32790

REPORT OF MEETING OF THE INTERDEPARTMENTAL COMMITTEE ON FOREST SPRAYING OPERATIONS

Sir Charles Tupper Building, Ottawa

January 3, 1967 2:30-5:00 PM

In Attendance

R. R. Logie	Department of Fisheries
K. C. Lucas	Department of Fisheries
E. W. Burridge	Department of Fisheries
J. A. Keith	Canadian Wildlife Service
M. L. Prebble (Chairman)	Department of Forestry and Rural Development
H. W. Beall	Department of Forestry and Rural Development
J. J. Fettes	Department of Forestry and Rural Development
D. A. S. Dyer	Department of Forestry and Rural Development

1. The Chairman stated that the meeting was called to review the proposals advanced at the meeting of December 16, 1966, for the 1967 control program against the spruce budworm in New Brunswick. The proposals presented by K. B. Brown, president of Forest Protection Limited, were contained in Appendix IX of the report of the December 16 meeting, and the preliminary discussion was reported in section 8 of the aforementioned report.

2. Examination of the map showing areas requiring protective treatment in 1967 disclosed that virtually all sectors lay within the Miramichi, Nashwaak, and St. John River drainages, which the Committee at its meeting of December 9, 1965, had recommended be limited to not more than 1/2 lb. DDT per acre (2 applications at 1/4 lb. per acre) in the 1966 control program; and that none, or virtually none, of the area proposed for treatment in 1967 lay within the zone which the Committee, at its meeting of December 9, 1965, had accepted for treatment in 1966 at 2/3 lb. DDT per acre (2 applications at 1/3 lb. per acre). The proposed 1967 control program therefore envisaged the use of the higher application rate of DDT in the areas of most sensitive concern to the Fisheries Department within which only the lower application rate of DDT was accepted in 1966.

3. Members of the Committee were not convinced that the 2/3 lb. DDT applications in 1966 effected any greater control than the 1/2 lb. DDT applications. (See report of December 16, 1966 meeting - section 3 and Appendix III). The over-all average percentage difference in budworm population reduction was very small in relation to variations within the separate treatments, and numerous aberrations were evident in the data. The evidence therefore did not support a conclusion that 2/3 lb. DDT produced significantly better results than 1/2 lb. DDT in the operational program of 1966.

4. Dr. Logie and Mr. Lucas stated that the Department of Fisheries is uneasy over the use of DDT at application rates over 1/4 lb. per acre; favoured stream-side buffer spraying with phosphamidon in salmon-bearing areas; and pointed out that even with the phosphamidon buffer-spraying, there was still a considerable inflow of DDT from the smaller tributary streams that could not readily be detected from aircraft for effective stream-side buffer spray treatment.

5. The extensive experimental use of sumithion was supported by all members of the Committee, in the hope that it might be found to be a suitable substitute for DDT for budworm control, without the hazards of DDT (fish) or phosphamidon (birds).

6. The Committee agreed to the following guidelines for the 1967 control program:

   (a) DDT should not be used at greater concentrations than 1/2 lb. per acre in any of the areas proposed for treatment in 1967. This could be in one application at 1/2 lb. or two applications at 1/4 lb. All areas treated with DDT should have stream-bank buffer zones sprayed with phosphamidon.

   (b) Sumithion should be employed in extensive trials, as one application of 1/2 lb. per acre, and also as two applications at 1/4 lb. per acre. The drainage areas thus treated with sumithion should not be treated with any other insecticide in 1967. The object should be to test the effect of one 1/2 lb. application vs. two 1/4 lb. ? applications, in terms of budworm control and influences on wildlife, fish, and bottom fauna. The Fisheries Department would be willing to accept sumithion applications over extensive areas containing salmon-bearing streams such as the Renous and Dungarvon Rivers, Rocky Brook, Clearwater Brook, or the main Southwest Miramichi River.

   (c) A trial of a spray mixture of sumithion and phosphamidon would be acceptable, provided the total organophosphate released per acre did not exceed 1/2 lb. The object should be to determine if the mixture can achieve satisfactory budworm control with reduced hazard to wildlife (lesser amount of phosphamidon) and reduced hazard to fish and bottom fauna (reduced amount of sumithion, and no DDT in test treatment area). The test area should be reasonably close to the sumithion test areas (b) to facilitate coverage of all check points by field study crews.

   (d) Phosphamidon should be used in mixture with sumithion, as outlined in (c); and in stream-buffer zones in DDT-sprayed areas, at application rates not exceeding 1/2 lb. per acre (one application at 1/2 lb., or two applications at 1/4 lb. at intervals of not less than 4 days), as outlined in (a). Consideration should also be given to the use of phosphamidon in block treatments in the upper headwater areas of drainages with salmon streams, to reduce DDT

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contamination in the headwater areas where stream-side buffer zone spraying with phosphamidon may be impractical owing to reduced visibility of the streams from the air.

(e) Special attention should be given to the treatment of the infestation in the Doaktown-Boiestown area along the main Southwest Miramichi. This is an area of persistent infestation, where evidence of resistance to DDT has been obtained in successive years. This would be a logical area for use of other insecticides than DDT (see paragraph (b) and (c) above).

7. The Committee felt that these guidelines would be helpful to Forest Protection Limited and members of the three departments in subsequent meetings devoted to working out details of the spray program for 1967. It also recognized that considerable consultation among the several groups would be necessary to transform these general recommendations into an acceptable and effective operational program. Toward this end, representatives of the three departments are available for consultation with officers of Forest Protection Limited as needed. The Committee requests that suitable advance notice be given to representatives of each department of meetings to work out definitive plans.

8. The Committee also felt the need to be kept better informed of progress in the development of definitive operational planning, with particular regard to the delineations of areas to be treated with different insecticide formulations and the measures to be taken to evaluate the results in terms of budworm mortality and hazards to fish and wildlife. A better distribution of minutes of meetings held in Fredericton to work out the detailed plans would satisfy the needs of the Committee in regard to this feature.

Ottawa, January 6, 1967

M. L. Prebble,
Chairman

E. W. Burridge,
Secretary

APPENDIX I

Not for Publication

SUMMARY REPORT ON INSECTICIDE INVESTIGATIONS 1966

Project (CC 1 - 1) Ultra Low Volume Control Trials Against the Spruce Budworm in New Brunswick 1966

by

A. P. Randall

Chemical Control Research Institute

Forestry Branch

Department of Forestry and Rural Development

Ottawa, Ontario

December, 1966

SUMMARY REPORT ON INSECTICIDE INVESTIGATIONS 1966

Project (CC 1-1) Ultra Low Volume Control Trials Against the Spruce Budworm in New Brunswick 1966

by

A. P. Randall

Results of the 1965 Mini-Spin Trials at Chipman, New Brunswick, indicated that the concept of ultra-low volume spray application of concentrate insecticides for the control of the spruce budworm was basically sound but that further experimentation on equipment development was necessary in order to delineate the effective dosage range and droplet size spectrum of the chemicals tested. The main problem encountered with U.L.V. spray application was primarily the failure of the spray equipment to operate continuously without leaks and mechanical break-downs.

The introduction of the new "Turbair" spray units (a multiple spinning disc apparatus) as a potential ultra low volume spray device, initiated the 1966 series of spray trials. These were carried out from the Dunphy Air Strip, Blackville, New Brunswick using commercially available concentrate insecticides and the 1965 experimental field plan. Several approaches to the problem of spruce budworm control using the new concept of spray application were undertaken. The major issues were as follows:-

(1) Calibration and appraisal of the "Turbair" ultra low volume spray device.

(2) Early and late spray application of systemic and non-systemic insecticides to determine systemic efficiency and effective spraying dates.

(3) Effectiveness of concentrate insecticides as possible substitutes for DDT and phosphamidon that would be compatible with other biological populations that comprise the ecological fauna of the New Brunswick forest.

(4) Effectiveness of the various insecticidal spray on budworm populations in balsam fir and spruce.

With the exception of Plot 11 (18% DDT at 1/2 GPA boom and nozzle system) all data presented in this summary report is representation of U.L.V. spray application with the Turbair device using concentrate insecticides. The general information on the mechanical and physical conditions existing at the time of each trial is summarized in Table I. Spray deposit data and biological effectiveness of the various insecticides are presented in Table II for balsam fir and Table III for spruce host species. The mortality data have been conveniently grouped to express gross differences and should not be interpreted as absolute values in view of the fact that the Turbair spray device was subject to mechanical failure and was thus not operating at expected efficiency.

Two series of applications were scheduled:

(1) An early spray series (May) to determine the effectiveness of the three most promising systemic insecticides (Phosphamidon, Sumithion and Zectran), against the 2nd and 3rd instar budworm larvae when the latter were in the needle and bud mining stages. A non-systemic insecticide (Dylox) was included to show the degree of difference between the action of systemic and non-systemic insecticides.

(2) A later series (June) where insecticides could be used as both systemic and contact materials.

Each experimental site was a fir-spruce forest of approximately 400 acres, (80 X 50 chains) with two transect lines of 30 to 40 chain lengths with biological and chemical stations at chain intervals along each line. Spray application was by means of a Stearman aircraft, flown cross-wind lengthwise down the plot with an overlap swath pattern to provide single, double and triple dosage ranges. Spray emission rate was calculated on the basis of laboratory effectiveness of each material, (i.e. 1/4 lb/ac. actual Phosphamidon, 1/2 lb/ac. Sumithion etc.) and converted in terms of liquid ounces/ac. for the insecticide concentration available. Thus for a 98% concentrate such as Sumithion one would require approximately 20 gals for a 400 acre plot.

Results and Comments

(1) Of the insecticides tested as U.L.V. conc. sprays, against the spruce budworm the relative order of effectiveness (on an equivalent weight basis) would be Phosphamidon, Sumithion, Zectran, Dimethoate, Malathion, Dylox and Dibrom on both balsam fir and spruce host species. Since the DDT formulation was applied at 1/2 GPA emission rate and the plot was resprayed twice by Forest Protection Limited with a 6.25% DDT at 1/2 GPA it is difficult to compare this compound against the others tested. The 1965 data however, in which DDT was tested as a 19% concentrate LV spray would place this material between Malathion and Dylox on the above scale.

(2) The early series of L.V.C. spray trials using the Turbair device was quite successful. The high budworm mortality results obtained with the systemic insecticides (Phosphamidon 80-94%, and Sumithion 60-62%) versus the non-systemic material (Dylox 0%) clearly indicate the effective absorption and possible translocation of the organophosphorus compounds within the plant system. Adequate coverage (10-20 drops/cm^2) of the plant surface must be obtained to ensure a high mortality rate of spruce budworm at the 3-4 Oz/ac. dosage rate.

(3) The non-systemic organophosphorus compounds such as Dibrom, Dylox and Malathion, appeared to be less effective than the systemic compounds.

(4) Three separate applications of DDT at 18%, 6.25% and 6.25% at 1/2 GPA per application failed to eliminate the spruce budworm larvae from the

plot. It is extremely interesting to note that DDT, at our* droplet count data of 10-15 drops/cm^2 produced only 74% control after 12 days. In earlier trials with DDT, this dosage would have produced 99% control on a single application of a 10% DDT formulation. These results suggest that the resistance factor in New Brunswick is developing at a faster rate than anticipated. This holds true for populations in both fir and spruce trees.

(5) In consideration of the positive findings of U.L.V. spray application, continued investigation of this method of application and formulation potentials of concentrate insecticides is suggested. Formulation combinations of concentrate materials may partially elevate the adverse toxicity factors of the more promising materials.

(6) Although the data from Spruce host species is not as numerous as that from fir host species and thus is not as statistically significant, nevertheless the data does indicate a similarity of budworm mortality values and thus suggest that very little difference in budworm mortality can be attributed to host species, especially in the systemic insecticides.

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* Deposit density only recorded for first spray.

A. P. Randall

TABLE I

SUMMARY OF OPERATIONAL DATA FOR ULTRA-LOW V
USING TURBAIR NOZZLES. NEW BR

	SPRAY TRIAL N					
	1	2	3	4	5	
Date	10/6/66	27/5/66	30/5/66	28/5/66	28/5/66	1
Time	6:30 AM	5:50 AM	6:00 PM	7:15 AM	8:05 PM	7
Insecticide	Sumithion	Phosphamidon	Zectran	Sumithion	Dylox	D
% active	98%	90%	17.9%	100%	39.1%	I
Invaline (ml)	(300 ml)	None	None	None	None	3
Plot (ac.)	400	400	400	400	400	4
Gall. emitted	22.5	15	12.5	15	17.5	1
Aircraft Data						
Speed (mph)	100	90-100	100	90-100	90-100	9
Height (ft)	100-110	100	90-100	75-100	75-100	1
Equipment	Turbair	Turbair	Turbair	Turbair	Turbair	T
No. of units	4	4	4	4	4	4
No. of Swaths	30	20	18-21	19	28	1
Spray time (min.)	40	32	30	30	40	2
Disc. No.	41	41	41	41	41	4
Emission (GPM)	1	1	1	1	1	1
Pressure (PSI)	40	40	40	40	40	4
Weather Data						
Wind Vel. (mph)	2-3	4-5	8-10	3-5	1-2	2
Temp. (°F)	42	48	45	55	65	6
RH %	94	96	89	84	87	8
Stability	Stable	Moderate	Unstable	Gusts Stable	Stable	S
Cloud coverage	10/10	0/10	2/10	8/10	10/10	C
Post Spray(24 hrs)	Cloudy	Sunny	Clear	Cloudy	Cloudy	S
Spray Charac.						
Stain (D max. µ)	1500	1500	800	1100	900	1
Drop (D max. µ)	200	200	170	200	200	
Spray Class. *	M	M	F	M	M	M
Spray Coverage	Good	Good	Poor	Good	Good	C
Max. drops cm^2	33.2	27.8	6.3	17.8	36.8	
Max. oz/ac.	2.9	3.3	0.4	3.5	-	

* M = Medium F = Fine M/c = Medium/coarse C = Coarse

TABLE II

NEW BRUNSWICK SPRUCE BUDWORM CONTROI

(TURBAIR L.V.C.)

Plot No.	Treatment	Spray Date	No. drops /cm^2	Deposit oz/ac.	No. of Samples	Maximu stain μ	c
2	Phosphamidon 90% conc.	27/5/66 A.M.	0-5	3.0	34		
			5-10	4.2	16		
			10-20	3.3	11		
3	Zectran 17.9% conc.	30/5/66 A.M.	0-1	0.4	38	800	
			-	-	-		
			-	-	-		
4	Sumithion 98% conc.	28/5/66 A.M.	0-5	0.7	39	1100	
			5-10	1.5	9		
			10-15	3.5	2		
5	Dylox 39.1% conc.	28/5/66 A.M.	0-5	-	9	900	
			5-10	-	6		
			10->20	-	24		
1	Sumithion 98% conc.	10/6/66 A.M.	0-5	0.6	11	1100	
			5-10	1.1	16		
			10->20	2.9	35		
6	Dibrom 100% conc.	11/6/66 A.M.	0-5	0.1	7	1200	
			5-10	0.4	12		
			10->20	1.9	20		
7	Dylox 39.1% conc.	10/6/66 A.M.	0-5	5.1	9	1100	
			5-10	6.8	18		
			10->20	7.4	38		
8	Malathion 100% conc.	19/6/66 AM & PM	0-5	2.0	8	1700	
			5-10	3.0	16		
			10-20	6.2	37		
9	Dimethoate 50% conc.	16/6/66 A.M.	0-1	-	28	800	
			1-3	-	16		
			5-10	-	2		
10	Zectran 25.3% conc.	17/6/66 A.M.	0-5	0.5	32	1100	
			5-10	1.0	5		
			10->20	-	-		
11	DDT 18% conc.	9/6/66 P.M.	0-5	0.6	2	1600	
			5-10	3.7	5		
			10-15	6.1	7		
			15-20	8.3	6		
			20-30	14.4	18		
			30-50	25.6	8		

* Corrected for natural mortality and population

TABLE III
NEW BRUNSWICK SPRUCE BUDWORM CONTROL TRI
(TURBAIR U.L.V.C.)

Plot No.	Treatment	Spray Date	No. drops /cm^2	Deposit oz/ac.	No. of Samples	Maximum stain µ	Maximum drop µ
2	Phosphamidon 90% conc.	27/5/66 A.M.	>0-5	3.0	3		
			5-10	4.2	0		
			10-15	3.3	1		
3	Zectran 17.9% conc.	30/5/66 A.M.	>0-1	0.4	24	800	17
			1-2				
4	Sumithion 98% conc.	28/5/66 A.M.	>0-1	-	8	-	-
			1-5	0.1	4	1100	20
			10-15	3.5	1		
5	Dylox 39.1% conc.	28/5/66 A.M.	>0-5	-	10		
			5-10	-	2	900	20
			10-20	-	6		
1	Sumithion 98% conc.	10/6/66 A.M.	>0-5	0.7	0		
			5-10	1.5	0	1100	20
			10-20	3.5	2		
6	Dibrom 100% conc.	11/6/66 A.M.	>0-5	0.1	4		
			5-10	0.4	2	1200	-
			10-20	1.9	3		
7	Dylox 39.1% conc.	10/6/66 A.M.	>0.5	5.1	0		
			5-10	6.8	0	1100	24
			10-15	7.4	1		
8	Malathion 100% conc.	19/6/66 AM & PM	>0-5	2.0	0		
			5-10	3.0	0	1700	23
			10-20	6.2	3		
9	Dimethoate 50% conc.	16/6/66 A.M.	>0-1	-	16		
			1-3	-	7	800	16
			5-10	-	0		
10	Zectran 25.3% conc.	17/6/66 A.M.	>0-5	0.5	8		
			5-10	1.0	7	1100	23
			10-20	-	7		
11	DDT 18% conc.	9/6/66 P.M.	>0-5	0.6	0		
			5-10	1.0	0		
			10-15	6.1	4		
			15-20	8.3	9	1600	28
			20-30	14.4	-		
			30-40	-	4		
			30-50	25.6	4		

83.2

* Corrected for natural mortality and population di

Not for Publication

Laboratory Evaluation of New Insecticidal Compounds against Spruce Budworm, Larch Sawflies, and Jackpine Sawflies - 1966

by

A. P. Randall and P. C. Nigam

Chemical Control Research Institute

Forestry Branch

Department of Forestry and Rural Development

Ottawa, Ontario

December, 1966

Laboratory Evaluation of New Insecticidal Compounds against Spruce Budworm, Larch Sawflies, and Jackpine Sawflies - 1966

by

A. P. Randall and P. C. Nigam

Preliminary screening of six new experimental compounds was conducted against three species of forest insects. The compounds used were Matacil, SD-8447, Dursban, Bromophos, C-8874 and C-9491. They were provided by Chemagro Corporation, Shell Development Co., Dow Chemical Co., Cela Limited, and Ciba Limited, respectively.

All tests were conducted under laboratory conditions using a modified Potter's tower to deliver 0.5 gallons per acre of insecticide solution. Five concentrations of each insecticide were sprayed directly over the larvae for contact toxicity. The insecticide solutions were formulated in AR-50-G dyed with 0.5% orasol red. Mortality observations were taken at 24, 48 and 72 hours and corrected for natural mortality by Abbott's formula.

The results for 24 hours mortality are tabulated in Table No. 1. It appears from these results that among the compounds tested Matacil is highly toxic against spruce budworm, SD-8447 against larch sawfly and C-9491 against Jackpine sawflies. They show some degree of specificity against the species, but futther testing is still required.

TABLE NO. I

CONTACT TOXICITY OF SIX DIFFERENT COMPOUNDS TO THREE

(Corrected Per Cent Mortality after 24 hours

Name of Compound	Spruce Budworm *Choristoneura fumiferana* (Clem.)					Larch Sawfly *Pristiphora erichsoni*		
	Concentration %					Concentratio %		
	.05	.08	0.5	1	2	.05	.08	0.5
Matacil	0.00	20.00	35.00	100.00	100.00	69.90	100.00	100.00
SD-8447	5.00	0.00	0.00	0.00	5.00	94.95	100.00	100.00
Dursban	0.00	0.00	20.00	55.00	90.00	9.57	20.21	100.00
Bromophos	0.00	5.00	0.00	0.00	20.00	50.00	20.00	100.00
C-8874	3.06	0.00	3.06	0.00	0.00	11.46	1.04	100.00
C-9491	0.00	[illegible]	4.04	0.00	19.19	0.00	6.45	56.6

Appendix III

FOREST RESEARCH LABORATORY
FREDERICTON, NEW BRUNSWICK

SUMMARY STATEMENT ON THE ENTOMOLOGICAL

ASSESSMENT OF THE 1966 SPRUCE BUDWORM

AERIAL SPRAYING PROGRAM IN NEW BRUNSWICK

AND FORECAST OF CONDITIONS FOR 1967

D. R. Macdonald

October 15, 1966.

TABLE I

FOREST PROTECTION LTD.

1966 SPRUCE BUDWORM FOREST SPRAYING OPERATIONS

AREA BREAKDOWN: By insecticide, single application dosage, number of applications, initial and final areas for all airstrips. Numbers are rounded to the nearest 1,000 acres.

INSECTICIDE & DOSAGE	AIRSTRIP	TWO APPLICATIONS INITIAL	TWO APPLICATIONS ADDED	TWO APPLICATIONS TOTAL	ONE APPLICATION INITIAL	ONE APPLICATION ADDED	ONE APPLICATION TOTAL	TOTAL INITIAL	TOTAL ADDED	GRAND TOTAL
D.D.T. 0.25 lbs. in ½ U.S.G./ac.	Juniper	169	129	298	-	1	1	169	130	299
	F'ton	114	-	114	-	-	-	114	-	114
	Dunphy	268	39	307	-	8	8	268	47	315
	Taxes	240	22	262	5	14	19	245	36	281
	Sub-Total	791	190	981	5	23	28	796	213	1009
D.D.T. 0.33 lbs. in ½ U.S.G./ac.	Chipman	444	-	444	6	-	6	450	-	450
	Trout Bk.	264	-	264	12	-	12	276	-	276
	Dunphy	19	-	19	-	-	-	19	-	19
	Sub-Total	727	-	727	18	-	18	745	-	745
Total D.D.T. Treated		1518	190	1708	23	23	46	1541	213	1754
Phosphamidon All Strips 0.25 lbs. in ½ U.S.G./ac.		172	32	204	-	12	12	172	44	216
GRAND TOTAL		1690	222	1912	23	35	58	1713	257	1970

November 11, 1966

Summary Statement on The Entomological Assessment of the 1966 Spruce Budworm Aerial Spraying Program in New Brunswick and Forecast of Conditions for 1967

1. Introduction

The 1966 aerial spraying operation was the seventh in the current series to protect the forests of central New Brunswick from damage by the spruce budworm. It was also the fourteenth operation since the commencement of large-scale aerial spraying operations in the Province in 1952. A preliminary assessment of the operational and experimental work is provided herein together with a forecast of budworm populations for 1967. Analyses of data are still in progress. Therefore, while conclusions drawn in this statement are believed to be valid, they may be subject to change.

It is a pleasure to acknowledge the assistance rendered by my associate G. E. Beanlands, and also that by two entomologists, N. R. Brown and R. W. Nash, assigned by Forest Protection Ltd. to assist with the timing of the spraying.

2. The 1966 Spraying Plan and Operation

The 1965 egg-mass infestation survey indicated that some 1.6 million acres were heavily infested and some 0.8 million acres were moderately infested. The spray plan developed for the 1966 operation provided that approximately 1.6 million acres would definitely be sprayed and a further 20 per cent could be added to the plan if surveys for larvae in the spring of 1966 indicated that populations in areas around the basic plan were high enough to warrant treatment. This latter provision was necessary since there has sometimes been considerable dispersal of young larvae from heavily infested stands in previous years, with the result that severe defoliation has occurred in areas nominally lightly infested with egg-masses.

The operational plan called for two applications of DDT throughout the entire area except along major salmon-producing streams where Phosphamidon was to be applied in buffer strips as in previous years. The DDT was to be applied at the rate of 1/4 pound per acre on the Miramichi, Nashwaak, and Tobique River watersheds, and at 1/3 pound per acre on the other watersheds. Phosphamidon was to be applied at the rate of 1/4 pound Phosphamidon per acre in two applications, not less than four days apart.

Spraying was conducted from Fredericton, Juniper, Dunphy, Taxes, Chipman and Salmon Brook airports. Stearman and TBM Grumman Avenger aircraft were used to spray DDT, while two new aircraft types, the Grumman Ag-Cat and the S-2-D Snow Commander, were used to apply Phosphamidon along the streams.

Forest Protection Ltd. continued to modify their aerial spraying techniques. This year they adopted a system which they had developed in 1965, in which the Stearman aircraft sprayed in five-plane formations. The formation leaders were equipped with two-way radios and were directed by navigators flying above them in observation planes. Further details will be reported by Mr. B.W. Flieger.

Pre-spray surveys for larvae in May and early June indicated that very little dispersal of young larvae had occurred in the areas between the scattered infestations on the western side of the operational area. The surveys did indicate that some areas along the borders of the basic operational plan were more infested than had been forecast and some 275,000 acres were added mostly near the periphery of the scattered blocks on the northwestern side of the outbreak and on the northeastern side of the lower end of the Dungarvon River watershed. The acreages sprayed are listed in Table I according to treatment. The areas sprayed operationally with DDT are shown in Figure I and the salmon-producing streams within the area that were protected from DDT contamination by application of Phosphamidon along their banks are shown in Figure 2.

3. Population Reduction in Operational Area in 1966

The annual survey for surviving budworm pupae made in July provides data to assess the percentage reduction in populations by spraying. The data collected in the sprayed area were separated by phenological development categories and sub-divided according to the treatments applied in each category. Data collected in infested areas outside the sprayed area were pooled for early (0 and 1) and later (2, 3, and 4) phenological categories to provide estimates of surviving budworm populations per 18-inch branch tip. These estimates were:

	Fir	Spruce
Categories 0 & 1	3.35	0.65
Categories 2, 3, & 4	2.13	0.47

The percentage reductions in population in each treatment are shown in Table II. The estimated reduction in population over the entire DDT sprayed area was 87 per cent on fir and 70 per cent on spruce.

These estimates are based on the percentage reduction in each phenological category and are weighted according to the proportion of the total sprayed area in that category. Certain DDT treatments covering some 67,000 acres in categories 1, 2, and 4 were not sampled and this area was excluded from the total area for computation purposes. The 216,000 acres sprayed with Phosphamidon were also excluded.

FIGURE 1

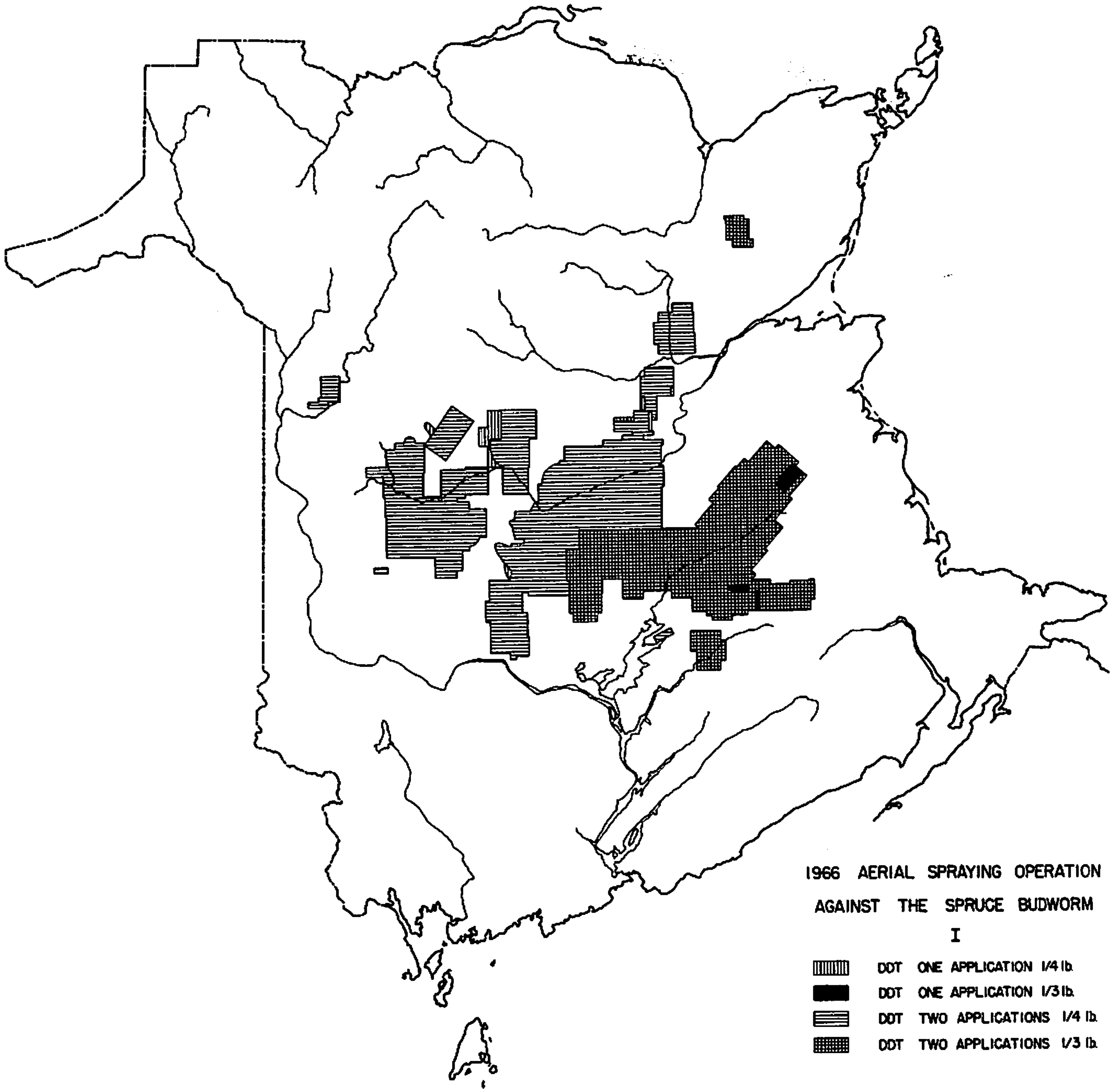

1966 AERIAL SPRAYING OPERATION
AGAINST THE SPRUCE BUDWORM
I
DDT ONE APPLICATION 1/4 lb.
DDT ONE APPLICATION 1/3 lb.
DDT TWO APPLICATIONS 1/4 lb.
DDT TWO APPLICATIONS 1/3 lb.

FIGURE 2

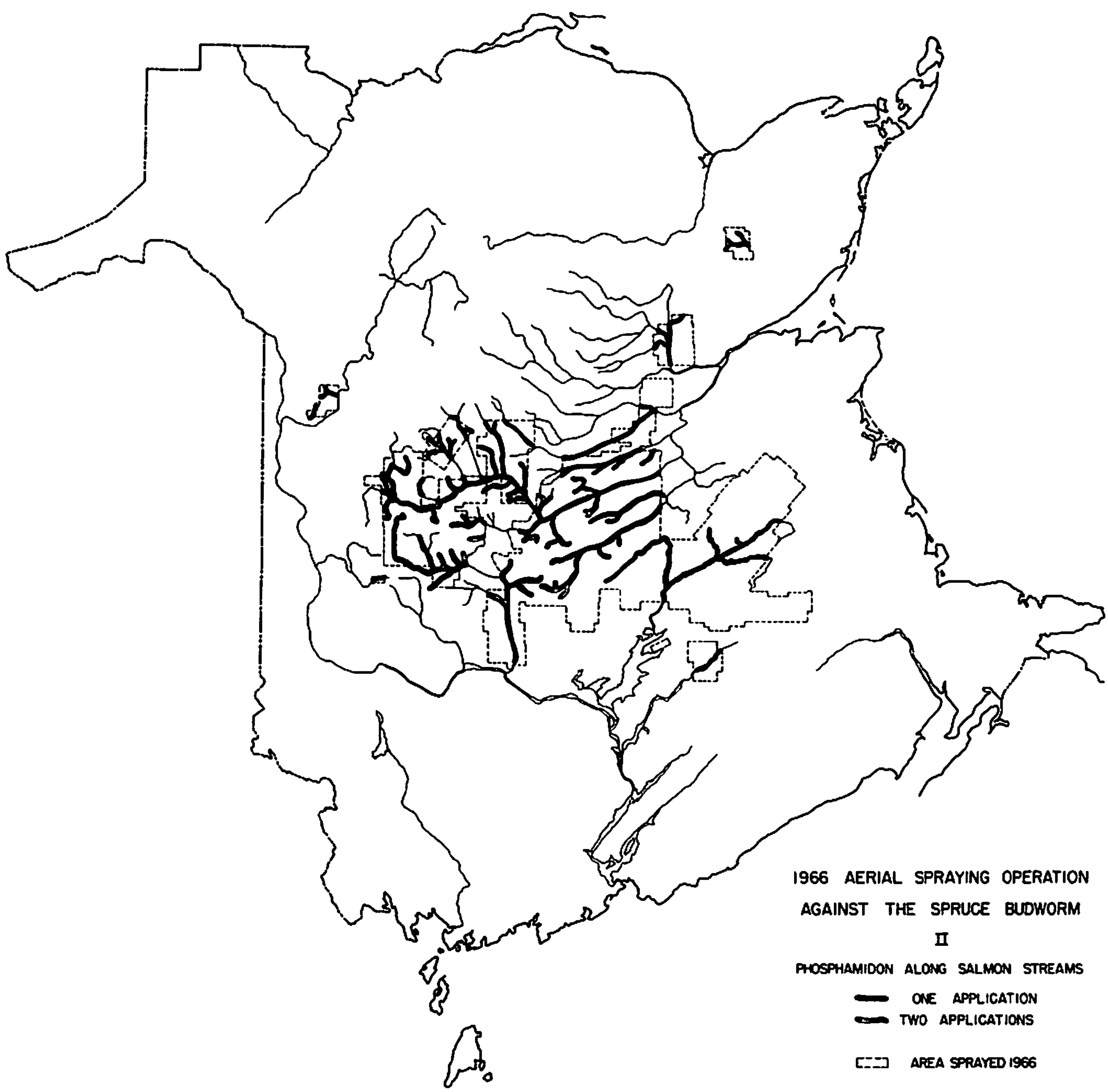

1966 AERIAL SPRAYING OPERATION
AGAINST THE SPRUCE BUDWORM
II
PHOSPHAMIDON ALONG SALMON STREAMS
ONE APPLICATION
TWO APPLICATIONS
AREA SPRAYED 1966

Table I. Areas Sprayed in the 1966 Aerial Spraying Operation Against the Spruce Budworm in New Brunswick (Data supplied by Forest Protection Ltd.)

Operational Program

	Acres			
DDT	One application	Two applications	Total	
1/4 lb. per acre				
Original plan	5,000	791,000	796,000	
Added to plan	23,500	189,900	213,400	
Sub-total	28,500	980,900		1,009,400
1/3 lb. per acre				
Original plan	0	726,800	726,800	
Added to plan	17,800	0	17,800	
Sub-total	17,800	726,800		744,600
			Total DDT	1,754,000
Phosphamidon				
1/4 lb. per acre				
Original plan	0	171,900		
Added to plan	12,000	31,800		
		Total Phosphamidon		215,700
		Total Operational		1,969,700

The samples collected in areas sprayed with Phosphamidon were analysed separately. The average percentage reductions in population attributable to Phosphamidon spraying along the rivers were: 81.8 per cent on fir, based on 59 samples; and 58.6 per cent on spruce, based on 53 samples.

The estimate of over-all percentage reduction in population is subject to a number of extraneous influences but it does provide an index of the relative effectiveness of the operation. The reduction on balsam fir, 86.6 per cent is the highest that has been achieved since this series of operations started in 1960. The reduction on red spruce is the highest since 1963. The two applications of DDT have undoubtedly contributed greatly to the higher percentage control.

The efficacy of the 1/3 pound over the 1/4 pound application is not well defined, but there does appear to be a slight margin in favour of the extra 2½ ounces of DDT per acre. The data in Table II are rearranged in Table III and the weighted total percentage reductions in population on fir and spruce are calculated according to the treatment applied. For the operation as a whole, the reduction in population on balsam fir is 1.2 per cent greater in the area treated twice with 1/3 lb DDT. On spruce the reduction is 4.6 per cent greater.

4. Defoliation by Spruce Budworm in 1966

Forest Protection Ltd. again conducted the annual aerial survey for defoliation. The resultant map is shown in Figure 3.

Very little defoliation was observed within the 1966 operational area. On the southwest Miramichi watershed a few small isolated patches of severe defoliation were observed near New Bandon, along Rocky Brook, along the upper part of Clearwater Brook and northwest of Juniper. Patches of severe defoliation and more extensive areas of moderate defoliation also occur along the Upper Nashwaak River, the Napadogan River, and between Rocky and McLean brooks on the Nashwaak watershed. On the southeastern side of the operational area some patches of moderate and severe defoliation extend along the south side of the Salmon River as far as the Lake Stream. A large part of the Coal Creek watershed is moderately defoliated.

The spray treatments on the two outlying infestations on the Tobique and Tabusintac rivers appeared to have been successful. A very small area of light defoliation was observed within the Tobique area although a pocket of moderate and severe defoliation was observed immediately south of the spray boundary on Pokiok Brook. In the Tabusintac area only light and moderate defoliation was observed in a band along the river, which would be the area treated with Phosphamidon.

Table II. Per Cent Reduction in Population by Spraying with DDT in the 1966 Operational Area. Estimated on an Area Basis from Survey of Surviving Pupae.

Pheno-logical Category	Treatment DDT	% of Area sampled	No. of Samples		% Reduction in population		Contribution to weighted total		Area
			Fir	spruce	Fir	spruce	Fir	spruce	
0	2 x 1/4#	5.1	15	11	83.0	66.2	4.3	3.4	St. John R. valley and Nashwaak R. north to Cross Creek Station
	2 x 1/3#	1.2	6	5	86.0	61.5	1.0	0.7	
1	2 x 1/4#	20.7	66	65	86.6	66.2	17.9	13.7	Millville to Stanley to Boiestown and S.W. Miramichi to Chatham
	2 x 1/3#	40.7	51	54	87.5	73.8	35.6	30.0	
	2 x 1/4#added	2.4	8	7	73.5	49.2	1.8	1.2	
	Tobique 2 x 1/4#	1.1	12	6	98.8	100.0	1.1	1.1	
2	2 x 1/4#	9.0	18	19	85.7	91.5	7.7	8.2	A 10-mile-wide band running N.E. Crosses S.W. Miramichi from Boiestown to Salmon Bk. includes middle of Renous and Dungarvon drainage, Taxis and Upper Nashwaak drainages.
3	2 x 1/4#	9.4	17	16	91.2	74.5	8.6	7.0	An 8-mile-wide band running N.E. Includes most of S.W. Miramichi drainage from Salmon Bk. to Juniper.
	2 x 1/4#added	5.6	14	14	81.2	72.3	4.6	4.1	
	Tabu. 2 x 1/3#	1.1	15	12	96.8	70.2	1.1	0.8	
4	2 x 1/4#added	2.8	3	3	96.3	0.0	2.7	0.0	Headwaters of McKiel, Burnthill, Clearwater, and Rocky Bks.
	1 x 1/4#added	0.9	3	3	18.8	23.4	0.2	0.2	

Total per cent reduction in population in operational area sprayed with DDT — Fir 86.6%, spruce 70.4%

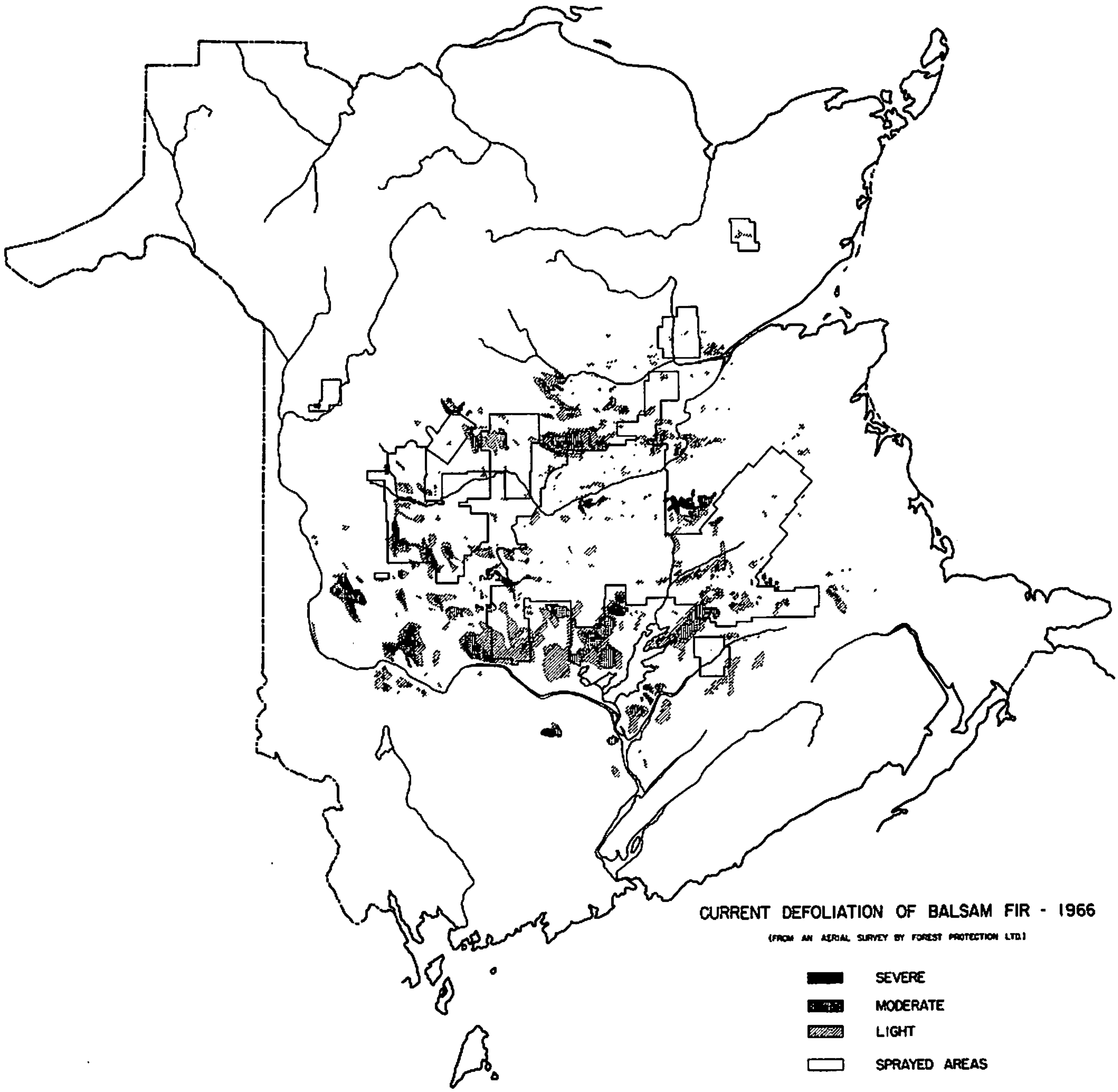
Area Sampled = 1,687,120 acres

Total Area Sprayed with DDT = 1,754,000 acres

Table III. Comparison of Percentage Reduction in Population on Fir and Spruce in Areas Sprayed: Twice with 1/4 lb. DDT *vs*. Twice with 1/3 lb. DDT

Phenological Category	Acres	% of Area in Treatment	% Reduction in Population		Contribution to Weighted Total	
			Fir	Spruce	Fir	Spruce
		Treatment: 1/4 lb. DDT per acre twice				
0	86,000	9.1	83.0	66.2	7.6	6.0
1	348,675	36.9	86.6	66.2	32.0	24.4
	18,225	1.9	98.8	100.0	1.8	1.9
	41,000	4.3	73.5	49.2	3.2	2.1
2	151,000	16.0	85.7	91.5	13.7	14.6
3	159,000	16.8	91.2	74.5	15.3	12.5
	94,000	9.9	81.2	72.3	8.0	7.2
4	48,000	5.1	96.3	0.0	4.9	0.0
Total	945,900	100.0				
	Total per cent reduction:				86.5	68.7
		Treatment: 1/3 lb DDT per acre twice				
0	20,000	2.8	86.0	61.5	2.4	1.7
1	687,000	94.6	87.5	73.8	82.8	69.8
3	19,040	2.6	96.8	70.2	2.5	1.8
Total	726,040	100.0				
	Total per cent reduction				87.7	73.3

FIGURE 3


CURRENT DEFOLIATION OF BALSAM FIR - 1966
(FROM AN AERIAL SURVEY BY FOREST PROTECTION LTD.)
SEVERE
MODERATE
LIGHT
SPRAYED AREAS

Outside the sprayed area patches of moderate defoliation were observed in several widely scattered areas. Some of these infestations included areas of severe defoliation. The most extensive areas were located as follows: Along the North Renous River drainage; on the South Renous and Dungarven River drainages; along the Clearwater Brook; in the Becaguimec Game Refuge; from Hainesville southwest to Nackawic on the St. John River; north of Keswick and Douglas, north and northeast of Acadia Experiment Station to Newcastle Creek; the east side of Grand Lake between Jemseg and Waterboro and between Cumberland Bay Stream and Coal Branch Stream; South of Shinnickburn (Cains River) on the Six Mile and Sabies River drainages.

Further defoliation was also observed on the west side of Base Gagetown near Rockwell Stream and Geary Brook and on the east side near Hampstead and Lower Gagetown.

Scattered defoliation was also seen from the ground in Fundy National Park.

In general there was less defoliation by spruce budworm in 1966 than in any year since the outbreak in central New Brunswick commenced. The fact that most of the defoliation that was observed occurred outside the sprayed area indicates that a high degree of crop protection was achieved by the 1966 spraying operation.

5. Operational Experiments with Insecticides - 1966

Two series of operational size experiments were conducted in 1966 with Phosphamidon and Sumithion. The first, using Phosphamidon, was an outgrowth of the 1965 experimental program and was made to test the feasibility of obtaining effective population reduction by spraying very early in the season shortly before the larvae emerged from hibernation. The second experiment using Sumithion, was made to determine the effectiveness of this poison against budworm and other organisms when used over a large area, also to determine the operational problems that might be associated with its use.

The first series of experiments was plagued by a number of unfortunate circumstances, mostly associated with unusually cool weather in early May that disrupted the normal development of the insect population. The experimental treatment failed to produce an appreciable degree of control and for the sake of brevity the detailed results are not presented in this preliminary report. In fact the hypothesis that a pre-emergence application of a systemic insecticide will give acceptable budworm control still remains to be tested. Whether or not it is necessary, or desirable, to restrict such a test to a 1/4 lb. per acre treatment of Phosphamidon is another matter. In view of the promising results with Sumithion described below, and the probability that other insecticides with less damaging side-effects than Phosphamidon will also be available, it seems worthwhile to concentrate our limited investigative efforts for the next year or two on other more promising insecticides rather than attempting to develop a technique to use an insecticide with known serious side-effects.

The second series of experiments in 1966 were conducted with Sumithion. This is an organophosphate insecticide which had been recommended by the Canada Department of Forestry and Rural Development Chemical Control Research Institute as being promising for spruce budworm control. It is reported to have a low toxic action on animals and relatively little effect on aquatic organisms.

The most extensive tests with Sumithion were made on June 10 when the population development was between the peaks of the fourth- and fifth-instars. Four 1000 acre blocks were sprayed at the rates of 1, 3/4, 1/2 and 1/4 pounds Sumithion in 1/2 U. S. gallon formulation per acre. The spray was applied from Stearman aircraft flying in a five plane formation guided by a navigator-observor flying in a Cessna observation plane. The blocks were approximately 90 by 110 chains and were covered in six passes of the formation. This entailed at least five formation turns for each block in contrast to the one turn required on an operational block. Some confusion occurred during a few of the turns with the result that spray coverage was erratic and there were more gaps and oversprays than might normally be expected during an operational treatment.

Spray coverage was monitored at a number of stations on each block however and the population counts at these stations indicate the control achieved with the four doses of Sumithion. Population counts were also made in a nearby unsprayed area for control purposes. Estimates of the percentage reduction in survival on balsam fir, corrected for the influence of population density, for the different dosages of Sumithion, are shown in Figure 4 plotted over the spray drop indices. These estimates were determined from the relationship

$$\% \text{ Reduction} = \frac{\text{Expected pop'n. (treated)} - \text{Observed pop'n. (treated)}}{\text{Expected pop'n. (treated)}} \times 100$$

where Expected pop'n = Initial pop'n (treated) x Unsprayed survival from a survival/density curve for the control population.

These graphs indicate that very good reduction in survival was achieved with 1, 3/4 and 1/2 pound per acre treatments of Sumithion where the spray drop index was greater than 1 drop per square centimeter. Reduction on the block sprayed with 1/4 lb. Sumithion per acre appeared to be less consistent in relation to spray drop coverage although a small proportion of the plots received a high number of droplets.

A survey of surviving populations on spruce at or near the balsam fir sampling stations (Figure 4) indicated that the surviving population density on spruce was also related to spray drop coverage. The average number of survivors on red spruce in the control area was 2.0 budworms per 18 inch branch-tip. Control was good on the blocks sprayed with 1, 3/4 and 1/2 pound Sumithion per acre but was poor on the block sprayed with 1/4 pound Sumithion (Figure 5).

A general survey of surviving populations on fir and spruce was also made across each block. The average numbers of surviving budworms per 18-inch branch tip are shown in Table IV. The relatively high number of survivors on fir in Block 17 is attributed to sampling difficulties that were experienced in this block where the fir is clustered in pockets and spray coverage was erratic. Over half the budworms found in the survey of Block 17 were on the first 40 of the 199 trees sampled and these occurred in an area where the spray coverage was generally light. If these samples are deleted, the average number of survivors on the remaining 159 trees in survey drops to 0.50 budworm per 18-inch tip. Another trial was conducted on June 18 when most of the population was in the sixth-instar. One-half of Block 19 was treated with 1/3 lb. Sumithion in 1/2 U. S. gallon of formulation per acre, and the other half with 1/2 lb. Sumithion. The survival of the budworm population on balsam fir was reduced by only 67 per cent on the area sprayed with the 1/4 lb. per acre dosage, and by 71 per cent on the area sprayed with the 1/2 lb. dosage. Both estimates are corrected for the influence of population density on survival. The surviving populations on spruce were reduced by approximately 93 and 87 per cent by the 1/4 and 1/2 lb. Sumithion treatments respectively. The estimates for spruce are subject to a high error, largely because the block was on the edge of the infestation and may have been subject to a high level of natural control; and because the pre-spray densities on spruce were not measured.

Although these data are incomplete they suggest that a treatment of 1/2 pound or more Sumithion per acre in 1/2 U. S. gal. of formulation will cause a substantial reduction in the budworm population if it is applied when the larvae are in the fourth- or fifth-instars. Most of the survivors that were found shortly after the June 10 application were large sixth-instar larvae. It is possible that the ultimate-instar larvae have a much greater tolerance to Sumithion than those in earlier instars.

Sumithion has a definite systemic action and should prove to give better control to that portion of the population that is feeding in protected

Fig. 4

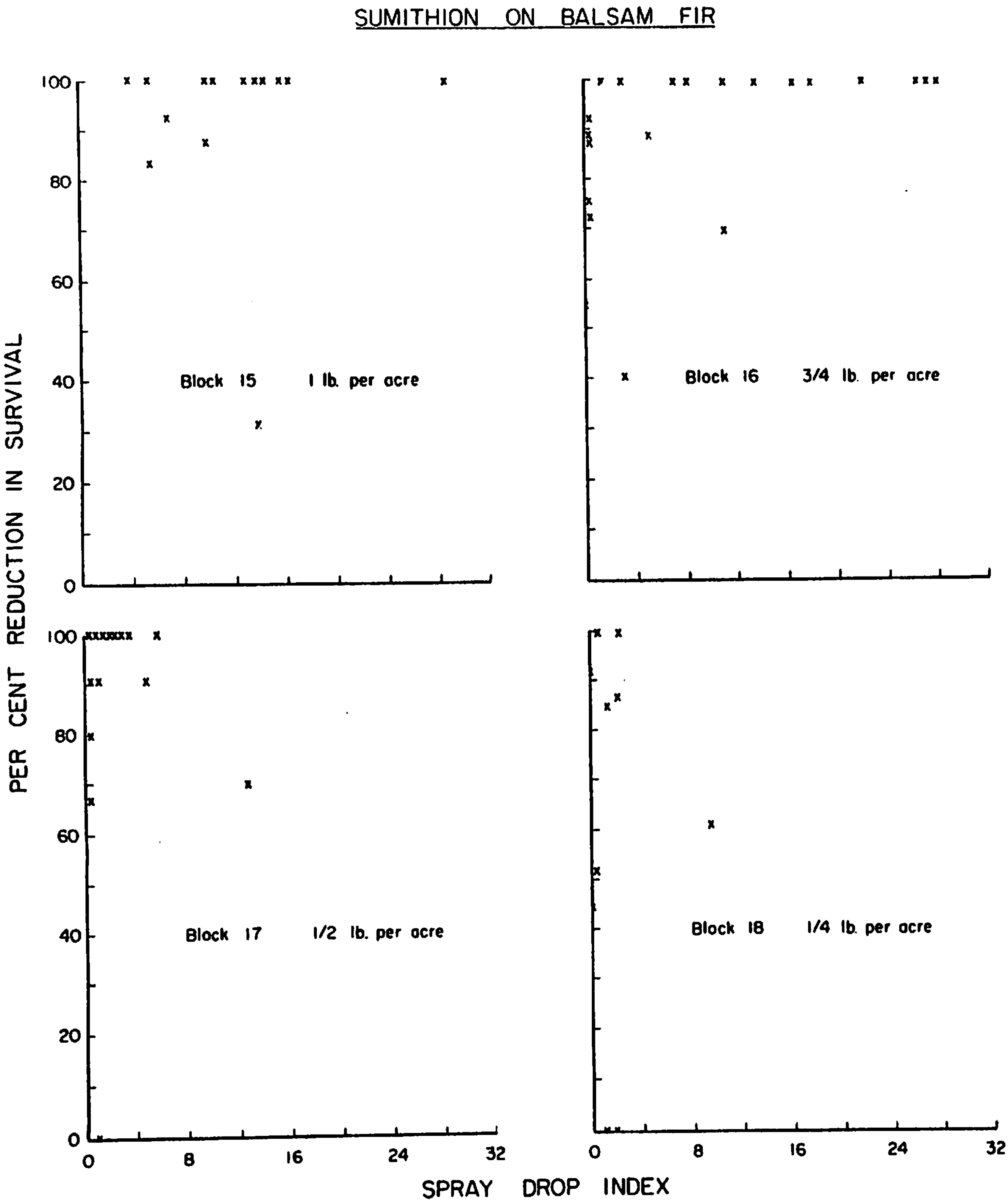

SUMITHION ON BALSAM FIR
PER CENT REDUCTION IN SURVIVAL
SPRAY DROP INDEX
Block 15 1 lb. per acre
Block 16 3/4 lb. per acre
Block 17 1/2 lb. per acre
Block 18 1/4 lb. per acre
0
20
40
60
80
100
8
16
24
32

Fig. 5

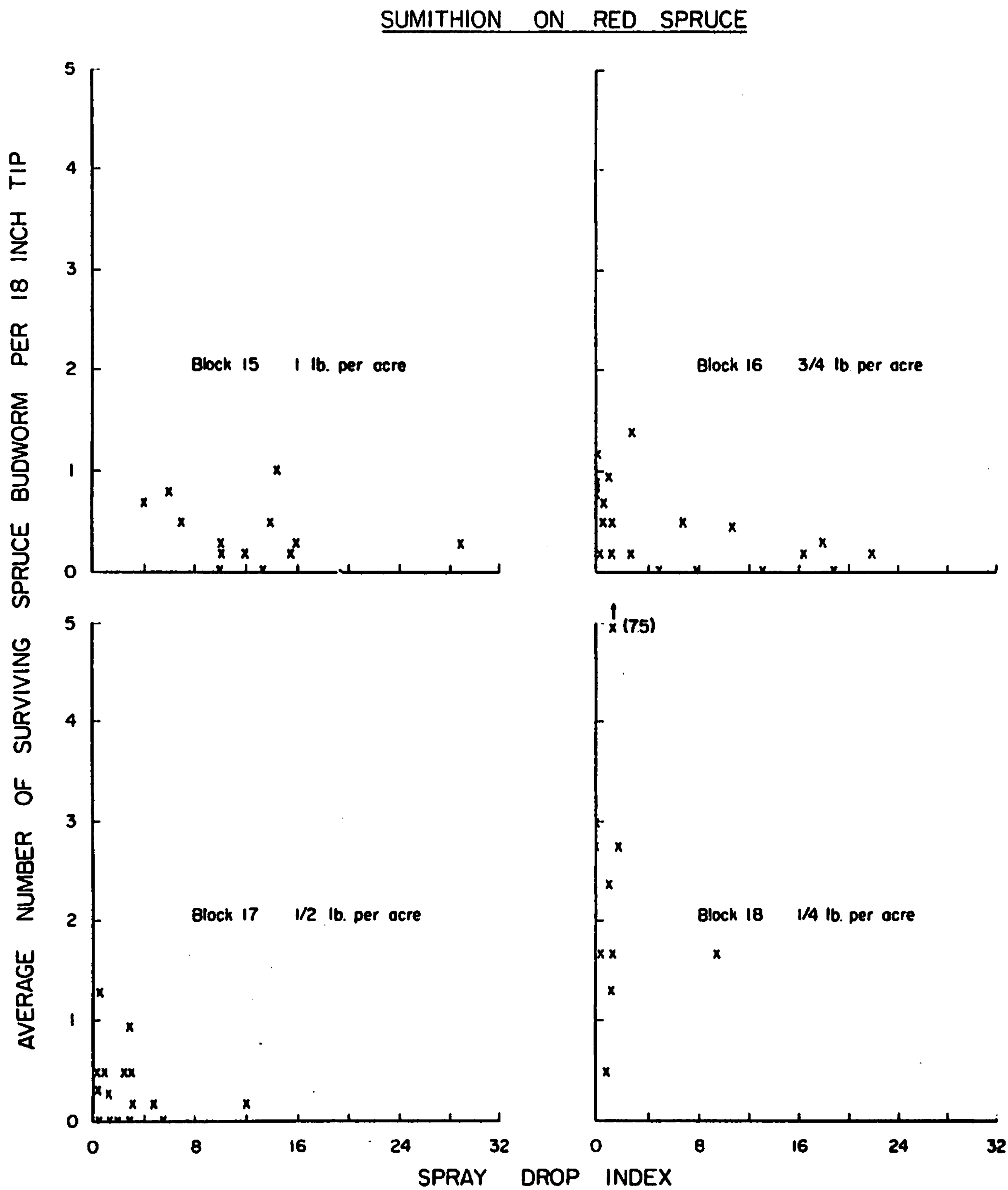

SUMITHION ON RED SPRUCE
AVERAGE NUMBER OF SURVIVING SPRUCE BUDWORM PER 18 INCH TIP
Block 15 1 lb. per acre
Block 16 3/4 lb per acre
Block 17 1/2 lb. per acre
Block 18 1/4 lb. per acre
(75)
0
1
2
3
4
5
0
8
16
24
32
SPRAY DROP INDEX

Table IV. Average Number Surviving Spruce Budworm per 18-inch tip on Blocks Sprayed with Different Dosages of Sumithion June 10, 1966.

Block	15	16	17	18	
Dose/acre	1#	3/4#	1/2#	1/4#	Control
Fir	0.30	0.30	0.80	0.62	2.40
No. trees sampled	120	200	199	149	199
Spruce	0.77	0.58	0.70	1.26	1.12
No. trees sampled	120	200	199	150	199

niches than DDT. Evidence of this was found in a survey for a twig-mining sawfly, Pleroneura borealis Felt., on balsam fir reproduction. Only 7 out of 61 larvae were found to be alive in samples taken in the block sprayed with 1/4 lb. Sumithion per acre on June 10. In a nearby unsprayed area only 3 larvae were dead out of a total of 25. These insects were completely protected from direct contact with the insecticide at this time and it is concluded that the poison must have been translocated to them.

It is also worth noting that budworm larvae poisoned by Sumithion react differently than those poisoned by DDT or Phosphamidon. Normally budworm larvae sprayed with the latter insecticides go into tremors and convulsions and drop from their feeding sites to the ground. In fact it is usually difficult to find dead budworm larvae in DDT sprayed areas. In the area sprayed with Sumithion however numerous budworm cadavers were found in the feeding sites a few days after spraying. It is possible that a large supply of poisoned budworms on the foliage may lead to a new sequence of side-effects but we did not observe any such effects.

6. Associated Experimental Work

The scientific co-ordinating committee consisting of the project leaders from the entomological, fisheries and wildlife study groups and Forest Protection Ltd.'s manager and operations co-ordinator, met regularly again this summer to plan and review the progress of the experimental work. Again this committee found that there was a very high return in information and improved operations for the small investment of one or two hours discussion each week.

One important outgrowth of the committee is that several people working on the long-term effects of the spraying program in the ecosystem in New Brunswick have been able to co-ordinate their work to mutual advantage. Studies in several disciplines are being made in the same areas where background data on spraying and infestation history, pesticide residue levels, forest descriptions etc., are being gathered for general reference. The present members of this informal group and their research interests include the following:

Spruce budworm and associated insects	D. R. Macdonald G. E. Beanlands	Dept. of Forestry and Rural Development Fredericton, N. B.
Wildlife	Dr. C. D. Fowle W. Wilson J. A. Keith	York University Toronto Canadian Wildlife Service
Soil biology	P. Salonius	Dept. of Forestry and Rural Development, Fredericton
	Dr. M.G. Boyer	York University, Toronto
Pesticide residues	Fr. J. Regis Duffy	St. Dunstan's University Charlottetown, P. E. I.

We hope that other workers might be encouraged to join in this study of pesticide residues and that we can develop a group covering as broad a spectrum of the ecosystem as possible.

Some interesting results are already evident from the preliminary work done this summer. Foliage was collected before spraying from the mid-crowns of co-dominant balsam fir trees in the study areas which have a graduated series of spraying histories. Twigs produced each year since 1961 were separated and analyzed for DDT residues by Fr. J. Regis Duffy. A partial listing of the results is given in Table V. Litter was also collected from the snow surface in late March or May, 1966, in each area and analyzed for residues. (Table VI).

It is of interest to note that appreciable amounts of DDT are retained on the foliage for at least five years and that it is added to the soil when the leaves and other litter fall. DDT residues also occur on foliage produced after the area was last sprayed. Note the op'DDT on the 1963 Waasis foliage and the pp'DDT on the 1962, 1963, and 1964 foliage and the Acadia foliage for 1963 to 1965. These residues either came as drift from spray operations 8 to 10 miles away, or else the material is translocated through the crown.

These data illustrate the complexity of the pesticide residue problem. They also show that there is an excellent opportunity in central New Brunswick to evaluate the importance of the cycling of the residues in a quantitative manner in a broad ecological study. It is to be hoped that this work will be expanded in the near future by all agencies concerned.

7. Infestation Status in 1966 and Hazard for 1967

The results of the annual egg-mass survey are presented in Figure 6. The map is based on sequential counts of egg masses on mid-crown branches of balsam fir collected at over 1,100 locations throughout the Province. The survey indicates that the areas of heavy infestation are more widely dispersed than in recent years and that the total acreage of heavy infestation has declined slightly from 1965. The outbreak, however, is still spread throughout central New Brunswick and has extended further to the southeast.

The largest infestation found in the 1966 survey occurs on parts of the Renous, Dungarvon, Cains and Southwest Miramichi River watersheds and covers approximately 594,000 acres. There are two smaller closely associated infestations. The first covers some 46,000 acres between the Cains River and the headwaters of the Gaspereau River. The second extends over some 50,000 acres between the lower part of the Gaspereau River and the Salmon River. Some 67,000 acres on the Cains River and Meadow Brook watersheds between these latter infestations and the large infestations on the Miramichi watershed are moderately infested.

Table V. DDT residues (p.p.m.) Found on Mid-crown Balsam Fir Foliage in 5 Study Areas in Central New Brunswick. Analysis by J. Regis Duffy.

Area	Sprayed	Foliage Produced in				
		1961	1962	1963	1964	1965
para para DDT						
Waasis	1961	1.96	0.17	0.15	0.22	0.0
Acadia	1961, 62	0.59	0.42	0.18	0.29	0.23
Trout Bk.	1961, 62, 63	1.02	0.73	3.10	0.27	0.04
Weaver	1961, 62, 63, 64	1.82	3.05	1.81	4.11	0.36
Ludlow	1961, 62, 63, 64, 65	4.26	3.60	4.48	4.21	3.03
ortho para DDT						
Waasis	1961	0.48	0.04	1.00	0.0	0.0
Acadia	1961, 62	0.02	0.02	0.0	0.0	0.0
Trout Bk.	1961, 62, 63	0.21	0.07	0.08	0.0	0.0
Weaver	1961, 62, 63, 64	0.28	0.54	0.39	1.00	0.04
Ludlow	1961, 62, 63, 64, 65	1.08	0.79	1.00	1.07	0.66

Table VI. Pesticide Residues Found in Coniferous Needles and Other Organic Litter Collected From Snow Surface in the Spring of 1966. Analysis by J. Regis Duffy.

	Sprayed	p.p.'-DDE (p.p.m.)	o.p.'-DDT (p.p.m.)	p.p.'-DDT (p.p.m.)
Waasis	1961	0.12	0.0	0.65
Acadia	1961, 62	0.19	0.30	1.54
Trout Brook	1961, 62, 63	0.06	0.0	0.81
Weaver	1961, 62, 63, 64	0.60	0.33	3.50
Ludlow	1961, 62, 63, 64, 65	0.30	0.70	4.74

Smaller infestations associated with this general complex occur: On the Stewart Brook watershed at the confluence of the Southwest and Northwest Miramichi Rivers, 12,000 acres; on the Chaplin Island Road northwest of Newcastle, 9,000 acres; and on the Rocky and Clearwater Brook watersheds, 33,000 acres. Practically all of these heavily infested areas are outside the 1966 sprayed area.

On the western side of the outbreak area, some 43,000 acres near Hainesville, and 24,000 acres in and around the Becaguimec Game Refuge are heavily infested. Both areas suffered some moderate to severe defoliation in 1966.

There are three heavy infestations on the south side of the outbreak: 23,000 acres between Penniac and Little River; 92,000 acres on the Acadia Forest Experiment Station and extending northeast to Newcastle Creek; and 43,000 acres on the southeastern shore of Grand Lake.

Two small infestations also occur on and adjacent to Base Gagetown. Approximately 10,000 acres on the Rockwell Stream watershed at Geary, and some 5,000 acres near Hampstead are infested and will probably be moderately to severely defoliated in 1967.

On the southeastern side of the outbreak, some 121,000 acres on the Canaan River watershed between Cranberry Lake and Havelock are heavily infested, and 41,000 acres on the headwaters of the Canaan River around Pacific junction are infested.

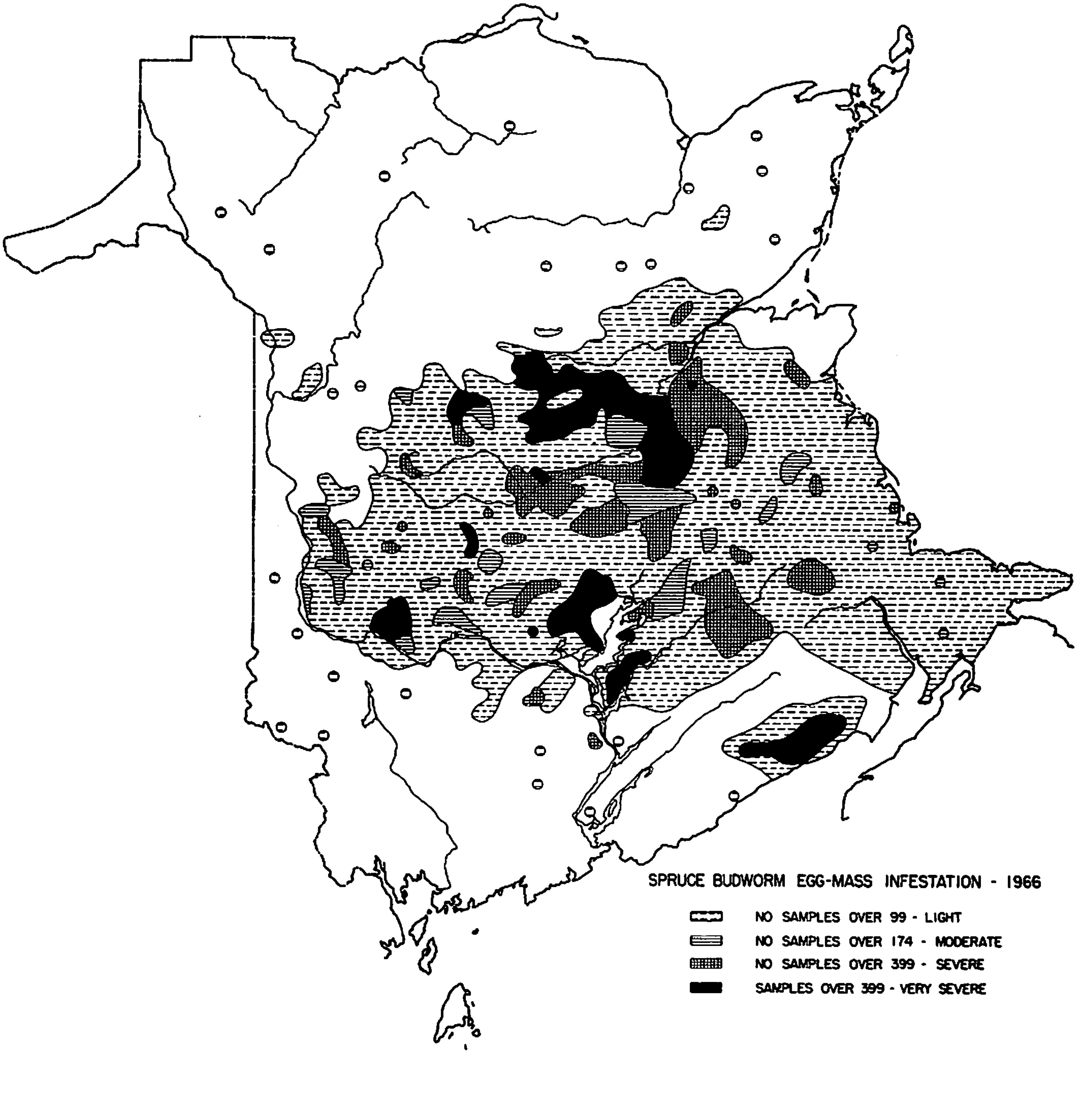
An infestation has also developed along the Bay of Fundy coast. Some 57,000 acres including most of the Fundy National Park area are now heavily infested.

There are a number of small widely scattered spot infestations. Six were found in Kent County covering a total of approximately 29,000 acres. Several small infestations were also found in York County, particularly near Cross Creek and Stanley, on the headwaters of the Dunbar Brook, near Becaguimec Lake, McGivney, and parts of McKiel Brook.

The areas where potentially severe defoliation will occur in 1967 total 1,264,000 acres, and moderate to light defoliation can be expected over another 305,000 acres.

The trends in egg-mass populations from 1960 to 1966 are shown in Table VII for the 1966 sprayed and unsprayed areas in the Province. The data from the sprayed area are separated to show populations and trends in the various treatment areas. There is little difference in the egg-mass infestation in areas sprayed with 1/4 lb. DDT compared with areas sprayed with 1/3 lb., however the trend ratio is decidedly in favour of the heavier dose because of the markedly

FIGURE 6


SPRUCE BUDWORM EGG-MASS INFESTATION - 1966
NO SAMPLES OVER 99 - LIGHT
NO SAMPLES OVER 174 - MODERATE
NO SAMPLES OVER 399 - SEVERE
SAMPLES OVER 399 - VERY SEVERE

higher population on those areas in 1965. Egg-mass populations along the rivers were effectively reduced with two applications of 1/4 lb. Phosphamidon per acre but it is apparent that one application did not result in good control, in line with previous experience.

The data from the unsprayed area are separated into northern, central and southern regions and these regions are further sub-divided to show trends in certain areas within them. There was no detectable change in the low populations in the northern part of the Province. The population in the unsprayed portion of the Miramichi Bay area increased by one-half this year but still remains low. In central New Brunswick populations doubled on both the eastern and western sides of the Province and extensive defoliation can be expected on the eastern side. There was a slight increase in the average population in southwestern New Brunswick but this is primarily caused by the two small infestations in the Base Gagetown area. Populations over most of this sub-region remain endemic. In southeastern New Brunswick the population doubled again, continuing a trend that was first noted in 1964.

Although the infestation still extends over a large part of central New Brunswick and is spreading to the southeast, it is encouraging to note that the egg-mass density index* for severely infested areas declined appreciably in 1966. The indices for the past seven years are:

1960	1961	1962	1963	1964	1965	1966
338	266	347	320	332	457	282

The lower index in 1966 does not indicate that the collapse of the outbreak is imminent, but it does suggest that defoliation in 1967 will probably be more sporadic even within the severely infested area.

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* Egg-mass density index

$$= \frac{\Sigma\ (\text{Av. No. Egg-masses/100 sq. ft. foliage x acres infested at that density})}{\text{Total acres}}$$

Table VII. Trends in Spruce Budworm Egg-mass Population by Area 1960 - 1966
(Number of Sample Points in Brackets)

	Avg. No. Egg-masses / 100 sq. ft. Foliage							Ratios of No. Egg-masses					
	60	61	62	63	64	65	66	61/60	62/61	63/62	64/63	65/64	66/65
Sprayed in 1966													
DDT													
2 x 1/4#	187(82)	79(76)	54(81)	193(93)	272(112)	323(135)	81(148)	0.42	0.68	3.58	1.41	1.19	0.25
2 x 1/3#	210(23)	172(37)	88(32)	121(38)	191(41)	506(58)	83(59)	0.82	0.51	1.38	1.58	2.65	0.16
Phosphamidon													
2 x 1/4#	239(41)	81(40)	78(39)	180(58)	272(65)	281(65)	95(74)	0.34	0.96	2.31	1.51	1.03	0.34
1 x 1/4#	45(3)	12(2)	154(5)	177(6)	179(6)	77(6)	238(6)	0.27	12.28	1.15	1.00	0.43	3.07
Unsprayed in 1966													
East Central N.B.	201(103)	111(110)	38(112)	102(129)	126(135)	78(145)	169(172)	0.55	0.35	2.66	1.23	0.62	2.16
West Central "	103(161)	46(183)	26(181)	90(212)	100(245)	28(252)	54(278)	0.45	0.56	3.43	1.11	0.29	1.92
North	7.6(166)	4.2(169)	0.6(170)	0.6(178)	1.7(182)	1.5(178)	1.6(186)	0.55	0.14	1.00	2.88	0.88	1.07
Miramichi Bay	48(26)	40(26)	6(26)	44(29)	43(30)	21(32)	31(33)	0.82	0.15	7.42	0.97	0.48	1.50
South													
East	8(61)	6(63)	3(64)	2(54)	16(57)	35(78)	69(113)	0.67	0.57	0.69	7.18	2.23	1.96
West	15(49)	8(57)	2(58)	4(61)	8(55)	12(64)	21(72)	0.52	0.21	2.38	2.16	1.46	1.74

Observations of current and previous defoliation and the recovery of foliage production following spraying were made at 1400 points during the egg-mass survey to detect areas of high hazard. This survey revealed that the living forest is generally in very good condition and is recovering rapidly from previous damage. Of the 1400 observations only 1.7 per cent were classed as being in a very high hazard condition, and 5.4 per cent were classed as high. Another 7.6 per cent are in a moderate hazard condition and 15.3 per cent are low. There was no appreciable damage observed at the remaining 70 per cent of the locations. The observation points classed as high are widely scattered and represent damage in localized pockets of forest and there are no extensive areas where tree mortality is imminent. Certain areas, however, such as parts of the Cains River watershed where the forest has had a prolonged history of defoliation, require continued protection to promote further recovery of foliage growth. Most of the remaining forest in central and southeastern New Brunswick is in good condition and will be able to sustain moderate to severe defoliation in 1967 without the risk of top-killing or tree mortality.

It is difficult to delineate areas of high hazard under these circumstances. Severe defoliation will be evident in scattered areas throughout central and southeastern New Brunswick next year. But even if the widely scattered areas with high egg-mass populations were to be sprayed in 1967, the low and moderate populations in the adjacent areas have the potential to increase to densities high enough to cause severe defoliation in 1968 given favourable weather next summer. The writer believes that in view of the generally good condition of the forest, defoliation should be tolerated over most of the infestation area next year, with the anticipation that the infestation will either coalesce, or decline, depending on weather conditions next summer. Only those stands which require further protection to promote foliage recovery, and those on the north side of the outbreak where the budworm threatens to spread to the forest protected between 1952 and 1958 are thought to warrant control action.

FOREST PROTECTION LTD.

43 Roseberry Street

Campbellton, N.B.

AERIAL FOREST SPRAYING OPERATIONS

1966

November 1966

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AERIAL SPRAYING OPERATIONS OF FOREST PROTECTION LTD.

1 9 6 6

1. Introduction

The report to the Interdepartmental Committee on forest spraying is an account of the planning and conduct of spraying operations against spruce budworm in New Brunswick by the operating Company - operations which are jointly financed and supported by the Province, Canada and Industry.

2. Spray Plans

A year ago agreement was reached on the desirability of incorporating the following elements into an overall plan:

a) Areas included in the program of spraying would receive two applications each, time permitting.

b) Upper limit of D.D.T. dosage in a single application to be raised from 1/4 pound/ac. to 1/3 pound/ac. for spraying outside of the Miramichi Nashwaak and Tobique drainages.

c) Phosphamidon to be continued in use on forest areas along salmon streams at not more than 1/4 pound/ac. in a single application and these not less than four days apart.

3. From the original outline plan, which found general support, a block plan was built up by the Company during the winter and this was broken down into six airstrip plans of operation.

Altogether it contained some 1.72 million acres, representing some of the heaviest indicated insect populations in spraying history. When spring came and entomologists checked in the field additional neighboring areas, some 0.25 million acres were added for spraying, some of these during the spraying schedule. See small scale maps Figs. 1 and 2 in report by D.R. MacDonald, October 15, 1966.

4. The final plan involved some 1,970,000 acres. D.D.T. spraying made up about 1.75 million (89%) and Phosphamidon spraying 0.22 million (11%). The acreages sprayed from the various strips, dosage, etc. are set forth in Table 1.

While overall area of D.D.T. spraying is roughly equivalent to that of 1965, its make up by Phenological Classes is strikingly different as shown by the following area breakdown.

....2

TABLE I

FOREST PROTECTION LTD.

1966 SPRUCE BUDWORM FOREST SPRAYING OPERATIONS

AREA BREAKDOWN: By insecticide, single application dosage, number of applications, initial and final areas for all airstrips. Numbers are rounded to the nearest 1,000 acres.

INSECTICIDE & DOSAGE	AIRSTRIP	TWO APPLICATIONS INITIAL	TWO APPLICATIONS ADDED	TWO APPLICATIONS TOTAL	ONE APPLICATION INITIAL	ONE APPLICATION ADDED	ONE APPLICATION TOTAL	TOTAL INITIAL	TOTAL ADDED	GRAND TOTAL
D.D.T. 0.25 lbs. in ½ U.S.G./ac.	Juniper	169	129	298	-	1	1	169	130	299
	F'ton	114	-	114	-	-	-	114	-	114
	Dunphy	268	39	307	-	8	8	268	47	315
	Taxes	240	22	262	5	14	19	245	36	281
	Sub-Total	791	190	981	5	23	28	796	213	1009
D.D.T. 0.33 lbs. in ½ U.S.G./ac.	Chipman	444	-	444	6	-	6	450	-	450
	Trout Bk.	264	-	264	12	-	12	276	-	276
	Dunphy	19	-	19	-	-	-	19	-	19
	Sub-Total	727	-	727	18	-	18	745	-	745
Total D.D.T. Treated		1518	190	1708	23	23	46	1541	213	1754
Phosphamidon All Strips 0.25 lbs. in ½ U.S.G./ac.		172	32	204	-	12	12	172	44	216
GRAND TOTAL		1690	222	1912	23	35	58	1713	257	1970

November 11, 1966

1966
Phenological Classes (F.E. Webb adjusted 1966)*
Thousands of Acres*

Airstrip	0	1	2	3	4	All Strips
Fred'cton	73	40				113
Chipman	34	413				447
Trout Bk.		268				268
Dunphy		262	58	20		340
Taxes		111	68	77	18	274
Juniper		18	50	167	59	294
All Classes	107	1112	176	264	77	1736
% 1966	6.2	64.0	10.1	15.2	4.5	100.0
% 1965	12	28	20	27	13	100

* Estimated from maps and spray record - approx. only.

Extreme variation in the size of area which would reach spraying optimim at a time was a powerful factor in fixing the size and make-up of the spray fleet. The size of Class one, for instance, made flying of T.B.M.'s out of Chipman mandatory.

5. Log of the D.D.T. portion of the spraying program is shown in Table II. The manner in which the operations successfully completed two applications is best seen in Table III, where progress by Phen. classes is tabulated.

From May 30 until completion June 22, there were 36 spray periods (possible 48), 20 were in the mornings (possible 24). There occured 10 good days averaging 130,000 U.S.G. output/day, which must be a record.

6. As in 1965, a mixed fleet of T.B.M.'s (22) and Stearman(55) was required to man the six airstrips. The Stearmans were at Taxes (25) and Trout Bk. (30) while T.B.M.'s at varying strengths worked from Dunphy, Chipman, Juniper and Fredericton Airports. Stearmans moved into Juniper to spray some of the hilly terrain and a small amount of Stearman spraying took place from Dunphy late in the project. Stearman flying for all experimental use of insecticides also based at Dunphy. Altogether the fleet had the required mobility.

During operations a Helicopter, T.B.M. and Stearman were lost, but without serious injuries to crew.

7. As estimated initially, the project cost was very close to $1.00/ac.

Expenditures - total approx.	$2,025,000
1966 Surplus Materials Inventory	50,000
Net Cost	$1,975,000
Acres Sprayed	1,970,000

TABLE II

DATE	AIRSTRIP						SPRAY PERIOD TOTALS	DAILY CUMUL. TOTAL
	DUNPHY	JUNIPER	CHIPMAN	TAXES	FRED'CTON	TROUT BK		
30					12620		12620	
30					4100		4100	16720
31			16190		16570		32760	
31			4820		9745		14565	64045
1			32035		13820		45855	
1			12600				12600	122500
2						3459	3459	
2	16210		23877	3008		4210	47305	173264
3	29843		33450	19226		17876	100395	
3								273659
4	33821		58490	18761		26584	137656	
4						4203	4203	415518
5	12470		33465	12155		14259	72349	
5	9630	2677		4200			16507	504374
6	29102	9570	26745	15769		26284	97470	
6								601844
7								
7								
8								
8								601844
9					8365		8365	
9		17000	5630	7813	7595	10050	48088	658297
10	38559	67125	18295	23564	24910	26116	198569	
10								856866
11		26720					26720	
11				2253	2760		5013	888599
12	27657	35040	5600	15155	13195	17872	114519	
12								1003118
13		5030					5030	
13								1008148
14								
14				9605			9605	1017753
15								
15	5701	4792	9100	5400		13153	38146	1055899
16	24856		48830	9454		12602	95742	
16								1151641
17	23440	150		3151		5250	31991	
17	8350	12360	29455	16950		21000	88115	1271747
18	17955	27147	33620	15004		30902	124628	
18	11011	7112	17460	3451		10500	49534	1445909
19	23724	32260	47256	21152		20252	144644	
19	4340	11740		13203		3000	32283	1622836
20	6446	18180		17254			41880	
20	1201			3750			4951	1669667
21		7050					7050	
21	1501						1501	1678218
22	10503	10636		25806			46945	
22	3000			7918			10918	1736081
TOTALS	339320	294589	446918	274002	113680	267572	1736081	1736081

TABLE II

LOG OF SPRAYING OPERATION U.S.G.-D.D.T. ONLY

TABLE III

U.S.G. D.D.T. INSECTICIDE SPRAYED 1966 IN TWO APPLICATIONS BY PERCENTAGE OF TOTAL IN EACH PHENOLOGICAL CLASS AND BY PERCENTAGE OF TOTAL GALLONS OVER DATE

PHEN. CLASS		MAY 30	31	JUNE 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	% TOTAL GALLONS
0	F	30	95	100																						
	S								5			44	93		95					97	100					6.2
1	F		2	12	26	40	66	78	86			88	95					95		96	97	100	100			
	S								1			1	9	9	21		22	28	44	58	77	94	97	97	100	64.1
2	F						0	26	58			67	98									99	100			
	S													11	17	19			27	43	76	92	95		100	10.1
3	F								13			24	70	81	90	92		93		100						
	S														14	15					33	73	81	82	100	15.2
4	F												12	22	47			48		68	85		100			
	S																				4	11	35	55	100	4.4
% TOTAL GALLONS		1	4	7	10	16	24	29	35			38	49	51	58	58	59	61	66	73	83	93	96	97	100	100.0

Note: F and S refer to First and Second Application.

TABLE III

8. Over 96% of the area was sprayed according to plan. Some 2.75% in the Miramichi was sprayed at 1/3 pound dosage instead of 1/4 pound because at the time it seemed to be the sensible thing to do. About 1.2% of the total area received one applications instead of two.

This year estimates of acres sprayed and gallons of material used, which are of course independent of each other, show a rather remarkable resemblance to those theoretically obtained from the plan. For instance as it turned out some 1,708,000 acres got two applications of D.D.T. and 46,000 one spray. This should have required 1,731,000 U.S.G. Actually the total is 1,736,000. One could say that it took about 1.003 gallons to do 1.000 gallons worth of work. In the case of Phosphamidon it turns out to be close also, but in the other direction. Theoretically, the acres treated should have required 84,000 gallons. 83,158 were used so that perhaps a 0.25 pound credit was gotten at the expenditure of 0.247 pounds. Such results are, of course, well within the reliability of Company estimates and records, and when it is further found that the correspondence extends to individual airstrip operations, one can be sure that no large discrepancy is possible.

9. T.B.M. spraying employed the same technique as in 1965. Formations of five Stearman using the same aerial flagging as T.B.M.'s and flying straight line swaths replaced the 14 year old system of spraying in pairs natural boundary blocks while under partial surveillance.

This step increased the cost, slowed down the output, but improved results. Most difficult was the finding of additional acceptable navigators.

Essentially, a Stearman spraying group consists of a leader radio equipped, and four others in either V or echelon formation in which the individual aircraft should be laterally separated approx. 6 wing-spans or 200 ft. or say 3 chains. The combined swath is approximately 15 chains. As used most of the time in 1966 Stearmanssprayed blocks 6.25 miles long x 0.37 miles wide in one outward pass plus one formation turn plus a return pass. In doing so they used up a load of 150 U.S. gallons and applied the liquid at a rate of 0.5 U.S.G./ac. At the cost of additional turns the number of swaths may be increased and the block shortened to suit shape of area to be sprayed.

Difficulties encountered in using the system operationally for the first time were:-

a) A reluctance in pilots to fly the V formation which is preferred by the Company.

b) Determination of ideal flagging balance for a number of groups had to be found by trial and error. Fortunately, some time lost in smoothing out this relationship did not affect the outcome of the operation.

c) Slowness in reporting aircraft which are not functioning as calibrated.

It is thought that these and other minor difficulties in using this sytem can be overcome with practice.

At present results are gratifying and pilots seem to like being guided, especially in flat country. Without breaking formation it was possible to fly Stearmans in this way in terrain too hilly for close contact T.B.M. spraying.

10. A special two man calibration team brought the fleet into working condition and maintained calibration during the operating period. They also calibrated aircraft for special assignments.

Greater standardization of equipment was achieved this year as can be seen from Table IV.

TABLE IV

AIRCRAFT CALIBRATION DATA 1966

	STEARMAN	T.B.M.	AG-CAT	SNOW
Nozzle Type	No.4664 T-Jet Diaphragm Check Valve	do	do	do
Nozzle Tip	T-8010 Flat Spray	none	T-8010 Flat Spray	T-8010 Flat Spray
Nozzles on Boom	19-20	22	9	12
Pressure P.S.I.	40-45	18	40	65
Flow Rate G.P.M.	20.2	62.4	8.8	11.0
Application Rate U.S.G. per acre	0.5	0.5	0.2	0.2
M.M.D. by & Max. Method	165	170	-	-

11. More than 200,000 acres of forest bordering salmon streams (over 600 miles of stream border) was sprayed by AG-CAT and Snow aircraft with an assist from T.B.M.'s.

These aircraft were particularly suited to the river side spraying operating in pairs.

For this work the Company continued to use 0.25 pounds/ac. in a single application in the 7.1 dilution. Two applications more than 4 days apart was the rule.

12. Excellent utilization was made of a Helicopter supplied for sampling in hard-to-get to spots in advance of spraying and and during surveys.

Two entomologists, R.W. Nash of Augusta, Me., and N. Rae Brown of U.N.B., took part in the program for a month and swelled to four the entomological team which certainly paid off in this particular year.

The Company was responsible for the housing and feeding of scientific personnel and helpers in Blackville and at airstrips on a cost basis.

13. Field testing of insecticides was carried out from Dunphy Airstrip as described by D.R. MacDonald. The Company found the materials, made up the required formulations and applied these as directed by the several workers in charge of the trials. Exception to the above is the Chemical Control Institute Program, in which case the Company supplied one Stearman aircraft and pilot as required and all the while kept a weather eye on the Institute's outdoor formulation shop.

In the Sumithion program not enough material was available on site soon enough to allow tests to be made in early stages of larval development. In the case of tests reported by D.R. MacDonald (Forestry) and J.R. MacDonald (Fisheries), valuable experience in handling the material was obtained and under the surveillance of Dr. McCarthy (Health and Welfare).

Emulsifiable Concentrate of Sumithion was made up by the Company as required according to the formulation supplied by Cyanamid of Canada, Dr. Cooper, as follows:-

<u>Weight by Weight Basis</u>

Sumithion from the drum	82.4%
Atlox 3409 Emulsifier	9.0%
Texaco Aerotex 3470 Solvent Oil	8.6%
	100.0%

The Company conducted two substantial trials of the insecticide as an oil solution, i.e. eliminating the emulsifier and water.

14. Attention was given to the safe handling of materials in the formulating stage and in loading aircraft. For field testing of new materials a closed system was constructed at Dunphy which cut exposure to a minimum after material was pumped from original container.

All spray aircraft came equipped for bottom loading and fitted with one half a dri-break connection. The mating part was on the Company loading line. This is a forward step cutting out all loading time exposure to pilot and practically eliminating dripping and blow back at the loader position.

All precautions taken a year ago to minimize the chance of exposure to ground and air personnel are still in force.

An incident which was more or less expected by Dr. McCarthy involved a mechanic who was drenched with 7:1 dilution of Phosphamidon trapped in a spray plane system and loosened by the accidental tripping of a dump valve. Prompt attention to this case by the doctor soon had the man out of trouble. In this instance had the doctor not been nearby the man could have had serious eye damage to say the least. It would seem that flushing of spraying systems between spray periods in an area which can be decontaminated is a requirement when using organo phosphate insecticides.

It must be reported that a shipment of poisonous material was received by the Company in poor condition (containers). It is a miracle that some did not get loose in transit. Less care was taken in loading the car than usually is accorded a carload of road primer. Motor transport shipments must be watched. It is customary for a lone driver to roll barrels off the back end of the trailer with or without benefit of a tire on the ground to absorb the shock. The Company knows of such an instance in 1966 in which contents of several drums were lost (not budworm project, not organo phosphate).

Labelling has improved. Exception 1966 Sumithion. These labels looked like laundry tickets and were just as hard to find, an indication of a last minute diversion of material from a Japanese destination with no time left to put Cyanamid on the package. This will in all probability not recur.

15. The Company has dropped L.V.C. spraying tests while retaining interest until such time as proven reliable hardware becomes available in quantity.

16. Activities relating to spruce budworm since completion of spraying June 24, are listed briefly:-

a) An aerial defoliation survey was made in late June early July. Results were turned over to Canada Department of Forestry.

b) Assistance was given to the annual egg-mass survey for which helicopter service was reactivated.

c) The usual house-keeping and maintenance program which follows spraying has kept key operating personnel busy.

d) On October 13, a meeting of representatives of Company Shareholders was held in Fredericton for the purpose of discussing the current budworm situation. Those attending were woodlands personnel.

e) A Company meeting of the Directors was held in Fredericton on November 8 for the purpose of studying results of the 1966 spraying and surveys. At this and the meeting of October 13th, D.R. MacDonald gave detailed explanations on the insect outbreak situation and of forest conditions.

17. Last year the report said re invidious year to year comparison of spraying experience that "It will be interesting to hear how results are rated in a good operating year which is also a good year for the pest". Well, we have just had such a season. Miraculously along came the weather pattern best shaped for the successful handling of the unbalanced spray plan. Insecticide was applied for the most part when those who know about timing agreed it would do the most good. The project was completed before any pupation of consequence. It is assumed that coverage was improved. Defoliation was light, trees were helped. According to surveys populations have been reduced further than in most past programs. Sponsors seem happier (because of forest condition probably) in spite of an increase in cost.

Such a glowing picture (as good as can be expected in crop insurance) is not likely to come this way again soon. Therefore, the Company will bask in the glow against the day when the warmth must not be forth-coming.

18. The Company thanks all who took part in the 1966 program in the field and in the office and on the ground as well as in the air.

19. Finally for the 1967 suggestion box:-

a) The Company wishes to alert the Committee to the fact that on occasion large amounts of expensive powerful poisons move from seller to customer without the necessary safeguards to the public health.

b) While it is most gratifying to see the number of studies of effect of spraying increase it seems important to point out again that no time should be lost in the search for acceptable alternatives to the time dishonoured D.D.T. and family.

c) The Company is interested in seeing the Phosphamidon experimental file kept open. This material has a good reputation as a budworm insecticide with the Chemical Control Institute and has been an excellent stop gap alternative to D.D.T. along the Salmon waters. No answer so far is available regarding its potential during the early stages of budworm development or on early and late combined use for that matter. Should not experimentation with this material be continued?

d) Sumithion shows some promise of fitting the prescription of the specific poison required. But, its use should continue to be monitored on a larger scale than in 1966, in order to satisfy all parties regarding possible side effects not detected at the present scale of use.

e) It is recommended that consideration be given to testing combinations of insecticides in order to determine compatability, possible synergistic action and potential of combinations. One which is suggested is Sumithion 1/4 pound/ac. fortified with Phosphamidon 1/8 pound/ac. in emulsion.

f) It is recommended that continuity in study of occupational hazards to health be maintained in possible future spray projects.

B.W. Flieger/jc
November 11, 1966

REPORT ON THE HEALTH ASPECTS OF THE NEW BRUNSWICK FOREST SPRAYING OPERATION 1966

The 1966 Spruce Budworm Spraying Operation was, from a health viewpoint, successful. There were no fatalities to report.

As in previous years, concern has been expressed regarding the labelling of containers of concentrate as received from the suppliers.

Last year, an attempt by the suppliers to improve labelling was noted. This year, there was a return to former procedures with inadequate, small and illegible paper labels. A few drums left over from last year were conspicuous by the much more adequate stencilled labelling on the drums.

The new product, Sumithion, was received in metal drums with securely locked tops. There was, however, a complete lack of meaningful labelling. There were some paper stickers on the drums but since these were presumably in Japanese, they were of limited value as warning devices.

The inner plastic liners on the phosphamidon drums were of excellent quality. The outer metal containers had been obviously subjected to rough handling. The lid of one drum was partly torn off but the inner plastic liner, although deformed, was intact and holding. The plastic liners for the sumithion drums were of light gauge and quite fragile. There were, however, no detectable ruptures of the liners.

There was, as in previous years, an experimental program of pesticide formulation and application under the direction of the Department of Forestry. The pesticide containers were smaller than those supplied for the operational program but were, on casual observation, as inadequately labelled. There was some pesticide shipped in one-gallon glass jars.

Glass does not seem to be an adequate container for potent pesticide subjected to rough handling.

The formulating was, on the whole, handled very well this year. There was some difficulty experienced in convincing formulators and loaders of the necessity of wearing protective gear. The gear worn at present is adequate to protect the wearer but is bulky and cumbersome. The plastic face shields that attach to the respirators and protect the eyes from splashes were missing from some of the masks. Other masks fit poorly and cartridges had not been changed.

Sumithion was applied as a water emulsion. The emulsifying agent caused pronounced foaming of the formulation and a few spills occurred. These were disposed of by applying caustic soda and hosing liberally with water. This procedure appears to have been adequate.

An aircraft caught the loading hose and tore it from its mooring and, in so doing, sprayed a loader with 1 in 7 phosphamidon solution. He swallowed a small amount, probably less than a spoonful. He was kept under observation for twenty-four hours but suffered no untoward effects.

The mechanics continue to be a source of concern since the nature of their work makes adequate protective gear difficult to wear. One mechanic working on the sump of an Ag Cat was drenched with phosphamidon solution. (There is a tendency for phosphamidon solution to settle out so that the sump contains a much darker solution. Whether or not it is more highly concentrated is unknown.) He was seen within minutes and appropriate measures instituted. He recovered completely on two doses of antidote and suffered no more than inflamed eyes and a bad scare.

There was no evidence of illness among the pilots and it is thought likely that their exposure except in unusual circumstances, is minimal. The constant changing from one operational site to another with only intermittent exposure to the organo phosphates probably prevents any cumulative effect.

The experimental program of the Forestry Department is disturbing to the medical personnel attempting to prevent accidental poisoning. All the recommended procedures are not always followed and protective gear is not always worn. The officer in charge being quite familiar with the chemicals used has probably developed a system that is adequate to prevent accidental exposure. It is hoped, however, that a consistent approach to safety can be developed, particularly when two programs, experimental and operational, are carried on from a single site. The blood tests would tend to confirm that the experimental program is safe.

From the single significant exposure encountered this year and from the observations made on him a few unusual features emerge. Although the man showed some of the clinical signs of organo phosphate poisoning, his blood studies did not confirm the clinical findings.

It is possible that our present blood tests are too crude for use as a device to detect incipient poisoning.

There were several aircraft mishaps which did not appear to have any relation to the use of pesticide. From none of these were there any serious or permanent injuries.

The recommendations that could be made with a view to preventing accidental poisoning are much the same as other years. Medical participation would be valuable at the planning stage of the 1967 operation.

Any information on the toxicology of new pesticides proposed for use should be made available for perusal prior to the actual beginning of the operation. This is of importance with the experimental pesticides.

Medical supervision should be continued and a search for new diagnostic tests should be undertaken.

Lighter protective gear might be considered, particularly a lighter rubber boot.

There should be an attempt made to keep gear intact and repaired from year to year.

Appendix VI

PRELIMINARY REPORT ON THE EFFECTS OF THE 1966 FOREST SPRAYING ON NEW BRUNSWICK SALMON

by

G. H. PENNEY and J. R. MacDONALD

RESOURCE DEVELOPMENT BRANCH
DEPARTMENT OF FISHERIES OF CANADA
HALIFAX, N.S.

1966

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Preliminary Report on the Effects of the 1966 Forest Spraying on New Brunswick Atlantic Salmon

INTRODUCTION

Results of previous studies have documented the serious effects of DDT to Salmonids and to fish food organisms. This is the latest of a series of assessments made each year to measure the effects of budworm spray on the salmon resource of New Brunswick. Early field investigations were carried out by the Fisheries Research Board of Canada. Since 1960, the Resource Development Branch of the Canadian Department of Fisheries has monitored the effects of forest spraying on stream-dwelling juvenile salmon in New Brunswick.

The Fisheries Research Board of Canada found by quantitative sampling of native salmon from 1951 to 1963 that DDT sprayed at one-half pound per acre reduced fish-of-the-year by about 90 per cent, yearling salmon by about 70 per cent and two year old parr by about 50 per cent. It was also shown that double applications of one-quarter pound DDT per acre caused as much damage to fish as the single application of one-half pound per acre. In 1962 the Research Board investigated the effects of one-pound of Phosphamidon per acre on aquatic insects and preliminary results indicated no serious effects.

Investigations carried out by the Resource Development Branch of the Canadian Department of Fisheries from 1960-1965 can be summarized as follows:

1. Severe mortality occurred to salmon and trout juveniles when exposed to applications of DDT at the rate of one-half pound per acre.

2. Applications of DDT at the rate of one-quarter pound per acre reduced caged fish mortality by about one-half.

3. Double applications of one-quarter pound of DDT per acre caused caged fish mortalities similar to those observed in areas receiving a single application of one-half pound per acre.

4. No significant mortality was observed among juvenile salmon held in areas sprayed with Phosphamidon.

5. In areas sprayed with Phosphamidon but being a short distance below tributary streams sprayed with DDT, mortalities were moderate to high, apparently reflecting the amount of DDT reaching Phosphamidon sprayed areas. Beyond the immediate influence of DDT sprayed tributaries, the Phosphamidon safety zone spraying has resulted in greatly reduced fish mortality.

6. A species of Caddisfly larvae subjected to Phosphamidon spraying at the rate of one-quarter pound per acre showed no ill effects six days following spraying.

The above results show the serious effects of DDT on fish life. They also show that extensive use of Phosphamidon on salmon streams and their tributaries greatly reduces the serious DDT effects. As a result of these investigations, the present spray program has evolved whereby Phosphamidon is extensively used along streams that can be readily seen from the air.

In 1966 approximately two million acres of New Brunswick forests were sprayed. An area of 1.196 million acres was sprayed with DDT at the rate of one-quarter pound per acre, with 1.163 million of these acres receiving a second application of DDT at one-quarter pound per acre. Two applications of DDT at the rate of one-third pound per acre were sprayed on 0.74 million acres and .017 million acres received a single application of DDT at one-third pound per acre. In the operational spray area forest lands adjacent to major streams or lakes were sprayed with Phosphamidon. These buffer zones were approximately 1,000 feet wide on each side of streams or around lakes. A total of approximately 600 miles of streams was sprayed in this manner with Phosphamidon applied twice at one-quarter pound per acre and on approximately 24 miles with Phosphamidon applied once at one-quarter pound per acre. An area of about 7,700 acres was experimentally sprayed with Sumithion at one-half pound per acre. Spray areas for 1966 are shown in Figure 1.

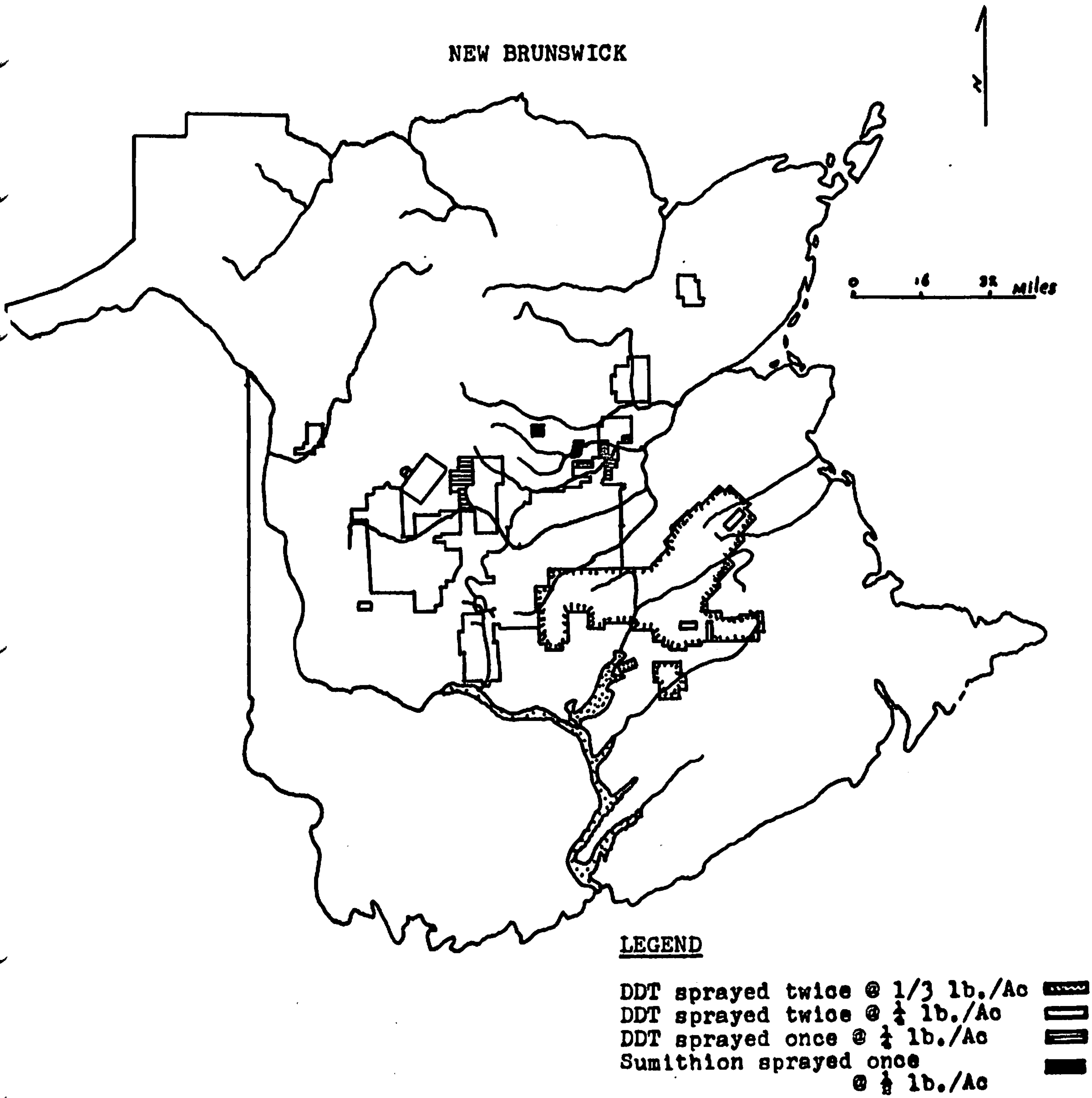


Figure 1. Map showing 1966 New Brunswick post spray area and principal salmon streams.

This report is a preliminary analysis of the data collected during 1966 by the Resource Development Branch of the Canadian Department of Fisheries. The report presents five groups of data.

First, the comparative toxicities of various insecticide applications were studied by observing the mortality rates of caged yearling Atlantic salmon in spray area streams. These caged fish tests provide a useful measure of the various spray treatments used and allow a distinction to be made in their evaluation which would be difficult to make by any other field evaluation.

Secondly, the short term effects of the 1966 spraying on the native stream parr populations were studied by comparing pre-spray and post-spray population densities. This was done in order to measure the actual change in natural populations affected by the budworm spray program.

Thirdly, a late summer population census on juvenile salmon was conducted on Phosphamidon buffered streams. The population densities of underyearling salmon found in this study give an indication of the effects of the 1966 forest spray to fish of the year, while the population densities of the salmon parr show survival rates of populations that have been exposed to previous sprayings as well.

Fourthly, the effects of Sumithion on the fish food organisms of the stream bottom were examined.

Fifth, a section of a stream that was sprayed twice with DDT was enclosed by fine mesh nets and dead salmon parr that were collected on these nets were recorded.

METHODS

(a) Caged Fish Studies

Salmon yearlings of hatchery origin were held in live-cars at seven stations in six spray area streams and in two unsprayed control streams. Generally, two live-cars 36" x 15" x 15" were held at each station and twenty-five three inch hatchery parr were placed in each cage at least one week prior to spraying. Daily inspections were made at each location up to the tenth day following spraying, and records were kept of fish mortality, maximum-minimum water temperatures and water level fluctuations. Salmon fry were used as test organisms at six locations and native parr were used at one location. Test streams were as follows:

1. Stewart Brook - sprayed twice with DDT at the rate of one-quarter pound per acre with no Phosphamidon buffer zone protection.

2. Taxis River - (two stations) - sprayed twice with DDT at the rate of one-quarter pound per acre and protected by Phosphamidon buffer zones except for the headwaters and smaller tributaries.

3. Betts Mill Brook - sprayed twice with DDT at the rate of one-quarter pound per acre and protected by Phosphamidon buffer zones.

4. Big Hole Brook - sprayed twice with DDT at the rate of one-quarter pound per acre and protected by Phosphamidon buffer zones.

5. Black Brook - sprayed with Sumithion at the rate of one-half pound per acre applied directly over and parallel to the stream.

6. Stewart Brook (South Esk) - unsprayed control for the above-listed stations.

7. East Sabbies River - sprayed with Sumithion at the rate of one-half pound per acre, applied directly over and parallel to the stream.

8. West Sabbies River - unsprayed control for East Sabbies River.

Figure 2 shows the location of the tests conducted at the Sumithion sprayed streams.

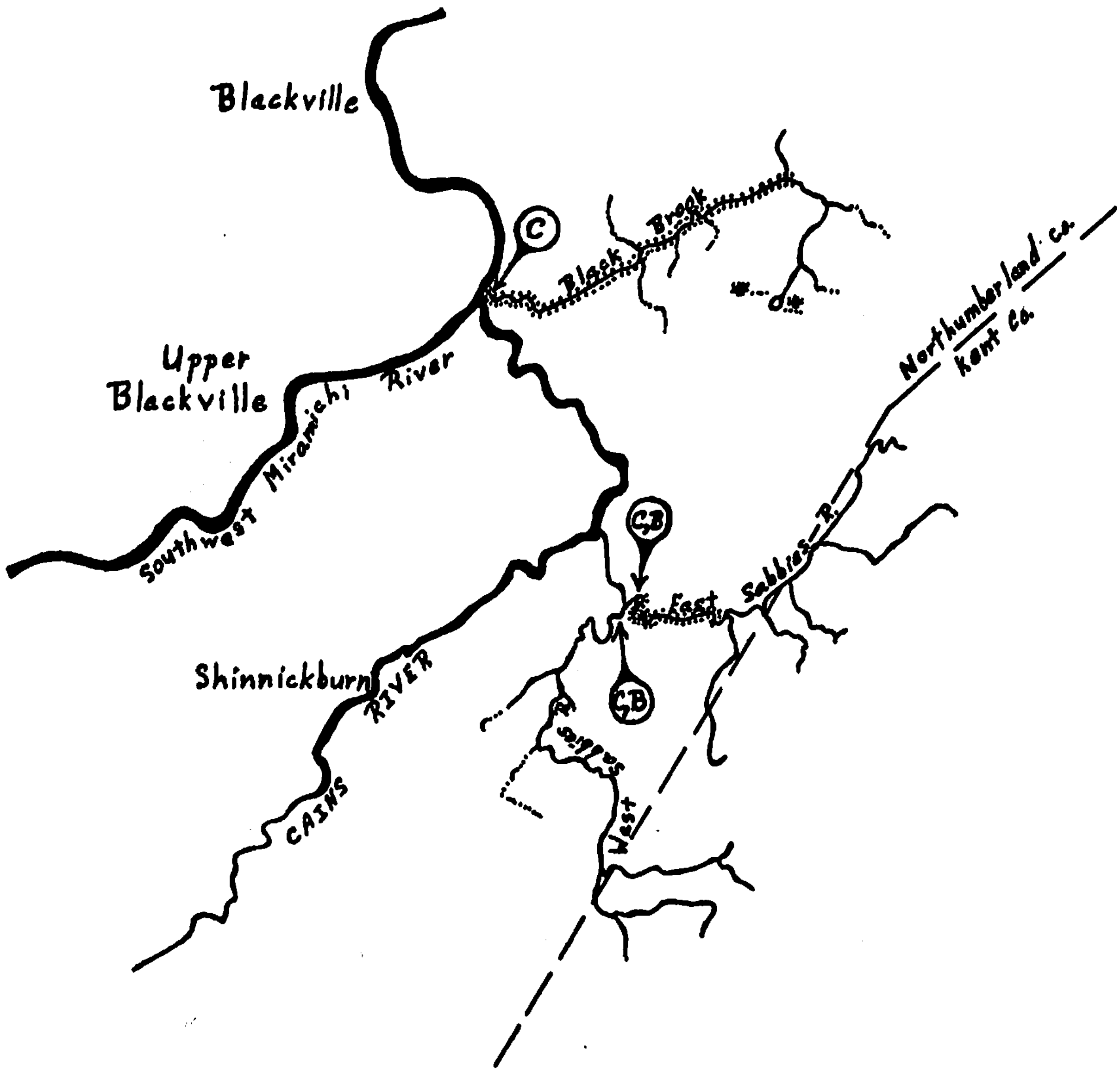


Figure 2
Scale 1"=4 mi.

Black Brook and Sabbies River watersheds showing extent of Sumithion spraying indicated by dotted lines along stream.
Caged fish stations indicated (C)→

Bottom fauna study areas indicated (B)→

(b) Pre Spray - Post Spray Population Studies

Population studies were conducted in sprayed and unsprayed streams to assess the immediate effects of spraying on native populations of salmon parr. Three stations were situated on streams which had Phosphamidon buffer zone protection. These were McBean, Hayes and Burntland brooks. One station, Stewart Brook, was situated on a stream sprayed with DDT but with no Phosphamidon protection. One sampling station was situated on an unsprayed control stream, the North Branch of the Dungarvon River. Sampling stations were physically similar and were considered representative of good salmon rearing areas.

At each station one-quarter-inch-mesh barrier nets were used to enclose 300 feet of stream and this area was electro-fished one week before spray. Salmon parr were measured, counted and released to the section of the stream from which they had been seined. A few days following final spray, each station was again electro-fished in the same manner. In this way, an estimate of juvenile salmon abundance before and after spraying was made for a discrete area of the sampled stream.

(c) Late Summer Census

In addition to the short term population studies described above, longer term effects of spraying were assessed by additional population estimates of juvenile salmon beginning one month following spraying. These tests also enabled us to evaluate the spray program from the point of view of damage to fry, which previous to this time are too small to be adequately sampled. Fourteen stations were sampled, two of which were on unsprayed control streams, the North Renous and Little Southwest Miramichi rivers. Three stations were located on each of the Taxis and Southwest Miramichi rivers and six on the Cains River. All spray area stations received Phosphamidon buffer zone protection. Areas adjacent to buffer zones each received two applications of DDT at one-quarter pound per acre, with the exception of three test areas on the Upper Cains River which received two applications of DDT at the rate of one-third pound per acre. Figure 3 shows the location of the six Cains River stations. One-quarter inch mesh barrier nets were, as in the preceding study, erected to enclose approximately 500 square yards of stream. The enclosed area was electro-fished five times in succession. After each seining, the size and numbers of juvenile salmon were recorded. No fish were returned to the area, so with each successive sweep the number of fish caught became smaller. A regression of catch per unit effort was thereby obtained. A projection of this regression by the method of DeLury (1951) yielded an estimate of fish in the area.

(d) Effects of Sumithion on Bottom Fauna

To determine the effects of Sumithion on bottom fauna, the East Sabbies River was chosen as the test stream and the West Sabbies River as the unsprayed control. Both streams had similar physical characteristics. Twenty samples were taken from each stream one day previous to spraying; from the test stream three days following spraying, and again from both streams two weeks following spraying. Samples were taken by means of a one-foot square Surber stream bottom sampler. The number of fish food organisms and their wet weight was determined for each square foot of stream bottom sampled.

(e) Barrier Net Studies

In an attempt to observe the effects of DDT applied without buffer zone protection to native uncaged fish, one-quarter inch mesh barrier nets were erected 300 feet apart on Stewart Brook. The nets were carefully sealed to the bottom to prevent parr from entering or leaving the enclosed area. Daily inspections were made in the area enclosed by the barrier nets and in an area extending 350 feet above the barrier nets. Nets were also cleaned daily to prevent heavy accumulation of debris. Dead fish were removed and recorded according to the area from which they came.

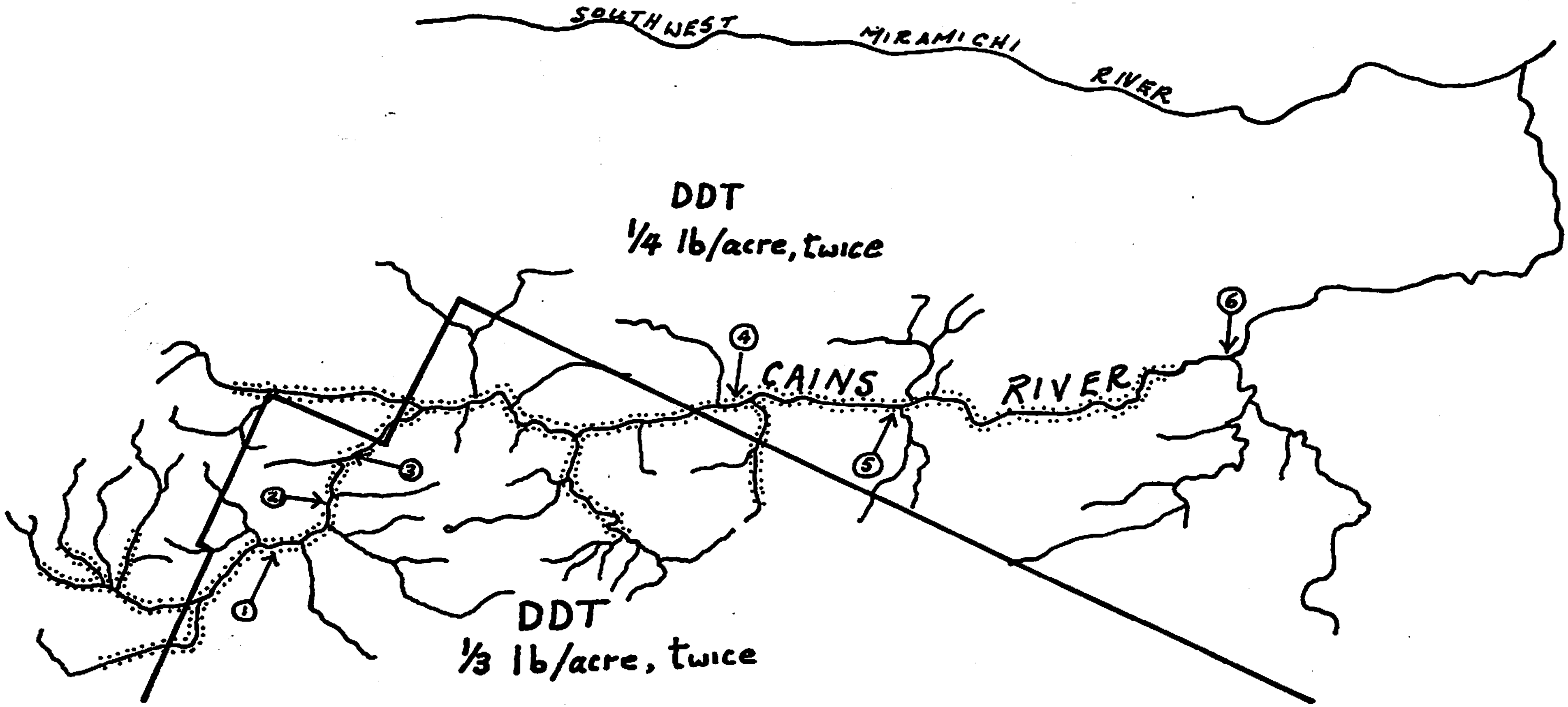
RESULTS

(a) Caged Fish Studies

Data from these tests are recorded in Table 1, as percent mortality. The percent mortality is based on mortalities that occurred during the period extending from the first spraying in the area of the test station to the tenth day after the last spraying in that area. Results show that no short term mortality of juvenile salmon is attributable to Sumithion sprayed at one-half pound per acre. Percent mortalities of salmon parr in Sumithion sprayed streams gave about the same values as their unsprayed controls. Fry mortality in Sumithion sprayed tests was also found to be insignificant.

The effectiveness of Phosphamidon buffer zones along salmon streams is shown by data in Table 1. Parr mortality in the sprayed streams averaged 13 per cent and was 8 per cent at the unsprayed control. The single test using salmon fry did not show significant mortality. Mean percentage mortality of parr in Phosphamidon protected streams is higher than in the Sumithion tests. However, all Phosphamidon protected streams received water from DDT sprayed tributary streams, while Sumithion was the only insecticide influencing the Sumithion tests. Stewart Brook, which did not receive Phosphamidon protection, gave results that would be expected from two applications of DDT at one-quarter pound per acre each.

An additional caged fish test was run at the DDT sprayed Stewart Brook to compare mortalities of hatchery and native parr. This test was terminated on the fifth day after the first DDT spraying. During that period about three-quarters of the caged hatchery fish died while only ten per cent of the native parr died. No mortalities occurred in the unsprayed hatchery fish or native fish controls during this period.



Scale 1" = 4 miles

Figure 3. Cains River watershed showing 1966 spray coverage as indicated within marked boundaries; stream Phosphamidon indicated by dotted lines; population study areas indicated by encircled number and arrow.

	Percent Mortality of salmon parr Cage No.			Percent Mortality of salmon fry
Sumithion Tests	1	2	Ave	
Black Brook ½ lb/Ac	0	5	2.5	1
E. Sabbies River ½ lb/Ac	0	5	2.5	3
Unsprayed Control	0	0	0	3
" "	4	4	4	16
Phosphamidon Safety Zones				
Taxis River R.B.	19	6	12.5	
" " M4	19	25	22	
Betts Mill Brook	12	-	12	
Big Hole Brook	7	0	3.5	6
Unsprayed Control	12	4	8	

Mean of sprayed parr tests - 12.5%

DDT only				
Stewart Brook 2 x ½ lb/Ac	74	96	85	
Unsprayed Control	12	4	8	

Table 1: Percent mortality of caged salmon parr and fry of hatchery origin to the tenth day following spraying in areas with Sumithion, DDT, Phosphamidon safety zones, and at unsprayed controls.

Compared with the 1965 results, the caged parr mortality this year has decreased, probably resulting from increased Phosphamidon protection on smaller brooks and tributary streams. Examination of the 1965 and 1966 spray maps show that in 1966 the Taxis River received some extended Phosphamidon buffer zone protection in the headwaters and smaller tributary streams, along with the additional influence of an unsprayed corridor extending for five miles along the river. Included in this corridor are several tributary streams not sprayed in 1966 but which were sprayed in 1965. Stewart Brook shows 15 per cent lower mortality over the 1965 results. In that year Stewart Brook was sprayed with two applications of DDT at one-quarter pound per acre, along its entire length of six miles. In 1966, spraying of this brook consisted of only two miles on its lower end with two applications of DDT at one-quarter pound per acre each. Betts Mill and Big Hole brooks were almost wholly sprayed with Phosphamidon buffer zones in 1966.

(b) Pre Spray - Post Spray Population Studies

Juvenile salmon population estimates are presented below as the numbers of salmon parr per 100 square yards of stream bottom.

Station & Spray Type	Pre Spray Estimates Small Parr	Large Parr	Total	Post Spray Estimates Small Parr	Large Parr	Total	% Change
Stewart Br. DDT-2x¼ lb/Ac	15	0	15	16	1	17	+13
McBean Br. Phos. Zones	6	2	8	7	4	11	+37
Hayes Br. Phos. Zones	14	2	16	10	4	14	-12
Burntland Br. Phos. Zones	15	11	26	14	8	22	-15
N.Br. Dungarvon Unsprayed Control	30	9	39	34	7	41	+ 5

This study was conducted in an effort to compare survival rates of wild salmon parr subjected to conditions of direct DDT spraying versus Phosphamidon protective spraying. Unfortunately, results from this study do not permit such a comparison. These data suggest that DDT applied at the rate of a double application of one-quarter pound per acre caused no mortality of salmon parr. In fact, they would seem to indicate that DDT causes spontaneous generation of parr! The observation that no reduction in parr abundance was found in the stream sprayed with DDT despite the fact that dozens of dead parr were observed in the sampling area during the week following spray, invalidates these tests. The results are attributed to movements of salmon parr into the cold water of the sampling streams during the period when adjacent main river waters became increasingly warmer.

(c) Late Summer Census

In order to measure parr abundance and the 1966 post spray fry survival, population estimates were determined on major salmon streams from one to two months following spraying. Salmon parr and fry populations, expressed as numbers of fish per 100 square yards of stream bottom during this late summer period, are presented in Table 2.

An examination of the data presented in Table 2 shows that abundance of salmon fry and parr was low, despite Phosphamidon safety zones, where the two applications of one-third pound of DDT were sprayed over the drainage area. The highest abundance of fry and parr in this area was at the Bantalor Road station, but even here the population densities were less than half the unsprayed control densities. Average population densities at these stations is less than was found in years when DDT was sprayed over the entire drainage basin, with no protective zones. At the other nine spray area stations where two quarter pounds of DDT had been sprayed in combination with Phosphamidon safety zones, average fry abundance is similar to the control fry abundance while small parr and large parr are about two-thirds as abundant as in the control streams. Parr populations at the lower

Station		Small Parr	Mean	Large Parr	Mean	Fry	Mean
Taxis River, Maple Grove	2 x ¼ lb. DDT/	16		2		49	
" " , Red Bridge	Acre in area	5		2		53	
" " , Mile 4	with Phosphamidon protection	5	9	5	3	3	35
S.W. Miramichi, Grey Ledge	"	17		10		73	
" " , Ansel Brook	"	20		3		31	
" " , Duff Pond	"	6	14	3	5	19	41
Cains River, Leighton Brook	"	28		15		28	
" " , Estey Brook	"	17		9		11	
" " , 6 Mile Brook	"	23	23	10	11	25	21
Cains River, Bantalor	2 x 1/3 lb. DDT/	0		1		0	
" " , McKinley Br.	Acre in area with	2		4		1	
" " , Bantalor Road	Phosphamidon protection	2	1	5	3	12	4
North Renous River, Richard's Mill	Unsprayed Control	31		6		26	
Little S.W. Miramichi, Mile 32	Unsprayed Control	17	24	15	11	38	32

Table 2: Post spray population densities of juvenile salmon, given as numbers of fish per 100 square yards of stream bottom.

Cains River were similar to control populations in size. This part of the Cains River area has had very little DDT spraying since 1962. The parr populations of the Taxis River and the main Southwest Miramichi stations were generally lower than the unsprayed control, probably reflecting the compounded damage from exposure to successive years of spraying. The populations of large parr, which will be the source of the 1967 smolt crop, are low at the stations on the Taxis, Miramichi and Upper Cains rivers. They represent about one-third the density of the control populations.

(d) Effects of Sumithion on Bottom Fauna

Results of the three series of bottom samples are tabulated as follows:

	Sumithion ½ lb/Ac		Unsprayed Control	
	Number of organisms per sq.ft.	Wet weight organisms per sq.ft. 95% limits	Number of organisms per sq.ft.	Wet weight organisms per sq.ft. 95% limits
Pre spray	71	.57 (.45-.70)	61	.53 (.44-.62)
Post spray	21	.28 (.20-.36)		
Post spray	25	.19 (.11-.28)	62	.47 (.39-.59)

Results of preliminary investigations of the effects of Sumithion on bottom fauna show that an application of one-half pound per acre applied directly to the stream reduced the numbers and weight of bottom organisms by about two-thirds the pre spray levels, two weeks following spraying. During the same period, bottom fauna in the control stream remained stable in regard to numbers and weight.

(e) Barrier Net Studies

Barrier nets were erected in Stewart Brook on May 25, but were partially washed out on June 10. They were not replaced until June 15, from which time they were held in place until completion of observations on June 28. DDT was applied at the rate of one-quarter pound per acre on June 6 and again at the same rate on June 22.

Figure 4 shows the number of dead salmon parr found daily at Stewart Brook from May 26 to June 28.

Examination of this graph shows that significant numbers of dead salmon parr were found following DDT spraying. The highest values were recorded a few days following the first application of DDT. No satisfactory explanation can be offered for the fact that most of the dead parr were recovered from this section of stream following the first spraying with DDT, and very few after the second spraying. However, the caged fish mortalities at this stream followed the same pattern where 83 per cent of the caged parr died following the first DDT spraying with only about 3 per cent dying after the second DDT spray. It might be, therefore, that the second spray application did not reach the stream in the same proportions as the first application.

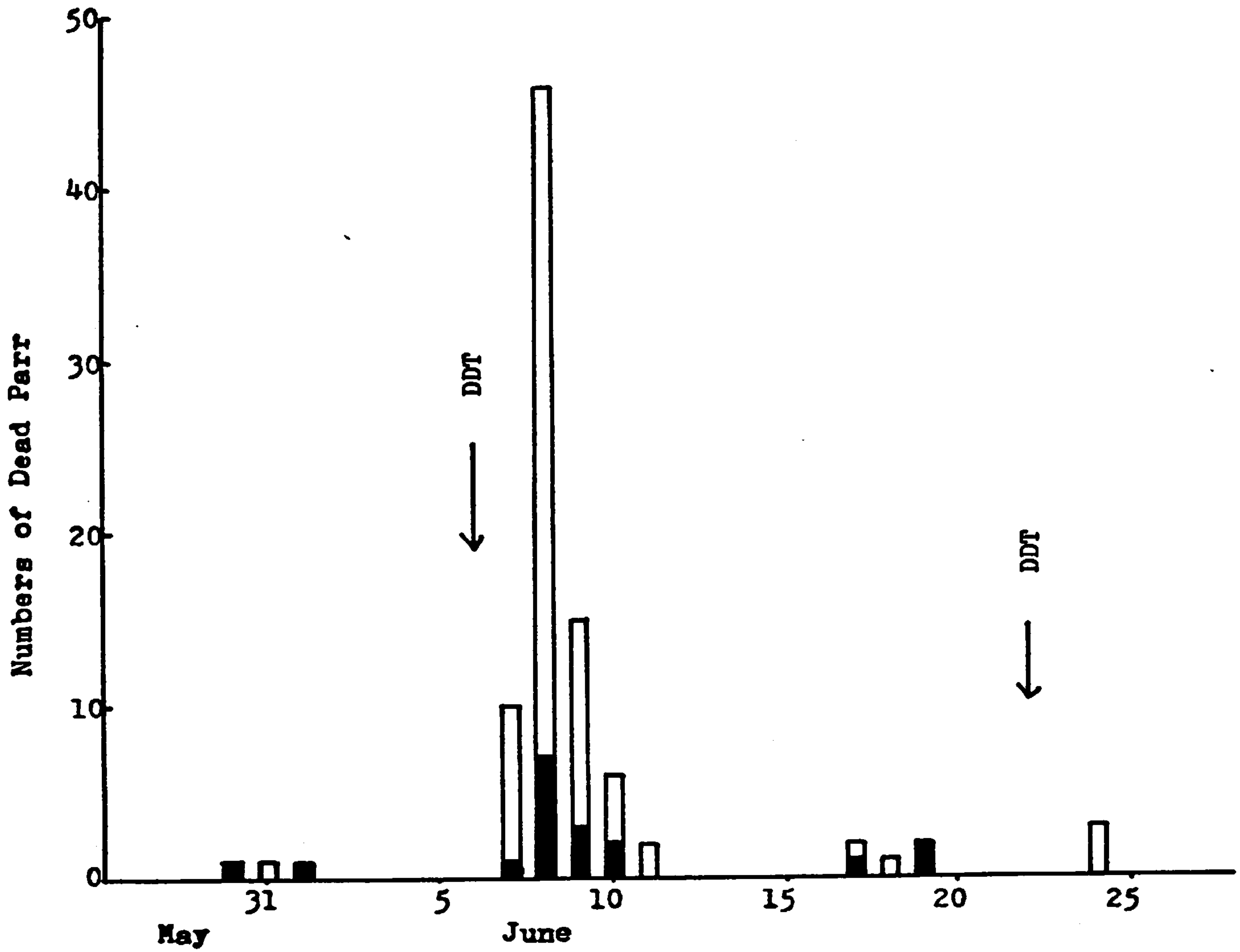


Figure 4. Numbers of dead salmon parr collected on barrier nets in Stewart Brook in 1966. The dark bar represents fish collected from the lower net, the light bar from the upper net.

DISCUSSION

The use of Phosphamidon safety zones along streams in the 1966 forest spray area has, with one exception, resulted in significantly reducing the mortality of juvenile Atlantic salmon. The one exception, at the Upper Cains River where two-thirds pound of DDT was sprayed over much of the drainage area, resulted in severe reductions of young salmon stocks. In the remaining spray areas, August sampling revealed that young salmon populations were at least two-thirds that of normal densities. Caged fish tests also indicated that the 1966 juvenile salmon mortality was reduced from previous years. It is believed that the extended use of stream side Phosphamidon in 1966 was mainly responsible for the improved fish survival.

The hazard of DDT to fish was once again demonstrated in 1966 in a DDT sprayed tributary, Stewart Brook, where caged fish studies and observations of native stocks indicated significant losses of salmon parr. Also at the Upper Cains River, despite Phosphamidon protection, salmon parr as well as underyearlings were scarce following spraying.

Sumithion, sprayed at the rate of one-half pound per acre, did not cause any mortality to caged salmon fry or parr. Bottom fauna at the Sumithion sprayed streams were reduced to about one-third of the pre spray level while there was little change at the unsprayed control during the same period. Further studies should be made on the effects of Sumithion on bottom organisms if this insecticide is to be used in future spray programs. However, although studies in 1966 indicated a definite hazard to bottom organisms, the Sumithion did not kill young salmon and hence must be considered as less damaging than DDT at similar rates of application.

For the third time an attempt was made to relate mortalities of native stream parr to mortality rates of caged hatchery parr in spray area streams. In 1964 it was estimated that in a DDT sprayed stream, approximately 20 percent of the native parr died while 95 percent of the caged hatchery parr died. In 1965 an estimated 20 percent of the native parr died in a DDT sprayed stream, while caged hatchery parr mortalities were 100 percent. In the 1966 study it was found that there was a 10 percent mortality to caged native parr during the same period that about 80 percent of the caged hatchery parr died. These data indicate that, whereas the caged hatchery parr are useful in comparing the relative toxicities of different insecticides and varying dosages, the short term mortality of the caged hatchery parr is much greater than the short term mortality of the wild stream-reared fish.

In general, these 1966 data indicate increased protection of juvenile salmon in spray area streams when compared with previous years of spray treatment. The yield of large parr, those fish which have been exposed to three annual sprayings, such as in the Taxis and Main Miramichi rivers, is low, being about one-third the unsprayed density. Smolt production will be limited by this factor, and for this reason continued effort must be made to further reduce the forest insect control hazard to New Brunswick salmon in future years.

DRMacdonald
APPENDIX VII

REPRODUCTIVE EFFECTS OF DDT ON NEW BRUNSWICK ROBINS

Preliminary report

by

S.M. Teeple and J.A. Keith
Canadian Wildlife Service

December 1966

INTRODUCTION

This study was a trial run. It aimed at defining methods by which reproductive effects of forest spraying on songbirds might be measured in New Brunswick.

The spray variable was the operational use of DDT, with the assumption that the current year's DDT use was less important than that of the previous five years, since much breeding-robin food consists of earthworms. An examination of DDT residues in robins and their environment is part of the study, but not of this report, since the chemical analysis is not yet complete.

METHODS

The field work was done by S.M. Teeple and K.N. Child during May, June and July 1966 on DDT-sprayed and unsprayed forest areas of east central New Brunswick. The treated study area consisted in one old clearing of about 16 acres and another of about 5 acres, and roughly two-thirds of a mile of sodded, unused road near them. It lay approximately two miles north-northwest of Doaktown, in an area over which it is believed that a total of 2.4-3.1 lb/acre of DDT was emitted during the years 1960-65 inclusive. In 1966, 0.5 lb/acre was emitted in June. The larger clearing had 8-10 foot spruce and alder encroaching on it. The other had a scattered growth of 6-8 foot white pine and alder. Both were completely surrounded by the spruce-fir-hardwood association typical of central New Brunswick.

Data on reproductive success in untreated areas was collected from two sources. One was a study, similar to that on the treated area, on an untreated area 1.5 to 5.5 miles south and east of Newcastle. At its closest point, this area was about five miles from forest that had been sprayed with DDT (0.5-0.7 lb/acre 1960-65). The other source was the Maritime Nest Record Scheme, maintained by the Canadian Wildlife Service. Most of the records in this system were submitted to the Service by amateur naturalists. Data on robin nests in unsprayed areas of New Brunswick from 1960 to 1965, inclusive, were extracted from the Scheme.

Nests on both the treated and the untreated areas were located by searching on foot the type of forest cover known to be favourable to nesting robins. Nests were checked, in general, every second day on the treated area and every third day on the untreated area.

On the treated area there were 15 nests for which sufficient data were collected to render them useful in calculating parameters of reproductive success. The untreated area yielded 13 such nests. Data from 23 nests were assembled from the Nest Record Scheme.

RESULTS

Table 1 sets forth some statistics derived from the study. Also included, for comparison, are results obtained by Howell (1937) in western New York and Young (1947, 1948) in Wisconsin.

Many of the reproductive parameters measured in New Brunswick robins show great variability, so great that with the sample sizes used, no definite conclusions can be drawn regarding differences in reproductive success between sprayed and unsprayed areas.

Robins, due to their marked preference for agricultural areas, are not an especially good species on which to carry out a study in a forested region. Also, they are a multi-brooded species, and so final assessment of population increments must include data on all broods within a season, and this data was not collected. But these and other design defects have greatly improved our knowledge of what constitutes a good method of measuring songbird reproductive success in these conditions.

Table 1.

ROBIN NEST DATA

	Treated Area New Brunswick 1966	Untreated Area New Brunswick (Chatham) 1966	Untreated Area New Brunswick (other areas) 1966	Howell Western New York 1937	Young Wisconsin 1948, 1949
Active nests 1/	15	13	23	69	176
Number successful 2/	11 (14)	7 (12)	14 (16)	45 (69)	86 (176)
% successful	79	58	87	65	49
Eggs known to have been laid	46 (13)	34 (10)	81 (23)	132 3/ (?)	548 3/ (over 100)
Average per nest	3.5	3.4	3.5	?	3.4
Eggs known to have hatched	30 (9)	27 (9)	71 (21)	86 (?)	316 (over 100)
% hatched	91	87	97	65	58
Fledglings	27 (13)	12 (10)	40 (15)	70 (?)	246 (86)
Average per active nest 1/	2.1*(13)	1.2*(10)	2.7*(15)	?	1.4 (176)
Average per successful nest 2/	3.0 (9)	2.4 (5)	3.1 (13)	?	2.9 (86)
% young fledged	92 (7)	52 (9)	82 (14)	81 (?)	78 (86)
% eggs producing fledged young	64 (12)	40 (9)	78 (15)	53 (?)	45 (86)

Bracketed numbers indicate number of nests involved.

1/ In which at least one egg laid.
2/ In which at least one young fledged.
3/ Obviously incomplete clutches excluded.
* No significant difference at 95% level among treated and untreated areas.

DR Macdonald
Appendix VIII
(Part 1)

EFFECTS OF FOREST-SPRAY PESTICIDES ON NEW BRUNSWICK BIRDS

1. Effects of Phosphamidon and Experimental Insecticides on Birds.

2. Effects of DDT on Birds.

Preliminary Reports on Investigations

Sponsored by the Canadian Wildlife

Service, 1966

by

C.D. Fowle and W.G. Wilson

Department of Biology, York University

October 1966

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.

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 13% 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.

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

<u>Veery</u>: 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.

<u>Wood warblers</u>: 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.

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

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

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

<u>Bay-breasted warbler</u>: 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.

REFERENCES

Fowle, C.D. - 1965

A preliminary report on the effects of phosphamidon on bird populations in central New Brunswick.

Canadian Widlife Service, Occ. Paper No. 7.

Keith, J.O. and M.S. Mulla - 1966

Relative toxicity of five organophosphorus mosquito larvicides to mallard ducks.

Jour. Wildl. Mgt., 30(3): 553-563.

Vardanis, A. and L.G. Crawford - 1964

Comparative metabolism of 0,0-dimethyl 0-p-nitrophenyl phosphorothioate (methyl parathion) and 0,0-dimethyl 0-(3-methyl-4-nitrophenyl) phosphorothioate (Sumithion).

Jour. Econ. Ent., 57(1): 136-139.

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	29.3	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	55	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

D/ Macdonald

APPENDIX VIII

(PART 2)

2. EFFECTS OF DDT ON BIRDS

BY W.G. WILSON

This investigation, initiated in 1965 by the Canadian Wildlife Service, was continued in the summer of 1966. The purpose was two-fold: (1) To determine population density and distribution of birds on several sample plots, and (2) to observe the effects, if any, of the operational application of DDT on survival, distribution and behaviour of birds.

In general, operational spraying of one quarter to one half pounds of DDT per acre apparently has little or no observable effect on bird populations. Detrimental effects have been noticed only on areas receiving 5 lbs. per acre or more (Rudd, 1964). W.G. Sheldon at the Massachusetts Cooperative Wildlife Research Unit has been unable to detect any change in populations of towhees over a three year period with an annual application of 1 lb. per acre.

However, low doses of DDT may have subtle effects on birds by altering the food supply, contributing to residue accumulations in food chains and altering reproductive rate and behaviour. Changes in food supply could result in the expansion or shifting of utilized territories or to abandonment.

Featherstone and Falls (1966) in their recent study of the feeding habits of ovenbirds in relation to the size of utilized territory, showed that when portions of territories were sprayed with insecticide to reduce food supply an increase in the size of utilized territory resulted. The birds increased their feeding area significantly into unsprayed portions of territories. These observations suggest that operational spraying covering large areas might have important effects on the availability of insect foods which would be reflected in changes in distribution and behaviour of birds.

In an attempt to answer some of these questions two plots of about 25 acres each were established in 1965 and surveyed so that lines ran the length of the plot at two-chain intervals with each line marked at chain intervals to facilitate mapping and plotting of observations.

Plot DDT-1 was situated approximately 3/4 mile southwest from Parker Ridge and it received two dosages of 1/4 lb. DDT per acre. Plot DDT-2 was located just south of Napadogon along the Williamsburg Road and received one application of 1/4 lb. of DDT per acre. Spray cards indicated satisfactory coverage for each application.

In 1966 the work on Plot 2 was discontinued but Plot 1 was used and a third plot (DDT-3) was set up near Weaver Siding. It received two applications of 1/4 lb. DDT per acre. Plot 1 received two dosages of 1/4 lb. each as it did in 1965 but spray cards indicated that coverage was negligible on the second application. Observers in aircraft stated that weather conditions caused the spray to rise and drift instead of falling. Attempts to re-spray the plot were not successful and only the eastern one-third received the required dose. Spray application was considered good on Plot DDT-3.

Estimates of population density and numbers of pairs per unit area were obtained by various methods. In 1965, censusing consisted in traversing the length of the plot along the grid lines and recording the species and, where possible sex, as well as position of each bird seen and heard. Censusing was done between 0700 and 1200 hours ADT. In 1966, a number of censuses, particularly on Plot 1, were begun as early as 0500 and 0600 hours. Occasionally, two or more observers were employed. They traversed the plot abreast of one another at a distance of 1.5 to 2 chains. This allowed coverage of the entire plot during the morning song peak.

In 1966 several modifications in method were tried. The most helpful was the use of mist nets and colour banding. It was intended to band as many birds as possible so as to permit identification of separate individuals. However, as only limited time was available before the spray was applied, the banding done fell considerably short of the amount desired, but enough was done to establish its great value. In total, 62 birds were banded on Plots 1 and 3 including 10 ovenbirds, 7 sapsuckers, 7 juncos, 6 white-throated sparrows, 5 Tennessee warblers, 4 Cape May warblers and 4 robins. The value of colour bands was soon apparent. For example, one banded female sapsucker was observed feeding two separate sets of nestlings at excavations approximately ten chains apart. Two separate males were observed feeding the broods. Without the use of coloured bands it would have been impossible to establish that a single female was involved at the two nest sites.

Improvements in censusing methods were also made. By mid-season three two-way radios were employed and they proved to be quite useful. Two observers with radios traversed the plot in the usual manner and dictated the information on each bird sighted to a third man who remained at the centre of the plot recording the data. This allowed each observer to know what was happening on the adjacent grid line. Birds which were seen between the lines could be pin-pointed more accurately by two observers using radios. Radios also tended to minimise double sightings of individuals, especially those which were not banded.

From the field information obtained, individual territories could be plotted. Nests were also recorded and were important in establishing territorial areas. They were very hard to find and a good deal of diligent searching was necessary to discover them.

In 1965 the estimated breeding population was 42 resident pairs on Plot 1 and 38 on Plot 2. On each plot there were some birds which appeared to be partially resident on the plot and there were some that were of questionable status as shown in Tables 1 and 2. The population density calculated from the 1965 figures approximates 160 pairs per 100 acres.

Data have not been examined sufficiently to determine the population densities this year. Preliminary estimates indicate that 41 and 46 resident and partial resident pairs were on Plots 1 and 3 respectively. Comparatively, in 1965, Plot 1 contained a total of 51 resident and partial resident pairs while 45 were found on Plot 2.

Thirty-four nests were found on Plots 1 and 2 in 1965, and only 11 of them were successful (Table 3). In 1966, 26 nests were discovered of which 9 were considered successful and the status of 7 is uncertain (Table 3). The low nesting success may in part be attributed to the continual disturbance of the plot by human observers which may have increased predation on the nests.

Careful observations were made after the DDT was applied to see if any changes in population, distribution and behaviour had occurred. There may have been small changes in population as, for example in 1965, on Plot 1 where the number of white-throated sparrows apparently fell from three pairs to one and on Plot 2 from five to four. In 1966 there was only one pair on Plot 1. No sick or dead white-throats were found.

On June 18, 1965, one day after the second spraying on Plot 1, a male scarlet tanager was found dead. The bird was collected but as it was not possible to make analysis for DDT the cause of death is unknown.

None of the nest mortalities appeared to have been caused directly by spraying. In most cases the eggs or young were missing and the nest itself showed signs of predation. A veery's nest was found on a low hanging spruce bough on Plot 1 where the eggs were exposed to the spray. The young in this nest fledged and were observed in early July and appeared to be normal.

It is of interest to note that Mott (in Morris, 1963) in 1960 in New Brunswick observed that least flycatchers, Swainson's thrushes, and magnolia and myrtle warblers appeared to emmigrate from the sprayed area immediately after spraying. No such an effect was noticed in this study.

Territorial data have not been analysed for 1966 and the problem of territorial change has not been fully examined as yet. Results of the 1965 work suggests that little or no change occurred which could be detected by our methods. However, estimates of mortality of budworm following spraying suggested that the potential food supply had been considerably reduced on both plots (Table 4). With the depression in the budworm population we might have expected a shift in territorial behaviour. In attempting to interpret these observations it is important to distinguish between total territory and utilized territory, as used by Featherstone and Falls and defined by Odum and Kuenzler (1955). It is quite possible that the extent of utilized territory increased within the limits of total territory but our data has not yet been examined for evidence of this.

The data on changes in budworm and other insect populations following the spraying for 1966 is still being analysed. It is obvious from a cursory examination of the data that considerable mortality of budworm did occur but it was apparently not sufficient to reduce the food level to a point where the behaviour of the birds was effected. Observations for 1966 show that some insect populations, Aphididae for example, increase very greatly after the spraying and may to some extent have compensated for the reduction in other insects. The effect of spraying on the food supply cannot be properly assessed until we have more knowledge of the feeding habits of the various species of birds.

An important factor to be considered is that the study plots are located in areas of light to moderate budworm infestation. Thus our observations are probably affected by the density of budworm. Similarly, the density of birds per 100 acres is considerably below that reported in heavily infested areas by Kendeigh (1947) in Ontario and Morris et al. (1958) in New Brunswick. Kendeigh estimated 319 pairs per 100 acres and Morris et al. tallied 200 to 355 pairs per 100 acres during a 10 year period 1947-56. If we had been working in any area of higher budworm populations we might have recorded higher bird populations. Dramatic reductions in the number of budworm from a very high to a very low level might have an effect on birds living in a high infestation area.

Feeding is undoubtedly linked with the required habitat; that is to say, the utilized territory for a given bird species. Thus a knowledge of habitat selection is very important. Analysis of the types of vegetation and physical structure of the forest have been made on all three plots to attempt to assess the effect of habitat on the distribution of the birds. This assessment consisted of tree cruises, height and age determination of trees, sampling of shrub and ground flora and the mapping of the plots to show the various physical aspects of the individual territories. Certain species show definite correlations between territorial extent and the physical form of the forest. For example, the territory of the ruby-crowned kinglet on Plot 1 in 1966 shows a definite correlation with a band of tall conifers which is bounded on one side by mixed forest dominated by a deciduous canopy and on the other by a semi-open area of regenerating aspen and small conifers.

SUMMARY

1. Estimates from three study plots in central New Brunswick in 1965 and 1966 indicate that bird populations in areas of moderate budworm infestation number 140 to 180 breeding pairs per 100 acres.

2. Aerial applications of up to 1/2 lb. of DDT in 1/2 gallon of formulation have little to no effects on bird populations and distribution according to our methods of observation.

3. Data on habitat selection of major bird species are presently being analysed to further the understanding of the ecology of the area.

REFERENCES

Featherstone, J.D. and J.B. Falls, 1966: Regulation of utilized territory size in the ovenbird. From paper presented at 20th Technical Sessions on Fish and Wildlife Research (Ontario Research Foundation) at University of Toronto, February, 1966.

Kendeigh, S.C., 1947: Bird population studies in the coniferous forest biome during a spruce budworm outbreak. Ontario Department of Lands & Forests, Division of Research, Biol. Bull. 1.

Morris, R.F., W.F. Cheshire, C.A. Miller and D.G. Mott, 1958: The numerical response of avian and mammalian predators during a gradation of the spruce budworm. Ecology 39:487-494.

Morris, R.F. (Ed.), 1963: The dynamics of epidemic spruce budworm populations. Memoirs of the Entomological Society of Canada, No. 31.

Odum E.P. and E.J. Keunzler, 1955: Measurement of territory and home range size in birds. Auk 72: 128-137.

Rudd, R.L., 1964: Pesticides and the Living Landscape. The University of Wisconsin Press, Madison.

TABLE 1. BIRD POPULATION ON PLOT 1 BEFORE AND AFTER SPRAYING (1965)

Species	BEFORE Resident	BEFORE Partial Resident	BEFORE Possible Resident	AFTER Resident	AFTER Partial Resident	AFTER Possible Resident
Yellow-bellied sapsucker	4			3		1
Least flycatcher	1	1		1	1	
Robin	4			4(?)		
Hermit thrush	2	1		1	2	
Veery	1			1		
Ruby-crowned kinglet	2			2		
Nashville warbler	1			1		
Magnolia warbler	1			1		
Cape May warbler	1		1	2		
Black-throated blue warbler	1			1		
Myrtle warbler	1			1		
Blackburnian warbler	1		1			1
Bay-breasted warbler	3		1	3		
Ovenbird	4		1	4		
White-throated sparrow	3			1		1
Other species	12	7	7	10	7	7
Totals	42	9	11	36	10	10

TABLE 2. BIRD POPULATION ON PLOT 2 BEFORE AND AFTER SPRAYING (1965)

Species	BEFORE Resident	BEFORE Partial Resident	BEFORE Possible Resident	AFTER Resident	AFTER Partial Resident	AFTER Possible Resident
Ruffed grouse	1			1		
Yellow-bellied sapsucker	1			2		
Brown creeper	1			1		
Winter wren	3			3		
Swainson's thrush	3			3		
Tennessee warbler	3	1		2	2	
Magnolia warbler	1	1			2	
Cape May warbler			1			3
Myrtle warbler	1			1		
Black-throated green warbler	3			3		
Blackburnian warbler	2	1		1	1	
Bay-breasted warber	2			2		
Ovenbird	6			4		
Canada warbler	2			2		
White-throated sparrow	5			4		
Other species	4	4	5	5		9
Totals	38	7	6	34	5	12

TABLE 3. NEST DATA

Species	No. of nests		Successes		Results Unknown
	1965	1966	1965	1966	1966
Ruffed grouse	1		1		
Yellow-shafted flicker		1		1	
Yellow-bellied sapsucker	6	6	5	4	
Boreal chickadee	1	1	0	0	
Winter wren	1		1		
Robin	6	5	0	1	1
Swainson's thrush		3		1	1
Hermit thrush	3		0		
Veery	1		1		
Myrtle warbler	1		0		
Magnolia warbler		1		0	
Nashville warbler	1		0		
Tennessee warbler	1		0		
Black-throated blue warbler		1		0	
Ovenbird	5	3	2	1	2
Slate-colored junco		3		1	1
White-throated sparrow	7	2	1		2
TOTALS	34	26	11	9	7

TABLE 4. **SAMPLES OF INSECT POPULATION (1965)**

PLOT NO. 1.

June 10	Sprayed
June 14	24% mortality of budworm 46% mortality of other insects*
June 17	Sprayed
June 22	92% mortality of budworm 85% mortality of other insects*

PLOT NO. 2.

June 16	Sprayed
June 21	78% mortality of budworm 100% mortality of other insects*

*"Other insects" includes lepidopterous larvae other than budworm.

General Outline of a Plan for continuation in 1967 of the protection of forests in New Brunswick against damage by the spruce budworm outbreak.

Recommended to the Province of New Brunswick by Forest Protection Ltd.

Based upon studies of the current nature of the spruce budworm outbreak and of the forest condition within the outbreak area, the Company recommends (a) that spraying be undertaken for the protection in 1967 of some 750,000 of infested forest which generally is in poor vigor and (b) that some leeway be left in the planning stage for adding to this minimum acreage other acres if and as spring field examination 1967 finds such addition to be necessary.

A map of New Brunswick (attached) outlines areas in categories (a) and (b).

The Company realizes that studies of new materials and methods necessary to improve forest protection are matters of high priority in dealing with the budworm problem. It is recommended therefore, that cooperative experimentation with promising insecticide be intensified and continued in 1967.

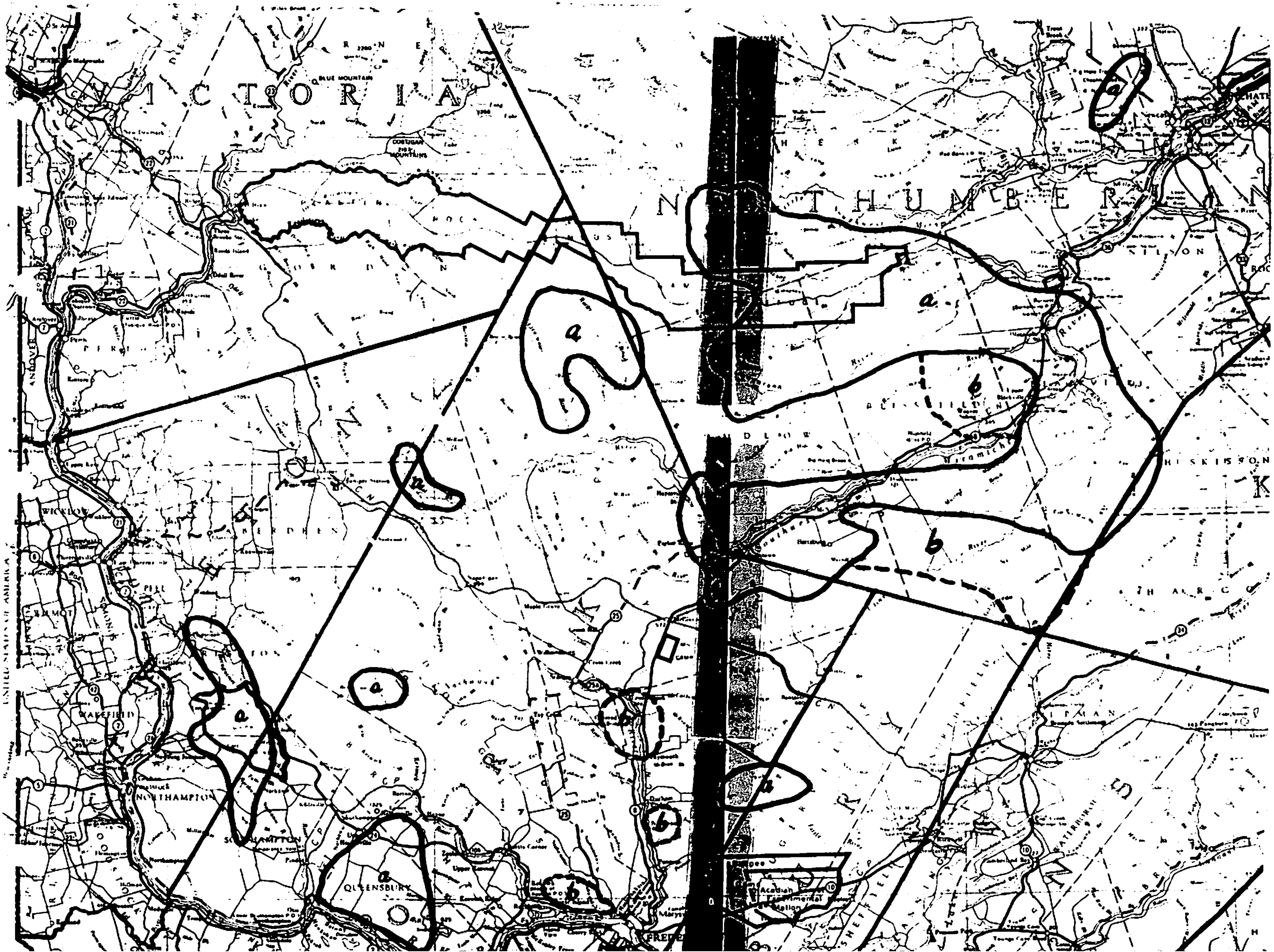
In order to make wider use of present knowledge of the nature and effect of insecticides already under study, it is recommended:-

1. that a fixed but substantial portion of the spray plan total area be sprayed with Sumithion alone and in combination with Phosphamidon, at dosages, acceptable to Forestry Fisheries and wildlife interests.

2. that the larger and variable part of such a plan use D.D.T. in two applications at 1/3 pound/ac. each, supplemented along the salmon growing water courses by a continued use of Phosphamidon in applications not to exceed 1/4 pound/acre not less than 4 days apart.

For the purpose of budgeting it is suggested that $1,200,000 be considered an outside figure to cover costs of such a program of spraying.

K.B. Brown,
President, F.P.Ltd.


VICTORIA
NORTHUMBERLAN
BLUE MOUNTAIN
WICKLOW
WAKEFIELD
NORTHAMPTON
QUEENSBURY
HUSKISSON
UNITED STATES OF AMERICA

CHEMICAL CONTROL STUDIES OF THE BALSAM WOOLLY APHID (*Adelges piceae* (Ratz.)) IN CANADA

by

A.P. Randall, W.W. Hopewell and P.C. Nigam

Resume

Results of the preliminary experiments on the study of the potential effectiveness of some insecticides against the balsam woolly aphid indicate that there are chemicals that exhibit toxicity to this species of insect. Of the series of compounds tested, the carbamate insecticides (Baygon and NIA-10242) appear to exhibit far greater activity than do the organophosphorus compounds. To date, all findings have been obtained experimentally, with no field experimentation conducted on aerial application of insecticide to determine operational effectiveness of these compounds. The data, however, do suggest that the above two compounds may be highly effective in controlling the balsam woolly aphid on plantation and ornamental stock. Confirmation by field experimentation is required before any recommendation can be made.

British Columbia

Preliminary laboratory and field investigations were conducted on the control of balsam woolly aphid in British Columbia using the following chemical insecticides: Baygon, Bidrin, Bayer 29493, C8514, C8874, C9491, Dylox, Diazinon, Formothion, Meta-systox-R, NIA-10242, Phosphamidon, Sumithion and the solvents DMSO, and Invadine. These compounds were tested under laboratory and field conditions as contact insecticides. A summary of the results of these trials indicate that the carbamate compounds such as Baygon and NIA-10242 are superior to all materials tested under the conditions of the experiments. There appear to be some indications that the solvents and penetrants played an important role in the effectiveness of the compounds.

Newfoundland

During the period 1963 to 1966, 27 insecticidal compounds (AC 47470, AC 47772, Aphidan, Aramite, Bayer 37289, Baygon, Bidrin, Ciba 8514, Ciba 8874, Ciba 9491, Diazinon, Dicapthon, Dimethoate, DuPont 1179, Dursban, Dylox, Formothion, Malathion, Menazon, Meta-systox-R, Nellite, Phosphamidon, Sumithion, Thimet, Thiocron, Vamidothion and Zectran) were field tested against the balsam woolly aphid. Each test comprised of a foliar and trunk treatment on infested balsam fir tree (*Abies balsamea* (L)).

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In all, Baygon, Diazinon, Menazon, and Sumithion gave significant control with Baygon being superior to the other compounds. Bidrin, C8874, Dursban and Diazinon showed some activity.

New Brunswick

Investigations on balsam woolly aphid at New Brunswick (1966) were conducted as an adjunct to Newfoundland and British Columbia projects. Work was carried out under controlled laboratory conditions using egg masses, infested twigs and infested potted plants. Eighteen insecticides; Baygon, Bidrin, Ciba 8514, Diazinon, Dicapthon, Di-syston, DuPont 1179, Dursban, Dylox, Formothion, Lindane, Matacil, Meta-systox-R, NIA-10242, Phosphamidon, Sumithion, Thimet and Zectran were tested. NIA-10242, Baygon, Bidrin and Diazinon appear to be promising insecticides on the basis of ovicidal activity and contact and systemic toxicity to adults. The overall indications of effectiveness of the compounds are summarized in Table I.

TABLE I

SUMMARY OF INSECTICIDES TESTED AGAINST THE BALSAM WOOLLY APHID (1963 - 1966)

Insecticide	British Columbia		Newfoundland	New Brunswick	Remarks
	Lab. Exp.	Field Exp.	Field Exp.	Lab. Exp.	
AC 47470	-	-	N. eff.	-	
AC 47772	-	-	M. eff.	-	
Aphidan	-	-	S. eff.	-	
Aramite	-	-	S. eff.	-	
Bayer 29493	S. eff.	N. eff.	-	-	
Bayer 37289	-	-	M. eff.	-	
Baygon	H. eff.	H. eff.	H. eff.	H. eff.	Most promising
Bidrin	S. eff.	N. eff.	M. eff.	H. eff.	
Ciba 8514	M. eff.	N. eff.	M. eff.	N. eff.	
Ciba 8874	M. eff.	N. eff.	M. eff.	-	
Ciba 9491	N. eff.	N. eff.	N. eff.	-	
Diazinon	H. eff.	M. eff.	M. eff.	M. eff.	Some promise
Dicapthon	-	-	S. eff.	N. eff.	
Dimethoate	-	-	S. eff.	-	
Di-syston	-	-	-	N. eff.	
DuPont 1179	-	-	S. eff.	?	
Dursban	-	-	H. eff.	?	
Dylox	M. eff.	M. eff.	S. eff.	?	
Formothion	M. eff.	M. eff.	S. eff.	N. eff.	
Lindane	-	-	-	N. eff.	
Matacil	-	-	-	N. eff.	
Malathion	-	-	S. eff.	-	
Menazon	-	-	M. eff.	-	
Meta-systox-R	S. eff.	N. eff.	S. eff.	N. eff.	
Nellite	-	-	N. eff.	-	
NIA-10242	H. eff.	H. eff.	-	H. eff.	Most promising
Phosphamidon	N. eff.	N. eff.	S. eff.	N. eff.	
Sumithion	S. eff.	N. eff.	S. eff.	N. eff.	
Thimet	-	-	N. eff.	?	
Thiocron	-	-	N. eff.	-	
Vamidothion	-	-	N. eff.	-	
Zectran	-	-	M. eff.	N. eff.	

Legend: N. eff. = Non effective; H. eff. = Highly effective; M. eff. = Moderate effective; S. eff. = Slightly effective; ? = Doubtful

INTERDEPARTMENTAL COMMITTEE ON FOREST SPRAYING

- OTTAWA -

TESTS OF FOUR NEW INSECTICIDES FOR THE PROTECTION OF SAWLOGS FROM AMBROSIA BEETLE ATTACK

by
H.A. Richmond, Entomologist,
B.C. Loggers' Association

For the past six years a large volume of winter cut, high value sawlogs and peelers have been sprayed each spring for their protection from ambrosia beetle attack. The insecticide used has been Benzene Hexachloride, applied as a concentrated oil spray by helicopter to logs floating in water. The spraying of logs elsewhere than in water has not proven to be particularly satisfactory. Because of the toxicity of BHC to fish certain restrictions have been necessary. Principal of these has been a zero date of April 15, this being the average date of commencement of the seaward migration of young salmon from the streams and rivers; the restriction of spraying log booms in river estuaries or the mouths of important streams; and the requirement that spraying shall be restricted to water of a depth approved by the Department of Fisheries. Although there has been no difficulty in adhering to these requirements, they have been extremely costly to the Industry. The greatest of these has been the April 15 deadline since only a fraction of the winter cut logs are in the water by that date. Many millions of feet of logs reach the water between April 15-30, which could have been sprayed before beetle flight, about May 1, but must of necessity be left to the ravages of the ambrosia beetle. For these reasons an effective spray which would be safe for fish would be of tremendous value to the Industry.

Four insecticides were given preliminary trials in the spring of 1966 all of which were known to be relatively safe for fish. These were Methyl Trithion, Baytex, Baygon and Abate. Of these four materials only Methyl Trithion showed potentials as a spray equal or superior to BHC.

Tests of these chemicals were carried out on MacMillan Bloedel, Nanaimo River Operations under the auspices of the B.C. Loggers' Association.

Method of Tests

Because autumn or winter cut logs are the most attractive to ambrosia beetles, logs for these tests were felled in November 1965. Three hemlock and two fir logs were used.

Those portions of the logs designated for tests were wrapped with polyethylene in March to assure that no unexpected attack would occur before spray application. Sprays were applied April 16 and 17 and the sprayed areas were barked and examined for evidence of attack June 16.

The first beetle attack was noted May 2 and activity seemed at its height May 15.

Spray Application

Each test area consisted of five square feet of bark. Because of variation in attack density between areas on a given log and between individual logs, each spray area was bordered on one side with an untreated check and on the other side with an equal area treated with Benzene Hexachloride.

All sprays were diluted to the required strength with

Acetone and applied at a rate of 10 c.c.'s per square foot of bark area giving a uniform dosage at a rate of 10 pounds active ingredient per acre. This is the standard amount of gamma isomer of BHC used in the regular spraying of log booms for ambrosia beetle control.

Although each insecticide was applied on 12 test areas the absence of beetle attack over some of the test areas reduced the number as listed in the tabulation below:

NUMBER OF ENTRANCE HOLES PER SQUARE FOOT LOG SURFACE - June 16

Methyl Trithion

Test No.	1	2	3	4	5	6	7	8
Check	7	31	13	32	37	42	37	10
Methyl Trithion	19	19	9	24	28	22	19	5
BHC	46	19	10	36	36	24	31	12
Check	78	48	16	-	-	36	43	28

Baytex

Test No.	1	2	3	4	5	6	7
Check	25	31	13	13	25	36	26
Baytex	16	19	5	15	16	28	19
BHC	12	11	0	17	21	25	7
Check	-	13	-	28	42	27	-

Baygon

Test No.	1	2	3	4	5
Check	7	31	28	42	37
Baygon	8	23	17	26	27
BHC	12	16	17	21	25
Check	25	-	-	25	36

Abate

Test No.	1	2	3	4	5
Check	40	36	41	26	17
Abate	47	32	43	28	21
BHC	19	24	31	12	7
Check	31	42	37	-	19

Results

Methyl Trithion appears to be the most promising insecticide of those materials tested for ambrosia beetle control. In no test was it less effective than BHC. It looks particularly promising in Tests 6, 7 and 8.

Baytex and Baygon showed some degree of control but not consistently as effective as BHC.

Abate appears to be useless.

Discussion

Tests as undertaken, are little more than indicators of insecticidal effectiveness. Selected test logs, felled so as to be particularly attractive to the insect, and isolated from other host logs so that the beetle has little choice of selection in an area of known beetle abundance are not typical of log booms where control will be exercised.

Furthermore, because of the pronounced intra-log variability of infestation the attack density represented by entrance holes in the wood are not necessarily true indicators of the spray's effectiveness. This is well illustrated in Methyl Trithion, Test No. 1, in which the two untreated check areas were but six feet apart on the log but the degree of infestation per square foot log surface was 7 and 78 holes.

BHC used under operational conditions has given total protection while unsprayed logs , replicates of those sprayed, undergo attack as high as 75%.* At the same time tests in the

* Richmond, H.A. 1961 "Helicopters protect log booms in B.C." Canadian Lumberman, December 1961.

woods, similar to those described above, showed a serious degree of attack on the test areas sprayed with BHC. Hence individual tests of this type can be considered only as indicators.

A greatly refined and enlarged series of field tests will be necessary to confirm the practicability of Methyl Trithion as an ambrosia beetle spray under various conditions. These tests, it is hoped, will be undertaken in 1967. The actual efficiency of a spray under operational conditions can be determined, however, only when applied to booms of suitable logs of known history accompanied with a similar volume of untreated replicate logs.

MEMORANDUM • GOVERNMENT OF CANADA

TO : Mr. K. Jackson, Biologist

YOUR FILE No:

FROM : Mr. J. Watkins, Technician

OUR FILE No: 34-5-2

SUBJECT: Bioassay - Methyl-Trithion 4E

DATE: November 10, 1966.

In July, 1966, a series of bioassays was initiated using facilities set up in our Vancouver warehouse. These consisted of a water bath using domestic water for cooling which kept the temperature at 15°C ± 2°C. A bank of 3.5 gal. aquaria aerated with Titan III air pumps contained the test solutions and fish. Coho fry were used in all tests. These were procured from Tenderfoot Creek near Squamish, B.C., and held and fed at the University of B.C., using the facilities of the B.C. Research Council. The fry had a mean length of 44.9 mm with a range of 34-80 mm. Water used in the aquaria was initially procured from a small stream in North Vancouver, but it was later found more convenient to use the dechlorinated water available from the Research Council.

Among the substances tested, was Methyl-Trithion 4E, a tentative insecticide for control of ambrosia beetle.

Twenty-four hour preliminary tests were conducted to determine the best concentrations to use in determining the 96 hr. TLm.

The aquaria were set up using appropriate concentrations of Methyl-Trithion 4E, on a linear scale in the method used by Servizi et al. Twenty fish in 10 l. of each test concentration were used in each aquarium along with a similar sized control. Observations were made at frequent intervals over the 96 hours and mortalities recorded every 24 hours.

From the results obtained, the 96 hr. TLm was determined and the highest concentration at which no mortalities occurred over 96 hours was noted.

Observations: - fish took no avoidance action at concentrations tested;

- most mortalities occurred after 48 hours had elapsed.

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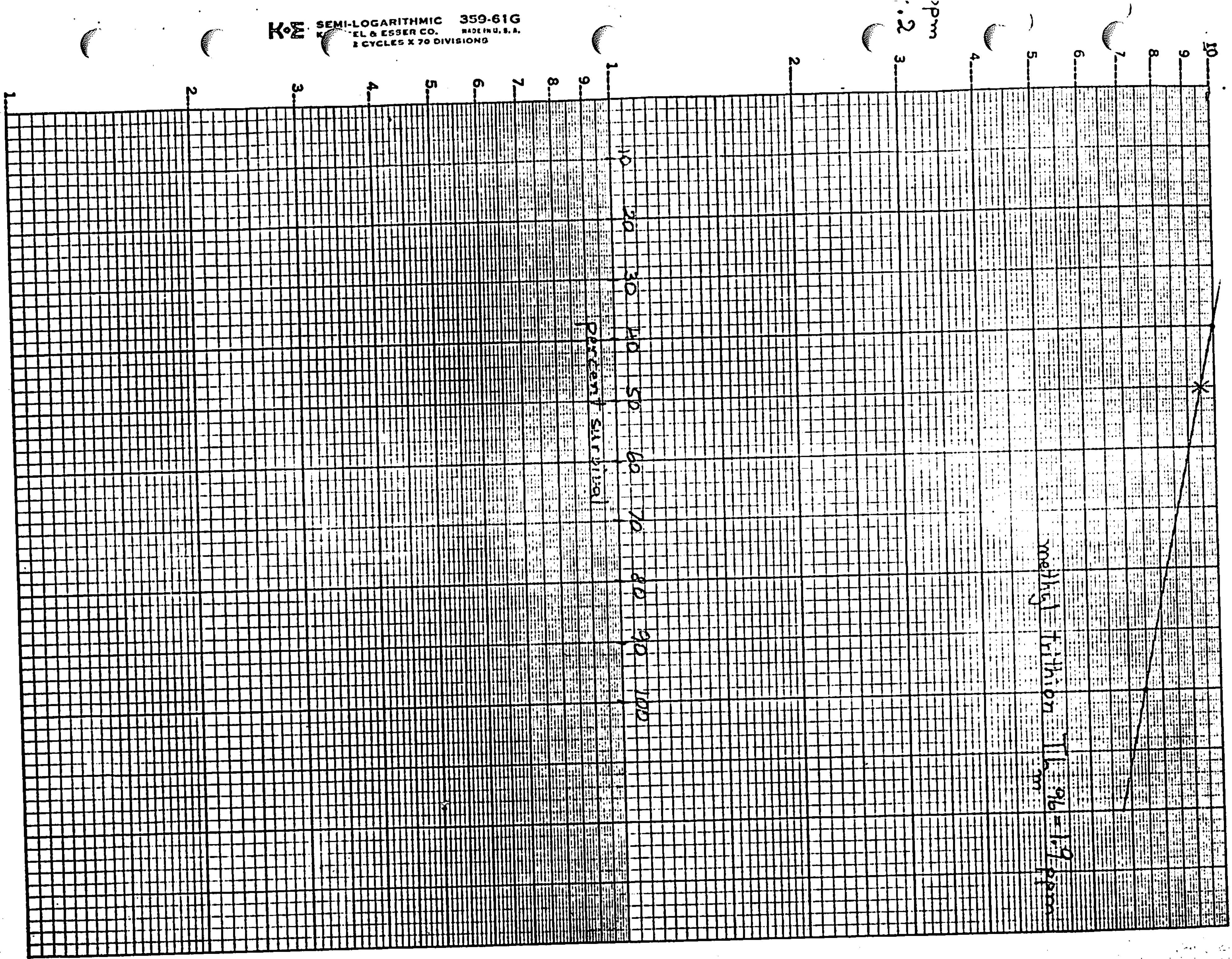
Results: Methyl-Trithion 4E

Concentration	% Survival 24 Hr.	48 Hr.	72 Hr.	96 Hr.
2.0 ppm	95%	95%	65%	40%
1.5 ppm	100%	100%	100%	100%
1.0 ppm	100%	100%	100%	100%

96 Hr. TLm of concentrate = 1.9 ppm
100% survival over 96 Hr. at 1.5 ppm

All of these concentrations pertain to the dilution by volume of the sample used rather than to the concentrations of active toxic ingredient.

J. V. Watkins,
Technician.


K&E SEMI-LOGARITHMIC 359-61G
KEUFFEL & ESSER CO. MADE IN U.S.A.
2 CYCLES X 70 DIVISIONS
Percent Survival
10 20 30 40 50 60 70 80 90 100
methyl Trithion TL m 96 = 1.9 ppm

CONTROL OF <u>NEODIPRION</u> <u>SERTIFER</u> IN PINE PLANTATIONS, SOUTHERN ONTARIO, 1966

Project carried out by Ontario Department of Lands and Forests

Biological assessment by Department of Forestry and Rural Development staff

Summary prepared by G. W. Green, Sault Ste. Marie, Ontario

In the spring of 1966 the Ontario Department of Lands and Forests conducted an operational control project against *N. sertifer* in pine plantations in the counties of Dufferin, Simcoe, Ontario, Northumberland and Durham. Ontario Regional Staff, C. S. Kirby and A. A. Harnden, cooperated in assessing the degree of control obtained in the check area (Lot 3, Con. IV, Adjala Township, Simcoe County). This check area consisted of 157 acres of mixed pine plantations managed by the Ontario Department of Lands and Forests for the Metro Toronto and Region Conservation Authority.

Operational details are listed below:

Insecticide - Phosphamidon (Ortho Agricultural Chemicals Limited)

Formulation - Water solution

Concentration - 1.2 ounces active ingredient (2 diethyl carbamoyl-1-methylvinyl dimethyl phosphate per Imperial gallon of spray.

Dosage - One Imperial gallon of spray per acre

Methods of Application - Helicopter:
Type - Bell 47G-5
Tank Capacity - 2 tanks, 60 U.S. gallons each
Spray Boom width - 35 feet
Nozzles - 25 D3 nozzles with 46 swirl plates
Delivery - Centrifugal pump - 60 lbs. per sq. inch
Flight Speed - 60 m.p.h.
Flight Height - 30 feet
Swath Width - 100 feet

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Infestations of N. sertifer were heavy on Scots, red, Austrian and jack pine in the check area prior to spraying and were medium to heavy in nearly all plantations throughout the spray area. Many of the areas had been treated with D. D. T. or virus sprays in previous years. Larval hatching in N. sertifer commenced about May 25 and the spraying operations commenced about one week later. The check area was sprayed on June 1.

Assessments in the check area showed that larvae sprayed during the first week of operation were all killed, although not quickly. In the check area, all larvae were feeding actively 4 hours after spraying, Many larvae were moving about 24 hours after spraying but feeding was much reduced. All larvae were dead when examined on the 4th day after spraying.

In the check area, the helicopter flew in an east to west line of flight and a narrow strip along the north side of the plantation was missed completely. The larval population in this strip was, of course, unaffected by the spraying operation. Larval colonies were taken from this area 5 days after the spraying operation and were placed on trees within the sprayed area. These larvae consumed sprayed foliage and completed their development, apparently without adverse effects. Nesting birds (robins, redwings and song sparrows) within the check area incubated their eggs and raised their young with no apparent ill effects.

In other plantations, sprayed during the second week of the operation, larvae overcame the effects of the spray and these areas were re-sprayed with D. D. T.

Assessments have indicated that:

(a) Helicopter application is well suited to this type of operation, but as with all such operations, complete coverage is essential to satisfactory control.

(b) Phosphamidon at a concentration of 1.2 oz. active ingredient per acre gives satisfactory control of early instar larvae but not of later stage larvae.

(c) Phosphamidon kills slowly when compared to D. D. T. and with N. sertifer appears to act as a contact insecticide rather than a systemic.

(d) Phosphamidon at this concentration has a short residual effect and fails to kill larvae transferred to treated foliage 5 days after application.

On the basis of the foregoing assessment it is recommended that for control of N. sertifer with Phosphamidon at low concentrations, spraying should be conducted within one week of larval hatching. Further field trials should be conducted to determine what concentration of Phosphamidon is required for control of N. sertifer larvae in their later stages of development.

REPORT OF MEETING OF THE INTERDEPARTMENTAL COMMITTEE
ON FOREST SPRAYING OPERATIONS

Sir Guy Carleton Building, Ottawa
December 16, 1966

9:00 AM - 4:30 PM

In Attendance:

Members of the Committee

K. C. Lucas	Department of Fisheries
J. A. Keith	Canadian Wildlife Service
D. A. S. Dyer (for H. W. Beall),	Department of Forestry and Rural Development
H. L. Prebble, Chairman	Department of Forestry and Rural Development
E. W. Burridge, Secretary	Department of Fisheries

Others

R. R. Logie	Department of Fisheries, Ottawa
C. P. Ruggles	Department of Fisheries, Halifax
J. R. MacDonald	Department of Fisheries, Halifax
K. Jackson	Department of Fisheries, Vancouver
J. J. Fettes	Department of Forestry and Rural Development, Ottawa
W. A. Reeks	Department of Forestry and Rural Development, Ottawa
I. C. M. Place	Department of Forestry and Rural Development, Fredericton
D. R. Macdonald	Department of Forestry and Rural Development, Fredericton
T. McCarthy	Department of Health and Welfare, Ottawa
T. G. Willis	Department of Agriculture (representing
H. Hurtig	Department of Agriculture (Federal Inter- (departmental (Committee on (Pesticides
K. B. Brown	New Brunswick Department of Natural Resources
R. L. Bishop	New Brunswick Department of Natural Resources
B. W. Flieger	Forest Protection Limited, Campbellton
H. A. Richmond	B.C. Loggers' Association, Vancouver
C. D. Fowle	York University, Toronto
W. G. Wilson	York University, Toronto

1. The Chairman introduced the following agenda, which were accepted:

   A. Spruce budworm control and associated problems in New Brunswick

      (i) Experimental studies with insecticides, 1966

      (ii) Operational control project, 1966

      (iii) Studies of hazards to humans

      (iv) Studies of hazards to fish and other aquatic life

      (v) Studies of hazards to wildlife

      (vi) Infestation status in the fall of 1966 and areas of hazard for 1967

      (vii) Proposed spray program in New Brunswick, 1967

   B. Experimental control projects, 1966, and proposed experimental projects, 1967 (exclusive of the spruce budworm)

   C. Operational control projects, 1966 (exclusive of the spruce budworm)

   D. Review of infestations that might require operational control action in 1967 (exclusive of the spruce budworm)

2. Agenda Item A(i)

Dr. Fettes reviewed the experimental field studies of insecticides for the control of the spruce budworm undertaken by the Chemical Control Research Institute in 1966. The studies were directed toward evaluation of ultra low volume applications, particularly of newer insecticides. Although available spray break-up equipment for low-volume application was found to be faulty under operational conditions, it yielded better results than equipment tested in 1965, as attested by maximum spray droplet size of about 200 microns in 1966 as compared with maximum droplet sizes of 800 to 1000 microns in earlier trials. He drew attention particularly to data in Table II of a report by A.P. Randall (Appendix I). High density droplet deposit of phosphamidon at 3.3 ounces per acre late in May yielded a control of 94%. Sumithion was less effective in May applications than those made in June, wherein 1 to 3 ounces per acre at adequate droplet deposit densities yielded over 90% control. Zectran was ineffective in late May, but in mid-June applications produced control of about 95% at 0.5 to 1.0 ounces per acre, even at low to moderate droplet density patterns. Unfortunately, there are difficulties in using zectran, including problems of formulation, crystallization, and plugging of spray nozzles. Other materials tested gave less satisfactory results. The comparison trials with DDT (see Table II and text) suffered interference through two additional sprayings that contributed to the recorded mortality, but for which there was no record of insecticide deposit. The failure to achieve almost complete elimination of the budworm from the treated plot by the time of the second count, despite repeat applications of DDT, was interpreted as further evidence of increasing tolerance of the budworm to DDT. The results of population counts following the application of different insecticides to spruce (Table III) supported the more extensive data for balsam fir (Table II).

Laboratory trials of a number of new insecticides against the budworm and two species of sawflies, carried out by A.P. Randall and P.C. Nigam (Appendix II), were discussed briefly by Dr. Fettes. The compound "Matacil" showed great promise against the budworm, yielding 95% control at an assessed deposit of one-half gallon per acre of a 0.5% concentration, and 100% control in concentrations of 1% and 2% (Table I).

The Chemical Control Research Institute proposes to continue its studies of ultra low volume applications of insecticides against the spruce budworm.

D.R. Macdonald described semi-operational field trials of phosphamidon and sumithion in New Brunswick in 1966. The test with phosphamidon was designed to determine whether a pre-emergence application of this systemic insecticide would produce satisfactory control. The cold weather of May resulted in freezing of the insecticide in the spray booms, inadequate application, and very protracted emergence of the young budworms from hibernation. Under these circumstances it was not possible to determine whether pre-emergence application would be effective in a more normal season. The experiments with sumithion (Appendix III, pages 5 to 7, figures 4 and 5, Table IV) were carried out in 1000-acre blocks sprayed with one-half U.S. gallon of formulation containing 1/4, 1/2, 3/4 or 1 pound of the insecticide. Good control of the budworm on balsam fir was provided at 1/2 pound or more per acre. Control was more difficult to achieve on red spruce. Macdonald stated that sumithion is very toxic to younger budworm larvae but much less so to the 6th instar. In reference to protection of red spruce, he described the susceptibility of this tree species to early-seasonal bud-killing, and the importance of killing the budworm in its younger stages to afford protection. With regard to the minimum dosage rate for sumithion, he felt that 1/4 pound per acre is too close to being marginal for effective operational use. Dr. Fettes considered that with improved coverage, through the use of better guidance systems and improved knowledge of meteorological limitations to spraying, lower volumes of sumithion could be used effectively (c.f. Appendix I).

The field trials of various insecticides were made possible by the use of aircraft and various services provided by Forest Protection Limited (Appendix IV, page 5).

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3. <u>Agenda Item A(ii)</u>

Mr. Flieger outlined some of the operational characteristics of the 1966 spray project (for details, see Appendix IV). The acreage sprayed totalled 1.97 million acres, of which 1.754 million acres were treated with DDT, and 0.216 million acres were treated with phosphamidon (along salmon streams). About 13% of the total area was added to the spray program as a result of surveys made by entomologists just prior to and during the spraying operations (Table I). Over 1.1 million acres of the project fell in one phenological category. This caused considerable concern in operational planning, owing to the limited time available for delivery of the two spray applications (see Appendix IV, page 2). However, despite the occurrence of two periods generally unsuitable for spraying, the weather favoured the operation during the first and last 8-day periods, and also during a 4-day mid period, so that the lack of phenological variation in the area to be treated did not cause undue congestion (Table III). The flying pattern involved the use of 5 Stearman aircraft in formation (the lead aircraft radio-equipped), and the use of TBM's in pairs. Particular attention to aircraft calibration resulted in improved spray coverage. Forest Protection Limited procedures for loading insecticides into the aircraft were further improved, but Flieger mentioned incidents of laxity in the shipment and labelling precautions in connection with some shipments of insecticides received by FPL (page 6).

D.R. Macdonald stated that employment of two additional entomologusts by FPL aided in the pre-spray surveys and in timing of the spray applications. The areas sprayed with DDT and phosphamidon are shown in Figures 1 and 2, respectively, of Appendix III. In the DDT spraying, 1.009 million acres were treated with 1/4 pound in each of two applications, and 0.745 million acres were treated with 1/3 pound in each of two applications. Overall population reduction in the DDT-treated area, based on surviving pupae, was 86.6% on balsam fir and 70.4% on spruce (Table II). The population data indicated a slight advantage of the 1/3 pound application rate over that of 1/4 pound per acre, namely 87.7% vs. 86.5% mortality on balsam fir, and 73.3% vs. 68.7% mortality on spruce (Table III). The significance of these small differences was questioned by representatives of the Fisheries Department. Macdonald stated that the defoliation survey was not sensitive enough to detect differences in effect as between the 1/3 pound and 1/4 pound application rates. Population reduction due to phosphamidon treatment along the stream banks was assessed at 81.8% on balsam fir, and 58.6% on spruce.

Protection afforded by the spray project, as assessed by the defoliation survey (Figure 3, Appendix III), was markedly better than in recent operations. A number of scattered areas of moderate to heavy current defoliation were found, but most of these were outside the treated area of 1966. Foliage production was good in 1966, and the trees were generally in good condition at the close of the 1966 season.

4. Agenda Item A(iii)

Dr. McCarthy's report on human health aspects of the 1966 operation is attached as Appendix V. He was critical of the lack of precautions taken by shippers of some of the insecticides. In the case of sumithion, thecontainers were too light, the skull and crossbones cautionary symbol was concealed, and the descriptive label was in Japanese! Some of the small lots of experimental insecticides were shipped in glass containers. The protective clothing supplied by Forest Protection Limited was adequate, but was not worn at all times by the workmen; the mechanics were careless in this regard. Flieger stated that FPL had instituted bottom loading with "dri-break" connections to reduce spillage, but nevertheless there is leakage from joints in the plumbing system within the aircraft. It was very difficult to enforce the wearing of the protective gear in warm weather.

Dr. McCarthy also noted that members of the team carrying out the experimental studies were apparently less concerned with the precautions than were the operational crews. The experimental team was more familiar with the hazards, so the indifference was probably more apparent than real. Repeated tests showed no evidence of toxic effects among members of the experimental team. Dr. McCarthy expressed doubt as to the adequacy of the standard blood tests as a sensitive measure of cholinesterase levels. Dr. Fettes suggested that a safety officer should be employed to enforce adherence to safety regulations.

Dr. McCarthy stated that a medical doctor should be on hand at the project headquarters during the entire spraying operations, and he should have the most up-to-date information on the toxicity of the insecticides being used. The New Brunswick Department of Health is apparently unable to supply a qualified doctor for the spraying project. According to Dr. Hurtig, the Department of Health and Welfare can, on request from a provincial minister of health, provide funds for training and medical assistance in cases of special need or hazard. Suggestions to ensure the availability of qualified personnel included (a) that the Interdepartmental Committee on Forest Spraying Operations urge the Department of Health and Welfare to see that medical assistance would always be available to FPL during spraying operations (Flieger); (b) that the Department of National Defence be asked to supply a medical officer from the chemical warfare section to FPL during spraying operations (Hurtig); (c) that hazards to humans and inadequacies in shipping precautions be drawn to the attention of the Federal Interdepartmental Committee on Pesticides (Logie).

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Dr. Hurtig stated that in the event of accidents leading to personal injury, the use of an unregistered insecticide would expose the employer to a damage claim. Dr. McCarthy noted that acceptance of workmen's compensation amounts to waiving, by the employee, of a claim for damage against the employer.

5. Agenda Item A(iv)

Mr. Ruggles indicated that in 1966 the effects of phosphamidon stream-side spraying in DDT treated areas, straight DDT treatments, and Sumithion spray areas were monitored. Caged hatchery fish were used in spray areas and are considered to provide a good comparison with previous years' results. The effects on fish in the wild environment were measured by carrying out an assessment of stream dwellers. Early winter mortality studies were conducted in the spray areas.

Results of fisheries studies are dealt with in Appendix VI and are reported as the best to date, with substantially lower overall mortality rates than in previous years. It was suggested that this is related to the increased use of phosphamidon stream-side spraying. Reference was made to the following spray area results:

(a) 1/2 lbs/acre DDT (no stream protection) - 85% mortality

(b) 1/2 lbs/acre Sumithion - 0 mortality

(c) 2/3 lbs/acre DDT (headwater area therefore little stream protection) - natural population reduced to less than half

(d) 1/4 lbs/acre DDT, twice (with phosphamidon stream protection) - average fry abundance similar to control streams with some reduction in small and large parr

(e) studies indicated some fall mortality (greater than 1965 but less than 1964) in areas treated with DDT

(f) Sumithion reduced bottom fauna biomas by one-third.

Mr. Flieger questioned the data on parr populations on the Cains River (Appendix VI, page 16). He suggested that there was insufficient evidence to prove that there were many fish in the upper Cains prior to spraying in 1966. Mr. Ruggles stated that results from the Department's studies are not precise since there were relatively few stations on the Cains but that they were the best that could be found under existing conditions. Mr. Ruggles stated that the reduced large parr population in 1966 would suggest that the 1967 smolt output would be small.

6. Agenda Item A(v)

Mr. Keith reported that two separate studies had been undertaken by the Canadian Wildlife Service in 1966 in the N.B. spray area. One designed to study the sublethal effects of DDT on the reproductive capacities of robins was unsuccessful (Appendix VII). Tests did indicate that modified studies of this problem should be proceeded with in 1967. In general, residue studies have indicated that many bird and mouse samples contain DDT.

Dr. Fowle reported that studies on toxic effects of phosphamidon have confirmed previous findings. Results of these studies are presented in Appendix VIII, Part I (c.f. Tables III, IV, V). Studies of absorption of phosphamidon through the feet of birds in the test area indicated that only a very small quantity of phosphamidon is required to kill birds.

Studies in sumithion-treated areas indicated mortality occurred at 1 lbs/acre but not at lesser rates. Recent laboratory studies of the effects of sumithion and phosphamidon on house sparrows indicate that sumithion acts more slowly but with longer effect than phosphamidon. This suggests that the birds under observation in the field studies may have been released too soon to provide a measure of the full toxicity of sumithion. It is proposed that this comparative study be continued in 1967.

Dr. Fowle referred briefly to studies of the effects of DDT on birds carried out by W.G. Wilson (Appendix VIII, Part 2). No apparent effects on bird population or distribution were observed as result of aerial applications of 1/2 lb. DDT in 1/2 gal. of formulation per acre. It was admitted that an indirect effect on bird populations might result from reduction of the budworm population as bird food supply, but confirmation of this would require comparative studies of birds in areas of differing budworm population density.

7. Agenda Item A(vi)

Dr. Place described the status of the budworm infestation in the fall of 1966 by referring to the egg-mass infestation map (Appendix III, figure 6). High egg populations occur in a considerable number of areas quite widely dispersed in central and southern portions of New Brunswick. Some of the concentrations of high egg populations occur in areas where the trees are in poor condition from previous defoliation injury. These are the areas of "hazard" for 1967.

D.R. Macdonald remarked on the difficulty of defining hazard areas under the conditions prevailing in New Brunswick in the fall of 1966 (see also page 11 of Appendix III). The original concept of hazard (risk of imminent tree mortality if no protective action were taken) has been broadened to include top-killing of badly weakened trees and progressive deterioration through the entrance of wood-rotting fungi. He referred to a map showing hazard areas in detail. These correspond to the "a" areas in the map accompanying Appendix IX. The largest areas of hazard occur in the Miramichi drainage in the southern part of Northumberland County. Lesser areas occur near Newcastle, in the Rocky Brook-Clearwater Brook sector of York County, near Juniper, near Bantalor, and in the Nashwaak and St. John River drainage areas. He also referred to the particular desire to repress populations in the northern sectors of the infestation area.

Dr. Logie queried the persistence of hazard areas along the Southwest Miramichi River, and the apparent difficulty of achieving control in this area. Macdonald stated this was due to the prevalence of red spruce in this region.

8. Agenda Item A(vii)

Mr. Brown stated that the directors of Forest Protection Limited had reviewed the infestation and hazard maps and had developed proposals for a control program in 1967. These had been submitted to and accepted by the Government of the Province of New Brunswick, with estimate provision being made for action in 1967. The proposals are contained in Appendix IX and the accompanying map. The plan envisages treatment of some 750,000 acres (identified by "a" on the map), with the proviso that a small additional acreage, possibly reaching 150,000 acres (identified as "b") be added to the spray program if surveys in the spring of 1967 should show such addition to be necessary. The proposed use of insecticides includes:

(i) DDT over the greater portion of the area, in two applications of 1/3 pound each;

(ii) phosphamidon along salmon streams in two applications of not more than 1/4 pound each, spaced not less than 4 days apart; and

(iii) that a substantial part of the project area be treated with sumithion alone and in combination with phosphamidon, at dosage rates mutually acceptable to forestry, fisheries and wildlife interests.

Mr. Flieger suggested that certain areas be treated experimentally with sumithion at 1/4 to 3/8 pounds per acre, and also with phosphamidon at say 1/8 pound per acre. He was not anxious to multiply the number of insecticides used in the operation, and hoped that sumithion might be shown to be an acceptable material to replace both DDT and phosphamidon in budworm control operations. An order had been placed for 50 tons of sumithion for use in 1967.

Dr. Hurtig pointed out that sumithion is not yet registered and questioned whether, on principle, as much as 50 tons should be dispersed in the present state of knowledge of the material. Mr. Keith stated that although the Canadian Wildlife Service is not willing to support carte blanche use of sumithion at 1/2 pound per acre, it is anxious to see a large area treated to determine effects. Dr. Fowle supported this view and suggested that the program be worked out jointly by fisheries, forestry and wildlife interests. Mr. Ruggles suggested that large blocks be treated with sumithion, preferably complete watersheds, with phosphamidon being used along stream banks; that certain areas be treated with a mixed formulation of sumithion and phosphamidon; and that other areas be treated with sumithion alone.

Dr. Logie reserved the right of the Fisheries Department to give more thorough study to the FPL program proposals for 1967. He noted that there was possibly some hazard to stream bottom fauna in the use of sumithion, and he did not wish the Department to entertain the prospect of having DDT used over an extensive area at 2/3 pounds per acre.

M.L. Prebble reminded the meeting that it was customary for proposals for both operational and experimental spray programs to be considered by official members of the Interdepartmental Committee. He thanked representatives of FPL for the proposals that had been submitted, and stated he would call a further meeting of the members in the near future to review the proposals in greater detail.

9. Agenda Item B

Experimental Control, Balsam Woolly Aphid

Dr. Fettes drew attention to studies by Hopewell, Randall, and Nigam on the chemical control of the balsam woolly aphid in Newfoundland, British Columbia, and New Brunswick (Appendix X). A large number of materials were tested, but the most promising results were produced by the carbamates ""Baygon" and NIA 10242, which showed both contact and systemic activity. Dr. Fettes stated that the studies of insecticides against the balsam woolly aphid would be continued. and that it would be appropriate to try aerial applications on a small scale in 1967. Fisheries representatives in Newfoundland and British Columbia would be informed of any aerial trials carried out in these provinces (V.R. Taylor, St. John's; K. Jackson, Vancouver).

Experimental Control, Ambrosia Beetles

H.A. Richmond reviewed the problem of ambrosia beetle control in log booms in British Columbia and experiments in 1966 to find an insecticide that could be used beyond the present cut-off date of April 15 that applies to the use of benzene hexachloride (Appendix XI). Preliminary field trials in 1966 indicated that methyl trithion may be an acceptable substitute for B.H.C., but testing needs to be extended to include treatment of log booms under actual operating conditions. Mr. Richmond predicted a very heavy inventory of logs in 1967, and stated that B.H.C. will be used for protection under the limitations that apply to the use of this insecticide. He also proposed extensive trials with methyl trithion.

K. Jackson introduced a report on bioassays of methyl trithion using coho fry (Appendix XII). No mortality occurred over a 96-hour period at concentrations of 1.5 ppm or lower. The compound was judged to be about 1/125 as toxic to coho fry as B.H.C. He therefore supported the field testing of methyl trithion.

Dr. Fettes drew attention to the apparent conflict in the published data on dermal toxicity of methyl trithion.

Plantation Insects, Ontario

M. L. Prebble referred briefly to a number of experimental or semi-operational control projects that were of lesser concern to the interdepartmental committee because of the small areas involved or lack of hazard to fish and wildlife.

(a) Control of *Hylobius pales* and *Neodiprion sertifer* in a 16 to 20-acre private plantation of Scots pine Christmas trees at Alliston, employing 1 qt. of 25% DDT per gallon of spray per acre.

(b) Spraying of pine nursery transplant stock at the Midhurst nursery with DDT to prevent oviposition by *Neodiprion sertifer*.

(c) Control of *Neodiprion sertifer* in a 35-acre infestation on Manitoulin Island (most westerly known infestation in Ontario), with the polyhedrosis virus of this species. The virus was dispersed in water suspension using a mist blower. Complete or virtually complete mortality of larvae resulted within 3 weeks of spraying in early June. The project will be repeated in 1967 to take care of subsequently discovered infestations on Manitoulin Island.

(d) Control of *Neodiprion lecontei* on Cockburn Island, Lake Huron, by the use of the polyhedrosis virus of this species is planned in 1967, by the Insect Pathology Research Institute, Sault Ste. Marie.

Control of Large Aspen Tortrix, Alberta

Experimental control studies of the large aspen tortrix are planned in 1967 by the Forest Research Laboratory, Calgary, employing 1/10-acre plots in the Cypress Hill Provincial Park, Alberta. The purpose is to devise effective controls for individual trees or groups of trees, so that "nuisance" infestations can be controlled around campsites and homesites in areas where recurrent infestations of this defoliator are experienced. The selection of insecticides and formulations has not yet been made.

10. Agenda Item C

An operational program was carried out in 1966 by the Ontario Department of Lands and Forests for the control of the European pine sawfly, Neodiprion sertifer, in infested pine plantations in southern Ontario. Biological observations were carried out by staff of the Forest Research Laboratory, Sault Ste. Marie. Results showed that young larvae of this species were very susceptible to phosphamidon at 1.2 ounces per acre. Spray applications at this dosage rate made later against older larvae were not effective (Appendix XIII). Nesting birds and their young showed no apparent ill effects of the spray application.

11. Agenda Item D

M. L. Prebble stated that a proposal to protect some 2000 acres of Scots, jack and lodgepole pine plantations in the Spruce Woods Forest Reserve from further damage by the jack-pine budworm in 1967 had been advanced by the Manitoba Department of Mines and Natural Resources. It had been suggested that the plantations be sprayed from aircraft with 1 pound DDT in 1 U.S. gallon of oil solvent per acre. Staff of the Forest Research Laboratory at Winnipeg expect to carry out parallel tests of various insecticides using conventional ground spray equipment. Plans are still in the formative stage.

Mr. Keith expressed concern over the potential hazard to nesting geese in the general area of the proposed control project, and wished to be assured that DDT would not be allowed to contaminate the breeding sites. It was agreed that Mr. Reeks would follow the development of plans for the project and would keep Mr. Keith fully informed.

Mr. Flieger asked whether a proposal had been advanced for operational control of the jack-pine sawfly in Quebec in 1967. Prebble replied that no such proposal had been advanced to Forestry Branch headquarters from the Quebec Forest Research Laboratory or through other channels. If a proposal is received, it will be brought forward at a later meeting of the Interdepartmental Committee.

E. W. Burridge
Secretary

M. L. Prebble
Chairman

Ottawa, December 30, 1966.