PESTICIDE SECTION

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Effects of Phosphamidon and
Experimental Insecticides on Birds

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EFFECTS OF FOREST-SPRAY PESTICIDES ON NEW BRUNSWICK BIRDS

Effects of Phosphamidon and Experimental Insecticides on Birds

Preliminary Reports on Investigations

Sponsored by the Canadian Wildlife

Service, 1966

by

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This report summarizes the results of the preliminary analysis of data collected during the summer of 1966.

The objectives of the program were:

1. To follow-up the work on phosphamidon carried out in 1964 and 1965.
2. To assess the effects of experimental applications of other insecticides being investigated by the Chemical Control Research Institute of the Department of Forestry and Forest Protection Ltd.
3. To assess the effects of operational applications of DDT.*

The field work was carried out from a headquarters provided by Forest Protection Ltd. at Blackville by a party consisting of Dr. C.D. Fowle (Canadian Wildlife Service and Department of Biology, York University, Toronto), P. Pearce (New Brunswick Department of Natural Resources), S.M. Teeple (Canadian Wildlife Service), W.G. Wilson, (Canadian Wildlife Service, graduate student - Department of Biology, York University), and student assistants R. Gibbon (McGill University), K. Child (Carleton University) and R. MacLean and M. Lapp (York University).

Field work began late in April and continued to the end of July.

* See Wilson, W.G., 1966. Effects of DDT on Birds. Pesticide Section Manuscript Series.

1. EFFECTS OF PHOSPHAMIDON AND EXPERIMENTAL INSECTICIDES ON BIRDS

BY C.D. FOWLE

A. EFFECTS OF PHOSPHAMIDON

Previous work in 1964 (Fowle, 1965) and 1965 showed that the operational application of 0.5 lbs. of technical phosphamidon per acre often resulted in bird mortality. Experiments with captives suggested that birds pick up lethal doses of the insecticide through their feet from sprayed twigs, branches and foliage.

In 1966 there was an opportunity to repeat two earlier experiments on field applications and to conduct further experiments with captive birds.

Methods used were similar to those developed in the two previous years. The effects of field applications of the spray were monitored by obtaining indices to changes in population before and after spraying and searching sample areas for evidence of mortality and sick birds (Fowle, 1965).

Two plots (Nos 3 and 22) were available for the study of field applications. Census routes were established along a marked line running down the middle of the long axis of each plot.

The first experiment was carried out on Plot 3 where three early applications at the rate of 0.25 lbs. in 0.2 USG of water per acre were made between May 5 and 18 as shown in Table I. Effects of insecticides on birds at that time of year are difficult to assess because migrants are continually arriving on the plot and

this obscures possible mortality due to spray. Moreover, very few wood warblers which appear to be among the more vunerable species are back. In this case no warblers were tallied at the time of the first spraying and only myrtle warblers were present for the second.

The data suggest some reduction in birds after the spraying on May 5. The number seen per minute dropped and song frequency declined on May 6 and 8. The weather during the period was cold and snow on May 8 may have contributed to the low count on that date. Experience in 1964 and 1965 suggested that ruby-crowned kinglets were often reduced and there is further slight evidence in this year's data (Table II). It was particularly noticeable that the kinglets were reduced along the portion of the census route that had been sprayed while song-frequency and occurrence was unchanged on that portion which was missed.

The second experiment was a low volume application carried out on Plot 22 on May 22, by A.P. Randall (Chemical Control Research Institute). Technical phosphamidon was applied from two Turbair nozzles on a Stearman aircraft which flew north and south over the 400 acre plot gradually increasing the swath width in an attempt to place the heaviest concentration on the east side and the lightest on the west. The census line ran north and south midway across the plot and therefore should have received an intermediate dose. However, chemical analysis of deposition on glass plates revealed that a graduated application was not achieved. About 12.5 USG of technical material was applied or about 0.33 lbs. per acre.

The data in Tables III, IV and V show that there was a decrease in numbers and song activity after spraying. Additional evidence comes from the discovery of a sick Tennessee warbler and a white-throated sparrow about 4 hours after spraying. Later in the afternoon on May 27 a sick magnolia warbler, two ovenbirds and a white-throated sparrow were collected. On the morning of May 28 the following birds were seen on the census route apparently suffering from the effects of spray: Swainson's and hermit thrush, magnolia and Cape May warblers, slate-colored junco, and two white-throated sparrows. On June 1 a dead white-throated sparrow was picked up.

In order to assess the variation in effect of graduated concentration of spray across the plot, two series of listening stations were established on two transects running at right angles to the census route and the flight lines of the aircraft. The first station on each transect was four chains outside the eastern boundary of the plot. The second station was four chains inside and the next four stations were placed at eight-chain intervals and extended 36 chains. The terminal stations were beyond the western edge of the plot. Singing activity at each station was measured by recording species and numbers of songs heard during a three-minute interval at each station. Table IV shows that after spraying singing was considerably depressed from the eastern boundary to at least 24 chains into the plot. It appeared that virtually the whole area was affected, as subsequent chemical analysis of glass plate deposits showed.

Table V lists the species apparently most affected by the spray.

A depression in sapsuckers has not been previously observed and the change recorded here may be due to mobility of birds establishing breeding sites at this time of year, and not to the effects of spraying. There is, however, a striking difference between the columns for May 25 and May 28. A general trend to recovery is indicated by the data for June 20 but the population should still be regarded as lower than it would have been if the area had not been sprayed.

The observations on the plots and the work of previous years was followed up in July with experiments with birds collected with mist nets and held in cages. As anyone who has ever tried to work with fresh-caught wild birds knows, systematic experiments with controls which might be expected to yield reasonably consistent results are very difficult to perform. In the first place, except for a few species, such as white-throated sparrows, it is virtually impossible to capture at will a substantial number of any one species at the same time. Netting warblers, for example, seems to be largely a matter of chance, especially late in the summer. Moreover, the response of birds to experiments is likely to be conditioned by such factors as age, sex, time in the net before release, duration and conditions of captivity before the experiment and time since last feeding. As a consequence of these and other complications such as the interference of weather in netting operations, experimentation is limited. However, it was possible to obtain some useful information which although meagre is probably the more valuable in that it does apply to birds which actually live in the forest where the

insecticides are being applied. Controls were used whenever possible but here there were also limitations in that the supply of the various species was usually limited.

A few trials with various concentrations of phosphamidon painted on perches confirmed that birds could easily pick up a lethal dose through their feet. For example, a cedar waxwing exposed to perches with 1% solution (equivalent to 0.2 U.S. gallons of dilution) was incapacitated in 6 hours. In a similar experiment in 1964 the bird was helpless in 5 hours. Experiments with magnolia warblers, ovenbirds and white-throated sparrows confirmed experiments done in 1965 showing that these species could also absorb lethal or debilitating doses through their feet.

Additional experiments employing a microsyringe with which it was possible to deposit carefully measured quantities of technical phosphamidon on the soles of the feet of birds provided a rough quantitative measure of levels of dermal toxicity. Observations from these experiments may be summarized by species as follows:

Robin: One bird treated with 200 mg/kg survived without symptoms for 7 hours and died during the night following. It cannot be shown that death was directly due to poisoning.

Thrushes:

Swainson's: Two birds tested with 600 and 550 mg/kg died in 5 and 3 hours respectively with typical symptoms. Another treated with 400 mg/kg was affected in 4 hours and dead in 8. A juvenile treated with 100 mg/kg

was liberated after 10 hours. A control bird survived 17 hours and was liberated.

Hermit: One bird treated with 400 mg/kg died in 2.5 hours. Another showed some effects in 2 hours and died in 4.

Veery: One bird treated with 200 mg/kg survived under observation for over 10 hours and died some time during the night following.

Experience with thrushes during the summers shows that untreated birds may survive in captivity for at least 12 hours and usually for 24.

Wood warblers: This is an important group as its members seem to be among the most vulnerable to phosphamidon. Unfortunately, they are difficult to catch in numbers and very difficult to maintain in captivity.

The following is a summary of observations on several individual birds.

Tennessee warbler: Treated with 100 mg/kg, survived for 10 hours and was released.

Myrtle warbler: Treated with 500 mg/kg, began to show symptoms in 2 hours and was dead in 4.

Blackburnian warbler: Treated with 100 mg/kg, survived under observation for 17 hours and was released.

Bay-breasted warbler: Treated with 400 mg/kg, survived for 10 hours and was released.

Ovenbird: Treated with 400 mg/kg, showed some symptoms in 5 hours and was dead in 9.5 hours.

Northern water thrush: Treated with 400 mg/kg, died in 15 minutes (0.25 hours).

Juvenile warbler: (Magnolia or Cape May) Treated with 200 mg/kg, died in 3 hours.

The variation in response among these warblers is difficult to interpret. There is probably a good deal of variation in the physiological condition of the bird depending upon the length of time it is in the mist net, the length of time it is held in the cage before the experiment begins and the general degree to which it has been disturbed and excited by handling and by the activity in the bird house.

Ruby-crowned kinglet: A female ruby-crowned kinglet was treated with 200 mg/kg but some of the material was lost and consequently a lower dose was actually applied. Symptoms appeared in about 1.5 hours but the bird became more active 6 hours later. It died overnight. Results of this experiment are inconclusive.

Brown-headed cowbird: Two juvenile birds were each treated with 400 mg/kg. The first one showed symptoms in 1 hour, was incapacitated in 6 and died during the night. The second bird was affected in 3.5 hours and dead in 5. A control bird survived for 6 hours and was liberated.

Evening grosbeak: One bird treated with 200 mg/kg survived for 18 hours, but was very weak. Another bird treated with

400 mg/kg showed some effects in 1 hour and was dead in 2.5 hours. A second bird with similar treatment showed effects in 3.5 hours and was dead in 5.5 hours. A bird treated with 600 mg/kg showed typical symptoms at 4 hours, was still alive at 6, but died sometime during the next 10 hours.

Slate-colored junco: A juvenile treated with 400 mg/kg showed symptoms in 2.5 hours and was dead in 7. A second juvenile treated with 500 mg/kg showed symptoms in slightly less than 4 hours and was dead in 12.

White-throated sparrows: One bird treated with 200 mg/kg was dead in 9.5 hours. Two other birds were treated with 400 mg/kg. The first one showed symptoms in 1.25 hours and was dead in 7, the second showed symptoms in 4-5 hours and was dead in 7. A control survived 16 hours and was liberated. A bird treated with 700 mg/kg showed symptoms in 3 hours and was dead in 5.

Song sparrow: A bird treated with 200 mg/kg showed symptoms in 2.5 hours, was still alive in 7 hours but very weak and died during the night following.

In summary, the work with phosphamidon this year suggests the following conclusions:

1. Low volume application of phosphamidon resulted in some bird mortality. On plot 22 the measured rate of deposition ranged from 0.10 to 1.05 lbs. per acre and was more than 0.25 lbs. per acre at 1/2 of the sampling stations on the plot. At 5 stations

the dosage exceeded 0.5 lbs. per acre.

Information collected in 1964 and 1965 suggested that mortality might occur when 0.5 lbs. per acre or more was released from the aircraft. We did not, however, have any estimate of the amount of material actually reaching the ground. We might assume that when aqueous solutions of phosphamidon were used the amount reaching the ground would be somewhat less that the dose emitted if allowance were made for drift and evaporation. Thus 0.5 lbs. emitted probably means between 0.25 and 0.5 lbs. on the ground. Similarly, 0.25 lbs. emitted means something less on the foliage and twigs.

We have therefore moved a little closer to determining the actual toxic level on vegetation although we are still some way from accurate information. The extreme variation in the rate of deposition as illustrated on Plot 22 suggests that it may never, under operational conditions, be possible to apply a given dose uniformly over an area. However, the experience in 1966 illustrates the great value of chemical analysis in supplementing field observations. It is essential if we are to move quickly to accurate assessments of the side effects of pesticides that provision be made for more extensive and immediately available chemical analysis.

2. Experiments with captives confirmed that small doses picked up from perches or applied to the feet with a micro-syringe can be lethal. Variation in response in these experimental birds makes it difficult to generalize as to what constitutes a lethal

dermal dose, but doses in the range of 200 mg/kg or more seem to be effective.

However, the experiments did indicate how it would be possible for a bird to pick up a lethal dose in a relatively short time under conditions of operational spraying. For example, the dose that killed a juvenile warbler in 3.5 hours was a droplet 0.002 ml. in volume (200 milligrams per kg). It would not take long for a bird moving over surfaces receiving 5 to 20 drops per square cm. in a low volume application to pick up a lethal dose of this size.

B. EFFECTS OF OTHER INSECTICIDES

In addition to the investigations of phosphamidon, it was possible to do some work on other pesticides tested by the Chemical Control Research Institute, by the Department of Forestry and Forest Protection Limited. The compounds tested were: Zectran, Dylox (trichlorfon), Dibrom (naled), malathion, dimethoate and Sumithion (fenitrothion).

No effects on birds were observed in any of the trials except in the case of Sumithion. However, having said this there must be a strong qualification of the statement in that the trials were so limited that general conclusions are quite unwarranted. This year's work with these compounds must be regarded as preliminary.

As the data for these trials are still being analysed no detailed statement can be made but the following summary will indicate the kinds of results and the preliminary nature of the work.

Zectran: Eighteen to twenty USG of Zectran was applied as a 17.2% concentrate in solvent on Plot 23 on May 30, and the same amount again on the same plot on June 17. The first application was not considered satisfactory in that the droplet density on the detection cards was very low. No changes in bird population or activity were observed after either application. Four and one half man-hours of searching in the afternoon following the morning application on June 17 failed to reveal any effects on birds.

Dylox: Eighteen USG of Dylox was applied as a 39.1% concentrate in solvent on Plot 25 on May 28 and again on June 22, and the same amount

was applied on Plot 22 on June 10. There were apparently no detrimental effects on birds but censusing and searching were less extensive and intensive on these areas than on some others.

Dibrom: Plot 26 was sprayed with 10 USG of Dibrom on June 12, before any bird censuses were taken. 3.5 man-hours of searching in the afternoon following the morning application failed to reveal any effect on birds.

Dimethoate: Dimethoate was applied on Plot 29 on June 16 (20 USG) during a very busy period when it was impossible to carry out adequate post-spray censusing. Droplet distribution on detection cards revealed a very uneven distribution of spray. 12 man hours were spent about six hours after application in searching but no signs of sick birds were found.

Malathion: Part of Plot 28 was sprayed on the evening of June 18 and the operation was completed on the morning of the 19th (20 USG). A fairly even distribution of insecticide was achieved. No effect on birds was detected.

In summarising the observations on these 5 compounds it must be said that the data are very limited and quite unsatisfactory for drawing general conclusions. A good deal was learned about the problems of logistics and integrating two investigative programs in which mechanical problems, weather, limited manpower and the relentless march of the season all seemed to conspire together to frustrate the best efforts of investigators. This year's experience suggests that if co-operative

investigations on the effects of pesticides are to continue, more manpower and detailed advanced planning will be necessary in order to get a reasonable return on our investment.

Sumithion: Sumithion was applied on Plots 1, 2, 9, 15-21, 24, and 25 but our observations were limited to the following plots.

Plot 9

This plot was sprayed on May 9 with 0.5 lbs. in 0.5 USG per acre. Cold, wet weather with snow during post-spray censusing made assessment difficult but no effect on birds was noticed.

Plot 15-18

These four were sprayed on June 10 as follows:

Plot 15 - 1.00 lbs. per acre in 0.5 USG formulation

Plot 16 - 0.75 " " " " " " "

Plot 17 - 0.50 " " " " " " "

Plot 18 - 0.25 " " " " " " "

Heavy rain during the night following spraying continuing on into the next day precluded adequate bird censuses until June 12, when reduction in singing and "birds per minute" were recorded on Plot 15 (Table VI).

On Plot 16 five birds were found which were apparently affected by the spray (Swainson's thrush and white-throated sparrow found dead, yellow-bellied flycatcher, hermit thrush and Tennessee warbler trembling, captured). A dead yellow-throat was found on Plot 18.

All these birds were in areas near the boundaries of spray blocks where overlapping of spray swaths could have deposited exceptionally heavy doses. This is consistent with the evidence that the application of one pound per acre on Plot 15 probably depressed the population.

In order to check the toxicity of one-pound dosage second applications of one pound and half a pound were applied on Plots 24 and 25 on June 22. Unfortunately, through a navigational error only about one-third of Plot 24 was covered with all the spray intended for the whole plot. Hence, more than one pound per acre was applied. In spite of this no effect on the bird population was detected. An even application of half a pound per acre on Plot 25 apparently had no effect on birds.

No effect was detected on Plot 19 where two areas were treated with 0.25 and 0.50 lbs. per acre respectively.

Birds were apparently not affected on Plot 21 where a low volume application was made.

In summarizing field observations it should be emphasized that the experiments so far are preliminary. Our observations were affected by such variables as navigational errors, weather, possible overlapping of spray swaths and limited time for censusing. At this stage we might reasonably conclude that doses of less than one pound per acre of Sumithion probably do not cause depressions in bird populations but we need further experiments to confirm this.

A series of experiments with captive birds was carried out to supplement the field observations and to provide estimates of comparative dermal toxicity with phosphamidon. The procedures were

similar to those used in testing phosphamidon.

A few simple trials showed that birds could pick up lethal doses from perching surfaces. A waterthrush, Tennessee warbler, evening grosbeaks, and white-throated sparrows were all affected within a few minutes when exposed to perches painted with technical Sumithion. Swainson's thrushes and white-throats showed symptoms in 0.5 - 1 hour after exposure to perches painted with a 20% solution and usually died a few hours later. It is of interest to note that in the case of one white-throated sparrow a large number of parasitic mites left the bird about four hours after exposure. Exposure to 11% solution induced symptoms in 3 to 6 hours. A juvenile white-throat exposed to a 6% solution survived seven hours without apparent symptoms and was liberated.

Tests of dermal toxicity by applying technical Sumithion to the soles of the feet of a variety of birds can be summarized as follows:

Robin

One bird, treated with 400 mg/kg, survived for 17 hours and was liberated.

Swainson's thrush

400 mg/kg - Of two birds, one survived 6 hours and the other 16 hours liberation.

600 mg/kg - One bird was unable to fly after 6 hours and died later, and another survived 4 hours and died during the next 10 hours.

700 mg/kg - Of two birds, one survived 14 hours and the other 8.25 hours before liberation.

Hermit thrush

700 mg/kg - One bird survived 9 hours and died during the night following.

Wood warblers

Experiments with phosphamidon suggested that for some species a lethal dermal dose might be as low as 200 mg/kg but comparable trials with Sumithion showed that this compound is considerably less toxic.

Tennessee warbler

Two birds received 400 mg/kg. One of these showed symptoms in about 1.5 hours but survived and was liberated in 8.25 hours. The second showed no effects in 6 hours but died during the next 10 hours. A third bird receiving 600 mg/kg also survived 8.25 hours and was freed.

Myrtle warbler

Three juveniles treated with 500, 600 and 700 mg/kg survived and were liberated after 10.5, 20.5 and 16 hours respectively. This is in contrast to a bird receiving 500 mg/kg of phosphamidon which died in 4 hours.

Canada warbler

One bird received 800 mg/kg and was freed 16 hours after treatment.

Brown-headed cowbird

Two birds were treated with 400 mg/kg, and each survived 7.5 hours without symptoms. One was then liberated and the other died during the next 10 hours. Similar treatment with phosphamidon resulted in

symptoms in 1 to 3.5 hours and eath later.

Evening grosbeak

Two birds were treated with 400 mg/kg and two others with 500 and 600. All survived without symptoms for over 12 hours. Treatments with 400 and 600 mg/kg of phosphamidon were lethal.

Slate-colored junco

One bird died very suddenly, apparently without symptoms, 9 hours after treatment with 400 mg/kg. Another given 600 mg/kg showed slight symptoms, survived 7.5 hours but died during the night following. 400 and 500 mg/kg of phosphamidon were lethal.

White-throated sparrow

Six birds were involved. Two treated with 400 mg/kg showed no symptoms in 6.5 hours. 500 mg/kg induced symptoms in 2.5 hours in one bird but it recovered and was liberated in 6 hours. Two birds receiving 600 mg/kg died. The first showed virtually no symptoms but was dead in 8 hours. The second was affected in 1.5 hours and died sometime during the night following. Another bird treated with 700 mg/kg showed symptoms but seemed to recover. It died after 20 hours.

Again, comparison with phosphamidon shows the lower toxicity of Sumithion. This is consistent with the findings of others who report lower mammalian toxicity of Sumithion in comparison with the closely related methyl parathion. Vardanis and Crawford (1964) suggest that in mice the lower toxicity is due to the ability of the liver to degrade

Sumithion faster than methyl parathion. Keith and Mulla (1966) report fairly low toxicity of Sumithion in mallard ducks.

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TABLE I

Population indices, early repeated application of Phosphamidon, Plot 3, 1966(1)

Date	Total Birds	Time min.	Birds/ min.	Total Songs	Songs/ min.	Total Species
April 29	51	40	1.3	255	6.4	12
May 2	36	37	1.0	287	7.8	10
May 3	67	40	1.7	385	9.6	16
May 4	87	40	2.2	348	8.7	17
May 5	86	39	2.2	417	10.7	20
Spray applied morning May 5.						
May 6	64	37	1.7	265	7.2	19
May 8	70	43	1.6	152	3.5	21
May 9	78	47	1.7	310	6.6	19
May 11	47	32	1.5	154	4.8	16
May 12	90	42	2.1	443	10.6	21
Spray applied morning May 13.						
May 14	98	43	2.3	553	12.9	21
May 16	111	42	2.6	530	12.6	20

(1) Third application May 18 not monitored for effect on birds.

TABLE II

Comparison of numbers of ruby-crowned kinglets, 1966, on Plot 3 (sprayed May 5,13) and two unsprayed plots (Control, Plot 13) together with data from a plot similarly treated in 1965 (Plot 1, sprayed May 16,1965)

Date	April 29	May 2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Plot 3	5	4	7	13	13	7	-(1)	5	10	-	9	14	-	8	-	13	-	-	-	-	-	-
Control	-	-	-	-	6	6	2	9	15	6	7	-	12	8	-	8	-	-	-	-	-	-
Plot 13	-	1	5	7	9	12	-	12	-	7	-	10	-	14	-	-	-	-	-	-	-	-
Plot 1 (1965)	-	-	-	-	10	15	-	-	-	17	-	15	17	11	16	-	2	-	1	-	-	0

(1) - no census

TABLE III

Population indices, low volume concentrate application, Plot 22, phosphamidon, 1966.

Date	Total Birds	Time mins.	Birds/ min.	Total songs	Songs/ min.	Total Species
May 17	91	65	1.4	481	7.4	25
May 19	70	50	1.4	337	6.7	21
May 22	121	55	2.2	857	15.6	35
May 24	109	55	2.0	817	14.9	32
May 25	133	60	2.2	1286	21.4	34
Spray applied morning, May 27.						
May 28	55	50	1.1	339	6.8	24
June 1	61	50	1.2	726	14.5	27
June 20	74	45	1.6	604	13.4	29

TABLE IV

Low volume. concentrate application, phosphamidon, 1966. Songs per minute at listening stations on two transects, A and B, across Plot 22.

STATIONS	1	2	3	4	5	6
Transect A						
May 17	14.3	20.3	10.0	9.0	-	-
May 19	12.0	8.7	8.3	3.3	1.3	9.7
May 22	25.7	25.3	19.3	21.0	21.7	26.3
May 24	24.3	28.0	22.7	29.7	17.0	27.3
May 25	36.3	31.0	37.3	35.3	34.3	37.0
Average May 17-May 25	22.5	22.6	19.5	19.4	13.5	25.0
Spray applied morning May 27						
May 28	12.0	7.7	5.3	4.0	15.7	24.0
June 1	17.0	5.7	10.0	5.3	7.3	15.3
June 20	-	25.7	27.0	23.3	19.3	18.3
Transect B						
May 17	8.0	20.3	10.0	9.0	-	-
May 19	4.3	6.3	3.7	1.7	5.3	10.3
May 22	20.0	15.0	23.0	23.0	7.0	21.3
May 24	25.0	17.7	23.0	22.3	21.7	23.3
May 25	31.3	32.0	30.7	32.7	32.3	31.3
Average May 17-May 25	17.7	18.2	18.1	17.8	16.6	21.6
Spray applied morning May 27						
May 28	11.0	5.0	7.7	5.7	15.0	20.0
June 1	10.7	8.7	2.7	8.3	13.2	14.3
June 20	-	21.0	8.0	20.3	24.3	26.3

TABLE V

Species apparently reduced by low volume application of phosphamidon, Plot 22, 1966. (Spray applied morning May 27)

	DATES OF CENSUS							
	May 17	May 19	May 22	May 24	May 25	May 28	June 1	June 20
Yellow-bellied sapsucker	12	10	8	10	10	5	5	3
Boreal chickadee	1	2	1	1	2	0	0	0
Ruby-crowned kinglet	11	8	9	6	5	2	1	2
Tennessee warbler	0	0	5	16	22	8	13	14
Magnolia warbler	0	0	3	3	5	1	5	3
Cape May warbler	3	3	5	3	5	0	1	2
Myrtle warbler	9	8	9	7	6	1	3	2
Black-throated green warbler	0	0	2	2	1	0	0	0
Bay-breasted warbler	0	0	1	1	4	0	1	2
Ovenbird	1	2	11	11	13	2	4	6
Purple finch	5	7	6	6	4	1	2	3
White-throated sparrow	14	11	16	11	12	8	2	4

TABLE VI

Population indicies, 1 pound per acre Sumithion, Plot 15, 1966

Date	Total birds	Time mins.	Birds/ min.	Total Songs	Songs/ min.	Total Species
June 1	146	60	2.4	1041	17.4	31
June 2	153	57	2.7	1112	19.5	31
June 3	132	60	2.2	1117	18.6	29
June 8	129	60	2.2	1154	19.2	29
Plot sprayed June 10						
June 12	75	55	1.4	608	11.0	24
June 13	70	46	1.5	561	12.2	21
June 17	100	46	2.2	984	21.4	22

Variations nombre d'oiseaux en fonction du temps