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AQUATIC IMPACT STUDIES OF A SPRUCE BUDWORM *CHORISTONEURA FUMIFERANA* CLEMENS, CONTROL PROGRAM IN THE LOWER ST. LAWRENCE REGION OF QUEBEC IN 1978

S. B. Holmes

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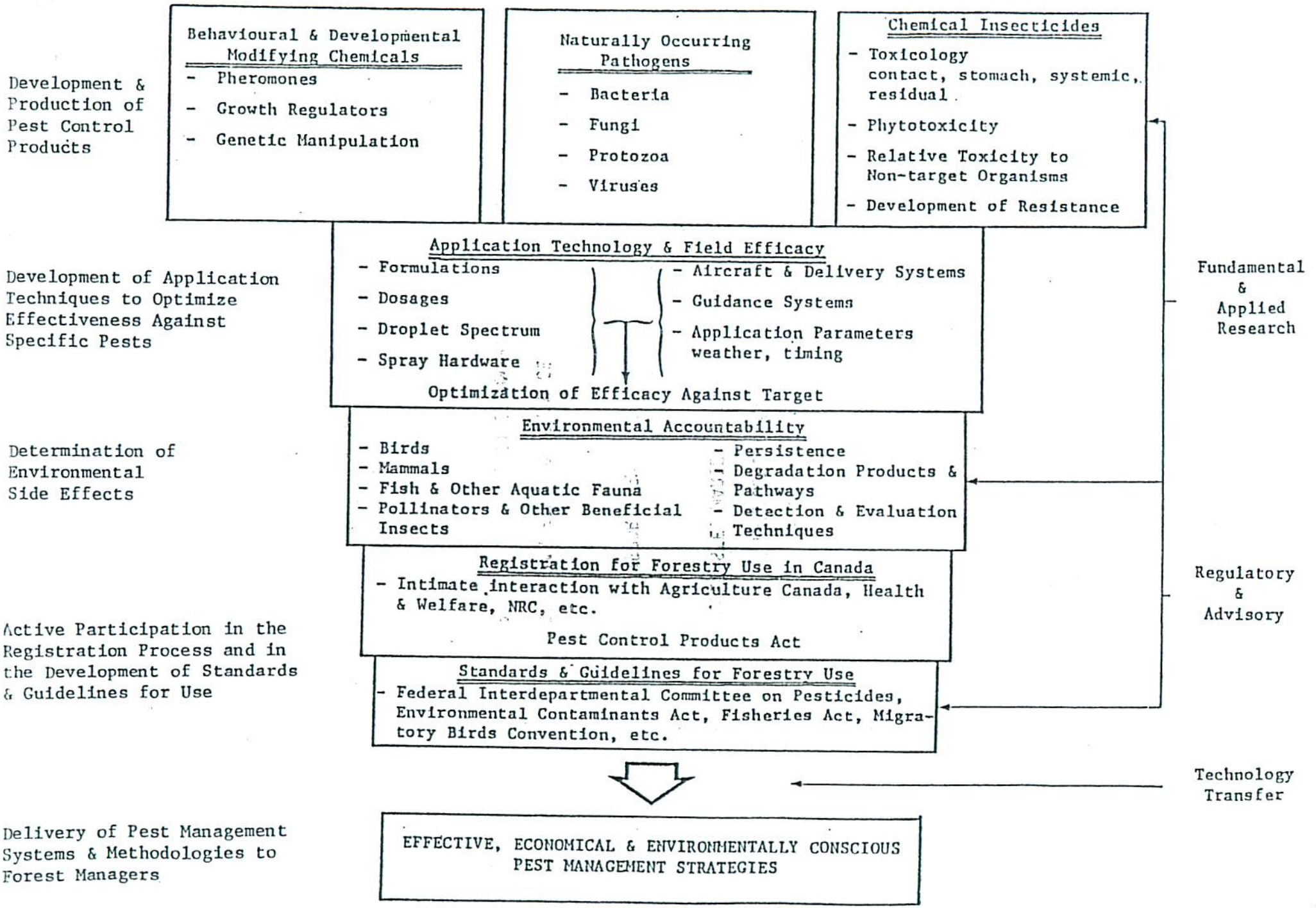

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ABSTRACT

Experimental and operational applications of fenitrothion at 0.210 kg AI/ha (3 oz/acre) and aminocarb (Matacil®) at 0.053 kg AI/ha (3/4 oz/acre) were monitored in Kamouraska County, Quebec to assess the impact of these treatments upon selected components of the aquatic environment. Applications at the dosage rates studied had little or no adverse effects on aquatic invertebrates or fish. Small increases in the drift of mayfly nymphs after a fenitrothion application, and of blackfly larvae after an aminocarb application, were documented. A slight depression in populations of heptagenid and baetid mayfly nymphs was noted after an application of aminocarb.

RÉSUMÉ

Des applications expérimentales et opérationnelles de fénitrothion à raison de 0.210 kg IA/ha (3 oz/acre) et d'aminocarb (Matacil®), à raison de 0.053 kg IA/ha (3/4 oz/acre) furent surveillées de près dans let comté de Kamouraska, au Québec, en vue d'évaluer l'influence de ces traitements sur des éléments choisis due milieu aquatique. Ces applications aux doses expérimentées eurent peu ou pas d'effet adverse sur les invertébrés aquatiques et les poissons. On observa de légères augmentations des rassemblements de nymphes d'éphémères après une application de fénitrothion et des larves de mouche noire après une application d'aminocarb. On observa un léger déclin dans des populations de nymphes "heptagénides" et "baetides" d'éphémères après une application d'aminocarb.

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INTRODUCTION

The Forest Pest Management Institute, Environment Canada, was involved in studying the impact on aquatic environments of portions of the 1978 Quebec spruce budworm, *Choristoneura fumiferana* Clemens, control program. This work was carried out in cooperation with other groups from the Ministère des Richesses Naturelles of the Quebec Government and the Division des Eaux Interieurs of Environment Canada.

Three spray blocks located in Kamouraska County (Blocks 101, 102 and 109) and two insecticide formulations (14.9% fenitrothion + 35% Dowanol TPM + 50.1% insecticide diluent "585"; 26% Matacil + 74% insecticide diluent "585") were studied. The dosage rates and timing of the various insecticide applications are summarized in Table 1. Douglas DC-3, Douglas DC-6, and Lockheed Constellation L 1049 aircraft were used to deliver the insecticide formulations at a nominal application rate of 1.122 ℓ/ha.

METHODS

The insecticide applications studied and components monitored at each station are summarized in Table 2.

Site Selection

In general the water systems monitored were selected to complement other studies being carried out at the same time by groups from the Ministère des Richesses Naturelles of the Quebec Government and the Division des Eaux Interieures of Environment Canada. Individual sampling stations were selected on the basis of accessability, public acceptability, ease of sampling, and apparent ability to support healthy populations of aquatic fauna over the entire study period. For the stream studies, downstream stations were monitored to assess the impact of downstream movement of insecticide into unsprayed portions of a watershed. The locations of the sampling stations in each block are shown in Figures 1, 2, 3 and 4.

Deposit Measurement

Insecticide deposit was estimated by two methods: colorimetric measurement of dyed spray deposited on aluminum pans, and counting of spray droplets landing on Kromekote cards. Immediately before spraying began eight 10 cm x 10 cm Kromekote cards and four 13 cm x 17 cm aluminum pans were set out at each station. For the stream surveys, the deposit samplers were positioned in such a way as to take into account the relative amount of stream surface area covered by over-storey and bank vegetation. At the lake stations deposit samplers were placed in

Table 1
Timing of Insecticide Applications

Block	50% Emergence		Peak 4th instar larvae		5 days later	
	Insecticide Dosage (kg AI/ha)		Insecticide Dosage (kg AI/ha)		Insecticide Dosage (kg AI/ha)	
102	Fenitrothion	0.210	Aminocarb	0.053	Aminocarb	0.053
101	Aminocarb	0.053	Aminocarb	0.053	---	
109	---		Aminocarb	0.053	Aminocarb	0.053

Table 2
Insecticide Applications and Sampling Strategy

Block	Insecticide	Dosage Rate	Sampling Station	Component Monitored
101	aminocarb	0.053 kg AI/ha	Riviere Manie	PC,D
			Riviere du Loup	PC,D
			Riviere du Loup Downstream*	PC,D
102	fenitrothion	0.210 kg AI/ha	Ruisseau Blanc	PC,BF
			Riviere du Loup	PC,D,BF
			Riviere du Loup Downstream*	PC,D
			Control	PC,D,BF
	aminocarb	0.053 kg AI/ha	Ruisseau Blanc	PC,BF,FS,FR
			Riviere du Loup	PC,D,BF,FS,FR
			Riviere du Loup Downstream*	PC,D,BF
	aminocarb	0.053 kg AI/ha	Ruisseau Blanc	PC,BF,FS,FR
			Riviere du Loup	PC,BF
			Riviere du Loup Downstream*	PC,BF
			Lac des Cinq Milles	PC,FR
			Lac Perdu	PC,FR
			Lac Jaune	PC,FR
109	aminocarb	0.053 kg AI/ha	Riviere Chaudiere	PC,D,BF,FS,FR
			Riviere Ouelle	PC,D,BF,FS,FR
			Riviere Ouelle Downstream*	PC,D,BF,FS,FR
	aminocarb	0.053 kg AI/ha	Riviere Chaudiere	BF,FS,FR
			Riviere Ouelle	BF
			Riviere Ouelle Downstream*	BF,FS,FR

PC Physical chemistry
D Drift
BF Bottom fauna
FS Analysis of fish stomach contents
FR Analysis for residue in fish tissues
* The term Downstream refers to a station located outside of and downstream from the spray block. All other stations are located within the spray block.

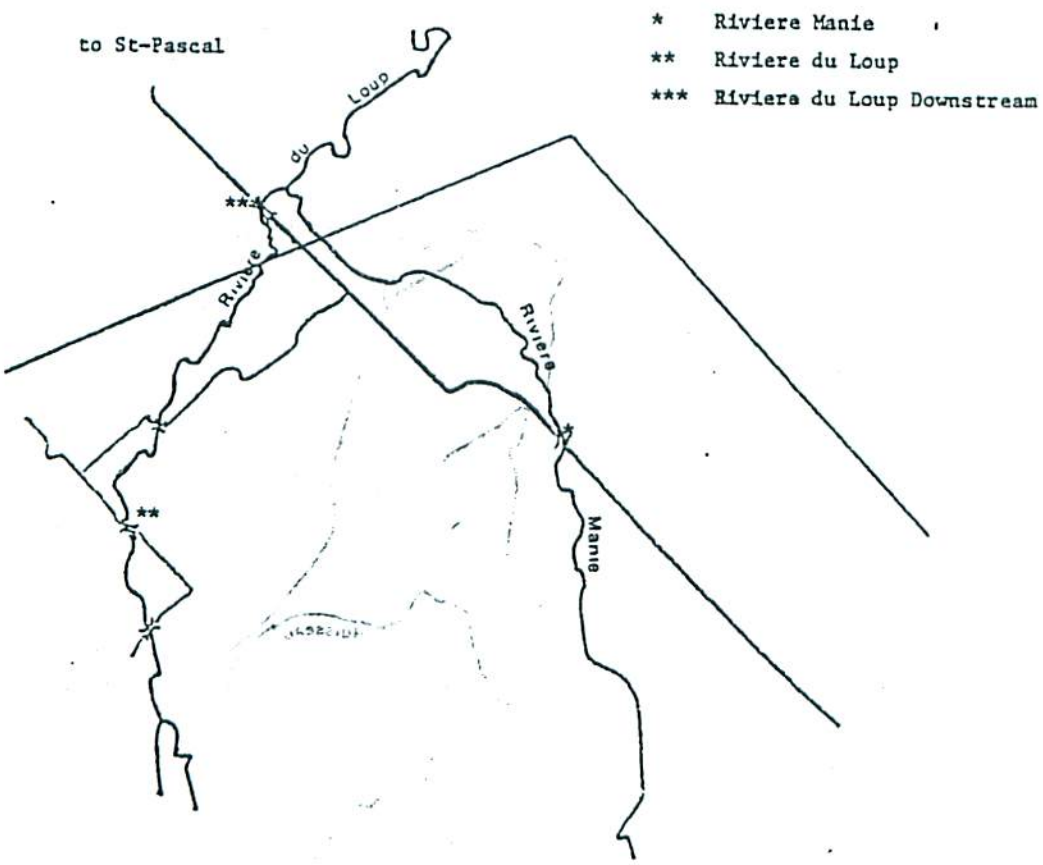

Figure 1: Location of sampling stations in Block 101

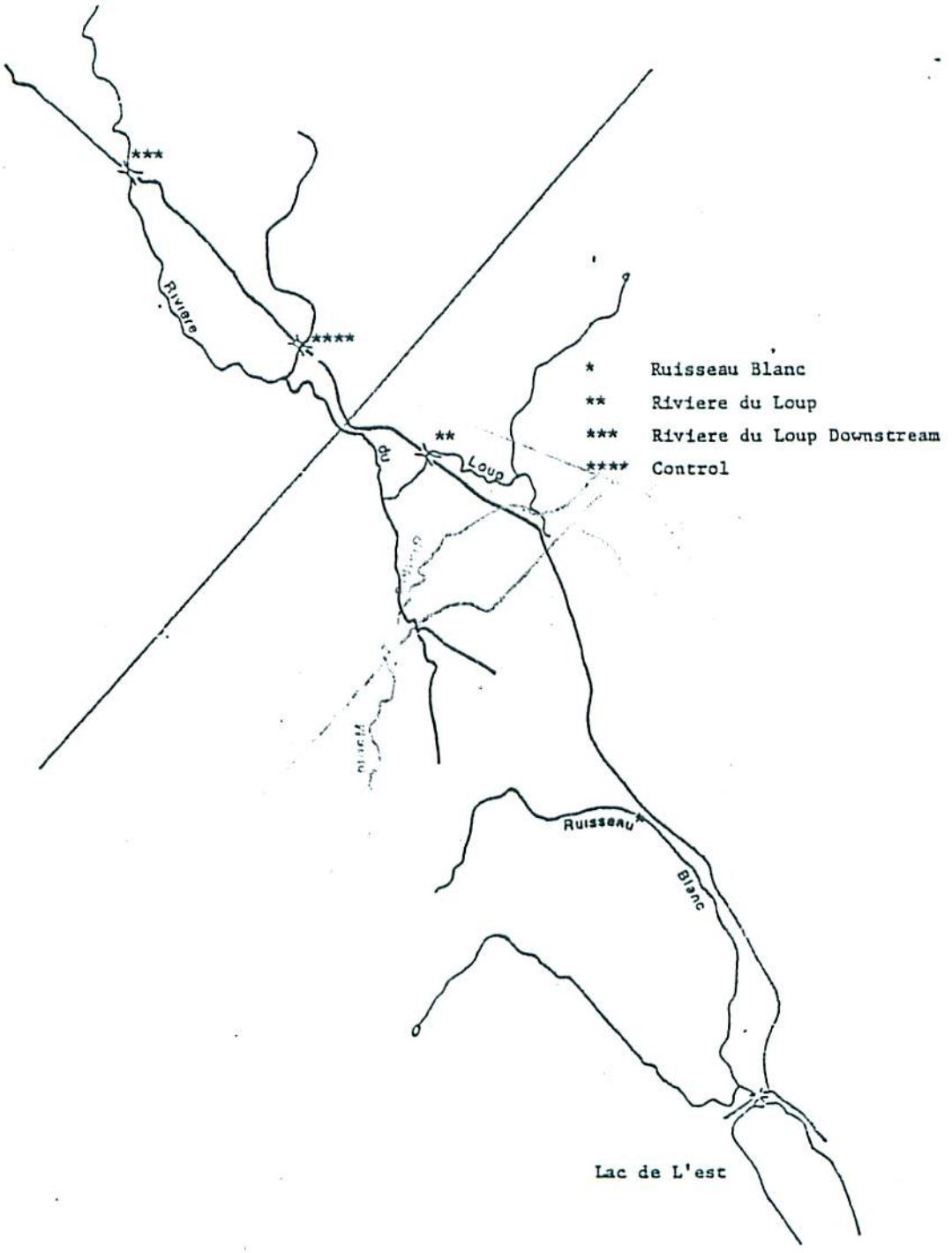

Figure 2: Location of sampling stations in Block 102.

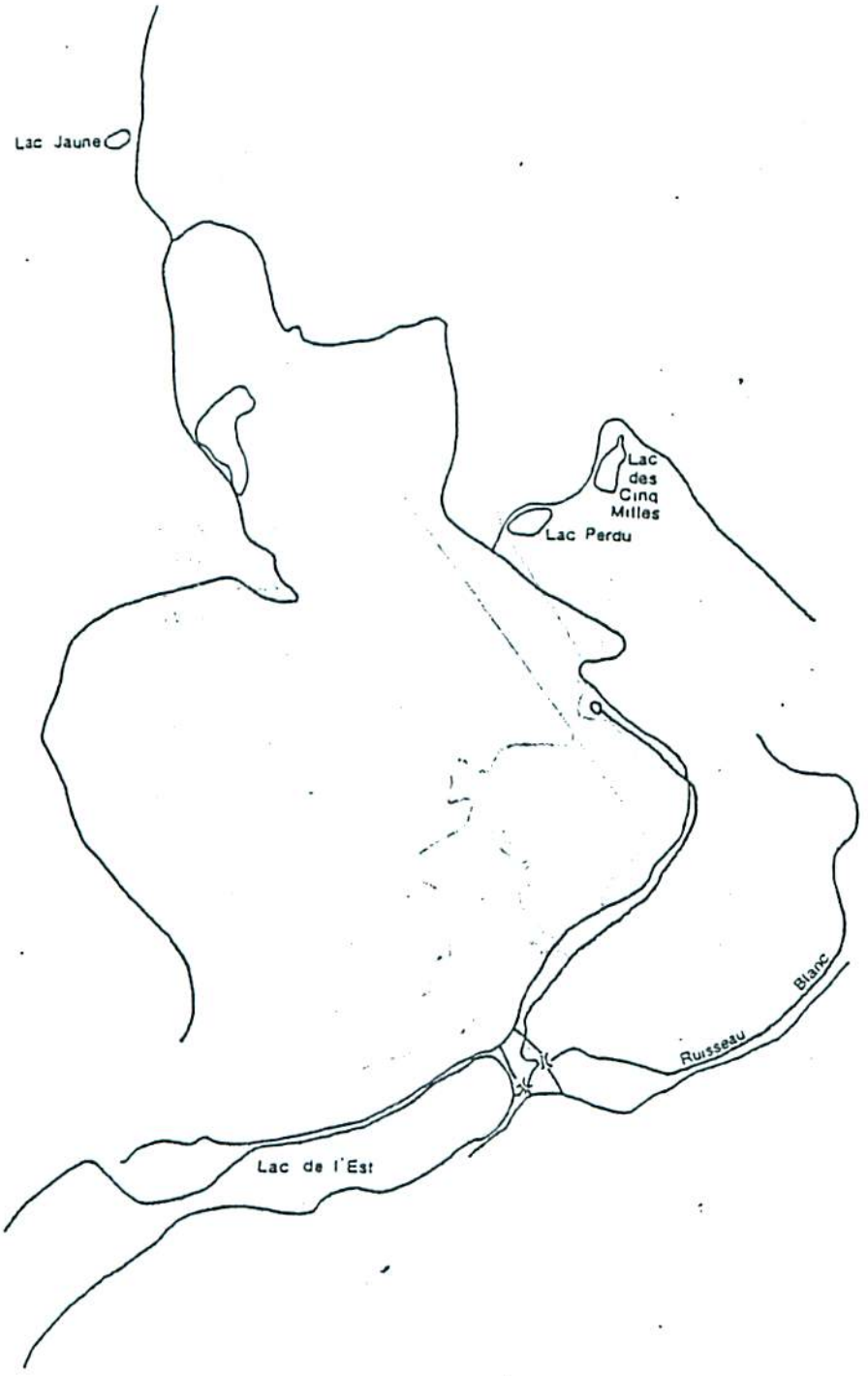

Figure 3: Location of lake sampling stations in Block 102

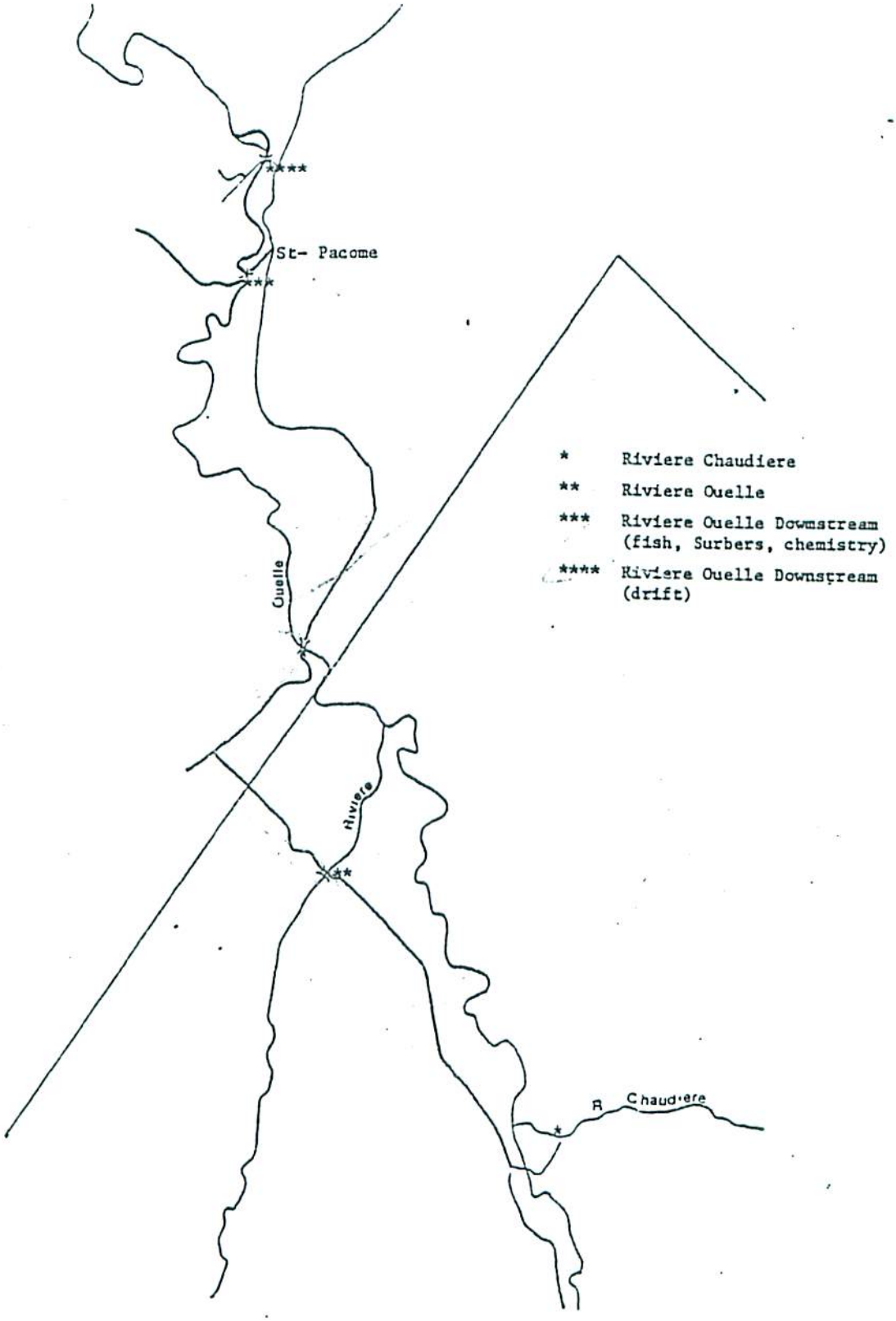

Figure 4: Location of sampling stations in Block 109

the open. Insecticide deposit on the aluminum pans was estimated by washing the dye off the pans with a small volume of toluene and determining the amount of dye deposited on the pans with a colorimeter. This was compared with the amount of dye in a reference standard taken from the original spray formulation to determine the actual spray deposit. Insecticide deposit on Kromekote cards was estimated by spot-counting after the method of Hurtig et al. (1953).

Physical Chemistry

Air and water temperatures, dissolved oxygen, pH, alkalinity and hardness were measured at each station before and after each spray using a Hach Kit, Model AL-36B.

Bottom Fauna

Bottom fauna were sampled before and after each spray using a standard 0.093 m^2 Surber sampler (Surber, 1936). Samples were either picked immediately or preserved in their entirety in the field in a 10% solution of formaldehyde. In the laboratory, benthic organisms were separated from the substrate, counted and identified to order or family using a dissecting microscope. For each sampling date, results were expressed as mean number and standard deviation of aquatic organisms of a particular group collected in four Surber samples.

Drift

Morning and evening drift samples of measured duration were taken for at least three days before and three days after each spray. On spray days, additional drift samples were taken periodically to determine any immediate effects due to the insecticide applications.

Drift nets measuring 0.47 m x 0.32 m were placed in the stream to sample a column of water from surface to bottom, including the surface film. Where water levels were extremely high a drift from the surface to a depth of 0.32 m was taken. Current speed was measured at the mouth of the drift nets half way between the surface and bottom using either the Teledyne Gurley No. 625 Pygmy Current Meter or the Teledyne Gurley No. 665 Direct Reading Current Meter.

Using the above information the following could be calculated:

depth at station (m) x width of drift net (0.47 m) x current speed (m/sec) x duration of drift sample (sec) = m^3 of water in drift column.

width of drift net (0.47 m) x current speed (m/sec) x duration of drift sample (sec) = m^2 of surface area of drift column.

Drift samples were picked and identified in the same way as bottom fauna samples, and the results expressed as:

number of invertebrates/m^3 of water in drift column (for aquatic invertebrates)

number of invertebrates/10 m^2 of surface area of drift column (for terrestrial invertebrates)

Fish Diets

Fish for stomach content analysis were collected using either minnow traps or by electrofishing (Appendix III, Tables 1-5). Total length, fork length, weight and sex were recorded for each fish caught for stomach content analysis. Stomachs were excised and preserved immediately in formaldehyde. In the laboratory, the volume of the stomach contents was measured and the composition of food items determined under a dissecting microscope. In measuring the volume of the stomach contents, the amount of indigestible material present was estimated and the measured volume corrected accordingly so as to represent actual volume of food items..

Insecticide Residues in Water and Fish Tissues

Fish caught for analysis for insecticide residues (Table 3) were frozen as soon after collection as possible. Water samples were taken at intervals from a number of aquatic sampling stations (Tables 6-10) by personnel from the Ministere des Rechesses Naturelles. All samples were analysed by gas-liquid chromatography in the Quebec Services de Protection de l'Environnement laboratory in Quebec City. For a more detailed description of field and laboratory procedures for collection and analysis of samples, refer to Mathieu et al (1979).

RESULTS

Water Chemistry

The water chemistry parameters for each sampling station are summarized in Table 4. As stream water temperatures increased over the study period from near freezing to a maximum of 17.0°C a corresponding decrease in dissolved oxygen content from a maximum of 14.0 mg/ℓ to a minimum of 8 mg/ℓ was noted. Although the temperatures of lake surface waters (18.5-20°C) were slightly higher than stream water temperatures by the end of the study period, dissolved oxygen content was in the same range for both (8.0-10.0 mg/ℓ).

Table 3
Fish Collected for Insecticide Residue Analysis

Station	Date	Fish Species*	Sample Weight (g)
Ruisseau Blanc	31 May 1978	BT,SLS	31.48
	4-7 June 1978	BT,SLS	23.33
	15 June 1978	BT,SLS	35.44
	19-21 June 1978	BT	53.69
		SLS	62.05
	27 June 1978	BT	93.52
		SLS	24.93
Riviere du Loup (102)	31 May 1978	BND	43.40
	6-7 June 1978	BND	78.03
Riviere Chaudiere	29-31 May 1978	BND	44.80
	5-6 June 1978	AS,NRBD,BND,CC	23.20
	17 June 1978	BND	10.91
Riviere Ouelle	29 May 1978	SS,BND	15.65
	3-6 June 1978	PD	31.00
		AS,FD,RS,BND,BS	23.17
Riviere Ouelle Downstream	29 May 1978	CS	82.47
		CM,LND	95.83
	5-6 June 1978	CM,CS	153.87
	18 June 1978	CM,CS,BND,LND,WS	32.85
Lac des Cinq Milles	8 June 1978	NRBD	87.14
	21 June 1978	NRBD	88.24
Lac Perdu	8 June 1978	NRBD	74.32
	19 June 1978	NRBD	96.91
Lac Jaunne	8 June 1978	NRBD	51.16
	19 June 1978	NRBD	31.91

* AS	Atlantic salmon	*Salmo salar*
BT	brook trout	*Salvelinus fontinalis*
NRBD	northern redbelly dace	*Chrosomus eos*
FD	finescale dace	*Chrosomis neogaeus*
CM	cutlips minnow	*Exoglossum maxillingua*
CS	common shiner	*Notropis cornutus*
RS	rosyface shiner	*Notropis rubellus*
SS	sand shiner	*Notropis stramineus*
BND	blacknose dace	*Rhinichthys atratulus*
LND	longnose dace	*Rhinichthys cataractae*
CC	creek chub	*Semotilus atromaculatus*
PD	pearl dace	*Semotilus margarita*
WS	white sucker	*Catostomus commersoni*
BS	brook stickleback	*Culaea inconstans*
SLS	slimy sculpin	*Cottus cognatus*

INSECTICIDE DEPOSIT AND RESIDUE ANALYSIS

Deposit Measurement

Deposit of emitted spray products as measured by colorimetric analysis and spot counting was extremely variable, ranging from < 1 to 37% of the emitted dosage rates (Table 5). This variability in deposit is probably due to:

a) differences in the positioning of sample units to approximate the effects of stream cover
b) the basic inefficiency of the flat sample surface
c) problems with the present application technology of large-scale operational sprays.

The generally lower results from spot counting probably reflect a loss of the most volatile fraction of the formulations, the insecticide diluent "585", from descending spray droplets through evaporation.

Some technical problems were encountered with the fenitrothion formulation on May 15 such that not all of the spray lines received the same concentration of insecticide. Lines 1, 5*, and 9 were treated with formulation found to be 60% and 144% of the planned concentration according to two samples taken at different times during loading, lines 17, 21**, and 25 were treated with formulation 136-140% of the planned concentration, and line 13*** was treated with formulation 27% of the planned concentration (Figure 5).

In three out of four instances where deposit was measured at a downstream station some drift of spray products was noted. Rivere du Loup Downstream Station, located 0.35 miles from Block 101 (Figure 1), had a deposit on May 11, as measured by spot counting, of 3.54×10^{-3} ℓ/ha, Riviere du Loup Downstream Station, located 2.55 miles from Block 102 (Figure 2), had a deposit on May 15 of 1.22×10^{-3} ℓ/ha, and Riviere Quelle Downstream Station, located 2.55 miles from Block 109 (Figure 3), had a deposit on June 2 of 3.38×10^{-4} ℓ/ha. On May 15, the Control Station, located 0.65 miles from Block 102 (Figure 2), was inadvertently sprayed with fenitrothion and received a deposit of 2.36×10^{-1} ℓ/ha.

Residues in Water

In general, levels of fenitrothion in stream waters peaked very soon after spraying (< 6 hours) and then declined more or less steadily to close to the level of detection (0.010 µg/ℓ) or below within 96 hours (Tables 6 and 7). Levels of aminocarb

* Riviere du Loup Station
** Ruisseau Blanc Station
*** headwaters of Riviere du Loup

Table 4
Water Chemistry

ock	Station	Date	Time	Air Temp (°C)	Water Temp (°C)	D.O. (mg/l)	Alkalinity (mg/l)	Hardness (mg/l)	pH
01	Riviere Manie	7 May 78	8:50 AM	6.7	0.0	14.0	17.0	51.0	6.5
		14 May 78	11:36 AM	20.0	4.0	12.0	17.0	17.0	7.0
	Riviere du Loup	7 May 78	10:50 AM	6.6	0.8	13.0	17.0	68.0	7.0
		14 May 78	12:26 PM	20.0	5.0	12.0	17.0	17.0	7.0
	Riviere du Loup Downstream	8 May 78	8:40 AM	4.5	0.0	13.0	17.0	34.0	7.0
		14 May 78	10:55 AM	20.0	3.0	12.0	17.0	17.0	7.0
02	Ruisseau Blanc	12 May 78	12:20 PM	21.0	2.0	12.0	17.0	34.0	7.0
		18 May 78	12:25 PM	15.0	5.0	11.0	17.0	34.0	7.5
		30 May 78	11:30 AM	19.0	14.0	10.0	34.0	51.0	7.5
		7 June 78	12:30 PM	23.0	12.0	9.0	17.0	51.0	9.0
		21 June 78	1:20 PM	26.0	16.0	9.0	34.0	51.0	7.5
	Riviere du Loup	12 May 78	10:50 AM	16.0	1.0	11.0	17.0	34.0	7.0
		18 May 78	11:44 AM	16.0	6.0	11.0	17.0	17.0	7.0
		30 May 78	10:47 AM	19.0	14.0	9.0	34.0	34.0	7.5
		7 June 78	11:30 AM	19.0	16.0	9.0	17.0	34.0	7.5
		21 June 78	1:10 PM	21.0	16.0	9.0	34.0	51.0	7.5
	Riviere du Loup Downstream	12 May 78	8:55 AM	12.0	1.5	13.0	17.0	17.0	7.0
		18 May 78	10:30 AM	22.0	6.0	12.0	17.0	17.0	7.0
		30 May 78	10:00 AM	17.5	14.0	9.0	17.0	34.0	7.5
		7 June 78	11:30 AM	21.0	14.0	10.0	17.0	68.0	7.5
		21 June 78	12:50 PM	21.0	15.5	9.0	17.0	34.0	7.5
	Control	12 May 78	9:45 AM	10.0	2.0	11.0	17.0	17.0	6.0
		18 May 78	11:06 AM	22.0	10.0	9.0	17.0	17.0	6.0
	Lac Perdu	7 June 78	3:00 PM	25.6	20.6	9.0	17.0	34.0	8.0
		19 June 78	10:05 AM	23.0	20.0	8.0	17.0	17.0	7.5
	Lac des Cinq Milles	7 June 78	4:00 PM	22.0	21.0	8.0	17.0	34.0	7.5
		19 June 78	10:45 AM	23.0	20.0	9.0	17.0	17.0	7.5
	Lac Jaune	8 June 78	7:00 PM		18.5	11.0	51.0	68.0	7.5
		19 June 78	12:10 PM	24.0	18.5	10.0	34.0	51.0	7.5
109	Riviere Chaudiere	29 May 78	10:20 AM	24.0		10.0	17.0	34.0	7.0
		5 June 78	11:00 AM	20.0	15.0	9.0	34.0	34.0	7.5
	Riviere Ouelle	29 May 78	9:10 AM	20.0		9.0	51.0	51.0	7.0
		5 June 78	10:30 AM	19.0	17.0	8.0	34.0	34.0	7.5
	Riviere Ouelle Downstream	29 May 78	11:30 AM	24.0	12.0	9.0	34.0	34.0	7.5
		5 June 78	9:30 AM	17.0	16.0	9.0	34.0	34.0	7.5

Table 5
Deposit of emitted spray products on Kromekote cards and aluminum pans.

Block	Insecticide	Date	Station	Spot Counting *l/ha deposited	Spot Counting % deposit	Colorimetric analysis *l/ha deposited	Colorimetric analysis % deposit
101	aminocarb	11 May/78	Riviere Manie	7.88×10^{-3}	0.70	2.50×10^{-2}	2.23
			Riviere du Loup	6.70×10^{-2}	5.97	2.25×10^{-1}	20.05
			Riviere du Loup Downstream	3.54×10^{-3}	0.32	0	0
102	fenitrothion	15 May/78	Ruisseau Blanc	2.51×10^{-2}	2.24	8.25×10^{-2}	7.35
			Riviere du Loup	1.17×10^{-2}	1.04	3.75×10^{-2}	3.34
			Riviere du Loup Downstream	1.22×10^{-3}	0.11	7.50×10^{-3}	0.67
			Control	2.36×10^{-1}	21.39	2.30×10^{-1}	20.50
	aminocarb	3 June/78	Ruisseau Blanc	2.24×10^{-2}	2.00	7.50×10^{-2}	6.68
		4 June/78	Riviere du Loup	2.34×10^{-2}	2.10	1.25×10^{-1}	11.14
			Riviere du Loup Downstream	0	0	0	0
	aminocarb	16 June/78	Ruisseau Blanc	1.16×10^{-1}	10.70	2.00×10^{-1}	17.82
			Lac Perdu	3.66×10^{-1}	37.11		
			Lac des Cinq Milles	3.93×10^{-3}	0.35		
			Lac Jaune	3.10×10^{-1}	27.63		
109	aminocarb	2 June/78 AM	Riviere Chaudiere	3.33×10^{-4}	0.03	0	0
			Riviere Ouelle	1.74×10^{-2}	1.55	0	0
			Riviere Ouelle Downstream	3.38×10^{-4}	0.03	0	0
		PM	Riviere Chaudiere	4.59×10^{-2}	4.09	1.25×10^{-1}	11.14

* 1.122 l/ha emitted (nominal application rate).

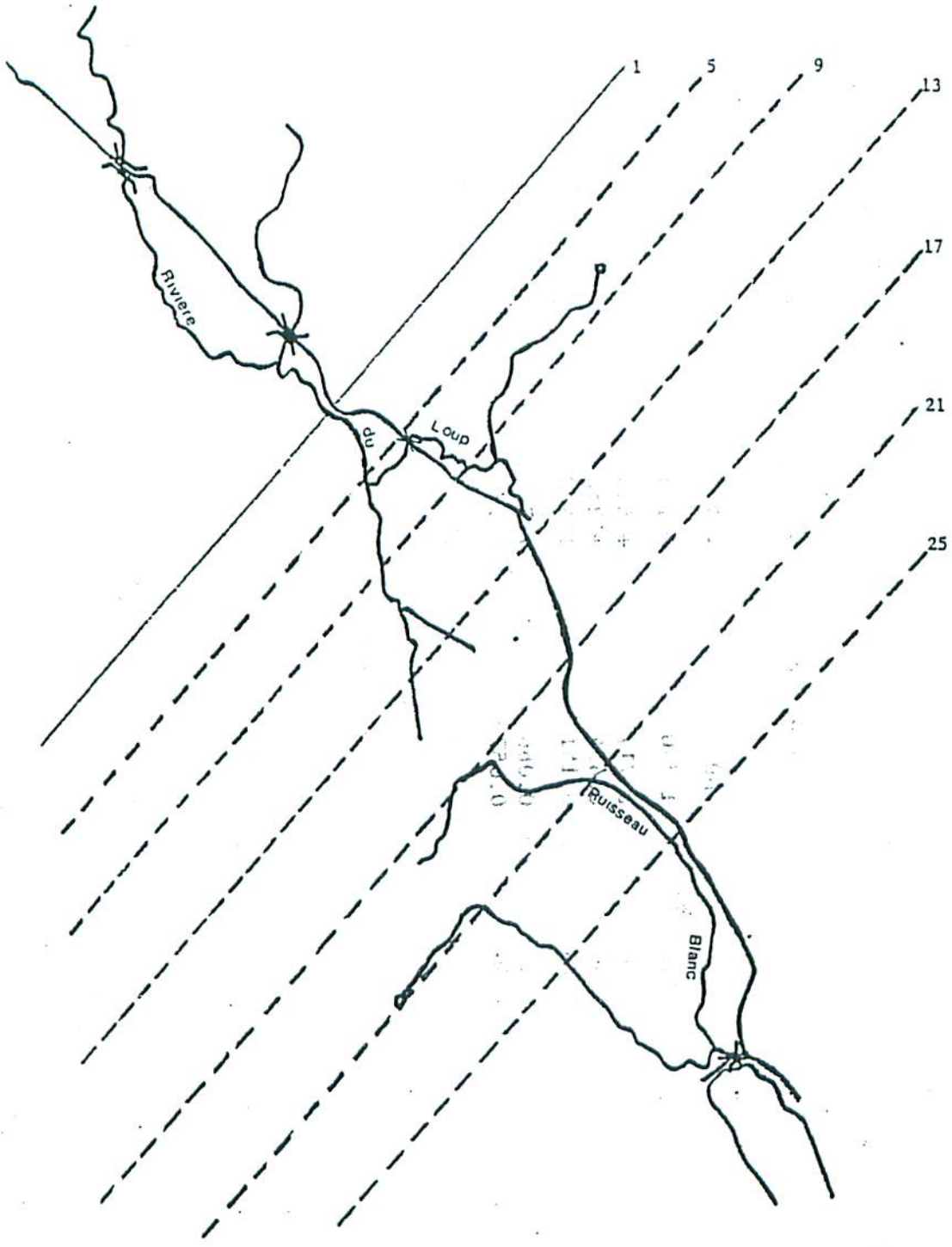

Figure 5: Location of spray lines in Block 102

Table 6
Residues of fenitrothion in the Riviere du Loup watershed,
Block 102, Kamouraska County, Quebec, 12 - 19 May, 1978

Date	Riviere du Loup		Riviere du Loup Downstream	
	Time*	Concentration (ug/l)	Time*	Concentration (ug/l)
12 May, 1978	-75:15	ND	-72:15	ND
15 May, 1978	+ 1:30	1.740	+ 2:30	0.401
16 May, 1978	+ 4:40	0.717	+ 5:55	0.878
	+11:00	0.434	+12:20	0.398
	+23:10	0.151	+24:05	0.203
17 May, 1978	+36:30	0.066	+37:45	0.063
	+47:00	0.057	+47:50	0.072
19 May, 1978			+96:00	0.019

* hours before or after application of 0.210 kg AI/ha fenitrothion

ND nondetectable (< 0.010 ug/l)

information supplied by the Ministere des Richesses Naturelles and the Services de Protection de l'Environnement

Table 7
Residues of aminocarb in Ruisseau Blanc,
Block 102, Kamouraska County, Quebec.
12 - 19 May and 1 - 7 June, 1978

Date	Time*	Concentration (ug/l)
12 May, 1978	-77:45	ND
15 May, 1978	+ 1:00	1.0310
16 May, 1978	+ 4:30	0.1060
	+10:45	0.5700
	+22:55	0.0690
17 May, 1978	+36:00	0.0229
	+46:40	0.0368
19 May, 1978	+96:00	ND
1 June, 1978	-54:55	ND
3 June, 1978	+ 1:00	0.404
4 June, 1978	+ 5:05	0.174
	+13:00	0.273
	+23:00	ND
5 June, 1978	+36:45	ND
	+47:00	0.058
7 June, 1978	+96:00	ND

* hours before or after application of 0.053 kg AI/ha aminocarb or 0.210 kg AI/ha fenitrothion

ND nondetectable (<0.010 ug/l)

information supplied by MNR and SPEQ

in stream waters in Block 101 peaked sooner (< 2 hours) and disappeared more quickly to below the level of detection in only 24 hours (Table 8). In Block 109 the persistance of aminocarb residues in stream waters is not so clearly defined (Table 9) because the watershed was sprayed in two sections; the lower station was sprayed in the morning and the upper station in the evening of the same day (Figure 3). Generally, however, levels had peaked within 16 hours and dropped to close to the level of detection within 36 hours (Table 9).

In lake surface waters, levels of aminocarb were generally higher and more persistant than in stream waters (Table 10). Because the aminocarb was applied in an oil formulation it may have become concentrated in the surface waters of the downwind side of the lake very soon after spraying. This, along with differences in deposit, may explain the large differences in levels of aminocarb found in the three study lakes immediately after spraying. By 48 hours the carrier oil had evaporated and the chemical had become more evenly dispersed throughout the surface waters (Table 10).

The aminocarb concentrations of 2.083 µg/ℓ for Lac Jaune and 0.726 µg/ℓ for Lac des Cinq Milles on June 6 are the result of the June 3 spray in Block 102.

Residues in Fish

Residues of aminocarb were not detected (< 0.003 µg/g) in any of the fish tissue samples subjected to GLC analysis (Table 3).

BIOLOGICAL SAMPLING

Aquatic Invertebrates

Results of drift netting and Surber sampling are summarized in Appendix I, Tables 1-18.

Block 101 Erratic fluctuations in numbers of most groups of aquatic invertebrates, notably heptagenid mayfly nymphs (Ephemeroptera:Heptageneidae), baetid mayfly nymphs (Ephemeroptera:Baetidae), stonefly nymphs (Plecoptera) and caddisfly larvae (Trichoptera) were noted in the drifts at all three stations (Appendix I, Tables 1-3). This is most likely the result of changes in water level associated with the early spring runoff, rather than any effect related to the aminocarb application.

Table 8
Residues of aminocarb in the Riviere du Loup watershed,
Block 101, Kamouraska County, Quebec
10 - 15 May, 1978

Date	Riviere Manie		Riviere du Loup		Riviere du Loup Downstream	
	Time*	Concentration (ug/l)	Time*	Concentration (ug/l)	Time*	Concentration (ug/l)
10 May, 1978			-33:50	ND	-33:10	ND
11 May, 1978	+ 1:20	0.942	+ 1:10	0.933	+ 1:55	0.359
12 May, 1978	+ 5:15	0.213	+ 5:00	0.035	+ 5:35	0.089
	+11:05	0.044	+10:50	ND	+11:25	0.034
	+23:15	ND	+23:00	ND	+24:15	ND
13 May, 1978	+36:30	ND	+36:05	ND	+36:45	ND
	+47:00	ND	+46:40	ND	+47:05	ND
15 May, 1978			+89:30	ND	+89:50	ND

* hours before or after application of 0.053 kg AI/ha aminocarb

ND nondetectable (< 0.010 ug/l)

information supplied by MNR and SPEQ

Table 9
Residues of aminocarb in the Riviere Ouelle watershed,
Block 109, Kamouraska County, Quebec
30 May - 6 June, 1978

Date	Riviere Chaudiere		Riviere Ouelle		Riviere Ouelle Downstream	
	Time*	Concentration (ug/1)	Time*	Concentration (ug/1)	Time*	Concentration (ug/1)
30 May, 1978					-63:05	ND
2 June, 1978	+ 1:10	ND	+ 1:30	1.500	+ 2:00	0.016
	+ 4:40	0.030	+ 5:10	3.340	+ 5:30	0.528
	+14:45	0.561	+14:55	0.085	+15:20	0.991
3 June, 1978	+19:15	0.030	+19:35	0.376	+20:00	0.123
	+32:40	ND	+32:50	0.016	+33:15	0.026
4 June, 1978	+51:10	ND	+51:30	ND	+51:40	ND
6 June, 1978			+97:40	ND	+98:00	ND

* hours before or after application of 0.053 kg AI/ha aminocarb

ND nondetectable (< 0.010 ug/1)

information supplied by MNR and SPEQ

Table 10
Residues of aminocarb in three lakes in Block 102,
Kamouraska County, Quebec, 6 - 18 June, 1978

Date	Lac Jaune		Lac Perdu		Lac des Cinq Milles	
	Time*	Concentration (ug/l)	Time*	Concentration (ug/l)	Time*	Concentration (ug/l)
June, 1978	-240:00	2.083			-240:00	0.726
June, 1978	+ 1:00	2.533	+ 1:00	5.541	+0.5:00	0.442
			+ 1:00	5.709**	+ 1:00	0.311
June, 1978	+48:00	1.414	+48:00	1.993	+48:00	1.241

* hours before or after application of 0.053 kg AI/ha aminocarb

** concentration of aminocarb in emissaire du Lac Perdu

information supplied by MNR and SPEQ

Block 102 There was a slight but very definite increase (< one order of magnitude) in number of heptagenid and baetid mayfly nymphs showing up in the drift at the Riviere du Loup Downstream station 2 hours after the fenitrothion application and persisting to the next morning, after which numbers returned to close to the pre-spray levels (Appendix I, Table 5; Figure 6). No increases in the drift were noted at either the Riviere du Loup station or the Control station (Appendix I, Tables 4 and 6).

For the second spray, numbers of blackfly larvae (Diptera: Simuliidae) in the drift at Riviere du Loup station fluctuated considerably (Appendix I, Table 7), but this does not appear to be related to the aminocarb application. Numbers of aquatic invertebrates caught in the drift at the downstream station remained fairly constant over this sampling period (Appendix I, Table 8).

Bottom fauna populations in the streams of Block 102 were monitored from 12 May to 26 June. Over this period, which covered all three sprays (Table 1), populations of most aquatic invertebrates either remained relatively constant or increased. At the Riviere du Loup Downstream station populations of a number of groups of aquatic invertebrates, notably heptagenid mayfly nymphs, stonefly nymphs, caddisfly larvae and chironomid larvae (Diptera: Chironomidae), appeared to peak about June 20, four days after the final spray (Appendix I, Table 14). At Riviere du Loup station, although populations of other invertebrates remained fairly constant, the population of baetid mayfly nymphs steadily increased over the sampling period to a level approximately 60 times higher than the pre-spray (Appendix I, Table 13). This steady increase in numbers of baetid mayfly nymphs was also noted at the downstream station (Appendix I, Table 14) but was not as dramatic (approximately 20 times higher than the pre-spray level). For Ruisseau Blanc, the population of heptagenid mayfly nymphs increased over the first part of the sampling period, reaching a peak about June 7 and 14 just before the third spray (Appendix I, Table 12). After the third spray there was a noticeable drop in the population (< one order of magnitude). A much smaller drop in numbers was noted for baetid mayfly nymphs at this time.

Block 109 Numbers of aquatic invertebrates caught in drift net sets at the Riviere Chaudiere and Riviere Ouelle Downstream stations remained fairly constant over the entire sampling period (Appendix I, Tables 9 and 11). There was a small but noticeable increase in the drift of blackfly larvae (< one order of magnitude) at the Riviere Ouelle station two hours after the aminocarb application (Appendix I, Table 10; Figure 7). By the next morning numbers had returned to the pre-spray level.

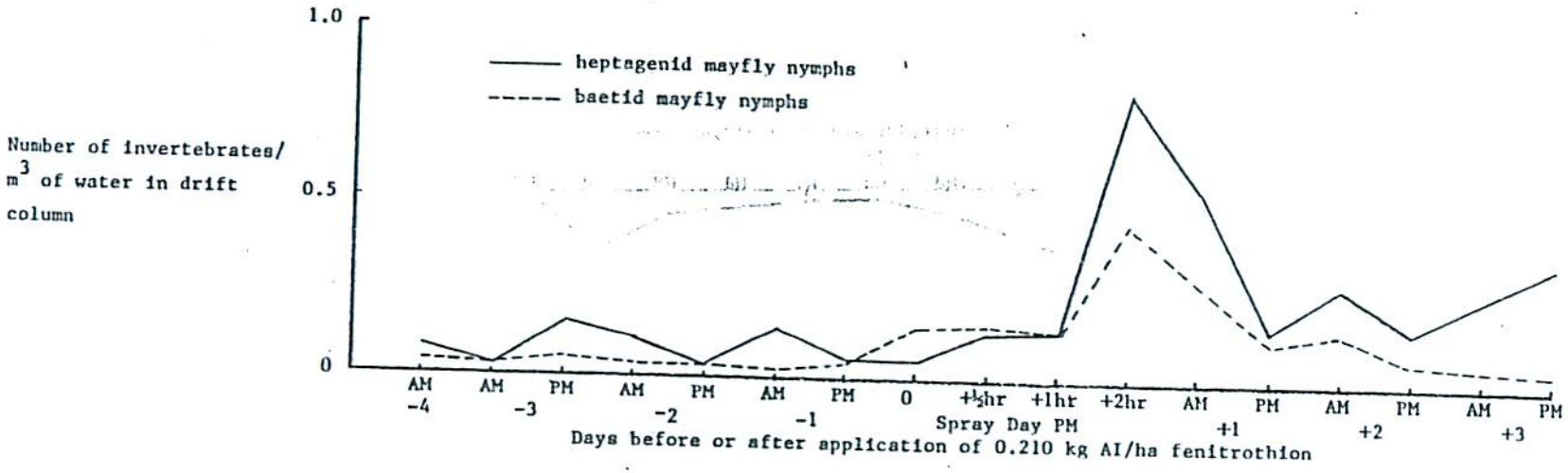

Figure 6: Heptagenid and baetid mayfly nymphs caught in drift net sets, 11-18 May 1978, Block 102, Riviere du Loup Downstream station, Kamouraska Co., Quebec.

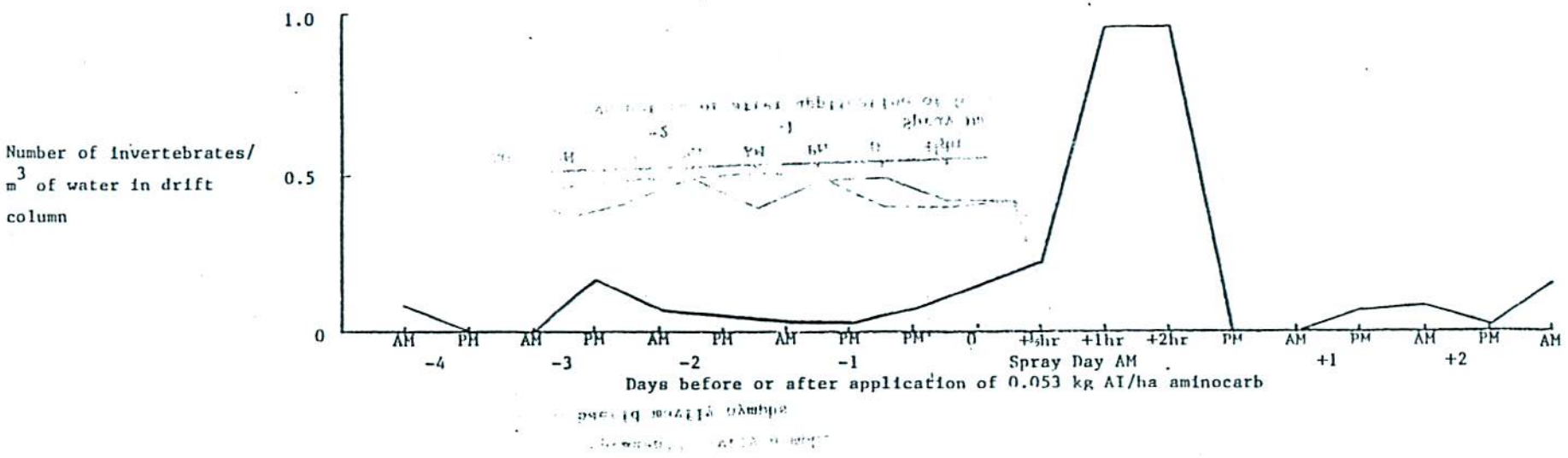

Figure 7: Blackfly larvae caught in drift net sets, 29 May-5 June 1978, Block 109, Riviere Ouelle, Kamouraska Co., Quebec.

There were no apparent changes in bottom fauna populations at either the Riviere Chaudiere or Riviere Ouelle stations (Appendix I, Tables 16 and 17). It was necessary to relocate the sampling station at Riviere Ouelle Downstream several times over the sampling period because drastic changes in water level made it impossible to Surber sample the same area consistently. As a result, the apparent changes in abundance of different groups of aquatic insects shown in Appendix I, Table 18 cannot be considered to truly reflect changes in bottom fauna populations.

Terrestrial Invertebrates

Results of drift netting are summarized in Appendix II, Tables 1-8.

Block 101 There was a noticeable increase in the number of adult Diptera showing up in the drift at the Riviere du Loup station (approximately 18 times more insects than in the pre-spray sample) 1/2 hour after the aminocarb application (Appendix II, Table 2; Figure 8). By 2 hours after the spray the number had dropped to near the pre-spray level. At the downstream station a large increase in the drift of spruce budworm larvae (Lepidoptera:Tortricidae) was noted on the evening of the first day after the spray (Appendix II, Table 3; Figure 9). No changes in the drift were observed at the Riviere Manie station (Appendix II, Table 1).

Block 102 An increase in the drift of budworm larvae at the Riviere du Loup Downstream station was noted immediately after the fenitrothion application (Appendix II, Table 5; Figure 10). In the next three days 2 or more peaks in numbers of budworm larvae of a similar magnitude were observed. No changes in the drift were noted for the second spray at the downstream station or for either spray at the other sampling stations (Appendix II, Tables 4 and 6-8).

Block 109 There were large increases in the drift of adult Hymenoptera and Diptera at the Riviere Chaudiere station beginning immediately after the aminocarb application (Appendix II, Table 9; Figure 11). Numbers had returned to near the pre-spray level by the next morning for Diptera and by the next evening for Hymenoptera. A peak in numbers of adult Diptera in the drift two days before the spray occurred as a result of heavy rains and high runoff. There were no apparent changes in the drift at the other two stations (Appendix II, Tables 10 and 11).

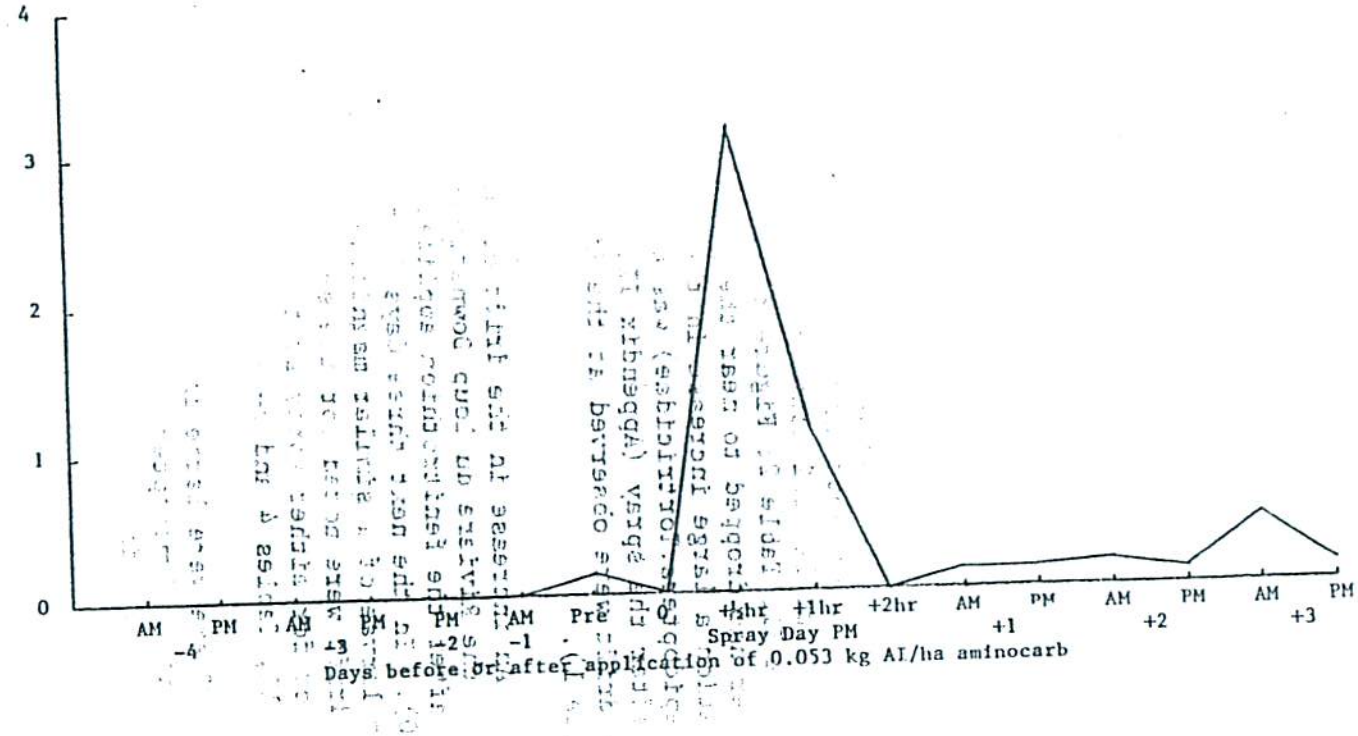

Figure 8: Adult diptera caught in drift net sets, 7-14 May 1978, Block 101, Riviere du Loup, Kamouraska Co., Quebec.

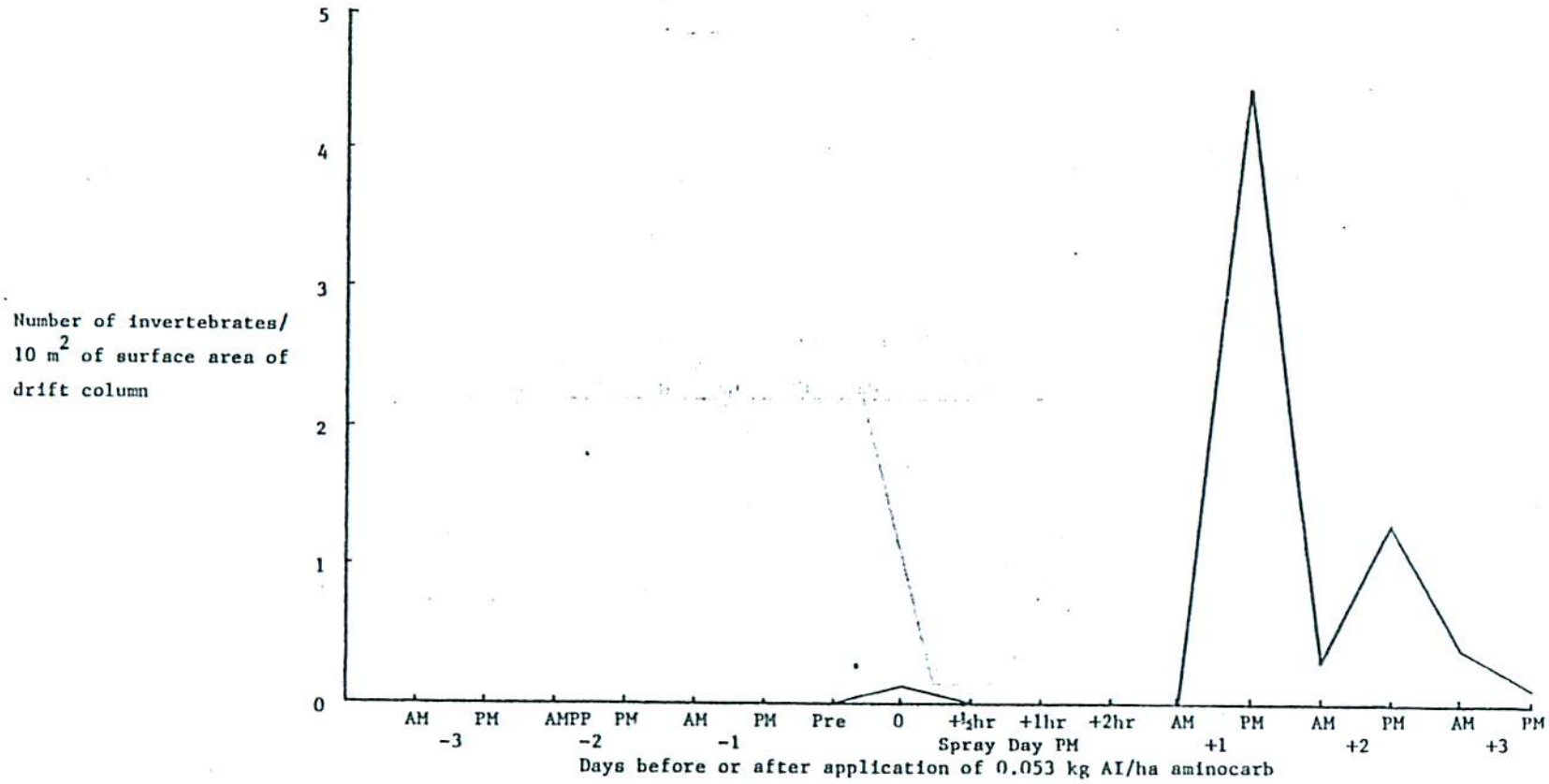

Figure 9: Spruce budworm larvae caught in drift net sets, 8-14 May 1978, Block 101, Riviere du Loup Downstream station, Kamouraska Co., Quebec.

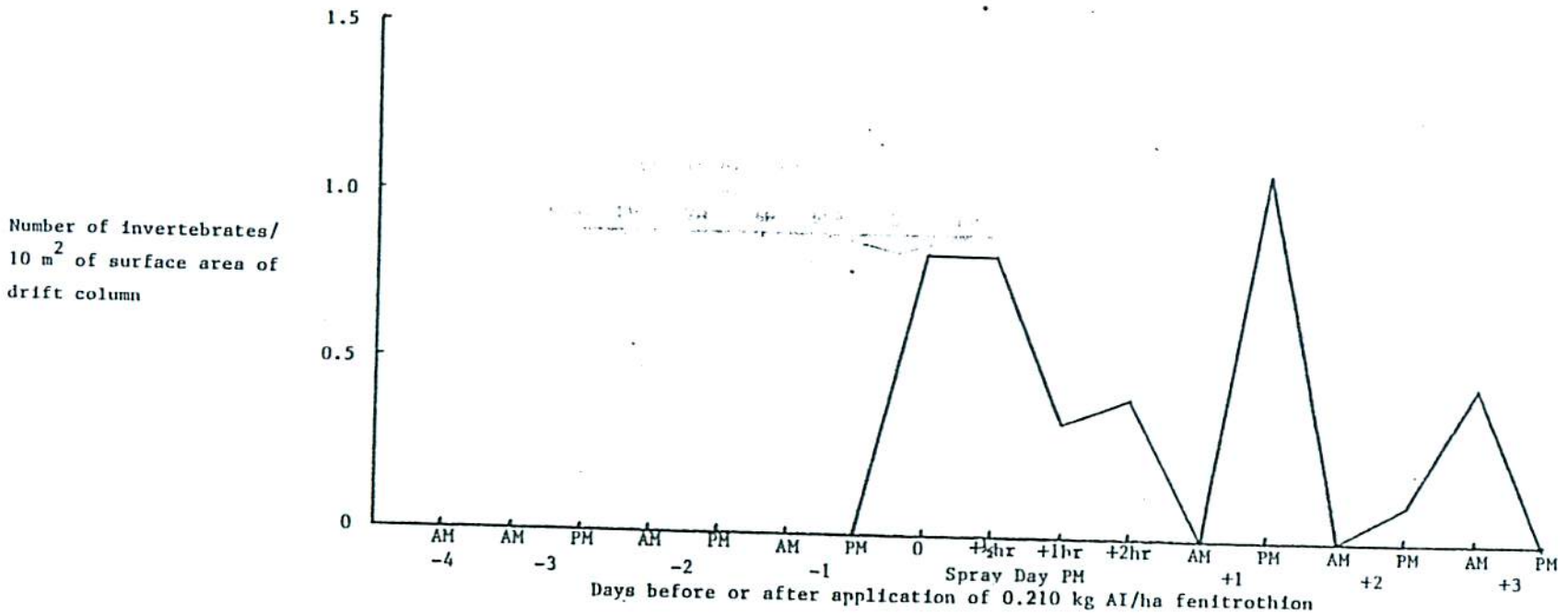

Figure 10: Spruce budworm larvae caught in drift net sets, 11-18 May 1978, Block 102, Riviere du Loup Downstream Station, Kamouraska Co., Quebec.

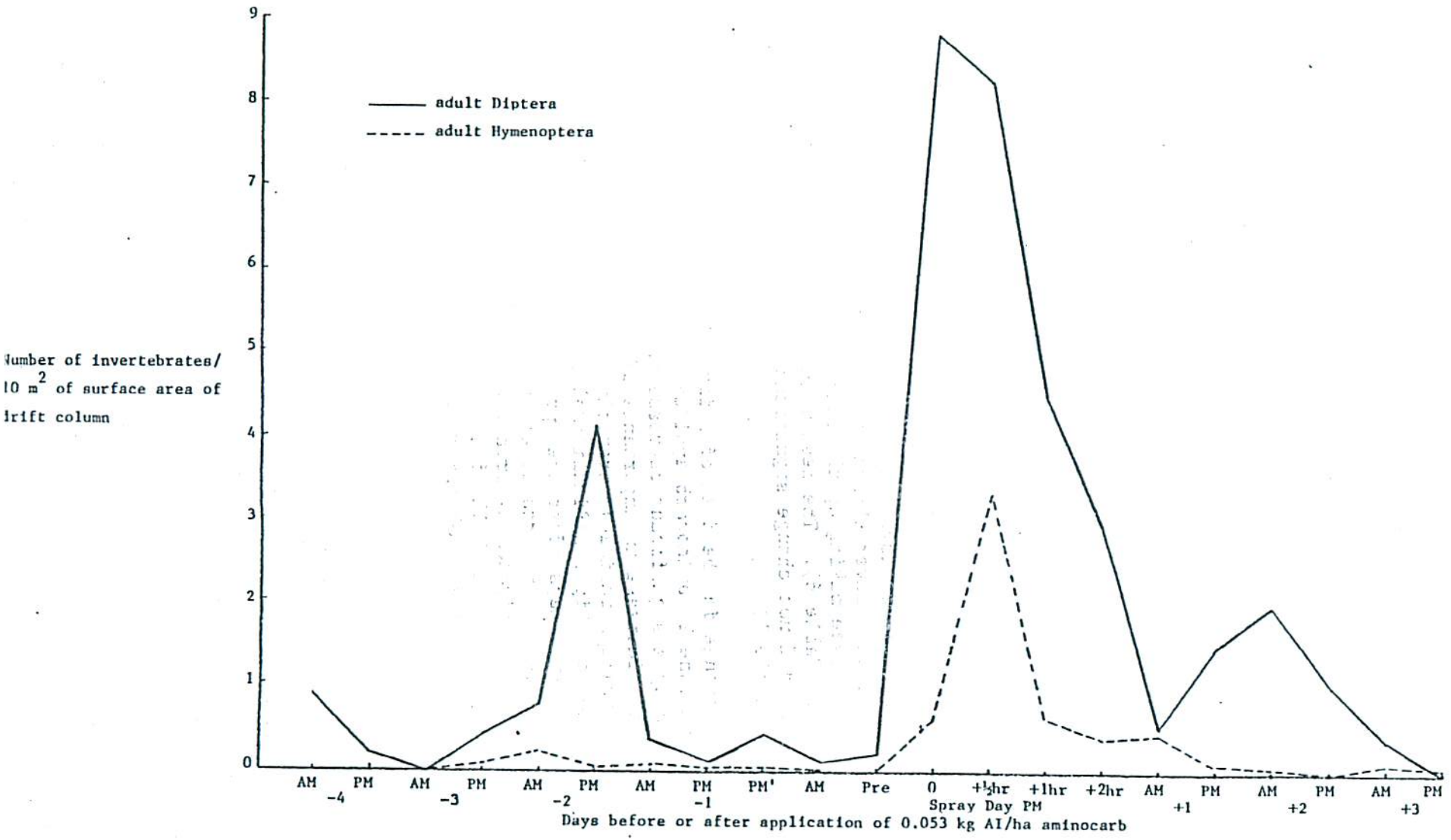

Figure 11: Adult diptera and hymenoptera caught in drift net sets, 29 May-5 June 1978, Block 109, Riviere Chaudiere, Kamouraska Co., Quebec.

Fish Diets

Fish were obtained for stomach content analysis from two stations in Block 102 and from three stations in Block 109 by electrofishing or trapping: brook trout (*Salvelinus fontinalis*) and slimy sculpin (*Cottus cognatus*) from Ruisseau Blanc; blacknose dace (*Rhinichthip atratulus*) from Riviere du Loup, Riviere Chaudiere and Riviere Ouelle); and cutlips minnows (*Exoglossum maxillinqua*) from Riviere Ouelle Downstream (Appendix III, Tables 1-5).

Ruisseau Blanc Because of the small numbers of prespray brook trout caught (Appendix III, Table 1) it is very difficult to point out with any degree of certainty specific changes in diet which may have resulted from the two aminocarb applications. In general, however, it appears that knocked-down terrestrial invertebrates, particularly Lepidoptera larvae, adult Coleoptera and adult Diptera, became increasingly important in the diet of brook trout between June 4, one day after the first application, and June 21, five days after the second application. By June 27, eleven days after the second application, the importance of terrestrial invertebrates had become much reduced with caddisfly larvae making up the bulk of the diet at this time (Appendix III, Table 6). The mean volume of food items found in trout stomachs did not change significantly over this period (Appendix III, Table 1).

A significant change in the diet of slimy sculpins was observed following the June 16 aminocarb application. Three to five days after the spray a significant decrease in importance of baetid mayfly nymphs and increase in importance of burrowing mayfly nymphs (Ephemeroptera:Ephemeridae), cranefly larvae (Diptera: Tipulidae), blackfly larvae (Diptera:Simuliidae) and chironomid larvae was noted. By eleven days after the spray baetid mayfly nymphs had further decreased in importance as had burrowing mayfly nymphs, cranefly larvae and chironomid larvae, with stonefly nymphs and caddisfly larvae making up the bulk of the diet at this time (Appendix III, Table 7). Unlike brook trout, slimy sculpins did not appear to feed opportunistically on knocked-down terrestrial invertebrates.

Riviere du Loup (Block 102) Blacknose dace diets changed significantly following the June 4 aminocarb application with a shift in importance away from heptagenid mayfly nymphs, stonefly nymphs and caddisfly larvae and towards blackfly larvae, chironomid larvae and terrestrial Lepidoptera larvae (Appendix III, Table 8). Unfortunately no fish could be trapped after June 7 and so it is impossible to determine for how long this shift in diet persisted.

Riviere Chaudiere On May 29, four days before the first aminocarb application, blacknose dace in Riviere Chaudiere were feeding primarily on baetid mayfly nymphs and chironomid larvae. At this time five of the eleven fish caught had no food present in their stomachs. On May 31, two days before the first application, all eight fish sampled had empty stomachs, and on June 17, one week after the second application, only one fish of the five caught had been feeding (Appendix III, Table 9).

Riviere Ouelle Prior to the first aminocarb application, blacknose dace at Riviere Ouelle were feeding primarily on baetid and heptagenid mayfly nymphs, caddisfly larvae and chironomid larvae. Three of the five fish caught for stomach content analysis after the spray had no food present in their stomachs. A total of only four insects, one caddisfly larva, one caddisfly pupa, one blackfly larva, and one adult Diptera, were found in the stomachs of the other two fish caught at this time (Appendix IV, Table 10).

Riviere Ouelle Downstream On May 29, four days prior to the first aminocarb application, cutlips minnows at Riviere Ouelle Downstream were feeding on a variety of aquatic invertebrates including heptagenid and baetid mayfly nymphs, stonefly nymphs, caddisfly larvae, water pennies (Coleoptera:Psephenidae), chironomid larvae and dancefly larvae (Diptera:Empididae). After the first spray three of the seven fish sampled had empty stomachs. The other four fish taken at this time were feeding primarily on chironomid larvae and to a much lesser extent caddisfly larvae. After the second spray the diet was made up almost exclusively of chironomid larvae and a few caddisfly larvae for the two out of three fish taken which had food in their stomachs (Appendix III, Table 11).

DISCUSSION

Insecticide Residues

Work carried out by Eidt and Sundaram (1975) on three tributaries of the Nashwaak River in New Brunswick demonstrated that, at application rates of 140-210 g/ha fenitrothion, most peak concentrations were lower than 15 ppb and diminished very rapidly, even when entire drainage basins were sprayed. The persistence of both fenitrothion and aminocarb in water were studied as part of the environmental monitoring of the 1977 spruce budworm spray program in Newfoundland (Barnes, 1979). Maximum levels of fenitrothion occurred within six hours of each spray application (210 g/ha). These levels were: 39 ppb after the first spray and 49 ppb after the second spray. In each case the concentrations decreased rapidly and no fenitrothion was detected after about 50 hours. Aminocarb reached peak levels of 19 ppb to

24 ppb within three to four hours of application (88 g/ha) and had diminished to non-detectable levels within 15 to 20 hours.

In the present study maximum levels of fenitrothion and aminocarb found in stream and river water were much lower. The highest concentration of fenitrothion (1.74 ppb) was found at Riviere du Loup station in Block 102, one and a half hours after application. The highest concentration of aminocarb (3.34 ppb) was recorded at Riviere Ouelle station in Block 109, approximately 5 hours after application. In general, levels of fenitrothion and aminocarb had diminished to close to the level of detection (0.010 ppb) or below within 96 hours and 36 hours respectively.

In lake surface water aminocarb levels were generally higher and residues persisted longer than in streams and rivers. Concentrations of from 1 to 2 ppb were still present in all three study lakes even 48 hours after application. These higher levels may be the result of a number of factors:

1) relatively little insecticide applied over a lake is intercepted by foliage
2) foliar washing by rain and runoff from adjacent land areas continues to wash insecticide into lake surface waters
3) in running water a large proportion of the insecticide is washed downstream, whereas in lakes the disappearance of aminocarb is primarily the result of hydroxylation, hydrolysis and biodegradation by various microorganisms.

The concentration of aminocarb in the surface water of Lac Perdu and in the small stream which drains Lac Perdu were very similar (5.541 µg/ℓ and 5.709 µg/ℓ respectively) one hour after application (Table 10). This concentration of aminocarb, which is higher than in any of the other streams studied, should be expected since this stream drains surface water from the lake. In general, streams which drain sprayed lakes probably contain higher concentrations of insecticide and more persistent residues than other sprayed streams and consequently aquatic fauna in these streams should be more likely to suffer an impact. Further field studies will be required to test this hypothesis.

Effects on Aquatic Invertebrates

Two increases in drift were noted which appear to be directly related to the insecticide applications. At Riviere du Loup Downstream station a slight (< one order of magnitude) increase in numbers of heptagenid and baetid mayfly nymphs was observed 2 hours after the May 15 fenitrothion application. This increase in drift persisted to the next morning, but by the next evening numbers had returned to normal. This corresponds to the highest level of fenitrothion encountered in the study (1.740 ppb at Riviere du Loup station one and one half hours after application). It is about 11 km from Riviere du Loup station to the

downstream station and at a current speed of 3.6 km/hr (Appendix I, Table 5) it would take at least 3 hours for any insects affected at Riviere du Loup station to drift as far as Riviere du Loup Downstream. Since there was no increase in drift at Riviere du Loup station, and because the increase in drift at the downstream station showed up in less than 3 hours, it would appear that the impact must have occurred somewhere between the two stations.

A small increase in the drift of blackfly larvae at Riviere Ouelle station was observed one and two hours after the June 2 aminocarb application. By the next morning numbers had returned to normal. This corresponds to the highest levels of aminocarb in stream water recorded in the study (1.50 and 3.34 ppb at Riviere Ouelle station one and one half and 5 hours after application). Thus it would appear that there was an impact on blackfly larvae above the Riviere Ouelle station.

In both cases the increases in drift were small in magnitude and of a short duration and did not result in any significant changes in bottom fauna populations.

In only one instance in the present study was a reduction in bottom fauna populations apparently linked to an insecticide application. Although numbers of heptagenid and baetid mayfly nymphs at Ruisseau Blanc station increased following the June 3 aminocarb application, a significant reduction in the populations of both groups was noted following June 16 application. Deposit of insecticide, as measured by spot counting and colorimetric analysis, was approximately 5 and 3 times higher respectively for the second aminocarb application as compared to the first. Unfortunately water residue data is not available for this spray, so it is impossible to determine whether this heavier deposit resulted in higher concentrations of aminocarb in the stream.

Effects on Fish

Terrestrial invertebrates were particularly important items in the diets of brook trout caught between June 4, one day after the first aminocarb application, and June 21, four days after the second application. Since populations of aquatic invertebrates were only slightly affected by the second spray, and not at all by the first spray, this shift in importance is probably the result of opportunistic feeding by brook trout on terrestrial invertebrates which became more available at this time, either because of insecticide knockdown or insect emergence.

Following the June 16 aminocarb application there was a significant decrease in importance of baetid mayfly nymphs in the diets of slimy sculpins with a corresponding increase in importance of several other groups of aquatic insects. This change in diet reflects the reduction in numbers of baetid mayfly

nymphs resulting from the aminocarb application relative to other bottom fauna populations (Appendix I, Table 12). Since sculpins are primarily bottom feeders, knocked-down terrestrial insects were not as available an alternate source of food as for brook trout.

There was a shift in importance away from heptagenid mayfly nymphs, stonefly and caddisfly larvae, and towards blackfly larvae, chironomid larvae and terrestrial Lepidoptera larvae, in the diets of blacknose dace caught at Riviere du Loup station (Block 102) following the June 4 aminocarb application. Since numbers of heptagenid mayfly nymphs, stonefly nymphs and caddisfly larvae all increased in Surber samples between May 31 and June 7, it is unlikely that the observed changes in diet were in any way related to the spray.

At Riviere Ouelle and Riviere Chaudiere stations black nose dace stopped feeding at about the time of the June 2 aminocarb application. Since bottom fauna populations at both stations were unaffected by the insecticide application, it is unlikely that this change in diet is in any way related to the spray. The change in diet of cutlips minnows at Riviere Ouelle Downstream may or may not be related to the two aminocarb applications. Large fluctuations in water level, and the fact that these fish were spawning during the sampling period, were probably important factors at this station.

None of the fish samples collected for insecticide residue analysis from either lakes or streams contained detectable levels of aminocarb (0.003 µg/g) in their tissues, indicating that at peak water residue levels of 3,340 ppb in streams and 5.541 ppb in lakes no accumulation of aminocarb in fish tissues is likely to occur.

CONCLUSIONS

Applications of fenitrothion and aminocarb at the dosage rates studied had little or no adverse effects on aquatic invertebrates. Diets of brook trout, slimy sculpins and blacknose dace changed significantly following aminocarb applications but, since none of the applications resulted in any drastic changes in bottom fauna populations, this change in diet was probably only temporary. There was no accumulation of aminocarb residues in fish tissues at the water residue levels encountered in this study.

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APPENDIX I

AQUATIC INVERTEBRATES

Table I-1

Aquatic organisms caught in drift net sets*,

7 May - 14 May 1978, Block 101,

Riviere Manie, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb			-4 days		-3 days		-2 days	-1 day		Spray Day PM			+1 day		+2 days		+3 days	
			AM	PM	AM	PM	PM	AM	Pre	0	+½ hr	+1 hr	+2 hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)			0.70	0.70	0.75	0.80	1.00	0.70	1.50	1.50	1.50	1.50	1.50	1.60	1.13	0.91	0.91	1.52	0.58
Volume of drift column (m^3)			50.5	50.5	54.1	57.8	72.2	25.3	54.1	54.1	54.1	54.1	54.1	57.8	40.8	32.9	32.9	54.9	20.9
Nematomorpha			0.10							0.02									
Nematoda				0.08	0.02	0.02	0.17	0.04	0.04		0.06		0.04		0.03	0.03		0.02	0.05
Oligochaeta			0.02	0.12		0.02	0.01	0.08									0.03		
Pelecypoda					0.02														
Arachnida	Hydracarina			0.02		0.04	0.01	0.04	0.02	0.02					0.03	0.09		0.02	
Crustacea	Amphipoda												0.02					0.02	
Collembola											0.02					0.03	0.03		
Ephemeroptera	Ephemeridae	nymphs											0.02						
	Heptageniidae	nymphs	0.46	0.50	0.04	0.07	0.06	5.42	0.41	0.11	0.09	0.20	0.04	0.12	0.20	0.15	0.40	0.02	0.38
	Baetidae	nymphs	0.48	1.17	0.11	0.04	0.07	2.26	0.19	0.20	0.13	0.09	0.26	0.14	0.05	0.06	0.30		0.14
Odonata	Petaluridae	nymphs										0.02			0.03				
	Cordulegastridae	nymphs							0.04										
Plecoptera		nymphs	0.04	0.14	0.04	0.09		0.16	0.04		0.02	0.04		0.05			0.09	0.02	
Hemiptera	Ochteridae	adults																	0.05
	Unidentified	adults		0.02															
Megaloptera	Sialidae	larvae				0.02	0.01												
	Corydalidae	larvae		0.06									0.02						
Trichoptera		larvae	0.06	0.06	0.04	0.02	0.03	0.16	0.04	0.04		0.04	0.08		0.05	0.03	0.03	0.06	0.24
Coleoptera	Elmidae	larvae						0.04	0.02			0.02	0.02						
		adults					0.01		0.02										
	Psephenidae	larvae					0.01												
	Amphizoidae	adults																	0.05
	Chrysomelidae	larvae										0.02							
		adults				0.02		0.04											
	Helyridae	larvae									0.04		0.02						
	Staphylinidae	adults					0.01	0.08			0.02			0.02					
	Unidentified	adults																0.02	
Diptera	Tipulidae	larvae		0.22	0.02	0.02	0.04	0.04			0.02								
	Simuliidae	larvae	0.02			0.04	0.03		0.02	0.02	0.04		0.02		0.05			0.04	
	Chironomidae	larvae	0.48	0.40	0.37	0.16	0.47	1.15	0.37	0.28	0.30	0.13	0.30	0.26	0.07	0.21	0.21	0.16	0.19
		pupae									0.04								
	Heleidae	larvae	0.06	0.52	0.02	0.05		0.20	0.02					0.02					
	Empididae	larvae	0.02														0.03		
Total Aquatic Organisms			1.74	3.31	0.68	0.62	0.97	9.71	1.23	0.69	0.78	0.56	0.84	0.61	0.52	0.61	1.12	0.32	1.10

* Number of invertebrates/m^3 of water in drift column.

Table I-2

Aquatic organisms caught in drift net sets*, 7 May - 14 May 1978, Block 101, Riviere du Loup, Kamouraska County, Quebec

Days before or after application of 0.53 kg AI/ha aminocarb			-4 days		-3 days		-2 days	-1 day		Spray Day			+1 day		+2 days		+3 days	
			AM	PM	AM	PM	PM	AM	Pre	0	+½ hr	+1 hr	+2 hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)			0.95	1.00	1.20	1.40	1.20	1.40	0.98				0.95	0.76	0.76	1.01	1.07	0.79	0.67
Volume of drift column (m^3)			68.6	72.2	86.6	101.1	43.3	50.5	35.4	**34.8	**34.8	**34.8	34.3	27.4	27.4	36.5	38.6	28.5	24.2
Nematoda				0.07	0.02		0.02	0.22	0.03	0.09	0.09		0.06			0.08		0.04	0.04
Oligochaeta				0.01				0.02			0.03								
Gastropoda				0.01															
Arachnida	Hydracarina				0.01			0.02			0.03				0.04	0.06			
Crustacea	Decapoda						0.02												
Collembola			0.02	0.01			0.07	0.10		0.03	0.14	0.12			0.04			0.04	0.04
Ephemeroptera	Ephemeridae	nymphs						0.02					0.03						
	Heptageniidae	nymphs	0.28	0.07	0.06	0.02	0.09	0.16	0.20	0.32	0.32	0.09	1.08	0.11	0.44	0.17	0.10	0.25	1.16
	Baetidae	nymphs	0.89	1.54	0.24	0.07	0.09	0.63	0.17	0.09	0.49	0.06	0.47	0.26		0.14	0.18	0.25	0.21
Odonata	Gomphidae	nymphs						0.02		0.03			0.03						0.04
Plecoptera		nymphs	0.10	0.17	0.06	0.04	0.12		0.06	0.06	0.09		0.18		0.11	0.08		0.11	0.17
Hemiptera	Saldidae	adults																	
	Unidentified	adults	0.02		0.01							0.03							
Megaloptera	Sialidae	larvae		0.07		0.02	0.05	0.02									0.03		
	Corydalidae	larvae						0.02				0.03					0.03		
Trichoptera		nymphs	0.07	0.07	0.02	0.05	0.05	0.06	0.06		0.26	0.14	0.09	0.11	0.04			0.07	0.29
Coleoptera	Dytiscidae	adults										0.03						0.04	
	Hydrophilidae	adults						0.02			0.03								
	Elmidae	larvae	0.02	0.06		0.02			0.03	0.09	0.06		0.09		0.11				0.04
		adults	0.02					0.04	0.06	0.03	0.06		0.06						
	Carabidae	adults					0.02					0.06				0.03			
	Chrysomelidae	adults											0.03				0.04		
	Noteridae	adults																	
	Staphylinidae	adults		0.03		0.01	0.09	0.04	0.06		0.03					0.03	0.05		0.04
Diptera	Psychopodidae																		
	Tipulidae	larvae	0.02	0.07	0.01		0.07	0.04		0.03			0.03	0.04	0.11	0.03			
	Culicidae	larvae												0.04					
	Dixidae	larvae		0.01											0.04				0.04
	Simuliidae	larvae	0.02						0.03	0.03	0.06								0.04
	Chironomidae	larvae	0.48	0.24	0.30	0.06	0.25	1.01	0.54	0.66	1.41	0.43	0.53	0.22	0.07	0.17	0.05	0.91	0.37
	Heleidae	larvae	0.07	0.29		0.03		0.04		0.03					0.11				
	Tabanidae	larvae										0.03							
	Sciomyzidae	larvae													0.11				
	Unidentified	pupae															0.03		
Total Aquatic Organisms			2.00	2.72	0.73	0.32	0.94	2.48	1.24	1.49	3.10	1.02	2.68	0.78	1.22	0.79	0.47	1.75	2.48

* Number of invertebrates/m^3 of water in drift column.

** Volume of drift column is an average of the pre-spray and +2 hr values.

** Volume of drift column is an average of the pre-spray and +2 hr values.

Table I-3

Aquatic organisms caught in drift net sets*, 8 May - 14 May 1978,
Block 101, Riviere du Loup Downstream Station, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb			-3 days		-2 days		-1 day		Spray Day PM				+1 day		+2 days		+3 days	
			AM'	PM'	AM'	PM'	PM	AM	PM	Pre	0	+½ hr	+1 hr	+2 hr	AM	PM	AM	PM
Current speed (m/sec)			1.00	1.10	1.20	1.30	1.30	0.75	0.80	0.78	0.78	0.78	0.78	0.78	1.20	0.85	1.34	1.19	1.16	0.88
Volume of drift column (m^3)			30.0	33.0	36.0	39.0	46.9	27.1	28.9	28.2	28.2	28.2	28.2	28.2	43.3	40.8	48.4	43.0	38.6	31.8
Nematomorpha																			0.08	
Nematoda																			0.03	
Oligochaeta																	0.02			
Gastropoda							0.02												0.03	
Pelecypoda	Sphaeridae																			0.03
Arachnida	Hydracarina			0.03			0.02			0.04						0.07	0.02	0.07	0.03	0.03
Collembola			0.10	0.09			0.13	0.11		0.50	0.21		0.25	0.07	0.07	0.71	0.10	0.09	0.98	
Ephemeroptera	Heptageniidae	nymphs	0.57	0.03		0.03	0.11	0.70				0.04	0.14	0.28	0.21		0.12		0.03	
	Baetidae	nymphs	1.73	0.52	0.03	1.64	6.65	3.36		0.18	0.07	0.04	0.11	0.32	0.02	0.05	0.02	0.05	0.03	
Plecoptera		nymphs		0.03									0.04	0.07						
Hemiptera	Unidentified	adults					0.02										0.02			
Trichoptera		larvae						0.04		0.04						0.03		0.02		
Coleoptera	Dytiscidae	larvae														0.03		0.02		
		adults				0.03										0.03			0.03	
	Hydrophilidae	adults														0.03			0.03	
	Elmidae	larvae		0.03			0.02		0.04	0.07		0.04		0.11	0.02	0.07	0.02	0.02	0.03	0.03
	Amphizoidae	adults					0.04					0.04		0.07						
	Staphylinidae	larvae	0.10			0.03	0.26		0.04							0.20		0.02	0.08	
		adults			0.03		0.04	0.67			0.04	0.04				0.07	0.08	0.05	0.05	
Diptera	Culicidae	larvae					0.02							0.04			0.04			
	Dixidae	pupae																		
	Chironomidae	larvae	0.03	0.12	0.06	0.08			0.04											
	Heleidae	larvae				0.03														
	Unidentified	pupae	0.33																	
Total Aquatic Organisms			2.93	0.85	0.12	1.84	7.33	4.88	3.48	0.83	0.32	0.20	0.54	0.96	0.32	1.31	0.42	0.36	1.40	0.09

* Number of invertebrates/m^3 of water in drift column.

Drift samples denoted by AM' or PM' were taken using plankton nets, all others were taken using standard drift nets.

Table I-4

Aquatic organisms caught in drift net sets*, 11 May - 18 May 1978, Block 102, Riviere du Loup, Kamouraska County, Quebec

Days before or after application of 0.210 kg AI/ha fenitrothion			-4 days	-3 days		-2 days		-1 day		Spray Day PM					+1 day		+2 days		+3 days	
			AM	AM	PM	AM	PM	AM	PM	0	+½ hr	+1 hr	**0'	**+½' hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)			0.80	0.87	0.92	0.91	0.64	0.98	1.07	0.98	0.98	0.98	0.98	0.98	0.91	1.35	0.85	0.98	0.97	0.97
Volume of drift column (m^3)			72.2	71.2	77.8	80.8	57.8	85.7	92.0	84.3	84.3	84.3	84.3	84.3	61.6	108.5	65.9	55.3	61.6	54.7
Nematoda							0.02													
Oligochaeta							0.04	0.01				0.02	0.01		0.02		0.03			
Arachnida	Hydracarina		0.01								0.01					0.01				0.02
Crustaceae	Amphipoda															0.01				
	Decapoda									0.01										
Collembola			0.01		0.03	0.01		0.02			0.01					0.04			0.03	
Ephemeroptera	Ephemeridae	nymphs			0.01									0.06	0.03	0.02		0.02		
	Heptageniidae	nymphs	0.14	0.08	0.19	0.05	0.09	0.05	0.01	0.02	0.02	0.04	0.07			0.07	0.02	0.02	0.11	0.02
	Baetidae	nymphs	0.08	0.08	0.08	0.03	0.17	0.21	0.02	0.04	0.04	0.13	0.14	0.05	0.05	0.03	0.05	0.09	0.07	0.11
Plecoptera		nymphs	0.01	0.11	0.10	0.05	0.19	0.01	0.07	0.12	0.08	0.18	0.06	0.12	0.03	0.20		0.13	0.05	0.06
Hemiptera	Gerridae	adults						0.01												
Megaloptera	Sialidae	larvae																0.02		
Trichoptera		larvae	0.01	0.03	0.03	0.01	0.05	0.01		0.04	0.10	0.04	0.04			0.08	0.05	0.07	0.05	0.06
		pupae																0.02		
Coleoptera	Dytiscidae	adults		0.01													0.03			
	Hydrophilidae	larvae	0.01								0.01									
	Elmidae	larvae							0.01	0.02		0.01	0.02			0.01	0.02			
	Psephenidae	larvae																		0.02
	Chelonariidae	adults														0.01				
	Limnichidae	larvae										0.01								
	Staphylinidae	adults					0.02							0.01						0.02
Diptera	Tipulidae	larvae	0.01	0.01	0.03	0.03	0.04		0.04	0.01	0.01		0.04							
	Culicidae	larvae									0.01									
	Simuliidae	larvae		0.04		0.06	0.02		0.01	0.02	0.01	0.01		0.01	0.03	0.02		0.04	0.02	0.09
		pupae											0.01							
	Chironomidae	larvae	0.14	0.07	0.03		0.24	0.08		0.05	0.11	0.07		0.10	0.07	0.10		0.20	0.11	0.15
		pupae					0.02													
	Heleidae	larvae			0.15		0.05													0.02
	Athericidae	larvae				0.01														
Total Aquatic Organisms			0.42	0.43	0.65	0.25	0.95	0.40	0.16	0.33	0.41	0.51	0.39	0.35	0.23	0.60	0.20	0.61	0.44	0.57

* Number of invertebrates/m^3 of water in drift column.

** Spray plane passed over station twice. T_o = 6:58 pm; T_o' = 8:07 pm.

Table I-5

Aquatic organisms caught in drift net sets*, 11 May - 18 May 1978, Block 102, Riviere du Loup Downstream Station, Kamouraska County, Quebec

Days before or after application of 0.210 kg AI/ha fenitrothion			-4 days	-3 days		-2 days		-1 day		Spray Day PM			+1 day		+2 days		+3 days	
			AM	AM	PM	AM	PM	AM	PM	0	+½ hr	+1 hr	+2 hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)			1.75	0.82	0.79	0.85	0.79	0.95	0.85	0.88	0.88	0.88	0.88	1.04	0.79	0.55	0.85	0.73	0.61
Volume of drift column (m^3)			79.0	37.0	35.6	76.7	35.6	46.9	76.7	39.7	39.7	39.7	39.7	37.5	35.6	24.8	30.7	65.9	27.5
Nematoda				0.03		0.03	0.03	0.05		0.03	0.10	0.03	0.05	0.03	0.06	0.04	0.03		
Oligochaeta										0.03		0.03							
Arachnida	Hydracarina					0.01				0.03			0.03	0.03	0.11	0.08	0.07		
Crustaceae	Decapoda												0.03						
Collembola						0.20	0.20	0.02	0.01		0.03		0.08	0.05	0.06	0.04	0.03	0.02	
Ephemeroptera	Heptageniidae	nymphs	0.09	0.03	0.14	0.10	0.03	0.12	0.05	0.05	0.13	0.13	0.81	0.56	0.14	0.28	0.16	0.24	0.33
	Baetidae	nymphs	0.04	0.03	0.06	0.03	0.03	0.02	0.04	0.13	0.15	0.13	0.45	0.29	0.11	0.16	0.07	0.06	0.04
Plecoptera		nymphs		0.03	0.06			0.05	0.01	0.05	0.03	0.03	0.13	0.03	0.17	0.04	0.03	0.05	
Megaloptera	Sialidae	larvae	0.01																
Trichoptera		larvae	0.04			0.05	0.06	0.02		0.13	0.10	0.13	0.05		0.20	0.32	0.03	0.08	0.11
		pupae				0.01			0.01										
Coleoptera	Haliplidae	adults																	
	Hydrophilidae	larvae										0.05							
	Elmidae	larvae							0.01	0.03	0.03		0.03	0.03					
	Amphizoidae	adults	0.01						0.03			0.03							
	Chrysomelidae	adults																	
	Staphylinidae	adults	0.01	0.03		0.01													
	Unidentified	larvae							0.03		0.03						0.03		
		adults									0.03			0.03		0.04	0.03		
Diptera	Tipulidae	larvae	0.04	0.03															
	Blepharideridae	larvae																	
	Culicidae	larvae														0.04	0.03	0.05	
	Dixidae	larvae										0.03		0.03					
	Simuliidae	larvae			0.06				0.01	0.05	0.13		0.20		0.06				
		pupae													0.17	0.12		0.06	0.25
	Chironomidae	larvae	0.34	0.19	0.03	0.05	0.31	0.63	0.03	0.30	0.58	0.43	0.45	0.03 0.40	0.48	0.28	0.03 0.29	0.18	0.29
		pupae		0.03															
	Heleidae	larvae	0.03				0.03										0.03		
	Unidentified	larvae																	0.04
Total Aquatic Organisms			0.61	0.40	0.38	0.50	0.69	0.91	0.23	0.83	1.34	1.02	2.31	1.51	1.56	1.44	0.89	0.74	1.06

* Number of invertebrates/m^3 of water in drift column.

Table I-6

Aquatic organisms caught in drift net sets*, 11 May - 18 May 1978,
Block 102, Control, Kamouraska County, Quebec

Days before or after application of 0.210 kg AI/ha fenitrothion			-4 days	-3 days		-2 days		-1 day		Spray Day PM					+1 day		+2 days		+3 days	
			AM	AM	PM	AM	PM	AM	PM	Pre	0	+½ hr	+1 hr	+1½ hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)			0.40	0.49	0.38	0.55	0.52	0.55	0.91	0.43	0.43	0.43	0.43	0.43	0.24	0.33	0.67	0.24	0.27	0.27
Volume of drift column (m^3)			36.1	44.2	34.3	49.6	46.9	49.6	82.1	32.0	32.0	32.0	32.0	32.0	16.8	27.9	56.7	15.2	20.9	20.9
Nematoda					0.06		0.02		0.01											
Oligochaeta					0.18	0.04	0.06	0.02									0.02			
Arachnida	Hydracarina		0.03				0.02		0.02							0.04				
Crustacean	Amphipoda												0.03							
	Decapoda								0.01											
Collembola											0.06				0.06			0.07		
Ephemeroptera	Ephemeridae	nymphs	0.03											0.03						
	Heptageniidae	nymphs	0.11	0.07	0.12			0.20	0.02		0.06		0.03							
	Baetidae	nymphs		0.07	0.09	0.06	0.02	0.02				0.03	0.03							
Plecoptera		nymphs	0.14	0.07	0.03				0.06	0.16	0.16	0.03	0.13	0.28	0.18		0.04		0.29	
Hemiptera	Notonectidae	adults																0.07		0.05
Megaloptera	Sialidae	larvae	0.03										0.03	0.03						
Trichoptera		larvae	0.03	0.05		0.02	0.04	0.06	0.06	0.03	0.09	0.03	0.09	0.13	0.06	0.04	0.02			0.10
Coleoptera	Haliplidae	adults							0.01											
	Dytiscidae	larvae													0.06					
	Hydrophilidae	larvae													0.06					
		adults		0.02	0.06					0.03										
	Elmidae	larvae		0.02																
		adults															0.02			
	Limnichidae	larvae						0.02			0.03				0.06					
Diptera	Tipulidae	larvae					0.04											0.07		
	Culicidae	larvae			0.03	0.02		0.08	0.05				0.06				0.02	0.13		
	Simuliidae	larvae		0.07			0.02		0.02	0.06			0.06	0.16	0.06	0.04	0.05		0.29	
	Chironomidae	larvae	0.22	0.05	0.12	0.04	0.13	0.08	0.15	0.25		0.03	0.28	0.28	0.18		0.04		0.33	0.05
		pupae								0.03						0.04	0.02	0.13	0.05	0.05
	Heleidae	larvae							0.02											
Total Aquatic Organisms			0.59	0.42	0.69	0.18	0.35	0.48	0.43	0.56	0.40	0.12	0.74	0.91	0.72	0.16	0.23	0.47	0.96	0.25

* Number of invertebrates/m^3 of water in drift column.

Table I-7

Aquatic organisms caught in drift net sets*, 30 May - 7 June 1978,
Block 102, Riviere du Loup, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb			-5 days		-4 days		-3 days	-2 days	-1 day		Spray Day AM				+1 day		+2 days		+3 days
			AM	PM	AM	PM	AM	PM	AM	PM	Pre	0	+½ hr	+1 hr	+2 hr	PM	AM	PM	AM	PM	AM
Current speed (m/sec)			0.37	0.37	0.31	0.24	0.37	0.34	0.31	0.34	0.29	0.29	0.29	0.29	0.29	0.27	0.27	0.24	0.24	0.27	0.24
Volume of drift column (m^3)			29.2	29.2	32.8	25.4	43.8	38.8	34.1	39.9	30.7	30.7	30.7	30.7	30.7	19.8	18.3	23.4	16.9	28.6	25.4
Nematoda					0.03																
Arachnida	Hydracarina			0.03															0.12		
Collembola			0.03										0.03	0.03	0.03		0.06				
Ephemeroptera	Heptageniidae	nymphs	0.03	0.03	0.03		0.02				0.03					0.05			0.12		
	Baetidae	nymphs	0.07		0.12				0.03		0.07			0.03	0.03	0.15	0.06		0.12		0.08
Plecoptera		nymphs			0.03								0.07		0.03	0.05				0.04	
Trichoptera		larvae			0.06	0.08	0.02		0.03						0.03						
Coleoptera	Hydrophilidae	adults		0.03			0.02	0.05				0.03									0.04
	Elmidae	adults		0.03		0.04			0.03										0.06		0.04
	Chelonariidae	larvae		0.03																	
	Staphylinidae	adults				0.12											0.06				
	Unidentified	adults															0.06				
Diptera	Dixidae	larvae																	0.06		
	Simuliidae	larvae	0.41	0.31		0.39		0.05	0.32	0.18	1.17	1.01	0.39	1.01	0.78	0.56	0.93	0.13	1.77	0.67	0.47
		pupae			0.09		0.05														
	Chironomidae	larvae						0.08	0.03	0.03		0.03				0.05	0.11		0.12		
		pupae															0.06			0.14	
Total Aquatic Organisms			0.54	0.46	0.36	0.63	0.11	0.21	0.41	0.21	1.27	1.07	0.49	1.07	0.90	0.86	1.34	0.13	2.37	0.85	0.63

* Number of invertebrates/m^3 of water in drift column.

Table I-8

Aquatic organisms caught in drift net sets*, 30 May - 7 June 1978,
Block 102, Riviere du Loup Downstream Station, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb			-5 days		-4 days		-3 days	-2 days	-1 day		Spray Day AM					+1 day		+2 days		+3 days
			AM	PM	AM	PM	AM	PM	AM	PM	Pre	0	+½ hr	+1 hr	+2hr	+3 hr	PM	AM	PM	AM	PM	AM
Current speed (m/sec)			0.52	0.52	0.39	0.43	0.49	0.43	0.40	0.43	0.37					0.40	0.40	0.31	0.37	0.40	0.37	0.34
Volume of drift column (m^3)			68.9	66.0	74.2	74.6	93.3	81.9	76.1	72.8	62.6	**64.3	**64.3	**64.3	**64.3	66.0	45.1	31.5	56.3	45.1	62.6	57.5
Nematoda										0.01											0.03	
Arachnida	Hydracarina		0.02	0.05	0.05			0.01													0.02	0.04
Ephemeroptera	Heptageniidae	nymphs	0.04	0.09	0.05	0.03	0.02			0.01	0.02	0.05	0.02	0.03	0.02	0.06	0.02	0.09	0.02		0.05	
	Baetidae	nymphs	0.07	0.02	0.05	0.01	0.02				0.02	0.03	0.02	0.02				0.02		0.04		0.02
Plecoptera		nymphs		0.02	0.05						0.02	0.05									0.02	
Hemiptera	Mesoveliidae	adults																				0.02
	Saldidae	adults																	0.02	0.04		
Trichoptera		larvae	0.09	0.02	0.04	0.03			0.01	0.01		0.05										
Coleoptera	Elmidae	larvae					0.01		0.01													
		adults							0.01				0.02									
	Hydroscaphidae	adults											0.02									
	Staphylinidae	adults														0.02				0.02		
Diptera	Tipulidae	larvae		0.02	0.01	0.01					0.02	0.02										
	Simuliidae	larvae		0.05		0.03	0.14			0.01	0.11	0.16	0.17	0.06	0.12	0.06	0.07	0.11	0.07	0.22	0.14	0.04
		pupae	0.02														0.02			0.07		0.02
	Chironomidae	larvae		0.03	0.04	0.03	0.04	0.01			0.06		0.06	0.05				0.02				
		pupae					0.02				0.02	0.02										
	Heleidae	larvae	0.02																			
Total Aquatic Organisms			0.26	0.30	0.29	0.14	0.25	0.02	0.03	0.04	0.27	0.38	0.31	0.16	0.14	0.14	0.11	0.24	0.11	0.39	0.26	0.14

* Number of invertebrates/m^3 of water in drift column.

** Volume of drift column is an average of the pre-spray and +3 hr values.

Table I-9

Aquatic organisms caught in drift net sets*, 29 May - 5 June 1978,
block 109, Riviere Chaudiere, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb			-4 days		-3 days		-2 days		-1 day			Spray Day PM					+1 day		+2 days		+3 days	
			AM	PM	AM	PM	AM	PM	AM	PM	**PM'	AM	Pre	0	+½ hr	+1 hr	+2 hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)			0.82	0.79	0.73	0.91	0.76	0.82	0.95	1.04	1.04	0.98	0.88	0.88	0.88	0.88	0.88	0.88	0.88	1.01	***	0.70	0.70
Volume of drift column (m³)			69.4	133.7	123.5	77.0	64.3	208.1	171.5	187.7	187.7	176.9	238.2	238.2	238.2	238.2	238.2	158.8	158.8	159.5	250.7	159.9	166.6
Nematomorpha							0.02				0.01				0.01				0.01				
Nematoda								0.02		0.02							0.02						
Oligochaeta			0.01	0.02	0.01					0.01			0.01								0.01		
Gastropoda																	0.01						
Pelecypoda	Sphaeridae													0.01									
Arachnida	Hydracarina						0.03							0.01	0.01		0.01		0.01				
Crustacea	Decapoda			0.01																			
Collembola															0.01								0.01
Ephemeroptera	Ephemeridae	nymphs									0.03												
	Heptageniidae	nymphs	0.07	0.06	0.06	0.03	0.03	0.01	0.03	0.02	0.03		0.01	0.01	0.03	0.01	0.11		0.04	0.01	0.01	0.03	
	Baetidae	nymphs	0.03	0.02	0.04		0.05	0.03	0.10	0.01	0.10	0.02	0.08	0.01		0.03	0.14	0.01	0.02	0.03	0.06	0.01	0.03
Odonata	Gomphidae	nymphs												0.01									
Plecoptera		nymphs	0.01	0.04	0.02			0.03				0.01			0.01	0.01	0.02			0.01			
Hemiptera	Hebridae	nymphs													0.01								
Megaloptera	Corydalidae	larvae											0.01										
Trichoptera		larvae		0.01	0.02		0.03		0.02			0.01	0.01		0.01	0.01	0.04		0.01				
		pupae							0.01											0.01			
Lepidoptera	C. fumiferana	larvae														0.01		0.01				0.01	
	Unidentified	larvae													0.01		0.02						
Coleoptera	Haliplidae	adults		0.01																			
	Dytiscidae	adults						0.01							0.01			0.01				0.01	
	Hydrophilidae	adults	0.01	0.01	0.01			0.02							0.01	0.01	0.01						
	Elmidae	larvae	0.01					0.01	0.02					0.01			0.01						
		adults								0.01							0.03			0.01			
	Psephenidae	larvae														0.01	0.01		0.01	0.01	0.01		
	Chrysomelidae	adults		0.01												0.01							
	Staphylinidae	adults						0.01							0.01								
														0.02		0.01							
Diptera	Tipulidae	larvae							0.01	0.01													
		pupae																0.01		0.01			
	Blepharoceridae	larvae						0.01	0.02		0.01		0.01		0.01		0.01			0.01			
		pupae	0.01	0.01																			
	Culicidae	pupae	0.01	0.02																			
	Simuliidae	larvae	0.01	0.06		0.01	0.02		0.11	0.02	0.03	0.01	0.06		0.04	0.01	0.09		0.09	0.09	0.17	0.08	0.07
		pupae								0.01													
	Chironomidae	larvae	0.04	0.02	0.02	0.04	0.05	0.03	0.02	0.01	0.03		0.05	0.01	0.02	0.02	0.06		0.01	0.03	0.02	0.01	0.02
		pupae				0.01		0.01	0.01		0.01			0.01	0.01	0.01	0.01		0.01	0.02	0.01		0.01
	Heleidae	pupae									0.01	0.01					0.01			0.01			
	Athericidae	larvae										0.01											
	Tabanidae	larvae						0.03															
Total Aquatic Organisms			0.21	0.29	0.17	0.09	0.21	0.22	0.35	0.12	0.25	0.08	0.27	0.10	0.22	0.17	0.62	0.04	0.21	0.24	0.31	0.15	0.14

* Number of invertebrates/m³ of water in drift column.

** On the evening of 1 June 1978, there was a spray in Block 109 south of the sampling stations. An additional PM drift (PM') was taken 2 hours after the first drift (PM) to determine any impact due to drift or downstream movement of the chemical.

*** On 4 June 1978 (PM), current speed could not be measured due to a defective current meter. Volume of drift column was calculated using the current speed from +2 day AM.

Table I-10

Aquatic organisms caught in drift net sets*, 29 May - 5 June 1978,
Block 109, Riviere Ouelle, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb			-4 days		-3 days		-2 days		-1 day			Spray Day AM				+1 day		+2 days		+3 days
			AM	PM	AM	PM	AM	PM	AM	PM	**PM'	0	+½ hr	+1 hr	+2 hr	PM	AM	PM	AM	PM	AM
Current speed (m/sec)			0.43	0.37	0.38	0.40	0.34	0.34	0.27	0.34	0.34	0.31	0.31	0.31	0.31	0.31	0.27	0.27	0.31	0.31	0.24
Volume of drift column (m^3)			34.0	57.4	61.1	40.6	28.8	74.8	38.1	71.9	71.9	42.8	42.8	42.8	42.8	42.0	38.1	38.1	43.7	64.3	47.7
Nematomorpha								0.01													
Oligochaeta												0.02								0.02	
Arachnida	Hydracarina				0.03		0.04								0.02	0.02					
Collembola															0.02						
Ephemeroptera	Heptageniidae	nymphs	0.03			0.03	0.10	0.01			0.15	0.21	0.07	0.05		0.02	0.03				
	Baetidae	nymphs	0.09			0.17	0.10	0.01	0.03	0.01	0.24	0.09	0.05	0.14	0.09	0.05			0.05	0.02	0.17
Plecoptera		nymphs								0.01		0.05		0.12							
Hemiptera	Unidentified	adults									0.01										
Trichoptera		larvae	0.06			0.03	0.04			0.01			0.02	0.02				0.03	0.02	0.02	
		pupae								0.01											
Coleoptera	Dytiscidae	adults								0.01											
	Hydrophilidae	adults				0.03		0.01													
	Elmidae	larvae										0.02		0.07	0.02						
		adults					0.04								0.02						
Diptera	Tipulidae	larvae					0.04				0.01			0.02							
	Blephariceridae	larvae										0.02				0.02		0.03			
	Simuliidae	larvae	0.09			0.17	0.07	0.05	0.03	0.03	0.08	0.14	0.21	0.96	0.96			0.08	0.09	0.02	0.15
		pupae																			0.02
	Chironomidae	larvae			0.03	0.10		0.03	0.18	0.06	0.06		0.02	0.02	0.09	0.02		0.05		0.02	
		pupae	0.09					0.01	0.05	0.04	0.03				0.05				0.02		0.02
	Heleidae	pupae			0.02										0.05						
	Tabanidae	larvae								0.01											
		pupae											0.02								
Total Aquatic Organisms			0.36	0	0.08	0.53	0.43	0.13	0.29	0.19	0.58	0.55	0.39	1.40	1.32	0.13	0.03	0.19	0.18	0.10	0.36

* Number of invertebrates/m^3 of water in drift column.

** On the evening of 1 June 1978, there was a spray in Block 109, south of the sampling stations. An additional PM drift (PM') was taken 2 hours after the first drift (PM) to determine any impact due to drift or downstream movement of the chemical.

Table I-11

Aquatic organisms caught in drift net sets*, 29 May - 5 June 1978, Block 109,
Riviere Ouelle Downstream Station, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb			-4 days AM	-4 days PM	-3 days AM	-3 days PM	-2 days AM	-2 days PM	-1 day AM	-1 day PM	Pre	Spray Day AM 0	Spray Day AM +½ hr	Spray Day AM +1 hr	Spray Day AM +2 hr	Spray Day AM +3 hr	Spray Day PM	+1 day AM	+1 day PM	+2 days AM	+2 days PM	+3 days AM
Current speed (m/sec)			0.43	0.15	0.76	0.82	0.67	0.73	0.61	0.58	0.70					0.73	0.58	0.64	0.67	0.61	0.55	0.52
Volume of drift column (m^3)			38.8	23.7	107.2	106.4	75.6	98.8	68.8	111.2	121.4	**122.5	**122.5	**122.5	**122.5	123.5	78.5	61.4	75.6	61.9	81.4	77.0
Nematomorpha					0.01				0.02													
Oligochaeta										0.01					0.02				0.01	0.02		
Arachnida	Hydracarina				0.18		0.23															
Ephemeroptera	Heptageniidae	nymphs	0.03		0.01		0.08				0.02				0.01	0.01						0.01
	Baetidae	nymphs			0.01		0.07			0.01	0.06		0.03	0.03		0.01	0.01				0.01	
Plecoptera		nymphs			0.01				0.02		0.03	0.01										
Trichoptera		larvae	0.03		0.01				0.02		0.02		0.02	0.02		0.01			0.01			
		pupae									0.01			0.01								
Coleoptera	Haliplidae	adults					0.01	0.01			0.01											
	Dytiscidae	adults			0.01						0.01										0.01	
	Gyrinidae	adults										0.01						0.02				
	Elmidae	larvae	0.03								0.01											
		adults									0.02											
	Staphylinidae	adults					0.01															
Diptera	Tipulidae	larvae					0.03						0.01	0.02			0.01			0.02		
		pupae																				
	Blephariceridae	larvae	0.05													0.01						0.01
	Dixidae	pupae																				
	Simuliidae	larvae	0.13		0.01		0.05	0.01			0.02	0.01										
		pupae										0.01	0.06	0.09	0.02	0.08			0.04	0.05	0.03	
	Chironomidae	larvae	0.08		0.03		0.08	0.03	0.02		0.16	0.01		0.05	0.01	0.09				0.05	0.03	0.03
		pupae					0.05	0.01			0.04			0.01		0.01				0.02	0.01	
	Heleidae	pupae												0.01								
	Tabanidae	pupae											0.01			0.01						
	Empididae	pupae																				
Total Aquatic Organisms			0.35	0	0.28	0	0.61	0.06	0.08	0.02	0.38	0.03	0.13	0.24	0.06	0.23	0.02	0.02	0.06	0.16	0.09	0.04

* Number of invertebrates/m^3 of water in drift column.

** Volume of drift column is an average of the pre-spray and +3 hr values.

Table I-12

Bottom fauna populations*, 12 May - 26 June 1978, Block 102,

Ruisseau Blanc**, Kamouraska County, Quebec

			12-13 May	18 May	31 May	7 June	14 June	20 June	26 June
Nematomorpha			--	--	--	--	--	0.3 ± 0.5	--
Nematoda			0.3 ± 0.5	0.5 ± 1.0	0.5 ± 0.6	0.3 ± 0.5	--	0.3 ± 0.5	--
Oligochaeta			--	--	0.3 ± 0.5	--	0.3 ± 0.5	--	--
Arachnida Hydracarina			--	--	0.3 ± 0.5	--	--	0.8 ± 1.0	1.3 ± 1.9
Collembola			--	--	--	0.3 ± 0.5	--	--	--
Ephemeroptera Heptageniidae		nymphs	0.8 ± 1.0	0.5 ± 1.0	3.2 ± 3.3	9.0 ± 7.5	7.2 ± 6.3	1.8 ± 1.5	1.0 ± 1.4
	Baetidae	nymphs	1.8 ± 1.7	0.8 ± 0.5	3.5 ± 3.5	4.0 ± 1.2	3.8 ± 1.0	2.0 ± 1.8	1.5 ± 1.7
Plecoptera		nymphs	0.5 ± 0.6	1.3 ± 1.3	0.3 ± 0.5	1.3 ± 1.3	0.3 ± 0.5	0.8 ± 1.0	0.3 ± 0.5
Hemiptera Macroveliidae		adults	--	--	--	--	--	--	0.3 ± 0.5
Megaloptera Sialidae		larvae	0.3 ± 0.5	--	--	--	--	0.3 ± 0.5	--
Trichoptera		larvae	0.8 ± 1.0	1.8 ± 1.0	2.8 ± 4.3	7.5 ± 8.1	1.0 ± 1.4	5.3 ± 4.0	2.5 ± 2.4
		pupae	--	0.3 ± 0.5	0.3 ± 0.5	--	0.3 ± 0.5	0.3 ± 0.5	--
Coleoptera Dytiscidae		adults	--	--	--	--	--	0.3 ± 0.5	--
	Elmidae	larvae	--	0.3 ± 0.5	--	0.5 ± 0.6	0.5 ± 0.7	0.3 ± 0.5	1.5 ± 1.9
		adults	--	--	2.8 ± 3.2	1.5 ± 0.6	0.3 ± 0.5	1.5 ± 1.9	1.5 ± 1.3
Diptera	Tipulidae	larvae	0.3 ± 0.5	0.5 ± 0.6	0.8 ± 1.5	0.5 ± 0.6	0.3 ± 0.5	0.3 ± 0.5	--
	Simuliidae	larvae	--	--	--	1.2 ± 2.5	0.3 ± 0.5	1.3 ± 1.9	0.3 ± 0.5
	Chironomidae	larvae	0.5 ± 0.6	--	4.3 ± 6.6	2.8 ± 2.2	2.0 ± 0.8	0.8 ± 1.0	2.3 ± 1.7
		pupae	--	--	--	--	0.3 ± 0.5	--	--
	Heleidae	larvae	--	--	--	--	--	0.3 ± 0.5	0.3 ± 0.5
	Unidentified	larvae	0.3 ± 0.5	--	--	--	0.5 ± 0.6	--	--
Total Aquatic Organisms			5.0 ± 3.6	5.8 ± 1.3	19.0 ± 22.4	28.8 ± 10.6	17.3 ± 7.9	16.0 ± 8.3	13.0 ± 4.3

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

** Spray dates for Ruisseau Blanc Station: 15 May 1978 fenitrothion 0.210 kg AI/ha
3 June 1978 aminocarb 0.053 kg AI/ha
16 June 1978 aminocarb 0.053 kg AI/ha

Table 1-13

Bottom fauna populations*, 12 May - 26 June 1978, Block 102,
Riviere du Loup**, Kamouraska County, Quebec

			12-13 May	18 May	31 May	7 June	15 June	20 June	26 June
Oligochaeta			18.0 ± 15.8	14.3 ± 14.8	2.3 ± 2.6	2.5 ± 2.1	11.0 ± 10.6	0.3 ± 0.5	4.8 ± 2.4
Hirudinea			--	--	1.8 ± 3.5	--	--	--	--
Gastropoda			--	0.3 ± 0.5	--	--	0.3 ± 0.5	--	0.3 ± 0.5
Crustaceae	Decapoda		--	0.3 ± 0.5	0.5 ± 0.6	--	--	--	--
Ephemeroptera	Ephemeridae	nymphs	0.3 ± 0.5	--	--	--	--	0.3 ± 0.5	0.3 ± 0.5
	Heptageniidae	nymphs	3.0 ± 2.6	20.5 ± 18.1	18.5 ± 12.2	34.8 ± 14.6	10.0 ± 7.0	31.5 ± 11.9	25.8 ± 21.9
	Baetidae	nymphs	0.5 ± 0.6	2.3 ± 2.2	2.0 ± 2.7	12.0 ± 5.4	22.8 ± 15.8	29.5 ± 30.2	30.5 ± 10.9
Odonata	Gomphidae	nymphs	--	0.3 ± 0.5	--	0.3 ± 0.5	0.3 ± 0.5	--	0.5 ± 0.6
Plecoptera		nymphs	1.8 ± 2.1	8.8 ± 9.9	2.5 ± 2.7	4.3 ± 3.3	2.3 ± 0.5	2.8 ± 2.1	6.3 ± 2.2
Hemiptera	Saldidae	adults	--	0.3 ± 0.5	--	--	--	--	--
Homoptera		adults	--	--	--	0.3 ± 0.5	--	--	--
Megaloptera	Sialidae	larvae	--	0.3 ± 0.5	0.5 ± 0.6	--	--	--	--
Trichoptera		larvae	1.0 ± 1.4	7.8 ± 3.3	1.5 ± 1.7	2.3 ± 2.2	1.3 ± 1.0	10.8 ± 5.2	1.8 ± 1.7
		pupae	--	0.3 ± 0.5	--	--	--	0.5 ± 0.6	--
Coleoptera	Haliplidae	adults	--	0.3 ± 0.5	--	2.0 ± 2.7	0.8 ± 1.5	0.8 ± 1.0	--
	Dytiscidae	adults	--	0.3 ± 0.5	--	--	--	--	--
	Elmidae	larvae	0.3 ± 0.5	--	--	0.8 ± 1.0	--	0.3 ± 0.5	0.8 ± 1.0
		adults	--	--	--	0.3 ± 0.5	0.8 ± 1.5	2.0 ± 3.4	3.3 ± 3.0
	Hydrophilidae	adults	--	--	--	--	--	--	0.3 ± 0.5
	Hydroscaphidae	adults	--	0.3 ± 0.5	--	--	--	--	--
Diptera	Tipulidae	larvae	0.8 ± 0.5	1.3 ± 1.5	0.5 ± 0.6	1.3 ± 1.5	2.3 ± 1.7	0.5 ± 0.6	1.8 ± 1.5
	Simuliidae	larvae	--	1.0 ± 2.0	--	0.3 ± 0.5	--	0.5 ± 0.6	--
	Chironomidae	larvae	2.0 ± 2.3	7.5 ± 7.7	1.3 ± 2.5	1.0 ± 1.2	1.3 ± 1.0	1.8 ± 2.1	3.5 ± 4.7
		pupae	--	--	0.3 ± 0.5	--	0.3 ± 0.5	--	--
	Heleidae	larvae	0.3 ± 0.5	--	--	--	--	--	--
	Empididae	larvae	--	--	--	--	--	0.3 ± 0.5	--
	Stratiomyidae	larvae	--	0.3 ± 0.5	--	--	--	--	--
	Unidentified	prepupae	--	--	--	--	--	0.3 ± 0.5	--
Total Aquatic Organisms			27.8 ± 16.2	65.0 ± 51.5	31.5 ± 19.8	61.8 ± 16.6	53.0 ± 30.8	81.5 ± 36.5	79.8 ± 37.4

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

** Spray dates for Riviere du Loup station: 15 May 1978 fenitrothion 0.210 kg AI/ha

Table I-16

Bottom fauna populations*, 29 May - 18 June 1978, Block 109,
Riviere Chaudiere**, Kamouraska County, Quebec

			29 May	5 June	9 June	18 June
Nematomorpha			--	--	0.3 ± 0.5	--
Oligochaeta			0.8 ± 1.5	7.3 ± 7.8	0.8 ± 1.5	5.0 ± 4.7
Gastropoda			--	0.3 ± 0.5	0.3 ± 0.5	--
Arachnida	Hydracarina		1.5 ± 1.9	--	--	--
Crustacese	Decapoda		--	0.3 ± 0.5	--	--
Ephemeroptera	Ephemeridae	nymphs	--	--	0.3 ± 0.5	--
	Heptageniidae	nymphs	13.5 ± 5.8	9.3 ± 7.8	15.5 ± 6.8	14.3 ± 8.1
	Baetidae	nymphs	16.0 ± 6.2	5.0 ± 4.4	8.8 ± 6.2	9.5 ± 8.7
Odonata	Gomphidae	nymphs	0.5 ± 0.6	0.5 ± 1.0	0.5 ± 1.0	0.5 ± 0.6
Plecoptera		nymphs	5.3 ± 2.4	4.3 ± 3.9	5.3 ± 2.1	6.5 ± 3.0
Megaloptera	Sialidae	larvae	--	--	0.3 ± 0.5	--
	Corydalidae	larvae	0.8 ± 1.5	0.5 ± 0.6	2.3 ± 1.9	1.8 ± 1.5
Trichoptera		larvae	6.0 ± 2.3	5.5 ± 3.5	2.8 ± 1.0	7.0 ± 6.8
		pupae	--	--	0.5 ± 0.6	0.8 ± 1.5
Coleoptera	Dytiscidae	adults	--	--	0.3 ± 0.5	--
	Hydrophilidae	adults	0.3 ± 0.5	0.3 ± 0.5	0.3 ± 0.5	--
	Elmidae	larvae	1.5 ± 0.6	1.5 ± 3.0	0.8 ± 1.0	3.0 ± 4.7
		adults	0.3 ± 0.5	--	0.3 ± 0.5	--
	Psephenidae	larvae	0.3 ± 0.5	0.8 ± 0.5	1.3 ± 1.0	0.5 ± 0.6
Diptera	Tipulidae	larvae	0.8 ± 1.0	0.8 ± 0.5	0.8 ± 1.0	0.8 ± 0.5
		pupae	0.5 ± 0.6	0.3 ± 0.5	--	0.3 ± 0.5
	Simuliidae	larvae	0.3 ± 0.5	--	--	--
		pupae	0.5 ± 0.6	--	--	--
	Chironomidae	larvae	1.5 ± 1.0	2.3 ± 1.7	3.3 ± 1.3	2.3 ± 1.0
		pupae	--	1.0 ± 1.4	1.0 ± 0.8	0.3 ± 0.5
	Athericidae	larvae	0.3 ± 0.5	--	--	--
	Empididae	pupae	0.5 ± 1.0	--	--	--
Total Aquatic Organisms			50.8 ± 9.0	40.3 ± 22.5	45.0 ± 6.9	52.5 ± 23.4

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

** Spray dates for Riviere Chaudiere Station: 2 June 1978 aminocarb 0.053 kg AI/ha
7, 9, 10 June 1978 aminocarb 0.053 kg AI/ha

Table I-17

Bottom fauna populations*, 29 May - 18 June 1978, Block 109,

Riviere Ouelle**, Kamouraska County, Quebec

			29 May	5 June	9 June	18 June
Oligochaeta			0.8 ± 1.0	--	--	3.3 ± 2.8
Gastropoda			2.3 ± 2.6	2.0 ± 2.8	--	--
Crustaceae	Decapoda		--	0.3 ± 0.5	--	--
Ephemeroptera	Ephemeridae	nymphs	--	0.3 ± 0.5	--	--
	Heptageniidae	nymphs	11.8 ± 4.6	13.3 ± 12.5	10.8 ± 3.3	16.0 ± 8.0
	Baetidae	nymphs	9.3 ± 4.8	5.8 ± 4.4	5.8 ± 5.6	4.5 ± 1.7
Odonata	Gomphidae	nymphs	1.5 ± 1.3	0.5 ± 0.6	0.8 ± 0.5	2.0 ± 1.4
Plecoptera		nymphs	6.3 ± 2.2	2.3 ± 2.2	7.0 ± 2.5	6.0 ± 1.8
Trichoptera		larvae	8.8 ± 5.6	5.8 ± 4.3	8.5 ± 8.8	5.5 ± 5.5
		pupae	1.3 ± 2.0	--	0.3 ± 0.5	--
Coleoptera	Haliplidae	adults	--	0.3 ± 0.5	0.3 ± 0.5	--
	Dytiscidae	adults	0.3 ± 0.5	--	--	--
	Elmidae	larvae	3.3 ± 2.2	2.0 ± 2.2	7.0 ± 5.7	5.0 ± 3.4
		adults	0.5 ± 0.6	1.0 ± 0.8	1.5 ± 3.0	1.0 ± 0.8
	Psephenidae	larvae	2.5 ± 4.4	1.8 ± 2.2	1.3 ± 1.3	1.5 ± 0.6
Diptera	Tipulidae	larvae	0.5 ± 1.0	--	0.3 ± 0.5	1.3 ± 1.9
	Blephariceridae	larvae	0.3 ± 0.5	0.3 ± 0.5	--	--
	Dixidae	pupae	0.3 ± 0.5	--	--	--
	Chironomidae	larvae	3.3 ± 1.5	1.0 ± 1.4	9.0 ± 8.8	8.8 ± 11.5
		pupae	0.3 ± 0.5	1.0 ± 1.4	0.5 ± 1.0	1.0 ± 1.4
Total Aquatic Organisms			52.5 ± 19.5	37.3 ± 29.1	56.8 ± 36.8	55.8 ± 30.3

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

** Spray dates for Riviere Ouelle Station: 2 June 1978 aminocarb 0.053 kg AI/ha
9,10 June 1978 aminocarb 0.053 kg AI/ha

Table I-18

Bottom fauna populations*, 29 May - 18 June 1978, Block 109,
Riviere Ouelle Downstream Station**, Kamouraska County, Quebec

			29 May	5 June	9 June	18 June
Oligochaeta			0.5 ± 0.6	0.3 ± 0.5	0.5 ± 1.0	0.5 ± 0.6
Gastropoda			0.3 ± 0.5	--	--	--
Arachnida	Hydracarina		--	--	--	0.3 ± 0.5
Ephemeroptera	Heptageniidae	nymphs	19.0 ± 9.4	9.5 ± 7.5	3.3 ± 1.5	24.8 ± 3.2
	Baetidae	nymphs	4.0 ± 3.6	7.3 ± 5.1	1.0 ± 0.0	12.8 ± 7.0
Odonata	Gomphidae	nymphs	--	0.3 ± 0.5	--	--
Plecoptera		nymphs	3.3 ± 1.0	3.5 ± 1.3	0.5 ± 0.6	3.3 ± 1.3
Megaloptera	Corydalidae	larvae	--	--	--	0.5 ± 0.6
Trichoptera		larvae	14.8 ± 12.1	74.5 ± 37.3	1.5 ± 0.6	16.3 ± 14.5
		pupae	--	0.5 ± 0.6	--	--
Coleoptera	Elmidae	larvae	4.3 ± 3.1	1.0 ± 1.2	--	3.8 ± 1.7
	Psephenidae	larvae	0.5 ± 0.6	--	0.3 ± 0.5	--
	Staphylinidae	adults	--	--	--	0.5 ± 0.6
Diptera	Tipulidae	larvae	--	2.0 ± 1.4	--	1.8 ± 1.7
		pupae	--	0.8 ± 1.0	--	0.3 ± 0.5
	Chironomidae	larvae	5.8 ± 4.9	5.8 ± 5.5	2.0 ± 1.8	5.3 ± 3.8
		pupae	1.3 ± 1.0	1.8 ± 1.3	0.3 ± 0.5	2.3 ± 1.3
	Dolichopodidae	larvae	0.3 ± 0.5	--	--	--
Total Aquatic Organisms			53.8 ± 25.7	107.0 ± 51.9	9.3 ± 2.2	72.0 ± 23.7

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

** Spray dates for Riviere Ouelle Downstream Station: 2 June 1978 aminocarb 0.053 kg AI/ha
9,10 June 1978 aminocarb 0.053 kg AI/ha

APPENDIX II

TERRESTRIAL INVERTEBRATES

Table II-1

Terrestrial organisms caught in drift net sets*, 7 May - 14 May 1978,

Block 101, Riviere Manie, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb			-4 days		-3 days		-2 day	-1 day			Spray Day PM			+1 day		+2 days		+3 days	
			AM	PM	AM	PM	PM	AM	Pre	0	+½ hr	+1 hr	+2 hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)			0.70	0.70	0.75	0.80	1.00	0.70	1.50	1.50	1.50	1.50	1.50	1.60	1.13	0.91	0.91	1.52	0.58
Surface area of drift column (m^2)			79.0	79.0	84.6	90.2	112.8	79.0	169.2	169.2	169.2	169.2	169.2	180.5	127.5	102.7	102.7	171.5	65.4
Arachnida	Araneida					0.33		0.76	0.18	0.18		0.06	0.18	0.22	0.24	0.10			
Plecoptera		adults			0.12	0.55	0.27	0.13	0.41	0.24	0.30	0.06	0.06	0.11			0.20	0.06	
Lepidoptera	C. fumiferana	larvae									0.06		0.06				0.10	0.12	0.15
	Unidentified	larvae		0.13															
Hymenoptera	Formicidae	adults													0.08				
	Unidentified	adults	0.13	0.13	0.12		0.09			0.12	0.18		0.12	0.06				0.35	
Diptera		adults			0.12	0.11	0.09			0.06					0.24	0.10		0.12	0.15
Total Terrestrial Organisms			0.13	0.26	0.36	0.99	0.45	0.89	0.59	0.60	0.54	0.12	0.42	0.39	0.56	0.20	0.30	0.65	0.30

* Number of invertebrates/ 10 m^2 of surface area of drift column.

Table II-2

Terrestrial organisms caught in drift net sets*, 7 May - 14 May 1978,
Block 101, Riviere du Loup, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb		-4 days		-3 days		-2 days	-1 day		Spray Day PM			+1 day		+2 days		+3 days	
		AM	PM	AM	PM	PM	AM	Pre	0	+½ hr	+1 hr	+2 hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)		0.95	1.00	1.20	1.40	1.20	1.40	0.98				0.95	0.76	0.76	1.01	1.07	0.79	0.67
Surface area of drift column (m^2)		107.2	112.8	135.4	315.8	135.4	157.9	110.5	**108.9	**108.9	**108.9	107.2	85.7	85.7	113.9	120.7	89.1	75.6
Arachnida	Araneida																	
		0.09	0.18		0.03	0.15	0.06	0.27	0.28	0.18	0.37	0.47	0.12	0.12	0.18		0.11	0.40
Plecoptera	adults	0.09	0.36	0.37	0.22	0.30	0.13	1.18	0.28	1.56	2.30	0.60	0.58	0.23	0.35	0.17	0.11	0.13
Hemiptera	adults											0.09	0.23					
Homoptera	adults									0.09								
Trichoptera	adults									0.28			0.12					
Lepidoptera	C. fumiferana larvae													0.12				1.06
	Unidentified larvae		0.09			0.07				0.37			0.12				0.67	0.27
	pupae					0.07												
Hymenoptera	Formicidae adults				0.03													0.13
	Unidentified adults	0.09	0.18	0.37		0.15		0.18	0.09	0.28	0.55	0.09	0.93	0.35	0.09	0.08	0.67	0.40
Diptera	adults							0.18		3.12	1.10		0.12	0.12	0.18	0.08	0.45	0.13
Thysanoptera														0.12				
Total Terrestrial Organisms		0.27	0.81	0.74	0.28	0.74	0.19	1.81	0.65	5.88	4.32	1.25	2.22	1.06	0.80	0.33	2.01	2.52

* Number of invertebrates/10 m^2 of surface area of drift column.

** Surface area of drift column is an average of the pre-spray and +2 hr values.

Table II-3

Terrestrial organisms caught in drift net sets*, 8 May - 14 May, 1978, Block 101,

Riviere du Loup Downstream Station, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb			- 3 days		-2 days			-1 day			Spray Day PM				+1 day		+2 days		+3 days	
			AM'	PM'	AM'	PM'	PM	AM	PM	Pre	0	½ hr	+1 hr	+2 hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)			1.00	1.10	1.20	1.30	1.30	0.75	0.80	0.78	0.78	0.78	0.78	0.78	1.20	0.85	1.34	1.19	1.16	0.88
Surface area of drift column (m^2)			282.0	310.2	338.4	366.6	366.6	84.6	90.2	88.0	88.0	88.0	88.0	88.0	135.4	95.9	151.2	134.2	130.9	99.3
Arachnida	Araneida						0.11	0.24		0.57			0.23	0.23		1.25	0.13	0.22	0.15	
Plecoptera		adults					0.11	0.12		0.11			0.11	0.11	0.07	0.10	0.07	0.07	0.23	0.10
Homoptera		adults											0.11			0.10				0.10
Lepidoptera	C. fumiferana	larvae									0.11					4.49	0.27	1.27	0.38	0.10
	Unidentified	larvae	0.04																	
Hymenoptera		adults						0.12		0.34					0.07	1.25	0.27	0.22		
Coleoptera		adults					0.06			0.23					0.07				0.15	0.10
Diptera		adults	0.04				0.27			0.11			0.11			0.73		0.22	0.15	
Total Terrestrial Organisms			0.08	0	0	0	0.55	0.48	0	1.36	0.11	0	0.56	0.34	0.21	7.92	0.74	2.00	1.06	0.40

* Number of invertebrates/10 m^2 of surface area of drift column.

Drift samples denoted by AM' or PM' were taken using plankton nets, all others were taken using standard drift nets.

Table II-4

Terrestrial organisms caught in drift net sets*, 11 May - 18 May 1978,
Block 102, Riviere du Loup, Kamouraska County, Quebec

Days before or after application of 0.210 kg AI/ha fenitrothion		-4 days	-3 days		-2 days		-1 day		Spray Day PM					+1 day		+2 days		+3 days	
		AM	AM	PM	AM	PM	AM	PM	0	+½ hr	+1 hr	**0'	**½' hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)		0.80	0.87	0.92	0.91	0.64	0.98	1.07	0.98	0.98	0.98	0.98	0.98	0.91	1.35	0.85	0.98	0.97	0.97
Surface area of drift column (m^2)		112.8	122.7	136.8	132.5	90.2	138.2	150.9	138.2	138.2	138.2	138.2	138.2	102.7	190.4	119.9	110.5	136.8	136.8
Gastropoda						0.11													
Arachnida	Araneida		0.08	0.22		0.22	0.07		0.15		0.15	0.07	0.07	0.10	0.11	0.08			0.07
Plecoptera	adults	0.09				0.11													
Trichoptera	adults						0.07												
Lepidoptera	C. fumiferana larvae								0.36	0.07	0.29		0.15		0.58	0.25	0.36	0.59	0.22
Hymenoptera	adults														0.05				
Diptera	adults						0.07					0.07		0.10	0.05	0.08			
Total Terrestrial Organisms		0.09	0.08	0.22	0	0.44	0.21	0	0.51	0.07	0.44	0.14	0.22	0.20	0.79	0.41	0.36	0.59	0.29

* Number of invertebrates/10 m^2 of surface area of drift column.

** Spray plane passed over station twice. T_o = 6:58 pm; $T_{o'}$ = 8:07 pm.

Table II-5

Terrestrial organisms caught in drift net sets*, 11 May - 18 May 1978, Block 102, Riviere du Loup Downstream Station, Kamouraska County, Quebec

Days before or after application of 0.210 kg AI/ha fenitrothion			-4 days	-3 days		-2 days		-1 day		Spray Day PM				+1 day		+2 days		+3 days	
			AM	AM	PM	AM	PM	AM	PM	0	+½ hr	+1 hr	+2 hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)			1.75	0.82	0.79	0.85	0.79	0.95	0.85	0.88	0.88	0.88	0.88	1.04	0.79	0.55	0.85	0.73	0.61
Surface area of drift column (m^2)			246.8	115.6	111.4	239.8	111.4	134.0	239.7	124.1	124.1	124.1	124.1	117.3	111.4	77.6	95.9	205.9	86.0
Arachnida	Aranecida		0.12		0.18	0.08	0.09	0.15	0.08	0.16	0.24	0.08	0.32		0.27	0.26		0.05	
Plecoptera		adults	0.04	0.09		0.08	0.09	0.82	0.29			0.16	0.08	0.26				0.05	
Hemiptera		adults												0.09					
Trichoptera		adults			0.09				0.04		0.08	0.08				0.13	0.10		
Lepidoptera	C. fumiferana	larvae								0.81	0.81	0.32	0.40		1.08		0.10	0.44	
	Unidentified	larvae			0.09				0.08						0.09			0.05	
Hymenoptera	Formicidae	adults						0.15					0.08						
	Unidentified	adults	0.08		0.18										0.18	0.13		0.10	0.12
Diptera		adults	0.04	0.17		0.08		0.15	0.04		0.32	0.08	0.08		0.54	0.26			0.35
Thysanoptera		adults	0.04																
Total Terrestrial Organisms			0.32	0.26	0.54	0.24	0.18	1.27	0.53	0.97	1.45	0.72	0.96	0.35	2.16	0.78	0.20	0.69	0.47

* Number of invertebrates/10 m^2 of surface area of drift column.

Table II-6

Terrestrial organisms caught in drift net sets*, 11 May - 18 May 1978,
Block 102, Control, Kamouraska County, Quebec

Days before or after application of 0.210 kg AI/ha fenitrothion			-4 days	-3 days		-2 days		-1 day		Spray Day PM				+1 day		+2 days		+3 days	
			AM	AM	PM	AM	PM	AM	PM	Pre	0	+½ hr	+1 hr	+1½ hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)			0.40	0.49	0.38	0.55	0.52	0.55	0.91	0.43	0.43	0.43	0.43	0.43	0.24	0.33	0.67	0.24	0.27	0.27
Surface area of drift column (m^2)			56.4	69.1	53.6	77.6	73.3	77.6	128.3	48.5	48.5	48.5	48.5	48.5	27.1	46.5	94.5	27.1	38.1	38.1
Arachnida	Araneida		0.36		0.19	0.13			0.08	0.41										
Plecoptera		adults																	0.26	
Lepidoptera	C. fumiferana	larvae													0.37			1.85	2.10	
	Unidentified	larvae							0.08									0.74	0.53	
Trichoptera		adults													0.37					
Hymenoptera	Formicidae	adults																	0.26	
Diptera		adults			0.19				0.16	0.21	0.62			0.21			0.11			0.26
Total Terrestrial Organisms			0.36	0	0.38	0.13	0	0	0.32	0.21	1.03	0	0	0.21	0.74	0	0.11	2.59	3.15	0.26

* Number of invertebrates/10 m^2 of surface area of drift column.

Table II-7

Terrestrial organisms caught in drift net sets*, 30 May - 7 June 1978,

Block 102, Riviere du Loup, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb			-5 days		-4 days		-3 days	-2 days	-1 day		Spray Day AM				+1 day		+2 days		+3 days
			AM	PM	AM	PM	AM	PM	AM	PM	Pre	0	+½ hr	+1 hr	+2 hr	PM	AM	PM	AM	PM	AM
Current speed			0.37	0.37	0.31	0.24	0.37	0.34	0.31	0.34	0.29	0.29	0.29	0.29	0.29	0.27	0.27	0.24	0.24	0.27	0.24
Surface area of drift column (m^2)			104.3	104.3	131.1	101.5	156.5	143.8	131.1	153.4	122.7	122.7	122.7	122.7	122.7	76.1	76.1	101.5	67.7	114.2	101.5
Arachnida	Araneida		0.19			0.10	0.06								0.08		0.13				
Ephemeroptera		adults	0.29		0.15					0.07							0.13				0.20
Plecoptera		adults											0.08								
Trichoptera		adults													0.08						0.10
Lepidoptera	C. fumiferana	larvae		0.10																	
	Unidentified	larvae				0.10											0.13				0.10
Hymenoptera	Formicidae	adults				0.10															0.10
	Unidentified	adults			0.08	0.10	0.06	0.14	0.31		0				0.08	0.13					
Diptera		adults	0.58	1.34	0.31	0.99	0.38	0.45	1.45	0.59	0.16	0.08	0.16	0.08	1.47	1.18	1.45	0.10	0.44	0.18	1.18
Total Terrestrial Organisms			1.06	1.44	0.54	1.39	0.50	0.59	1.76	0.66	0.16	0.08	0.24	0.08	1.71	1.31	1.84	0.10	0.44	0.18	1.68

* Number of invertebrates/10 m^2 of surface area of drift column.

Table II-8

Terrestrial organisms caught in drift net sets*, 30 May - 7 June 1978, Block 102,
Riviere du Loup Downstream Station, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb		-5 days		-4 days		-3 days	-2 days	-1 day		Spray Day AM						+1 day		+2 days		+3 days
		AM	PM	AM	PM	AM	PM	AM	PM	Pre	0	+½ hr	+1 hr	+2 hr	+3 hr	PM	AM	PM	AM	PM	AM
Current speed (m/sec)		0.52	0.52	0.39	0.43	0.49	0.43	0.40	0.43	0.37					0.40	0.40	0.31	0.37	0.40	0.37	0.34
Surface area of drift column (m^2)		146.6	146.6	165.0	181.9	207.2	181.9	169.2	181.9	156.5	**162.9	**162.9	**162.9	**162.9	169.2	112.8	87.4	156.5	112.8	156.5	143.8
Arachnida	Araneida		0.07		0.12				0.06								0.23				
Ephemeroptera		adults	0.07	0.34				0.11		0.28						0.09			0.18		0.14
Plecoptera		adults					0.05			0.06										0.32	
Hemiptera		adults						0.06									0.11				
Homoptera		adults																			0.07
Neuroptera		adults							0.06												
Trichoptera		adults													0.24		0.11		0.09		
Lepidoptera	C. fumiferana	larvae						0.06	0.12												
Hymenoptera		adults						0.50									0.11		0.09	0.13	0.07
Coleoptera		adults															0.11				
Diptera		adults	0.55	0.75	0.30	0.06	0.10	0.88	0.18	0.17	0.06	0.31	0.18			0.30	0.36	0.57		0.09	0.51	0.14
Total Terrestrial Organisms			0.69	1.09	0.42	0.06	0.15	1.61	0.42	0.51	0.06	0.31	0.18	0	0	0.54	0.45	1.24	0	0.45	0.96	0.42

* Number of invertebrates/10 m^2 of surface area of drift column.

** Surface area of drift column is an average of the pre-spray and +3 hr values.

Table II-9

Terrestrial organisms caught in drift net sets*, 29 May - 5 June 1978,
Block 109, Riviere Chaudiere, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb		-4 days		-3 days		-2 days		-1 day			Spray Day PM					+1 day		+2 days		+3 days	
		AM	PM	AM	PM	AM	PM	AM	PM	**PM'	AM	Pre	0	+½ hr	+1 hr	+2 hr	AM	PM	AM	PM	AM	PM
Current speed (m/sec)		0.82	0.79	0.73	0.91	0.76	0.82	0.95	1.04	1.04	0.98	0.88	0.88	0.88	0.88	0.88	0.88	0.88	1.01	***	0.70	0.70
Surface area of drift column (m^2)		115.6	222.8	205.9	128.3	107.2	346.9	267.9	293.3	293.3	276.4	372.2	372.2	372.2	372.2	372.2	248.2	248.2	284.8	427.2	296.1	197.4
Arachnida	Araneida			0.19		0.19	0.09				0.04			0.08	0.05	0.03					0.03	
Ephemeroptera	adults	0.26	0.05	0.29	0.39	0.47	0.32	0.86	3.51	0.14	0.91		1.21	0.75	0.47	0.30	0.12	3.91	0.25	0.33	0.27	0.20
Plecoptera	adults	0.09	0.05	0.05				0.11	0.03	0.21	0.07		0.03	0.24	0.51	0.19		0.08				
Homoptera	adults							0.09							0.08				0.04			
Neuroptera	adults													0.05								
Trichoptera	adults		0.58	0.68	0.16		0.09		0.03				0.05	0.13		0.16	0.04	0.08		0.02		
Hymenoptera	adults				0.08	0.19	0.03	0.08	0.03	0.03			0.62	3.30	0.65	0.40	0.44	0.08	0.04		0.10	0.05
Coleoptera	adults					0.28	0.11		0.39				0.03	0.08	0.05	0.08						
Diptera	adults	0.87	0.22	0.53	0.39	0.75	4.12	0.37	0.24	0.44	0.15	0.22	8.73	8.25	4.51	2.93	0.48	1.45	1.97	1.01	0.41	
Total Terrestrial Organisms		1.39	0.90	1.21	1.02	1.88	4.56	1.42	3.84	0.82	1.17	0.22	10.67	12.88	6.32	4.09	1.08	5.60	2.30	1.36	0.81	0.25

* Number of invertebrates/10 m^2 of surface area of drift column.

** On the evening of 1 June 1978, there was a spray in Block 109 south of the sampling stations. An additional PM drift (PM') was taken 2 hours after the first drift (PM) to determine any impact due to drift or downstream movement of the chemical.

*** On 4 June 1978 (PM), current speed could not be measured due to a defective current meter. Surface area of drift column was calculated using the current speed from +2 day AM.

Table II-10

Terrestrial organisms caught in drift net sets*, 29 May - 5 June 1978,

Block 109, Riviere Ouelle, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb	-4 days AM	-4 days PM	-3 days AM	-3 days PM	-2 days AM	-2 days PM	-1 day AM	-1 day PM	**PM'	C	Spray Day AM +½ hr	Spray Day AM +1 hr	Spray Day AM +2 hr	Spray Day PM	+1 day AM	+1 day PM	+2 days AM	+2 days PM	+3 days AM
Current speed (m/sec)	0.43	0.37	0.38	0.40	0.34	0.34	0.27	0.34	0.34	0.31	0.31	0.31	0.31	0.31	0.27	0.27	0.31	0.31	0.24
Surface area of drift column (m^2)	60.6	104.3	107.2	56.4	47.9	143.8	76.1	143.8	143.8	87.4	87.4	87.4	87.4	131.1	76.1	76.1	87.4	131.1	101.5
Arachnida Araneida	0.17				0.21				0.07										0.10
Ephemeroptera adults	0.50		0.19	4.43		0.56	0.26	0.35	0.21	0.23						0.39		0.23	0.20
Plecoptera adults	0.17							0.07				0.11							
Trichoptera adults	0.33			0.18					0.14								0.11		
Hymenoptera adults									0.07		0.11	0.23		0.08				0.08	
Coleoptera adults											0.11	0.11							
Diptera adults	0.99		0.09	2.66	0.83	0.63	0.26	1.04	2.16	0.57	0.34	0.46	1.83	0.30	1.44	1.31	0.46	0.46	0.59
Total Terrestrial Organisms	2.16	0	0.28	7.27	1.04	1.19	0.52	1.46	2.65	0.80	0.56	0.91	1.83	0.38	1.44	1.70	0.57	0.77	0.89

* Number of invertebrates/10 m^2 of surface area of drift column.

** On the evening of 1 June 1978, there was a spray in Block 109, south of the sampling stations. An additional PM drift (PM') was taken 2 hours after the first drift (PM) to determine any impact due to drift or downstream movement of the chemical.

Table II-11

Terrestrial organisms caught in drift net sets*, 29 May - 5 June 1978, Block 109, Riviere Ouelle Downstream Station, Kamouraska County, Quebec

Days before or after application of 0.053 kg AI/ha aminocarb			-4 days		-3 days		-2 days		-1 day			Spray Day AM				+1 day		+2 days		+3 days
			AM	PM	AM	PM	AM	PM	AM	PM	Pre	0	+½ hr	+1 hr	+2 hr	+3 hr	PM	AM	PM	AM	PM	AM
Current speed (m/sec)			0.43	0.15	0.76	0.82	0.67	0.73	0.61	0.58	0.70					0.73	0.58	0.64	0.67	0.61	0.55	0.52
Surface area of drift column (m^2)			121.3	42.3	214.3	231.2	188.9	308.8	172.0	278.1	296.1	**302.5	**302.5	**302.5	**302.5	308.8	245.3	180.5	188.9	172.0	232.7	220.0
Arachnida	Araneida						0.05													0.06		
Ephemeroptera		adults	0.08			0.04		0.03									0.04					
Plecoptera		adults	0.08						0.06					0.03		0.03	0.04				0.04	0.14
Trichoptera		adults					0.16														0.09	
Lepidoptera	C. fumiferana	larvae						0.03						0.07								0.05
Hymenoptera	Formicidae	adults													0.03							
		adults	0.17				0.05	0.10									0.33					
Coleoptera		adults	0.08														0.04					
Diptera		adults	0.17		0.19	0.08	0.85	0.29		0.04	0.10		0.03	0.17	0.69	1.20	1.71	0.28	1.48	2.44	0.99	0.82
Total Terrestrial Organisms			0.58	0	0.19	0.12	1.11	0.49	0.06	0.04	0.10	0	0.03	0.27	0.72	1.23	2.16	0.28	1.48	2.50	1.12	1.01

* Number of invertebrates/10 m^2 of surface area of drift column.

** Surface area of drift column is an average of the pre-spray and +3 hr values.

APPENDIX III

FISH

Notes on Appendix III, Tables 1-11

Mean volume of stomach contents - Mean of all fish in sample including those with empty stomachs.

Percent occurrence - Percent of fish in a sample with a particular food item in their stomachs.

Mean percent contribution to volume - Only fish with some food in their stomachs are included in calculating these values. The % contribution to volume of each food item in an individual fish's stomach is determined for each fish in the sample with some food in its stomach. For each food item, the % contributions to volume for each fish stomach in which that food item occurs are then summed and the total is taken as a percentage of the possible total contribution (the number of fish with food in their stomachs x 100%).

Mean number of organisms/stomach - Only fish with the particular food item in question in their stomachs are included in taking the mean.

Example Fish 1 (0.4 ml) 6 chironomid larvae (0.2 ml), 2 stonefly nymphs

2 3 stonefly nymphs (0.5 ml)
3 4 baetid mayfly nymphs (0.7 ml)
4 no food present

Mean volume of stomach contents: $\frac{0.2 + 0.4 + 0.5 + 0.7}{3} = 0.6$ ml

Percent occurrence:

chironomid larvae	¼ x 100 = 25%
stonefly nymphs	2/4 x 100 = 50%
baetid mayfly nymphs	¼ x 100 = 25%
no food present	¼ x 100 = 25%

Mean percent contribution to volume:

chironomid larvae	$\frac{33}{3 \times 100\%} \times 100 = 11.0\%$
stonefly nymphs	$\frac{67\% + 100\%}{3 \times 100\%} \times 100 = 55.7\%$
baetid mayfly nymphs	$\frac{100\%}{3 \times 100\%} \times 100 = 33.3\%$

Mean number of organisms/stomach:

chironomid larvae	6/1 = 6.0
stonefly nymphs	5/2 = 2.5
baetid mayfly nymphs	4/1 = 4.0

Table III-1

Brook trout sampled for stomach content analysis from Ruisseau Blanc, 31 May - 27 June, 1978

	31 May	4,5 June	15 June	19,21 June	27 June
No. of fish sampled	4	2	4	10	10
Mean Total Length (mm)	102.5	107.0	88.3	84.4	97.3
Range	99-106	99-115	71-107	65-115	74-124
Mean Fork Length (mm)	99.8	102.0	85.0	81.6	94.7
Range	97-103	94-110	68-103	63-110	72-122
Mean Weight (gm)	8.53	10.75	7.70	7.19	11.38
Range	8.1-9.5	8.1-13.4	3.2-13.1	2.9-14.1	4.8-26.5
Mean Volume of Stomach Contents (ml)	0.15	0.70	0.48	0.44	0.43
Range	0.1-0.3	0.4-1.0	0.2-1.0	<0.1-1.0	<0.1-1.8

Sculpins sampled for stomach content analysis from Ruisseau Blanc, 4 June - 27 June, 1978

4,7 June	15 June	19,21 June	27 June
3	6	10	10
65.7	60.5	78.2	59.7
50-76	50-74	55-98	47-88
2.70	2.27	5.72	2.97
1.4-4.0	0.9-4.9	1.8-10.7	1.2-7.7
0.05	0.08	0.13	0.04
0 - <0.1	<0.1-1.0	0-0.6	<0.1-0.1

Table III-2

Blacknose dace sampled for stomach content analysis from Riviere du Loup, Block 102
31 May - 6,7 June, 1978

	31 May	6,7 June
No. of fish sampled	11	10
Mean Total Length (mm)	80.4	79.5
Range	71 - 93	70 - 85
Mean Fork Length (mm)	75.4	75.9
Range	66 - 88	68 - 83
Mean Weight (gm)	5.05	5.20
Range	3.0 - 8.2	3.3 - 7.2
Mean Volume of Stomach Contents (ml)	0.09	0.04
Range	0 - 0.3	0 - 0.1

Table III-3

Blacknose dace sampled for stomach content analysis from Riviere Chaudiere
29 May - 17 June, 1978

	29 May	31 May	17 June
No. of fish sampled	11	8	5
Mean Total Length (mm)	71.4	67.6	66.1
Range	62 - 81	61 - 73	63 - 72
Mean Fork Length (mm)	68.1	64.4	63.2
Range	58 - 76	59 - 69	60 - 69
Mean Weight (gm)	3.91	3.00	2.60
Range	2.3 - 6.4	2.6 - 3.8	2.0 - 3.5
Mean Volume of Stomach Contents (ml)	0.05		<0.01
Range	0 - 0.2		0 - <0.1

Table III-4

Blacknose dace sampled for stomach content analysis
from Riviere Ouelle.
29 May - 3,4 June, 1978

	29 May	3,4 June
No. of fish sampled	6	5
Mean Total Length (mm)	66.2	71.4
Range	56 - 70	58 - 84
Mean Fork Length (mm)	62.2	67.4
Range	53.5 - 66	56 - 78
Mean Weight (gm)	2.78	3.58
Range	1.7 - 3.5	20 - 6.1
Mean Volume of Stomach Contents (ml)	0.02	0.01
Range	<0.1	0 - <0.1

Table III-5

Cutlips minnows sampled for stomach
content analysis from Riviere Ouelle Downstream
29 May - 18 June, 1978

	29 May	5,6 June	18 June
No. of fish sampled	10	7	3
Mean Total Length (mm)	100.4	77.6	61.7
Range	86 - 124	68 - 91	53 - 70
Mean Fork Length (mm)	93.3	72.4	58.7
Range	80 - 116	63 - 84	50 - 66
Mean Weight (gm)	12.30	4.73	2.50
Range	6.6 - 21.9	3.2 - 7.8	1.5 - 3.4
Mean Volume of Stomach Contents (ml)	0.1	0.01	0.01
Range	0 - 0.4	0 - <0.1	0 - <0.1

Table III-6

Percent occurrence, average percent contribution to the volume of each stomach and average number in each stomach present of various food items found in brook trout stomachs from Ruisseau Blanc, 31 May - 27 June, 1978.

Sample Date	Percent Occurrence					Mean Percent Contribution to Volume					Mean Number of Organisms/Stomach				
	31 May	4,5 June	15 June	19,21 June	27 June	31 May	4,5 June	15 June	19,21 June	27 June	31 May	4,5 June	15 June	19,21 June	27 June
No Food Present	0	0	0	0	0										
Aquatic Insects															
Burrowing mayfly nymphs	50	—	25	10	20	11.5	—	5.3	1.8	5.4	1.0	--	1.0	1.0	1.0
Heptagenid mayfly nymphs	--	50	50	20	--	--	2.5	7.5	0.6	--	--	1.0	1.0	1.0	--
Baetid mayfly nymphs	50	—	100	30	10	1.5	—	12.5	1.1	7.8	1.0	--	3.3	1.0	1.0
Stonefly nymphs	25	—	75	50	30	0.8	--	2.8	3.3	2.3	1.0	--	2.7	1.2	1.3
Caddisfly larvae	100	100	100	80	90	25.5	4.0	16.3	12.9	32.3	3.3	4.0	7.5	3.1	11.8
Coleoptera adults	75	100	50	20	60	18.5	3.5	1.3	0.4	16.3	1.7	2.5	1.5	1.0	2.7
Cranefly larvae	--	--	50	10	10	--	--	12.5	0.1	0.8	--	--	1.5	1.0	1.0
Cranefly pupae	25	--	—	—	--	8.8	—	—	--	--	1.0	--	--	--	--
Blackfly larvae	—	--	50	30	30	--	--	0.8	4.2	0.9	--	—	3.0	1.7	2.7
Chironomid larvae	50	--	75	20	50	5.0	—	0.8	0.2	1.9	6.0	—	7.0	1.5	4.6
Chironomid pupae	—	--	25	10	10	—	—	1.5	0.1	0.2	--	--	47.0	1.0	2.0
Culicoides larvae	25	--	25	--	--	0.5	--	0.3	--	--	1.0	--	1.0	--	--
Dancefly larvae	25	--	50	10	10	1.0	--	0.8	0.1	1.2	2.0	--	1.0	1.0	3.0
Dancefly pupae	--	--	25	—	10	—	—	0.5	—	0.5	--	--	1.0	--	1.0
Other Aquatic Invertebrates															
Oligochaetes	--	—	—	20	—	—	--	—	1.5	--	--	--	--	1.5	--
Hydracarina	--	—	—	20	60	—	—	—	0.2	0.7	--	--	--	1.0	1.2
Terrestrial Arthropods															
Mayfly adults	25	—	75	10	10	7.3	—	4.3	0.2	0.1	1.0	--	1.0	1.0	1.0
Stonefly adults	--	—	--	50	60	--	--	--	1.3	7.0	--	--	--	1.2	4.3
Caddisfly adults	25	50	50	20	—	0.5	1.0	1.0	1.5	--	1.0	1.0	1.5	1.0	--
Hemiptera adults	25	—	—	--	--	6.3	--	—	--	--	1.0	--	--	--	--
Homoptera adults	--	--	--	--	20	--	--	--	--	0.5	--	--	--	--	4.5
Lepidoptera larvae	25	100	75	80	60	2.5	30.0	28.8	54.5	8.6	1.0	6.5	6.3	9.0	2.2
Hymenoptera adults	25	100	50	20	10	1.5	2.5	1.0	0.8	0.2	3.0	1.0	1.0	1.0	1.0
Ants	--	--	--	10	30	--	--	--	0.5	2.0	--	--	--	1.0	1.3
Coleoptera adults	25	100	--	30	30	5.3	24.5	--	7.9	4.1	1.0	3.0	--	2.0	2.7
Mecoptera adults	--	--	--	--	10	--	--	--	--	2.0	--	--	--	--	1.0
Diptera adults	50	100	75	50	70	1.3	30.0	2.3	4.0	4.1	2.5	9.5	3.7	4.2	5.0
Spiders	50	100	25	30	50	2.5	2.0	0.3	0.3	1.1	2.5	1.0	1.0	1.0	1.2
Fish															
Sculpins	—	--	—	10	--	--	--	--	2.5	--	--	--	--	1.0	--

Spray dates for Ruisseau Blanc Station:

15 May 1978	fenitrothion	0.210 kg AI/ha
3 June 1978	aminocarb	0.053 kg AI/ha
16 June 1978	aminocarb	0.053 kg AI/ha

Table III-7

Percent occurrence, average percent contribution to the volume of each stomach and average number in each stomach present of various food items found in sculpin stomachs from Ruisseau Blanc.
31 May - 27 June, 1978

Sample Date	Percent Occurrence				Mean Percent Contribution to Volume				Mean Number of Organisms/Stomach			
	4,7 June	15 June	19,21 June	27 June	4,7 June	15 June	19,21 June	27 June	4,7 June	15 June	19,21 June	27 June
No Food Present	33	0	10	0								
Aquatic Insects												
Burrowing mayfly nymphs							13.9	5.0	--	--	3.0	1.0
Heptagenid mayfly nymphs	33				24.9		1.2	7.0	2.0	--	2.0	2.0
Baetid mayfly nymphs	67	100	40	30	47.0	66.0	19.0	8.0	2.0	2.3	1.8	1.3
Stonefly nymphs	--	50	40	30	--	5.7	4.0	12.8	--	1.3	1.8	3.3
Caddisfly larvae	33	50	50	80	27.5	20.0	14.0	36.1	2.0	2.0	3.4	3.0
Coleoptera adults	--	--	10	10	--	--	1.7	2.0	--	--	5.0	1.0
Cranefly larvae	--	17	40	--	--	0.2	11.1	--	--	1.0	2.0	--
Blackfly larvae	33	17	40	60	0.5	2.5	9.8	9.9	1.0	6.0	24.3	4.2
Blackfly pupae	--	17	--	--	--	2.5	--	--	--	1.0	--	--
Chironomid larvae	33	67	80	50	0.5	3.0	21.8	8.3	1.0	3.0	7.1	6.8
Culicoides larvae	--	17	--	--	--	0.2	--	--	--	1.0	--	--
Dancefly larvae	--	--	20	20	--	--	0.4	2.2	--	--	1.0	2.0
Unidentified Diptera larvae	--	--	--	10	--	0.2	--	4.0	--	--	--	1.0
Other Aquatic Invertebrates												
Hydracarina	--	--	10	10	--	0.8	0.3	0.2	--	--	--	1.0
Snails	--	--	30	20	--	0.8	3.3	--	--	--	1.0	--
Terrestrial Arthropods												
Caddisfly adults	100	100	80	80			3.3	--	--	--	1.0	--
Unidentified Diptera larvae	--	--	--	10	0.8	--	--	4.5	--	--	--	1.0

Spray dates for Ruisseau Blanc Station:

15 May 1978	fenitrothion	0.210	kg AI/ha
3 June 1978	aminocarb	0.053	kg AI/ha
16 June 1978	aminocarb	0.053	kg AI/ha

Table III-8

Percent occurrence, average percent contribution to the volume of each stomach and average number in each stomach present of various food items found in blacknose dace stomachs from Riviere du Loup, Block 102.
31 May - 6,7 June, 1978

Sample Date	Percent Occurrence		Mean Percent Contribution to Volume		Mean Number of Organisms/Stomach	
	31 May	6,7 June	31 May	6,7 June	31 May	6,7 June
No Food Present	9	10				
Aquatic Insects						
Heptagenid mayfly nymphs	54	10	35.3	5.3	2.5	1.0
Baetid mayfly nymphs	54	60	33.5	44.8	3.7	2.8
Stonefly nymphs	27	--	10.6	--	1.3	--
Caddisfly larvae	27	10	10.5	0.6	1.0	1.0
Blackfly larvae	--	10	--	11.1	--	22.0
Chironomid larvae	18	60	2.1	24.0	1.0	1.5
Terrestrial Arthropods						
Lepidoptera larvae	--	20	--	14.4	--	1.0
Diptera adults	9	--	8.0	--	4.0	--

Spray date for Riviere du Loup Station: 4 June, 1978 aminocarb 0.053 kg AI/ha

Table III-9

Percent occurrence, average percent contribution to the volume of each stomach and average number in each stomach present of various food items found in blacknose dace stomachs from Riviere Chaudiere.
29 May - 17 June, 1978

Sample Date	Percent Occurrence			Mean Percent Contribution to Volume			Mean Number of Organisms/Stomach		
	29 May	31 May	17 June	29 May	31 May	17 June	29 May	31 May	17 June
No Food Present	45	100	80						
Aquatic Insects	51	--	10						
Heptagenid mayfly nymphs	18	--	10	9.5	--	--	4.0	--	--
Baetid mayfly nymphs	45	--	10	47.2	--	--	5.4	--	--
Caddisfly larvae	9	--	--	0.2	--	--	1.0	--	--
Cranefly larvae	9	--	--	8.3	--	--	1.0	--	--
Net-winged midge larvae	9	--	--	1.2	--	--	1.0	--	--
Blackfly larvae	18	--	10	0.5	--	--	2.0	--	--
Chironomid larvae	54	--	--	17.0	--	--	5.3	--	--
Other Aquatic Invertebrates									
Hydracarina	27	--	20	1.2	--	100	1.0	--	1.0
Terrestrial Arthropods									
Mayfly adults						--	1.0	--	--
Diptera						--	1.0	--	--

Spray dates for Riviere Chaudiere Station: 2 June, 1978 aminocarb 0.053 kg AI/ha
7,9,10 June, 1978 aminocarb 0.053 kg AI/ha

Table III-10

Percent occurrence, average percent contribution to the volume of each stomach and average number in each stomach present of various food items found in blacknose dace stomachs from Riviere Ouelle.
29 May – 3,4 June, 1978

Sample Date	Percent Occurrence		Mean Percent Contribution to Volume		Mean Number of Organisms/Stomach	
	29 May	3,4 June	29 May	3,4 June	29 May	3,4 June
No Food Present	0	60				
Aquatic Insects						
Heptagenid mayfly nymphs	17	—	13.3	—	1.0	--
Baetid mayfly nymphs	83	—	73.3	--	1.4	--
Caddisfly larvae	17	20	4.2	42.0	4.0	1.0
Caddisfly pupae	—	20	—	50.0	--	1.0
Blackfly larvae	—	20	—	4.5	--	1.0
Chironomid larvae	50	—	7.5	--	2.3	--
Other Aquatic Invertebrates						
Hydracarina	17	--	1.7	--	1.0	--
Terrestrial Arthropods						
Diptera adults	--	20	—	3.5	—	1.0

Spray date for Riviere Ouelle Station: 2 June, 1978 aminocarb 0.053 kg AI/ha

Table III-11

Percent occurrence, average percent contribution to the volume of each stomach and average number in each stomach (dry weight of various food items found in cutlips minnow stomachs from Riviere Ouelle Downstream.

29 May - 18 June, 1978

Sample Date	Percent Occurrence			Mean Percent Contribution to Volume			Mean Number of Organisms/Stomach		
	29 May	5,6 June	18 June	29 May	5,6 June	18 June	29 May	5,6 June	18 June
No Food Present	20	43	33						
Aquatic Insects									
Heptagenid mayfly nymphs	10	--	--	1.0	--	--	1.0	--	--
Baetid mayfly nymphs	20	--	--	7.5	--	--	1.0	--	--
Stonefly nymphs	10	--	--	12.5	--	--	1.0	--	--
Caddisfly larvae	40	14	33	40.0	15.0	7.5	5.5	1.0	2.0
Water pennies	20	--	--	18.8	--	--	2.0	--	--
Chironomid larvae	30	57	67	14.0	82.5	92.5	1.0	8.2	13.5
Dancefly larvae	10	--	--	6.2	--	--	1.0	--	--
Terrestrial Arthropods									
Diptera adults	--	14	--	--	2.5	--	--	1.0	--

Spray dates for Riviere Ouelle Downstream Station: 2 June, 1978 aminocarb 0.053 kg AI/ha
9,10 June, 1978 aminocarb 0.053 kg AI/ha