IMPACT OF AERIAL APPLICATIONS OF ORTHENE [R]

UPON NON-TARGET ORGANISMS

by

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ABSTRACT

Experimental applications of the chemical insecticide Orthene® (acephate) at two dosage rates were monitored for environmental disturbances to select non-target components of the ecosystem. Populations of small forest inhabitating birds, small mammals, amphibia and honey bees were monitored during the application of 0.56 kg ai/hectare, and birds and small mammal populations monitored during application of 1.4 kg ai/hectare.

Population census data and field observations indicate that neither of these operations affected the organisms monitored except honey bees which suffered light short-term impact but quickly recovered.

RÉSUMÉ

On a contrôlé l'application à titre expérimental de deux doses d'Orthène (R) (acéphate) afin de déterminer leurs effets sur des éléments choisis et non visés de l'écosystème. On a observé les populations de petits oiseaux forestiers, de petits mammifères, d'amphibions, et d'abeilles domestiques pendant l'application de l'insecticide à raison de 0.56 kg par hectare; on a également surveillé les populations d'oiseaux et de petits mammifères pendant l'application de 1.4 kg d'insecticide par hectare.

Le recensement des animaux et les observations effectuées sur le terrain montrent que, à l'exception des abeilles domestiques qui ont légèrement et brièvement souffert, les animaux n'ont été dérangés par aucun de ces traitements.

INTRODUCTION

The spruce budworm, *Choristoneura fumiferana* Clem continues to cause wide spread damage to the coniferous forests of eastern North America. Chemical control practices are at the present time the only practical means of achieving any measure of control over these extremely high insect populations. As new insecticides are developed they must pass through a vigerous screening procedure prior to their registration for use in Canadian forests. Part of the screening process involves the testing of these compounds under operational conditions to measure their impact upon the non-target flora and fauna of the forest ecosystem. In 1975, field trials were carried out to field test the chemical insecticide Orthene (R) and to study the effects of aerial applications upon populations of song birds, small mammals, aquatic amphibia and honey bees, *Apis mellifera* L.

PLOT DESCRIPTION

Larose forest:- Five bird population monitoring plots were established in various ecological habitats common to the Larose forest. Four of these plots of 4 hectares (10 acres) each were located within the 1012 hecare (2500 acre) treatment block in the following stand types; treatment plot I, in a white spruce, *Picea glauca* (Moench) Voss stand approximately 25 years old with a tree height averaging about 11 meters (35 feet); treatment plot 2, located in a deciduous stand of maple, *Acer spp.*; beech, *Fagus grandifolia* Ehrh.; birch, *Betula spp.* and white elm, *Ulmus americana* L. with an overstory of about 20 meters (65 feet); treatment plot 3 in a plantation containing small blocks of white spruce approximately 4.5 meters (15 feet) high; and treatment plot 4 in an open plantation of white pine, *Pinus strobus* L. approximately 3 meters (10 feet) high.

The untreated control plot was located in an area covering 8 hectares (20 acres) encompassing the various habitats found in the treated plots.

Honey bee colonies were placed in open spaces close to the center of the treated area so that approximately 1.6 kilometers (1 mile) of treated forage area surrounded each "bee yard". One yard was located in a spruce stand adjacent to bird treatement plot 1 and the 2nd yard adjacent to bird treatment plot 2. Small mammal trap lines were also located in these two stands in order to minimize invasion of small mammals from adjacent untreated areas.

Petawawa Forest Experiment Station:- Three plots of 4 hectares (10 acres) each were established for the Petawawa experiment. Plots I and 2 were

located within the 81 hectare treatment block and the untreated control plot established several miles distant. Treatment plot I was established in a deciduous stand of beech, elm and birch about 12 meters (40 ft.) high with a moderate understory of hazelnut, *Corylus* sp. Treatment plot 2 and the untreated control were established in mixedwood stands containing balsam fir, *Abies balsamae* (L) Mill., black spruce, *Picea mariana* (Mill.), white spruce, birch, maple and elm. The understory consisted of thickets of speckled alder *Alnus rugosa* (DuRai) and hazelnut. Small mammal populations were also assessed on these plots.

METHODS AND MATERIALS

Spray application and deposit sampling:- The dyed insecticide solution was applied to both the Larose forest and Petawawa Station blocks using fixed winged aircraft fitted with a Micronair AV-3000 delivery system and flying just above the forest canopy.

The Larose block was treated with an application of 0.56 kg active ingredient per hectare (8 oz. ai/acre) in 1.4 liters/ha (20 fl. oz/acre) and the Petawawa block received a treatement of 1.6 kg active ingredient per hectare (20 oz ai/acre in 3.8 liters/ha (48 fl. oz/acre).

In the Larose block, spray deposit was sampled by placing 13 x 17 cm (5 x 7 inch) aluminum pans on small platforms and elevated to heights of 5.5, 4.0, 0.3 meters (18, 13 and 1 foot) and also at ground level. One set of these deposit sampling units was located on each bird population monitoring plot. Sampling pans were also placed on top of each bee hive and on the ground around the ponds being monitored for amphibian activity.

In the Petawawa block spray deposit samples were collected

using pairs of 50 x 75 mm glass slides (area of 75 cm^2) which were positioned throughout the experimental block to give representative samples of spray deposit.

Birds:- Bird populations were assessed on plots established in the various habitats in treated and untreated checks previously described. Population censuses commenced 5 days prior to the application of the insecticide and continued for a period of 5 days after the treatment. Census methods are similar to those described by Kendeigh, 1944, and Buckner and Turnock, 1965 and consisted of traversing the plot along parallel lines 40 meters (132 feet) apart. All birds seen or heard were recorded on plot maps. Census data collected over a period of several days results in the identification of breeding territories. On the day of treatment, plot searches were carried out in an attempt to recover any sick, dying or dead birds resulting from the spray. Pre and post-spray territories of selected birds are illustrated to demonstrate possible impact upon birds defending breeding territories (Figs 1 - 11).

Small mammals:- Small mammal specimens were trapped approximately 6 weeks after the application of Orthene using standard snap-back traps. A total of 50 traps were employed on each trap plot. A center line 82.2 meters (90 yards) long was established and flagged at 9 m (10 yard) intervals. Five traps were placed at .9 m (1 yard) intervals across the center line at each flagged location. Trapping took place on three consecutive nights resulting in a total of 150 trap nights per plot. Three plots, the check, a hardwoods plot and a mixedwoods plot, were trapped at Petawawa; a control and a mixedwoods plot were trapped at Larose.

Honey Bees:- Newly purchased 1.4 kgm (3 lb) packages of honey bees were set up at the headquarters apiary prior to their introduction to the Larose treatment sites. After colonies had become well established with healthy queens and with blood production well underway they were transferred to the treatment area. Five colonies were placed on each of 2 "yards" in the Orthene treatment plot and 5 located in the untreated check area. When the colonies had adjusted to these new areas, queens and brood were checked and activity monitoring equipment was attached to each hive. Monitoring equipment consisted of a dead bee trap attached to the outside of each colony to collect dead bees as they are removed from the hive, an electronic counter attached to the hive entrance to measure activity of the field force coming and going from the hive, a pollen trap which collects pollen being brought into the hive by the field foraging bees and a scale device which is placed under each colony to weigh (gross weight) the colonies periodically throughout the experimental period. Monitoring commenced 4 days prior to the treatment and continued for 5 days after the application. On the day of application, the dead bee and pollen traps were emptied and the activity counter zeroed immediately prior to the treatment and impact readings were taken every 3 hours from 0900 to 2100 hours.

Amphibians:- The impact of Orthene upon native amphibians was studied in the Larose area. Tadpoles of the wood frog, *Rana sylvatica* LeConte, were collected from ponds outside the treatment area and placed in basket enclosures in a pond within the treatment block as well as in ponds in an untreated check area. Tadpoles were collected 3 233ks prior to treatment and observed throughout the experimental period. Natural populations of the spring peeper, *Hyla crucifer* Weid, the wood frog, *R. sylvatica* and blue spotted salamander, *Ambystoma laterale* Hallowell, inhabiting ponds in both the treatment and untreated check areas, were

kept under constant observation for possible side-effects of the chemical. Ponds were swept daily with dip nets to recover larval carcasses which may have resulted from the treatment.

RESULTS

Larose Forest

Insecticide spray deposit:- Colorimetric analysis of spray deposited in the aluminum pans located in the various habitats throughout the Larose forest indicated an uneven deposit (Tables I, II and III).

Table I

Average spray deposit measured at sampling points on bird census plots in the Larose forest treatment block June 19, 1975

	Plot number and spray deposit							
	Plot 1		Plot 2		Plot 3		Plot 4	
Sampling level	l/ha	fl.oz/ac	l/ha	fl.oz/ac	l/ha	fl.oz/ac	l/ha	fl.oz/ac
5.5 meters (18 ft)	0.671	9.2	0.094	1.3	0.635	8.7	2.401	32.9
4.0 meters (13 ft)	0.722	9.9	0.116	1.6	0.635	8.7	11.249	154.1
0.3 meters (1 ft)	0.591	8.1	0.109	1.5	0.956	13.1	10.468	143.1
Ground level	0.277	3.8	0.087	1.2	0.803	11.0	5.234	71.7
Average (volume)	0.569	7.8	0.102	1.4	0.751	10.3	7.336	100.5
Average g ai/ha (gm/oz)	228	(3.1)	41	(0.6)	300	(4.1)	2934	(40)

Emitted dosage rate = 0.56 kg AI in 1.4 l/ha (8 oz AI in 20 fl.oz/acre)

Table II

Spray deposit measured on sampling units placed on top of bee hives in 2 "yards" in the Larose forest treatment block

June 19, 1975

Spray deposit - bee yard # 1			Spray deposit - bee yard # 2		
Hive number	l/ha	fl.oz/ac	Hive number	l/ha	fl.oz/ac
24	0.146	2.0	51	0.036	0.5
33	0.197	2.7	52	0.065	0.9
50	0.219	3.0	54	0.109	1.5
60	0.197	2.7	55	0.058	0.8
70	0.043	0.6	56	0.073	1.0
Average	0.160	2.2		0.065	0.9
Average g ai/ha (oz/ac)	64	(0.9)		26	(0.4)

Table III

Spray deposit measured on sampling units placed beside 2 ponds in the Larose forest treatment block
June 19, 1975

Location and unit no.	l/ha	fl oz/ac	Location and unit no.	l/ha	fl oz/ac
Location #1, unit 1	0.642	8.8	Location #2, unit 1	0.372	5.1
2	0.292	4.0	2	0.138	1.9
3	0.379	5.2	3	0.189	2.6
4	0.175	2.4	4	0.182	2.5
5	0.284	3.9			
6	0.357	4.9			
7	0.102	1.4			
8	0.233	3.2			
Average	0.306	4.2		0.219	3.0
Average g. ai/ha (oz./ac)	122	(1.7)		88	(1.2)

A temporary malfunction of an Micronair unit on the spray plane resulted in a high deposit of insecticide (in the form of very large droplets) in bird census plot 4, (Table I). Low deposits are recorded on bird census plot 2, on the honey bee hives and around the experimental ponds.

Birds: Small forest songbirds had settled into breeding and foraging territories by the time population censuses were conducted. Pre and post treatment territories of the Nashville warbler, *Vermivora ruficapilla* (Wilson); yellowthroat, *Geothlypis trichas* (Linnaeus); Myrtle warbler, *Dendroica coronata* (Linnaeus) and the white-throated sparrow, *zonotrichia albicollis* (Gmelin) are diagramed (Figs. 1 to 6) to illustrate possible pesticide impact. Some species such as the woodpeckers (family Picidae), crows and jays (family Corvidae) and woodcock (family Scolopacidae) have territories too large to measure on monitoring plots and may be missed by the daily census. Cowbirds, *Molothrus ater* (Boddaert), being parasitic do not defend a breeding territory and were recorded when observed foraging through the plots.

A total of 30 species of birds representing 11 families were recorded on the untreated plot (Table IV). Populations did not fluctuate significantly throughout the census period.

Treatment plot I, located in a pure stand of even aged white spruce contained a population of 29 species representing 15 families (Table V). A spray deposit averaging 0.5 kg/ha over the post spray census period and no pesticide impact is indicated.

Treatment plot 2, established in deciduous stand about 65 feet in height recorded a population of 25 species representing 10 families (Table VI). A very light spray deposit of 0.1 kg/ha (1.4 oz./acre) was

recorded. Bird populations remained relatively the same throughout the census period indicating that the application of Orthene on this plot did not affect the bird population.

Treatment plot 3, established in a plantation of white spruce about 12 meters high (40 feet) and jack pine about 4.5 meters high (15 feet) contained a population of 30 species representing 13 families (Table VII). A fairly heavy deposit of insectecide spray averaging 0.8 kg/ha (10.3 oz./acre) was recorded. Bird populations were recorded as increasing throughout the post spray period and is partially accounted for by a flock of common grackles, *Quiscalus quiscula* (Linnaeus) recorded on the plot on June 21 (treatment day + 2). The data indicates that this treatment did not affect birds inhabitating this plot.

Treatment plot 4, established in an open area where the bird inhabitants were exposed to the aerial application. A total 26 species representing 14 families were recorded (Table VIII). A leaky micronair (later corrected) produced the abnormally high spray deposit recorded which averaged 7.3 kg/ha (100.5 oz./acre). Populations were recorded as increasing over the post treatment period and the daily population census data indicates that this treatment did not affect birds on plot 4.

Table IV

Forest bird population census
Orthene untreated control plot
Larose Forest, Ont.
June 14 to June 24 1975

Family	Species	Pre-spray						Post-spray					
		June 14	June 15	June 16	June 17	June 18	Daily	June 20	June 21	June 22	June 23	June 24	Daily
		-5	-4	-3	-2	-1	ave	+1	+2	+3	+4	+5	ave
icidae	Yellow-shafted Flicker	0	0	0	0	0	0.0	0	1	0	0	0	0.2
	Hairy Woodpecker	0	0	0	0	0	0.0	0	0	0	0	1	0.2
yrannidae	Eastern Kingbird	0	0	0	0	0	0.0	1	0	0	2	0	0.6
	Eastern Phoebe	4	4	6	6	4	4.8	0	0	0	3	0	0.6
orvidae	Blue Jay	1	0	1	1	2	1.0	0	1	0	0	0	0.2
	Common Crow	0	0	0	0	0	0.0	1	0	0	0	0	0.2
aridae	Black-capped Chickadee	1	0	3	1	1	1.2	0	5	2	1	0	1.6
imidae	Catbird	4	4	1	5	4	3.6	2	2	2	4	3	2.6
urdidae	American Robin	0	1	1	4	3	1.8	3	3	1	1	2	2.0
	Hermit Thrush	0	0	0	0	0	0.0	0	2	0	0	0	0.4
	Veery	3	4	9	16	8	8.0	7	10	11	10	7	9.0
ylviidae	Golden-crowned Kinglet	2	2	4	4	2	2.8	2	2	4	0	4	2.4
ombycillidae	Cedar Waxwing	0	0	1	5	0	1.2	0	0	0	0	0	0.0
arulidae	Nashville Warbler	2	5	3	10	2	4.4	4	2	8	2	4	4.0
	Yellow Warbler	28	26	21	30	20	25.0	20	21	17	26	22	21.2
	Magnolia Warbler	2	2	0	2	0	1.2	2	2	2	2	0	1.6
	Myrtle Warbler	0	0	2	2	0	0.8	0	1	0	0	0	0.2
	Yellowthroat	10	8	8	8	2	7.2	10	6	8	4	4	6.4
	American Redstart	0	2	0	0	0	0.4	0	0	0	0	0	0.0

Table IV (Cont'd)

Family	Species	Pre-spray June 14	June 15	June 16	June 17	June 18	Daily	Post-spray June 20	June 21	June 22	June 23	June 24	Daily
		-5	-4	-3	-2	-1	ave	+1	+2	+3	+4	+5	ave
Icteridae	Red-winged Blackbird	5	5	8	4	8	6.0	9	6	11	11	8	9.0
	Baltimore Oriole	0	1	0	0	0	0.2	0	0	0	0	2	0.4
	Common Grackle	2	0	0	0	0	0.4	5	5	1	1	0	2.8
	Brown-headed Cowbird	4	7	8	14	7	10.0	6	10	6	4	7	6.6
Fringillidae	Rose-breasted Grosbeak	0	0	0	3	0	0.6	0	0	0	0	0	0.0
	Purple Finch	2	4	0	5	2	2.6	0	0	2	0	0	0.4
	American Goldfinch	0	4	6	6	2	3.6	2	4	0	0	2	1.6
	Chipping Sparrow	0	8	4	4	0	3.2	2	4	2	4	2	2.8
	White-throated Sparrow	2	6	6	7	6	5.4	3	7	6	10	6	6.4
	Swamp Sparrow	10	7	4	14	14	9.8	9	10	7	7	10	8.6
	Song Sparrow	0	0	0	0	0	0.0	0	0	2	2	0	0.8
	Totals	82	100	96	151	87	103.2	88	104	92	94	84	92.4

Table V

Forest bird population census
Orthene treatment plot I (coniferous stand)
Larose Forest Ont.
June 14 - June 24 1975

Family	Species	Pre-spray						Post-spray					
		June 14	June 15	June 16	June 17	June 18	Daily	June 20	June 21	June 22	June 23	June 24	Daily
		-5	-4	-3	-2	-1	ave	+1	+2	+3	+4	+5	ave
Scolopacidae	American Woodcock	2	0	0	0	0	0.4	0	0	0	0	0	0.0
Columbidae	Mourning Dove	2	0	0	4	4	2.0	2	0	3	0	0	1.0
Picidae	Yellow-shafted Flicker	0	0	0	0	0	0.0	0	0	1	0	0	0.2
Tyrannidae	Eastern Wood Pewee	2	2	2	0	2	1.6	2	6	2	2	2	2.8
Corvidae	Blue Jay	0	0	0	0	0	2.0	1	0	0	2	0	0.6
Paridae	Black-capped Chickadee	2	0	2	0	2	1.2	0	3	0	0	0	0.6
Sittidae	Red-breasted Nuthatch	0	2	0	0	2	0.8	0	0	0	0	0	0.0
Mimidae	Brown Thrasher	0	0	0	0	0	0.0	0	0	2	0	0	0.4
Turidae	American Robin	2	2	2	0	0	1.2	3	2	0	0	0	1.0
	Wood Thrush	0	2	0	0	2	0.8	0	0	2	0	2	0.8
	Hermit Thrush	0	2	0	2	2	1.2	2	2	2	2	0	1.6
	Veery	2	0	2	0	0	0.8	2	2	0	0	0	0.8
Sylviidae	Golden-crowned Kinglet	0	2	0	0	0	0.4	0	2	2	4	6	2.8
	Ruby-crowned Kinglet	2	4	0	2	0	1.6	2	2	0	0	6	2.0
Bombycillidae	Cedar Waxwing	0	0	12	0	0	2.4	0	0	0	0	0	0.0

Table V (Cont'd)

Family	Species	Pre-spray June 14 -5	June 15 -4	June 16 -3	June 17 -2	June 18 -1	Daily ave.	Post-spray June 20 +1	June 21 +2	June 22 +3	June 23 +4	June 24 +5	Daily ave.
Parulidae	Nashville Warbler	0	2	0	2	2	1.2	2	2	2	0	0	1.2
	Magnolia Warbler	0	0	0	0	0	0.0	0	0	2	0	0	0.4
	Myrtle Warbler	2	0	2	2	4	2.0	4	8	4	2	2	4.0
	Ovenbird	0	2	0	0	0	0.4	4	4	4	4	2	3.6
	Mourning Warbler	2	0	0	0	0	0.4	0	0	0	0	0	0.0
	Yellowthroat	2	2	2	2	2	2.0	4	2	2	4	0	2.4
Icteridae	Red-winged Blackbird	2	0	0	0	0	0.4	2	2	0	0	0	0.8
	Common Grackle	0	0	0	0	0	0.0	1	1	3	0	0	1.0
	Brown-headed Cowbird	2	0	4	2	4	2.4	4	2	2	4	2	2.8
Thraupidae	Scarlet Tanager	0	0	0	0	0	0.0	0	0	0	2	0	0.4
Fringillidae	Rose-breasted Grosbeak	4	2	0	0	0	1.2	0	0	2	0	0	0.4
	American Goldfinch	4	0	3	2	0	1.8	4	0	0	0	0	0.8
	Chipping Sparrow	2	0	0	0	0	0.4	0	0	0	0	0	0.0
	White-throated Sparrow	4	4	4	5	2	3.8	5	2	7	6	6	5.2
Totals		38	28	35	23	28	30.4	44	42	42	32	28	37.6

Table VI

Forest bird population census
Orthene treatment plot 2 (Hardwoods)
Larose Forest Ontario
June 14 - June 24 1975

Family	Species	Pre-spray						Post-spray					
		June 14	June 15	June 16	June 17	June 18	Daily	June 20	June 21	June 22	June 23	June 24	Daily
		-5	-4	-3	-2	-1	ave	+1	+2	+3	+4	+5	ave
Alcedinidae	Belted Kingfisher	0	0	0	0	0	0.0	0	2	2	0	2	1.2
Picidae	Yellow-shafted Flicker	2	0	0	4	0	1.2	0	0	0	0	0	0.0
	Hairy Woodpecker	2	0	0	2	2	1.2	0	0	0	0	0	0.0
Tyrannidae	Great-crested Flycatcher	0	0	0	0	0	0.0	0	0	2	0	2	0.8
	Least Flycatcher	2	2	2	2	2	2.0	2	0	2	0	0	0.8
	Eastern Wood Pewee	4	0	2	2	2	2.0	0	4	0	4	2	2.0
Corvidae	Blue Jay	2	0	0	0	0	0.4	0	0	0	2	0	0.4
Paridae	Black-capped Chickadee	0	0	0	0	0	0.0	0	2	6	0	0	1.6
	Boreal Chickadee	0	0	3	2	0	1.0	0	0	0	0	0	0.0
Turdidae	American Robin	4	2	0	2	2	2.0	2	3	2	0	0	1.4
	Wood Thrush	2	2	2	4	2	2.4	2	2	2	2	0	1.6
	Hermit Thrush	0	0	0	0	0	0.0	2	2	0	2	2	1.6
	Veery	2	2	0	0	2	1.2	2	2	2	4	4	2.8
Vireonidae	Red-eyed Vireo	2	2	0	0	0	0.8	0	2	0	2	1	1.0
Parulidae	Magnolia Warbler	0	0	0	0	0	0.0	0	0	0	0	2	0.4
	Chestnut-sided Warbler	0	0	2	0	0	0.4	0	0	0	0	0	0.0
	Ovenbird	8	6	4	6	2	5.2	6	4	6	6	4	5.2
	Yellowthroat	0	0	0	0	0	0.0	2	2	2	2	2	2.0

Table VI (Cont'd)

Family	Species	Pre-spray June 14 -5	June 15 -4	June 16 -3	June 17 -2	June 18 -1	Daily ave	Post-spray June 20 +1	June 21 +2	June 22 +3	June 23 +4	June 24 +5	Daily ave
Icteridae	Red-winged Blackbird	2	2	2	4	2	2.4	2	2	5	4	4	3.4
	Baltimore Oriole	2	0	2	2	0	1.2	0	0	0	0	0	0.0
	Common Grackle	2	0	0	2	0	0.8	2	0	0	0	0	0.4
	Brown-headed Cowbird	2	2	4	0	4	2.4	0	0	4	4	2	2.0
Fringillidae	Rose-breasted Grosbeak	2	0	3	2	2	1.8	1	2	2	2	3	2.0
	Purple Finch	0	0	2	0	0	0.4	1	0	0	0	0	0.2
	American Goldfinch	0	0	0	0	0	0.0	0	0	0	0	7	1.4
Totals		40	20	28	34	22	28.8	24	29	37	34	37	32.2

Table VII

Forest bird population census
Orthene treatment plot 3 (jack-pine white spruce stand)
Larose Forest Ont.
June 14 - June 24 1975

Family	Species	Pre-spray						Post-spray					
		June 14	June 15	June 16	June 17	June 18	Daily	June 20	June 21	June 22	June 23	June 24	Daily
		-5	-4	-3	-2	-1	ave	+1	+2	+3	+4	+5	ave
Columbidae	Mourning Dove	0	0	0	2	2	0.8	1	3	3*	2	2	2.2
Picidae	Yellow-shafted Flicker	2	0	0	0	0	0.4	0	0	0	0	0	0.0
Tyrannidae	Great-crested Flycatcher	0	0	0	0	0	0.0	0	0	0	2	0	0.4
	Eastern Wood Pewee	0	0	0	0	0	0.0	0	0	2	0	0	0.4
Corvidae	Blue Jay	0	0	0	0	0	0.0	0	2	1	2	0	1.0
Paridae	Black-capped Chickadee	0	0	0	0	0	0.0	0	0	4	0	6	2.0
Sittidae	Red-breasted Nuthatch	0	0	0	0	0	0.0	0	2	0	2	0	0.8
Mimidae	Brown Thrasher	0	0	2	0	0	0.4	0	0	0	0	0	0.0
Turdidae	American Robin	2	2	2	0	2	1.6	4	6	4	0	4	3.6
	Wood Thrush	0	0	2	0	2	0.8	2	0	4	0	0	1.2
	Hermit Thrush	2	0	0	0	2	0.8	0	4	0	2	0	1.2
	Veery	2	0	0	0	0	0.4	0	2	2	2	0	1.2
Sylviidae	Golden-crowned Kinglet	0	0	0	0	2	0.4	0	0	0	0	0	0.0
	Ruby-crowned Kinglet	0	0	0	0	0	0.0	0	2	0	0	0	0.4

Table VII (Cont'd)

Family	Species	Pre-spray June 14 -5	June 15 -4	June 16 -3	June 17 -2	June 18 -1	Daily ave	Post-spray June 20 +1	June 21 +2	June 22 +3	June 23 +4	June 24 +5	Daily ave
Parulidae	Black and white Warbler	0	0	0	0	0	0.0	0	0	0	2	0	0.4
	Nashville Warbler	2	4	4	2	6	5.6	2	4	4	2	0	2.4
	Magnolia Warbler	0	0	0	2	0	0.4	2	0	0	0	0	0.4
	Cape May Warbler	0	2	2	0	0	0.8	0	0	0	0	2	0.4
	Myrtle Warbler	0	2	2	2	0	1.2	0	2	2	4	0	1.6
	Ovenbird	0	2	0	0	2	0.8	0	2	2	6	4	2.8
	Mourning Warbler	0	0	0	0	2	0.4	0	2	0	0	0	0.4
	Yellowthroat	0	0	0	0	0	0.0	0	1	2	2	0	1.0
Icteridae	Common Grackle	0	0	0	0	3	0.6	2	14	0	6	2	4.8
	Brown-headed Cowbird	4	0	4	2	2	2.4	2	4	4	2	4	3.2
Thraupidae	Scarlet Tanager	0	0	0	0	0	0.0	2	0	0	0	2	0.8
Fringillidae	Rose-breasted Grosbeak	0	2	2	0	4	1.6	2	0	2	0	0	0.8
	American Goldfinch	2	2	4	4	4	3.2	2	4	0	0	0	1.2
	Slate-coloured Junco	2	0	6	2	2	2.4	2	4	6	4	0	3.2
	Chipping Sparrow	0	0	0	0	2	0.4	0	0	0	0	0	0.0
	White-throated Sparrow	2	6	10	2	6	5.2	6	8	4	4	6	5.6
Totals		20	22	40	18	43	28.6	29	66	48	44	32	43.8

* fleglings present with parent bird

Table VIII

Forest bird population census
Orthene treatment plot 4 (white pine plantation)
Larose Forest Ont.
June 14 - June 28 1975

Family	Species	Pre-spray						Post-spray					
		June 14	June 15	June 16	June 17	June 18	Daily	June 20	June 21	June 22	June 23	June 24	Daily
		-5	-4	-3	-2	-1	ave.	+1	+2	+3	+4	+5	ave.
Columbidae	Mourning Dove	0	0	2	0	0	0.4	0	0	0	0	0	0.0
Alcedinidae	Belted Kingfisher	0	0	0	0	0	0.0	0	0	0	2	0	0.4
Picidae	Yellow-shafted Flicker	0	0	0	0	1	0.2	0	0	2	4	0	1.2
Tyrannidae	Eastern Phoebe	4	4	0	4	4	3.2	4	2	4	4	2	3.2
	Eastern Wood Pewee	0	2	0	2	0	0.8	2	2	2	0	0	1.2
Corvidae	Blue Jay	2	6	0	2	0	2.0	4	0	0	6	0	2.0
Paridae	Black-capped Chickadee	0	0	0	0	0	0.0	2	0	4	4	4	2.8
Sittidae	Red-breasted Nuthatch	0	0	0	2	0	0.4	2	2	0	0	2	1.2
Troglodytidae	Winter Wren	0	0	0	0	2	0.4	0	0	4	2	2	1.8
Turdidae	American Robin	0	0	0	0	2	0.4	0	0	0	0	0	0.0
	Wood Thrush	0	0	0	0	0	0.0	0	2	0	0	0	0.4
	Hermit Thrush	2	0	0	2	0	0.8	0	0	0	0	0	0.0
	Veery	0	0	0	0	0	0.0	0	2	2	4	0	1.8
Vireonidae	Red-eyed Vireo	0	0	0	2	0	0.4	2	0	2	0	0	0.8

Table VIII (Cont'd)

Family	Species	Pre-spray June 14 -5	June 15 -4	June 16 -3	June 17 -2	June 18 -1	Daily ave	Post-spray June 20 +1	June 21 +2	June 22 +3	June 23 +4	June 24 +5	Daily ave
Parulidae	Nashville Warbler	0	4	4	0	2	2.0	4	4	2	2	0	2.4
	Chestnut-sided Warbler	0	0	0	0	0	0.0	0	0	0	0	2	0.4
	Ovenbird	2	2	0	4	4	1.4	2	4	6	2	2	3.2
	Mourning Warbler	2	2	0	2	2	2.4	2	2	2	2	2	2.0
	Yellowthroat	4	2	2	2	4	2.8	2	2	2	6	7	3.8
Icteridae	Common Grackle	0	0	0	0	2	0.4	2	0	0	0	0	0.4
	Brown-headed Cowbird	0	2	0	2	4	1.8	2	2	2	0	2	1.8
Thraupidae	Scarlet Tanager	2	2	0	2	2	1.8	2	2	2	2	2	2.0
Fringillidae	American Goldfinch	0	0	0	2	0	0.4	2	2	0	2	0	1.2
	Chipping Sparrow	0	4	0	6	2	2.4	0	2	2	0	2	1.2
	White-throated Sparrow	4	6	2	2	10	4.8	8	4	4	8	6	6.0
	Song Sparrow	4	3	4	4	4	3.8	2	2	2	9	0	3.0
Totals		26	39	14	40	45	32.8	44	36	44	59	35	43.6

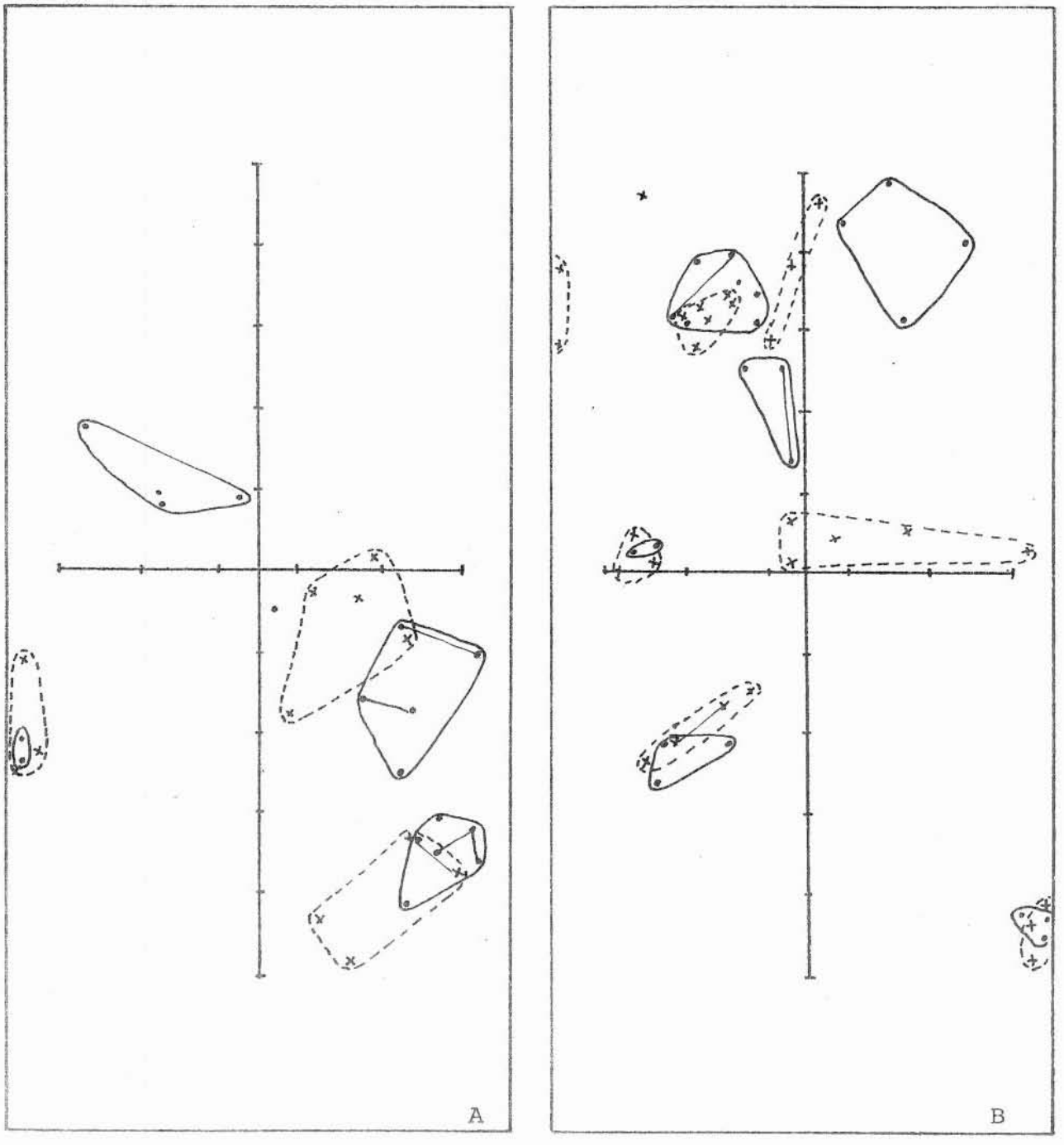

Fig. 1 Pre and post spray breeding territories of the Nashville warbler *V. ruficapilla*. (A) and the yellowthroat *G. Trichas* (B) on the untreated plot. Larose forest, June, 1975.

* ——— pre spray territory boundary

* - - - - - post spray territory boundary

⟷ 2 chains (40 meters)

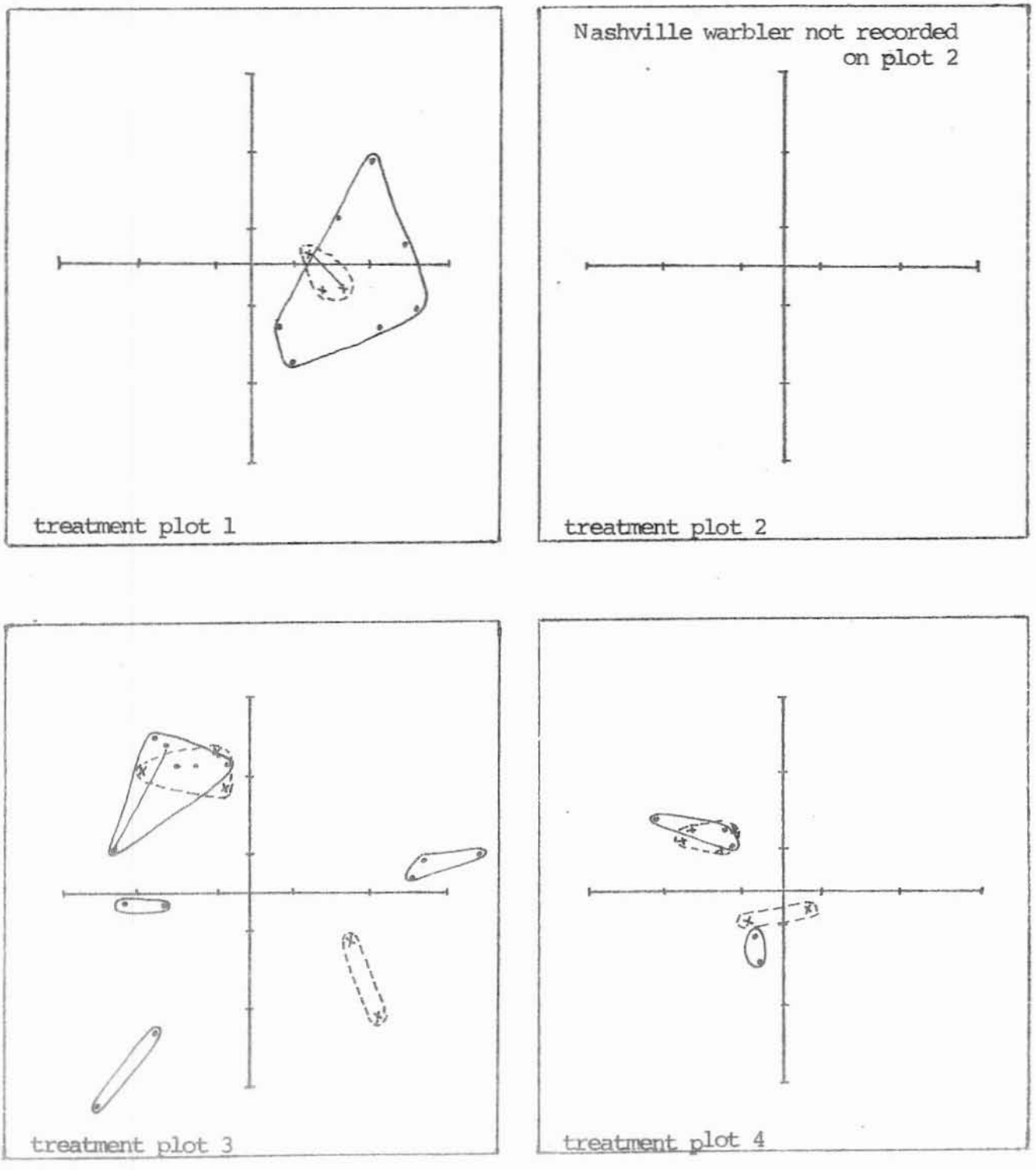

Fig. 2 Pre and post spray breeding territories of the Nashville warbler *V. ruficapilla* on Orthene treatment plots in the Larose forest, June, 1975.

* ——— pre spray territory boundary

* - - - - - post spray territory boundary

⊢——⊣ 2 chains (40 meters)

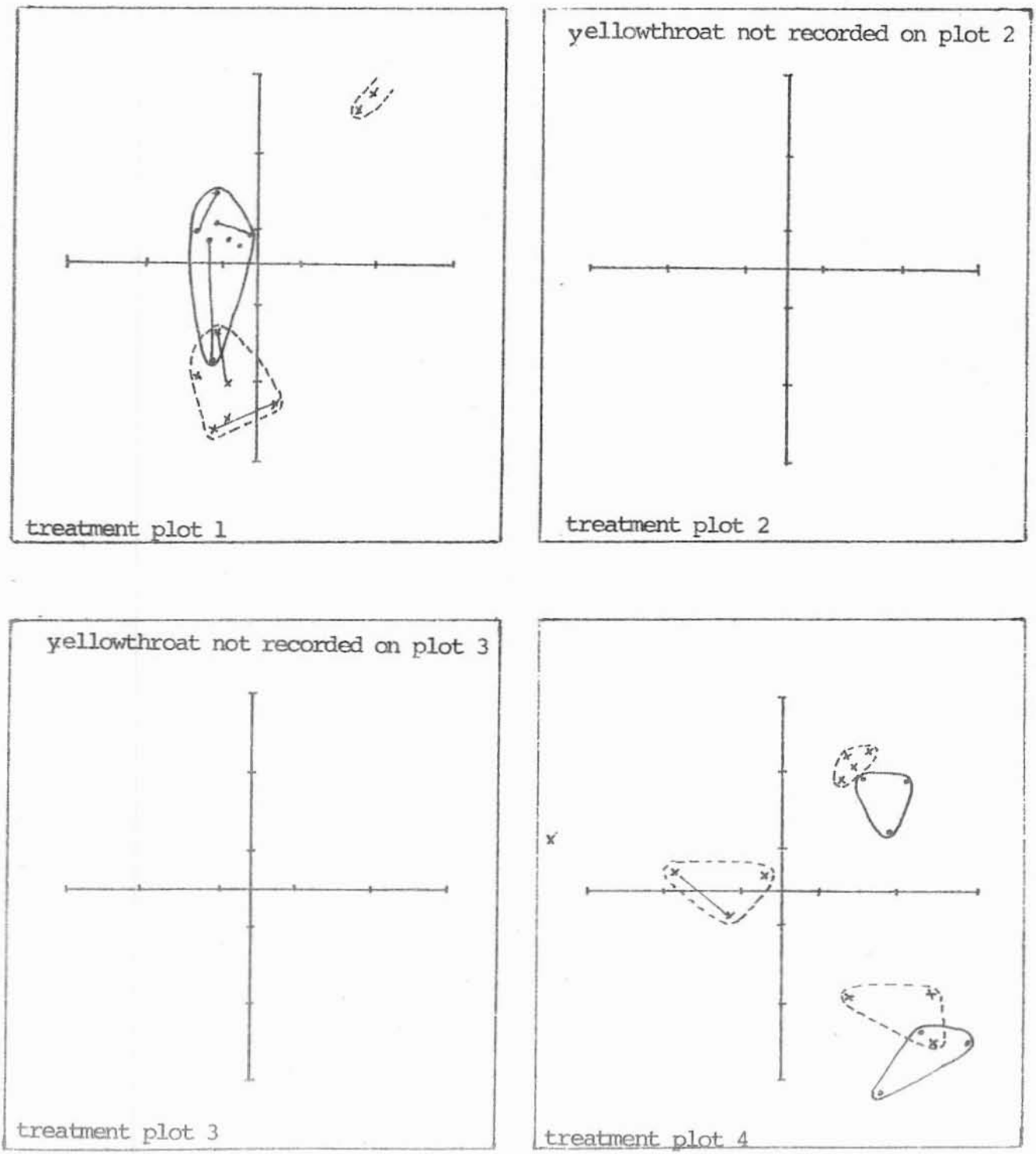

Fig. 3 Pre and post spray territories of the common yellowthroat *G. trichas* on Orthene treatment plots in the Larose forest, June, 1975.

* ——— pre spray territory boundary

× - - - - post spray territory boundary

⟷ 2 chains (40 meters)

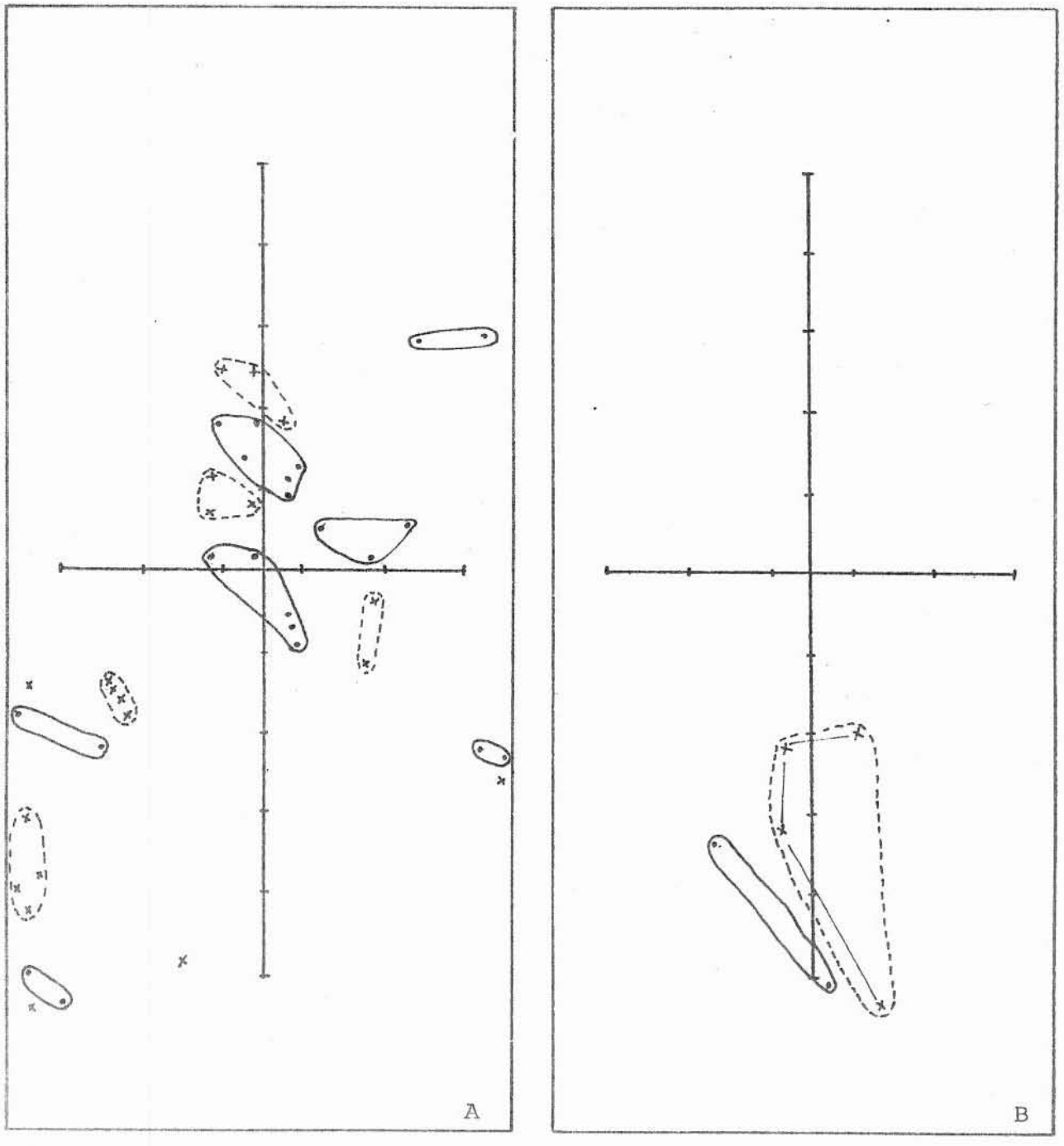

Fig. 4 Pre and post spray breeding territories of the white-throated sparrow *Z. albicollis* (A) and the Myrtle warbler *D. coronata* (B) on the untreated plot. Larose forest, June, 1975.

• ——— pre spray territory boundary

× - - - - - post spray territory boundary

|——| 2 chains (40 meters)

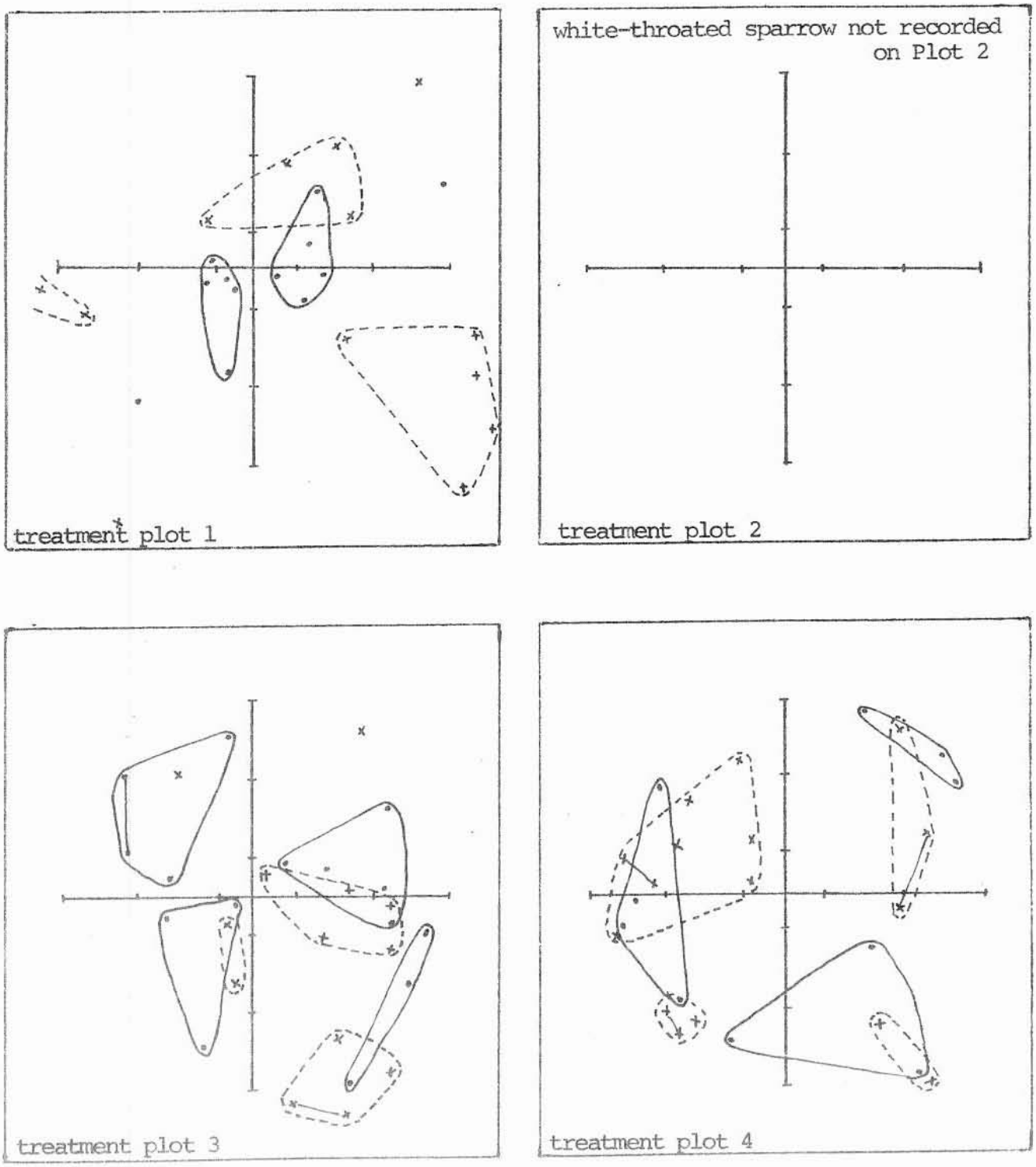

Fig. 5 Pre and post spray territories of the white-throated sparrow *Z. albicollis* on Orthene treated plots, Larose forest, June, 1975.

• ——— pre spray territory boundary

× - - - - - post spray territory boundary

⟷ 2 chains (40 meters)

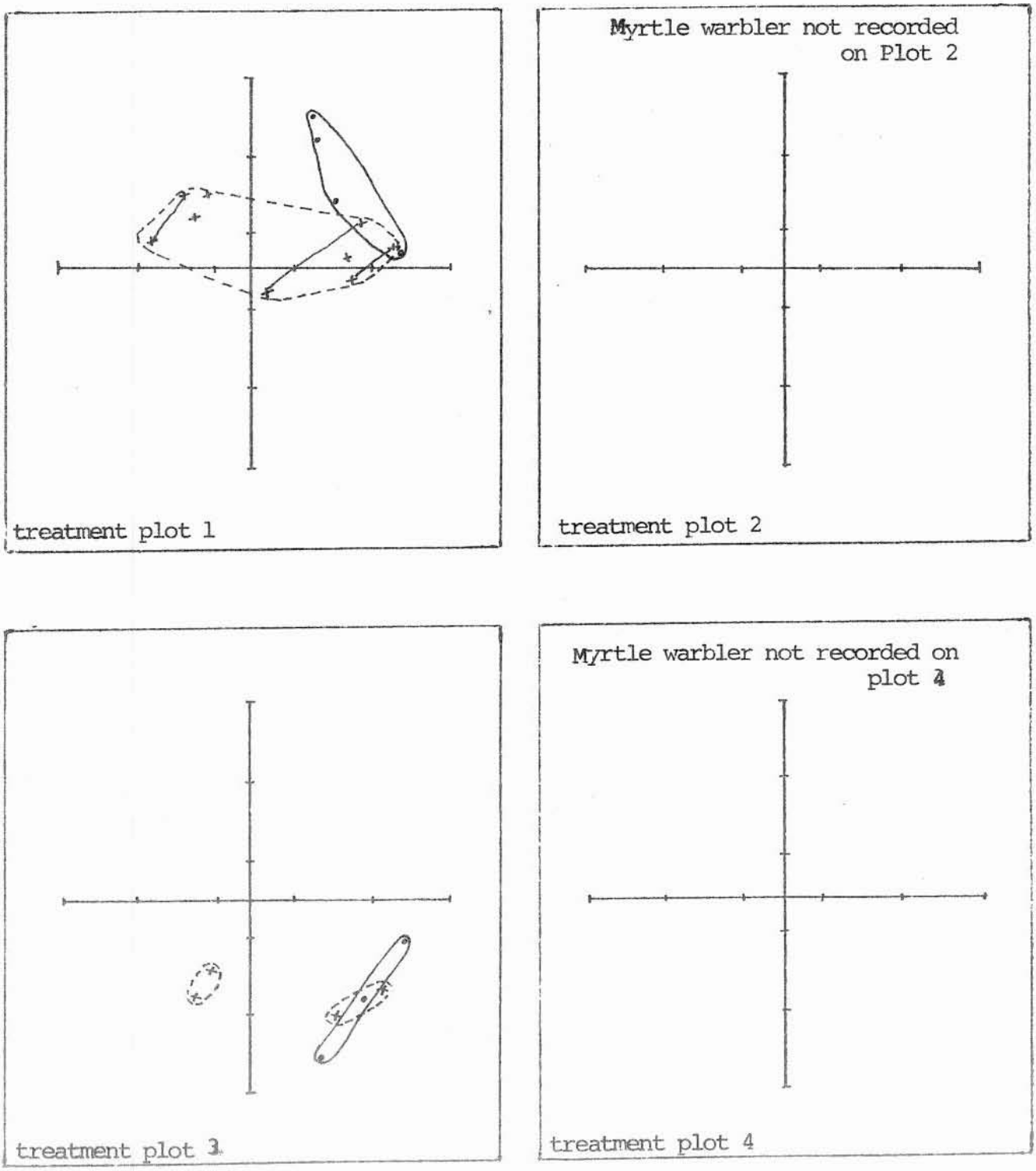

Fig. 6 Pre and post spray breeding territories of the Myrtle warbler *D. coronata* on Orthene treated plots, Larose forest, June, 1975.

° ——— pre spray territory boundary
× - - - - - post spray territory boundary
|——| 2 chains (40 meters)

Honey bees:- The aerial treatment commenced at 0630 hrs. and was completed by 0830 hrs. Foraging commenced around 0800 when the temperature was recorded at 19°C with a relative humidity of 90% and a wind speed of 2.5 kph (4 mph.). Initial impact of adult foraging bees was recorded in the 0900 readings (Table IX). Hive entrance activity on the treated and untreated colonies increased from 0900 hr. until 1500 hrs then declined until the 2100 hr. reading. Adult bee mortality was recorded as early as the 0900 hr. reading on the treated "yards" and increased steadily throughout the day. A few dead bees were taken from the untreated control plot at the 2100 hr. reading indicating that some foraging had taken place as far as the treated area (3.2 kilometers) later in the day (Table IX). Examination of the dead bee traps show that a large portion of the adult bee mortality was suffered by the nurse bee component (newly emerged adult bees tending to duties within the hive). A sharp reduction in pollen collection occurred the day after application on the treatment block and to a lesser extent on the untreated hives (Table X). A combination of hot dry weather (Table XI) and the insecticide application drasticly reduced pollen collecting on the treated hives while the weather only moderately reduced collecting in the untreated area. On June 24th activity recorded at the hive entrances in all locations increased noticeably with no increase in mortality and only a slight increase in pollen collecting in the treated area. The temperature at 1300 hrs. reached 32°C with a relative humidity of 56% causing adult bees to cluster at the entrances and fan the hives in order to cool them. Hives in the untreated area gained weight more rapidly than those exposed to the treatment. Examination of the colonies as late as Oct. 1, showed no differences in colony strength or honey production between the treated and untreated hives.

Table IX

Pesticide impact measurements collected at 5 intervals throughout the day of an Orthene treatment
Larose forest, Ontario
June 19, 1975

(average of 5 colonies at each plot)

Time	Untreated control plot		Treatment plot # 1		Treatment plot # 2	
	Adult mortality	Adult activity trips/census period	Adult mortality	Adult activity trips/census period	Adult mortality	Adult activity trips/census period
0900	2	30	22	222	7	57
1200	3	137	33	475	18	197
1500	0	230	46	749	25	366
1900	0	316	39	521	22	202
2100	11	171	102	351	43	93

TABLE X

Pesticide impact measurements on honey bee colonies
on Orthene treated and untreated plots
Larose forest, Ontario
June, 1975
(average of 5 colonies in each plot)

	Untreated control plot				Treatment plot I				Treatment plot II			
ays from reatment	Adult mortality	Adult activity trips/day	Pollen collected (gms)	Hive weights (kg)	Adult mortality	Adult activity trips/day	Pollen collected (gms)	Hive weights (kg)	Adult mortality	Adult activity trips/day	Pollen collected (gms)	Hive weights (kg)
-4	3	846	154.9		3	2400	206.1		2	1320	150.7	
-3	3	938	74.3	28.3	5	1828	108.0	33.5	3	926	94.3	33.5
-2	5	843	76.6		12	2162	87.6		6	1085	71.5	
-1	9	950	36.7		18	2511	65.4		9	1181	53.1	
0	16	884	43.9	29.9	242	2318	33.9	36.5	115	915	30.3	36.5
+1	8	758	20.3		87	1766	2.2		48	1065	3.7	
+2	3	922	17.0		20	2242	2.0		2	1022	4.2	
+3	1	860	20.2		3	2813	1.0		1	1167	4.7	
+4	0	1459	15.7		1	3359	14.0		1	1572	9.7	
+5	1	1839	11.7		1	2806	13.4		2	1315	6.9	
+8				36.7				38.3				39.0

TABLE XI

Weather conditions prevailing at Larose forest during experimental application of the insecticide Orthene

		Weather readings at 1300 hrs.		
Date	Day	Temperature °C	Relative humidity	Wind speed/direction (kph)
June 14	-5	26	64	11.2/S
June 15	-4	27	62	11.2/S
June 16	-3	24	64	19.3/S
June 17	-2	24	56	8.0/SW
June 18	-1	28	63	16.0/W
June 19	0	21	83	6.4/W
June 20	+1	22	50	11.2/NW
June 21	+2	22	75	6.5/W
June 22	+3	23	59	8.0/W
June 24	+4	32	56	8.0/SW
June 25	+5	27	54	12.8/SW

Amphibians:- *R. sylvatica* tadpoles confined to the basket enclosures and immersed in natural ponds in the treated area were not affected by the insecticide treatment. Daily dip net sweeps of the ponds failed to recover any amphibian mortality resulting from the spray. Spray deposited in and around the 2 ponds averaged 0.3 l/ha (4.2 fl.oz/acre) and 0.2 l/ha (3.0 fl.oz/acre) respectively. Natural populations of *R. sylvatica*, *Hyla crucifer*, and *Amystoma laterale*, all continued to thrive throughout the experimental period. Newly metamorphosed toads and frogs were observed 7 days after the experimental treatment.

Small mammals:- Previous studies conducted in this area indicate that very low small mammal populations are normally recorded at this time of year (July). A single specimen (a sub-adult male) of the woodland jumping mouse, *Napaezapus insignis* (Miller) was trapped in the treated block.

Petawawa Forest Experiment Station

Insecticide spray deposit: The 20 glass slide sampling units placed throughout the treated area recorded a light spray deposit (Table XII)

Table XII

Spray deposit at twenty sample points in the Petawawa Forest Experiment Station plot June 1975

Sample Unit No.	l/ha	fl.oz/acre	Sample Unit No.	l/ha	fl.oz/acre
1	0.562	7.7	11	0.532	7.3
2	1.365	18.7	12	0.262	3.6
3	0.518	7.1	13	0.876	12.0
4	0.277	3.8	14	1.073	14.7
5	0.408	5.6	15	1.438	19.7
6	1.022	14.0	16	1.992	27.3
7	0.292	4.0	17	0.934	12.8
8	0.584	8.0	18	0.773	10.6
9	2.628	36.0	19	0.372	5.1
10	2.190	30.0	20	0.657	9.0
			Mean deposit	0.934	12.85
			Equivalent AI content	392 g	5.3 oz.av.

Birds:- A total of 35 species representing 15 families were recorded on the untreated control plot. Declines in populations over the treatment period were observed among white-throated sparrows, chipping sparrows, *Spizella passerina* Bechstein and ovenbirds (Table XIII).

Treatment plot I established in a hardwoods stand contained a relatively small complement of birds (Table XIV). Least flycatchers, *Empidonax minimus* (Baird and Baird) and ovenbirds were the most abundant species. Similar population declines were also recorded but the data does not indicate this to be a result of the insecticide treatment.

Treatment plot 2 contained a recorded population of 31 species representing 12 families (Table XV). Again a post-spray population decline was recorded which appears to parallel that recorded on treatment plot 1 and on the untreated plot. The pre and post-spray territories of 5 species of birds, the red-eyed vireo, *Vireo olivaceus* (Linnaeus); the least flycatcher, *E. minimus*; Nashville warbler, *V. ruficapilla*, chestnut-sided warbler, *Dendroica pensylvanica* (Linnaeus) and ovenbird, *Seiurus aurocapillus* (Linnaeus) are presented in Fig. 7 to 11. The territory illustrations show that the territories were not affected by this experimental treatment.

TABLE XIII

Forest bird population census
Orthene untreated control plot
Petawawa Forest Experiment Station, Ont.
May 25 - June 4, 1975

Family	Species	Pre-spray					Daily	Post-spray					Daily
		May 25	May 26	May 27	May 28	May 29		May 31	June 1	June 2	June 3	June 4	
		-5	-4	-3	-2	-1	ave	+1	+2	+3	+4	+5	ave
Alcedinidae	Belted Kingfisher	2	0	0	0	0	0.4	0	0	0	0	0	0.0
Picidae	Yellow-shafted Flicker	0	0	2	0	0	0.4	0	0	0	2	0	0.4
	Hairy Woodpecker	1	1	0	1	2	1.0	1	0	0	1	0	0.4
Tyrannidae	Least Flycatcher	2	4	0	2	0	1.6	0	0	2	2	0	0.8
	Olive-sided Flycatcher	0	2	2	2	2	1.6	6	4	2	2	2	3.2
Hirundinidae	Tree Swallow	0	0	0	1	0	0.2	0	0	0	0	0	0.0
Corvidae	Blue Jay	0	0	0	0	0	0.0	0	0	4	0	0	0.8
Paridae	Black-capped Chickadee	0	0	0	0	4	0.8	0	0	0	0	0	0.0
Sittidae	Red-breasted Nuthatch	2	6	0	2	2	2.4	4	0	2	5	0	2.2
Troglodytidae	Winter Wren	6	2	2	2	6	3.6	2	4	4	8	6	4.8
Turdidae	American Robin	0	0	0	0	0	0.0	1	0	0	3	0	0.8
	Veery	5	4	0	4	2	3.0	3	2	0	2	0	1.4
Sylviidae	Golden-crowned Kinglet	0	0	0	2	0	0.4	0	0	0	0	0	0.0
	Ruby-crowned Kinglet	2	0	0	0	0	0.4	0	0	0	2	0	0.4
Vireonidae	Red-eyed Vireo	0	0	0	3	4	1.4	2	0	0	2	0	0.8

Table XIII Cont'd

Family	Species	Pre-spray May 25 -5	May 26 -4	May 27 -3	May 28 -2	May 29 -1	Daily ave	Post-spray May 31 +1	June 1 +2	June 2 +3	June 3 +4	June 4 +5	Daily ave
Parulidae	Black & White Warbler	10	2	4	0	0	3.2	0	4	2	0	0	1.2
	Tennessee Warbler	0	2	0	0	0	0.4	0	0	0	0	0	0.0
	Nashville Warbler	8	12	6	4	8	7.6	8	8	8	14	6	8.8
	Magnolia Warbler	12	6	4	8	8	7.6	6	2	4	4	6	4.4
	Black-throated Blue Warbler	6	6	2	4	2	4.0	10	2	0	0	0	2.4
	Blackburnian Warbler	0	4	0	2	2	1.6	0	0	0	7	0	1.4
	Chestnut-sided Warbler	6	10	7	12	8	8.6	8	4	2	12	6	6.4
	Ovenbird	8	6	6	12	8	8.0	4	2	4	6	4	4.0
	Mourning Warbler	2	0	0	0	0	0.4	0	0	0	0	0	0.0
	Yellowthroat	0	2	6	0	4	2.4	2	6	3	6	6	4.6
Icteridae	Red-winged Blackbird	0	0	2	2	4	1.6	0	2	2	2	2	1.6
	Common Grackle	0	0	0	0	0	0.0	1	0	0	10	0	2.2
	Brown-headed Cowbird	0	0	0	6	5	2.2	2	2	4	4	0	2.4
Thraupidae	Scarlet Tanager	1	0	2	0	0	0.6	0	0	2	2	0	0.8
Fringillidae	Rose-breasted Grosbeak	2	0	0	0	0	0.4	2	0	0	0	0	0.4

Table XIII Cont'd

Family	Species	Pre-spray May 25 -5	May 26 -4	May 27 -3	May 28 -2	May 29 -1	Daily ave	Post-spray May 31 +1	June 1 +2	June 2 +3	June 3 +4	June 4 +5	Daily ave
Fringillidae Cont'd	Purple Finch	0	0	1	2	0	0.6	0	0	0	0	0	0.0
	American Goldfinch	2	2	0	0	2	1.2	0	0	0	2	0	0.4
	Chipping Sparrow	11	10	0	0	4	5.0	4	0	0	0	0	0.8
	White-throated Sparrow	12	16	4	11	8	10.2	7	2	2	6	4	4.2
	Swamp Sparrow	0	0	0	0	0	0.0	0	2	2	2	2	1.6
Unidentified Species		0	0	0	0	0	0.0	0	0	0	1	0	0.2
Totals		100	97	50	82	85	82.8	73	44	49	107	44	63.4

Table XIV

Forest bird population census
Orthene treatment block # 1 (hardwoods plot)
Petawawa Forest Experiment Station
May 25 - June 4 1975

Family	Species	Pre-spray						Post-spray					
		May 25	May 26	May 27	May 28	May 29	Daily	May 31	June 1	June 2	June 3	June 4	Daily
		-5	-4	-3	-2	-1	ave	+1	2	+3	+4	+5	ave
Trochilidae	Ruby-throated Hummingbird	0	1	0	0	0	0.2	0	0	0	0	0	0.0
Picidae	Hairy Woodpecker	1	2	0	1	0	0.8	0	0	0	3	0	0.6
Tyrannidae	Least Flycatcher	18	14	24	26	28	22.0	22	28	20	20	14	20.8
Turdidae	Veery	6	8	7	8	6	7.0	6	5	0	1	3	3.0
Vireonidae	Red-eyed Vireo	4	12	10	8	10	8.8	2	6	6	12	6	6.4
Parulidae	Black-throated Blue Warbler	6	2	2	2	2	2.8	2	0	0	2	2	1.2
	Blackburnian Warbler	0	2	2	0	0	0.8	0	0	0	0	0	0.0
	Chestnut-sided Warbler	4	6	4	8	2	4.8	4	6	4	3	3	4.0
	Ovenbird	8	7	18	6	16	11.0	10	14	8	10	4	9.2
Icteridae	Common Grackle	0	0	2	0	0	0.4	0	0	0	0	0	0.0
	Brown-headed Cowbird	0	2	0	0	0	0.4	0	2	0	0	0	0.4
Fringillidae	Rose-breasted Grosbeak	11	6	5	2	0	4.8	0	0	2	0	0	0.4
Unidentified	Species	0	1	5	0	0	1.2	0	0	0	0	0	0.0
Totals		58	63	79	61	64	65.0	46	61	40	51	32	46.0

Table XV

Forest bird population census
Orthene treatment plot 2 (Mixwoods plot)
Petawawa Forest Experiment Station
May 25 - June 4 1975

Family	Species	Pre-spray						Post-spray					
		May 25	May 26	May 27	May 28	May 29	Daily	May 31	June 1	June 2	June 3	June 4	Daily
		-5	-4	-3	-2	-1	ave	+1	+2	+3	+4	+5	ave
Trochilidae	Ruby-throated Hummingbird	1	0	0	0	0	0.2	0	2	0	0	0	0.4
Picidae	Yellow-shafted Flicker	2	0	0	0	0	0.4	0	0	0	0	0	0.0
	Hairy Woodpecker	2	0	1	0	2	1.0	0	0	0	0	0	0.0
Hirundinidae	Tree Swallow	0	2	0	0	0	0.4	0	0	0	0	0	0.0
Corvidae	Blue Jay	0	4	4	0	0	1.6	0	0	0	0	0	0.0
Paridae	Black-capped Chickadee	3	0	0	0	0	0.6	0	0	0	0	0	0.0
Sittidae	Red-breasted Nuthatch	1	4	3	0	0	1.6	0	0	4	4	0	1.6
Turdidae	American Robin	0	0	0	1	3	0.5	0	0	0	0	0	0.0
	Veery	13	0	3	6	6	5.6	0	3	4	3	0	2.0
Sylviidae	Golden-crowned Kinglet	0	0	2	0	0	0.4	0	0	0	0	0	0.0
	Ruby-crowned Kinglet	4	0	0	6	4	2.8	4	2	0	6	2	2.8
Vironidae	Red-eyed Vireo	4	4	6	8	6	5.6	0	4	2	0	0	1.2
Parulidae	Black and White Warbler	2	0	2	4	0	1.6	6	2	0	0	0	1.6
	Nashville Warbler	8	0	10	16	10	8.8	6	6	8	10	6	7.2
	Yellow Warbler	2	4	0	0	0	1.2	0	0	0	0	0	0.0
	Magnolia Warbler	2	4	6	8	4	4.8	6	14	10	8	8	9.2

Table XIV Cont'd

Family	Species	Pre-spray						Post-spray					
		May 25	May 26	May 27	May 28	May 29	Daily	May 31	June 1	June 2	June 3	June 4	Daily
		-5	-4	-3	-2	-1	ave	+1	2	+3	+4	+5	ave
Parulidae (cont'd)	Black-throated Blue Warbler	4	6	6	2	8	5.2	2	2	6	4	4	3.6
	Blackburnian Warbler	0	0	0	6	4	2.0	8	4	4	3	0	3.8
	Chestnut-sided Warbler	6	8	4	1	8	5.4	6	6	8	4	4	5.6
	Bay-breasted Warbler	0	0	2	0	0	0.4	0	0	0	0	0	0.0
	Ovenbird	14	14	14	12	6	12.0	8	8	8	2	2	5.6
	Northern Waterthrush	2	8	10	4	6	6.0	6	4	2	6	6	4.8
	Yellowthroat	0	0	2	2	0	0.8	0	0	0	0	0	0.0
Icteridae	Red-winged Blackbird	2	0	0	0	0	0.4	0	0	0	0	0	0.0
	Brown-headed Cowbird	0	4	0	0	0	0.8	0	0	0	0	2	0.4
Fringillidae	Rose-breasted Grosbeak	0	0	0	5	2	1.4	2	0	2	0	0	0.8
	Evening Grosbeak	2	0	0	0	0	0.4	0	0	0	0	0	0.0
	American Goldfinch	6	2	0	2	3	2.6	0	0	0	0	0	0.0
	Chipping Sparrow	4	0	0	2	0	1.2	0	0	0	0	0	0.0
	White-throated Sparrow	5	8	4	4	3	4.8	2	8	4	2	2	3.6
	Swamp Sparrow	2	0	0	0	0	0.4	2	0	0	0	0	0.4
Unidentified Species		0	0	0	0	0	0.0	2	3	4	0	0	1.8
Totals		91	72	79	89	75	81.2	60	68	66	52	36	56.4

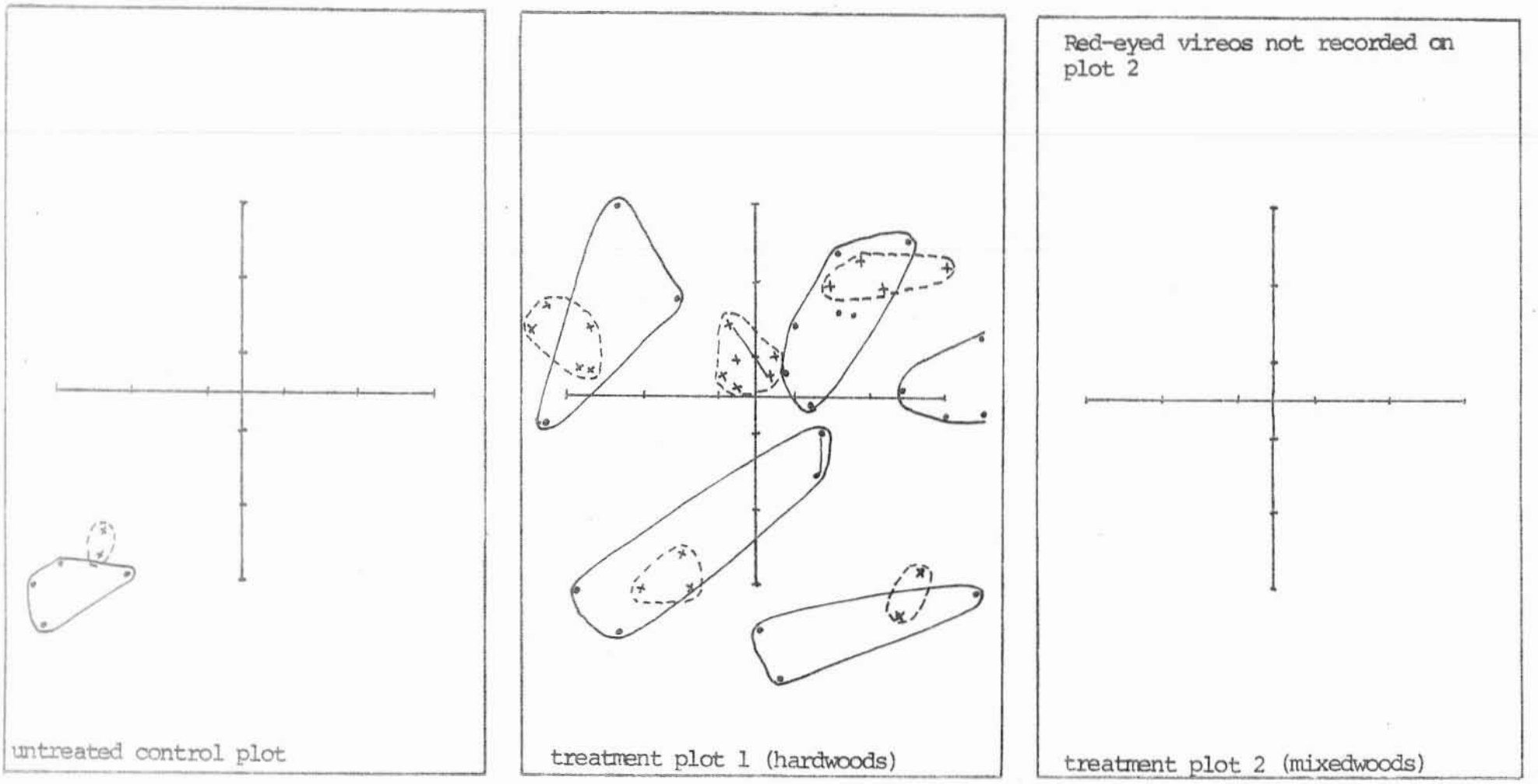

Fig. 7. Pre and post spray breeding territories of the red-eyed vireo, *V. olivaceus* on Orthene treated and untreated plots, Petawawa Forest Experiment Station, May - June, 1975.

_____ pre spray territory boundary

- - - - - post spray territory boundary

|——| 2 chains (40 meters)

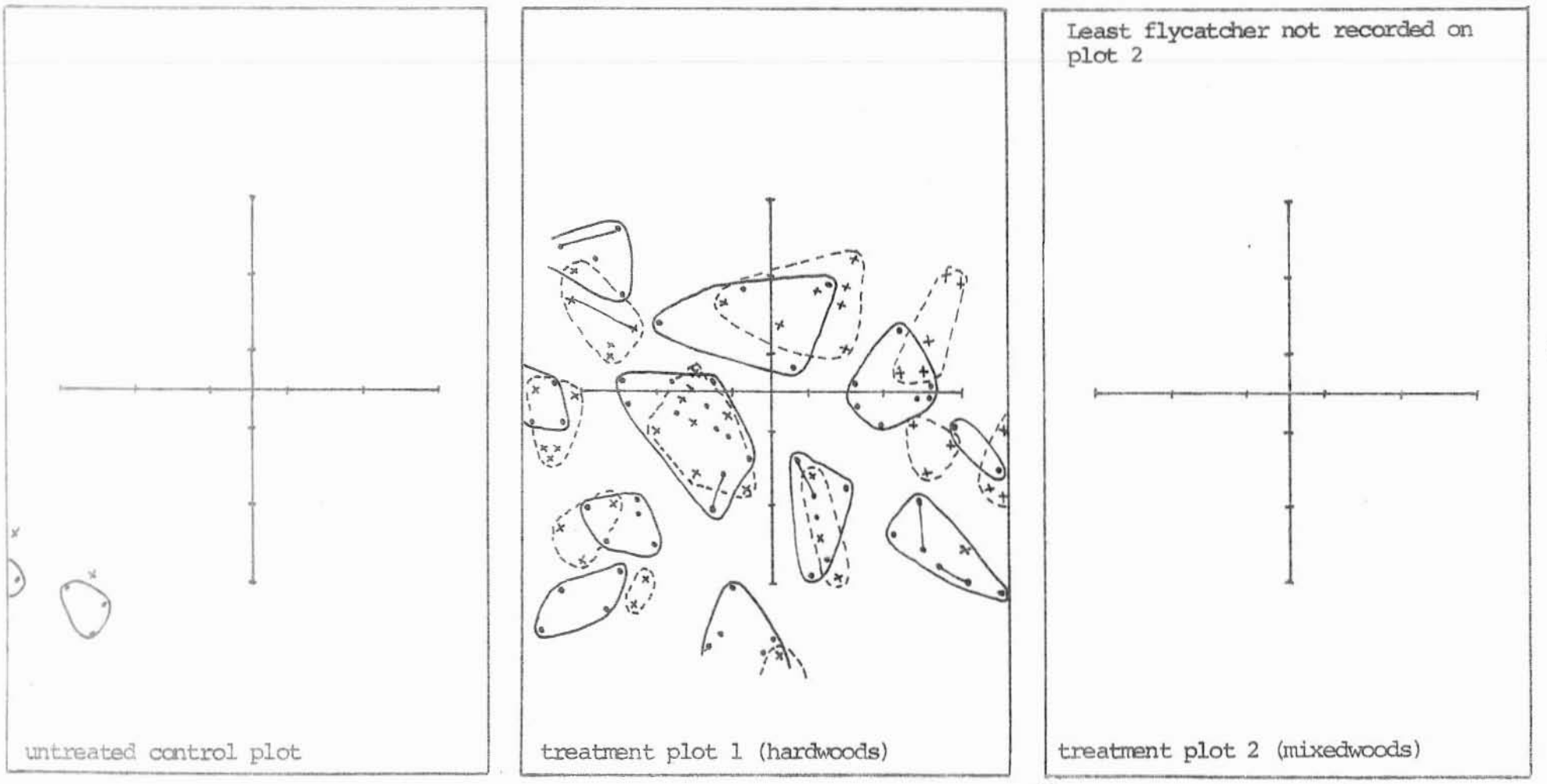

Fig. 8. Pre and post spray breeding territories of the least flycatcher, *E. minimus* on Orthene treated and untreated plots, Petawawa Forest Experiment Station, May - June, 1975.

——— pre spray territory boundary

- - - - - post spray territory boundary

⟷ 2 chains (40 meters)

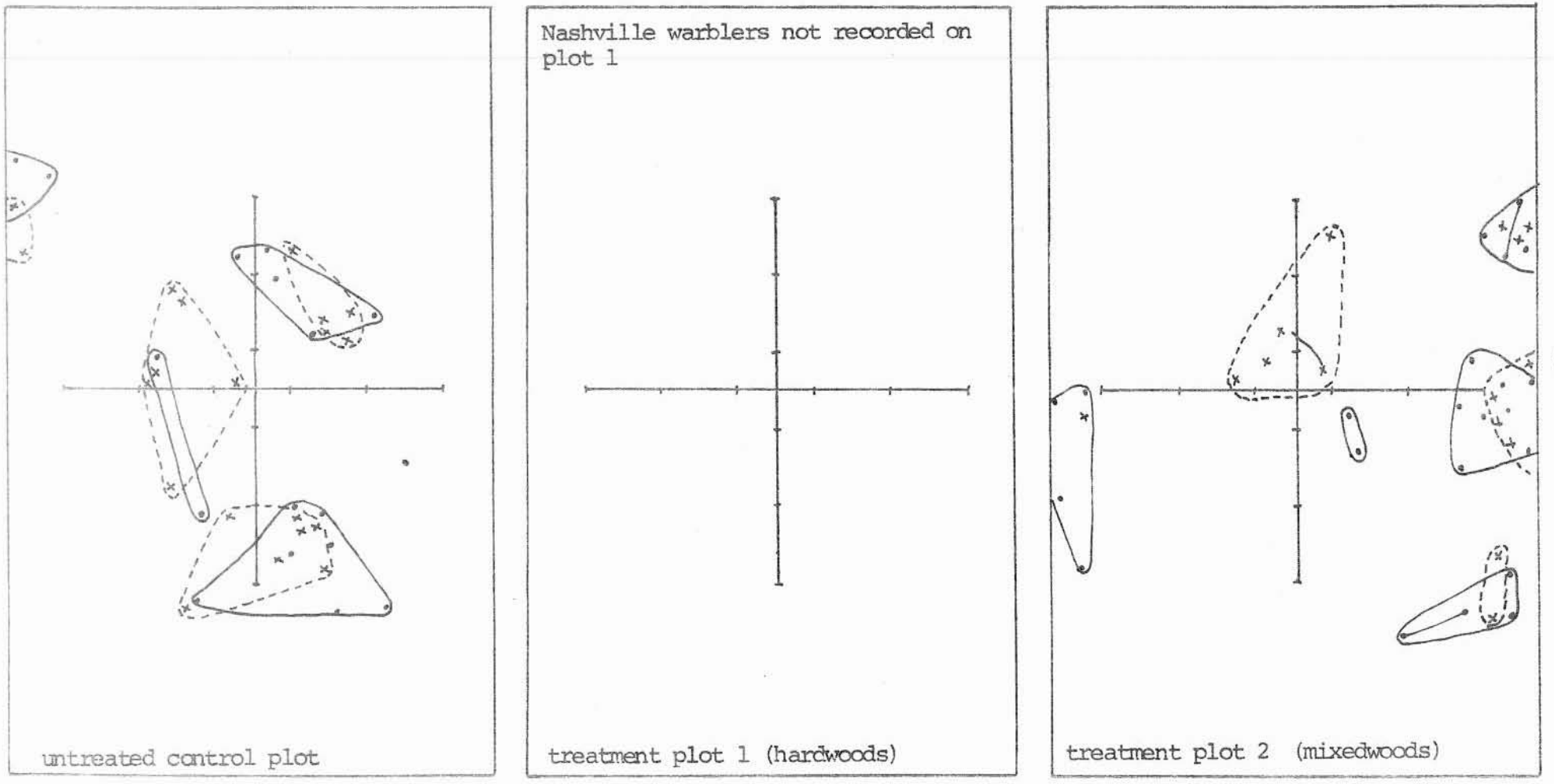

Fig. 9. Pre and post spray breeding territories of the Nashville warbler *V. ruficilla* on Orthene treated and untreated plots, Petawawa Forest Experiment Station, May - June, 1975.

——— pre spray territory boundary

- - - - - - post spray territory boundary

⊢——⊣ 2 chains (40 meters)

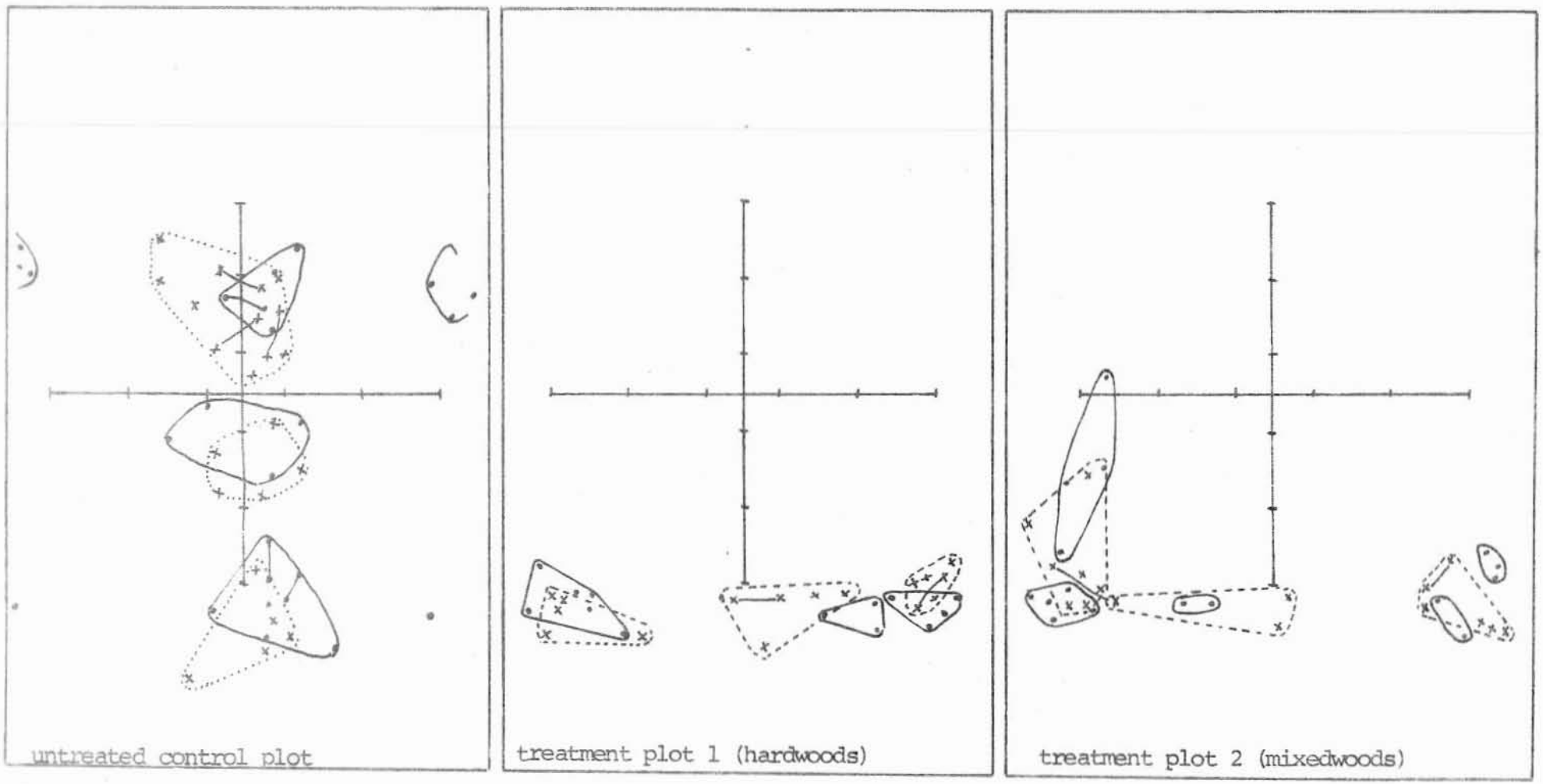

Fig. 10. Pre and post spray breeding territories of the chestnut-sided warbler, *D. pensylvanica* on Orthene treated and untreated plots, Petawawa Forest Experiment Station, May - June, 1975.

——— pre spray territory boundary

- - - - - - post spray territory boundary

⟝——⟞ 2 chains (40 meters)

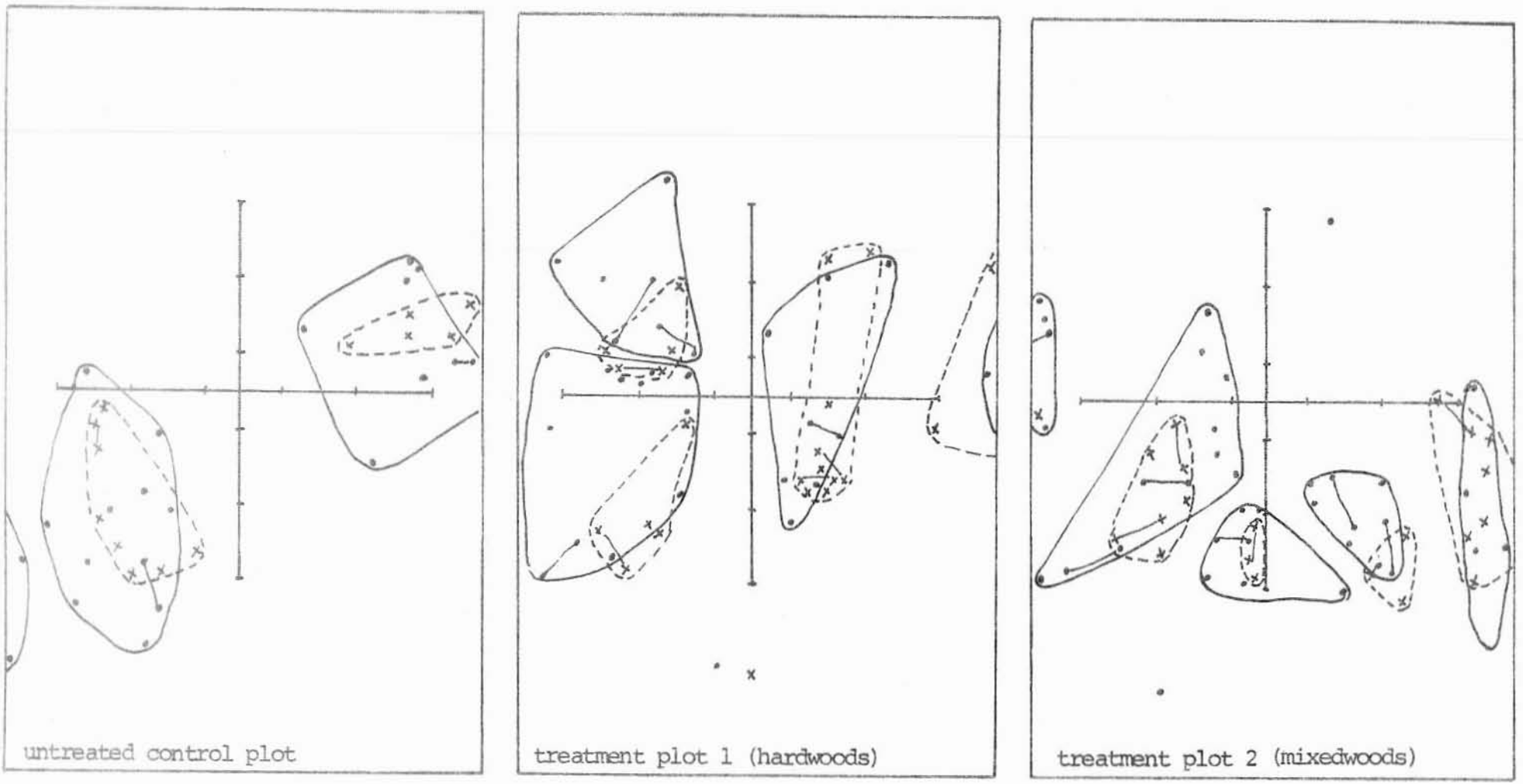

Fig. 11. Pre and post spray breeding territories of the ovenbird, *S. aurocapillus* on Orthene treated and untreated plots, Petawawa Forest Experiment Station, May - June, 1975.

——— pre spray territory boundary

- - - - - - post spray territory boundary

|——| 2 chains (40 meters)

Small mammals:- Low population levels of forest dwelling small mammals were recorded in the Petawawa area where a total of 16 specimens representing 3 species were trapped, (Table XVI). The most common species trapped was the deer mouse, *Peromyscus maniculatus* (Wagner). Two specimens of the red-backed vole, *Clethrionomys gapperi* (Vigors) and a single specimen of the eastern chipmunk, *Tamias striatus* (Linnaeus) were also trapped. Low populations of small mammals are the norm for that time of year (July) and reflect the normal yearly cycle rather than an impact of the pesticide treatment.

Table XVI

Small mammal populations trapped on Orthene treated and untreated control plots
Petawawa Forest Experiment Station
July 1975

Plot	Species	Males			Females					Total animals trapped
		Sub adult	Adult	Total males	Sub adult	Adult				
						Pregnant	Pregnant with placental scars	Placental scars only	Total females	
untreated control	*P. maniculatus*	0	1	1	1	0	0	0	1	2
	C. gapperi	0	0	0	0	0	0	1	1	1
	T. striatus	0	1	1	0	0	0	0	0	1
Plot 1	*P. maniculatus*	1	1	2	6	1	0	1	8	10
Plot 2	*C. gapperi*	0	0	0	0	1	1	0	2	2
Totals		1	3	4	7	2	1	2	12	16

CONCLUSIONS

Orthene ^{R}, as was applied in both the Larose forest and Petawawa Forest Experiment Station, did not affect the avifauna monitored in either area. Population fluctuations recorded are attributed to factors (weather, census time etc.) other than to exposure to the aerial insecticide applications. Small mammals likewise did not appear to have been affected. The low numbers encountered are normal for the time of the year the population census was conducted. Sub-adults, pregnant females and females containing placental scars were trapped indicating that no interruption of the breeding cycle had occurred. Honey bees suffered immediate knockdown and the treatment affected nurse bees within the hive. These adverse effects were recorded for 2 days and pollen collections were curtailed for as long as 5 days. The impact of Orthene on honey bee colonies was temporary, but they produced a honey crop comparable to the untreated control and to hives located in the headquarters apiary.

Amphibians, either in the larval or adult stages, were not affected by the Orthene application.

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