+3	+3	
	AM	PM	AM	PM	AM	PM	AM	PM	hr	hr	hr	hr	hr	hr	hr	AM	PM	AM	PM	AM	PM	
Tipulidae larvae	-	-	-	-	-	-	-	-	-	-	0.09	-	-	-	0.05	-	-	0.03	0.03	0.03	-	
pupae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	-	
Remaneopoda	-	-	-	-	-	-	-	0.05	0.09	-	-	-	-	-	0.10	-	-	-	-	-	-	
Oligochaeta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05	-	-	0.04	-	-	0.03	0.10
Gastropoda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Arachnida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Hydrocarina	-	0.04	-	0.13	0.09	-	0.04	0.05	-	-	-	-	-	-	-	0.02	-	-	-	-	-	
Cystacea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Oniscoidea	-	0.12	-	-	-	0.05	-	0.05	-	-	-	-	-	0.25	0.10	-	0.02	-	-	-	0.06	
Total	2.24	1.87	0.46	1.44	0.92	2.33	0.29	0.54	1.88	1.43	1.88	1.12	2.69	0.63	1.25	0.76	0.63	1.21	2.20	1.59	1.55	

* expressed as organisms per m³ of flow through drift net.

** located approximately 7 km downstream from a block (301) treated with 17.5 g Al/La permethrin at 0700 to 0729 hrs on 7 June 1980.

Table A-8

Aquatic invertebrates* collected from drift nets set in Riviere Huile 304**
 Kamouraska County, Quebec
 27 May to 6 June 1980

Volume of Drift Column (m ³)	26.73	26.73	39.33	19.03	7.86	7.10	7.36	7.61	19.03	39.33
Current Velocity (m/sec)	0.33	0.33	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Days before or after permethrin application	-10	-10	-0	+0	+1	+1	+2	+3	+6	+12
	AM	PM	AM	hr	hr	hr	hr	hr	hr	hr
						***	***		***	
Ephemeroptera: Total nymphs	0.0	0.11	0.08	0.05	2.03	56.4	35.6	11.7	9.93	0.38
Baetidae	-	0.04	0.03	0.05	0.64	29.8	8.5	1.05	3.31	0.10
Ephemerellidae	-	0.07	-	-	-	4.3	4.21	3.02	1.63	0.20
Heptageniidae	-	-	0.03	-	0.13	11.8	11.4	4.34	2.21	-
Leptophlebiidae	-	-	0.03	-	1.27	10.4	11.4	3.28	2.78	0.08
Plecoptera	0.04	-	-	0.10	1.27	7.46	4.21	1.97	-	-
Perlidae	-	-	-	-	-	-	-	-	-	0.02
Gurbiidae	-	-	-	-	-	0.14x	0.14x	-	-	-
Gerridae	-	-	-	-	-	-	-	-	0.10x	-
Veliidae	-	-	-	-	0.13	0.28x	-	-	-	-
Trichoptera: Total larvae	0.0	0.0	0.03	0.0	1.27	13.4	3.12	3.42	1.68	0.18
Brachycentridae	-	-	-	-	-	-	-	0.13	-	-
Hydropsychidae	-	-	-	-	1.14	8.87	2.72	1.31	1.10	0.08
Hydroptilidae	-	-	-	-	-	1.55	0.14x	0.26	-	-
Leptoceridae	-	-	-	-	-	-	-	0.13	-	-
Limnephilidae	-	-	0.03	-	-	-	-	0.13	-	0.05
Hiloponmatidae	-	-	-	-	0.13	2.96	0.27x	1.31	0.58	0.02
Rhyacophilidae	-	-	-	-	-	-	-	0.13	-	0.02
pupae	-	-	-	-	0.13	-	-	-	-	-
Coleoptera	-	-	-	-	-	-	-	-	-	-
Elmidae	-	-	-	-	-	1.97x	0.95x	0.79	0.16x	0.05
Bytiscidae	-	-	-	-	-	-	-	-	0.05x	-
Diptera: Total	0.67	0.11	0.10	0.16	2.29	7.46	10.1	3.15	12.2	0.86
Tipulidae larvae	0.49	-	-	0.05	-	-	-	-	-	-
Simuliidae larvae	-	0.11	0.08	0.10	1.91	7.46	2.85	1.84	8.36	0.33
pupae	-	-	-	-	-	-	2.85	0.13	-	-
Chironomidae larvae	0.19	-	0.03	-	0.25	-	2.85	1.05	3.89	0.53
pupae	-	-	-	-	0.13	-	1.49	0.13	-	-
Crustacea	-	-	-	-	-	-	-	-	-	-
Ostracoda	-	0.45	-	0.05	-	-	-	-	1.10	-
Gastropoda: Limpet	-	-	0.03	-	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-
Hydracarina	0.07	0.04	-	-	-	-	-	-	0.58	-
Total	0.78	0.71	0.23	0.37	7.12	87.2	54.1	21.0	20.6	1.50

* expressed as organisms per m³ of flow through drift net.

** located in block 304 treated with 17.5 g Al/ha permethrin at 0647 to 0716 hrs on 6 June 1980.

*** numbers extrapolated from a subsample except where actual count is indicated by "x"

Table A-9

Aquatic Invertebrates* collected from drift nets set in Rivière Haute 308**
 Kamouraska County, Québec
 27 May to 18 June 1980

Days before or after 11st or second application	-10 AM	-10 PM	-7 AM	-6 PM	-5 AM	-5 PM	-4 AM	-4 PM	-0 AM	0hr	1 hr AAA	1hr AAA	2hr AAA	3hr AAA	4hr AAA	12hr AAA	11 AM AAA	11 PM AAA	12 AM	12 PM	
Volume of drift column (m ³)	44.16	41.11	45.68	30.79	29.61	31.97	30.45	28.42	14.21	5.68	5.68	5.68	2.74	0.36	2.74	14.21	19.41	37.39	40.26	36.97	24.11
Current Velocity (m/sec)	0.54	0.54	0.54	0.42	0.42	0.42	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.51	0.51	0.51	0.57	0.57
Ephemeroptera: Total nymphs	0.29	0.07	0.13	0.23	0.47	0.0	0.52	0.18	0.63	0.53	950.0	1854.9	1241.6	797.1	290.9	58.9	17.8	29.76	0.54	5.39	
Baetidae	0.12	0.04	0.02	0.16	0.41	-	0.33	0.14	0.56	0.18	304.2	300.5	100.4	23.4	34.3	7.11	3.66	2.63	0.03	0.08	
Ephemerellidae	0.12	0.02	0.04	0.06	-	-	0.13	0.04	0.07	-	1.94	22.4	193.4	290.1	91.0	13.1	4.52	18.2	0.16	1.00	
Plecoptera	0.05	-	0.07	-	0.07	-	0.03	-	-	-	472.2	955.4	556.9	228.1	73.8	14.7	2.54	4.22	0.19	0.33	
Leptophlebiidae	-	-	-	-	-	-	0.03	-	-	0.35	171.6	576.6	390.9	255.5	91.8	24.0	7.09	4.74	0.16	3.98	
Trichoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.07x	-	-	-	-	-	
Aeshnidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Gomphidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
early instar unidentified	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Plecoptera	-	-	-	0.03	0.03	-	-	-	0.14	0.18	93.3	194.0	193.4	154.7	36.5	9.27	5.67	11.6	-	0.46	
Trichoptera	-	-	-	-	-	-	-	-	-	-	-	0.18x	-	-	-	-	-	-	-	-	
Gerridae	-	-	-	-	-	-	-	-	-	-	-	-	0.36x	-	-	-	-	-	-	-	
Velidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Hymenoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.14x	0.15x	0.11x	0.12x	-	0.04	
Corydalidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Diptera: Total larvae	0.12	0.0	0.02	0.10	0.0	0.0	0.03	0.0	0.35	0.0	871.6	307.7	175.9	88.7	40.3	13.8	7.06	24.7	0.38	0.58	
Brachycentridae	-	-	-	0.03	-	-	-	-	-	-	1.94	2.64x	0.36x	-	0.07x	0.10x	-	0.07x	-	-	
Glossosomatidae	-	-	-	-	-	-	-	-	-	-	-	1.41x	0.36x	-	1.48	0.41x	-	0.55	0.03	0.04	
Hydropsychidae	-	-	-	-	-	-	-	-	-	-	8.03	76.6	34.7	7.66	3.73	3.30	1.12	2.76	0.05	0.25	
Hydropsychidae	0.02	-	0.02	-	-	-	0.03	-	-	-	-	0.70x	0.73x	11.7	2.96	0.15x	-	0.32x	-	-	
Hydropsychidae	0.02	-	-	-	-	-	-	-	0.07	-	-	-	0.36x	-	-	-	-	0.02x	-	-	
Leptoceridae	-	-	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04	
Limnephilidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Limnephilidae	-	-	-	-	-	-	-	-	-	-	789.3	212.7	100.7	54.0	29.8	8.19	5.64	20.5	0.16	0.21	
Limnephilidae	-	-	-	-	-	-	-	-	0.28	-	-	-	-	-	-	-	-	-	-	-	
Polycistropodidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Polycistropodidae	0.07	-	-	0.03	-	-	-	-	-	-	0.18x	13.7	38.7	15.33	2.25	1.65	0.29	0.47	0.14	0.04	

Table A-9 (continued)

Aquatic Invertebrates* collected from drift nets set in Riviere Mule 303**
 Kankaraska County, Quebec
 27 May to 18 June 1980

Days before or after first or second application	-10 AM	-10 BM	-7 AM	-6 BM	-5 AM	-5 BM	-4 AM	-4 BM	-0 AM	+0hr	+1hr	+1hr	+2hr	+3hr	+4hr	+12hr	+1 AM	+1 BM	+2 AM	+2 BM
	AM	BM	AM	BM	AM	BM	AM	BM	AM		***	***	***	***	***	***	***	***	***	***
Volume of drift column (m ³)	44.16	41.11	45.68	30.79	29.61	31.97	30.45	28.42	14.21	5.68	5.68	5.68	2.74	2.74	14.21	19.41	37.39	40.26	36.97	24.11
Current Velocity (m/sec)	0.54	0.54	0.54	0.42	0.42	0.42	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.51	0.51	0.51	0.57	0.57
Collembola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dytiscidae larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elaeidae adult	-	-	-	-	-	-	-	-	-	-	0.35x	4.58x	2.19x	0.36x	-	0.10x	-	0.02x	0.03	-
larvae	-	-	-	-	-	-	0.03	-	0.14	-	-	-	1.82x	1.09x	0.77	-	0.29	0.02x	-	0.46
Hydraenidae adult	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04
Hydrophilidae	-	-	-	-	-	-	-	-	-	-	-	-	0.36x	-	-	-	-	-	-	-
Isopoda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02x
Unidentified larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diptera: Total	1.73	1.20	1.34	2.56	1.82	0.0	1.64	0.60	5.42	1.23	168.0	235.9	340.9	233.9	102.3	19.5	14.1	24.7	0.60	1.00
Athericidae larvae	-	-	-	-	-	-	-	-	-	-	-	-	0.73x	0.73x	0.20x	0.10x	-	0.10x	0.03	-
popae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beptarcticidae larvae	-	-	-	-	-	-	-	-	-	-	0.18x	6.69x	2.19x	-	-	-	-	-	0.07x	-
Chironomidae larvae	0.02	0.04	0.07	0.03	0.07	-	0.06	-	-	0.53	14.8	80.3	119.7	127.7	29.8	8.19	9.33	16.6	0.16	0.71
popae	0.05	-	-	0.03	-	-	0.03	-	-	-	-	3.70	15.3x	-	0.07x	-	0.56	1.59	-	-
Ephydriidae	-	-	-	-	-	-	-	-	-	-	-	-	0.73x	-	0.07x	-	-	0.05x	-	-
Ephydriidae larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.07x	0.57	-	-	-	-
popae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simuliidae larvae	1.65	1.16	1.27	2.50	1.76	-	1.54	0.60	5.42	0.70	153.0	143.7	201.1	104.4	71.6	10.4	4.25	5.79	0.38	0.21
Tipulidae larvae	-	-	-	-	-	-	-	-	-	-	-	1.58x	1.09x	1.09x	0.35x	0.26x	-	0.52	0.03	0.08
Isotomaria	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gastropoda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Limpet	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydracarina	0.05	-	0.18	0.23	0.03	-	0.16	0.04	-	-	1.94	0.53x	1.46x	-	-	0.57	1.42	0.17x	0.16	-
Crustacea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.08
Amphipoda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ostracoda	0.05	0.11	0.15	0.13	-	-	0.13	-	-	-	1.94	0.17x	0.36x	-	-	0.26x	-	-	0.08	0.21
Total	2.24	1.38	1.82	3.28	3.71	0.0	2.53	0.81	6.54	1.94	2007.1	2598.1	1958.0	1275.9	471.0	102.6	46.5	91.2	1.81	8.25

* expressed as organisms per m³ of flow through drift net.

** located in block 303 treated with 17.5 g Al/ha permethrin at 0455 to 0528 hrs on 6 June and again at 1430 to 1500 hrs on 15 June 1980.

*** numbers extrapolated from subsample except where actual count is indicated by "x".

Table A-9 (concluded)

Aquatic Invertebrates* collected from drift nets set in Riviere Haute 30**
 Kamouraska County, Quebec
 27 May to 18 June 1980

Days before or after first or second application	†3 A1	†3 B1	†4 A1	†4 B1	†5 A1	†5 B1	†0hr AAA	†1hr AAA	†1hr AAA	†2hr AAA	†3hr AAA	†6hr	†12hr	†1	†1	†2	†2	†3	†3
	A1	B1	A1	B1	A1	B1	AAA	AAA	AAA	AAA	AAA			A1	B1	A1	B1	A1	B1
Volume of drift column (m ³)	28.34	34.68	32.14	32.30	20.123	19.03	13.95	2.79	2.66	2.91	2.79	2.97	4.01	5.92	8.12	19.79	19.03	18.69	12.69
Current Velocity (m/sec)	0.67	0.82	0.76	0.79	0.51	0.54	0.45	0.45	0.45	0.45	0.45	0.48	0.57	0.42	0.60	0.54	0.54	0.51	0.36
Collembola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dytiscidae larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	0.17	-	-	-	-	-
Elmidae adult	-	-	0.03	-	-	-	1.72	7.53	4.51	0.69x	1.08x	1.68	-	0.17	-	0.05	0.05	-	-
larvae	0.64	0.12	0.25	-	-	-	-	-	-	-	1.08x	2.69	1.75	0.84	-	0.15	0.10	0.11	-
Hydraenidae adult	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydrophilidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Daphniidae	-	0.03	-	-	-	-	-	-	-	0.36x	-	-	-	0.17	-	-	-	-	-
Unidentified larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diptera: Total	4.52	0.75	0.56	0.25	0.15	0.05	4.52	20.1	28.6	111.7	84.2	20.5	5.24	3.21	0.62	0.96	0.42	-	-
Athericidae larvae	-	-	-	-	-	-	-	-	-	0.69x	3.94	0.67	-	0.34	-	-	-	-	-
pupae	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mephiticidae larvae	0.07	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gironomidae larvae	3.25	0.40	0.31	0.22	0.15	0.05	1.51	19.0	24.1	109.3	64.5	14.5	4.24	2.36	0.25	0.76	0.32	-	0.24
pupae	0.35	0.12	-	-	-	-	1.51	0.72x	0.38x	-	7.53	3.03	0.25	0.34	0.25	0.15	-	-	-
Empididae	0.11	-	-	-	-	-	-	-	-	-	0.36x	1.01	-	-	-	0.05	0.05	-	-
Blepharidae larvae	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pupae	-	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Simuliidae larvae	0.67	0.12	0.19	-	-	-	1.51	0.36x	4.14	-	3.94x	0.67	0.50	-	-	-	-	-	-
Tipulidae larvae	0.07	0.03	0.03	0.03	-	-	-	-	-	1.72x	3.94	0.67	0.25	0.17	0.12	-	0.05	-	0.08
Hemiptera	-	-	-	-	-	-	0.07x	-	-	-	-	-	-	-	-	-	-	-	-
Gastropoda	-	-	-	-	-	-	0.07x	-	-	-	-	-	-	-	-	-	-	-	-
Lepidoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydracarina	-	-	-	0.03	-	-	0.29x	-	0.38	-	7.53	-	0.25	-	0.12	0.05	0.10	-	-
Ctenocephala	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Amphipoda	-	-	-	0.03	-	0.05	-	0.36x	-	0.69x	-	-	-	-	-	0.05	-	-	-
Oligochaeta	-	-	-	0.09	-	-	-	-	-	-	-	-	-	-	0.12	0.10	-	0.05	-
Total	10.1	3.17	1.59	1.05	0.89	0.68	77.0	443.4	609.8	657.4	458.1	164.0	153.1	21.5	1.85	2.63	1.47	0.37	0.47

* expressed as organisms per m³ of flow through drift net.

** located in block 303 treated with 17.5 g A.i./ha permethrin at 0455 to 0528 hrs on 6 June and again at 1430 to 1500 hrs on 15 June 1980.

*** numbers extrapolated from subsample except where actual count is indicated by "x".

Table A-10

Aquatic Invertebrates* collected from drift nets set in Rivière Haute-Du-Roost**
 Kamouraska County, Quebec
 27 May to 18 June 1980

Volume of Drift column (m ³)	51.01	56.68	44.98	46.53	42.53	45.79	65.87	61.76	57.64	11.53	5.76	5.76	5.76	5.97	5.97	5.97	29.84	59.22	57.25	50.53	26.79
Current Velocity (m/sec)	0.67	0.67	0.55	0.55	0.58	0.58	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.70	0.70	0.64	0.76
Days before or after first or second application	-10	-10	-7	-6	-5	-5	-4	-4	+1hr	+1hr	+1hr	+3hr	+4hr	+8hr	+8hr	+7hr	+10hr	11	11	12	12
	AM	PM	AM	PM	AM	PM	AM	PM	***	***	***	***	***	***	***	***	***	AM	PM	AM	PM
Ephemeroptera: Total nymphs	0.10	0.21	0.07	0.17	0.19	0.04	0.43	0.08	4.58	227.1	215.1	863.0	693.8	139.9	204.2	93.8	49.2	6.81	0.33	0.33	1.16
Baetidae	0.04	0.11	0.07	0.06	0.16	0.04	0.29	0.02	3.49	95.6	108.5	71.7	57.1	5.56	24.0	7.29	12.4	0.35	-	0.06	0.07
Ephemerellidae	0.04	-	-	-	0.02	-	0.05	0.02	0.54	-	-	9.20	128.8	108.5	64.4	27.6	9.58	1.44	0.12	0.02	0.22
Rhyacidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leptagyniidae	0.02	0.11	-	0.09	-	-	0.06	0.05	0.19	96.5	99.3	548.4	334.9	20.3	60.5	36.8	13.5	1.98	0.09	0.16	0.22
Leptophlebiidae	-	-	-	0.02	-	-	0.03	-	0.36	35.0	7.29	233.7	172.9	5.56	55.2	22.0	10.7	3.04	0.12	0.14	0.63
Plecoptera	0.02	-	0.09	0.02	-	-	-	0.02	4.04	15.6	20.3	77.3	79.2	29.5	49.7	29.5	12.8	0.71	0.02	-	0.15
Perlidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gerridae	-	-	-	-	-	-	-	-	-	-	-	0.17x	-	-	-	-	-	-	-	-	-
Wolffidae	-	-	-	-	-	-	-	-	-	0.09x	-	-	-	-	-	-	0.07x	0.02x	-	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gorytiidae	-	-	-	-	-	-	-	-	-	-	-	-	0.17x	0.74x	-	-	-	-	0.00x	-	0.04
Trichoptera: Total larvae	0.00	0.00	0.00	0.02	0.02	0.02	0.02	0.02	0.02x	198.6	150.9	77.3	144.8	33.3	34.9	24.1	24.4	3.29	0.07	0.08	0.22
Baetocentrinae	-	-	-	-	-	-	-	-	-	-	1.74	-	-	-	-	-	0.03x	-	-	-	-
Glossosomatidae	-	-	-	-	0.02	-	-	-	-	-	-	-	6.94x	1.04x	0.35x	0.17x	-	0.03x	-	-	-
Hydropsychidae	-	-	-	-	-	-	-	-	-	-	-	3.65	66.3	24.0 x	18.4	5.56	0.10x	0.54	0.05	0.02	0.19
Hydroptilidae	-	-	-	-	-	-	-	-	-	-	-	-	0.17x	-	0.17x	0.17x	0.03x	-	-	-	-
Leptostomatidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hiloponemidae	-	-	-	-	-	-	0.02	-	0.02x	198.6	149.0	71.7	75.5	6.77x	14.6	14.6	24.2	2.68	0.02	-	-
Polycentropodidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04	0.04
Rhyacophiliidae	-	-	-	0.02	-	0.02	-	0.02	-	-	0.17x	1.91	1.91x	1.56x	1.39x	3.64	0.07x	0.03x	-	-	-
pupae	-	0.05	-	-	-	0.02	-	0.02	-	-	-	-	0.17x	-	-	-	-	-	-	0.02	-

Cont. Invertebr.

Table A-10 (concluded)

Aquatic Invertebrates* collected from drift nets set in Rivière du Loup downstream**
 Kamouraska County, Québec
 27 May to 18 June 1980.

Volume of Drift column (m ³)	35.96	36.68	37.15	36.53	32.15	30.88	18.81	7.52	7.52	7.26	8.86	8.37	10.58	9.82	10.20	8.68	11.45	29.61	30.00	26.17	23.72	
Current Velocity (m/sec)	0.85	0.82	0.85	0.79	0.76	0.73	0.46	0.46	0.46	0.46	0.55	0.55	0.67	0.67	0.67	0.61	0.70	0.70	0.76	0.64	0.58	
Days before or after first or second application	+3 A1	+3 B1	+4 A1	+4 B1	+5 A1	+5 B1	+1hr	+3hr	+4hr	+3hr	+7hr ***	+11hr ***	+12hr ***	+13hr	+13hr	+10hr	+1 hr	+2 hr	+2 hr	+3 hr	+3 hr	
Collembola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elmidae adults	0.03	-	0.03	-	-	0.03	-	-	-	-	1.61x	0.48x	1.04x	0.70	0.29	0.16	-	-	-	-	-	
larvae	0.19	0.03	0.11	0.03	-	-	-	0.13	-	-	0.12x	1.31	0.57x	1.01	6.86	0.47	-	0.03	-	-	-	
Heteridae adults	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Buprestidae larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Diptera total	0.25	0.32	0.19	0.26	0.09	0.06	0.11	0.00	0.00	0.00	1.15	24.1	4.54	3.16	3.92	2.67	1.05	0.37	0.30	0.08	0.00	
Athericidae larvae	-	-	-	0.03	-	-	-	-	-	-	0.12x	2.51	0.47x	0.61	0.78	0.23	-	-	-	-	-	
Megaluracidae larvae	0.06	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Gastrocnemidae larvae	0.03	0.23	0.19	0.17	0.09	0.06	0.05	-	-	-	0.46	21.5	1.98	1.63	2.65	1.63	0.70	0.34	0.17	0.04	-	
pupae	-	0.03	-	0.06	-	-	0.05	-	-	-	0.23x	0.12x	1.04	0.30	0.29	0.47	0.09	-	-	-	-	
Epididae larvae	-	-	-	-	-	-	-	-	-	-	0.12x	-	-	0.10	0.10	0.23	-	-	-	-	-	
Blepharidae larvae	0.03	-	-	-	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	-	-	-	
Simuliidae larvae	0.14	0.06	-	-	-	-	-	-	-	-	0.12x	-	1.04	0.30	0.10	0.16	0.26	0.03	0.13	0.04	-	
pupae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tipulidae larvae	-	-	-	-	-	-	-	-	-	-	0.12	-	0.10	-	-	-	-	-	-	-	-	
Oligochaeta	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	-	-	-	
Polychaeta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tentaculata	-	-	-	0.03	0.06	-	-	-	-	-	0.12	-	-	-	-	-	-	0.07	-	0.04	-	
Gastropoda	-	-	-	0.17	0.06	0.03	0.05	-	-	-	-	0.12	-	-	-	0.16	-	-	-	0.04	-	
Total	1.59	1.04	0.67	0.81	0.65	0.5	0.32	0.26	0.80	0.14	51.2	149.8	99.0	63.4	29.9	23.1	1.92	1.05	0.60	0.92	0.17	

* expressed as organisms per m³ of flow through drift nets.

** located approximately 3 km downstream from block 303 treated with 17.5 g Al/Lva permethrin at 0455 to 0528 hrs on 6 June 1980, and again at 1430 to 1500 hrs on 15 June 1980.

*** Values extrapolated from subsamples except where actual count is indicated by "x".

Table A-11

Aquatic Invertebrates* collected from drift nets set in the untreated Riviere Manic upstream station**
 Kenouraska County, Quebec
 27 May to 18 June 1980

Date	27 May		30 May	31 May	1 June		2 June		6 June		7 June		8 June	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Volume of drift column (m ³)	21.82	31.52	27.24	29.01	27.63	29.01	29.83	29.83	32.14	27.32	27.63	27.32	31.64	23.26
Current Velocity (m/sec)	0.43	0.43	0.46	0.49	0.49	0.49	0.46	0.46	0.57	0.51	0.49	0.51	0.51	0.55
Ephemeroptera: Total nymphs	0.14	0.13	0.00	0.03	0.22	0.24	0.10	0.10	0.06	0.00	0.33	0.00	0.06	0.21
Heptageniidae	-	0.10	-	-	0.18	0.14	0.07	-	-	-	0.07	-	0.03	0.09
Ephemerellidae	0.05	0.03	-	-	0.04	0.03	0.03	0.03	0.06	-	0.11	-	-	0.04
Heptageniidae	0.09	-	-	0.03	-	0.03	-	0.07	-	-	0.14	-	-	0.04
Leptophlebiidae	-	-	-	-	-	0.03	-	-	-	-	-	-	0.03	0.04
Odonata	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1st instar unidentified	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plecoptera	-	-	-	-	-	-	-	0.03	-	-	0.04	-	-	-
Trichoptera: Total larvae	0.09	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.07	0.00	0.03	0.00
Hydropsychidae	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-
Hydroptilidae	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
Limnephilidae	-	-	-	-	-	0.03	-	-	-	-	-	-	-	-
Polycentropodidae	-	-	-	-	-	-	-	-	-	-	0.07	-	-	-
Rhyacophilidae	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elmidae adult	-	-	-	-	-	-	-	-	-	-	-	-	-	-
larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diptera: Total	0.69	0.29	0.07	0.07	0.69	1.10	0.20	0.00	0.19	0.44	0.87	0.11	0.06	0.17
Athericidae larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chironomidae larvae	-	0.10	0.04	0.03	-	0.17	0.03	-	0.12	0.33	0.58	0.07	-	0.04
pupae	-	-	-	-	-	-	-	-	-	-	0.07	-	-	-
Heleidae pupae	-	-	-	-	-	-	-	-	-	-	-	-	-	0.04
Simuliidae larvae	0.69	0.19	0.04	0.03	0.69	0.86	0.17	-	0.06	0.07	0.22	0.04	0.06	0.09
pupae	-	-	-	-	-	0.07	-	-	-	0.04	-	-	-	-
Tipulidae larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oligochaeta	-	-	-	-	-	0.03	-	-	-	-	-	-	-	-
Gastropoda: Limpet	-	-	-	-	-	-	0.03	-	-	-	-	-	-	-
Pelecypoda	-	-	-	-	0.11	-	-	-	-	-	-	-	-	-
Arachnida: Hydracarina	0.05	-	-	0.10	0.04	0.14	0.03	0.03	-	-	-	-	-	-
Crustacea: Cladocoda	-	0.03	0.04	0.14	-	0.10	0.03	0.03	-	-	0.04	0.22	-	0.04
Total	0.96	0.44	0.11	0.34	1.05	1.66	0.40	0.30	0.25	0.44	1.34	0.33	0.16	0.43

* expressed as organisms per m³ of flow through drift net

** an untreated control station located approximately 1.5 km upstream from block 304 and 3 km upstream from block 303.

Table A-11 (concluded)

Aquatic Invertebrates* collected from drift nets set in the untreated Rivière Haute Upstream station**
 Kamouraska County, Quebec
 27 May to 18 June 1980

Date	9 June		10 June		11 June		15 June		16 June		17 June		18 June	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Volume of drift column (m ³)	21.65	30.87	25.26	26.45	21.65	22.70	11.05	5.58	6.20	12.43	13.81	15.53	14.72	15.53
Current Velocity (m/sec)	0.64	0.73	0.64	0.67	0.64	0.70	0.49	0.55	0.55	0.49	0.49	0.58	0.58	0.58
Ephemeroptera: Total nymphs	0.09	0.06	0.04	0.04	0.0	0.00	0.36	1.08	0.65	0.08	0.22	0.00	0.14	0.13
Heptageniidae	0.05	-	0.04	-	-	-	0.27	0.54	0.16	-	0.14	-	0.14	0.13
Ephemerellidae	0.05	0.03	-	0.04	-	-	-	0.18	0.32	-	0.07	-	-	-
Heptageniidae	-	0.03	-	-	-	-	0.09	0.18	-	0.08	-	-	-	-
Leptophlebiidae	-	-	-	-	-	-	-	0.18	0.16	-	-	-	-	-
Odonata	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1st instar unidentified	-	-	-	-	-	0.04	-	-	0.16	-	-	-	-	-
Plecoptera	-	-	-	-	-	-	0.09	-	-	0.08	0.07	-	0.07	-
Trichoptera: Total larvae	0.00	0.00	0.00	0.04	0.0	0.00	0.00	0.18	0.00	0.00	0.00	0.00	-	-
Hydropsychidae	-	-	-	-	-	-	-	0.18	-	-	-	-	-	-
Hydroptilidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Limnephilidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycentropodidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rhyacophilidae	-	-	-	0.04	-	-	-	-	-	-	-	-	-	-
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elmidae adult	-	-	-	-	-	-	-	0.18	-	-	-	-	-	-
larvae	0.14	0.13	0.20	-	-	0.4	-	0.36	-	-	-	-	-	-
Diptera: Total	0.14	0.23	0.16	0.00	0.0	0.13	0.45	0.18	0.65	0.16	0.51	0.13	0.20	0.06
Athericidae larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chironomidae larvae	0.05	0.06	0.16	-	-	0.13	0.27	0.18	0.65	0.16	0.29	0.13	0.07	-
pupae	-	0.10	-	-	-	-	0.09	-	-	-	0.14	-	0.14	-
Blepharidopterus pupae	0.05	0.03	-	-	-	-	-	-	-	-	-	-	-	-
Simuliidae larvae	0.05	-	-	-	-	-	0.09	-	-	-	0.07	-	-	-
pupae	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06
Tipulidae larvae	-	0.03	-	-	-	-	-	-	-	-	-	-	-	-
Oligochaeta	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gastropoda: Limpet	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polychaeta	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arachnida: Hydracarina	-	-	-	0.04	-	-	-	-	-	-	-	0.19	-	0.06
Crustacea: Ostracoda	0.05	-	-	-	-	0.04	-	-	-	0.08	-	0.13	-	0.13
Total	0.42	0.42	0.40	0.11	0.0	0.26	0.90	1.97	1.45	0.40	0.80	0.45	0.41	0.39

* expressed as organisms per m³ of flow through drift net

**An untreated control station located approximately 1.5 km upstream from block 304 and 3 km upstream from block 303.

Table A-12

Aquatic Invertebrates* collected from drift nets set in Riviere du Loup untreated control station
 Kamouraska County, Quebec
 27 May to 18 June 1980

Date	27 May		30 May	31 May	1 June		2 June		7 June		8 June	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Volume of drift column (m ³)	48.22	48.22	45.00	33.16	45.00	48.22	46.61	35.53	30.79	15.22	14.59	27.07
Current velocity (m/sec)	0.57	0.57	0.57	0.42	0.57	0.57	0.57	0.42	0.42	0.45	0.45	0.60
Ephemeroptera: Total nymphs	0.15	0.12	0.09	0.06	0.04	0.06	0.09	0.45	0.13	0.20	0.07	0.15
Bietidae	0.06	0.06	0.04	0.06	0.04	0.02	0.02	0.17	0.06	0.07	0.07	0.07
Ephemerellidae	0.04	0.02	0.02	-	-	0.04	0.04	0.14	0.06	0.13	-	0.07
Leptageniidae	0.02	-	0.02	-	-	-	0.02	0.14	-	-	-	-
Leptophlebiidae	0.02	0.04	-	-	-	-	-	-	-	-	-	-
Plecoptera	0.08	0.02	-	0.03	-	-	0.04	-	0.13	-	-	0.04
Trichoptera: Total larvae	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.03	0.00	0.00	0.04
Brachycentridae	0.04	-	-	-	-	-	-	0.06	0.03	-	-	-
Hydropsychidae	0.02	-	-	-	-	-	-	-	-	-	-	-
Hydroptilidae	-	-	-	-	-	-	-	-	-	-	-	-
Lepidostomatidae	-	-	-	-	-	-	-	-	-	-	-	0.04
Limnephilidae	-	-	-	-	-	-	-	-	-	-	-	-
Polycentropodidae	-	-	-	-	-	-	-	0.03	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	0.03	-	-	-	-
pupae	-	-	-	-	-	-	-	-	-	-	-	-
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-
Elmidae adults	-	-	-	-	-	-	-	-	-	-	-	0.07
larvae	-	-	-	0.03	-	-	-	-	-	-	-	0.04
Diptera: Total	0.44	0.21	0.24	0.51	0.18	0.41	0.13	0.17	0.46	0.07	0.48	0.48
Athericidae larvae	-	-	-	-	-	-	-	-	-	-	-	-
Chironomidae larvae	-	0.06	0.02	0.12	0.02	0.04	0.02	0.06	-	0.07	0.14	0.11
pupae	-	-	-	0.03	-	0.04	0.02	0.03	-	-	0.21	0.15
Heleidae pupae	0.04	-	0.04	-	-	0.02	-	-	0.03	-	-	0.04
Simuliidae larvae	0.33	0.15	0.18	0.36	0.16	0.30	0.09	0.08	0.42	-	0.14	0.15
Tipulidae larvae	0.06	-	-	-	-	-	-	-	-	-	-	-
pupae	-	-	-	-	-	-	-	-	-	-	-	0.04
Nemtonompha	-	-	-	-	-	-	-	-	-	-	-	-
Nematoda	-	-	-	0.06	-	-	-	-	-	-	0.07	-
Oligochaeta	-	-	-	-	-	-	-	-	-	-	-	-
Arachnida: Hydracarina	0.06	0.02	-	0.06	-	0.02	0.02	0.11	0.03	-	0.21	-
Crustacea: Ostracoda	-	0.06	-	0.18	0.11	0.10	-	0.25	-	-	0.27	0.07
Total	0.79	0.44	0.33	0.93	0.33	0.60	0.28	1.10	0.78	0.26	1.10	0.89

* expressed as organisms per m³ of flow through drift net.

Table A-12 (concluded)

Aquatic Invertebrates* collected from drift nets set in Rivière du Loup untreated control station
 Kamouraska County, Quebec
 27 May to 18 June 1980

Date	9 June		10 June		11 June		16 June		17 June		18 June	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Volume of drift column (m ³)	37.15	34.53	28.82	29.61	22.50	22.84	7.10	21.57	21.57	17.76	13.19	13.19
Current velocity (m/sec)	0.85	0.79	0.73	0.70	0.57	0.54	0.45	0.51	0.51	0.42	0.36	0.36
Ephemeroptera: Total nymphs	0.13	0.12	0.14	0.14	0.44	0.18	1.27	0.00	0.28	0.17	0.08	0.08
Heftidae	0.03	0.06	0.07	0.07	0.31	0.09	0.85	-	0.14	0.06	-	0.08
Ephemerellidae	0.05	-	0.03	0.03	0.13	-	-	-	0.09	0.06	-	-
Heptageniidae	0.05	0.06	0.03	-	-	-	0.42	-	-	-	0.08	-
Leptophlebiidae	-	-	-	0.03	-	0.09	-	-	0.05	0.06	-	-
Plecoptera	-	0.03	0.03	0.07	-	-	0.14	0.09	0.05	-	-	-
Trichoptera: Total larvae	0.00	0.03	0.03	0.00	0.00	0.00	0.28	0.00	0.00	0.06	0.00	0.08
Brachycentridae	-	-	-	-	-	-	-	-	-	0.06	-	-
Hydropsychidae	-	0.03	-	-	-	-	-	-	-	-	-	-
Hydroptilidae	-	-	-	-	-	-	-	-	-	-	-	0.08
Leptostomidae	-	-	-	-	-	-	-	-	-	-	-	-
Limnephilidae	-	-	0.03	-	-	-	0.14	-	-	-	-	-
Polycentropodidae	-	-	-	-	-	-	0.14	-	-	-	-	-
Rhyacophilidae	-	-	-	-	-	-	-	-	-	-	-	-
pupae	-	-	-	-	-	-	-	0.05	-	-	-	-
Glecoptera	-	-	-	-	-	-	-	-	-	-	-	-
Elmidae adults	-	-	-	-	-	-	0.14	-	-	0.06	-	-
larvae	0.38	-	0.14	0.03	-	0.04	-	-	-	-	-	-
Diptera: Total	0.08	0.12	0.10	0.24	0.27	0.26	0.85	0.00	0.19	0.00	0.08	0.08
Athericidae larvae	-	-	-	0.03	-	-	-	-	-	-	-	-
Chironomidae larvae	-	0.09	-	-	0.13	0.13	0.56	-	0.05	-	0.08	-
pupae	0.03	-	-	-	-	-	-	-	-	-	-	-
Heleidae pupae	-	0.03	-	-	-	0.04	-	-	-	-	-	-
Simuliidae larvae	0.05	-	0.10	0.20	0.13	0.09	0.28	-	0.14	-	-	0.08
Tipulidae larvae	-	-	-	-	-	-	-	-	-	-	-	-
pupae	-	-	-	-	-	-	-	-	-	-	-	-
Nematomorpha	-	-	-	-	-	-	-	-	-	-	-	-
Nemata	-	-	-	-	-	-	-	-	-	-	-	-
Oligochaeta	-	0.03	-	-	-	-	-	-	-	-	-	-
Arachnida: Hydracarina	-	-	-	-	0.09	0.09	-	-	-	-	-	-
Crustacea: Ostracoda	-	-	-	0.10	0.04	0.04	-	-	-	-	-	-
Total	0.59	0.32	0.45	0.57	0.84	0.61	2.68	0.14	0.51	0.28	0.15	0.23

* expressed as organisms per m³ of flow through drift net.

Table A-13
 Bottom fauna populations*
 Riviere du Loup untreated control station
 Kamouraska County, Quebec
 21 May to 24 September 1980

Date	21 May	25 May	30 May	2 June	10 June	20 June	9 July	19 August	24 September
Ephemeroptera: Total nymphs	18.5 ± 3.7	38.5 ± 11.6	40.2 ± 12.7	47.2 ± 11.4	17.8 ± 9.4	21.5 ± 9.1	15.5 ± 5.7	5.8 ± 3.0	12.8 ± 7.4
Baetidae	1.8 ± 2.1	3.5 ± 2.5	5.0 ± 3.2	4.5 ± 1.3	0.8 ± 1.0	1.8 ± 2.2	2.5 ± 1.3	1.2 ± 1.3	0.2 ± 0.5
Ephemerellidae	1.0 ± 0.0	4.5 ± 1.7	6.2 ± 2.2	4.0 ± 2.3	4.0 ± 3.4	1.8 ± 2.2	3.8 ± 2.8	0.5 ± 0.6	4.0 ± 2.7
Heptageniidae	15.0 ± 3.9	28.5 ± 9.5	26.5 ± 15.0	32.8 ± 6.8	12.5 ± 5.4	16.0 ± 9.5	6.5 ± 3.7	5.2 ± 1.0	8.2 ± 7.1
Leptophlebiidae	0.8 ± 0.5	2.0 ± 3.4	2.5 ± 1.7	6.0 ± 6.9	0.5 ± 0.2	2.0 ± 1.6	2.8 ± 1.9		0.2 ± 0.5
Odonata									
Gomphidae			0.2 ± 0.5		0.2 ± 0.5		0.5 ± 1.0	0.2 ± 0.5	0.8 ± 0.5
Plecoptera	1.2 ± 2.5	4.2 ± 2.1	2.5 ± 2.4	3.5 ± 2.5	0.2 ± 0.5	2.0 ± 0.8	1.2 ± 1.5	2.8 ± 3.0	5.5 ± 4.7
Megaloptera									
Sialidae									0.2 ± 0.5
Trichoptera: Total larvae	1.0 ± 1.2	2.8 ± 1.7	3.2 ± 2.8	2.5 ± 1.3	5.2 ± 3.4	2.5 ± 1.9	18.2 ± 8.3	69.2 ± 10.1	7.8 ± 6.6
Glossosomatidae	0.2 ± 0.5	0.2 ± 0.5	0.8 ± 1.0	0.8 ± 0.5	2.2 ± 1.5	1.5 ± 1.3	15.0 ± 7.4	39.5 ± 8.7	1.0 ± 0.8
Hydropsychidae	0.8 ± 1.0	1.2 ± 0.5	1.0 ± 0.8	0.5 ± 0.6	2.2 ± 1.5	0.5 ± 0.6	1.0 ± 1.4	22.5 ± 10.5	3.5 ± 4.0
Hydroptilidae						0.2 ± 0.5			0.8 ± 1.0
Lepidostomidae									
Limnephilidae						0.2 ± 0.5		0.2 ± 0.5	
Odontoceridae							0.5 ± 1.0	2.5 ± 3.3	
Polycentropodidae		0.2 ± 0.5	0.2 ± 0.5		0.5 ± 0.2			0.8 ± 0.5	
Philopotamidae							0.2 ± 0.5		
Psychomyiidae			0.5 ± 1.0	1.2 ± 1.3					
Rhyacophilidae		1.0 ± 1.4	0.8 ± 1.5		0.2 ± 0.5		0.2 ± 0.5	3.8 ± 4.2	1.0 ± 1.4
pupae	1.5 ± 0.6		0.2 ± 0.5	0.2 ± 0.5	1.5 ± 1.3		1.2 ± 1.0	1.2 ± 1.0	1.5 ± 1.3
Colcoptera									
Elmidae adults	0.2 ± 0.5	4.0 ± 4.8	3.8 ± 5.7	3.5 ± 5.1	0.5 ± 0.6	0.5 ± 0.6	1.0 ± 0.8	2.0 ± 1.8	1.5 ± 1.3
Elmidae larvae	0.8 ± 1.0	0.2 ± 0.5	1.2 ± 1.0	0.2 ± 0.5				2.3 ± 3.2	3.2 ± 2.1
Halplidae adult			0.2 ± 0.5						
Psephenidae adults				0.2 ± 0.5					
Diptera									
Tipulidae larvae				0.2 ± 0.5			0.2 ± 0.5	0.2 ± 0.5	1.0 ± 0.8
Simuliidae larvae	0.2 ± 0.5			0.2 ± 0.5	14.5 ± 14.0				
pupae					0.2 ± 0.5		0.2 ± 0.5	0.2 ± 0.5	
Chironomidae larvae	0.8 ± 1.0	0.2 ± 0.5	5.0 ± 2.6	13.5 ± 18.4	12.0 ± 9.1	5.7 ± 3.1	12.0 ± 14.1	50.0 ± 24.9	26.8 ± 6.8
pupae	0.2 ± 0.5	0.2 ± 0.5	0.5 ± 0.6		0.2 ± 0.5		1.5 ± 3.0	0.2 ± 0.5	
Heleidae larvae		0.2 ± 0.5					0.2 ± 0.5	0.2 ± 0.5	0.8 ± 1.0
Athericidae larvae							0.5 ± 0.6	0.2 ± 0.5	
Blephariceridae larvae		0.2 ± 0.5	0.5 ± 0.6		5.5 ± 3.5				
pupae		0.2 ± 0.5			1.5 ± 1.7				
Empididae larvae	0.8 ± 1.0		0.2 ± 0.5		0.2 ± 0.5			0.2 ± 0.5	
pupae					0.2 ± 0.5				

Continued

Table A-13 (concluded)
 Bottom fauna populations*
 Riviere du Loup untreated control station
 Kamouraska County, Quebec
 21 May to 24 September 1980

Date	21 May	25 May	30 May	2 June	10 June	20 June	9 July	19 August	24 September
Nematoda					7.0 ± 8.7				
Oligochaeta	1.8 ± 2.9	0.2 ± 0.5	5.0 ± 3.5	3.8 ± 2.5	1.8 ± 1.3	0.2 ± 0.5	4.8 ± 5.2	2.5 ± 2.4	5.8 ± 4.5
Gastropoda	0.5 ± 1.0	0.5 ± 1.0		0.2 ± 0.5	1.2 ± 1.5	0.2 ± 0.5	1.5 ± 1.3	1.2 ± 1.0	1.5 ± 1.3
Pelecypoda			0.2 ± 0.5	0.5 ± 1.0	0.2 ± 0.5				
Arachnida: Hydracarina			0.5 ± 1.0					0.5 ± 1.0	
Crustacea			0.2 ± 0.5						
Totals	27.5 ± 8.7	51.8 ± 16.5	62.5 ± 18.9	75.8 ± 34.8	70.5 ± 44.2	31.2 ± 7.0	58.0 ± 32.8	138.8 ± 46.0	67.5 ± 22.7

*mean numbers and standard deviations of organisms collected in four 0.093 m² Surber samples.

Table A-14

Aquatic invertebrates* collected from rocks
taken from Riviere du Loup untreated control station
Kamouraska County, Quebec
21 May to 24 September 1980.

Date	21 May	25 May	30 May	2 June	10 June	20 June	9 July	19 August	24 September
Ephemeroptera: Total nymphs	9.0 ± 12.2	27.5 ± 11.4	22.2 ± 7.7	25.2 ± 6.0	20.8 ± 9.4	17.5 ± 7.4	10.0 ± 9.4	40.5 ± 28.6	20.0 ± 11.3
Baetidae	2.7 ± 4.6	7.8 ± 5.1	4.8 ± 2.9	8.5 ± 2.6	4.0 ± 3.9	1.2 ± 1.9	3.8 ± 5.5	30.5 ± 24.4	10.8 ± 8.2
EphemereIIDae	0.3 ± 0.6	2.0 ± 3.4	0.8 ± 1.0		3.8 ± 6.2	1.0 ± 1.4	0.2 ± 0.5	0.2 ± 0.5	3.5 ± 5.0
HeptagenIIDae	6.0 ± 7.0	17.8 ± 8.2	16.5 ± 8.8	16.5 ± 4.9	13.0 ± 10.4	15.2 ± 5.1	6.0 ± 5.0	8.8 ± 6.3	5.8 ± 7.8
LeptophlebiIDae			0.2 ± 0.5	0.2 ± 0.5				1.0 ± 2.0	
Plecoptera				0.2 ± 0.5	0.2 ± 0.5	0.5 ± 0.6		0.8 ± 1.5	0.2 ± 0.5
Trichoptera: Total larvae	2.7 ± 3.1	3.7 ± 2.3	2.2 ± 0.5	4.2 ± 1.0	4.2 ± 2.2	2.5 ± 1.3	8.2 ± 11.2	14.0 ± 1.8	7.0 ± 3.2
GlossosomatIIDae				0.5 ± 1.0	0.5 ± 0.6	1.2 ± 0.5	6.2 ± 11.2	4.0 ± 2.6	2.2 ± 1.9
HydropsychIIDae		0.2 ± 0.5	1.0 ± 0.8	1.0 ± 0.8	1.5 ± 0.6	0.5 ± 0.6	1.0 ± 1.2	5.0 ± 2.2	1.2 ± 1.9
LepidostomatIIDae								0.8 ± 1.5	
LeptocerIIDae					0.2 ± 0.5			1.0 ± 2.0	
PhlebotomIIDae		0.5 ± 0.6			1.0 ± 0.8		0.2 ± 0.5		
PolycentropodIIDae				0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5			2.5 ± 2.4
LimnephilIIDae	0.3 ± 0.6							1.2 ± 1.9	0.8 ± 1.0
RhyacophilIIDae	0.3 ± 0.6	0.2 ± 0.5		0.5 ± 1.0	0.5 ± 1.0			2.0 ± 1.6	0.8 ± 1.5
pupae	2.0 ± 2.6	1.8 ± 2.1	1.2 ± 1.0	2.0 ± 1.4	0.2 ± 0.5	0.2 ± 0.5	0.8 ± 1.0		
Coleoptera									0.5 ± 0.6
ElmIIDae larvae		0.2 ± 0.5					0.2 ± 0.5		
adults			0.2 ± 0.5				0.2 ± 0.5		
Diptera				0.2 ± 0.5	1.8 ± 2.9			0.5 ± 1.0	0.2 ± 0.5
TipulIIDae larvae								14.8 ± 15.4	
SimuliIIDae larvae	8.0 ± 13.0	15.3 ± 7.8	9.0 ± 13.7	10.2 ± 15.2	2.0 ± 10.4	5.2 ± 6.7	19.2 ± 23.4	18.8 ± 9.5	3.0 ± 1.8
ChironomIIDae larvae	5.0 ± 3.0	3.8 ± 1.0	1.8 ± 2.1	2.2 ± 1.5	30.0 ± 49.4	8.8 ± 4.6	22.0 ± 13.6	0.2 ± 0.5	
pupae	0.3 ± 0.6								
BlepharocerIIDae larvae	2.3 ± 2.5	0.8 ± 1.0	5.8 ± 4.2	3.8 ± 3.3	0.5 ± 1.0				
EmpidIIDae larvae						0.2 ± 0.5			
Gastropoda	1.0 ± 1.7		0.5 ± 1.0	0.5 ± 0.6	0.2 ± 0.5	1.0 ± 2.0		0.5 ± 1.0	2.5 ± 3.1
Pelecypoda			0.2 ± 0.5						
Arachnida: Hydracarina	1.3 ± 1.2	1.0 ± 2.0	1.0 ± 1.2	1.8 ± 2.4	0.5 ± 0.6	4.5 ± 6.4		0.5 ± 0.6	
Nematoda					1.2 ± 2.5				
Totals	29.7 ± 24.7	47.5 ± 13.3	43.0 ± 21.0	48.5 ± 21.6	58.5 ± 54.0	28.0 ± 5.3	59.8 ± 22.6	90.5 ± 45.4	34.2 ± 14.2

*mean numbers and standard deviations of organisms collected from four rocks approximately 15 cm in diameter.

Table A-15
 Bottom fauna populations*
 untreated Manie Upstream station**
 Kamouraska County, Quebec
 22 May to 24 September 1980.

Date	22 May	26 May	31 May	3 June	9 June	18 June	9 July	22 August	24 September
Ephemeroptera: Total nymphs	31.2 ± 26.2	22.5 ± 7.0	20.5 ± 23.8	13.0 ± 5.6	14.0 ± 7.6	25.5 ± 18.0	11.8 ± 9.1	4.0 ± 2.4	27.2 ± 22.3
Baetidae	3.8 ± 4.9	0.2 ± 0.5	1.8 ± 1.3	0.2 ± 0.5	0.8 ± 0.5	3.5 ± 2.9	0.2 ± 0.5	2.2 ± 2.6	1.2 ± 1.9
EphemereIIDae	16.0 ± 13.5	17.2 ± 5.7	5.0 ± 2.2	7.8 ± 2.9	9.5 ± 6.8	16.0 ± 11.8	9.0 ± 6.5	1.2 ± 1.0	17.5 ± 13.4
HeptagenIIDae	6.2 ± 3.1	1.5 ± 1.0	12.0 ± 22.0	2.5 ± 1.9	1.2 ± 1.0	1.8 ± 3.5		0.5 ± 0.6	1.5 ± 1.9
LeptophlebiIIDae	5.2 ± 6.8	3.5 ± 1.7	1.5 ± 1.0	2.5 ± 3.7	3.5 ± 3.0	5.8 ± 3.8	2.5 ± 2.4		7.0 ± 8.4
Odonata									
Gomphidae	0.5 ± 0.6	1.0 ± 0.8		0.5 ± 0.6	0.2 ± 0.5	1.0 ± 1.2	1.0 ± 1.2		0.8 ± 1.0
Petaluridae				0.2 ± 0.5					
Plecoptera	2.2 ± 2.6	3.0 ± 2.2	3.5 ± 3.1	2.8 ± 2.1	2.5 ± 1.7	1.0 ± 0.8	6.2 ± 4.1	3.5 ± 1.3	4.0 ± 2.2
Hemiptera							0.5 ± 0.6		
Megaloptera									
Corydalidae		0.8 ± 1.0	0.8 ± 0.5			1.5 ± 2.4		0.5 ± 1.0	0.5 ± 0.6
Sialidae									0.2 ± 0.5
unidentified		0.2 ± 0.5					0.2 ± 0.5		
Trichoptera: Total larvae	6.2 ± 4.5	3.2 ± 3.6	5.5 ± 5.0	5.2 ± 5.1	8.0 ± 7.6	16.8 ± 13.8	6.2 ± 4.9	15.8 ± 7.1	14.5 ± 22.3
Glossosomatidae	2.0 ± 2.2		0.8 ± 1.0	0.8 ± 1.5	1.5 ± 1.2	3.8 ± 5.7	0.2 ± 0.5	4.0 ± 2.9	2.0 ± 3.4
Hydropsychidae	2.8 ± 2.8	2.5 ± 3.3	3.8 ± 3.3	2.5 ± 2.5	4.8 ± 7.1	3.8 ± 4.8	1.0 ± 1.2	8.0 ± 4.7	11.5 ± 18.4
Hydroptilidae					1.2 ± 2.5	4.8 ± 7.0			
Lepidostomatidae	0.2 ± 0.5			0.5 ± 0.6	7.5 ± 1.5	1.0 ± 1.4	0.8 ± 1.5		0.2 ± 0.5
Leptoceridae		0.2 ± 0.5							
Limnephilidae									0.2 ± 0.5
Odontoceridae	0.5 ± 1.0	0.2 ± 0.5	0.5 ± 1.0		1.8 ± 2.9	0.2 ± 0.5		0.8 ± 1.0	
Philopotomidae			0.2 ± 0.5	0.2 ± 0.5		1.2 ± 2.5			
Polycentropodidae	0.2 ± 0.5		0.2 ± 0.5		0.8 ± 1.0	1.8 ± 3.5	3.5 ± 4.4	1.2 ± 2.5	
Psychomyiidae				0.8 ± 1.5					
Rhyacophilidae	0.2 ± 0.5	0.2 ± 0.5		0.5 ± 1.0		0.2 ± 0.5		1.8 ± 1.7	
Sericostomatidae									0.5 ± 1.0
unidentified	0.2 ± 0.5				0.2 ± 0.5	0.5 ± 1.0	0.8 ± 1.5		
pupae	0.8 ± 1.0	0.5 ± 0.6	0.5 ± 0.6	1.5 ± 1.7	1.5 ± 1.7	0.2 ± 0.5	3.5 ± 3.1	1.5 ± 1.3	
Coleoptera									
Elmidae larvae	3.8 ± 5.2	5.2 ± 1.3	1.0 ± 1.2	1.5 ± 0.6	1.5 ± 1.7	3.8 ± 3.0	6.0 ± 6.2	3.8 ± 2.1	12.2 ± 13.2
adults	3.2 ± 4.7	2.8 ± 2.2	0.2 ± 0.5	1.0 ± 1.2	2.2 ± 2.6	2.0 ± 2.7	0.5 ± 1.0	1.5 ± 1.0	4.8 ± 6.9
Psephenidae larvae	1.2 ± 1.0	0.8 ± 1.0			1.8 ± 2.4	0.5 ± 0.6	1.2 ± 2.5	3.2 ± 2.1	0.8 ± 0.5
Diptera									
Athericidae larvae						0.5 ± 1.0		0.5 ± 0.6	
Blephariceridae larvae			0.2 ± 0.5						
pupae						0.2 ± 0.5			
Chironomidae larvae	3.0 ± 2.7	8.2 ± 6.1	5.2 ± 1.7	4.5 ± 3.1	8.0 ± 4.1	40.0 ± 42.5	10.2 ± 8.1	50.5 ± 45.4	40.5 ± 57.7
pupae		0.2 ± 0.5	0.2 ± 0.5		0.8 ± 1.0	3.0 ± 1.8		0.8 ± 1.5	0.2 ± 0.5
Empididae larvae					0.2 ± 0.5	0.5 ± 1.0		0.5 ± 0.6	0.2 ± 0.5
pupae			0.2 ± 0.5		0.2 ± 0.5	0.2 ± 0.5	0.5 ± 1.0		

Continued

Table A-15 (concluded)
 Bottom fauna populations*
 untreated Manie Upstream station**
 Kamouraska County, Quebec
 22 May to 24 September 1980

Date	22 May	26 May	31 May	3 June	9 June	18 June	9 July	22 August	24 September
Diptera									
Heleidae larvae		2.8 ± 3.0		0.2 ± 0.5		0.5 ± 1.0	0.2 ± 0.5		3.0 ± 6.7
pupae				0.2 ± 0.5	0.2 ± 0.5				0.2 ± 0.5
Simuliidae larvae			0.5 ± 0.6		0.2 ± 0.5				
pupae						1.5 ± 1.9			
Tipulidae larvae	0.5 ± 0.6	1.5 ± 1.3	1.8 ± 1.0	1.2 ± 1.5	2.5 ± 1.3	4.8 ± 5.2	1.2 ± 1.5	0.8 ± 1.0	3.2 ± 2.5
pupae						0.2 ± 0.5			
Psychodidae larvae		0.2 ± 0.5							
Rotifera							0.2 ± 0.5		
Oligochaeta	3.8 ± 5.0	8.0 ± 4.8	4.8 ± 4.8	1.5 ± 1.3	2.0 ± 0.8	5.5 ± 4.6	12.8 ± 7.8	3.8 ± 5.5	6.5 ± 7.0
Gastropoda			0.2 ± 0.5				0.2 ± 0.5		
Pelecypoda									0.2 ± 0.5
Arachnida: Hydracarina							0.2 ± 0.5		
Totals	56.5 ± 46.0	61.0 ± 16.8	45.0 ± 35.0	33.5 ± 14.2	49.8 ± 28.3	112.0 ± 97.5	63.0 ± 38.8	90.0 ± 55.7	118.2 ± 126.9

*mean numbers and standard deviations of organisms collected in four 0.093 m² Surber samples.

** untreated control station located approximately 1.5 km upstream from block 304 and 3 km upstream from block 303.

Table A-16
 Aquatic invertebrates* collected from rocks
 taken from the untreated Manie Upstream station**
 Kamouraska County, Quebec
 22 May to 24 September 1980

Date	22 May	26 May	31 May	3 June	9 June	18 June	9 July	22 August	24 September
Ephemeroptera: Total nymphs	19.0 ± 15.5	30.5 ± 12.4	26.0 ± 20.7	13.5 ± 4.4	13.8 ± 13.3	27.5 ± 5.5	9.5 ± 6.6	55.5 ± 38.8	10.0 ± 7.0
Baetidae	6.2 ± 9.0	9.0 ± 5.0	5.3 ± 8.4	4.8 ± 3.3	5.2 ± 6.6	19.0 ± 2.9	5.2 ± 5.4	26.3 ± 21.0	
EphemereHidae	2.2 ± 2.1	3.0 ± 2.2	2.2 ± 1.3	3.2 ± 0.5	2.8 ± 3.8	0.5 ± 0.6	0.8 ± 1.0	0.5 ± 0.6	3.0 ± 2.2
HeptagenHidae	10.2 ± 12.5	17.5 ± 8.1	15.5 ± 13.3	5.5 ± 1.7	5.8 ± 7.2	7.8 ± 5.2	3.5 ± 1.7	11.8 ± 6.2	5.5 ± 5.9
Leptophlebiidae	0.2 ± 0.5	1.0 ± 2.0	0.5 ± 0.6			0.2 ± 0.5		1.0 ± 1.4	1.5 ± 1.3
Plecoptera	1.0 ± 1.1	1.2 ± 0.5	1.0 ± 0.8	0.2 ± 0.5	0.8 ± 1.5	1.0 ± 0.0		1.5 ± 1.3	2.5 ± 1.7
Trichoptera: Total larvae	6.0 ± 3.6	5.2 ± 1.7	10.0 ± 8.5	5.0 ± 1.4	4.8 ± 2.1	5.0 ± 2.0	2.0 ± 1.8	11.2 ± 4.2	9.8 ± 3.1
Brachycentridae			0.2 ± 0.5						
Glossosomatidae	0.2 ± 0.5	1.5 ± 1.7		1.0 ± 1.1	0.2 ± 0.5	1.5 ± 1.7	0.2 ± 0.5	1.5 ± 1.3	1.2 ± 1.5
Hydropsychidae	2.4 ± 3.4	2.0 ± 0.8	7.8 ± 7.2	2.2 ± 1.5	1.5 ± 1.9	2.0 ± 2.7	0.2 ± 0.5	7.8 ± 3.8	6.5 ± 3.7
Hydroptilidae	0.2 ± 0.5				0.8 ± 1.0	0.2 ± 0.5			
Limnephilidae		0.2 ± 0.5		0.2 ± 0.5		0.8 ± 1.0			
Philopotamidae	0.5 ± 0.6	0.2 ± 0.5	0.8 ± 1.5	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5	0.8 ± 1.5	2.0 ± 1.8	1.2 ± 1.9
Polycentropodidae	0.2 ± 0.5	0.2 ± 0.5	0.5 ± 0.6		0.5 ± 0.6				0.2 ± 0.5
Psychomyiidae	0.2 ± 0.5								
Rhyacophilidae					0.2 ± 0.5				0.5 ± 0.6
pupae		1.0 ± 1.4	0.8 ± 1.5	1.2 ± 1.0	1.2 ± 1.5	1.0 ± 1.1	0.2 ± 0.5	1.0 ± 1.1	0.2 ± 0.5
Coleoptera									
Elmidae larvae	0.8 ± 1.5	1.0 ± 1.1	0.2 ± 0.5		0.2 ± 0.5		0.2 ± 0.5	0.2 ± 0.5	
Psephenidae larvae		0.2 ± 0.5							
Diptera									
Tipulidae larvae	0.8 ± 1.5	0.8 ± 1.0	0.2 ± 0.5	0.2 ± 0.5		0.8 ± 1.0			3.2 ± 2.2
Simuliidae larvae	3.8 ± 5.7	3.8 ± 2.9	1.2 ± 1.9		1.2 ± 2.5	0.2 ± 0.5		0.8 ± 1.0	
Chironomidae larvae	3.2 ± 1.3	5.0 ± 3.2	3.8 ± 3.8	5.8 ± 0.5	31.8 ± 45.7	33.8 ± 10.2	9.0 ± 11.2	78.8 ± 34.1	33.5 ± 29.3
pupae			0.2 ± 0.5			0.2 ± 0.5		0.2 ± 0.5	0.5 ± 1.0
Athericidae larvae	0.5 ± 0.6					0.2 ± 0.5		0.5 ± 0.6	
Empididae larvae	0.5 ± 0.6			0.2 ± 0.5	0.2 ± 0.5				
Gastropoda								0.5 ± 1.0	
Hydracarina	0.8 ± 1.5	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5		0.8 ± 0.5			
Totals	36.2 ± 25.0	48.0 ± 18.1	44.2 ± 21.7	25.5 ± 4.4	52.8 ± 55.6	69.5 ± 7.7	21.0 ± 16.7	152.8 ± 26.1	59.8 ± 36.6

*mean numbers and standard deviations of organisms collected from four rocks approximately 15 cm in diameter.

** untreated control station located approximately 1.5 km upstream from block 304 and 3 km upstream from block 303.

Table A-17
 Bottom fauna populations*
 Riviere St. Denis**
 Kamouraska County, Quebec
 20 May to 24 September 1980

Date	20 May	25 May	30 May	2 June	11 June	20 June	9 July	20 August	24 September
Days before or after permethrin application to block 301	-18	-13	-8	-5	-4	+14	+32	+74	+109
Ephemeroptera: Total nymphs	11.0 ± 7.3	18.0 ± 7.3	12.2 ± 7.3	25.2 ± 10.4	5.0 ± 0.8	5.0 ± 4.1	3.0 ± 2.3	7.8 ± 6.2	19.5 ± 7.0
Baetidae	0.2 ± 0.5	1.5 ± 1.3	0.5 ± 1.0	1.2 ± 1.0				1.2 ± 1.3	0.2 ± 0.5
EphemereIIDae	3.2 ± 2.4	7.5 ± 5.4	5.5 ± 6.0	5.2 ± 3.3	2.8 ± 1.7	1.2 ± 1.9	1.2 ± 2.5	5.8 ± 5.4	4.8 ± 2.2
HeptagenIIDae	5.8 ± 5.7	6.2 ± 8.1	2.0 ± 2.4	10.0 ± 8.5	1.8 ± 0.5	1.8 ± 2.4	0.2 ± 0.5	0.8 ± 0.5	5.0 ± 1.8
LeptophlebiIIDae	1.8 ± 1.7	2.8 ± 3.6	4.2 ± 3.6	8.8 ± 5.4	0.5 ± 1.0	2.0 ± 0.8	1.5 ± 2.4		9.5 ± 8.1
Odonata									
AeshnIIDae	0.5 ± 1.0	0.5 ± 1.0	0.5 ± 0.6					0.8 ± 1.5	0.2 ± 0.5
GomphIIDae									0.8 ± 1.0
Plecoptera	1.2 ± 1.5	1.2 ± 0.5		2.0 ± 2.2	3.0 ± 1.4	1.0 ± 1.2	0.8 ± 1.0	2.8 ± 4.3	6.0 ± 4.5
Megaloptera									
CorydalIIDae	0.2 ± 0.5	0.5 ± 1.0	0.5 ± 0.6	0.2 ± 0.5	0.8 ± 1.0		0.8 ± 1.0	1.0 ± 0.8	2.2 ± 1.0
Trichoptera: Total larvae	5.0 ± 6.4	6.2 ± 5.7	2.8 ± 2.2	2.0 ± 1.8	2.0 ± 0.8	0.2 ± 0.5	1.0 ± 1.2	19.0 ± 14.9	15.8 ± 19.6
GlossosomatIIDae	4.2 ± 5.7	5.8 ± 5.9	1.8 ± 2.4	1.8 ± 1.5	1.5 ± 0.6			4.5 ± 4.6	3.0 ± 3.8
HydropsychIIDae	0.8 ± 1.0	0.5 ± 0.6	0.2 ± 0.5	0.2 ± 0.5				12.5 ± 7.8	9.2 ± 15.8
HydroptilIIDae							0.2 ± 0.5		0.2 ± 0.5
LeptocerIIDae						0.2 ± 0.5			0.8 ± 1.5
LimnephilIIDae			0.2 ± 0.5						0.2 ± 0.5
OdontocerIIDae								2.0 ± 3.4	0.2 ± 0.5
PolycentropodIIDae					0.2 ± 0.5				0.2 ± 0.5
PhiloopotamIIDae			0.2 ± 0.5						0.2 ± 0.5
PhryganeIIDae							0.2 ± 0.5		0.8 ± 1.5
LepidostomatIIDae									
PsychomyIIDae			0.2 ± 0.5				0.2 ± 0.5		
RhyacophiliIIDae					0.2 ± 0.5				0.2 ± 0.5
pupae	1.8 ± 1.7	0.8 ± 1.5		1.5 ± 2.4	0.8 ± 0.5		0.2 ± 0.5		0.8 ± 1.5
Coleoptera									
HalipIIDae larvae	0.2 ± 0.5								
ElmIIDae adults	0.2 ± 0.5	1.2 ± 1.0	0.8 ± 1.0	0.5 ± 0.6	0.2 ± 0.5	0.5 ± 0.6		1.0 ± 1.4	0.2 ± 0.5
larvae	0.8 ± 0.5	0.8 ± 1.0		0.2 ± 0.5	1.2 ± 1.5	1.0 ± 0.0	2.2 ± 1.7	3.0 ± 2.2	3.8 ± 1.7
PsephenIIDae larvae				0.2 ± 0.5				0.5 ± 1.0	
Diptera									
TipulIIDae larvae		0.2 ± 0.5	0.5 ± 1.0		0.2 ± 0.5		0.2 ± 0.5	0.5 ± 0.6	1.0 ± 1.2
SimuliIIDae larvae	0.2 ± 0.5		1.8 ± 2.9	4.5 ± 8.4	0.5 ± 0.6		0.5 ± 0.6		
pupae				0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5			
ChironomIIDae larvae		0.8 ± 1.0	1.2 ± 1.0	0.8 ± 1.5	1.0 ± 1.4	3.2 ± 3.6	4.7 ± 4.7	25.0 ± 23.9	24.8 ± 20.9
pupae						0.2 ± 0.5	0.2 ± 0.5		
HeleIIDae larvae						0.2 ± 0.6		0.5 ± 1.0	0.2 ± 0.5
AthericIIDae larvae		0.2 ± 0.5	0.5 ± 1.0	0.2 ± 0.5	0.5 ± 0.6	0.2 ± 0.5		0.2 ± 0.5	0.8 ± 0.5
EmpidIIDae larvae								0.8 ± 0.5	0.5 ± 0.6
pupae	0.2 ± 0.5					0.2 ± 0.5			0.2 ± 0.5

Continued

Table A-17 (concluded)
 Bottom fauna populations
 Riviere St. Denis**
 Kamouraska County, Quebec
 20 May to 24 September 1980

Date	20 May	25 May	30 May	2 June	11 June	20 June	9 July	20 August	24 September
Days before or after permethrin application to block 301	-18	-13	-8	-5	-4	+14	+32	+74	+109
Oligochaeta	4.8 ± 9.5	11.0 ± 7.7	5.2 ± 5.0	3.2 ± 2.2	7.0 ± 10.7	3.2 ± 5.8	19.8 ± 34.9	22.8 ± 9.1	82.0 ± 103.8
Gastropoda								0.5 ± 0.6	0.2 ± 0.5
Pelecypoda			0.2 ± 0.5			1.5 ± 3.0	1.5 ± 1.9	0.2 ± 0.5	2.8 ± 1.7
Crustacea: Decapoda	0.2 ± 0.5	0.5 ± 1.0			0.2 ± 0.5				
Totals	26.5 ± 17.2	42.0 ± 18.5	26.2 ± 7.3	41.0 ± 15.9	22.8 ± 14.4	17.2 ± 12.4	33.2 ± 34.8	86.2 ± 43.7	161.0 ± 101.8

*mean numbers and standard deviations of organisms collected in four 0.093 m² Surber samples
 **located in block 301 treated with 17.5 g AI/ha permethrin at 0700 to 0720 hrs. on 7 June 1980.

Table A-18
 Aquatic invertebrates* collected from rocks
 taken from Riviere St. Denis**
 Kamouraska County, Quebec
 20 May to 24 September, 1980.

Date	20 May	25 May	30 May	2 June	11 June	21 June	9 July:	20 August	24 September
Days before or after permethrin application to block 301	-18	-13	-8	-5	+4	+14	+32	+74	+109
Ephemeroptera: Total number	13.5 ± 5.0	10.2 ± 7.1	13.2 ± 6.1	11.0 ± 7.4	0.5 ± 1.0		0.5 ± 1.0	3.2 ± 2.2	10.5 ± 4.7
Baetidae	1.2 ± 1.5	3.0 ± 4.2	6.5 ± 4.6	6.8 ± 6.7				0.5 ± 1.0	0.2 ± 0.5
Ephemerellidae	0.8 ± 0.5	0.5 ± 1.0	1.0 ± 0.8					0.2 ± 0.5	2.5 ± 1.0
Reptageniidae	11.5 ± 6.0	6.8 ± 6.4	5.2 ± 2.6	3.0 ± 2.2	0.5 ± 1.0		0.5 ± 1.0	2.2 ± 1.7	6.0 ± 2.0
Leptophlebiidae			0.5 ± 1.0					0.2 ± 0.5	1.8 ± 2.9
Plecoptera	0.2 ± 0.5	0.2 ± 0.5	0.5 ± 0.6	0.5 ± 1.0	0.2 ± 0.5	0.5 ± 0.6		0.8 ± 0.5	3.8 ± 3.0
Megaloptera									
Corydalidae					0.2 ± 0.5				
Trichoptera: Total larvae	8.5 ± 6.1	5.0 ± 2.4	5.5 ± 2.4	3.5 ± 4.5			0.2 ± 0.5	2.0 ± 1.4	6.5 ± 3.3
Glossosomatidae	7.2 ± 4.9	3.5 ± 2.4	3.5 ± 2.1	1.2 ± 1.5				0.2 ± 0.5	3.5 ± 2.4
Hydropsychidae	1.0 ± 1.4	1.0 ± 1.2	1.2 ± 1.3	0.2 ± 0.5				1.5 ± 1.0	1.5 ± 1.3
Hydroptilidae		0.2 ± 0.5	0.2 ± 0.5	1.5 ± 3.0					
Leptoceridae		0.2 ± 0.5							
Limnephilidae	0.2 ± 0.5								
Phliopotamidae								0.2 ± 0.5	
Polycentropodidae			0.2 ± 0.5				0.2 ± 0.5		
Psychomyiidae			0.2 ± 0.5						0.2 ± 0.5
Rhyacophilidae				0.5 ± 1.0					1.2 ± 1.9
pupae	2.2 ± 1.3	3.5 ± 3.7	3.0 ± 2.7	1.0 ± 0.8	2.2 ± 2.1	0.5 ± 1.0		0.2 ± 0.5	1.5 ± 1.0
Coleoptera									
Elmidae larvae	0.2 ± 0.5			0.2 ± 0.5					0.5 ± 0.6
Diptera									
Tipulidae larvae	0.5 ± 0.6	0.2 ± 0.5	0.2 ± 0.5	0.8 ± 1.5			0.2 ± 0.5		3.5 ± 5.7
Simuliidae larvae	3.5 ± 4.4	14.8 ± 24.9	0.8 ± 1.5	36.8 ± 69.6	1.2 ± 1.5		4.0 ± 7.3	1.8 ± 3.5	0.8 ± 1.5
Chironomidae larvae	3.8 ± 1.7	7.0 ± 5.3	5.2 ± 3.9	9.8 ± 5.1	1.5 ± 1.3	1.0 ± 0.8	17.8 ± 9.7	46.5 ± 21.1	18.0 ± 9.5
pupae								0.2 ± 0.5	0.8 ± 0.5
Empididae larvae									0.2 ± 0.5
pupae					0.2 ± 0.5				
Nematoda		0.5 ± 0.6							
Gastropoda		0.5 ± 1.0							
Pelecypoda					0.2 ± 0.5		0.2 ± 0.5		
Arachnida: Hydracarina			2.8 ± 2.2	0.2 ± 0.5	0.2 ± 0.5	4.2 ± 5.7		0.5 ± 1.0	
Totals	32.5 ± 13.3	42.0 ± 35.0	31.2 ± 8.1	62.2 ± 74.6	7.0 ± 6.1	6.2 ± 5.3	23.0 ± 17.2	60.5 ± 23.2	45.8 ± 16.3

*mean numbers and standard deviations of organisms collected from four rocks approximately 15 cm in diameter.

**located in block 301 treated with 17.5 g Al/ha permethrin at 0700 to 0720 hrs. on 7 June 1980.

Table A-19
 Bottom fauna populations*
 St. Denis Downstream**
 Kamouraska County, Quebec
 22 May to 24 September 1980

Date	22 May	25 May	27 May	2 June	11 June	21 June	9 July	20 August	24 September
Days before or after permethrin application to block 301	-16	-13	-11	-5	+4	+14	+32	+74	+109
Ephemeroptera: Total nymphs	26.5 ± 15.5	39.5 ± 17.8	65.2 ± 30.9	31.0 ± 12.2	30.8 ± 11.4	36.0 ± 10.4	30.2 ± 15.1	3.5 ± 2.6	16.8 ± 13.4
Baetidae	3.8 ± 1.7	7.0 ± 3.6	14.0 ± 13.3	0.5 ± 0.6	0.8 ± 0.5	3.8 ± 4.2	3.2 ± 2.5	1.0 ± 1.4	0.8 ± 0.5
Ephemerellidae	5.8 ± 6.3	7.0 ± 4.8	11.5 ± 2.4	7.5 ± 5.4	11.5 ± 7.3	6.5 ± 4.8	4.8 ± 2.9	0.5 ± 0.6	3.2 ± 2.9
Heptageniidae	10.0 ± 5.9	20.0 ± 13.0	30.5 ± 19.2	16.2 ± 8.7	5.2 ± 2.1	10.0 ± 3.4	15.2 ± 11.2	2.2 ± 2.2	8.5 ± 8.2
Leptophlebiidae	6.0 ± 3.6	5.5 ± 2.9	9.2 ± 5.3	6.8 ± 2.6	13.2 ± 8.7	15.75 ± 4.27	7.0 ± 1.8		4.2 ± 5.0
Odonata									
Aeshnidae								0.2 ± 0.5	
Gomphidae	1.0 ± 2.0		0.2 ± 0.5		0.5 ± 1.0		0.5 ± 1.0	0.5 ± 0.6	0.8 ± 1.0
Plecoptera	3.2 ± 1.5	3.7 ± 2.2	2.8 ± 2.2	4.0 ± 2.6	3.2 ± 2.1	4.8 ± 3.0	5.0 ± 1.6	4.5 ± 1.7	8.8 ± 4.6
Megaloptera									
Corydalidae		0.2 ± 0.5	0.5 ± 1.0		0.8 ± 1.0		1.5 ± 2.4	0.8 ± 1.0	2.2 ± 1.0
Trichoptera: Total larvae	4.0 ± 1.8	5.0 ± 2.8	4.8 ± 1.3	5.0 ± 5.3	13.2 ± 12.8	4.5 ± 3.1	8.0 ± 5.0	3.5 ± 2.9	
Glossosomatidae	0.8 ± 1.0	1.0 ± 1.4	1.5 ± 1.3	0.8 ± 0.5	6.0 ± 8.0	1.2 ± 1.9	1.8 ± 0.5	1.5 ± 1.0	2.0 ± 2.4
Hydropsychidae	2.0 ± 0.8	2.5 ± 2.4	2.0 ± 2.2	3.8 ± 3.3	5.2 ± 3.4	2.2 ± 1.0	3.0 ± 2.9	1.0 ± 0.8	7.2 ± 8.5
Hydroptilidae							0.2 ± 0.5		
Leptoceridae		0.2 ± 0.5				0.2 ± 0.5			
Limnephilidae		0.2 ± 0.5	0.5 ± 1.0						
Lepidostomatidae		0.5 ± 1.0							0.2 ± 0.5
Odontoceridae	0.5 ± 1.0	0.2 ± 0.5	0.2 ± 0.5		0.8 ± 1.5			1.0 ± 2.0	
Phlebotamidae									0.2 ± 0.5
Polycentropodidae									1.2 ± 1.5
Psychomyiidae			0.2 ± 0.5	0.5 ± 1.0	0.8 ± 1.5	1.5 ± 1.3	3.0 ± 2.6		
Rhyacophilidae	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5		0.2 ± 0.5				1.2 ± 1.2
Sericostomatidae									0.2 ± 0.5
Unidentified pupae	0.5 ± 1.0	0.2 ± 0.5	1.5 ± 2.4	0.2 ± 0.5		1.0 ± 0.8	1.2 ± 1.0	0.5 ± 1.0	1.5 ± 3.0
Coleoptera									
Elmidae adults	0.5 ± 1.0	0.8 ± 1.0	1.0 ± 0.8		2.0 ± 1.6	3.2 ± 1.5	1.5 ± 0.6	1.5 ± 1.9	0.8 ± 0.5
larvae	0.2 ± 0.5	0.5 ± 1.0	0.5 ± 0.6	0.2 ± 0.5	1.0 ± 0.8	1.2 ± 1.0	0.2 ± 0.5	1.2 ± 1.0	4.8 ± 2.5
Psephenidae larvae		0.5 ± 1.0	1.2 ± 1.9	0.2 ± 0.5	0.2 ± 0.5	1.0 ± 0.8	1.5 ± 1.7	4.0 ± 4.2	0.5 ± 1.0
Diptera									
Tipulidae larvae	1.5 ± 2.4	1.5 ± 1.9	2.0 ± 2.4	0.5 ± 0.6	1.2 ± 0.5	0.5 ± 0.6		1.8 ± 1.5	3.2 ± 2.1
Stenonematidae larvae	1.8 ± 2.4		0.8 ± 1.5	0.8 ± 1.5	0.2 ± 0.5			0.2 ± 0.5	
pupae					0.2 ± 0.5	0.5 ± 1.0			
Chironomidae larvae	1.8 ± 1.7	2.0 ± 1.4	0.2 ± 0.5	2.0 ± 0.8	18.8 ± 10.7	8.5 ± 3.7	21.0 ± 5.9	30.5 ± 42.7	35.5 ± 33.4
pupae	0.5 ± 1.0	0.2 ± 0.5	0.2 ± 0.5			0.2 ± 0.5	1.8 ± 1.7	1.0 ± 1.4	
Holelidae larvae									2.0 ± 1.6
Athericidae larvae						0.2 ± 0.5		0.2 ± 0.5	
Blephariceridae larvae	0.5 ± 0.6	0.2 ± 0.5		0.2 ± 0.5				0.2 ± 0.5	
pupae						0.2 ± 0.5		0.2 ± 0.5	

Continued

Table A-19 (concluded)
 Bottom fauna populations*
 St. Denis Downstream**
 Kamouraska County, Quebec
 22 May to 24 September 1980

(Concluded)

Date	22 May	25 May	27 May	2 June	11 June	21 June	9 July	20 August	24 September
Days before or after permethrin application to block 301	-16	-13	-11	-5	14	114	132	174	1109
Diptera								0.5 ± 0.6	0.5 ± 1.0
Empididae larvae		0.5 ± 1.0	2.0 ± 1.4	1.2 ± 1.5	1.0 ± 1.4	0.2 ± 0.5	0.5 ± 1.0		
pupae						0.8 ± 1.5	0.8 ± 1.0		0.5 ± 0.6
Oligochaeta	0.2 ± 0.5								0.2 ± 0.5
Gastropoda									0.2 ± 0.5
Pelecypoda						0.2 ± 0.5			0.2 ± 0.5
Arachnida: Hydracarina						0.2 ± 0.5			0.2 ± 0.5
Crustacea: Decapoda									0.2 ± 0.5
Turbellaria									
Totals	40.8 ± 26.2	55.2 ± 17.4	82.8 ± 33.3	44.5 ± 20.1	73.5 ± 36.7	63.5 ± 13.5	74.7 ± 24.9	55.0 ± 54.4	91.2 ± 58.4

*mean numbers and standard deviations of organisms collected in four 0.093 m² Surber samples.

**located approximately 7 km downstream from a block (301) treated with 17.5 g AI/ha permethrin at 0700 to 0720 hrs. on 7 June 1980.

Table A-20
 Aquatic invertebrates* collected from rocks
 taken from St. Denis Downstream**
 Kamouraska County, Quebec
 22 May to 24 September 1980

Date	22 May	25 May	27 May	2 June	11 June	21 June	9 July	20 August	24 September
Days before or after permethrin application to block 301	-16	-13	-11	-5	+4	+14	+32	+74	+109
Ephemeroptera: Total nymphs	33.0 ± 9.4	30.2 ± 21.4	30.2 ± 6.6	31.2 ± 8.1	33.0 ± 24.6	38.2 ± 9.2	25.5 ± 11.1	20.5 ± 10.8	14.7 ± 23.7
Baetidae	7.5 ± 4.2	8.8 ± 9.0	5.0 ± 3.3	13.2 ± 3.1	8.8 ± 7.5	20.0 ± 14.7	13.8 ± 8.8	8.5 ± 12.1	
EphemereIIDae	0.8 ± 1.0	2.5 ± 3.1	1.0 ± 1.2	2.2 ± 2.2	5.2 ± 6.7	1.2 ± 1.0	0.2 ± 0.5		0.3 ± 0.6
Heptageniidae	24.8 ± 9.3	18.2 ± 13.4	22.0 ± 7.1	15.2 ± 6.2	17.8 ± 13.1	17.0 ± 12.5	11.5 ± 9.9	12.0 ± 8.4	14.3 ± 24.0
Leptophlebiidae		0.8 ± 1.0	2.2 ± 4.5	0.5 ± 1.0	1.2 ± 1.5	0.5 ± 1.0			
Plecoptera nymphs		0.5 ± 0.6			0.2 ± 0.5	0.8 ± 1.0	0.2 ± 0.5		0.7 ± 0.6
Trichoptera: Total larvae	1.6 ± 0.9	5.8 ± 6.2	6.5 ± 4.8	6.8 ± 8.4	7.5 ± 11.7	3.2 ± 2.1	5.2 ± 5.5	5.2 ± 4.9	2.0 ± 2.6
Glossosomatidae		0.8 ± 1.0	1.8 ± 2.2	0.2 ± 0.5	0.2 ± 0.5		2.0 ± 3.4	2.5 ± 2.4	1.0 ± 1.0
Hydropsychidae	1.5 ± 0.6	4.2 ± 5.9	3.8 ± 2.8	3.5 ± 5.1	3.0 ± 4.7	2.0 ± 1.6		2.5 ± 2.4	1.0 ± 1.7
Leptoceridae		0.2 ± 0.5		0.5 ± 0.6	0.2 ± 0.5				
Limnephilidae		0.2 ± 0.5			0.5 ± 0.6				
Philopotamidae			1.0 ± 1.4	1.5 ± 3.0	2.8 ± 5.5	1.0 ± 0.8	0.5 ± 1.0		
Rhyacophilidae pupae	0.2 ± 0.5	0.5 ± 0.6		0.5 ± 0.6	0.8 ± 1.5	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5	0.3 ± 0.6
Goleoptera									
Haliplidae larvae			0.2 ± 0.5				0.5 ± 1.0		
Elmidae larvae			0.5 ± 1.0						
Psephenidae larvae					0.2 ± 0.5				
Diptera									
Tipulidae larvae				0.2 ± 0.5					0.3 ± 0.6
Simuliidae larvae	0.5 ± 1.0	11.0 ± 20.0	3.5 ± 1.9	12.8 ± 22.9	0.5 ± 1.0	2.8 ± 3.2		1.5 ± 3.0	
Chironomidae larvae	1.2 ± 0.5	4.5 ± 2.4	4.0 ± 5.4	3.0 ± 3.5	3.0 ± 4.8	111.8 ± 73.0	2.0 ± 3.4	5.8 ± 6.5	7.7 ± 4.5
pupae		0.2 ± 0.5		0.2 ± 0.5			0.2 ± 0.5		
Blephariceridae larvae	1.7 ± 1.7								
Oligochaeta							0.5 ± 0.6		
Centropoda	0.5 ± 1.0						0.5 ± 0.6	1.0 ± 2.0	
Hydracarina		0.2 ± 0.5		0.2 ± 0.5		0.5 ± 1.0	0.5 ± 0.6		
Total	39.0 ± 7.5	51.8 ± 49.3	45.0 ± 12.5	54.5 ± 41.8	44.5 ± 34.1	162.2 ± 74.2	33.2 ± 7.0	34.0 ± 12.8	25.7 ± 24.3

*mean numbers and standard deviations of organisms collected from four rocks approximately 15 cm in diameter.

**located approximately 7 km downstream from a block (301) treated with 17.5 g AI/ha permethrin at 0700 to 0720 hrs. on 7 June 1980.

Table A-21
 Bottom fauna populations*
 Riviere Manie 304**
 Kamouraska County, Quebec
 23 May to 24 September 1980

Date	23 May	26 May	31 May	3 June	10 June	20 June	9 July	22 August	24 September
Days before or after permethrin application to block 304	-14	-11	-6	-3	+4	+14	+33	+77	+110
Ephemeroptera: Total nymphs	23.8 ± 19.5	13.0 ± 6.5	11.5 ± 1.7	12.2 ± 6.2	15.2 ± 7.9	8.5 ± 4.8	9.5 ± 2.4	2.5 ± 2.4	11.0 ± 7.0
Baetidae	0.5 ± 0.6	0.8 ± 0.5	0.2 ± 0.5	1.0 ± 2.0	0.2 ± 0.5	0.2 ± 0.5	0.5 ± 0.6	0.2 ± 0.5	0.5 ± 0.6
Baetiscidae							0.5 ± 0.6	0.5 ± 1.0	0.2 ± 0.5
EphemereIIDae	17.2 ± 14.9	8.0 ± 3.7	6.8 ± 1.5	5.8 ± 3.0	11.8 ± 7.7	5.8 ± 2.2	5.5 ± 2.1	1.5 ± 1.7	4.8 ± 3.5
Ephemeridae					0.2 ± 0.5				
Heptageniidae	5.2 ± 5.7	3.2 ± 2.8	2.8 ± 1.5	4.5 ± 4.5	2.8 ± 1.9	1.5 ± 2.4	3.0 ± 2.9	0.2 ± 0.5	4.8 ± 4.5
Leptophlebiidae	0.8 ± 0.5	1.0 ± 0.8	1.8 ± 2.2	1.0 ± 1.4	0.2 ± 0.5	1.0 ± 1.2			0.8 ± 1.0
Odonata									0.5 ± 0.6
Aeshnidae									
Zygoptera	1.0 ± 2.0	0.5 ± 1.0	0.2 ± 0.5	0.2 ± 0.5		0.2 ± 0.5	1.5 ± 0.6		
Plecoptera	1.0 ± 2.0	1.0 ± 1.2	0.8 ± 1.0		0.5 ± 0.6	0.2 ± 0.5	1.2 ± 1.5	0.2 ± 0.5	
Hemiptera									
Gerridae					0.2 ± 0.5				
Megaloptera									
Corydalidae		0.2 ± 0.5			0.8 ± 1.5	0.2 ± 0.5		0.5 ± 0.6	1.2 ± 1.3
Stalidae		0.2 ± 0.5							
Trichoptera: Total larvae	5.5 ± 4.5	1.0 ± 0.8	1.5 ± 1.0	0.2 ± 0.5	0.2 ± 0.5	1.5 ± 1.3	1.0 ± 1.4	0.5 ± 1.0	3.2 ± 2.5
Glossosomatidae	1.0 ± 0.8	0.2 ± 0.5	0.8 ± 1.0		0.2 ± 0.5				0.2 ± 0.5
Hydropsychidae	3.0 ± 3.6	0.5 ± 0.6	0.5 ± 0.6	0.2 ± 0.5			0.2 ± 0.5	0.5 ± 1.0	2.8 ± 2.5
Hydroptilidae		0.2 ± 0.5							
Lepidostomatidae						0.5 ± 0.6	0.5 ± 1.0		
Leptoceridae	0.2 ± 0.5					0.8 ± 1.0			
Limnephilidae	0.5 ± 0.6								
Odontoceridae	0.5 ± 0.6								
Phlebotamidae						0.2 ± 0.5			
Polycentropodidae	0.2 ± 0.5						0.2 ± 0.5		0.2 ± 0.5
Rhyacophilidae									
unidentified pupae	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5		0.5 ± 0.6	0.8 ± 1.5		0.2 ± 0.5	
Coleoptera									
Elmidae adults	2.5 ± 1.7	1.0 ± 2.0	0.2 ± 0.5	1.0 ± 0.8	0.5 ± 0.6	0.5 ± 0.6	2.2 ± 4.5		
larvae	1.0 ± 1.4	0.2 ± 0.5	0.8 ± 1.0		0.2 ± 0.5	0.2 ± 0.5	1.2 ± 1.3	3.2 ± 0.5	3.0 ± 1.2
Paenidae larvae				0.2 ± 0.5	0.5 ± 0.6	0.2 ± 0.5			0.8 ± 1.0
Diptera									
Blephariceridae larvae	0.2 ± 0.5								
Chironomidae larvae	2.5 ± 3.8		1.5 ± 1.7	0.8 ± 1.0	1.2 ± 1.9	0.8 ± 1.0	2.2 ± 1.5	13.0 ± 8.8	6.5 ± 5.2
pupae					0.2 ± 0.5	0.2 ± 0.5			
Empididae pupae			0.2 ± 0.5		0.2 ± 0.5				
Heleidae larvae	0.2 ± 0.5		0.5 ± 1.0	0.2 ± 0.5	0.2 ± 0.5		0.2 ± 0.5		
pupae					0.5 ± 1.0				
Simuliidae larvae	0.2 ± 0.5		0.2 ± 0.5	0.2 ± 0.5					
pupae				0.5 ± 1.0					
Tipulidae larvae	0.5 ± 1.0	0.5 ± 0.6		0.8 ± 0.5	0.8 ± 1.0	1.2 ± 1.3	0.8 ± 0.5	0.2 ± 0.5	0.2 ± 0.5

Continued

Table A-21 (concluded)
 Bottom fauna populations*
 Riviere Manie 304**
 Kamouraska County, Quebec
 23 May to 24 September 1980

(Concluded)

Date	23 May	26 May	31 May	3 June	10 June	20 June	9 July	22 August	24 September
Days before or after permethrin application to block 304	-14	-11	-6	-3	+4	-14	+33	+77	+110
Oligochaeta	4.8 ± 7.6	0.8 ± 1.0	2.0 ± 1.2	0.5 ± 0.6	1.5 ± 3.0	1.2 ± 1.0	1.8 ± 2.1	3.0 ± 4.1	2.8 ± 1.5
Hirudinea							0.2 ± 0.5		
Gastropoda	0.5 ± 0.6						0.2 ± 0.5		
Pelecypoda							0.5 ± 1.0		
Sphaeriidae					0.8 ± 1.5				
Arachnida: Hydracarina	0.5 ± 1.0		0.5 ± 0.6						
Totals	44.5 ± 42.5	18.8 ± 8.1	20.0 ± 6.3	17.0 ± 10.0	24.2 ± 11.0	15.8 ± 8.8	22.8 ± 8.3	24.0 ± 13.0	32.2 ± 9.5

* mean numbers and standard deviations of organisms collected in four 0.093 m² Surber samples
 ** located in block 304 treated with 17.5 g AI/ha permethrin at 0647 to 0716 hrs on 6 June 1980.

Table A-22
 Aquatic invertebrates* collected from rocks
 taken from Riviere Manie 304**
 Kamouraska County, Quebec
 23 May to 24 September 1980

Date	23 May	26 May	31 May	3 June	10 June	20 June	9 July	22 August	24 September
Days before or after permethrin application to block 304	-14	-11	-6	-3	+4	+14	+33	+77	+110
Ephemeroptera: Total nymphs	26.7 ± 16.5	26.8 ± 18.6	14.2 ± 8.1	10.0 ± 5.5	13.0 ± 2.9	13.5 ± 11.1	4.5 ± 1.9	18.5 ± 10.3	17.8 ± 19.5
Baetidae	0.3 ± 0.6	4.0 ± 6.2	2.5 ± 3.3	1.0 ± 0.8	0.5 ± 1.0	0.2 ± 0.5	1.5 ± 1.7	2.2 ± 3.2	2.5 ± 3.3
Ephemerellidae	10.7 ± 7.8	6.2 ± 4.1	5.0 ± 4.2	5.0 ± 2.2	8.5 ± 4.4	1.8 ± 1.3	1.8 ± 0.5	6.5 ± 4.6	9.8 ± 9.4
Heptageniidae	15.7 ± 9.3	15.8 ± 10.4	6.5 ± 7.9	4.0 ± 3.8	1.8 ± 0.5	10.0 ± 11.8	1.2 ± 1.0	8.8 ± 5.7	5.0 ± 6.0
Leptophlebiidae		0.8 ± 1.0	0.2 ± 0.5		2.2 ± 2.2	1.5 ± 1.7		1.0 ± 0.0	0.5 ± 1.0
Plecoptera	0.3 ± 0.6	0.2 ± 0.5	1.0 ± 2.0	0.8 ± 1.0	1.0 ± 2.0	0.5 ± 0.6	0.5 ± 0.6	1.5 ± 0.6	8.5 ± 6.6
Odonata									0.2 ± 0.5
Aeshnidae									
Megaloptera								0.2 ± 0.5	
Corydalidae									
Trichoptera: Total larvae	2.3 ± 2.1	1.5 ± 1.3	1.0 ± 1.4	1.0 ± 0.8	1.2 ± 1.9	0.5 ± 0.6	0.2 ± 0.5	4.5 ± 1.3	2.2 ± 2.0
Brachycentridae		0.2 ± 0.5							
Glossosomatidae	0.3 ± 0.6	0.2 ± 0.5	0.2 ± 0.5		0.2 ± 0.5			0.5 ± 0.6	0.8 ± 1.5
Hydropsychidae	1.0 ± 1.7	0.5 ± 0.6	0.5 ± 1.0	0.8 ± 0.5		0.2 ± 0.5	0.2 ± 0.5	3.2 ± 1.0	1.0 ± 0.8
Hydroptilidae	0.3 ± 0.6		0.2 ± 0.5						
Limnephilidae	0.7 ± 1.2	0.2 ± 0.5			1.0 ± 2.0	0.2 ± 0.5		0.5 ± 0.6	
Polycentropodidae								0.2 ± 0.5	
Philopotamidae		0.2 ± 0.5							
Psychomyiidae				0.2 ± 0.5					
Rhyacophilidae pupae	1.0 ± 1.7	0.2 ± 0.5	0.1 ± 0.2	0.8 ± 0.5		0.5 ± 1.0	1.2 ± 1.9		0.5 ± 1.0
Coleoptera									
Elmidae larvae		0.2 ± 0.5	0.2 ± 0.5						0.2 ± 0.5
Diptera									
Tipulidae larvae			0.2 ± 0.5	0.2 ± 0.5				1.0 ± 1.2	1.8 ± 1.7
Simuliidae larvae		13.2 ± 23.2	38.0 ± 76.0	0.5 ± 1.0					0.5 ± 0.6
Chironomidae larvae	2.0 ± 12.8	7.8 ± 5.1	4.0 ± 4.1	4.5 ± 7.1	3.0 ± 2.2	60.3 ± 27.9	22.0 ± 13.4	41.8 ± 19.1	59.8 ± 33.2
Beteidae larvae									0.2 ± 0.5
Empididae larvae					0.2 ± 0.5				
Oligochaeta									0.2 ± 0.5
Gastropoda								0.2 ± 0.5	0.5 ± 0.6
Arachnida: Hydracarina	3.7 ± 3.2	0.2 ± 0.5		0.2 ± 0.5	1.8 ± 1.7	0.5 ± 1.0			
Totals	55.0 ± 12.5	51.5 ± 47.7	59.8 ± 88.8	18.0 ± 3.7	20.2 ± 7.3	75.8 ± 25.7	28.5 ± 13.8	50.2 ± 41.4	92.0 ± 56.4

* mean numbers and standard deviation of organisms collected from four rocks approximately 15 cm in diameter.

** located in block 304 treated with 17.5 g AI/ha permethrin at 0647 to 0716 hrs. on 6 June 1980.

Table A-23
 Bottom fauna populations*
 Riviere Manie 303**
 Kamouraska County, Quebec
 21 May to 24 September 1980

Date	21 May	24 May	28 May	1 June	9 June	18 June	9 July	22 August	24 September
Days before or after 1st (2nd) application to block 303	-16 (-25)	-13 (-22)	-9 (-18)	-5 (-14)	+3 (-7)	+12 (+3)	+33 (+24)	+78 (+69)	+110 (+101)
Ephemeroptera: Total nymphs	40.5 ± 14.4	35.0 ± 12.4	41.8 ± 20.0	17.0 ± 10.1	11.2 ± 4.8	1.2 ± 0.5	1.5 ± 1.7	9.8 ± 5.6	26.2 ± 12.2
Baetidae	1.8 ± 1.0	0.8 ± 0.5	1.2 ± 1.0	2.0 ± 3.4	1.0 ± 0.8			0.8 ± 1.5	0.8 ± 1.0
Baetiscidae									
Ephemerellidae	17.0 ± 8.1	11.2 ± 11.3	13.5 ± 7.4	1.0 ± 0.8	5.8 ± 3.1	0.2 ± 0.5		6.0 ± 4.7	10.8 ± 5.3
Heptageniidae	21.5 ± 7.1	20.5 ± 7.4	27.0 ± 12.6	13.5 ± 8.2	3.2 ± 1.5	0.2 ± 0.5		3.0 ± 1.2	5.5 ± 3.9
Leptophlebiidae	0.2 ± 0.5	2.5 ± 1.0		0.5 ± 1.0	1.2 ± 1.0	0.8 ± 1.0	1.5 ± 1.7		0.8 ± 0.5
Odonata									
Aeschnidae		0.2 ± 0.5	0.5 ± 0.6						
Cordulegastridae					0.2 ± 0.5				
Gomphidae		0.5 ± 0.6	0.8 ± 1.0	0.2 ± 0.5		0.2 ± 0.5		0.5 ± 0.6	
Plecoptera	1.0 ± 1.4	2.2 ± 2.6	2.5 ± 1.9	1.0 ± 1.4	2.5 ± 1.0	1.2 ± 1.5		0.8 ± 1.0	1.5 ± 1.9
Megaloptera									
Corydalidae	0.2 ± 0.5		0.5 ± 0.6	0.2 ± 0.5	1.2 ± 2.5	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5
Trichoptera: Total larvae	5.8 ± 2.2	8.5 ± 7.8	12.5 ± 5.4	3.0 ± 3.5	3.2 ± 3.6	1.0 ± 1.4	0.5 ± 1.0	4.5 ± 3.1	5.8 ± 4.2
Glossosomatidae	3.0 ± 2.4	2.8 ± 3.1	4.8 ± 3.5	1.2 ± 1.9	0.5 ± 1.0	0.2 ± 0.5		2.8 ± 3.6	0.2 ± 0.5
Hydropsychidae	2.8 ± 2.9	4.5 ± 5.3	5.0 ± 3.4	1.0 ± 1.2	2.2 ± 2.1	0.2 ± 0.5		1.5 ± 2.4	4.2 ± 3.3
Lepidostomatidae		0.8 ± 0.5					0.5 ± 1.0		
Leptoceridae		0.2 ± 0.5						0.2 ± 0.5	
Odontoceridae		0.2 ± 0.5	1.5 ± 1.3						0.5 ± 0.6
Polycentropodidae			1.0 ± 2.0	0.8 ± 1.0	0.2 ± 0.5				0.8 ± 0.5
Rhyacophiliidae pupae	0.2 ± 0.5	0.5 ± 1.0	0.2 ± 0.5	0.2 ± 0.5	1.0 ± 1.4	0.2 ± 0.5			
Coleoptera									
Elmidae adults	1.0 ± 0.8	0.5 ± 1.0	0.8 ± 1.5		0.5 ± 1.0	0.8 ± 1.0			0.5 ± 0.6
larvae	0.2 ± 0.5		0.2 ± 0.5		0.5 ± 0.6			0.5 ± 1.0	
Psephenidae larvae	1.2 ± 1.3		1.0 ± 0.8			0.2 ± 0.5		2.2 ± 2.2	0.8 ± 1.0
Diptera									
Athericidae larvae		0.2 ± 0.5	0.2 ± 0.5			0.8 ± 1.0		0.2 ± 0.5	
Blephariceridae larvae pupae	0.5 ± 1.0				3.5 ± 7.0	0.2 ± 0.5			
Chironomidae larvae pupae		1.8 ± 1.0	0.5 ± 1.0	1.2 ± 0.5	2.2 ± 3.3	1.5 ± 1.0	2.5 ± 3.0	3.5 ± 3.0	3.0 ± 3.2
Empididae larvae pupae				0.5 ± 0.6	0.5 ± 0.6	0.5 ± 0.6		0.5 ± 1.0	
Belidae larvae						0.2 ± 0.5	0.2 ± 0.5		
Simuliidae larvae pupae			0.2 ± 0.5				0.2 ± 0.5		0.8 ± 1.5
Tipulidae larvae pupae		0.5 ± 1.0	0.2 ± 0.5		0.2 ± 0.5				0.2 ± 0.5
					0.2 ± 0.5				0.5 ± 1.0

Continued

Table A-23 (concluded)
 Bottom fauna populations*
 Riviere Manie 303**
 Kamouraska County, Quebec
 21 May to 24 September 1980

Date	21 May	24 May	28 May	1 June	9 June	18 June	9 July	22 August	24 September
Days before or after 1st (2nd) application to block 303	-16 (-25)	-13 (22)	-9 (-18)	-5 (-14)	+3 (-7)	+12 (+3)	+33 (+24)	+78 (+69)	+110 (+101)
Gastropoda								0.2 ± 0.5	0.2 ± 0.5
Pelecypoda							0.2 ± 0.5		
Sphaeriidae									
Arachnida: Hydracarina		0.2 ± 0.5	0.2 ± 0.5						
Crustacea: Decapoda		0.2 ± 0.5		0.2 ± 0.5					
Totals	50.8 ± 10.2	50.5 ± 18.0	62.2 ± 24.0	23.8 ± 14.0	28.0 ± 10.7	8.0 ± 2.2	5.5 ± 4.6	23.8 ± 16.2	39.8 ± 17.9

* mean numbers and standard deviations of organisms collected in four 0.093 m² Surber samples.

** located in block 303 treated with 17.5 g AI/ha permethrin at 0455 to 0528 hrs. on 6 June 1980, and again at 1430 to 1500 hrs. on 15 June 1980.

Table A-24
 Aquatic invertebrates* collected from rocks
 taken from Riviere Manie 303**
 Kamouraska County, Quebec
 21 May to 24 September 1980

Date	21 May	24 May	28 May	1 June	9 June	18 June	9 July	23 August	24 September
Days before or after 1st (2nd) application to block 303	-16 (-25)	-13 (-22)	-9 (-18)	-5 (-14)	+3 (-7)	+12 (+3)	+33 (+24)	+78 (+69)	+110 (+101)
Ephemeroptera: Total nymphs	27.0 ± 12.2	41.8 ± 24.5	32.5 ± 20.5	42.0 ± 24.2	1.8 ± 1.3	0.5 ± 1.0		8.5 ± 7.7	18.0 ± 11.2
Baetidae	1.2 ± 1.9	1.0 ± 1.2	0.8 ± 1.5	3.2 ± 4.0		0.2 ± 0.5		4.5 ± 5.9	3.0 ± 6.0
EphemereIIDae	7.8 ± 6.7	24.0 ± 17.8	7.0 ± 4.1	3.2 ± 3.0	0.5 ± 0.6			1.5 ± 1.7	6.0 ± 9.4
HeptagenIIDae	17.5 ± 8.5	16.8 ± 8.4	22.8 ± 21.3	35.5 ± 19.2	1.2 ± 1.0			2.5 ± 1.9	7.8 ± 4.1
LeptophlebiIDae	0.5 ± 1.0		2.0 ± 1.8			0.2 ± 0.5			1.2 ± 1.9
Plecoptera	0.5 ± 0.6		0.5 ± 1.0		1.2 ± 1.9	0.5 ± 0.6		0.8 ± 1.0	1.5 ± 2.4
Trichoptera: Total larvae	3.2 ± 2.4	4.5 ± 2.6	5.2 ± 2.9	3.5 ± 1.7	0.8 ± 0.5			0.2 ± 0.5	6.5 ± 7.7
Brachycentridae									0.2 ± 0.5
GlossosomatIDae	1.0 ± 1.4	2.8 ± 1.9	1.8 ± 1.7	2.0 ± 1.4	0.5 ± 0.6				
HydropsychIDae	2.0 ± 1.6	1.8 ± 1.7	2.2 ± 1.9	1.2 ± 1.0	0.2 ± 0.5			0.2 ± 0.5	5.2 ± 6.7
HydroptilIDae									0.5 ± 1.0
LimnephilIDae	0.2 ± 0.5								0.2 ± 0.5
Phlebotamidae			1.2 ± 1.9	0.2 ± 0.5					
RhyacophilIDae									0.2 ± 0.5
pupae	0.5 ± 1.0					0.2 ± 0.5			
Coleoptera									
Elmidae adults		0.2 ± 0.5							
Larvae		0.2 ± 0.5					0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5
Psephenidae larvae	1.2 ± 2.5	0.8 ± 1.5	0.5 ± 0.6		0.2 ± 0.5		0.2 ± 0.5		0.2 ± 0.5
Diptera									
Tipulidae			0.2 ± 0.5						0.5 ± 1.0
Simuliidae larvae	1.8 ± 2.4		2.2 ± 4.5				0.2 ± 0.5		
pupae				0.2 ± 0.5					
Chironomidae larvae	4.5 ± 1.7	1.5 ± 1.3	3.0 ± 3.2	1.8 ± 1.0	0.8 ± 1.5	0.5 ± 0.6	30.8 ± 11.9	84.0 ± 41.6	5.8 ± 4.9
pupae	0.2 ± 0.5					0.2 ± 0.5		0.2 ± 0.5	
Athericidae larvae				0.2 ± 0.5					0.2 ± 0.5
Blephariceridae larvae			1.8 ± 2.1						
Empididae larvae			0.2 ± 0.5						0.2 ± 0.5
Oligochaeta					0.2 ± 0.5				
Gastropoda	0.5 ± 1.0	0.8 ± 1.5							
Arachnida: Hydracarina				0.2 ± 0.5	0.2 ± 0.5	0.5 ± 0.6	0.5 ± 1.0		
Totals	39.5 ± 15.2	49.8 ± 25.8	46.2 ± 23.3	48.0 ± 24.6	5.2 ± 4.0	2.5 ± 2.5	32.0 ± 12.1	94.0 ± 47.4	33.2 ± 12.0

*mean numbers and standard deviations of organisms collected from four rocks approximately 15 cm in diameter.

**located in block 303 treated with 17.5 g AI/ha permethrin at 0455 to 0528 hrs. on 6 June 1980, and again at 1430 to 1500 hrs. on 15 June 1980.

Table A-25
 Bottom fauna populations*
 Manie Downstream**
 Kamouraska County, Quebec
 20 May to 24 September 1980

Date	20 May	24 May	27 May	1 June	9 June	18 June	9 July	22 August	24 September
Days before or after 1st (2nd) application to block 303	-17 (-26)	-13 (-22)	-10 (-19)	-5 (-14)	+3 (-7)	+12 (+3)	+33 (+24)	+77 (+68)	+110 (+101)
Ephemeroptera: Total nymphs	41.8 ± 23.6	32.2 ± 22.7	44.0 ± 10.8	24.8 ± 15.9	4.5 ± 2.1	4.5 ± 3.4	10.2 ± 10.0	11.8 ± 8.5	20.0 ± 10.3
Baetidae	2.8 ± 2.2	4.5 ± 5.3	2.5 ± 1.7	0.8 ± 1.0	0.5 ± 1.0		1.8 ± 1.3	4.0 ± 2.7	1.5 ± 1.0
Baetiscidae	0.5 ± 1.0								
Ephemerellidae	3.5 ± 3.0	2.5 ± 3.1	4.2 ± 4.8	9.5 ± 7.6	0.5 ± 1.0	3.0 ± 2.4	0.8 ± 1.0	4.0 ± 2.9	5.2 ± 4.6
Ephemeridae							0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5
Heptageniidae	29.2 ± 23.3	24.5 ± 18.7	31.0 ± 5.0	9.5 ± 9.1	1.8 ± 1.3	1.8 ± 1.0	0.5 ± 1.0	3.5 ± 2.9	7.8 ± 2.8
Leptophlebiidae	5.8 ± 5.4	0.8 ± 1.0	6.2 ± 4.4	2.5 ± 2.5	1.8 ± 1.5	0.5 ± 1.0	7.0 ± 8.7	0.2 ± 0.5	5.7 ± 5.4
Odonata				0.2 ± 0.5					
Aeshnidae				0.5 ± 1.0	0.2 ± 0.5	0.2 ± 0.5			
Gomphidae			0.2 ± 0.5						
Plecoptera	2.8 ± 3.2	1.2 ± 0.5	2.5 ± 3.0	2.0 ± 3.4	2.2 ± 2.1	2.5 ± 1.7	2.0 ± 10.8	2.0 ± 0.8	6.2 ± 2.5
Megaloptera				0.2 ± 0.5	1.2 ± 1.9	0.5 ± 0.6	2.5 ± 0.6	0.2 ± 0.5	0.2 ± 0.5
Gorydidae	0.5 ± 0.58						0.5 ± 1.0		
Stalidae									
Trichoptera: Total larvae	2.2 ± 2.6	5.2 ± 6.6	13.0 ± 11.0	5.0 ± 4.2	5.2 ± 4.6	4.2 ± 3.4	2.0 ± 2.0	24.5 ± 29.7	17.2 ± 17.2
Glossosomatidae	0.5 ± 0.6	2.0 ± 3.4	3.2 ± 4.6	2.0 ± 1.4	0.2 ± 0.5			0.2 ± 0.5	0.2 ± 0.5
Hydropsychidae	1.2 ± 2.5	3.0 ± 2.8	9.0 ± 8.0	1.8 ± 2.1	4.5 ± 4.4	4.2 ± 3.4	0.8 ± 0.5	21.8 ± 28.4	10.5 ± 13.2
Lepidostomatidae					0.2 ± 0.5				
Limnephilidae								0.5 ± 1.0	0.2 ± 0.5
Odontoceridae	0.5 ± 1.0							1.2 ± 1.9	
PhiloPATOMIDAE									
Polycentropodidae		0.2 ± 0.5	0.5 ± 1.0	1.0 ± 1.4			0.2 ± 0.5	0.5 ± 1.0	0.2 ± 0.5
Rhyacophilidae			0.2 ± 0.5	0.2 ± 0.5				0.2 ± 0.5	
unidentified pupae			0.2 ± 0.5	0.8 ± 1.0	0.2 ± 0.5	0.8 ± 1.0	1.0 ± 2.0		
Coleoptera									
Elmidae adults	0.5 ± 0.6		0.5 ± 0.6		0.2 ± 0.5	0.2 ± 0.5		0.2 ± 0.5	
larvae	0.5 ± 0.6		0.2 ± 0.5				1.5 ± 1.9	0.2 ± 0.5	0.2 ± 0.5
Psephenidae larvae		1.5 ± 1.0	1.8 ± 1.0	0.2 ± 0.5	1.2 ± 1.3	1.8 ± 1.0	2.5 ± 2.6	7.5 ± 4.9	5.0 ± 6.9
Blephariceridae larvae			0.2 ± 0.5						
Diptera									
Tipulidae larvae				0.5 ± 0.6	0.5 ± 0.6		1.0 ± 1.4	0.5 ± 0.6	1.8 ± 2.2
Simuliidae larvae		0.2 ± 0.5		0.5 ± 0.6					
pupae	0.5 ± 0.6								
Chironomidae larvae	5.0 ± 5.0	1.5 ± 0.6	3.5 ± 3.9	4.5 ± 3.0	2.5 ± 2.1	6.0 ± 3.2	55.8 ± 45.4	20.5 ± 16.4	3.5 ± 3.5
pupae	0.5 ± 1.0		0.2 ± 0.5		0.2 ± 0.5	0.2 ± 0.5	2.8 ± 1.9	1.2 ± 1.5	
Heleidae larvae			0.2 ± 0.5	0.2 ± 0.5				0.8 ± 1.0	
Tabanidae larvae					0.2 ± 0.5				
Athericidae larvae				0.2 ± 0.5		0.5 ± 0.6		0.5 ± 0.6	0.5 ± 0.6
Empididae larvae					0.2 ± 0.5	0.2 ± 0.5	0.2 ± 0.5		
pupae								0.5 ± 0.6	

Continued

Table A-25 (concluded)
 Bottom fauna populations*
 Manie Downstream**
 Kamouraska County, Quebec
 20 May to 24 September 1980

(Concluded)

Date Days before or after 1st (2nd) application to block 303	20 May	24 May	27 May	1 June	9 June	18 June	9 July	22 August	24 September
	-17 (-26)	-13 (-22)	-10 (-19)	-5 (-14)	+3 (-7)	+12 (+3)	+33 (+24)	+77 (+68)	+110 (+101)
Oligochaeta							0.2 ± 0.5	0.5 ± 1.0	0.2 ± 0.5
Gastropoda			0.2 ± 0.5					0.8 ± 1.5	3.5 ± 6.4
Pelecypoda									
Sphaeriidae		0.2 ± 0.5	0.2 ± 0.5		0.5 ± 0.6	0.2 ± 0.5	0.2 ± 0.5		0.2 ± 0.5
Crustacea: Decapoda		0.5 ± 1.0				0.2 ± 0.5			0.2 ± 0.5
Arachnida: Hydracarina									0.2 ± 0.5
Totals	54.2 ± 32.2	42.8 ± 31.5	66.5 ± 26.5	39.0 ± 27.7	20.0 ± 7.3	22.2 ± 1.0	88.0 ± 65.6	72.2 ± 55.4	59.2 ± 45.6

* mean numbers and standard deviations of organisms collected in four 0.093 m² Surber samples.

** located approximately 3 km downstream from block 303 treated with 17.5 g AI/ha permethrin on 0455 to 0528 hrs. on 6 June 1980, and again at 1430 to 1500 hrs. on 15 June 1980.

Table A-26
 Aquatic invertebrates* collected from rocks
 taken from Manie Downstream**
 Kamouraska County, Quebec
 20 May to 24 September 1980.

Date	20 May	24 May	27 May	1 June	9 June	18 June	9 July	22 August	24 September
Days before or after 1st (2nd) application to block 303	-17 (-26)	-13 (-22)	-10 (-19)	-5 (-14)	+3 (-7)	+12 (+13)	+33 (+24)	+77 (+68)	+110 (+101)
Ephemeroptera: Total nymphs	35.2 ± 8.8	46.5 ± 13.2	25.5 ± 2.6	30.25 ± 14.1	3.2 ± 4.0	3.8 ± 2.5	2.0 ± 2.0	15.5 ± 17.2	9.5 ± 9.0
Baetidae	10.5 ± 8.6	13.8 ± 12.4	7.0 ± 4.7	5.0 ± 7.4		0.2 ± 0.5		9.8 ± 11.2	2.0 ± 1.8
Ephemerellidae	0.5 ± 0.6	2.0 ± 1.6	0.5 ± 1.0	2.2 ± 2.1	2.2 ± 3.3	2.2 ± 1.7	0.8 ± 0.5	1.2 ± 1.5	0.8 ± 1.0
Heptageniidae	24.2 ± 9.2	30.2 ± 4.5	18.0 ± 3.5	23.0 ± 6.1	0.8 ± 1.0	1.2 ± 1.3	1.2 ± 1.9	5.5 ± 4.0	6.8 ± 8.2
Leptophlebiidae		0.5 ± 1.0			0.2 ± 0.5			1.5 ± 1.9	9.8 ± 6.9
Plecoptera		0.8 ± 1.0		0.2 ± 0.5				0.5 ± 0.6	0.8 ± 0.5
Trichoptera: Total larvae	3.0 ± 2.2	4.0 ± 2.4	4.5 ± 0.6	6.0 ± 6.1	1.0 ± 2.4	1.2 ± 1.0	2.5 ± 1.7	18.5 ± 26.4	
Glossosomatidae	0.2 ± 0.5	1.2 ± 1.0	0.2 ± 0.5	1.8 ± 2.9		0.2 ± 0.5		0.2 ± 0.5	0.2 ± 0.5
Hydropsychidae	2.8 ± 2.5	2.0 ± 1.8	2.2 ± 1.0	5.2 ± 3.8	2.8 ± 2.4	0.8 ± 1.0	2.5 ± 1.7	18.0 ± 26.8	8.5 ± 6.4
Limnephilidae					0.2 ± 0.5				0.2 ± 0.5
Polycentropodidae									
Philopotamidae		0.2 ± 0.5	1.5 ± 2.4	0.2 ± 0.5					
Phryganeidae			0.5 ± 1.0	0.2 ± 0.5					
Rhyacophilidae pupae	0.2 ± 0.5					0.8 ± 0.5			
Coleoptera									
Elmidae larvae						0.2 ± 0.5			
Psephenidae larvae		0.5 ± 1.0		0.2 ± 0.5	0.2 ± 0.5	0.5 ± 1.0		1.2 ± 1.9	
Diptera									0.8 ± 1.0
Tipulidae larvae		0.2 ± 0.5							
Simuliidae larvae	2.5 ± 3.3	6.8 ± 12.2	100.8 ± 194.8	2.8 ± 5.5		0.2 ± 0.5	1.8 ± 2.1		
Simuliidae pupae	1.2 ± 1.5			0.2 ± 0.5					
Chironomidae larvae	4.0 ± 3.6	7.2 ± 6.6	3.5 ± 5.7	1.5 ± 1.7		0.8 ± 0.5	76.5 ± 46.8	56.8 ± 25.9	7.5 ± 5.4
Chironomidae pupae						0.2 ± 0.5			
Athericidae larvae		0.2 ± 0.5							
Elephariceridae larvae	1.0 ± 1.4		1.5 ± 1.9						
Gastropoda								0.8 ± 1.0	1.2 ± 1.3
Pelecypoda				0.5 ± 1.0					
Arachnida: Hydracarina	0.2 ± 0.5	0.5 ± 0.6	0.2 ± 0.5		1.0 ± 1.4			0.2 ± 0.5	
Totals	47.5 ± 16.0	68.5 ± 18.8	136.8 ± 203.0	41.8 ± 15.8	7.5 ± 7.2	7.5 ± 3.7	82.8 ± 51.2	80.5 ± 77.6	28.8 ± 10.3

*mean numbers and standard deviations of organisms collected from four rocks approximately 15 cm in diameter.

**located approximately 3 km downstream from block 303 treated with 17.5 g AI/ha permethrin at 0455 to 0528 hrs. on 6 June 1980, and again at 1430 to 1500 hrs. on 15 June 1980.

Table A-27
 Aquatic Invertebrates* collected in Surber samples from treatment and control streams approximately one year after permethrin applications, Kamouraska County, Quebec, 24 May 1981

	Control	Manie Upstream Control	Manie 303	Manie Downstream	St. Denis 301	St. Denis Downstream
Ephemeroptera - Total	67.25 ± 31.37	26.5 ± 11.5	50.75 ± 26.51	74.75 ± 14.25	15.0 ± 4.24	35.25 ± 17.37
Baetidae	9.25 ± 4.86	5.5 ± 4.04	8.75 ± 5.56	7.5 ± 2.89	0.75 ± 0.96	2.75 ± 3.59
Ephemerellidae	8.0 ± 7.87	7.5 ± 3.42	4.5 ± 2.65	5.25 ± 1.89	6.25 ± 1.89	6.75 ± 7.32
Ephemeridae	0.25 ± 0.5		0.25 ± 0.5	0.25 ± 0.5		
Leptageniidae	46.5 ± 20.17	9.75 ± 4.5	32.75 ± 19.7	29.0 ± 4.76	7.5 ± 4.8	14.5 ± 4.51
Leptophlebiidae	3.25 ± 2.5	3.75 ± 4.86	4.5 ± 2.52	32.75 ± 14.45	0.5 ± 1.0	11.25 ± 7.63
Odonata - Total	0.25 ± 0.5	0.25 ± 0.5	0.5 ± 0.58	0.25 ± 0.5		0.25 ± 0.5
Aeshnidae	0.25 ± 0.5					
Gomphidae		0.25 ± 0.5	0.5 ± 0.58			0.25 ± 0.5
Plecoptera	2.0 ± 1.63	1.75 ± 0.5	0.75 ± 0.96	3.75 ± 4.5	2.0 ± 0.82	4.5 ± 2.65
Megaloptera: Corydalidae		0.5 ± 1.0		1.25 ± 0.96	0.75 ± 0.96	1.0 ± 0.82
Trichoptera - Total	7.5 ± 3.70	5.75 ± 4.5	5.75 ± 3.5	12.25 ± 6.55	13.25 ± 5.56	6.25 ± 3.69
Glossosomatidae	0.5 ± 1.0	3.25 ± 4.57	1.0 ± 0.82		7.75 ± 4.5	2.5 ± 2.38
Hydropsychidae	3.0 ± 1.63	1.25 ± 1.89	2.75 ± 0.96	11.0 ± 6.16	2.4 ± 1.34	1.75 ± 1.26
Limnephilidae	0.25 ± 0.5	0.75 ± 0.96			0.5 ± 0.58	
Philopotamidae			0.25 ± 0.5			
Polycentropodidae		0.25 ± 0.5	0.75 ± 0.5	0.75 ± 0.96		1.0 ± 1.41
Rhyacophilidae	3.0 ± 2.45	0.25 ± 0.5	1.0 ± 1.41	0.5 ± 0.58	2.75 ± 3.2	1.0 ± 0.82
Pupae	0.75 ± 0.96	0.25 ± 0.5	1.0 ± 1.41	0.5 ± 0.58	4.75 ± 2.22	3.0 ± 4.08
Coleoptera - Total	1.25 ± 1.26	6.0 ± 2.16	3.75 ± 4.99	6.75 ± 4.27		0.25 ± 0.5
Amphizoidae adult			0.5 ± 0.5	0.5 ± 0.58	1.25 ± 2.5	
Elmidae adult	0.75 ± 1.5				4.0 ± 2.16	1.0 ± 0.82
Elmidae larva	0.5 ± 5.77	4.0 ± 2.31	2.25 ± 4.5			0.25 ± 0.5
Hydrophilidae adult					0.25 ± 0.5	0.25 ± 0.5
Psephenidae larvae		0.75 ± 0.5	1.5 ± 1.29	6.5 ± 4.04		11.5 ± 3.87
Diptera - Total	7.75 ± 5.74	11.75 ± 5.25	9.75 ± 4.72	20.25 ± 12.63		0.5 ± 1.0
Athericidae larvae			0.75 ± 0.5	0.25 ± 0.5	0.25 ± 0.5	
Blephariceridae larvae	1.25 ± 2.5		0.5 ± 0.58	0.5 ± 1.0		
Chironomidae larvae	1.75 ± 2.22	9.0 ± 5.35	4.25 ± 1.5	16.0 ± 10.92	9.0 ± 9.63	5.25 ± 3.59
Chironomidae pupae	0.75 ± 1.5	0.5 ± 0.58	1.2 ± 2.17	0.5 ± 1.0	0.5 ± 0.58	0.5 ± 1.0
Empididae larvae	0.5 ± 1.0	0.5 ± 0.58		0.75 ± 1.5		1.5 ± 1.29
Empididae pupae			0.25 ± 0.5			1.25 ± 1.5
Heleidae larvae	0.25 ± 0.5			0.25 ± 0.5		
Heleidae pupae	0.5 ± 1.0	0.25 ± 0.5	0.25 ± 0.5	0.25 ± 0.5	4.75 ± 5.5	0.75 ± 1.5
Simuliidae larvae	0.75 ± 1.5	0.75 ± 1.5	1.0 ± 0.82	0.25 ± 0.5	0.5 ± 0.58	0.5 ± 0.58
Simuliidae pupae	0.25 ± 0.5			1.5 ± 1.73	1.0 ± 1.15	1.25 ± 0.96
Tipulidae larvae	1.75 ± 1.71	0.75 ± 0.96	1.25 ± 1.5	0.25 ± 0.5		
Turbellaria: Planaria				0.25 ± 0.5		
Oligochaeta		16.5 ± 12.48	0.75 ± 1.5	0.75 ± 0.96	25.75 ± 11.5	
Gastropoda	0.25 ± 0.5					
Limpet				0.5 ± 0.58	0.25 ± 0.5	
Pelecypoda: Sphaeriidae	0.25 ± 0.5		0.25 ± 0.5	0.5 ± 0.58	0.25 ± 0.5	
Crustacea: Decapoda				0.75 ± 0.96	0.25 ± 0.5	
Total	86.5 ± 40.91	69.0 ± 17.53	72.25 ± 37.51	122.0 ± 25.31	78.25 ± 21.08	61.75 ± 26.13

* mean numbers and standard deviations of organisms collected in four 0.093 m² Surber samples.

Table A-28

Aquatic invertebrates^a collected from rocks taken from treatment and control streams approximately one year after permethrin applications, Kamouraska County, Quebec, 24 May, 1981.

	Control	Manie Upstream Control	Manie 303	Manie Downstream	St. Denis 301	St. Denis Downstream
Ephemeroptera - Total	30.5 ± 19.74	23.0 ± 20.28	42.0 ± 10.46	39.0 ± 24.43	4.5 ± 1.89	26.75 ± 10.53
Baetidae	1.75 ± 2.22	6.0 ± 5.83	14.5 ± 4.73	8.75 ± 5.85		3.25 ± 2.87
EphemereIIDae	0.5 ± 0.58	4.25 ± 2.06	2.0 ± 4.0	0.25 ± 0.5	0.25 ± 0.5	1.75 ± 0.5
HeptagenIIDae	28.0 ± 19.34	12.5 ± 16.68	24.75 ± 3.86	30.0 ± 18.74	4.5 ± 1.91	21.25 ± 8.54
LeptophlebiIIDae	0.25 ± 0.5	0.25 ± 0.5	0.75 ± 0.96		0.5	0.5 ± 1.0
Plecoptera		0.25 ± 0.5	3.0 ± 5.35		0.25 ± 0.5	1.25 ± 2.5
Trichoptera - Total	5.0 ± 4.16	6.25 ± 5.32	4.5 ± 1.29	4.25 ± 4.03	13.5 ± 11.59	4.0 ± 0.82
GlossosomatIIDae	0.75 ± 0.96	2.0 ± 2.45	0.75 ± 1.5		7.5 ± 9.26	0.25 ± 0.5
HydropsychIIDae	2.75 ± 2.75	0.75 ± 0.96	2.25 ± 1.71	3.75 ± 4.5	0.5 ± 1.0	2.25 ± 0.96
HydroptiliIIDae			1.0 ± 1.41			
LepidostomatIIDae		0.25 ± 0.5				
LimnephiliIIDae		0.75 ± 0.96			0.75 ± 1.5	
RhyacophiliIIDae		1.5 ± 1.92	0.5 ± 0.58	0.5 ± 1.0	0.25 ± 0.5	1.5 ± 1.73
Pupae	1.5 ± 1.73	1.0 ± 2.0			4.5 ± 3.42	
Coleoptera: Elmidae larvae		0.75 ± 0.96			0.75 ± 0.5	0.25 ± 0.5
PsephenIIDae larvae			0.25 ± 0.5			
Diptera - Total	5.75 ± 4.5	14.75 ± 27.44	109.75 ± 43.71	233.5 ± 262.85	67.25 ± 65.68	22.25 ± 16.19
BlepharicerIIDae larvae	0.5 ± 0.58		0.5 ± 1.0	6.25 ± 12.5		1.25 ± 1.5
ChironomIIDae larvae	1.5 ± 3.0	64.75 ± 24.02		20.75 ± 21.23	8.0 ± 6.68	5.25 ± 2.06
ChironomIIDae pupae		1.5 ± 1.0	0.75 ± 1.5	0.25 ± 0.5	0.5 ± 0.58	0.25 ± 0.5
EmpidiIIDae larvae		0.75 ± 0.96				0.25 ± 0.5
StmuliIIDae larvae	3.25 ± 4.57	4.5 ± 4.65	71.5 ± 48.95	206.0 ± 234.38	55.25 ± 63.9	15.0 ± 15.56
StmuliIIDae pupae	0.25 ± 0.5			0.25 ± 0.5		0.25 ± 0.5
TipulidiIIDae larvae	0.25 ± 0.5	3.0 ± 0.82	0.25 ± 0.5		3.5 ± 3.11	
Nematoda		0.25 ± 0.5				
Gastropoda: Limpet				0.25 ± 0.5		
Arachnida: Hydracarina				0.25 ± 0.5		
Total	41.25 ± 23.84	104.25 ± 47.83	159.25 ± 52.92	275.0 ± 288.47	85.75 ± 59.24	54.25 ± 25.32

^a mean numbers and standard deviations of organisms collected from rocks approximately 15 cm in diameter.

Table A-29

Terrestrial invertebrates* collected from drift nets set in Riviere St. Denis 301**
 Kamouraska County, Quebec
 27 May to 10 June 1980

Days before or after permethrin application	-11 AM	-11 PM	-8 AM	-8 PM	-6 AM	-6 PM	-5 AM	-5 PM	-0 AM	+0hr	+1hr ***	+1hr	+2hr	+3hr	+6hr ***	+12hr	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM
Surface area of drift column (m ²)	93	93	93	93	93	101	84	101	84	42	8	8	8	8	17	17	84	110	63	94	94	94
Current velocity (m/sec)	0.33	0.33	0.33	0.33	0.33	0.36	0.33	0.36	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.39	0.45	0.67	0.67	0.67
Arachnida: Araneida	0.11	-	-	0.11	-	-	-	-	-	0.24	-	-	-	-	-	-	-	0.09	0.16	0.11	-	-
Gollumbola	0.11	0.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plecoptera	-	-	-	-	-	-	-	-	0.12	0.24	1.18x	2.37	-	-	-	-	-	0.09	0.16	-	-	-
Thysanoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11	-	-
Hemiptera	-	-	-	-	-	-	-	-	-	0.71	-	-	-	-	-	-	-	-	-	0.32	0.21	0.11
Hymenoptera	-	-	-	-	-	-	-	-	-	-	2.37x	1.18	2.37	-	0.59x	-	0.12	0.09	0.16	0.11	-	-
Megaloptera	-	-	-	-	-	-	-	-	-	0.24	-	-	-	-	-	-	-	-	-	-	-	-
Trichoptera	-	-	-	-	-	-	-	0.10	-	-	-	-	-	-	-	-	-	0.27	-	-	-	-
Lepidoptera larvae	-	-	-	-	-	-	-	-	-	0.24	-	-	1.18	-	-	-	0.24	0.36	-	-	0.32	-
Hymenoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Saphyllinidae	-	-	-	-	-	-	-	-	-	0.24	-	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.16	-	-	-
Diptera	0.11	0.21	0.11	0.64	0.21	0.20	0.47	0.10	0.59	3.55	13.0	7.10	7.10	9.50	6.51	4.73	0.59	2.73	3.47	1.38	0.53	0.32
Total	0.32	0.32	0.11	0.75	0.21	0.20	0.47	0.20	0.71	5.44	16.57	10.65	10.65	9.50	7.1	4.73	0.95	3.64	4.41	2.01	1.06	0.32

* expressed as organisms per 10 m² of surface water flowing through drift net

** located in block 301 treated with 17.5 g AI/ha permethrin at 0700 to 0720 hrs on 7 June 1980.

*** numbers extrapolated from subsample except where actual count is indicated by "x".

Table A-30

Terrestrial Invertebrates* collected from drift nets set Riviere St. Denis Downstream**
 Kamouraska County, Quebec
 27 May to 17 June 1980

Days before or after permethrin application	-11 AM	-11 PM	-8 AM	-8 PM	-6 AM	-6 PM	-5 AM	-5 PM	+1hr	+2hr	+3hr	+4hr	+6hr	+9hr	+12hr	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM
Surface area of drift column (m ²)	127	127	127	102	127	101	127	102	51	51	51	20	20	36	90	180	180	103	107	103	106
Current velocity (m/sec)	0.45	0.45	0.45	0.36	0.45	0.36	0.45	0.36	0.36	0.36	0.36	0.36	0.36	0.64	0.64	0.64	0.64	0.73	0.76	0.73	0.73
Arachnida: Araneida	-	-	0.08	-	-	-	-	-	-	-	-	0.99	0.49	-	-	0.06	-	-	-	-	-
Gollanbola	-	0.16	-	0.20	-	0.10	-	0.10	-	0.20	0.59	-	-	-	0.33	0.06	0.06	0.10	-	0.10	-
Ephemeroptera	-	0.08	0.16	0.10	0.24	0.69	-	-	-	-	0.79	-	-	-	-	0.11	0.06	-	-	-	-
Plecoptera	0.08	-	-	-	-	-	-	-	-	-	0.20	0.49	-	-	-	-	-	-	-	-	-
Hemiptera	-	-	-	-	-	-	-	-	-	-	-	-	0.49	-	-	-	-	-	-	-	0.09
Hymenoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	0.06	-	0.09	-	-
Trichoptera	-	-	0.16	-	-	-	-	0.10	0.20	0.39	0.39	0.49	-	-	-	-	0.17	-	-	-	-
Lepidoptera	-	-	-	-	-	0.10	-	-	0.20	-	0.20	0.49	-	-	0.11	0.06	0.06	0.10	0.19	0.19	-
Hymenoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Formicidae	-	-	0.08	-	-	-	-	-	0.39	-	0.20	-	-	-	-	0.22	0.06	0.10	-	-	-
Others	-	-	-	0.10	-	-	-	-	-	-	-	-	-	-	0.11	0.06	0.06	-	-	-	-
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Staphylinidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.11	-	-	-	-	-	-
Others	-	-	-	-	-	-	-	-	0.39	-	0.49	-	-	-	-	-	-	-	-	0.19	-
Diptera	-	1.58	1.18	1.38	0.08	2.07	0.08	3.84	11.6	6.31	6.51	7.89	6.41	-	6.98	0.72	0.94	0.19	0.56	0.19	0.85
Total	0.08	1.81	1.65	1.77	0.32	2.96	0.08	4.04	12.4	7.29	8.87	11.3	7.40	0.00	7.65	1.33	1.44	0.49	0.84	0.68	0.94

* expressed as organisms per 10 m² of surface water flowing through drift net.

** located approximately 7 km downstream from a block (301) treated with 17.5 g Alpha permethrin at 0700 to 0720 hrs on 7 June 1980.

Table A-31

Terrestrial invertebrates* collected from drift nets set in Riviere Manie 304**
 Kamouraska County, Quebec
 6 June 1980

Days before or after permethrin application	-0 AM	+0hr	+½hr	+1hr ***	+2hr ***	+3hr	+6hr ***	+12hr
Surface area of drift column (m ²)	127	63	25	25	25	25	63	127
Current velocity (m/sec)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Collembola	-	0.16	0.39	1.18x	0.79x	-	0.16x	-
Ephemeroptera	-	-	-	-	0.79x	-	0.79x	0.32
Plecoptera	-	-	-	3.15x	-	0.39	0.47x	0.08
Hemiptera	-	0.16	-	1.18x	1.18x	1.58	-	0.08
Homoptera	-	-	0.39	0.79x	1.18x	1.18	3.31	0.24
Megaloptera	-	0.1	-	-	-	-	-	-
Coleoptera	-	-	-	-	-	-	-	-
Staphylinidae	-	0.32	0.39	0.79x	-	-	0.16x	0.24
Other	-	-	0.39	0.79x	0.39x	-	1.10x	0.16
Unidentified	-	-	-	-	0.39x	-	-	-
Trichoptera	-	0.63	-	10.39x	0.39x	-	-	-
Lepidoptera larvae	-	-	-	-	0.39x	0.39	3.31	0.16
Diptera	0.24	12.6	25.6	137.5	33.1	27.9	150.8	5.28
Hymenoptera	-	0.16	-	-	0.39	-	3.31	0.39
Arachnida	-	-	-	-	-	-	-	-
Araneida	-	0.16	0.79	0.79x	0.79x	0.39	0.32x	0.08
Arachnida	-	-	0.39	-	-	-	-	-
Total	0.24	14.3	28.4	146.6	39.8	31.5	163.8	7.01

* expressed as organisms per 10 m² of surface water flowing through drift net

** located in block 304 treated with 17.5 g AI/ha permethrin at 0647 to 0716 hrs on 6 June 1980.

*** numbers extrapolated from subsample except where actual count is indicated by "x".

Table A-32
 Terrestrial invertebrates* collected from drift nets set in Riviere Haute 303**
 Kamouraska County, Quebec
 27 May to 18 June 1980

Days before or after first or second application	-10 AM	-10 PM	-7 AM	-6 PM	-5 AM	-5 PM	-4 AM	-4 PM	-0 AM	+0hr	+1hr	+1hr	+2hr	+3hr	+6hr ***	+12hr ***	+1 AM ***	+1 PM	+2 AM	+2 PM
Surface area of drift column (m ²)	152	152	152	118	118	118	102	102	51	20	20	20	10	10	51	72	138	155	132	105
Current Velocity	0.54	0.54	0.54	0.42	0.42	0.42	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.51	0.51	0.51	0.57	0.57
Arachnida: Araneida	-	-	0.07	-	0.08	-	0.10	-	-	-	-	-	-	-	0.20	0.14x	0.14x	0.32	0.15	0.19
Gilleshola	0.07	-	-	0.08	-	-	-	-	-	-	-	-	-	-	0.20x	0.14x	0.07x	-	-	-
Ephemeroptera	-	-	0.20	0.17	-	0.08	-	-	-	-	-	-	-	-	-	-	-	0.13	0.30	0.10
Plecoptera	-	-	-	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	0.06	-	0.10
Thysanoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hemiptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hymenoptera	-	-	-	-	-	-	-	0.10	-	-	-	-	-	1.97	0.89x	0.28x	-	0.26	0.08	0.19
Trichoptera	-	-	-	-	-	-	0.20	-	-	-	-	0.99	0.99	-	-	-	-	-	-	-
Lepidoptera larvae	-	-	0.20	-	-	-	-	-	-	-	-	-	-	-	-	0.14x	0.79	0.13	0.08	-
Hymenoptera Formicidae	-	-	-	-	-	-	-	-	-	-	-	-	-	0.99	0.20x	0.14x	0.79	0.06	0.15	-
Gleoptera Staphylinidae	-	-	-	-	-	-	-	-	-	-	-	0.99	-	-	-	0.28x	-	0.13	-	-
Other	-	-	-	0.08	-	-	0.10	-	-	-	0.49	-	-	-	0.39x	0.14x	-	0.19	-	-
Diptera	-	-	0.53	-	0.25	0.34	0.39	1.77	-	0.49	5.42	0.99	10.8	2.96	14.6	11.8	17.6	2.71	4.62	2.86
Total	0.07	0.00	0.99	0.42	0.34	0.51	0.69	0.97	0.00	0.49	5.42	2.47	12.8	5.92	16.0	13.1	20.1	4.07	5.53	3.53

* expressed as organisms per 10 m² of surface water flowing through drift net

** located in block 303 treated with 17.5 g AI/ha permethrin at 0455 to 0528 hrs on 6 June 1980, and again at 1430 to 1500 hrs on 15 June 1980

*** numbers extrapolated from subsample except where actual count is indicated by "x"

Table A-32 (concluded)

Terrestrial Invertebrates* collected from drift nets set in Riviere Haute 303**
 Kamouraska County, Quebec
 27 May to 18 June 1980

Days before or after first or second application	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+5 PM	+0hr	+1hr	+1hr	+2hr	+3hr	+6hr	+12hr	+1 AM	+1 PM	+2 AM	+2 PM	+3 AM	+3 PM
Surface area of drift column (m ²)	94	116	104	101	72	76	63	13	13	13	13	14	16	24	34	76	76	72	51
Current Velocity	0.67	0.82	0.76	0.79	0.51	0.54	0.45	0.45	0.45	0.45	0.45	0.48	0.57	0.42	0.60	0.54	0.54	0.51	0.36
Arachnida: Araneida	0.21	0.17	-	0.20	-	-	0.16	1.58	0.79	-	-	-	-	0.62	-	0.13	-	-	-
Gollubola	0.11	-	-	-	-	-	0.16	0.79	-	-	-	0.79	-	0.62	-	-	0.13	-	-
Ephemeroptera	0.11	-	-	-	-	-	0.16	-	0.79	-	-	0.79	-	-	-	-	-	-	-
Plecoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thysanoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Beulptera	0.11	-	-	0.10	-	-	0.16	0.79	-	-	-	0.79	0.74	-	-	-	-	-	-
Homoptera	0.42	0.26	-	-	-	-	-	-	-	-	0.79	0.79	-	-	-	-	-	-	-
Trichoptera	-	-	-	-	-	-	-	0.79	-	-	-	-	0.74	-	-	-	-	-	-
Lepidoptera larvae	0.53	0.78	-	0.10	0.14	-	0.16	-	-	-	-	-	-	0.62	-	0.13	0.13	-	-
Hymenoptera	0.11	0.09	-	-	-	-	0.32	-	-	-	-	0.79	-	0.62	-	-	0.13	-	-
Formicidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Staphylinidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.30	-	-	-	-
Other	-	-	-	-	-	-	0.16	-	-	-	-	-	-	0.62	-	-	-	-	-
Diptera	2.65	4.76	0.19	2.66	0.42	1.58	3.31	8.68	1.58	-	-	13.40	-	8.71	2.07	1.44	4.99	0.83	0.39
Total	4.23	6.06	0.19	3.06	0.56	1.58	4.57	12.6	3.16	0.00	0.79	17.34	1.48	11.82	2.36	1.71	5.52	0.83	0.39

* expressed as organisms per 10 m² of surface water flowing through drift net.

** located in block 303 treated with 17.5 g AI/ha permethrin at 0455 to 0528 hrs on 6 June 1980, and again at 1430 to 1500 hrs on 15 June 1980.

*** numbers extrapolated from subsample except where actual count is indicated by "x".

Table A-33

Terrestrial Invertebrates* collected from drift nets set in Riviere Huile Downstream**
 Kamouraska County, Quebec
 25 May to 18 June 1980

Surface area of drift column (m ²)	189	189	155	155	163	163	205	205	205	41	21	21	21	21	21	21	103	197	197	180	107
Current Velocity (m/sec)	0.67	0.67	0.55	0.55	0.58	0.58	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.73	0.70	0.70	0.64	0.76
Days before or after first or second application	-10 AM	-10 PM	-7 AM	-6 PM	-5 AM	-5 PM	-4 AM	-4 PM	+1hr	+1hr	+1 1/2hr	+3hr	+4hr	+5hr	+6hr	+7hr	+10hr	+1 AM	+1 PM	+2 AM	+2 PM
Collembola	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10x	0.05x	-	-	-
Ephemeroptera	-	-	0.06	-	0.06	0.06	-	-	-	0.24	-	-	-	-	0.49	-	-	-	0.10	0.05	-
Plecoptera	-	-	-	-	-	-	0.05	-	0.10	-	-	-	-	0.49	0.49	-	-	-	-	-	-
Neuroptera	-	-	-	-	0.06	-	-	0.05	-	-	-	-	-	0.49	-	-	-	-	-	-	-
Knopptera	-	0.05	-	-	-	-	-	-	-	-	-	-	-	0.49	-	-	-	-	-	0.22	-
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Staphylinidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05	-
Other	-	-	-	-	0.06	-	-	0.05	-	-	-	0.49	-	0.49	-	-	0.19x	-	-	-	-
Trichoptera	0.05	-	0.06	-	-	-	0.05	-	0.15	-	-	-	-	-	-	-	-	-	-	-	0.09
Lepidoptera larvae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05x	-	0.17	-
Diptera	0.69	-	0.06	0.26	0.12	0.37	0.19	1.31	0.39	-	5.35	20.4	1.46	0.49	-	10.2	3.01	4.31	1.47	0.80	0.28
Hymenoptera	-	-	-	0.13	-	-	-	-	-	0.24	-	-	-	-	-	-	-	0.10x	0.05	0.05	-
Arachnida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Araneida	-	0.05	-	0.06	0.06	-	-	0.05	-	-	-	-	-	-	-	-	-	0.05x	0.05	0.05	-
Total	0.79	0.11	0.19	0.45	0.37	0.43	0.29	1.46	0.63	0.49	5.35	20.9	1.46	2.43	0.97	10.2	3.30	4.56	1.67	1.39	0.37

* expressed as organisms per 10 m² of surface water flowing through drift net

** located approximately 3 km downstream from block 303 treated with 17.5 g A.I./ha permethrin at 0455 to 0528 hrs on 6 June 1980, and again at 1438 to 1500 hrs on 15 June 1980.

*** numbers extrapolated from subsample except where actual count is indicated by "x".

Continued.....

Table A-33 (concluded)

Terrestrial Invertebrates* collected from drift nets set in Riviere Manie Downstream**
 Kamouraska County, Quebec
 25 May to 18 June 1980

Surface area of drift column (m ²)	120	116	120	111	107	103	65	26	26	26	31	31	38	38	38	34	39	99	107	90	82
Current Velocity (m/sec)	0.85	0.82	0.85	0.79	0.76	0.73	0.46	0.46	0.46	0.46	0.55	0.55	0.67	0.67	0.67	0.61	0.70	0.70	0.76	0.64	0.58
Days before or after first or second application	+3 AM	+3 PM	+4 AM	+4 PM	+5 AM	+5 PM	+11hr	+3hr	+4hr	+5hr	+7hr	+11hr	+12hr ***	+13hr	+15hr	+18hr	+1	+2 AM	+2 PM	+3 AM	+3 PM
Collembola	-	-	-	-	-	-	0.15	-	-	-	-	-	-	-	-	0.29	-	-	-	0.11	-
Ephemeroptera	-	-	-	-	-	-	0.15	-	-	-	-	-	-	-	-	-	-	-	0.09	-	-
Plecoptera	-	-	-	-	-	-	0.15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isopoda	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hemiptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Staphylinidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoptera	-	-	-	0.09	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	-	-	-
Lepidoptera larvae	-	-	-	-	-	-	-	-	-	-	-	0.32	-	-	-	0.29	-	-	-	-	-
Diptera	0.50	0.26	0.17	4.48	0.09	0.97	-	0.77	0.77	0.77	-	-	2.91	1.59	0.79	0.87	2.03	0.10	1.59	0.55	-
Hymenoptera	0.25	-	-	-	-	-	0.31	-	-	-	-	-	-	-	-	-	-	-	0.09	0.11	-
Arachnida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Araneida	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0.83	0.26	0.17	4.58	0.09	0.97	0.77	0.77	0.77	0.77	0.00	0.32	2.91	1.59	0.79	1.45	2.03	0.20	1.77	0.78	0.00

* expressed as organisms per 10 m² of surface water flowing through drift net.

** located approximately 3 km downstream from block 303 treated with 17.5 g A.I./ha permethrin at 0455 to 0528 hrs on 6 June 1980, and again at 1430 to 1500 hrs on 15 June 1980.

*** numbers extrapolated from subsample except where actual count is indicated by "x".

Table A-34

Terrestrial Invertebrates* collected from drift nets set in the untreated Rivière Haute Upstream section**
 Kamouraska County, Quebec
 27 May to 18 June 1980

Sample Date	27 May		30 May		31 May		1 June		2 June		6 June		7 June		8 June	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Surface area of drift column (m ²)	121	121	130	138	138	138	130	130	161	144	138	144	144	78		
Current velocity (m/sec)	0.43	0.43	0.46	0.49	0.49	0.49	0.46	0.46	0.57	0.51	0.49	0.51	0.51	0.55		
Arachnida: Araneida	-	0.08	0.08	-	-	0.07	0.62	-	-	-	0.14	-	-	-		
Collembola	0.08	-	-	-	-	-	-	-	-	-	0.14	-	-	-		
Ephemeroptera	-	0.08	0.08	0.07	-	0.14	-	-	-	0.14	-	0.21	-	-		
Hemiptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Hemiptera	-	0.16	0.15	-	-	-	-	-	-	0.21	0.14	-	-	-		
Lepidoptera larvae	-	-	-	-	-	-	-	-	-	-	-	0.14	-	0.13		
Hymenoptera	-	-	-	-	-	-	0.08	-	-	-	0.29	-	-	-		
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Staphylinidae	-	-	-	-	-	-	-	-	-	0.14	-	-	-	-		
Other	-	-	-	0.07	-	0.14	-	0.08	0.06	-	0.07	0.07	-	-		
Diptera	0.91	1.15	0.46	1.59	0.65	3.26	0.69	1.08	0.06	2.23	1.52	1.88	0.21	0.26		
Total	0.99	1.48	0.77	1.74	0.65	3.62	1.31	1.23	0.12	2.71	2.17	2.30	0.21	0.39		

* expressed as organisms per 10 m² of surface water flowing through drift net.

** an untreated control station located approximately 1.5 km upstream from block 304 and 3 km upstream from block 303.

Continued

Table A-34 (concluded)

Terrestrial Invertebrates* collected from drift nets set in the untreated Riviere Haute Upstream section**
 Kanouraska County, Quebec
 27 May to 18 June 1980

Sample Date	9 June		10 June		11 June		15 June		16 June		17 June		18 June	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Surface area of drift column (m ²)	90	103	90	94	90	99	69	31	31	69	69	82	82	82
Current velocity (m/sec)	0.64	0.73	0.64	0.67	0.64	0.70	0.49	0.55	0.55	0.49	0.49	0.58	0.58	0.58
Arachnida: Araneida	-	-	-	-	-	-	-	-	-	-	0.14	-	-	-
Gollanbola	-	0.19	-	-	-	-	0.14	-	-	-	-	-	-	-
Ephemeroptera	0.11	-	-	-	-	-	0.14	-	-	-	-	0.10	-	-
Hemiptera	-	-	0.11	-	-	-	-	-	-	0.14	-	-	-	-
Hemiptera	0.11	-	-	-	-	-	0.14	-	-	0.14	-	-	-	-
Lepidoptera larvae	-	-	-	-	-	-	0.14	-	-	-	-	-	-	-
Hymenoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Staphylinidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Diptera	0.22	0.39	0.11	0.32	-	0.20	3.19	1.29	1.61	1.01	0.72	0.24	0.37	0.24
Total	0.44	0.58	0.22	0.32	0.0	0.20	3.91	1.29	1.61	1.45	0.72	0.37	0.37	0.24

* expressed as organisms per 10 m² of surface water flowing through drift net.

** an untreated control station located approximately 1.5 km upstream from block 304 and 3 km upstream from block 303.

Table A-35

Terrestrial Invertebrates* collected from drift nets set in Rivière du Loup untreated control station
 Kamouraska County, Quebec
 27 May to 18 June 1980

Date	27 May		30 May		31 May		1 June		2 June		7 June		8 June		9 June		10 June		11 June		16 June		17 June		18 June	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Surface area of drift column (m ²)	161	161	161	118	161	161	161	118	118	63	63	85	120	111	103	99	80	76	25	72	72	59	51	51		
Current velocity (m/sec)	0.57	0.57	0.57	0.42	0.57	0.57	0.57	0.42	0.42	0.45	0.45	0.60	0.85	0.79	0.73	0.70	0.57	0.54	0.45	0.51	0.51	0.42	0.36	0.36		
Collembola	-	-	0.06	-	-	-	-	-	-	-	-	-	-	0.09	0.10	-	-	-	0.39	-	-	-	-	-	-	-
Ephemeroptera	-	-	0.06	0.34	-	0.06	-	-	-	0.32	-	0.71	-	0.09	-	-	-	-	-	-	-	-	-	0.39	-	-
Plecoptera	-	-	0.12	0.17	-	-	-	-	-	-	-	0.12	0.08	-	-	-	-	-	0.39	-	-	-	-	-	-	-
Trichoptera	-	-	-	-	-	-	-	-	-	-	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hemiptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	-	-	-	-	0.20	-
Hymenoptera	-	-	0.12	0.08	0.12	-	0.12	-	0.08	-	0.16	-	-	-	-	0.19	0.30	0.12	-	0.39	-	-	-	0.20	-	-
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Staphylinidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.12	-	0.39	-	-	-	-	-	-
Other	-	-	0.12	0.08	-	-	-	-	-	0.47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichoptera	-	-	0.19	-	-	-	0.06	0.08	-	-	0.16	0.12	-	-	-	-	-	-	-	0.39	-	-	-	-	-	-
Lepidoptera larvae	-	-	0.12	-	-	-	-	-	-	-	0.47	-	-	0.09	-	-	-	-	0.39	-	-	-	-	-	-	-
Diptera	0.62	-	2.68	21.1	0.50	5.04	1.12	14.44	0.68	7.25	1.26	1.48	-	0.99	0.39	3.24	1.49	2.36	3.55	0.70	0.83	0.02	0.20	0.39	-	-
Hymenoptera	-	-	0.06	-	-	-	0.06	-	-	-	0.16	0.12	-	-	-	-	-	0.26	0.39	0.28	0.14	0.05	-	-	-	-
Formicidae	-	-	-	-	-	-	-	-	-	-	0.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arachnida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acari	-	-	0.19	-	-	0.12	0.06	-	0.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0.62	0.00	3.73	21.8	0.62	5.23	1.43	14.52	0.84	8.20	2.36	3.66	0.08	1.26	0.68	3.65	1.74	2.63	6.30	0.97	0.97	0.07	0.98	0.39		

* expressed as organisms per 10 m² of surface water flowing through drift net.

Table A-36
Terrestrial arthropods* collected from knockdown samplers in treatment area 303-T1**, Kamouraska County, Quebec, 1980.

Date	27 May	29 May	30 May	3 June	4 June	5 June	6 June	7 June	8 June	9 June	10 June	11 June	12 June	15 June	16 June	17 June	18 June	19 June	20 June
Arachnida: Araneida			0.1	0.3	0.2	0.2	0.1		0.1			0.1	0.1	0.4		0.2	0.1	0.3	
Collembola			0.2							0.1	0.1	0.2			0.2			0.1	0.1
Thysanoptera									0.1	0.1									
Plecoptera adults			0.1																
Hemiptera							0.1												
Homoptera																			
Cicadellidae												0.1		0.1					
Aphididae			0.1						0.2	0.2				0.1		0.1			
Other					0.1				0.1	0.1		0.1			0.3	0.1		0.1	
Coleoptera adults																			
Carabidae			0.1				0.1							0.1		0.1			
Staphylinidae											0.1			0.1					
Elateridae				0.1			0.1	0.2					0.1	0.4		0.1	0.1		
Curculionidae							0.2												
Other							0.3	0.3	0.1	0.1		0.1	0.1					0.2	
Lepidoptera larvae																			
<i>Choristoneura fumiferana</i>	0.1		0.3	0.3				0.1	0.6	0.5		0.1	0.1	0.1	0.1	0.1	0.2	0.1	
Geometridae	0.1								0.1										
Other														0.2	0.3				0.1
Diptera adults																			
Tabanidae														0.1	0.1				
Tipulidae														0.1	0.1				
Gallidae					0.1														
Chironomidae	0.3		0.1	0.1	0.2	0.1	0.4	0.1	0.2	0.2	0.3	0.2		0.3	0.5	0.1	0.1	0.3	0.1
Sciaridae	0.9		0.4	1.4	1.1	0.5	0.7	0.7	0.8	0.5	1.7	0.5	0.3	1.5	1.5	0.5	0.5	0.4	0.3
Other	0.5	0.4	1.2	0.4	0.3		0.9	0.2	0.2	0.4	0.8	0.3		2.2	3.4	0.6	0.4	0.9	0.4
larvae	0.2						0.8								0.1				
Hymenoptera																			
Formicidae				0.3		0.1	0.3	0.1					0.1	0.2		0.1	0.1	0.2	0.1
Other	0.2		0.4	0.3		0.2	0.1	0.2	0.2	0.3	0.1	0.3		0.1	0.3	0.1	0.1	0.2	
Total	2.3	0.4	3.0	3.2	2.0	1.1	4.0	2.0	2.7	2.5	3.2	1.0	0.8	6.0	6.5	2.1	1.5	2.9	1.1

* expressed as organisms per sampler

** treated with 17.5 g AI/ha permethrin at 0455 to 0528 hrs on 6 June 1980 and again at 1430 to 1500 hrs on 15 June, 1980.

Table A-37
 Terrestrial arthropods* collected from knockdown samplers in treatment area 303-T2**, Kamouraska County, Quebec, 1980.

Date	27 May	29 May	30 May	31 May	3 June	4 June	5 June	6 June	7 June	8 June	9 June	10 June	11 June	12 June	15 June	16 June	17 June	18 June	19 June	20 June	
Arachnida									0.1												0.2
Acarid								0.2		0.1						0.1	0.1	0.1			
Araneida	0.2	0.1	0.1	0.2	0.1			0.1													
Plecoptera								0.1													
Homoptera								0.1			0.1			0.1	0.1						0.1
Cicadellidae									0.1						0.1						
Other					0.2				0.1						0.1						
Coleoptera								0.1							0.2						
Carabidae								0.1													
Staphylinidae									0.1												
Elateridae					0.1			0.1	0.1							0.1				0.1	0.2
Curculionidae					0.1				0.1	0.1			0.1								
Other												0.1	0.2		0.2	0.1					
Trichoptera									0.1	0.1											
Lepidoptera																					
<i>Choristoneura fumiferana</i>					0.1			0.2	0.6	0.3	1.3	0.3	0.3		0.6	1.2	0.4	0.6	0.2		
Geometridae	0.1							0.1	0.2	0.1	0.2				0.2						
Other						0.1															
Diptera																					
Bibionidae								0.1													
Tipulidae																					0.1
Chironomidae	0.1				0.6	0.1	0.1	2.5	0.6	0.1	0.2	0.2			0.1	0.3				0.1	
Selandriidae	0.2			0.1	3.7	1.6	1.7	1.4	0.9	0.6	0.7	1.1	0.2	0.4	1.8	0.3	0.7	0.3	0.5	0.1	
Cecidomyiid																0.6					
Other		0.1	0.2	1.2	1.4	0.3	0.1	7.6	2.0	0.5	0.9	0.3	0.2	0.1	2.1	0.6	0.3				0.1
Hymenoptera																					
Formicidae				0.1				0.1	0.1												
Other					0.3	0.1		0.5	0.3	0.1	0.2				0.1	0.1			0.3		
Total	0.6	0.2	0.3	1.6	6.6	2.2	1.9	13.1	5.3	2.0	3.6	2.0	1.0	0.6	5.5	3.4	1.5	1.3	1.1	0.7	

* expressed as organisms per sampler

** treated with 17.5 g AI/ha permethrin at 0455 to 0528 hrs on 6 June 1980 and again at 1430 to 1500 hrs on 15 June, 1980.

Table A-38

Terrestrial arthropods* collected from knockdown samplers in untreated control area, Kamouraska County, Quebec, 1980.

Date	5 June	6 June	7 June	8 June	9 June	10 June	11 June	12 June	15 June	16 June	17 June	18 June	19 June	20 June
Arachnida										0.2				
Acarid														
Araneida		0.4	0.2	0.4	0.4	0.2				0.6	0.8		0.4	
Collembola			0.2	0.4										
Plecoptera adults										1.0	0.4		0.7	
Homoptera														
Cicadellidae					0.2									
Other			0.2		0.2					0.2				
Coleoptera adults														
Carabidae		0.2		0.4				0.2	0.6	0.2			0.2	
Staphylinidae									0.2	0.2				
Other			0.4											
Lepidoptera larvae														
<i>Choristoneura fumiferana</i>		0.2	0.4	0.2						0.2		0.6	0.2	0.6
Other										0.6				
Trichoptera adults				0.2		0.2				0.2				0.2
Diptera adults														
Tipulidae					0.4					0.6				
Chironomidae		0.2	0.4	0.4	0.4					0.4	0.2	0.2	0.2	0.2
Scleridae	1.3	0.2	0.2	0.8	1.2	0.6	0.6	0.4	0.4	0.6	0.6	0.8	0.2	0.8
Other	0.3	0.6	0.6	0.4	1.2	1.2	0.8		1.0	1.8	0.4	0.2	0.2	1.0
Hymenoptera														
Formicidae										0.2				
Other				0.4			0.2		0.2		0.4	0.2	0.2	0.2
Gastropoda	0.3			0.2	0.2					1.2				0.8
Total	1.9	1.8	2.6	3.8	4.2	2.2	1.6	0.6	2.4	8.2	2.8	2.0	2.0	3.8