INSECTICIDE IMPACT AND RESIDUE STUDIES ON ANTICOSTI ISLAND, QUEBEC IN 1973

by

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ABSTRACT

The effects of juvenile hormone analogue on populations of small forest song birds, small mammals and aquatic fauna were monitored in an experimental treatment area on Anticosti Island in 1973. The bottom fauna populations of four streams within a nearby area treated with the organophosphate insecticide fenitrothion, were checked for damage. Soil and mice brains from the island were collected for DDT residue analysis. No adverse side effects on bird, mammal or aquatic fauna populations were found within the areas treated with the juvenile hormone analogue. Bottom fauna populations in the streams exposed to the fenitrothion treatment appeared to be normal. Most of the mice trapped carried background levels of DDT residues in their brains but two individuals contained significantly higher DDT residues.

RESUMÉ

En 1973, on a contrôle les effets d'une substance analogue à l'hormone juvénile sur les petits oiseaux chanteurs de la forêt, sur les petits mammifères et sur la faune aquatique, dans une superficie expérimentale située dans l'île Anticosti. La faune du lit de quatre cours d'eau, situés dans une région voisine traitée à l'insecticide organophosphoré fénitrothion a été étudiée pour déterminer les dommages causés par le produit. On a également recueilli des échantillons de sols et des cerveaux de souris pour l'analyse des résidus de DDT. Aucun effet néfaste n'a été observé chez les oiseaux, les mammiféres ou chez la faune aquatique des régions traitées par l'analogue de l'hormone juvénile. Les populations aquatiques du lit des cours d'eau exposés au fénitrothion semblaient normales. Les teneurs en DDT dans les cerveaux de souris étaient résiduelles dans la plupart des specimens, sauf dans deux où elles étaient considérablement plus fortes.

INTRODUCTION

Destructive infestations of defoliating forest insects have plagued Maritime forest based industries for many years. Chemical control measures have been used to protect forestry resources in this region almost continuously since 1952. Large scale operational spraying was based primarily on the organochlorine insecticide DDT until the late 1960's when the organophosphate insecticide fenitrothion replaced it. Fenitrothion is still the most widely used insecticide in forest insect control programs but other organophosphate and carbamate insecticides are also being used. Recently, concern over the adverse ecological side effects of chemical insecticide applications has led to increased interest in the development of biological insecticides which will control destructive forest insects without affecting other organisms in the forest community.

Control operations to suppress a small but severe infestation of hemlock looper, *Lambdina fiscellaria fiscellaria* (Guen) were conducted on Anticosti Island in 1973 using the chemical insecticide fenitrothion. This same infestation was used for the field testing of an anologue of juvenile hormone* to assess its potential as a biological insecticide. This experiment was conducted by a research team from the Insect Pathology Research Institute, Sault Ste. Marie, Ontario. A team from the Chemical Control Research Institute studied the ecological impact of the juvenile hormone analogue application on populations of small forest song birds, small mammals and aquatic fauna indigenous to the area. In addition, the bottom fauna of several streams within the fenitrothion treatment area were examined for damage and samples of mice brains and soil were collected for DDT residue analysis.

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* Altosid or ZR-515 manufactured by Zoecon Corporation, Palo Alto, Calif.

PLOT DESCRIPTIONS

Three plots were selected in the juvenile hormone analogue treatment area for monitoring bird and small mammal populations. A decline in insect populations necessitated last moment changes in the treatment plan resulting in a somewhat abbreviated pre-spray bird census. The two 4 hectare (10 acre) treatment plots were located in young stands of balsam fir *Abies balsamae* (L.) Mill. mixed with scattered white spruce *Picea glauca* (Moench) Voss and white birch, *Betula papyrifera* Marsh (Fig. 1, A and B). Stand height averaged less than 15 meters (50 feet) with a d.b.h. averaging less than 25 centimeters (10 inches). The understory was sparse and the ground cover was light. A moderately deep duff layer covered limestone bedrock. The 8 hectare (20 acre) untreated control plot was located on an ecologically similar area well outside the treatment site (Fig. 1, location 7).

A small stream flowing between two shallow lakes a half-mile south of the bird plots was treated with the juvenile hormone analogue and sampled at two locations (Fig. 1, locations 1 and 2). It was moderate-flowing, about 4.5 m (15 feet) wide and very shallow with riffle areas only 8 to 10 cm (3 or 4 inches) deep and very few pools deeper than 45 cm (18 inches). The bottom consisted of hard packed rough stones and gravel covered with limestone silt and travertine deposits. The stream opening ranged between 15 to 30 m (50 to 100 feet), the banks were treed with willow (*Salix spp.*) and alder (*Alnus sp.*) thickets and the ground covered with a dense mat of grasses, mosses and miscellaneous plants and shrubs. The forest covering, adjacent to the stream opening, was mainly black spruce, *Picea mariana* (Mill) B.S.P., grading to white spruce and balsam fir.

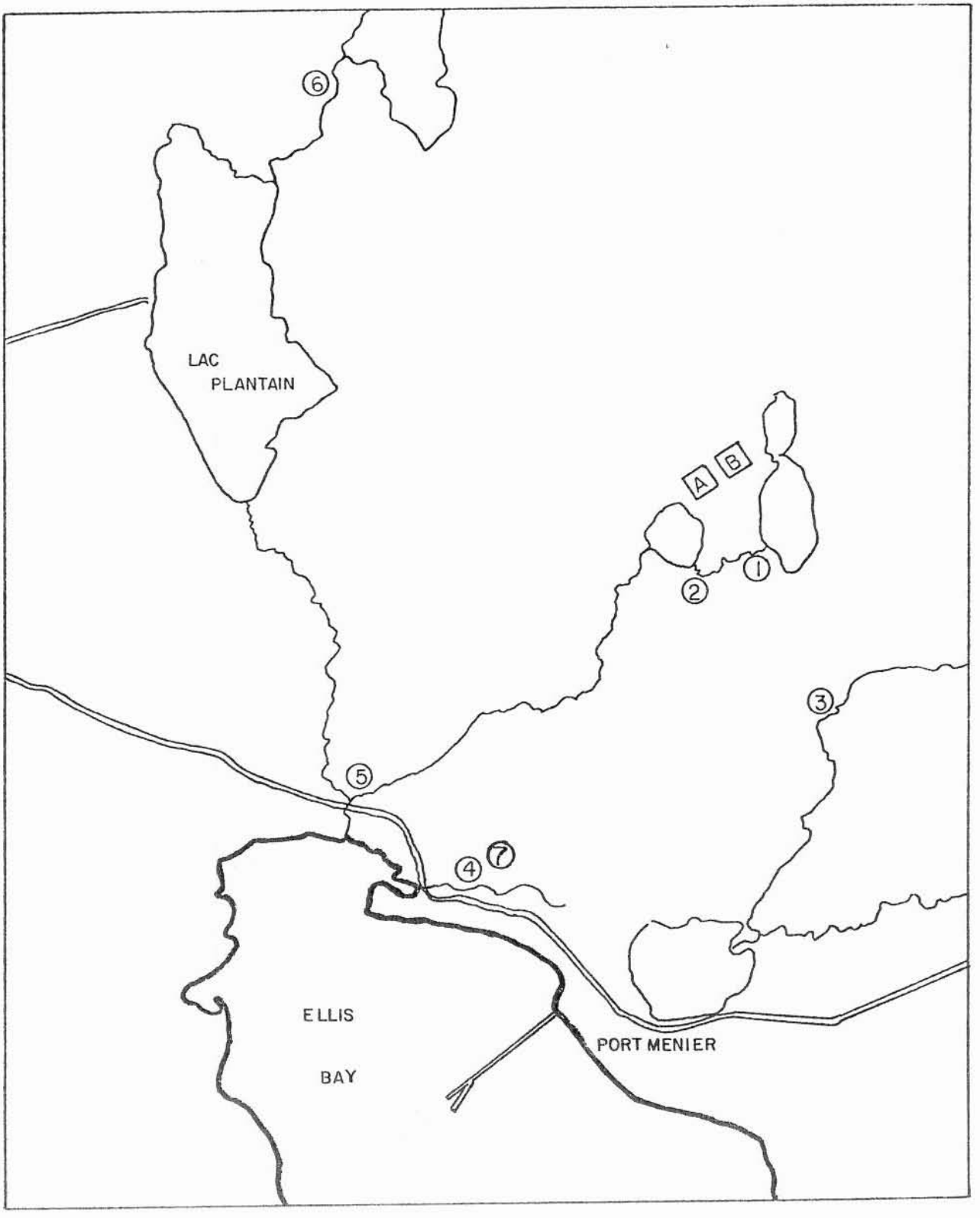

Fig. 1 Bird, small mammal and stream fauna monitoring locations on Anticosti Island, Quebec in 1973. See text for explanation.

METHODS

Birds: Small forest bird populations were measured on plots located on treated and untreated areas using techniques similar to those previously described by Kendeigt (1944) and Buckner and Turnock (1965). Daily populations were censused before and after treatment by counting all singing and sighted birds by slowly walking predetermined parallel lines covering the entire 4 hectare (10 acre) treatment blocks and on a 8 hectare (20 acre) untreated control plot well outside any treatment area. Special attention was directed to monitoring birds inhabiting ecological niches which are directly exposed to the aerial application. The untreated plot and plot A were censused for 4 days prior to treatment but due to operational changes plot B was censused on only 2 days prior to treatment. Plot searches for sick or dying birds was conducted for 2 days after the insecticide was applied.

Small mammals: Small mammal populations were censused 6 weeks after the areas were treated with insecticide. The time interval between the treatment and trapping allows any litters being carried by female rodents at the time of the application of insecticide to be weaned, leave the nest and become available for trapping.

Small mammal populations were censused on 82 x 3.6 meter (90 x 4 yard) plots using standard snap-back mouse traps. Center lines of each census plot was flagged (with surveyors plastic flagging tape) at 9 meter (10 yard) intervals. Five traps were placed at each location, one on the center line and two to each side at 1 meter intervals producing a total of 50 traps per plot. The trap period ran for 3 consecutive nights giving a total of 150 trap nights per plot. Two trap plots were established on the two treatment plots and an untreated control plot. Captured animals were

identified and their sex, age and breeding condition recorded. Female animals were dissected and the genital tract examined for the presence of embryos or placental scars. The brain of each animal was removed and preserved in residue free ethanol and returned to the laboratory for DDT residue analysis.

Aquatic fauna: Bottom fauna populations in the juvenile hormone analogue treated stream were monitored by taking series of five 0.1 square meter (1 square foot) Surber samples (Surber, 1936) before and after spraying at two stations. Station 1 was situated in a moderate-flowing riffle area about 90 meters (100 yards) downstream from the small lake which was the stream's source and Station 2 was located in a slightly faster flowing and shallower riffle about 225 meters (250 yards) further downstream. Organisms were picked from the samples taken at Station 1 while still alive but samples from Station 2 were preserved whole and picked later in the laboratory. The organisms from each sample were identified to class or order and counted. Two Surber samplers set in the current at the foot of riffle areas were used to sample drifting organisms for three days following spraying of the stream. Some incidental observations of fish and frog populations were also made.

Series of Surber samples were taken from four streams in the fenitrothion treated blocks. These were preserved with formaldehyde and picked later in the laboratory.

DDT residues in soil: Soil samples were collected from each small mammal trap line using an auger which removes a core of soil 3.5 x 10 cm (1.3 x 3.9 inches). Fifty samples were removed from each plot (1 core from each snap-back trap location) and thoroughly mixed from which enough soil was

removed to fill a 1.8 liter (60 ounce) mason jar. Each sample jar was covered with a sheet of aluminium foil then sealed with the regular jar top. The samples were then returned to the laboratory and frozen at -10°C until analysed for DDT residues.

RESULTS

The juvenile hormone treatment was applied by helicopter at about tree top level at the dosage rates of 210 gm AI/hectare (3 oz AI/acre) on plot A and 70 gm AI/hectare (1 oz AI/acre) for plot B. A stream was treated with an application of 210 gm AI/hectare (3 oz AI/acre).

Weather conditions throughout the monitoring period are presented in Table I. Light precipitation was recorded on July 20 (treatment day + 1), and on July 23 and 24 (treatment days +4 and +5).

Table I

Temperature and precipitation recorded at Port Menier during hemlock looper control operations
Anticosti Island, Quebec
July 16 - 24, 1973

Date	Temperature (°C) Max.	Min.	Rainfall (cm)
July 16	17.7	12.2	0.07
17	21.6	12.7	0.00
18	22.7	10.0	0.00
19	22.2	15.0	0.00
20	20.0	14.4	0.38
21	20.5	10.0	0.00
22	21.1	7.7	0.00
23	17.7	6.1	0.05
24	20.5	11.1	0.27
25	21.1	11.6	0.00

Birds: A total of 28 species of birds representing 8 families were recorded on the 2 treated and the untreated control plots during the population census period between July 16th and 24th, 1975. The family Parulidae (warblers) was the most widely represented with 10 species recorded followed by the family Fringellidae (finches, grosbeaks, sparrows etc.) with 8 species and the family Turdidae with 3 species (Tables II, III and IV).

The breeding territories of many of the species recorded had started to break down for the season and birds were observed foraging about the plots either singly or in small family groups with young of the year. Several species however, were recorded still defending breeding territories.

The breeding territories of 4 species of resident birds, the winter wren, *Troglodytes troglodytes* Linnaeus, Swainson's thrush, *Hylocichla ustulata* (Nuttall), the black-throated green warbler, *Dendroica virens* (Gmelin) and white-throated sparrow *Zonotrichia albicollis* (Gmelin) are presented in Figs. 2 to 7 to illustrate the fate of birds inhabiting the various ecological niches during the juvenile hormone operation.

Bird populations increased slightly on the untreated control plot while remaining relatively constant on treatment block A and B. The population data recorded on these plots does not identify an impact of the treatment on any segment of the avian component. The territories of birds inhabiting the various ecological niches were not harmed as illustrated in Figures 2-7 where upper crown feeders (black throated green warblers), mid and lower crown inhabitants (white throated sparrows and Swainson's thrush), as well as forest floor inhabitants (winter wren) are recorded before (location marked with a dot, and the breeding territory bounded by a solid line) and after (location marked with an "x" and breeding territory bounded

by a broken line) the treatment. Other species such as the slate-colored junco, *Junco hyemalis* (Linnaeus) and the blackpoll warbler, *Dendroica striata* (Forester) were observed in small flocks foraging through the plots.

Table II

Populations of small forest birds
on untreated control plot
Anticosti Island, Quebec
1973

Family	Species	Pre spray					Post spray						
		-3	-2	-1	-0	Daily ave.	+0	+1	+2	+3	+4	+5	Daily ave.
Corvidae	Gray Jay	0	0	0	0	0.0	0	2	1	0	0	0	0.5
	Common Raven	2	0	0	0	0.5	0	0	0	0	0	0	0.0
Paridae	Black-capped Chickadee	4	0	0	0	1.0	0	0	0	0	0	0	0.0
	Boreal Chickadee	2	2	2	3	2.2	3	6	2	0	0	8	2.6
Troglodytidae	Winter Wren	0	1	0	3	1.0	3	6	6	9	0	2	4.3
Turdidae	American Robin	3	4	4	4	3.7	4	4	4	3	3	2	3.3
	Hermit Thrush	5	0	0	1	1.5	5	4	5	5	2	3	4.0
	Swainson's Thrush	2	10	5	5	5.5	5	7	6	3	4	2	4.5
Parulidae	Tennessee Warbler	0	0	0	0	0.0	0	0	2	2	2	2	1.3
	Magnolia Warbler	2	2	0	0	1.0	0	0	0	0	0	0	0.0
	Myrtle Warbler	0	2	0	0	0.5	0	0	0	0	0	0	0.0
	Black-throated Green Warbler	3	4	0	2	2.2	2	2	4	4	0	4	2.6
	Bay-breasted Warbler	0	2	2	0	1.0	0	6	6	4	2	4	3.6
	Blackpoll Warbler	8	20	6	8	10.5	8	10	12	6	6	10	8.6
	Wilson Warbler	2	0	2	4	2.0	4	0	0	0	0	0	0.6

Table II Cont'd

Family	Species	Pre spray					Post spray						
		-3	-2	-1	-0	Daily ave.	+0	+1	+2	+3	+4	+5	Daily ave.
Fringillidae	Purple Finch	1	0	0	2	0.7	2	2	0	2	1	0	1.1
	American Goldfinch	0	0	0	2	0.5	2	0	0	0	0	0	0.3
	White-winged Crossbill	0	0	0	0	0.0	0	0	0	0	0	2	0.3
	Slate-coloured Junco	0	0	0	7	1.7	7	10	8	5	8	2	6.6
	White-throated Sparrow	4	10	8	12	8.5	12	4	5	12	7	8	8.0
	Fox Sparrow	15	8	10	10	10.7	10	6	10	6	8	6	7.6
	Swamp Sparrow	0	0	0	0	0.0	0	2	0	0	0	0	0.3
Totals		51	65	39	63	54.5	67	71	71	61	43	55	61.3

Table III

Populations of small forest birds
on treatment block A
Anticosti Island, Quebec
1973

Family	Species	Pre spray					Post spray					
		-3	-2	-1	-0	Daily ave.	+0	+1	+2	+3	+5	Daily ave.
Hirundinidae	Tree Swallow	0	0	0	1	0.2	0	1	0	0	0	0.2
Corvidae	Gray Jay	0	0	2	3	1.2	0	0	2	2	1	1.0
Paridae	Boreal Chickadee	0	2	0	0	0.5	2	0	2	0	0	0.8
Troglodytidae	Winter Wren	0	0	0	2	0.5	2	2	0	2	0	1.2
Turdidae	American Robin	6	1	2	3	3.0	0	2	3	3	2	2.0
	Hermit Thrush	0	0	3	5	2.0	8	6	4	4	7	5.8
	Swainson's Thrush	0	12	7	7	6.5	5	5	4	1	0	3.0
Parulidae	Black & white Warbler	0	0	0	2	0.5	0	0	0	0	0	0.0
	Black-throated Green Warbler	3	8	8	2	5.2	8	4	4	6	1	4.6
	Bay-breasted Warbler	0	0	4	0	1.0	0	2	0	2	2	1.2
	Blackpoll Warbler	6	0	0	0	1.5	0	0	0	0	0	0.0
	Yellowthroat	2	0	0	0	0.5	0	0	0	0	0	0.0
	Wilson's Warbler	4	0	0	0	1.0	0	0	0	0	0	0.0
Fringillidae	Evening Grosbeak	0	0	2	0	0.5	0	0	0	1	0	0.2
	Purple Finch	0	0	0	2	0.5	0	1	0	1	0	0.4
	Slate-coloured Junco	0	6	0	4	2.5	4	1	1	1	3	2.0
	White-throated Sparrow	2	4	3	6	3.7	0	4	6	1	2	2.6
	Fox Sparrow	0	0	2	4	1.5	4	2	4	2	0	2.4
Totals		23	33	33	41	32.5	33	30	30	26	18	27.4

Table IV

Populations of small forest birds
on treatment block B
Anticosti Island, Quebec
1973

Family	Species	Pre spray			Post spray					
		-1	-0	Daily ave.	+0	+1	+2	+3	+5	Daily ave.
Corvidae	Gray Jay	2	1	1.5	0	0	0	0	0	0.0
Paridae	Boreal Chickadee	2	0	1.0	2	3	2	4	2	2.6
Troglodytidae	Winter Wren	0	2	1.0	2	4	6	2	0	2.8
Turdidae	Hermit Thrush	4	2	3.0	2	10	2	4	4	4.4
	Swainson's Thrush	7	7	7.0	8	6	4	8	4	6.0
Vereonidae	Warbling Vireo	8	0	4.0	0	0	0	0	1	0.2
Parulidae	Nashville Warbler	0	0	0.0	2	0	0	0	0	0.4
	Magnolia Warbler	0	0	0.0	0	0	0	2	0	0.4
	Myrtle Warbler	0	0	0.0	0	0	0	0	2	0.4
	Black-throated Green Warbler	2	2	2.0	4	0	2	2	2	2.0
	Bay-breasted Warbler	2	0	1.0	0	0	0	0	0	0.0
	Blackpoll Warbler	0	0	0.0	4	0	0	0	0	0.8
	Yellowthroat	0	0	0.0	2	0	0	0	0	0.4
	Wilson's Warbler	2	0	1.0	0	0	0	0	0	0.0
Fringillidae	Evening Grosbeak	0	0	0.0	0	0	1	0	0	0.2
	Purple Finch	0	0	0.0	0	2	0	0	0	0.4
	Slate-coloured Junco	2	2	2.0	2	0	6	2	2	2.4
	White-throated Sparrow	2	4	3.0	6	6	4	2	2	4.0
	Fox Sparrow	0	2	1.0	2	4	4	2	4	3.2
Totals		33	22	27.5	36	35	31	28	23	30.6

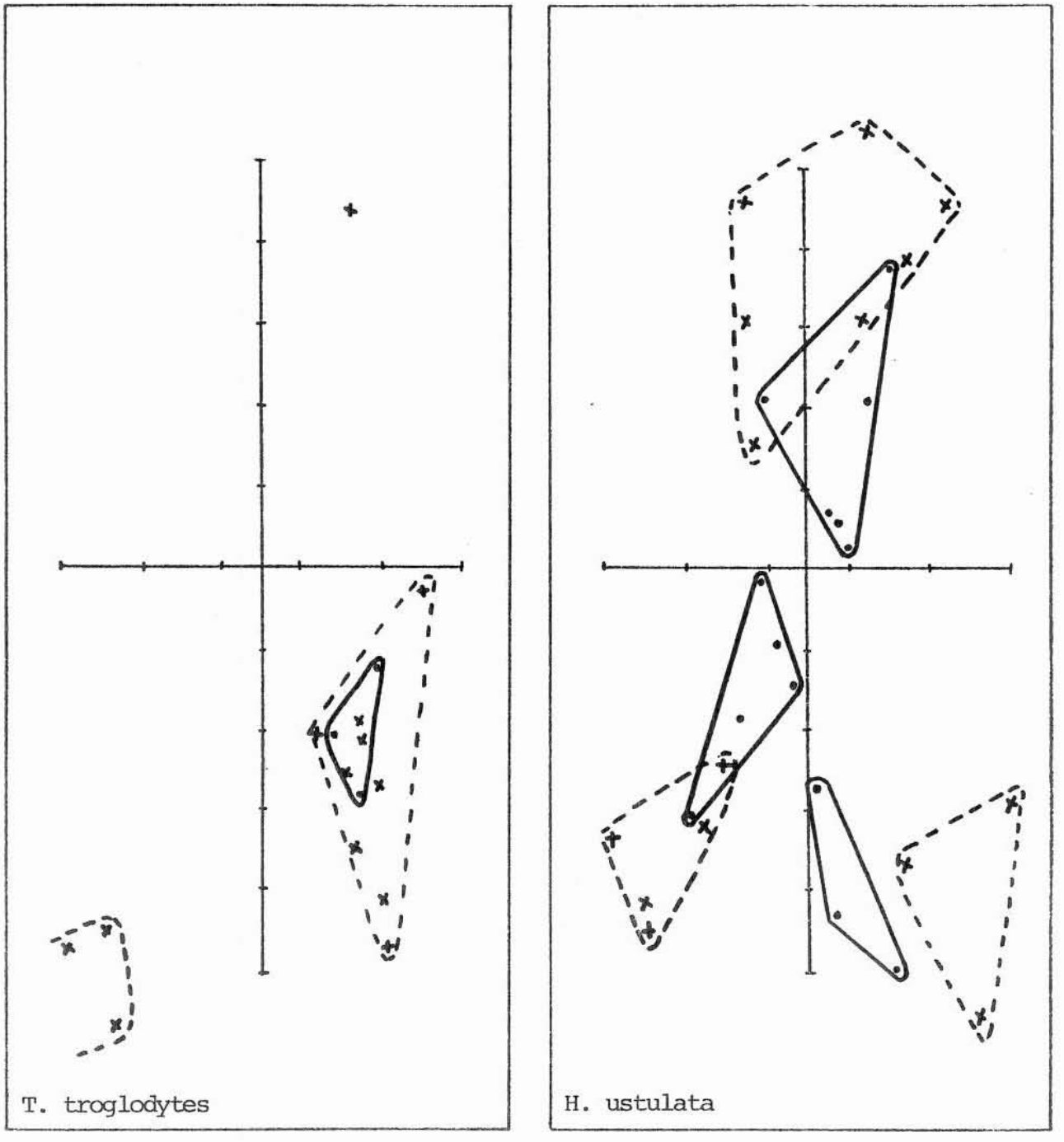

Fig. 2 Pre and post spray territories of the winter wren *T. troglodytes* and Swainson's thrush *H. ustulata* on the untreated control plot Anticosti Island, Quebec, 1973.

_____ . pre-spray

_ _ _ _ _ _ _ x post-spray

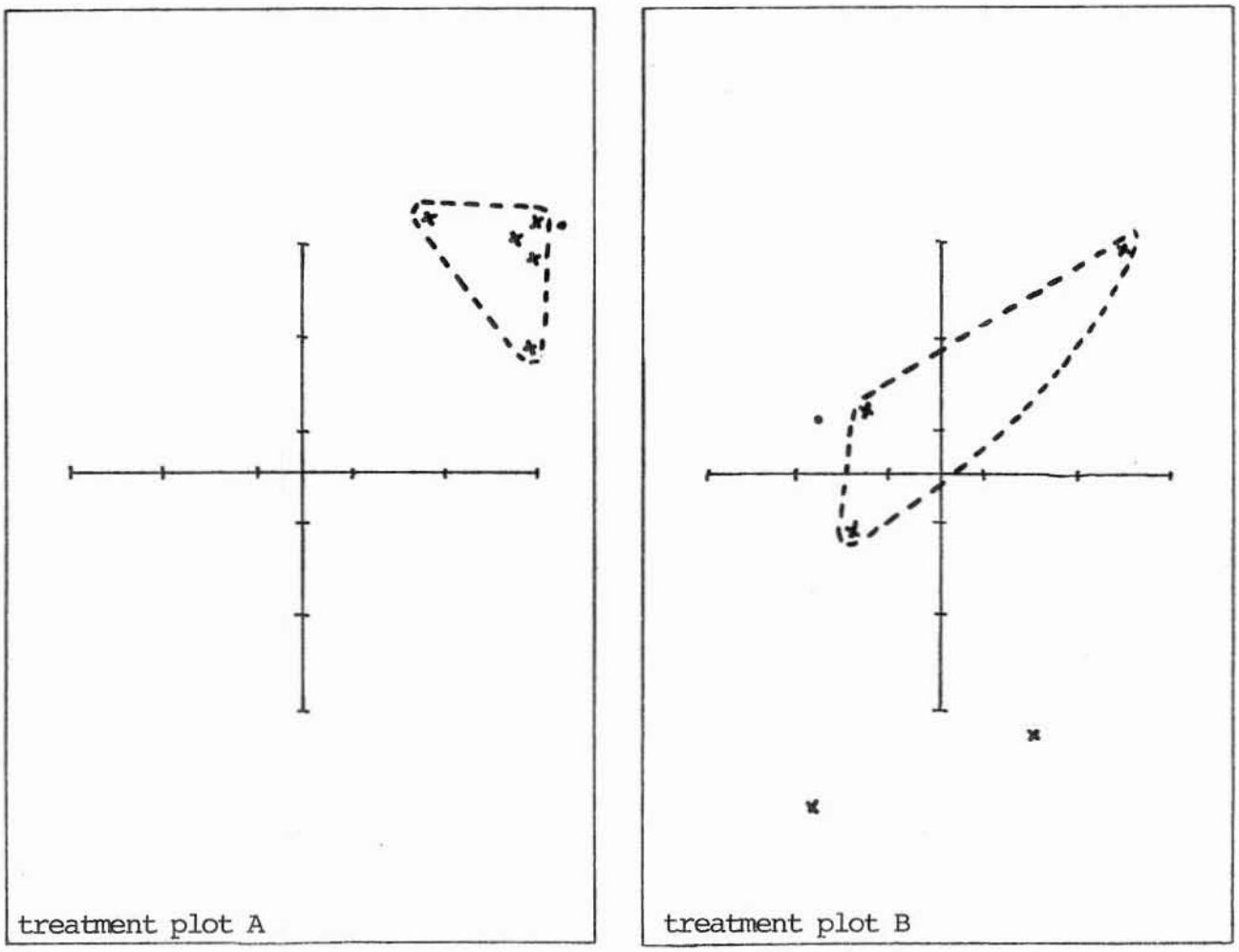

Fig. 3 Pre and post spray territories of the winter wren, *T. troglodytes* on treatment plots A and B, Anticosti Island, Quebec, 1975.

_____ . pre-spray

_ _ _ _ _ x post-spray

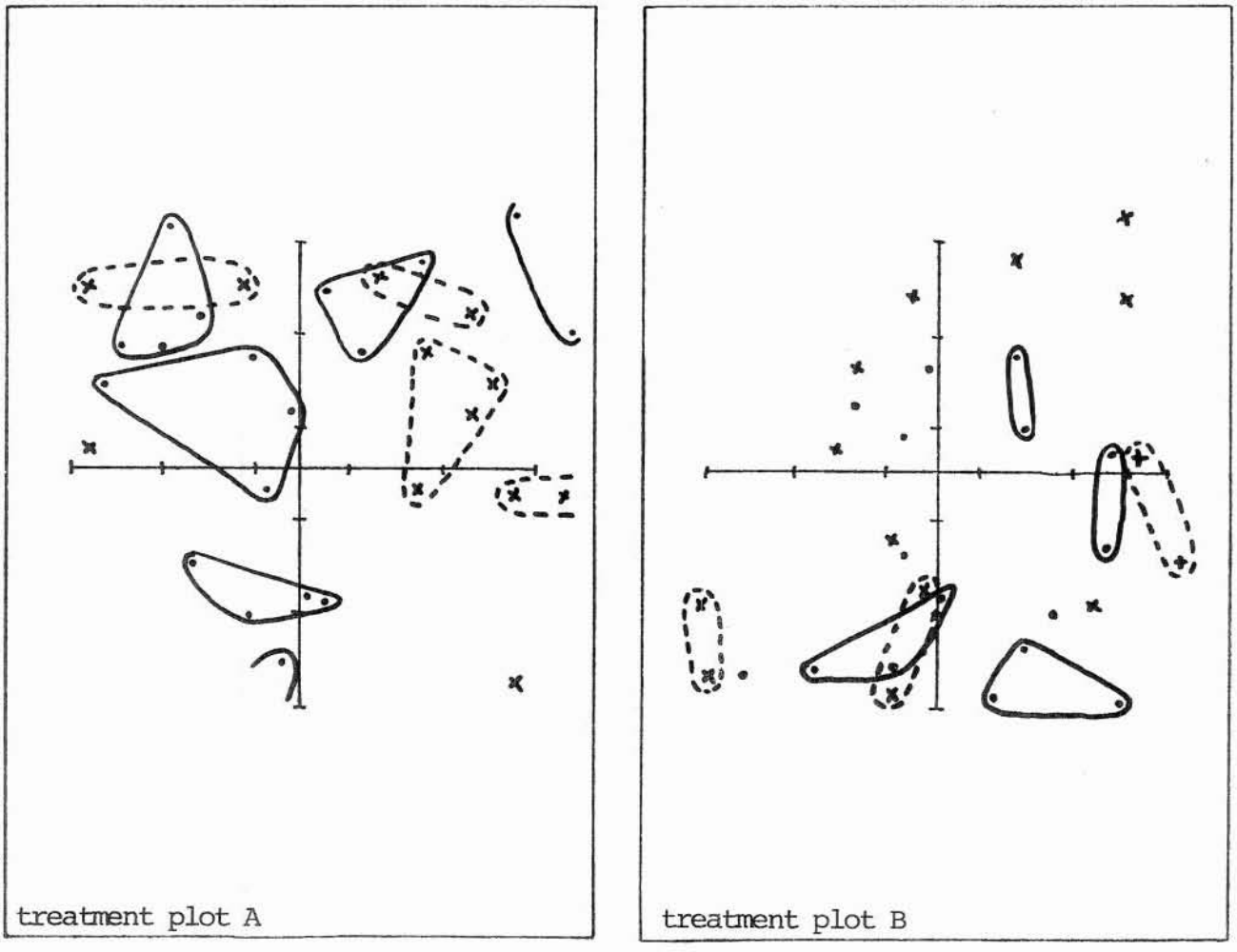

Fig. 4 Pre and post spray territories of the Swainson's thrush *H. ustulata* on treatment plots A and B Anticosti Island, Quebec, 1975.

_____ . pre-spray

_ _ _ _ _ x post-spray

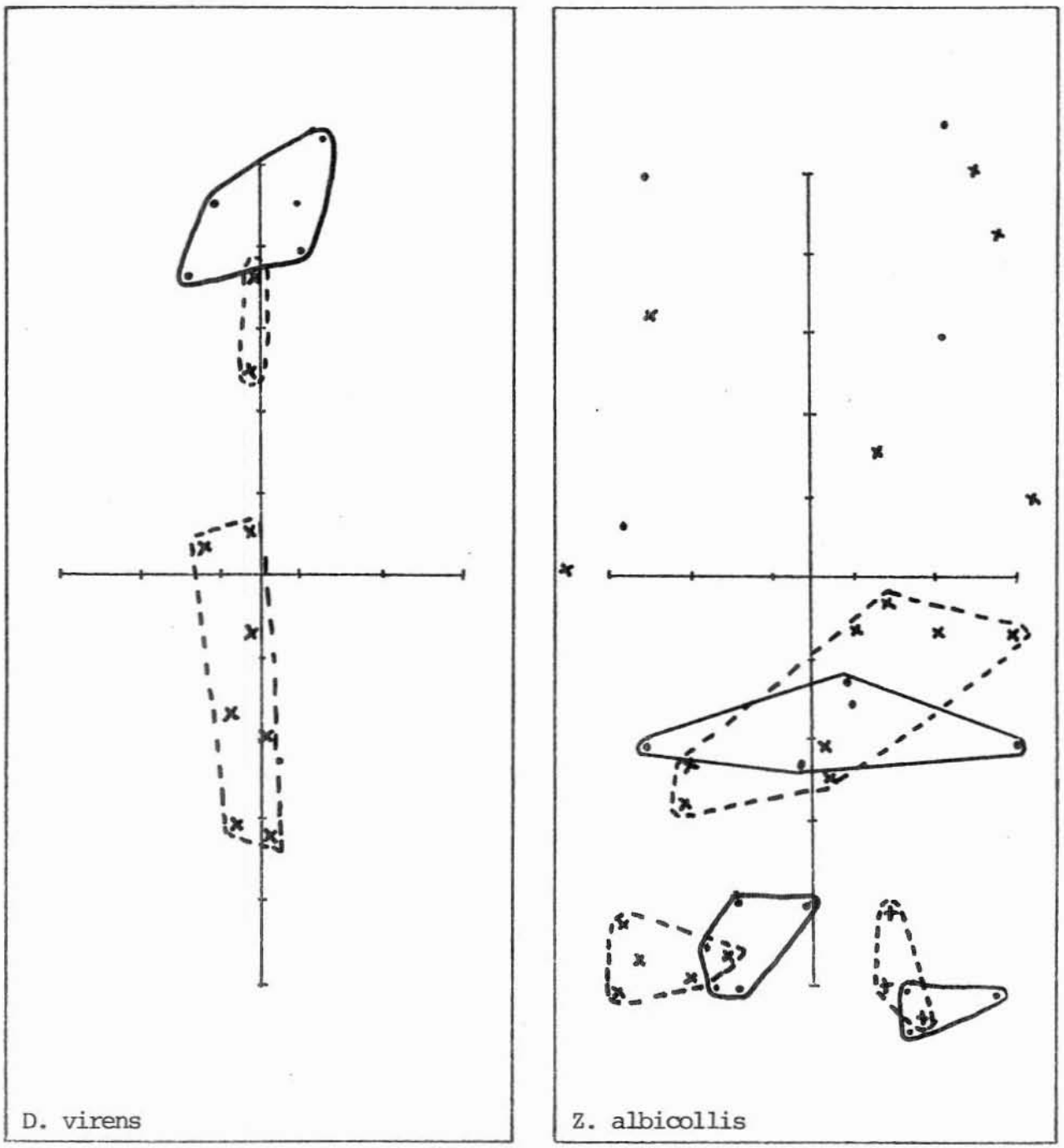

Fig. 5 Pre and post spray territories of the black throated green warbler, *D. virens* and the white throated sparrow, *Z. albicollis* on the untreated control plot, Anticosti Island, Quebec, 1973.

_____ . pre-spray

_ _ _ _ _ x post-spray

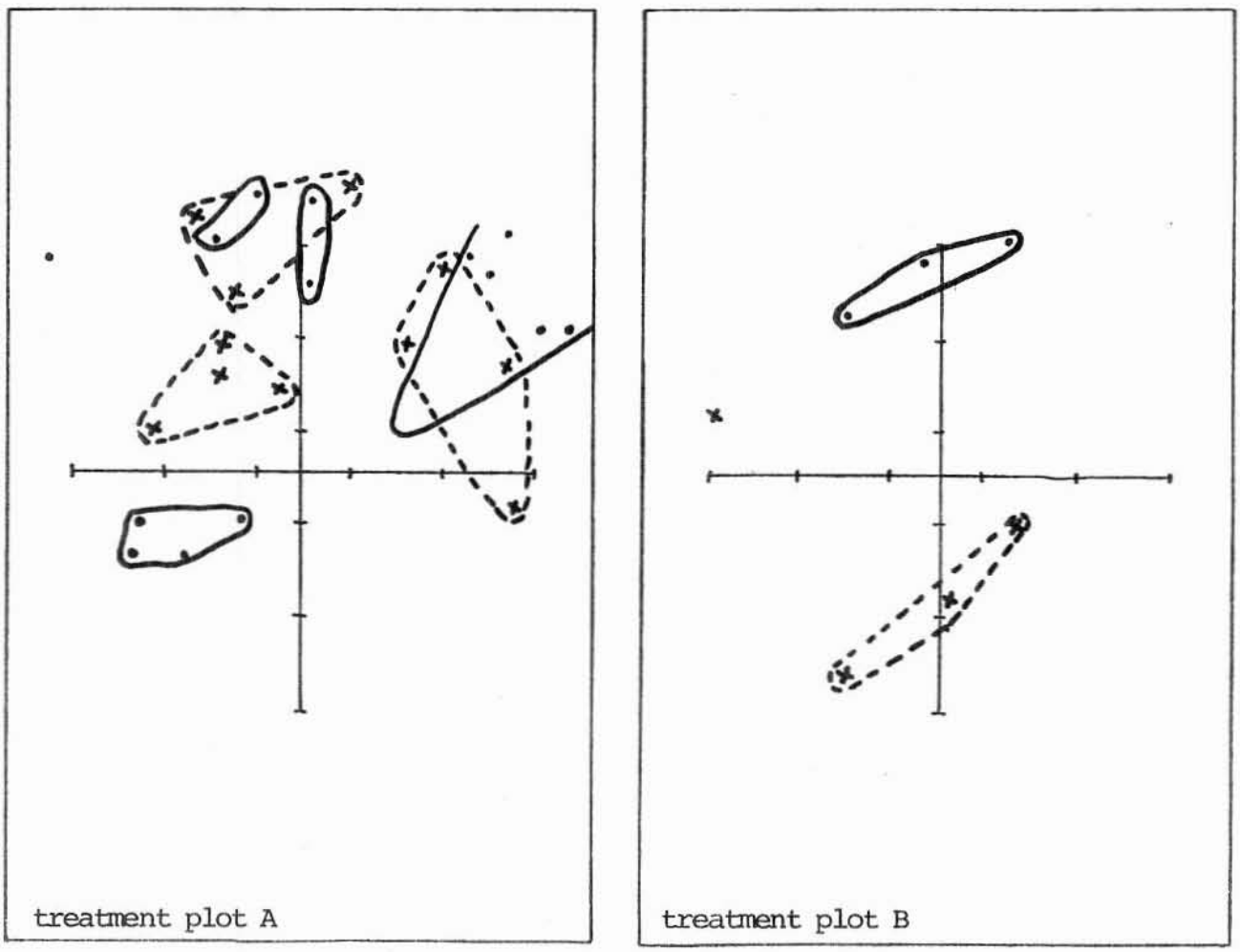

Fig. 6 Pre and post spray territories of the black-throated green warbler *D. virens* on treatment blocks A and B, Anticosti Island, Quebec, 1975.

_____ . pre-spray

_ _ _ _ _ x post-spray

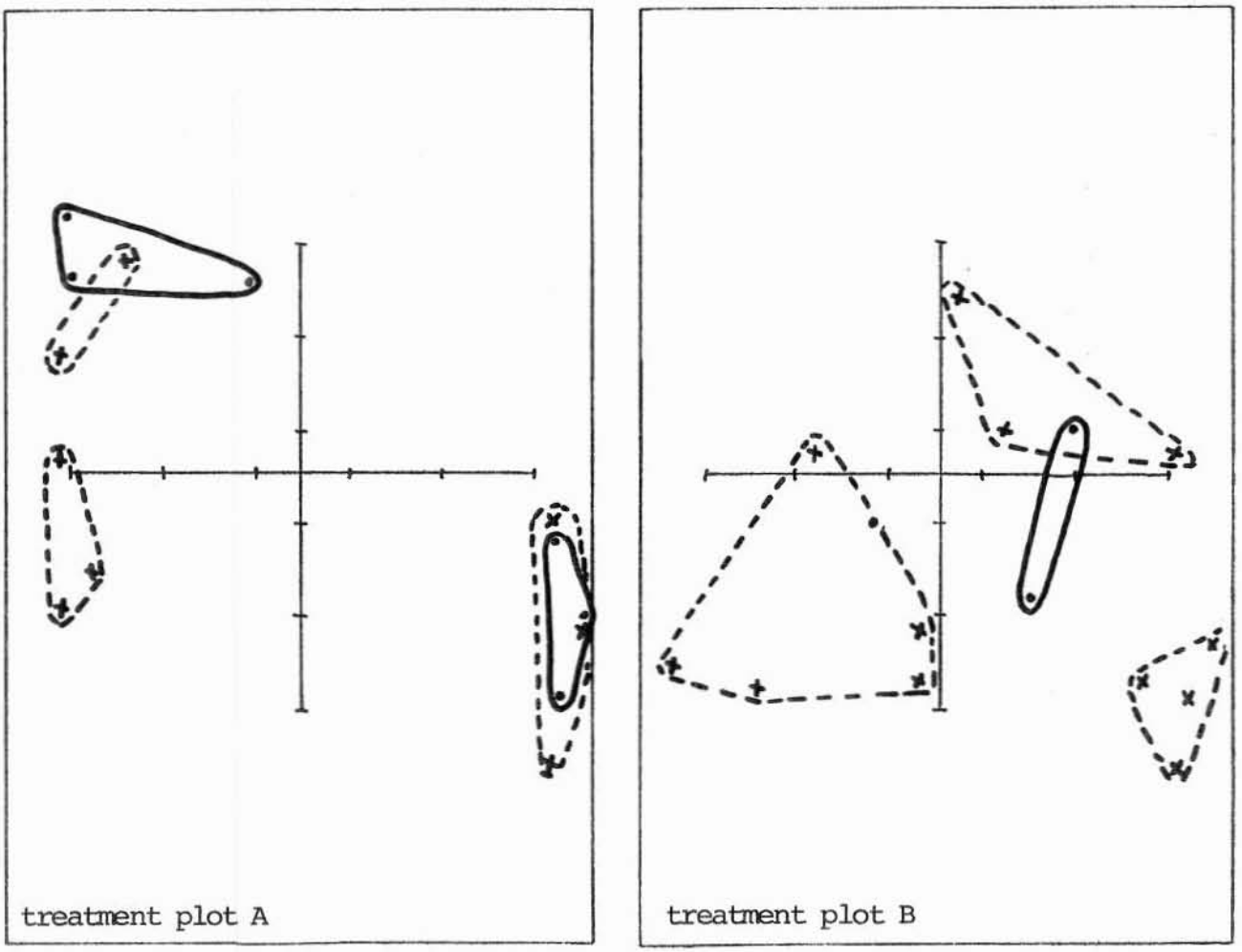

Fig. 7 Pre and post spray territories of the white throated sparrow, *Z. albicollis* on treatment plots A and B, Anticosti Island, Quebec

_____ . pre-spray

_ _ _ _ _ x post-spray

Small mammals: Very low populations of the deer mouse *Peromyscus maniculatus anticostiensis* Moulthrop were recorded (Table V). Six specimens were trapped from the treated plots (5 from plot A, 1 from plot B). No animals were taken from the untreated control plot. All animals were adults and the 4 females were not pregnant or carrying placental scars. All animals were in prime condition with a dense coat of fir and good fat deposits.

The low populations encountered are attributed to natural population fluctuations rather than a result of the insect control program.

Table V

Small mammal populations on treated and untreated control plots
Anticosti Island, Quebec
September 19-21, 1973

Plot No.	Males				Females							
							Adults					
	Juv.	Sub adults	Adults	Total males	Juv.	Sub adults	Pregnant	Pregnant with placental scars	Placental scars only	Not pregnant	Total females	Total animals
Control	0	0	0	0	0	0	0	0	0	0	0	0
Treatment plot A	0	0	2	2	0	0	0	0	0	3	3	5
Treatment plot B	0	0	0	0	0	0	0	0	0	1	1	1
Totals	0	0	2	2	0	0	0	0	0	4	4	6

Aquatic Fauna - Juvenile Hormone Analogue Treated Streams: Pre-spray Surber samples showed that Stations 1 and 2 in the juvenile hormone analogue treated stream differed significantly in the composition and abundance of their benthic invertebrate population. The small lake just upstream from Station 1 served as a source of plankton, micro-organisms and organic debris which supported significantly larger numbers of almost all groups of organisms at Station 1 than were present at Station 2. The input of organic matter into Station 1 was directly responsible for the large populations of current filtering caddisfly larvae (Trichoptera, Fam. Hydropsychidae) and fingernail clams (Mollusca, Fam. Sphaeriidae) at this station. These two groups of organisms strain organic matter from the current by means of silk nets and gills, respectively, and in so doing reduce the amount of food available to organisms further downstream. Outflow from the lake also carried weak swimming water mites (Arachnida, Order Acari) and scuds (Crustacea, Order Amphipoda) to Station 1 and relatively large populations were present there whereas these two groups were almost completely absent from Station 2.

Juvenile hormone analogue was applied to the stream at 9:00 am on 19 July by a helicopter flying directly over the stream and emitting 210 gm active ingredient/hectare (3 oz of AI per acre). Spray deposit was determined by colorimetric measurement of the amount of the dyed spray solution deposited on twenty glass slides set one chain apart along the stream. The average deposit of juvenile hormone analogue on the stream was measured to be 15.8 gm AI/ha (0.226 ounces AI/acre) (Retnakaran, personal communication).

Bottom fauna populations at both Station 1 and Station 2 showed no significant changes in composition or numbers following spraying (Table VI).

The groups showing the greatest differences in abundance before and after spraying were those which showed relatively large variation in numbers between individual Surber samples as reflected in the standard deviations calculated for each group.

Drift net samples revealed no significant increase in the number of drifting aquatic or terrestrial organisms after spraying (Table VII).

Amphipods were only present in the drift in samples collected after spraying and extending overnight but this is due to their well established diurnal periodicity wherein their drift at night is many times greater than in daylight (Waters, 1965). The number of threespine sticklebacks, *Gasterosteus aculeatus* (L.) and ninespine sticklebacks, *Pungitius pungitius* (L.) caught in the drift nets increased slightly after spraying, but all the fish caught were alive and healthy when removed from the net except for some captured in the samples of 24-hour or longer duration. Several schools of banded killifish, *Fundulus diaphanus* (Le Sueur) and some small American eels, *Anguilla rostrata* (Le Sueur) were observed to have been unaffected by the spray. Frog populations along the banks of the stream also appeared normal after spraying.

Table VI

Mean numbers and standard deviations of organisms/0.1 sq. m. collected by Surber sampler in a small stream before and after exposure to an aerially applied juvenile hormone analogue spray
Anticosti Island, Quebec
July 17-24, 1973

	Station 1		Station 2	
	Pre-spray	Post-spray	Pre-spray	Post-spray
Trichoptera	59.2 ± 40.5	116.2 ± 96.1	9.8 ± 4.2	9.0 ± 3.4
Ephemeroptera	70.4 ± 30.0	46.4 ± 32.2	29.0 ± 9.0	33.8 ± 17.3
Coleoptera	26.2 ± 12.7	73.4 ± 49.2	29.8 ± 16.9	17.4 ± 4.4
Diptera	36.2 ± 20.5	19.6 ± 7.8	23.0 ± 7.7	18.8 ± 16.8
Turbellaria	2.2 ± 1.8	0.8 ± 1.0	0.8 ± 0.5	1.2 ± 0.8
Oligochaeta	3.0 ± 0.9	2.6 ± 1.7	1.0 ± 0.8	0.2 ± 0.4
Hirudinea	2.8 ± 1.8	5.2 ± 3.2	1.8 ± 2.5	1.6 ± 1.9
Amphipoda	23.4 ± 11.9	27.6 ± 27.5	1.8 ± 1.3	2.4 ± 1.9
Hydracarina	7.6 ± 4.1	11.6 ± 5.5	0.5 ± 0.9	-
Mollusca	331.8 ± 275.0	208.6 ± 57.4	94.0 ± 70.1	70.0 ± 44.5
Total	562.8 ± 307.2	512.0 ± 137.4	191.2 ± 82.9	154.4 ± 55.7

Table VII

No. of organisms/hour collected in drift nets before and after spraying of a small stream with juvenile hormone analogue
Anticosti Island, Quebec
July 19-22, 1973

Hours before or after spraying sampling period begun	Drift net 1							Drift net 2				
	-2	-1	0	+1	+2	+10	+34	-2	-1	0	+1	+2
Duration of sampling period (hours)	1	1	1	1	4	24	37	1	1	1	1	4
Trichoptera	2	4	2	3	2.0	1.4	0.9	4	4	4	1	1.0
Ephemeroptera	13	9	5	5	9.0	1.9	0.9	14	16	18	9	10.8
Coleoptera	-	1	2	-	0.2	0.3	0.2	2	-	1	1	-
Diptera	4	1	-	1	1.5	2.5	3.2	4	3	2	3	2.5
Amphipoda	-	-	-	-	0.2	1.3	3.6	-	-	1	-	-
Pisces	3	2	1	10	9.8	6.5	2.0	-	1	5	1	-
Other aquatic organisms	-	1	1	-	0.2	0.4	0.1	1	-	-	1	-
Terrestrial organisms*	9	25	38	28	38.5	6.1	8.3	14	16	34	16	9.2
Total	31	43	49	47	61.4	20.4	19.2	39	40	65	32	23.5

* Primarily adult Ephemeroptera and Diptera.

Aquatic fauna - fenitrothion treated streams: The locations of the four streams sampled within the fenitrothion treatment block are shown in Fig. I. Bottom fauna populations in these streams are presented in Table VIII.

The Ruisseau Diane (Fig. 1, location 5) and Riviere Gamache (Fig. 1, location 3) flowed through the fenitrothion treatment block for most of their length. The Ruisseau Diane is very shallow (average depth 15 cm), moderate in flow and fairly wide (about five meters) with a bottom of bedrock covered in some areas by rough stones and gravel with a fine covering of organic silt. The Riviere Gamache is a larger river with fast flowing riffles interspersed with pool areas up to one meter deep. It has a hard packed bottom of bedrock, stones and gravel. A large school of brook trout (*Salvelinus fontinalis* Mitchill) was seen in one of the pools of this river.

The variety and abundance of benthic invertebrates in these two rivers was very similar and typical of rivers of their type. Very few stonefly nymphs (Plecoptera) were found in the Ruisseau Diane but this group was also absent from the juvenile hormone analogue treated stream before treatment and from the Lac Plantain stream. This may be due to the sensitivity of stonefly nymphs to waters of high alkalinity (Hart and Fuller 1974).

The Port Menier stream (Fig. 1, location 4) originates in a low swampy area just north of Port Menier and flows due east into Baie Jolliet along what appears to be an old shoreline. This stream appears to be spring fed along most of its length and in this respect it differs from the other streams sampled as it is much colder and probably has different water chemistry characteristics. The stream is very shallow (average depth 15 cm),

Table VIII

Bottom fauna populations within the fenitrothion spray block as numbers and standard deviations of organisms/0.1 sq. m. Anticosti Island, Quebec, July 20 to July 23, 1973

Stream	Ruisseau Diane	Port Menier Stream	Lac Plantain Stream	Riviere Gamache
Date sampled	July 21	July 21	July 20	July 23
Number of samples	6	3	5	5
Water temperature	20°C	9°C	23.5°C	17°C
Ephemeroptera	44.7 ± 22.9	122.3 ± 12.7	4.8 ± 4.1	47.8 ± 15.1
Plecoptera	2.5 ± 0.8	86.7 ± 70.2	----	23.2 ± 20.4
Trichoptera	7.3 ± 7.2	31.3 ± 21.9	19.2 ± 14.5	15.2 ± 9.5
Coleoptera	1.7 ± 1.5	----	5.2 ± 2.8	4.0 ± 1.9
Diptera	55.0 ± 36.0	447.1 ± 246.5	14.0 ± 10.9	12.0 ± 6.6
Turbellaria	0.3 ± 0.8	----	----	0.2 ± 0.4
Oligochaeta	4.7 ± 3.6	15.0 ± 2.6	----	5.4 ± 4.7
Hydracarina	1.8 ± 1.5	6.7 ± 4.5	----	0.4 ± 0.5
Amphipoda	----	----	0.4 ± 0.5	----
Mollusca-Sphaeriidae	----	----	8.0 ± 6.4	----
Mollusca-Gastropoda	0.8 ± 1.3	----	3.4 ± 3.3	----
Total	118.8 ± 57.3	709.7 ± 194.9	55.0 ± 33.0	108.2 ± 44.2

moderate in flow and fairly wide with open grassy banks. The bottom consists of smooth stones and gravel with lots of rooted plants and filamentous algae. Several Atlantic salmon parr (*Salmo salar* Linnaeus) were captured by running a dip net through these clumps of algae.

The bottom samples from the Port Menier stream contained very large populations of blackfly larvae (Diptera: Simuliidae), mayfly nymphs (Ephemeroptera) and stonefly nymphs (Plecoptera). The high population levels of these groups probably reflects the stable environment produced by the springs feeding this stream.

The Lac Plantain stream (Fig. 1, location 6) is a small stream flowing into the north-east end of Lac Plantain from a smaller lake about one and a half kilometers away. It is a small, narrow, very shallow (average depth 10 cm) stream with a predominantly silt bottom and very moderately flowing riffle areas of large stones and gravel. The bottom fauna present reflected its lentic nature with few running water forms and the presence of amphipods and snails (Mollusca: Gastropoda) which are more characteristic of slower flowing or lentic waters.

DDT residues in soil and mice brains: DDT residues found in soil and mice brains from five traplines on Anticosti Island are presented in Table IX. Total DDT residues in soil from the five traplines averaged 5.7 ppb and ranged from 1.6 to 10.4 ppb. The average total DDT residue in the seven mice brains analysed was 83 ppb and ranged from trace amounts to 362 ppb in individual brains.

Previous studies on DDT residue persistence in populations of small forest mammals have been reported from Maine (Dimond and Sherburne, 1969) and Northern Vancouver Island (Buckner et al, 1975). These studies

indicate average DDT residues of from 15 to 30 ppb in the whole bodies or brains of deer mice from areas with no history of DDT applications. Most of the mice trapped on Anticosti Island contained DDT residues at close to these background levels but two individuals contained significantly higher residue loads (362 and 148 ppb). Unusually high residues in individual deer mouse brains from areas where most individuals carry background levels of DDT has also been found on Northern Vancouver Island (Buckner et al, 1975), but the reason for this phenomenon remains unclear.

Table IX

DDT residues in parts per billion found in soil and mice brains from five trap lines on Anticosti Island, Quebec, September 1973

Trap line	Sample	DDE	o, p-DDT	p,p'-DDT	Total DDT
1	Soil	1.8	T	3.2	5.0
2	Soil	0.7	0.5	5.3	6.5
	Five mouse brains ave (range)	T	T (N.D.-T)	112.4 (T-362.0)	112.4 (T-362.0)
3	Soil	0.3	T	4.6	4.9
	One mouse brain	4.0	T	8.0	12.0
4	Soil	0.7	0.8	8.9	10.4
5	Soil	0.4	T	1.2	1.6
	One mouse brain	T	T	8.0	8.0

DDE:2, 2 - Bis (p-chlorophenyl) 1, 1 - dichloroethylene

o, p - DDT:2, 2 - Bis (o, p - chlorophenyl) 1, 1, 1 - trichloroethane

p, p'- DDT:2, 2 - Bis (p-chlorophenyl) 1, 1, 1 - trichloroethane

T = Trace (< 0.3 ppb for soil, < 2.0 ppb for mice brains)

N.D. = Not Detected

CONCLUSIONS

Juvenile hormone treatment: The data collected from monitoring resident breeding bird, small mammal and aquatic fauna populations indicate that under the conditions of application the juvenile hormone treatment had no immediate or short term adverse side effects on these components of the forest environment within the treated areas.

Fenitrothion treatment: Examination of the bottom fauna populations in four streams exposed to operational fenitrothion treatment several weeks before they were sampled revealed apparently normal populations of aquatic invertebrates. Groups of aquatic insects known to be sensitive to fenitrothion were present in normal populations in several of the streams and where they were absent, it could be accounted for by the physical and chemical characteristics of the stream.

DDT Residues: The DDT residues found in soil and mice brains from Anticosti Island in 1973 were generally similar in magnitude to those found in areas with no history of DDT applications. Residues greater than background levels were found in two individual deer mouse brains.

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