ACCIDENT INVESTIGATION ACTIVITIES OF THE ECOLOGICAL IMPACT TEAM IN FOREST AREAS TREATED WITH INSECTICIDE IN 1975

by

C. H. Buckner, B. B. McLeod and P. D. Kingsbury

Chemical Control Research Institute
Canadian Forestry Service
Department of the Environment
Ottawa, Ontario

Report CC-X-103

November, 1975

CONTENTS

ABSTRACT

Numberous reported incidents of insecticide poisoning on non-target organisms by forest insect control programs were investigated. Monitoring of the environment at the sites of accidental spills was also carried out in 1975.

The reported insecticide poisoning of birds and fish resulting from a forest insect control operation employing phosphamidon (Dimecron®) at the dosage rate of 140 g AI/ha (2 oz AI/acre) was investigated in an area near Gaspé, Quebec. Populations of birds and aquatic bottom fauna were censused in treated and untreated areas. The area around Lac Bazire was searched for evidence of a recent fish kill. Samples of soil, foliage, water and birds were collected from treated areas and analysed for insecticide residues. No evidence of insecticide damage to birds, fish or aquatic bottom fauna was found. Dimecron® residues persisted in samples of foliage, soil and water 12 days after application. Breeding toads, *Bufo americanus* (Holbrook), abounded in Lac Bazire, the site of the reported fish kill.

A commercial apiary near the town of Montmagny, Quebec was reported to be heavily damaged by an operational forest insect control program also using phosphamidon at the emitted rate of 140 g AI/ha (2 oz AI/acre). Forty-four hives were examined and samples of dead bees were analysed for pesticide residues. The results indicated that phosphamidon was responsible for the severe losses incurred.

At the operational airstrip at Juniper, New Brunswick, aborted spray plane take-offs resulted in numerous spills of insecticides (fenitrothion and phosphamidon). The monitoring of such immediate areas as the camp's water supply, Miramichi River and a small pond at the end of the runway indicated that the spills did not present a serious danger to personnel or

wildlife in the area.

The site of an operational spray plane crash (July, 1974) was revisited. Samples of soil and conifer foliage were collected for phosphamidon residue analysis. The results indicated a 99% degradation of the material over 1 year.

A fish hatchery located near La Tuque, Quebec reported losses of trout stocks resulting from nearby forest insect control operations using aminocarb (Matacil®) at the rate of 52 g AI/ha (0.75 oz AI/acre). Fish samples submitted for pesticide residue analysis indicated that the insecticide was not present and the fish mortality resulted from causes other than the insect control operations.

A fish kill was investigated on 26 June, 1975, in a small pond in Larose Forest just south of an area treated with the organophosphate insecticide acephate (Orthene®). An inspection of the pond using scuba gear found that brook trout, *Salvelinus fontinalis* (Mitchill) in the pond were very sluggish and a number were found dead or dying on the bottom. Newts, aquatic insects and zooplankton in the pond appeared normal. Collection and analysis of temperature, dissolved oxygen and acephate residue data showed conclusively that the fish mortality in the pond was caused by lethal high water temperatures and was unrelated to the nearby acephate treatment.

RESUME

On a examiné les nombreux cas d'empoisonnement par les insecticides, signalés chez les organismes non visés par la lutte contre les insectes de la forêt. En 1975, l'enquête a également porté sur les lieux de déversements accidentels.

Dans une région proche de Gaspé, au Québec, l'étude a porté sur les cas d'empoisonnement d'oiseaux et de poissons, attribués au phosphamidon (Dimecron®) appliqué à raison de 140 g d'ingrédient actif par hectare (2 oz à l'acre). On a dénombré les oiseaux et la faune benthique dans les régions traitées et non traitées. On a cherché autour du lac Bazire des preuves d'un récent massacre de poissons. Des échantillons de sol, de feuillage et d'eau ont été prélevés pour le dosage des résidus d'insecticide. Des oiseaux ont été soumis aux mêmes analyses. Aucun effet biocide n'a été décelé chez les oiseaux, les poissons et la faune benthique. On a remarqué que, 12 jours après l'application du traitement, les échantillons de sol et d'eau renfermaient encore des résidus de phosphamidon. De jeunes crapauds, Bufo Americanus (Holbrock) , abondaient dans le lac Bazire, le lieu présume du massacre de poissons

On a signalé le cas d'un rucher commercial situé près de Montmagny, au Québec, qui aurait subi de grosses pertes à la suite d'applications de phosphamidon à raison de 140 g d'ingrédient actif par hectare (2 oz à l'acre), dans la lutte organisée contre les insectes de la forêt. On a examiné 44 ruches et analysé des abeilles mortes afin d'y déceler des résidus de pesticide.

RESUME

On a examiné les nombreux cas d'empoisonnement par les insecticides, signalés chez les organismes non visés par la lutte contre les insectes de la forêt. En 1975, l'enquête a également porté sur les lieux de déversements accidentels.

Dans une région proche de Gaspé, au Québec, l'étude a porté sur les cas d'empoisonnement d'oiseaux et de poissons, attribués au phosphamidon (Dimecron®) appliqué à raison de 140 g d'ingrédient actif par hectare (2 oz à l'acre). On a dénombré les oiseaux et la faune benthique dans les régions traitées et non traitées. On a cherché autour du lac Bazire des preuves d'un récent massacre de poissons. Des échantillons de sol, de feuillage et d'eau ont été prélevés pour le dosage des résidus d'insecticide. Des oiseaux ont été soumis aux mêmes analyses. Aucun effet biocide n'a été décelé chez les oiseaux, les poissons et la faune benthique. On a remarqué que, 12 jours après l'application du traitement, les échantillons de sol et d'eau renfermaient encore des résidus de phosphamidon. De jeunes crapauds, Bufo Americanus (Holbrock) , abondaient dans le lac Bazire, le lieu présumé du massacre de poissons

On a signalé le cas d'un rucher commercial situé près de Montmagny, au Québec, qui aurait subi de grosses pertes à la suite d'applications de phosphamidon à raison de 140 g d'ingrédient actif par hectare (2 oz à l'acre), dans la lutte organisée contre les insectes de la forêt. On a examiné 44 ruches et analysé des abeilles mortes afin d'y déceler des résidus de pesticide.

Les résultats ont montré que le phosphamidon a bien été la cause des pertes signalées.

Les décollages manqués à la base de Juniper, au Nouveau-Brunswick, ont donné lieu à de nombreux déversements d'insecticides (fénitrothion et phosphamidon). L'étude des environs immédiats de la base, y compris son approvisionnement en eau, la rivière Miramichi et un petit étang, à l'extrémité de la piste d'envol, a montré que ces déversements ne constituaient pas de menace ni pour le personnel, ni pour la faune de la région.

On a visité de nouveau l'endroit où un avion utilisé pour l'épandage d'insecticide s'était écrasé (juillet 1974). Des échantillons de sol et de feuillage de conifères ont été prélevés en vue du dosage des résidus de phosphamidon. Les résultats indiquent que, après une année, la dégradation du produit a atteint 99%.

Dans un établissement piscicole de la région de La Tuque (Québec) on avait signalé la perte de stocks de truites, attribuable à l'épandage dans les environs de aminocarb (Matacil®) à raison de 52 g d'ingrédient actif par hectare (0.75 oz à l'acre) contre les insectes forestiers. L'analyse d'échantillons de poissons a indiqué qu'il n'y avait pas d'insecticide dans leur organisme et que leur mortalité avait été provoqué par d'autres causes.

Le 26 juin 1975, on a fait une investigation sur la mort de poissons, observée dans un petit étang de Larose Forest, situé au sud d'une région traitée à l'acephate (Orthène®) un insecticide organosphosphoré. L'inspection de cet étang, en plongée autonome, a montré que la truite de ruisseau, Salvélinus fontinalis (Mitchill), manquait de

vivacité et qu'il y avait sur le fond des truites mortes ou agonisantes. Quant au triton, aux insectes aquatiques et au zooplancton, ils semblaient normaux. La collecte et l'analyse des données relatives à la température, à l'oxygène dissous et aux résidus d'acéphate ont permis de conclure à une mortalité provoquée par la température élevée de l'eau et d'innocenter l'acéphate.

INTRODUCTION

In 1975, reports of ecological damage to non-target organisms were investigated in areas of New Brunswick, Quebec and Ontario where the insecticides fenitrothion (Sumithion®), aminocarb (Matacil®), phosphamidon (Dimecron®) and acephate (Orthene®) were being used in operational or experimental forest insect control programs. The investigations were carried out by personnel of the Chemical Control Research Institute's Ecological Impact Team co-operating with provincial wildlife and forestry officials. Soil, water, foliage and animal tissue samples collected were transported to the Chemical Control Research Institute and analysed there for insecticide residues by Dr. K.M.S. Sundaram and the personnel of the pesticide chemistry section.

ACCIDENT INVESTIGATIONS

1. Bird and Fish Kill Investigations - Gaspé Region, Quebec.

1.1 Introduction: On 26 May, 1975, the Quebec Department of Lands and Forests carried out spruce budworm, *Choristoneura fumiferana* Clem., control operations in the Gaspé area of Quebec (Fig. 1) using phosphamidon at the dosage rate of 150 g AI/ha (2 oz AI/acre). Weather conditions at the time of the operations were favourable with a temperature of 11°C, winds of 4 km/h (2.5 mph) and high humidity (light scattered fog patches).

On 4 June, reports of bird mortality occuring on or about the time of the insect control operations were received. Investigations into these reports and subsequent ones concerning a fish kill were carried out on 6 June.

Spring weather conditions were somewhat delayed in this area in 1975. Snow patches still clung to hill-sides and sheltered areas in the valleys. Deciduous tree foliage had not flushed at the time of the investigation (6 June) but leaf bud breaking of some broadleaf shrubs growing in exposed areas along roadsides and trails had begun. The new growth buds on spruce and fir had not started to swell and budcaps remained firm. Very few insects were observed in sunny sheltered areas but no black flies or mosquitoes were observed. Birds were quite active and vocal.

1.2 Methods: Bird populations were monitored at five locations within the treated area (Fig. 1, locations 1, 2, 3, 4 and 5) and in two locations in untreated area (Fig. 1, location 10 and Lac Bazire) by walking slowly along trails for a period of 30 minutes and recording all singing and sighted birds. Populations of stream bottom fauna were sampled by taking five Surber samples from a stream in treated (Fig. 1, location 1) and untreated areas, (Fig. 1, location 1A).

Intensive searches of the shoreline and shallow areas of Lac Bazire were carried out for evidence of the reported fish kill. Samples of soil, water and balsam fir, *Abies balsamea* (L.) Mill., foliage were collected for chemical residue analysis. Samples of dead birds (all warblers) were collected at the site of a fish camp operation on the Riviére St. Jean just outside the treatment area (spray block 618) and frozen and returned to the laboratory for residue analysis.

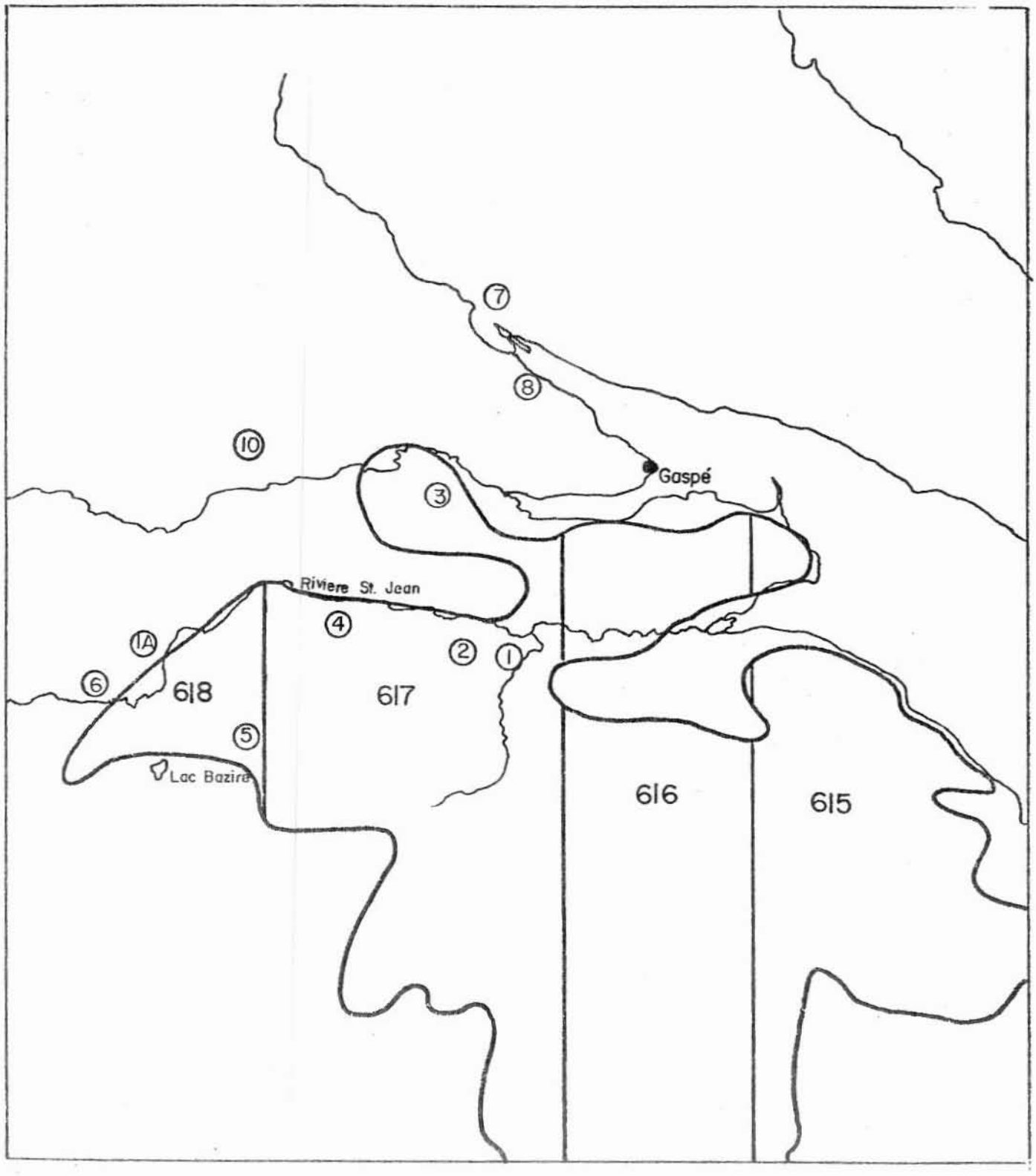

Fig. 1. Environmental sample locations in phosphamidon treatment areas Gaspé, Quebec, 1975. Treatment blocks 615, 616, 617 and 618 are shown.

1.3 Results: Some species of birds had set up breeding territories such as; the white-throated sparrow, *Zonotrichia albicollis* (Gmelin), the magnolia warbler, *Dendroica magnolia* (Wilson) and the Tennessee warbler, *Vermivora peregrina* (Wilson), while others such as ruby-crowned kinglets, *Regulua calendula* (Linnaeus), Myrtle warblers, *Dendroies coranata* (Linnaeus) and black-throated green warblers, *Dendroica virens* (Gmelin) were observed foraging in small flocks. The population census data taken on June 6th from treated and untreated areas do not indicate a reduction of bird fauna resulting from the budworm control program (Table I). The lateness of the spring undoubtedly delayed insect emergence, and insectivorous species, especially Myrtle warblers, were observed foraging over lakes, indicating that they were experiencing difficulty in aquiring food (as was observed in Quebec in 1974 when severe spring starvation mortality was observed).

Additional reports of bird mortality (Fig. 1, locations 7 and 8) were not investigated as all evidence (bird carcasses) had by then been discarded.

Examination of the data gathered from streams in the treated (Fig. 1, 1) and untreated areas (Fig. 1, 1A) does not indicate an impact of the insecticide upon the bottom fauna (Table II). Such organophosphate insecticide sensitive groups as mayfly nymphs (Ephemeroptera) and stonefly nymphs (Plecoptera), were present at normal population levels in the treated stream (Table II). Population of other groups were very low in both streams; this reflects the lateness of the spring and the very cold water temperatures (5°C to 8°C).

A report of a large fish kill in Lac Bazire just south of treatment block 618 was investigated. Shore line searches failed to provide any evidence of dead fish being washed ashore and there was also no evidence of fish

TABLE I

Small forest songbirds recorded in phosphamidon treated and untreated areas

Gaspé, Quebec

June 6, 1975

Species	Phosphamidon treated blocks					Untreated areas	
	Observation location					Observation location	
	1	2	3	4	4	Camp 10 Rd.	Bazire L
Yellow-bellied Sapsucker	1	1	1	-	-	-	-
Least Flycatcher	8	-	-	2	-	2	-
Eastern Wood Peewee	-	2	-	-	-	-	-
Olive-sided Flycatcher	-	-	-	2	-	2	-
Tree Swallow	-	-	-	2	-	-	-
Blue Jay	-	-	-	-	-	1	-
Black-capped Chickadee	2	3	-	-	-	-	-
Red-breasted Nuthatch	-	2	-	-	-	2	-
Winter Wren	2	2	-	2	-	-	2
American Robin	2	3	-	-	-	-	3
Hermit thrush	-	-	-	-	-	2	-
Golden-crowned Kinglet	-	2	-	-	-	-	2
Ruby-crowned Kinglet	-	-	8	2	-	6	2
Red-eyed Vireo	4	4	2	-	2	2	-
Black and White Warbler	2	-	-	2	-	-	-
Tennessee Warbler	2	-	4	2	4	10	-
Nashville Warbler	4	-	2	-	-	-	-
Parula Warbler	-	6	-	-	-	-	-
Magnolia Warbler	6	2	4	2	2	6	2
Cape May Warbler	-	-	-	-	-	4	2
Black-throated Blue Warbler	-	2	-	-	-	-	-
Myrtle Warbler	1	-	-	8	-	6	2
Black-throated Green Warbler	2	6	4	-	-	-	-
Blackburnian Warbler	-	-	2	-	-	-	-
Chestnut-sided Warbler	2	-	-	-	-	-	-
Bay-breasted Warbler	2	4	-	-	-	8	-
Blackpoll Warbler	-	-	-	4	-	-	-
Ovenbird	4	-	2	-	-	-	-
Northern Waterthrush	4	-	-	2	-	-	2
Canada Warbler	-	4	-	-	-	-	-
American Redstart	-	-	-	2	-	-	-
Brown-headed Cowbird	2	-	-	-	-	-	-
Red-breasted Grosbeak	2	-	-	-	-	-	-
Evening Grosbeak	-	-	1	-	-	-	-
Purple Finch	4	2	-	2	4	-	3
Pine Siskin	-	-	-	-	-	-	4
American Goldfinch	-	-	-	-	-	2	-
Chipping Sparrow	-	-	-	-	-	4	-
White-throated Sparrow	-	4	4	3	2	6	6
Unidentified Species	-	-	-	-	-	2	-
Totals	56	47	34	37	14	65	28

TABLE II

Populations of aquatic bottom fauna collected in Surber samples from phosphamidon treated and untreated streams

Gaspé area, Quebec

1975

quatic roup	Treated stream					Untreated stream				
	Surber sample number				Average and standard deviation	Surber sample number				Average and standard deviation
	1	2	3	4		1	2	3	4	
phemeroptera	58	22	15	31	31.5 ± 18.8	11	1	11	12	8.8 ± 5.2
lecoptera	2	2	5	3	3.0 ± 1.4	-	-	-	-	-
epidoptera	1	-	-	-	0.2 ± 0.5	-	-	-	-	-
iptera-Chironomidae	4	3	6	3	4.0 ± 1.4	3	1	-	2	1.5 ± 1.3
-Simuliidae	-	-	-	1	0.2 ± 0.5	1	-	-	-	0.2 ± 0.5
-Rhagionidae	1	-	-	-	0.2 ± 0.5	-	-	-	-	-
latyhelminthes	1	-	-	-	0.2 ± 0.5	-	-	-	-	-
ligochaeta	-	-	-	-	-	2	-	1	-	0.8 ± 1.0
ollusca-Gastropoda	-	-	-	-	-	-	-	1	-	0.2 ± 0.5
otal	67	27	26	38	39.5 ± 19.1	17	2	13	14	11.5 ± 6.6

TABLE III

Analysis of phosphamidon residues in samples of birds, soil, water and foliage obtained from the Gaspé area, Quebec.

June 9, 1975*

Sample and location	Mass	Phosphamidon ppb**		
		Trans	Cis	Total
Treatment Block 617, 1 - Soil	558 g	68	66	134
Treatment Block 617, Balsam Fir Foliage	100 g	400	335	735
Treatment Block 617, 1 - Water (Chesney Creek)	710 ml	11	13	24
Treatment Block 617, 2 - Balsam Fir Foliage	100 g	195	178	373
Untreated Area (Fig., 1, 6) birds	32.3 g	98	115	213

* Analysis provided by Dr. K.M.S. Sundaram, Pesticide Chemist, C.C.R.I.

** ppb = parts per billion

carrion being eaten by bears (seen in the area) or gulls. A search of the shallow bays of the lake did not reveal any dead fish on the bottom. Large numbers of American toads, *Bufo americanus* (Holbrook) were observed breeding in the shallow waters of the lake and no mortality was observed.

Phosphamidon residues remained in samples of soil, foliage, water and bird samples 12 days after application (Table III). Levels of insecticide at this time probably represent an original deposit of about 140 g AI/acre (2 oz AI/acre) in the sample areas (Sundaram, personal communication.

1.4 Conclusions: The late spring in this area of the Gaspé delayed insect activity probably causing a shortage of food for northward migrating insectivorous birds. This is further indicated by the peculiar situation observed of warblers (especially Myrtle warblers) feeding on emerging insects over lake surfaces. There would probably be fewer insects available for food on or about the day of the budworm control operation (26 May). Only warblers (in an advanced state of decomposition) were found in the bird sample obtained for residue analysis, and other areas of reported bird mortality were located well outside the treatment area. Seed feeding species such as the white-throated sparrow and purple finch, *Carpodacus purpureus* (Gmelin) were well established in breeding territories, indicating no disruption of reproductive behavior had taken place among species able to forage on other food material besides insects.

The sampling of streams in treated and untreated areas produced very few specimens of bottom dwelling organisms which is probably due to the earliness of the spring and very cold water. Specimens of such insecticide sensitive species as mayfly and stonefly nymphs were collected from samples from the treated stream indicating that the insecticide

application had not harmed stream bottom insect fauna. The absence of any evidence of dead fish in or around Lac Bazire coupled with the fact that the inshore shallows were teeming with breeding toads would indicate that the forest insect control program had not noticeably affected the lake.

Phosphamidon residues were found in foliage, soil, water and birds, but no biological damange to avian or aquatic fauna populations was found.

2. Damage to Honey Bees in a Phosphamidon Treated Area in Quebec.

2.1 Introduction: On 2 June, 1975, the emergency investigation team of the Ecological Impact Section, Chemical Control Research Institute examined the apiary of M. Guy Leblanc, located near Montmagny, P.Q., that had been reportedly damaged by forest insect control operations. The apiary contained 44 hives, and was located near treatment block 429. It is reported that this tract was treated on 15 and 16 May, 1975 with phosphamidon at the rate of 140 g AI/ha (2 oz/acre) for control of the spruce budworm.

2.2 Results: All 44 hives were opened and evaluated for resident population, age structure, egg and brood production, and pollen and nectar content. Without exception the hives were in an extremely weakened condition. Few workers were foraging, the nurse bee population was extremely low, little evidence of growth in terms of eggs or brood could be found, there was little pollen or nectar, and in several cases the hives were queenless. Large numbers of dead bees were observed at the entrances of the hives. The surviving bees were extremely disoriented in behaviour.

Samples of dead bees collected from the hive entrances about 25 May, 1975, were analysed chemically for the presence of phosphamidon. Eight replicates contained 1.10 to 1.30 ppm with an average of 1.14 ppm of this insecticide. The definitive concentration was undoubtedly much higher than this due to degradation of the compund between the date the damage occurred (15-16 May) and the date the samples were received by the Chemical Analyst (30 May). Anderson and Atkins (1968) regard phosphamidon as highly toxic to honey bees and have evaluated the LD_{50} (µg/bee) to be about 1.462. The concentrations recovered from the samples were of the same order of magnitude as Anderson and Atkins found lethal to honey bees in the laboratory.

2.3 Conclusion: It is concluded that the apiary examined had sustained severe damage resulting from accidental poisoning by the insecticide phosphamidon.

2.4 Reference:

ANDERSON, L.D. and E.L. ATKINS, JR. 1968. Pesticide usage in relation to beekeeping. Ann. Rev. Ent. 13: 213-238.

3. Insecticide Residues in Water, Juniper Airstrip, New Brunswick

3.1 Introduction: During the course of spruce budworm control operations in New Brunswick in 1975, several loads of insecticide were jetisoned on the Juniper airstrip as emergency procedures during aborted aircraft take-offs. On 7 June, 1975, water samples were collected from several locations around the airstrip and from the camp water supply for analysis for phosphamidon and fenitrothion residues. The samples were frozen immediately and transported in a frozen state to the pesticide chemistry section at the Chemical Control Research Institute.

3.2 Results: The insecticide residues found in water from the various sources are presented in Table IV. The residues present in southwest Miramichi River indicate rapid downstream dilution from the source of contamination. The levels of insecticides in the river water were well below the concentrations which have been shown to affect fish (Kingsbury, 1976) and probably caused little or no disturbance of aquatic invertebrates. The residues in the camp water supply would pose no hazard to human health.

3.3 Conclusion: It is concluded that the insecticide introduced into aquatic systems in the vicinity of the Juniper airstrip did not present a serious hazard to personnel or aquatic fauna in the area.

3.4 Reference:

KINGSBURY, P.D., 1976. A history of the effects of aerial forest spraying in Canada on aquatic fauna. Report CC-X-117, CCRI, Ottawa.

Table IV

Phosphamidon and fenitrothion residues in water samples collected in the vicinity of Juniper airstrip, N.B., 7 June 1975

Source	pH	Phosphamidon (ppb)	Fenitrothion (ppb)
S.W. Miramichi River - Closest point to airstrip	7.0	81.0	6.6
S.W. Miramichi River - ¼ mile downstream from airstrip	6.6	3.1	1.5
S.W. Miramichi River - 1 mile downstream from airstrip	5.9	1.0	0.8
Pond at the end of Juniper airstrip	6.9	1.9	8.3
Camp water supply, Juniper airstrip	7.0	2.9	1.1

4. Persistence of Phosphamidon Residues at a Spray Plane Crash Site, New Brunswick

4.1 Introduction: On 21 July, 1974, a TBM Avenger aircraft crashed in a forested area of New Brunswick while applying phosphamidon to control spruce budworm moths. On 25 July, 1974, members of the Ecological Impact Team of the Chemical Control Research Institute collected samples from the crash site for phosphamidon residue analysis. On 7 August, 1975, further samples were collected to determine the residue levels persisting at the crash site.

4.2 Results: The aircraft was found to have crashed heavily into the forest canopy in such a manner that the wreckage was confined to a small area (Fig. 2). The tail section of the plane came to rest upright (Fig. 3) with much of the insecticide from the spray tank resting in a water filled ditch dug out on impact beneath this portion of the wreckage. A water sample was collected from this source and soil and foliage samples were collected nearby. Soil and foliage were resampled from the same locations in 1975 but no water was present at the crash site as the ditch had dried up completely.

The phosphamidon residues found in various substrates are presented in Table I. Disappearance of phosphamidon from foliage and soil over a one year period was rapid with a loss of 99.0% of the residues in foliage and 99.6% of the residues in soil. The overall rate of degradation in soil was 2.5 times higher than in foliage. Disappearance of the cis-isomer was comparatively higher than of the trans-isomer in both substrates.

Fig. 2. Extent of THM crash site, New Brunswick, 1974.

Fig. 3. Ta 1974.

Table V

Phosphamidon residues in foliage, soil and water collected from the TBM crash site 25 July 1974 and 7 August 1975

Sample	1974 Phosphamidon residues (ppm) Trans	Cis	Total	1975 Phosphamidon residues (ppm) Trans	Cis	Total	Percent loss after 1 year*
Foliage	713	575	1,288	7.3	5.0	12.3	99.0
Soil	10,250	9,800	20,050	59.3	26.3	85.6	99.6
Water	1,830	7,400	9,230	-	-	-	

* 377 days exactly

5. Hatchery Fish Kill, Aminocarb Treatment Area, Quebec.

5.1 Introduction: Heavy mortality occurred among hatchery fish near La Tuque, Quebec during the period when nearby forest insect control operations were in progress using the carbamate insecticide aminocarb (Matacil®) applied at the rate of 52 g AI/ha (0.75 oz AI/acre). Samples of dead fish were transported in a frozen state to the pesticide chemistry section at the Chemical Control Research Institute.

5.2 Results: The fish samples were analysed for aminocarb residues by a sensitive analytical technique capable of detecting residues as low as 0.05 ppm. Results of the chemical analyses showed that the fish did not contain detectable aminocarb residues.

5.3 Conclusion: It is concluded that mortality among the hatchery fish was unrelated to the nearby aminocarb treatments.

6. Fish Kill in a Pond in Larose Forest, Ontario.

6.1 Introduction: On 26 June, 1975, members of the ecological impact team of the Chemical Control Research Institute investigated a fish kill in the Larose Forest on the property of R. Charbonneau. The kill occurred in a small pond which had been dug out of a sandpit and stocked with 500 fingerling brook trout, *Salvelinus fontinalis* (Mitchill) in May of 1974. The brook trout in the pond were reported to have started dying in large numbers on the day that a 1600 hectare (4000 acre) block of land just south of the pond was aerially treated with an application of 560 g AI/ha (8 oz AI/acre) of the organophosphate insecticide acephate (Orthene®). The pond was outside the boundary of the spray plot but the spray plane passed nearby at the end of one of its passes. M. Charbonneau's wife was watching the plane and reported that it was not emitting spray as it passed the pond. The insecticide formulation is dyed with a rhodamine red dye which makes the spray readily visible to an observer on the ground.

6.2 Results: An inspection of the pond was made with the use of scuba gear. The pond is approximately 45 m by 12 m (150 ft by 40 ft) with a pure sand bottom sloping gradually to a maximum depth of 2.3 m (7.5 feet). Some leaf debris has accumulated on portions of the bottom. A search of the entire pond showed that about 50 to 80 brook trout remained alive with another 15 being found dead on the bottom. All of the live fish showed signs of sluggishness and some could be caught by hand, even by reaching from the shore. Fungal growth was apparent on many of the fish. Other aquatic life seen in the pond included numerous adult red-spotted newts, *Triturus viridescens*, several larval salamanders, water boatmen (Hemiptera, Fam. Corixidae) and several types of water beetles. There was also an abundance of zooplankton near the bottom of the pond and large numbers of cladocerans were observed.

The temperature profile of the pond was checked with a thermistor. The pond was essentially unstratified with a surface temperature of 26.8°C (80°F) and a bottom (2.3 m) temperature of 26.0°C (79°F). The dissolved oxygen content of the pondwater from all depths was 8 µg/ℓ as determined using a Hach kit.

Samples of fish and sediment were collected from the pond for analysis of residues of acephate and its degradation product methamidophos. Neither compound could be detected in the samples, nor could either compound be found in samples of sand collected from the edge of the pond. Red pine foliage collected approximately 90 m (300 ft) from the pond contained average total residues of 1.05 parts per million. This indicates that a small amount of insecticide drift from the spray block occurred but the amount of insecticide deposited in the area of the pond was negligible.

6.3 Discussion: The upper lethal temperature limit for brook trout as established by Fry *et al.* (1946) is 25.3°C (77.5°F) for fully acclimated fish. MacKay (1963) states that in Ontario, brook trout do not thrive in water warmer than 20°C (68°F) and that this is close to the upper limit of water temperature for all stages in native brook trout's life history. The temperature of the pond water on the day the fish kill was investigated exceeded these published figures for upper lethal temperature for brook trout and weather data from the area indicate that the pond water probably reached these temperatures on the day fish mortality was first observed as the maximum air temperature that day was 29°C (84°F).

Acephate has been shown to be of very low toxicity to salmonid fish with a lethal threshold in the range of 500 ppm (Klaverkamp *et al.*, 1975).

6.4 Conclusions: The high water temperatures of the pond water coupled with the absence of acephate residues in the affected fish and acephate's extremely low toxicity to fish clearly show that the fish mortality in the pond was caused by lethal water temperatures and was unrelated to the nearby acephate treatment.

6.5 References:

FRY, F.E.J., J.S. HART and E.F. WALKER, 1946. Lethal temperature relations for a sample of young speckled trout, *Salvelinus fontinalis*. Univ. Toronto Stud. Biol. Serv. 54. Pub. Ont. Fish. Res. Lab. 66, pp 1-35.

KLAVERKAMP, J.F., B.R. HOLDEN and S.E. HARRISON, 1975. Acute lethality and in vitro brain cholinesterase inhibition of acephate and fenitrothion in rainbow trout. Proc. West. Pharmacol. Soc. 18: 358-361.

MACKAY, H.H., 1963. Fishes of Ontario. Ontario Dept. Lands and Forests, 1963.

ACKNOWLEDGEMENTS

The authors wish to thank the provincial authorities who co-operated in the investigations. Special assistance was rendered by R. Sarrazin of the Quebec Service des Recherches Biologiques, Ian Eden of the Quebec Service de la Chasse et de la Pêche, Gaspé, Gilles Gaboury of the Quebec Ministere des Terres et Forets and personnel of the Ontario Ministry of Natural Resources, Larose Forest. Roy Lidstone assisted with the environmental and ecological sampling in the Gaspé region.

The support of Dr. K.M.S. Sundaram and the staff of the pesticide chemistry section at the Chemical Control Research Institute is acknowledged with appreciation.