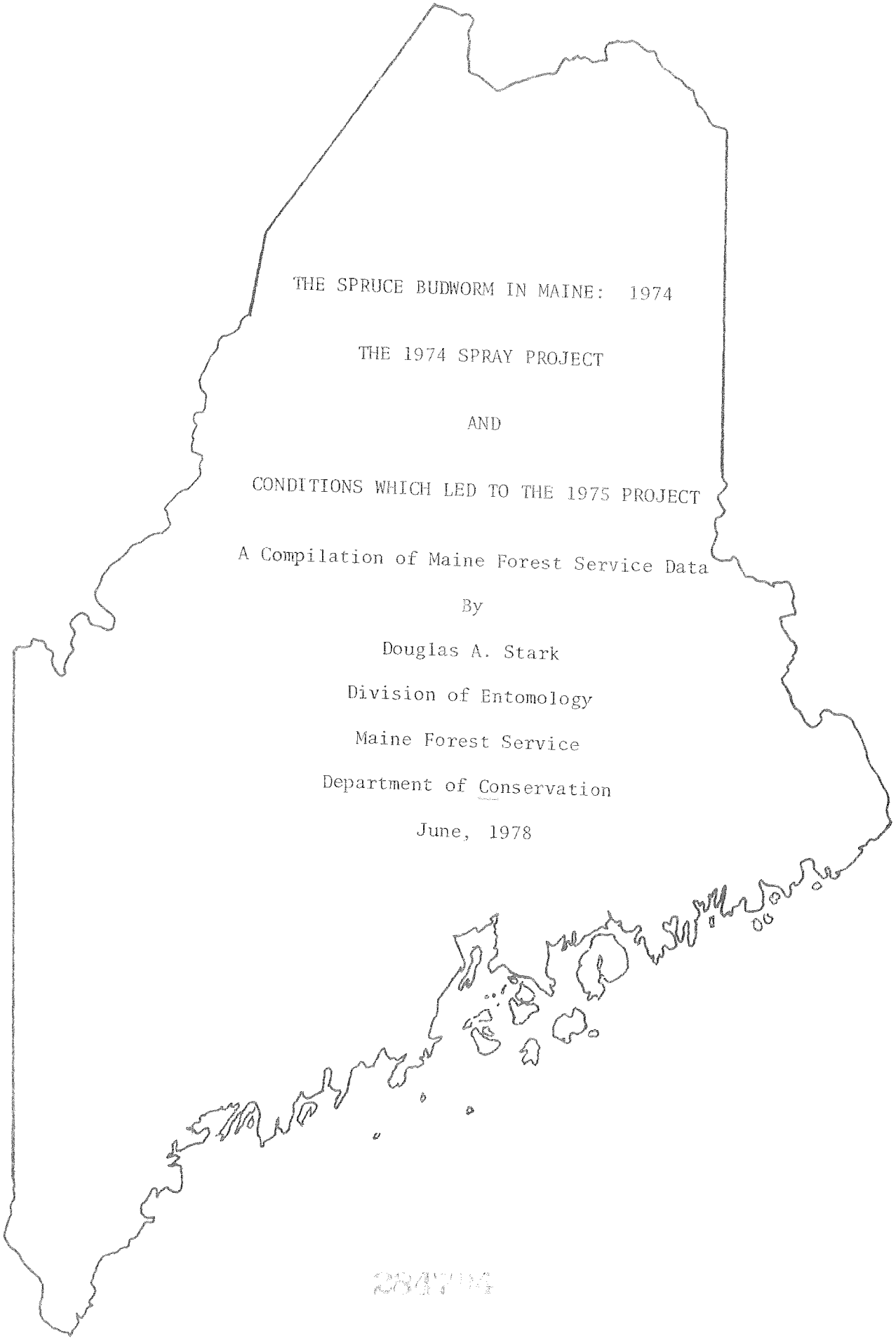

THE SPRUCE BUDWORM IN MAINE: 1974

THE 1974 SPRAY PROJECT

AND

CONDITIONS WHICH LED TO THE 1975 PROJECT

A Compilation of Maine Forest Service Data

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The late Nathalie Page typed some of the rough copy for the manuscript; Betty Barry completed the rough copy and typed all of the final copy. Their contribution is also gratefully acknowledged.

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INTRODUCTION

Although this report has been written well after the fact, it is being presented at this time mostly as an historical account of the events as they occurred in 1974, and to provide continuity of historical data through an epidemic budworm situation which still exists. Essentially, it is a compilation of data from the four Regional Entomologists; George LaBonte, David Struble, Hubbard Trefts, and Henry Trial, Jr.; and from former State Entomologist, Robley W. Nash; from former Survey Entomologist, Dr. Edmund Brower; and from the present Survey Entomologist, Richard Dearborn.

The use of trade and company names in this report is for the reader's benefit. It does not constitute official endorsement of these products or services by the Maine Forest Service to the exclusion of other products or services that may be equally suitable from other sources.

EVENTS LEADING TO THE 1974 SPRAY OPERATION

In July 1973, the results of an aerial defoliation survey indicated some 3.5 million acres were budworm-infested to some degree and approximately 800,000 acres were moderately to severely defoliated. Fall and winter soaking-out collections of 1973-74 provided hazard data which indicated top mortality was already occurring at some collection points; namely T5R13 east of Gero Island, Westmanland in the Guerette Camp area, T15R5 on the Blackstone Siding Road west of Square Lake Ridge, T17R5 in the Dickey Brook-Route 161 area, T9R7 1/2 mile north of Salmon Pool and T8R8 south of Chase Camp area. Dead trees were also reported in T9R4 on the Levesque Road, and in New Sweden in the Rista-Jemptland Station area.

Numbers of larvae recovered from fall-winter 1973-74 soaking-out collections also indicated moderate to extreme populations of overwintering larvae in most collections, with extreme populations of over 1000 larvae per 100 sq. ft. of fir foliage being recorded from several collections. Populations of 301-650 larvae were expected to produce 66 - 90% defoliation; the extreme numbers 90 - 100% defoliation of 1974 foliage, with some accompanying axil damage and back feeding on older foliage.

Heavy 1973 egg mass counts, heavy past defoliation and declining tree vigor indicated some 430,000 acres needed immediate treatment in 1974 to keep the trees alive. Although all areas proposed for treatment warranted such action, the hazard data were stratified in the event acreage had to be cut for some reason, and to satisfy requirements for approval in the Environmental Impact Statement. The areas needing treatment were 14 in number, were widely scattered, and included areas never before sprayed. Proposed spray areas were assigned priorities in decreasing order of need for treatment as determined by Nash, Stark and Trefts on November 15, 1973, and were as follows: 14, 5, 8, 1-2, 6, 10-9-12-13-11, 3, 7, and 4 (Fig. 1).

Eastern Spruce Beetle

In the spring of 1974 the eastern spruce beetle, Dendroctonus obesus was

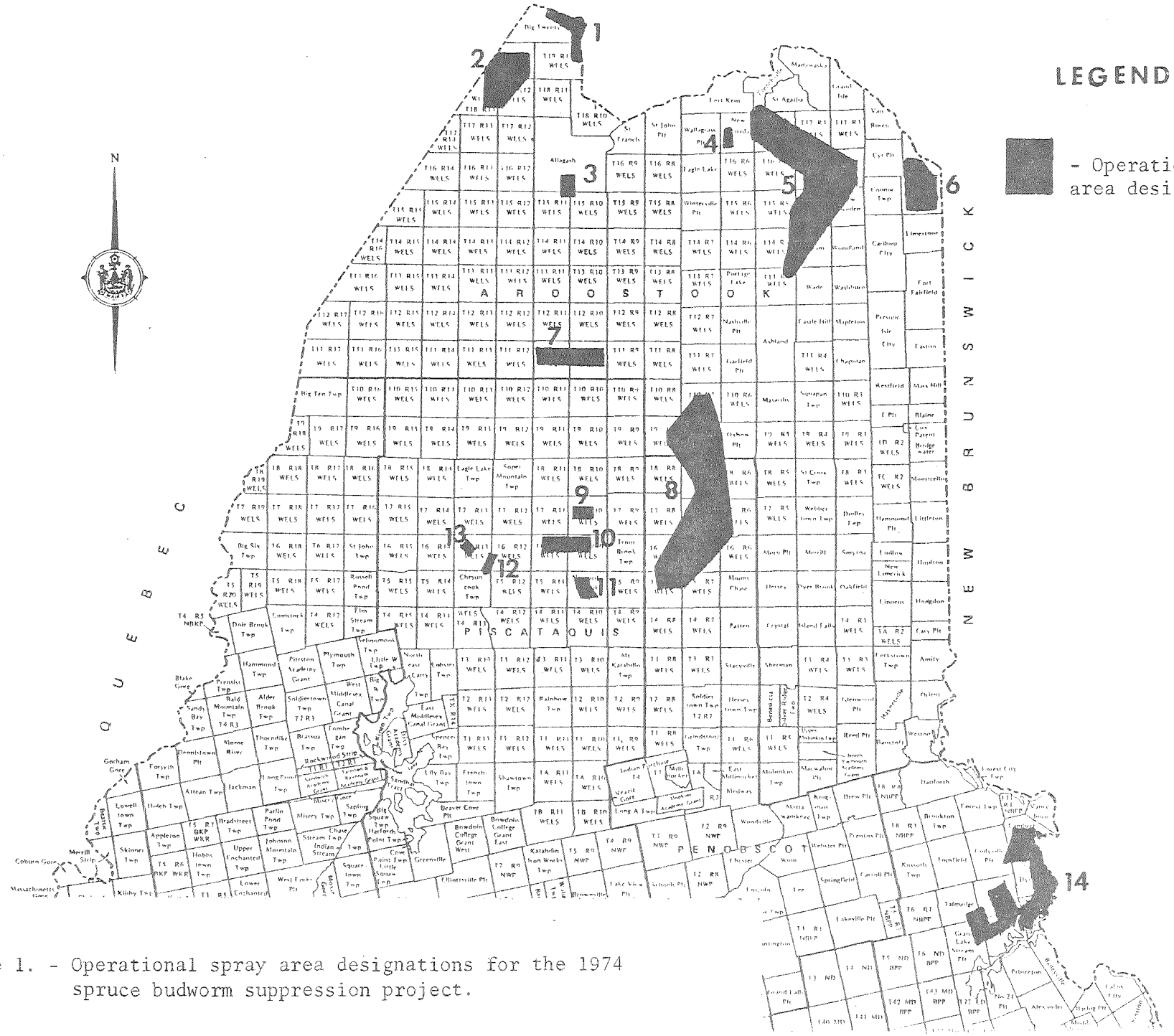


Figure 1. - Operational spray area designations for the 1974 spruce budworm suppression project.

collected near the Allagash River, south of the village of Allagash in T14R11 WELS by Insect Ranger McBreairty and Seven Islands personnel.

This beetle had the potential to increase in numbers due to weakening of spruce by heavy budworm-caused defoliation. Spruce 8 inches or more in diameter are usually first attacked, although in epidemic situations, trees of all diameters may be attacked. Beetle activity is most readily observed 3 feet above ground on the 8" dbh trees. The beetle is fairly large (about 1/4" long).

Although not a prime consideration in the spray-no spray decision, the potential buildup of this beetle was nevertheless a factor, along with increased susceptibility of the spruce budworm-damaged spruce-fir forest to lightning strikes and resultant forest fire danger.

THE 1974 SPRAY PROJECT AND RELATED OPERATIONS

Objectives of the treatment were to reduce significantly budworm populations and, by so doing, prevent budworm-caused tree mortality, maintain tree vigor, preserve and protect existing wildlife habitat, and maintain the recreational and aesthetic values of the area (keep the trees alive). An accompanying objective was to maintain a stable economy in an area where healthy, productive forests are the major source of income.

As in the past, the Maine Forest Service delayed the recommendation to spray until it was essential to protect spruce and fir from imminent and increasing tree mortality. Natural control factors, such as parasites, predators, and weather were given time to exert maximum influence against epidemic budworm populations with only limited success.

The 1974 protection project consisted of 14 operational spray areas (Fig. 1) and involved the usual preparations and detailed planning. Clearance was obtained first with the Board of Pesticides Control. Open explanatory meetings were held with conservation groups, related State agencies, and local groups. Publicity was released through the news media.

Funding and Cost

State of Maine funds were made available Feb. 20 through legislative action. Equal U.S. Forest Service funds were made available May 15 (50-50 funding). This delay was most frustrating in the planning and preparatory phases, since no funds could be committed until all project funds were in hand.

Direct operational costs were $2.33 per acre. Indirect operational costs amounted to approximately $2.44 per acre. Total project costs, including experimental spray costs, amounted to approximately $1,500,000 (@ $3.35/A).

The Operation

Presque Isle Airport was chosen as the best base of operations. For the

remote areas, detailed consideration was given to use of the Millinocket and Houlton Airports or of helicopters; however, these alternatives were abandoned due to associated administrative, transportation, and housing problems.

Planning and efficiency were aided greatly by the cooperation of numerous State and City departments which were listed in previous reports. The greatest financial benefit was from the Department of Education through the Northern Maine Vocational Technical Institute, where all personnel attached to the airport ate in the dining hall (at cost), and lived gratis in the dormitories. Having all airport personnel at one place facilitated their supervision as well as supervision of all associated functions.

Contacts and Caution Areas

Real cooperation was also realized from Loring Air Force Base officials, and Carl Betterley, the F.A.A. representative at Loring, plus the one at Houlton Airport. Pre-spray meetings and correspondence, good telephone and radio communications, and excellent advice on emergency procedures assured that all concerned were well informed and all contingencies were covered adequately. Since the Air Force had SAC bombers on low-level training flights over or adjacent to some spray areas, both Loring and Houlton were notified 24 hours prior to each spray period. Notification of completion of spray periods was also given. Bombers were commanded to rise to altitudes which would prevent collisions with our aircraft during spray periods. Two spray blocks (30 and 31) actually were adjacent to and over Loring property in the Town of Caswell. Again, notifications were made through good telephone and radio communications.

DOT in Canada was informed as to when our spray planes would be turning over the Canadian border.

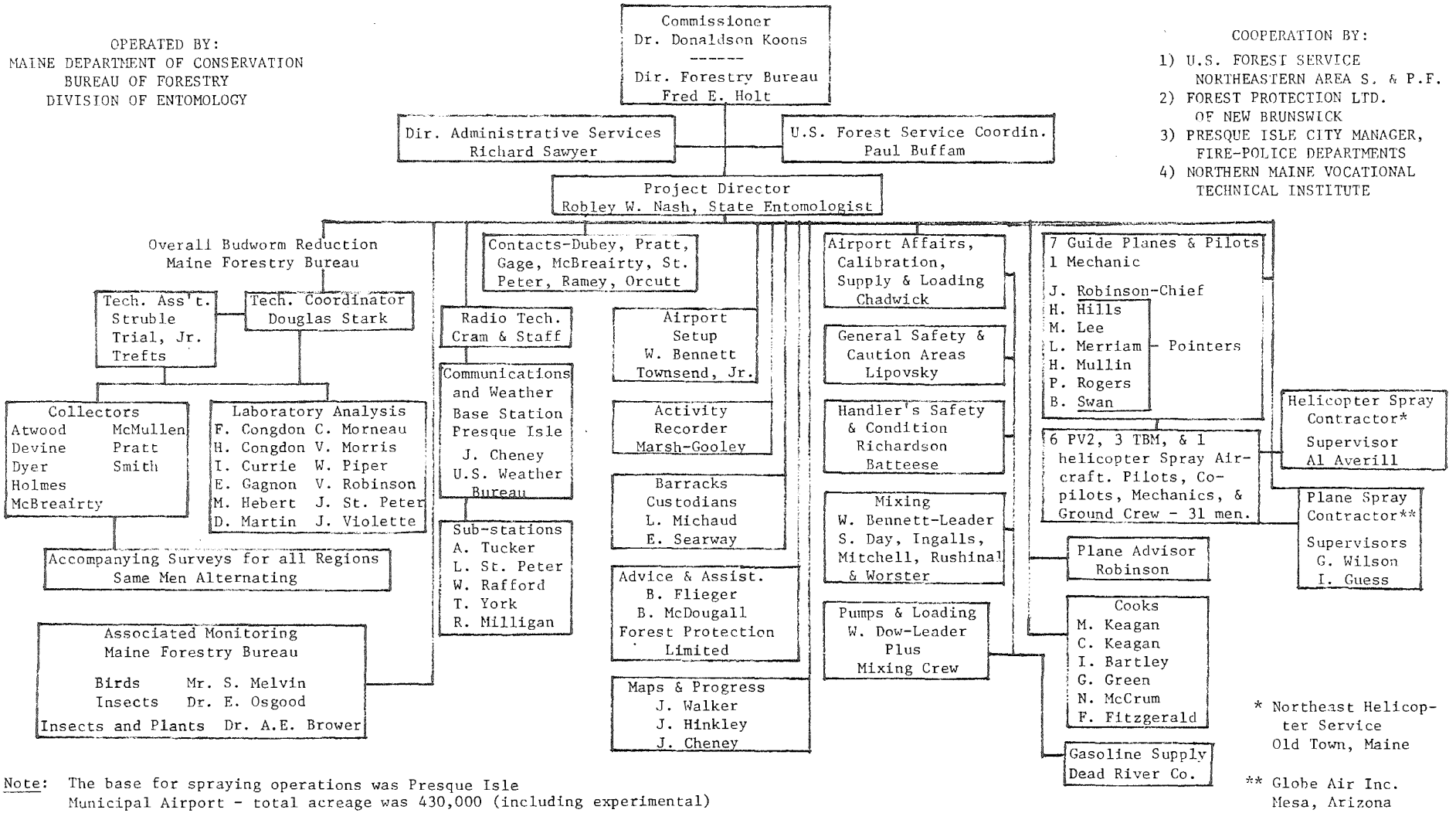
Passamaquoddy Indian Governor Socabasin was notified by Director Holt as to spray application on Indian Township. Personal contact work was conducted there by H. Trial, Jr. and Eastern Region personnel.

Personnel assignments and plane contractor are shown on the table of organization (Table 1).

The first spring field activity associated with the spray project was the contact work or public relations phase. Most of the contact work was concentrated in spray areas 4, 5, and 6 in Aroostook Co. and area 14 in Washington Co. (Fig. 1). Personal contacts beginning in March were made with all residents in or within 1/4 mile of spray areas to explain the project, procedures to be used, and to seek out caution and avoidance areas. A notice was left in the event no one was at home.

All summer camps within and adjacent to the proposed spray areas were also visited by Forestry personnel familiar with these areas. Remote areas impossible to reach by car or truck were reached by snowmobile. A notice of the proposed spray project and a fact sheet about the insecticide "Zectran" were posted conspicuously on each camp. Also contacted were non-resident owners, Town officials and public lot leasees. Telephone numbers and addresses of people to contact (Locke and Struble) for further information concerning the project were also left with the notices.

Table 1. - Table of organization for the June, 1974 Maine spruce budworm spray project and accompanying surveys.



Note: The base for spraying operations was Presque Isle Municipal Airport - total acreage was 430,000 (including experimental)

Caution areas sought were small fish ponds, bee-hives, poultry and mink farms, organic gardens, and other areas which were not to be sprayed nor flown over. These were detailed on USGS maps used by spray and guide plane pilots, and on the master map at the airport, and were eliminated from the spray plan. In late May, caution area markers, each consisting of a brush-filled cloth bag covered with a fluorescent orange hunting vest attached at the end of a long pole, were secured to a dominant tree or structure near the caution area so that it extended above the forest canopy. This difficult task was accomplished with the helpful assistance of Maine Public Service Co. personnel and equipment through Don Collins in Presque Isle.

The Insecticide

Zectran was used and was the best of only two chemicals registered for use against the spruce budworm at that time (See Appendix A for general information). Approximately 41,835 gallons of Zectran CF24 stock solution (1.5 lbs. or 24 oz. active ingredient per gallon) were shipped in May by Dow Chemical Co. to a railhead at the airport facility. This stock solution was diluted by our crews, 1 part to 1 1/2 parts kerosene supplied by the Dead River Co. Our storage tanks with a total capacity of 108,000 gallons were at the base to insure plenty of spray mixture at all times and to allow mixing of all material prior to start of spray application. The spray mixture was applied in one application at the rate of one quart per acre, each quart containing .15 lbs. (2.4 oz.) actual Zectran (vs. the same amount in one gallon of spray mixture per acre in 1973).

Spray Aircraft

Six PV2 aircraft, each with a capacity of 1,200 gallons, and 3 TBM aircraft, each with a capacity of 800 gallons, were used. TBMs were flown in teams of 3; PV2s flew in teams of 3 or 2. One helicopter was used to treat 2,660 acres along inhabited roadsides and lake shores (Table 2).

Spray plane teams were guided as in the past by a pair of Cessna planes flying above, each manned by an experienced navigator supplied by Forest Protection Ltd. of New Brunswick. The seven Cessna planes and pilots were supplied by Maine Aviation Corporation of Portland.

Swath width for each TBM was 367 feet; for each PV2 it was 550 feet. Spray aircraft flew at 165 m.p.h. and 100-175 feet above the trees. Aircraft spray systems using nozzles #8008 were calibrated to emit droplets 110 ± micron m.m.d.[1] Spray block size was usually nine miles (N & S) by 2 1/2 miles, although size was often adjusted to compensate for water areas, (Table 3). Flight was normally from north to south and return.

[1] m.m.d. = mass median diameter

Table 2. - Townships and approximate acreages sprayed by helicopter in 1974.

		Block #	Approx. Miles	Approx. Acres
1.	Indian Town	1	2 1/2	62 1/2
2.	Waite & Indian Town	2	10	250
3.	T1R1	3	23	575
4.	Perham	18	2 1/2	62 1/2
5.	New Sweden - Rista Sliding	22	8	200
6.	Westmanland Plt. - Railroad	21	8	200
7.	Stockholm	23	2	50
8.	T16R4WELS - Madawaska Lake	24	10	250
9.	T17R5WELS - South of Guerette	26	9	225
10.	T17R5WELS - Cross Lake	27	8 1/2	212 1/2
11.	Frenchville	28	1 1/2	37 1/2
			85 +	2,125 +

Timing of Spray Operations and Larval Development

Spraying started June 8 p.m. when the required 90% of the larvae were in the fourth and fifth instars (a strong 20% were fifth), as determined by field crews at the Portage and Cross Lake laboratories (Figs. 2, 3 and Table 4). It was completed June 16 a.m. Area 14 was the first area ready for spraying as expected, based on larval development checks in the various areas.

Duration of Spray Project

Weather was so favorable in 1974 (Table 5) that very few possible spray periods were cancelled. This was reflected in the 9-day completion period. Total plane-carrying-capacity was 7200 gallons less than the previous project, or 57% of that in 1973. This was due to using less spray mixture per acre in 1974, but we also had considerably more "haul distance" in 1974. A total of 420,000 operational acres were treated.

Safety and Radio Communications

Safety was again stressed - generally through police and fire protection, specifically through the provision by the Public Health Laboratory of Ernest Richardson and Robert Batteese. These men kept any of the crew exposed to the chemical under constant surveillance during mixing, loading, and spraying. Invaluable help was given by 12 men of the Fire Control Division in setting up and operating the mixing and loading equipment - also by the radio staff in providing excellent plane-to-plane-to-airport communications.

Table 3. - 1974 spruce budworm spray blocks and acreages.

Area	Block No.	Area Totals
1. Beau Lake *	14	13,441
2. 19R12	15 - 22,599	
	16 - 11,496	34,095
3. Allagash	17	3,051
4. New Canada	29	3,612
5. Cross Lake *	18 - 12,389	
	20 - 9,092	
	21 - 15,245	
	22 - 14,809	
	23 - 4,778	
	24 - 12,897	
	25 - 7,785	
	26 - 10,439	
	27 - 7,373	
	28 - 9,786	104,593
6. Hamlin-Caswell	30 - 13,308	
	31 - 10,593	23,901
7. Musquacooks	12	20,943
8. Grand Lake Seboeis	32 - 8,402	
	33 - 14,381	
	34 - 13,996	
	35 - 13,534	
	36 - 14,138	
	37 - 8,170	
	38 - 6,470	
	39 - 8,738	
	40 - 11,029	
	41 - 8,077	
	42 - 13,544	120,559
9. Beetle Mt.	43	4,970
10. Coffelos	8 - 14,940	
	9 - 4,447	19,387
11. McCarty Field	7	2,373
12. Umbazooksus Lake & Stream	10	2,204
13. Longley Pond	11	2,441
14. Washington Co. - St. Croix River	1 - 16,316	
	2 - 12,758	
	3 - 11,546	
	4 - 7,330	
	5 - 11,664	
	6 - 15,849	75,463
	Grand Total	431,033

* Block #19 was dropped. Acreage figure was not included in the totals.

Block #13 (Narrow band along west side of Beau Lake) was also dropped due to steepness of terrain and closeness to international boundary waters.

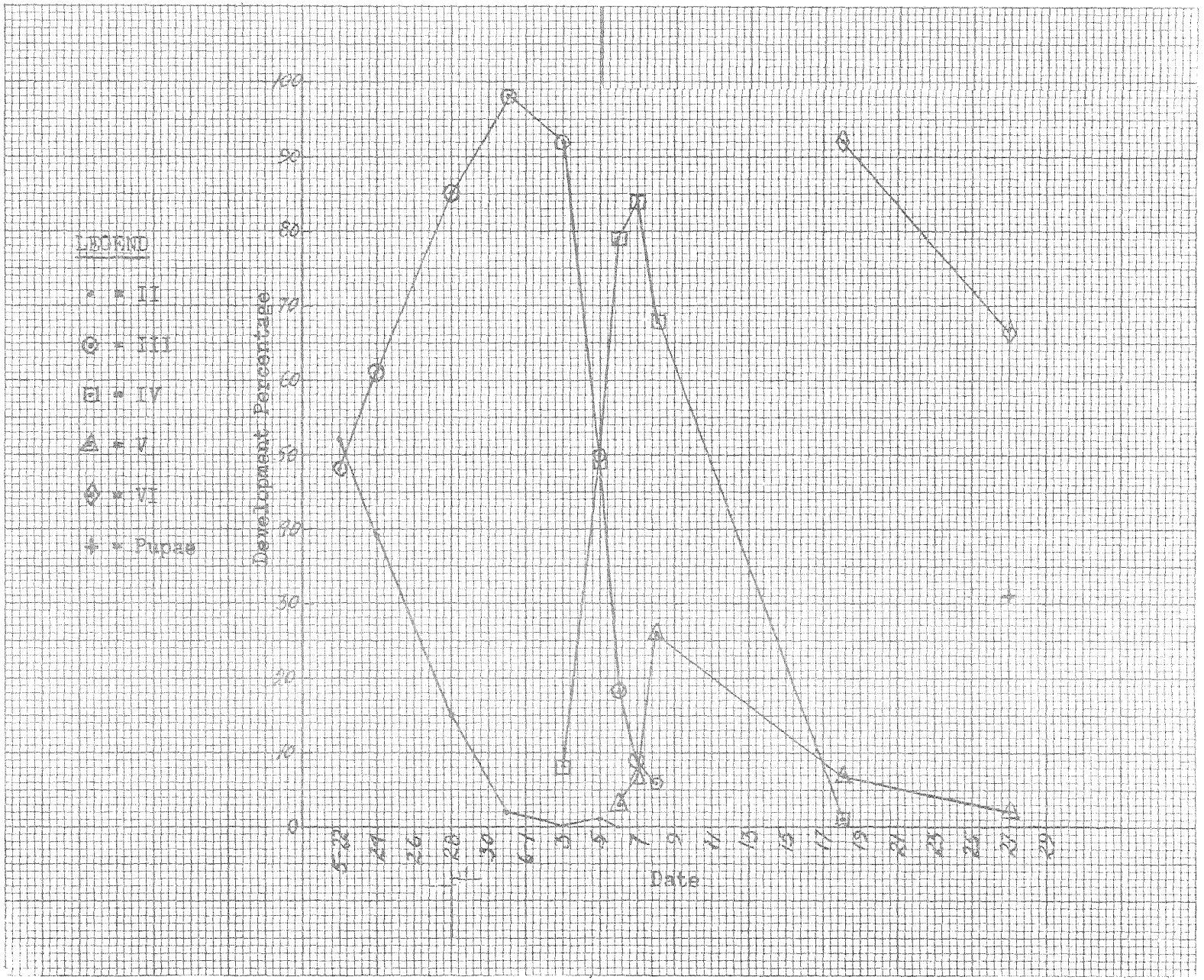


Figure 2. - Spruce budworm development - Flipper Creek Rd., Indian Township - 1974.

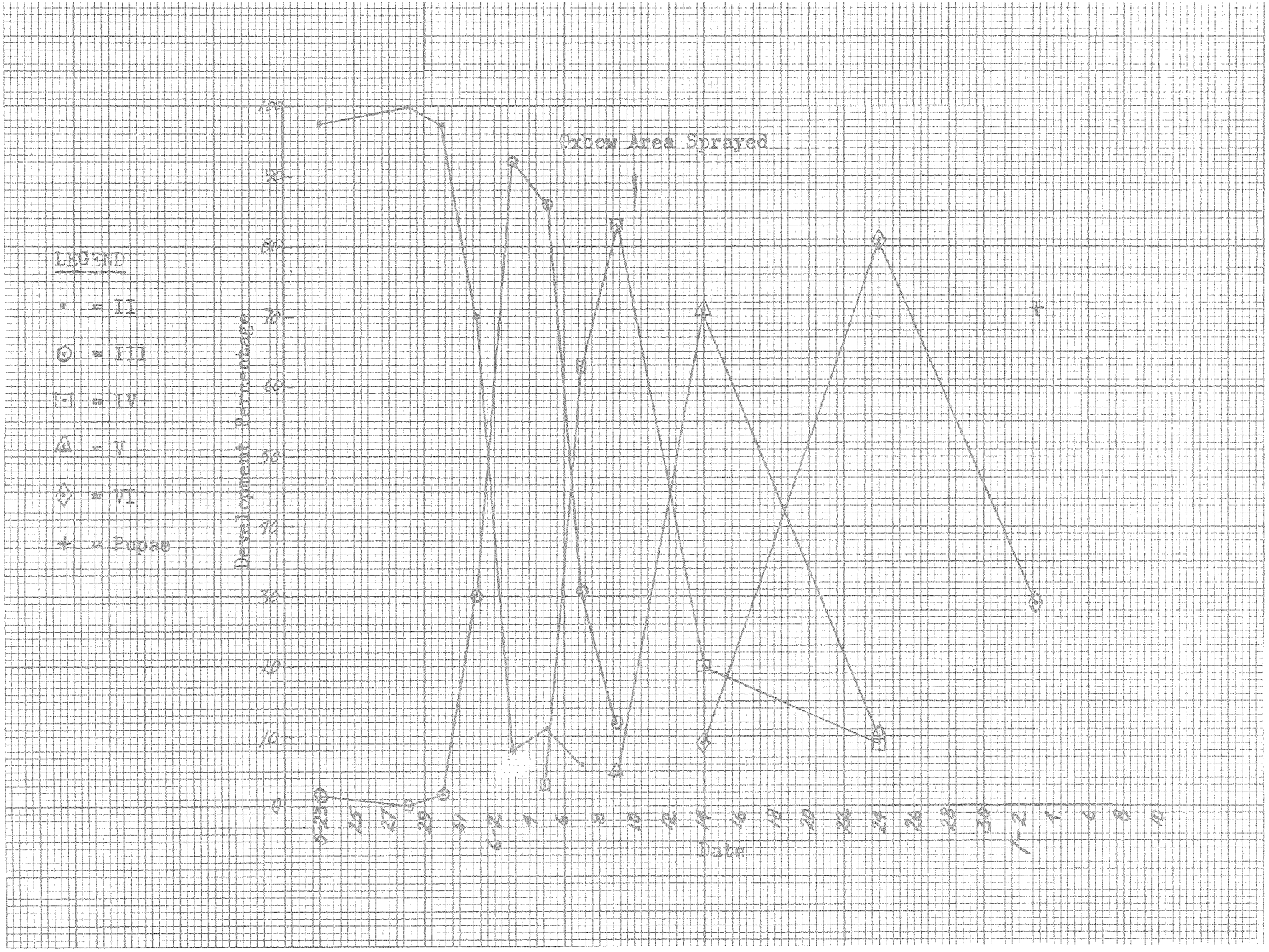


Figure 3. - Spruce budworm development - Oxbow - 1974.

Table 4. - Spruce budworm development 1971-1974 (Approximate peak dates).

Year	1-2 Weeks (Start Dev. Coll.)	Lasts a Week III	Few Days IV	1 Week V	2 Weeks VI	Start P	Light Trap M
			INSTAR OR DEVELOPMENT STAGE				
1971 (Oxbow)	5/19	5/26	6/3	6/11	6/20	6/20	7/1
1972 (Portage)	5/23	5/29	6/2	6/13	6/22	6/19	7/1
1973 (Wash. Co.)	----	5/28	6/4	6/7	6/18	6/26(60%+)	7/1
1973 (Garfield)	5/4	6/5	6/10	6/13	6/20	6/20	7/3
1974 (Wash Co.)	5/22 (Flipper Creek)	5/31	6/7	6/13	6/18	6/25(30%+)	
1974 (Oxbow)	5/23	6/3	6/9	6/14	6/24	7/3(71%)	
1974 (Allagash)			6/13				
1974 (Dickey Bk.)			6/12				
1974 (T14R6-Beaver Bk.)			6/10				
1974 (Third Musquacook)			6/14				
1974 (Round Pond - Telos)			6/12(62%)	6/12(31%)			

Table 5. - Weather records Caribou Weather Bureau
May 16-31, June, July and August, 1964-1974.

T= Temperature
R= Rainfall
Dep. = Departure from 30 yr. average 1940-70
Days = Days precipitation e.g. 11(7) 11 days, 7 of which had measurable precip.

		May			June			July			August		
			Dep.	Days		Dep.	Days		Dep.	Days		Dep.	Days
1964	T.	51.6	+1.8		58.8	-.2		65.8	+1.3		58.6	-4.0	
	R.	1.6	-.22	11(7)	1.8	-2.27	19(13)	3.58	-.46	22(17)	3.38	-.29	19(17)
1965	T.	51.6	-0.8		61.1	+2.1		61.5	-3.0		60.9	-1.7	
		1.86	-0.68	12 (10)	1.25	-2.82	18 (12)	3.71	-0.33	18(13)	3.60	-0.07	21(12)
1966	T.	58.5	-.9		60.4	+1.4		64.1	-0.4		62.0	-0.6	
	R.	0.97	-1.30	8 (3)	2.06	-2.01	18 (12)	3.27	-0.77	18(12)	1.54	-2.13	16(12)
1967	T.	43.4	-7.2		62.1	+3.1		68.4	+3.9		64.2	+1.6	
	R.	1.47	+0.92	10 (6)	1.69	-2.38	17 (10)	4.18	+0.14	(17-14)	4.81	+1.14	15(12)
1968	T.	50.7	-0.2		59.1	+0.1		66.3	+1.8		59.1	-3.5	
	R.	1.11	-1.70	10 (6)	1.65	-2.42	19 (9)	4.24	+0.20	18(9)	2.01	-1.66	19(11)
1969	T.	50.5	-1.7		60.7	+1.7		62.9	-1.6		64.0	+1.4	
	R.	1.84	-0.15	8 (7)	3.47	-0.60	16 (12)	3.73	-0.31	15(12)	4.02	+0.35	18(15)
1970	T.	52.1	+0.7		61.7	+2.7		69.7	+5.2		66.0	+3.4	
	R.	1.61	+1.23	10 (8)	3.25	-0.82	17 (12)	2.54	-1.50	16(10)	3.18	-0.49	15(13)
1971	T.	54.2	+1.7		59.3	+0.3		64.	-0.5		61.3	-1.3	
	R.	1.00	-0.97	5 (5)	2.62	-1.45	19 (13)	2.79	-1.25	20(13)	3.39	-0.28	19(15)
1972	T.	60.1	+2.5		61.5	+2.5		64.7	+0.2		60.5	-2.1	
	R.	1.60	+0.66	7 (5)	4.97	+0.90	17 (12)	4.21	+0.17	17(15)	5.07	+1.40	14(12)
1973	T.	50.1	-1.0		63.0	+4.0		68.6	+4.1		66.4	+3.8	
	R.	4.10	+2.00	12 (9)	2.13	-1.94	21 (13)	4.62	+0.58	17(12)	2.95	-0.72	21(16)
1974	T.	46.6	-4.5		62.7	+3.1		64.7	-0.2		64.3	+2.0	
	R.	1.11	+0.65	9 (7)	2.82	-0.59	19 (13)	3.39	-0.59	21(17)	3.98	+0.20	11(11)

Efficacy Determination and Results

FORTRAN IV computer programs were developed by Dr. Gary A. Simmons, University of Maine, Orono to process field data for determination of insecticide efficacy from the "Abbott" formula method or 70-twig sample Simmons and Chen method. All field efficacy data for the 1974 season were automatically handled by the University of Maine. Once phoned in, complete statistics were returned to Bureau of Forestry Regional Entomologist H. Trial, Jr. in Old Town within 15-30 minutes, resulting in a savings of considerable time and effort by Bureau of Forestry entomologists.

Efficacy determination for the project using Abbott's Formula showed an average of 93% and a range of 91-98% reduction in budworm populations when obvious misses were eliminated from plot data. Overall efficacy was 85%. Good protection of foliage also was obtained; a further reflection of the short completion period. (Good protection is considered 60% or better of current growth).

Using Abbott's formula and eliminating obvious misses, efficacy in the Allagash area (Area A) was 98.6% with a range of 97.3-99.9; for the Caswell-Stockholm-New Canada area (Area B) 90.9% with a range of 84.5-97.3; for the Musquacook-Grand Lake Mattagamon-Beetle Mt. area (Area C) 95% with a range of 92-98; and for the Washington Co. area (Area D) 97% with a range of 95-99.

Collections inside and outside the spray area were as follows:

	Pre- and post-Spray Samples	
Area (See Fig. 4)	No. Inside	No. Outside
A	20	10
B	30	10
A-B (Outside only, between areas A & B)		10
C	50	20
D	30	20
Totals	130	70
Grand Total	200*	

* 200 pre- and 200 post-spray samples

For the first time, the Simmons and Chen method for determination of efficacy was tried, but only in Washington County along the St. Croix River (Area D). Abbott's formula was used elsewhere as well as in the Eastern Region, as a comparison for the Simmons and Chen method.

Briefly, the new Simmons and Chen system involved taking seventy 18" long twig samples from within each large spray block as close to time of spray application as possible. Seventy 18" post-spray samples were taken from the same general area as the pre-spray samples and within a few days of spray application. The advantage of the Simmons and Chen method was that all samples were taken within spray blocks, and fewer samples per given area were

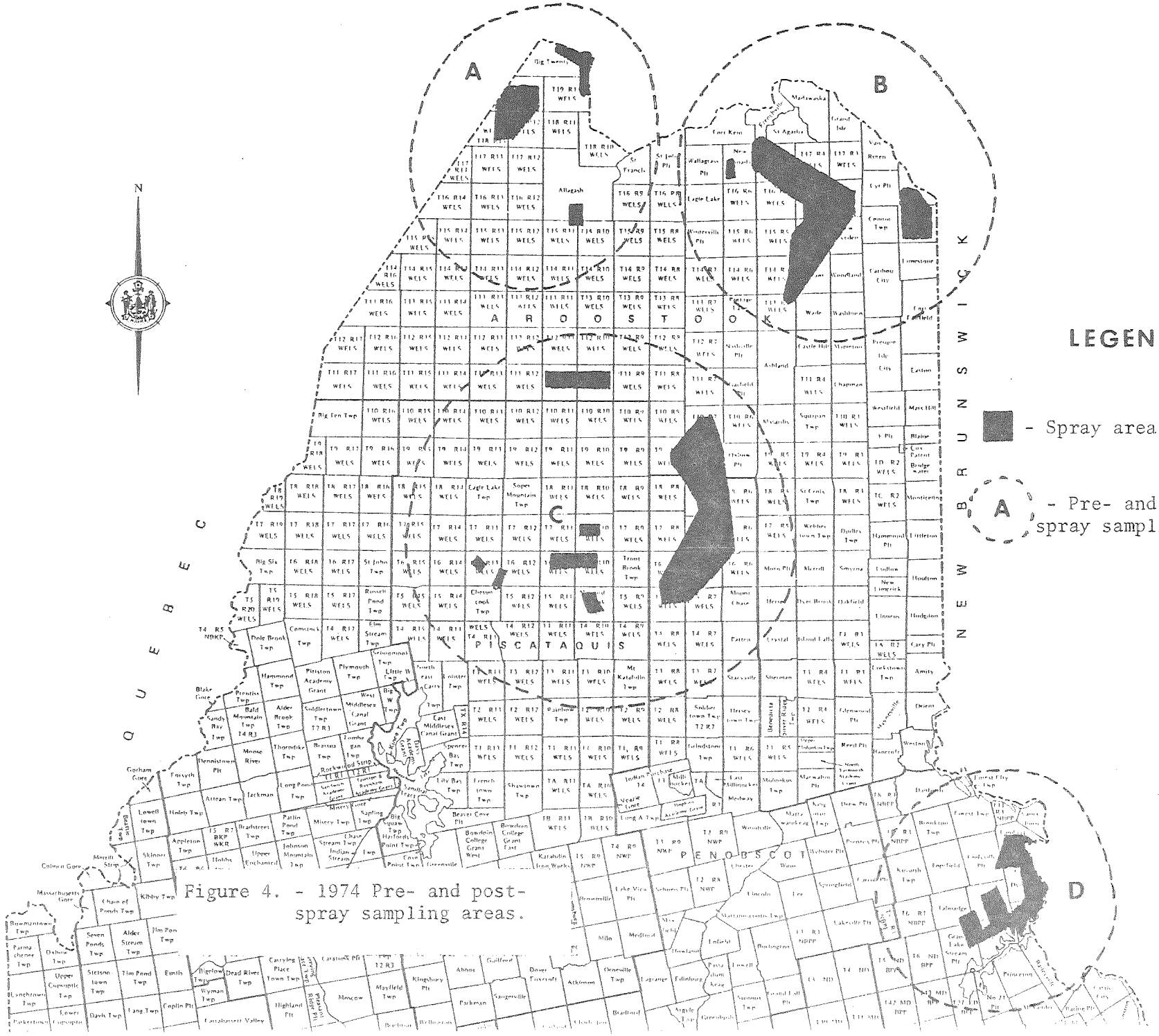


Figure 4. - 1974 Pre- and post-spray sampling areas.

necessary to obtain a reasonable confidence level.

The Simmons and Chen pre-spray count was 26 larvae per 18" twig. The unadjusted (all 70 twigs counted) post-spray count was 3.81 larvae per 18" twig and resulted in 85.346% control $\left(\frac{26-3.81}{26}\right) \times 100$).

Adjusted control similarly calculated and deleting 7 obvious misses (1.68 larvae per 18" twig) was 93.54% $\left(\frac{26-1.68}{26}\right) \times 100$).

Monitoring

Monitoring of non-target organisms was contracted with and conducted by retired colleague Dr. A.E. Brower. No harmful effects were indicated. (See Appendix B for Dr. Brower's summary of effects plus a list of moribund moths found and orders of insects killed by Zectran in 1974).

Research Projects

In addition to supplying funds for the 1974 budworm suppression project, the 106th Legislature also provided approximately $49,000 in funds for related studies. We contracted with Drs. John Dimond, David Leonard, Marshall Ashley, and Gary Simmons, University of Maine, Orono who conducted the following research:

Dr. Leonard conducted research on parasite releases (*Brachymeria intermedia*) and related studies. Dr. Ashley conducted research on aerial photography to improve efficiency in locating budworm-damaged areas needing control.

Dr. Gary Simmons conducted research on Development of Computer Programming for Handling, Sorting and Analyzing Budworm Survey Data, on Improving Efficiency of Egg Mass Sampling, on Malaise Traps for Adult Spruce Budworm Moth Sampling, and on Application of Degree Days to Spruce Budworm Phenology.

Field Tests of Sevin, Thuricide® and Zectran were conducted by Dr. John Dimond. The Sevin 4-Oil tests involved different timings, conventional or Beeco-mist nozzles, operational or helicopter application, and a new formulation.

Thuricide® tests included undiluted and water-diluted Thuricide® alone, Thuricide® plus Chitinase, Thuricide® plus Zectran, Thuricide® plus Sumithion.

Zectran tests involved 2.4 oz. a.i. in oil applied at the rate of 1 qt./acre when development was in the third and in the fourth instar.

Details and results of the above tests are available from the individual researcher or in a final progress report sent former Commissioner Koons which covered all cooperatively-funded research projects. Table 6 summarizes operational and research spray application data.

Table 6. - Summary of 1974 spray application data.

Treatment	Timing	Spray Block	Rate of Appl.	Gallons Mix	Acres	Spray Nozzles	Per Plane Swath	Aircraft
Sevin-4 Oil	Peak 3rd	42A,42B*	1 Qt./A	2383	9530	8004	367'	TBM
Zectran	Equal 3rd & 4th	39	1 Qt./A	2185	8738	8008	367'	TBM
Sevin-4 Oil	90% 4th & 5th	38	1 Qt./A	1618	6470	8004	367'	TBM
Zectran	90% 4th & 5th	All Other (Operational)	1 Qt./A	103,750	415,000	8008	367'	TBM
							550'	PV-2
B.t.					800			

* 42A = W 1/3; 42B = E 2/3

1974 Larval and Pupal Parasitism

Early larval parasitism was determined as in previous years; i.e. dissection of 100 second instar larvae from each sample point. Sample points were eleven in number.

The fourth and sixth instar samples were collected from nine plots scattered through northern Maine. Samples consisted of 10 larvae from each of 10 trees, making 100 larvae per plot. These larvae were reared through to adulthood (segregated by individual trees) and the parasites collected.

The pupal samples were taken from post-spray samples of budworm population density. The samples were allowed to complete development and the parasitism rates noted. Results of the parasite surveys are summarized in Table 7.

Note: In a memo from Dr. David Leonard, University of Maine Entomology Department, to Robley W. Nash, State Entomologist on September 13, 1974, Dr. Leonard reported lack of emergence of budworm adults from pupae to be 9.3% in Indian Twsp. (Washington Co.) and 23.3% in the Shin Pond area (Penobscot Co.). He speculated that pathogens may have killed more budworms than at first realized. Parasitism was not associated with this lack of emergence.

DISTRIBUTION OF SPRUCE BUDWORM LARVAE IN 1974

The Forest Insect and Disease Survey conducted throughout Maine each year has for many years provided information on larval spruce budworm

Table 7. - Spruce budworm parasitism data - 1974.

I-2 Parasitism: (Dissection by Jeanne St. Peter)

Sample Point	% Parasitism Apanteles	Glypta	Total Parasitism (%)
Black Brook* (64)	5	12	17
T9R4* (90)	8	10	18
Rockabema	8	9	17
T14R6	6	4	10
Oxbow	10	7	17
T15R5	3	10	13
Wallagrass	7	4	11
Webster Lake	6	5	11
T13R14	10	2	12
T14R12	7	9	16
T15R11	13	4	17
Average	7.5	6.9	14.4

* Incomplete sample. A full sample was 10 larvae from each of 10 trees (total of 100 larvae from each sample point).

I-4, I-6 & Pupal Parasitism: (Struble)

Parasite	When Sampled	% Parasitism
Hymenoptera		
Apanteles	I-4	4.67
Glypta	I-4	2.89
	I-6	5.24
Itoplectis	Pupation	0.10
Phaeogenes	Pupation	0.26
Meteorus	Pupation	2.62
Diptera		
Tachinids	Pupation	2.25

distribution. Past surveys have yielded larvae mostly from Aroostook, Piscataquis, Somerset and Washington Counties; however, the 1974 survey revealed larval budworm populations in virtually all counties (Fig. 5).

MOTH FLIGHTS

A storm originating in the St. Lawrence River area of Quebec evidently was responsible for transporting massive flights of spruce budworm moths into the Allagash-Fort Kent areas. On the night of July 14-15, windrows of spruce budworm moths were observed on the bridge at Allagash, and so many moths were attracted to street lamps that the ground underneath was made greasy. Heavy moth catches were noted in the Deboulie area which normally only catches low numbers of moths. In Portage, the light trap was completely full by 1:30 A.M. More than the usual numbers of moths were also caught at Hay Lake.

On the night of July 15-16, large numbers of budworm moths were attracted to street lights and spotlights in the Augusta area. On the 16th, many moths were observed on blue, Norway and white spruce at the Entomology Lab in Augusta and new egg masses observed on the foliage.

On July 22 in the Musquacook Lakes area, moths were still abundant on trees - most eggs were green and unhatched.

On July 24, moths were still flying at Topsfield and females were still gravid on this date.

On the nights of July 18-19 and 23-24, Maggie Marquis got 2 quarts of budworm moths at Chesuncook Dam. Moths were still flying at Pittston Farm and Chesuncook Dam on the night of July 25-26. Flights were seen in many Maine towns between July 14-17. Many moths were observed around a lighted greenhouse in Brunswick during this period.

On July 16 at 9:30 P.M. the Weather Bureau radar screen in the Caribou area showed an unknown mass 35 miles southerly of Loring Air Force Base. This was a band 20 miles wide at altitudes up to 8,000 feet, and with a very flat top. The flat top would indicate rather definitely that the mass was not a cloud formation.

Adult moths moved into states to the south of Maine on a massive mid-July cold front that carried moths as far South as West Virginia. News reports indicated that homes in the Pittsburg, Erie, and Cleveland, Ohio areas were covered with the moths. According to Jim Nichols, this apparently explains why adult budworm were picked up in Pennsylvania a month after native population adults had disappeared. Severe defoliation had occurred on hemlock in the spring at Prince Galliteen State Park in Cambria Co., on 8,900 acres in Cameron Co., 3,500 acres in Elk Co., and 500 acres in Clearfield Co., including Parker Dam State Park.[1]

[1] Pa. For. Pest Mgt. - Jim Nichols, 8/8/74

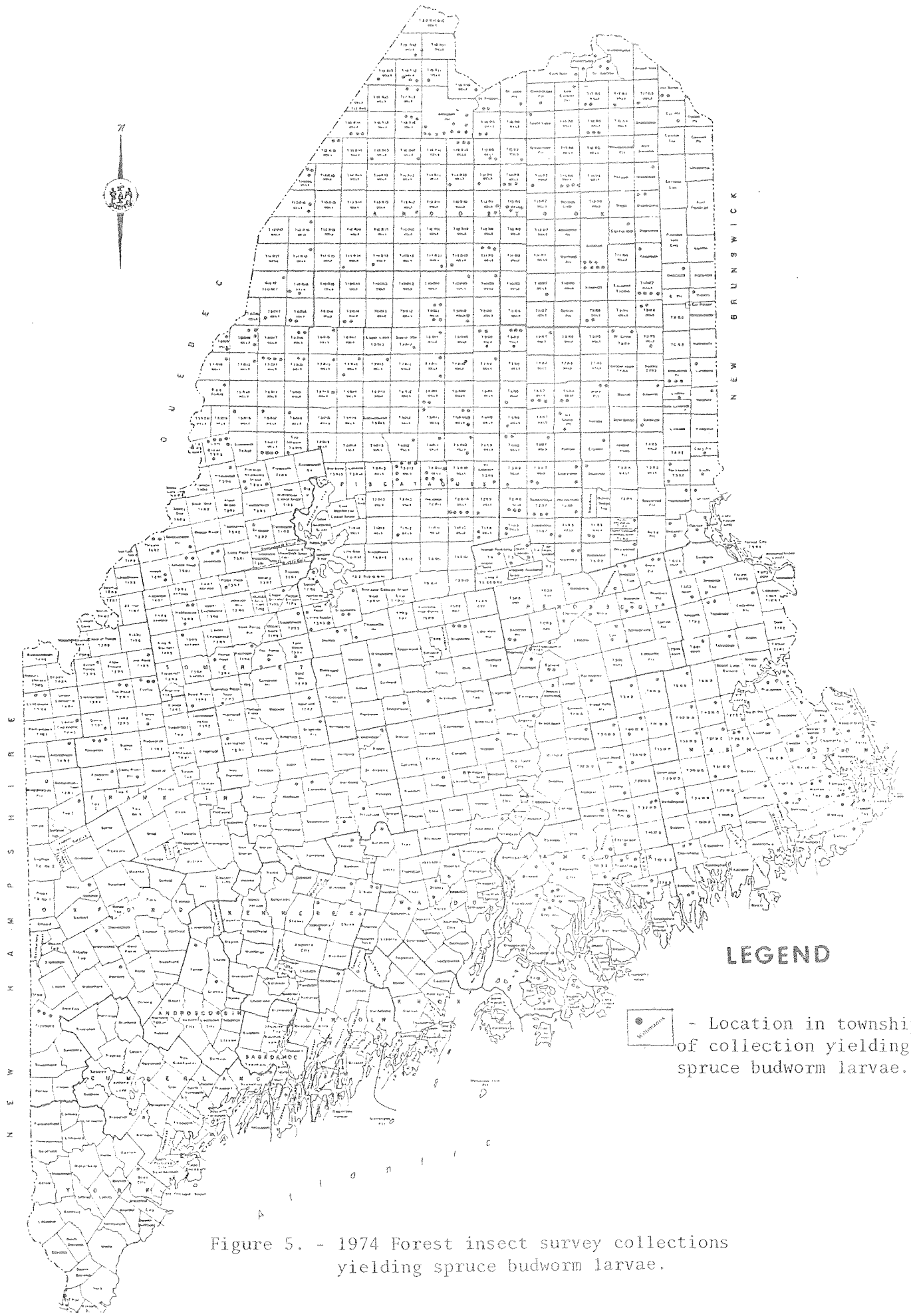


Figure 5. - 1974 Forest insect survey collections yielding spruce budworm larvae.

The following narrative report by Richard Dearborn also lends support to the massive numbers of moths encountered:

Spruce Budworm Moth Flights

Larval populations of the spruce budworm in 1974 reached levels unprecedented in Maine for more than 50 years and large moth flights resulted. While only those who live or travel through the spruce-fir areas of the State really felt directly the impact of the larval feeding, the moth flights were noticeable to nearly everyone, statewide. As a result, we had not only an increased awareness of the spruce budworm situation but the possibility of at least some budworm larval activity on spruce and fir even in southern Maine in 1975.

There seemed to be at least two distinct flights of moths in 1974 with the first being the larger of the two. The following is the sequence of events as they were reported to us:

Sunday night July 14	Allagash-St. Francis-Ft. Kent-Portage-Presque Isle-Caribou - Moths everywhere at lights across much of northern Maine. The road from Allagash to Ft. Kent was literally covered with moths with windrows along the side. They formed piles against the sides of the bridge crossing the Allagash. Moths seemed to precede a storm front from the NW.
Monday night July 15	Central-North Central Maine - Moths reported as heavy at lights in Jackman, Greenville, Long A, Enfield, Lincoln and many areas in between. Moths covered windows at some resorts such as the Squaw Mtn. Inn in Greenville. Moths were so abundant beneath lights in a mill yard at Holeb that when workers walked through them they left foot prints. Moths also caused concern at the GNP Mill at East Millinocket where they were abundant in work areas. Roads were very greasy. At a woods camp at Telos it was reported that moths could be shoveled off the ground.
Tuesday night July 16	Central-Southern Maine - Reports of abundant moth activity from Farmington, Old Town, Orono, Bangor and Winslow. A "snowstorm" of moths reported at lights and along highways from Portland to Saco-Biddeford & Kennebunk. A heavy dusting of moths reported from Fryeburg, Sebago, Brunswick and Kittery. A heavier continuation of Monday night's flight was reported from Lincoln to Springfield & St. Croix area, where some motorists claim they had to stop their cars to clean off windshields, and from Medway. This also appeared to be the heaviest flight night in Fredericton, N.B. Canada.

The dates and information listed above refer to peak nights and it should be pointed out that some moth activity followed these dates in the areas listed. In northern Maine moth activity also occurred on preceding nights but much less so in southern Maine where most moths were transients. Additional peaks of abundance were reported in northern and eastern Maine: Island Falls and other northern points on Sunday night, July 21; Springfield, Topsfield on Thursday night, July 18. Moths from all of these flights caused concern as they entered homes and production areas in mills. The early flight (July 14-16) seemed to move from the NW to the SE, generally but later flights were more spotty. Moths fell into vats of dyes in clothing mills, on to wet paper on screens at the start of processing in paper mills and many other nuisance areas. Moths also laid eggs on and in homes in some places where they were very abundant and these greenish spots were not appreciated. Moths fell beneath lights on roads making them greasy and causing some concern. Many newspapers were swamped with calls and requests for information on these flights of "millers."

While most of the moths in southern Maine were badly rubbed and probably came long distances, some were seen which were well marked and obviously the product of local populations. This was especially true at Augusta and Brunswick and most likely elsewhere.

Specimens were seen in most cases where a report was received and a definite determination made.

The results of a light trap and Malaise trap survey carried out for budworm moths in July have been released.

Note: See also pp. 5 and 6, Forest Insect and Disease Notes No. 1, 1974, Maine Forest Service, Augusta, Me.

Around mid-July, 1974, former State Entomologist R.W. Nash was informed by Forest Protection Ltd. that moths were quite abundant at 5,000 feet altitude, and that some guide and spray planes experienced danger in flying by 8 P.M. Maritime Daylight Time. Aircraft windshields were becoming opaque from battered moths and their exuded green eggs. Moths apparently were mostly females. Local dispersal of moths generally showed equal numbers of males and females, while long distance dispersal generally showed mostly females. First substantial flights generally contained males, second substantial flights generally contained female moths.

Light Trap Catches

As in past years, light trap stations were maintained throughout the month of July and were located as shown in Fig. 6. Spruce budworm moth catches identified from these light traps are listed in Table 8.

DEFOLIATION SURVEY

Defoliation in 1974 increased over that in 1973 in both magnitude and intensity. By late June and early July, 5.3 million acres were uniformly brown (Fig. 7).

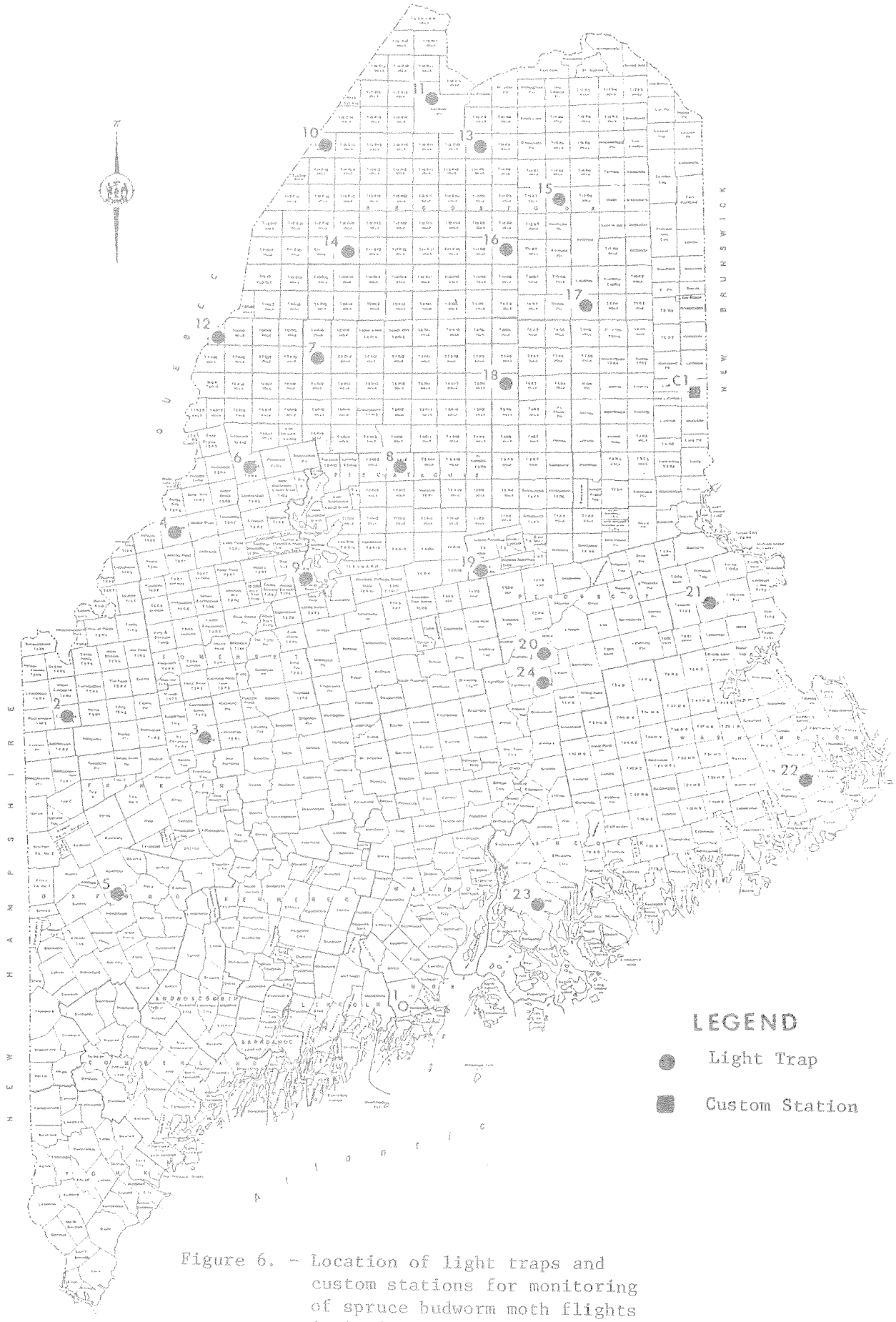


Figure 6. - Location of light traps and custom stations for monitoring of spruce budworm moth flights in 1974.

Table 8. - Spruce budworm moths identified from light trap collections during 1974.

SPRUCE BUDWORM MOTHS IDENTIFIED FROM LIGHT TRAP COLLECTIONS DURING 1974

		JULY												DATES OF COLLECTIONS																		AUG.		
	TRAP	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	2	TOTAL
1.	Warren																																0
2.	Lower Cupsuptic							15		180		35		233		170		366	40	11								3		4			1,057
3.	Kingfield								10	28			10	44	35	89																	216
4.	Dennistown Plt.						2		15	37	3	13	39	118	102	469		275	605														1,678
5.	Miltown Twp.			1	1			10	4	94	6	5	21	47	53	120	5	66	320	156	3	1	10	20	6	3	13	11					976
6.	Pittston Farm T2R4					1			1				35	286	114		17	203	64		4	8			3	1	5	38	10	2			792
7.	Caucomgomac T7R15								3			1	210			85	241	605	225				27			6	13						1,416
8.	Chesuncook T3R12										2	16	32	1174	63	90	60	2000+	20	15	11	3	1			1		2	2		3		3,495
9.	Big Squaw R2R6			1			2		10	40	3	2	13	157+	650+	1700+	82	1200+	2000+			25	103	72	18	6	28	63	6				6,181
10.	St. Pamphile T15R15										2	2		11	37	750	473	51	107	112	106	6	3	3	8	2	58	46	14				1,791
11.	Allagash T17R11					1	2	50	29	25	11	12	151	3000	17	19	526	1350	366	40	35	32	870	446	42	95	92	146	81	11			7,449
12.	T8R19 (Somerset Co.)			1			1	7	38	7		110	115		1500+	210	1400		140		125		120				22		35	25	10		3,866
13.	DeBoulie Mtn. T15R914	14					1	3			32	91	375	5000+	215	1000+	2200+		112	39	2200	1100	1200+	535	289	465							14,871
14.	Clayton Lake T11R14	1	1	1		1	1	9	12	38		100	112	(Too Poor to Process)																			276
15.	Portage Lake		1			7	3	46	10	11	10	20	381	2000	27500+	100	975		89	113	800	551	485	486	21	216	206	87	110	39			32,267
16.	Round Mtn. T11R5								1	1				7	235	63	60	50	580	105	235	370	20	176	78	37	20	91	20	10			2,159
17.	Camp Dana T9R5					4		17		1	5	12	519	15000+		1700+	7500+	45	1200+	46	700+		198+	190	200		46	10	3				27,396
18.	Hay Lake T6R8	No dates (105 Spruce Budworm)																															105
19.	Long A. Millinocket						8	4	27	10	12	18	200+	200+	750		1500+	500	35	1400+	400	600	180	80	200	60	136	50	3	24	7		6,404
20.	Enfield					4	4	6	45	32	11	8				4800+	1610+		8000				318	230			40			18	2	15,128
21.	Topsfield				1	1	1	2	6	7	7	11	5	72	600+	150	70	91	10000+	22	35	90	65	37	46								11,319
22.	Marion								1	51	22	52	15	69	408	144	280	167	15		111	7	3	26	7	5							1,383
23.	Blue Hill	3	1					11	13	7	1	8	5	42	42	256	131	600	20	28	24	31		1		6	4						1,234
24.	Passadumkeag						68	11	33	40	47	9	14	25	68	225	325	265	15000+	243		550	77	47	72	22	149		35					17,325
	TOTAL	18	2	5	2	19	93	192	258	608	174	525	2252	27485	32389	12140	17455	7834	38938	2330	4789	3374	3680	2349	990	925	832	547	319	133	20	2	158,784

Figure 7. - Heavy-to-severe spruce budworm defoliation in early July, 1974, as determined from aerial reconnaissance.

Western Region

In the Western Region, defoliation increased and was severe in the Dole-Long Pond-Penobscot Lake, Town Brook area of T3R5, T1R13 (Frenchtown) and T1R12 between Farrar Mt. and Big Spencer Mt. just north of First Roach and Kokadjo.

Light defoliation was reported in the following areas: Dennistown, Canada Falls Lake (west of Moosehead), north of Seboomook Lake, the St. Aurelie area, and east of Depot Camp on the S.W. Branch of the St. John River.

Baxter Park

In Baxter Park, the Center Mt., Wassaticook, Burnt Mt., Strickland Mt. areas suffered the second consecutive year of heavy defoliation. Defoliation was also heavy south of McCarty Field, and extremely heavy around McCarty Field. North of McCarty Field (all of T6R9 and T6R10), very heavy defoliation occurred.

Northern Region

In the Northern Region, with the exception of spray areas (Fig. 1) and the predominantly potato-growing areas in northeastern Aroostook, defoliation was uniformly heavy.

Eastern Region

In the Eastern Region, in addition to the area proposed for spraying, defoliation increased in intensity along Rt. 6 and north of Rt. 6 along Tomah Stream in Codyville Plt. Defoliation also increased in Lambert Lake and Vanceboro as well. A new epicenter started in Hainesville and defoliation was heavy to severe along the east and west branch of the Mattawamkeag. A hazard rating of 12-13 was calculated for the river area, and ratings decreased in value back from the river toward the Island Falls area.

In addition to formal Maine Forest Service survey results, additional information on defoliation was received from individuals, such as John Hartranft, Oxford Paper Co. (now Boise Cascade) who reported conditions in Big Ten, T10R17 on the Aroostook-Somerset border.

Aerial Photography

Prentiss and Carlisle, Great Northern Paper Co., and possibly others, independently hired Sewall Co. of Old Town to take infra-red photography for evaluation of spruce-fir stands damaged by the spruce budworm. This was a new approach to budworm damage evaluation over extensive areas.

SALVAGE

After the 1974 spray project was completed, it was learned that spray block #4 in the Eastern Region had been cut over as early as January of 1975. Spray application to this block was a waste of material and pointed up the need for a greater voice by landowners and landmanagers in designation of areas to be eliminated from the spray project area as recommended by Maine Forest Service, Division of Entomology personnel.

EGG MASS SURVEY

The egg mass survey commenced in August as in past years and provided information on egg mass numbers in relation to tree hazard and tree condition at specific locations. The number of samples searched was 902 and this averaged about 3.92 samples per township within the infested area. These data provided the main basis for 1975 spray-no spray decisions.

Egg mass counts were extremely heavy in 1974 with many reaching counts of 2,000 per 100 sq. ft. of foliage. The average for all samples was 1,116 per 100 sq. ft. of foliage. A count of from 241-400 was sufficient to cause complete defoliation of current growth in 1975. The extremely high counts were expected to result in complete defoliation of 1975 growth, including axils, and backfeeding on older foliage (Fig. 8, Table 9). Raw tree hazard data by grid designation is on file at the Entomology Laboratory and includes egg mass counts, tree condition and vigor values.

Egg Mass Parasitism, Dead of Other Causes and Old Egg Masses

The following values for parasitism and "dead of other causes" (DOC) are percentages of the total new egg masses. The values for old egg masses are a percentage of the total number of egg masses found, both old and new:

Parasitism	-	$\bar{x}$ =	4.56%
		S_d =	8.56
DOC	-	$\bar{x}$ =	0.24%
		S_d =	0.84
Old Egg Masses	-	$\bar{x}$ =	4.09%
		S_d =	5.99

SOAKING-OUT OF OVERWINTERING SECOND INSTAR LARVAE

Soaking-out procedures were the same as outlined in the 1973 spruce budworm report, with the exception that hexane or hexanes was substituted for benzene as recommended by Ernie Richardson of the Public Health Laboratory. Hexanes do not adversely affect liver tissues as does benzene in situations of inadequate ventilation. Also, the hexanes are more economical to use, and

Figure 8. - Spruce budworm egg mass deposition in 1974.

Table 9. - Spruce budworm hazard rating system - 1974.

Current Defoliation

Category	Hazard Value
Trace	0
Light	1
Moderate	2
Heavy	3
Severe	4

Previous Damage

Trace	0
Light	3
Moderate	6
Severe	9
Dead Tops	12

Tree Vigor

Poor	+1
Fair	0
Good	-1

Egg Mass Deposition

	No. Mass/100 Sq. Ft.	Infestation Level
None	0	0
Light	1-100	1
Moderate	101-240	2
Heavy	241-400	3
Very Heavy	401+	4
Extreme	1000+	5

Hazard Rating			Range of Total Values
Revision	Very Low		0 - 4
	Low		5 - 7
	Moderate		8 - 11
	High: Spray Recommendation		12 - 16
	Very High	Pre-salvage	17 - 22

perform about as well as the benzene in capturing the second instar larvae at the hexane - water interface in the separatory funnel.

In addition to use of soaking-out data to back up egg mass collection data for determination of control needs in the forest situation, soaking-out collections were also made in the Christmas tree growing areas of the State, particularly in Southern and Eastern Maine. Results of these surveys are contained in Appendices C - E. Guidelines for estimation of overwintering larval populations, infestation levels, and defoliation anticipated are given in Tables 10 and 11.

JET RANGER OVERFLIGHT OF A PORTION OF THE DEFOLIATED AREA

On December 20, 1974 an overflight of some of the more severely defoliated areas was made to assure that uniformity of stand damage appraisal existed between each Regional Entomologist and the Field Survey Coordinator. This was important at the time in the event hazard data had to be stratified. Priorities would have to be established to enable best use of the insecticide available in the event sufficient amounts could not be obtained to treat the entire area recommended following evaluation of the biological data. Reports on this flight are included in Appendices F - I.

SUMMARIZED REGIONAL REPORTS

Northern Region (David Struble - Regional Entomologist)

Despite better than 90% budworm kill and good foliage protection in the sprayed areas, in-flights of moths from unsprayed areas necessitates re-spraying most of the area as well as vast new acreages in 1975.

Defoliation in 1974 encompassed most of the available spruce-fir type in the region. This buildup of current population, coupled with the massive in-flights, gave egg mass deposits averaging 1100/100 sq. ft. of foliage; almost three times the population necessary to completely defoliate the new growth for 1975.

Overwintering larval samples were collected to assess the potential defoliation outside the major infestation and to recheck representative areas within the spray area to determine larval survival.

The spruce bark beetle was projected to become a major new problem for the next few years. While there were very few instances noted in 1974, the possibility of a major buildup of the spruce bark beetle was very real when one considers increasing numbers of budworm-weakened and killed trees and the massive blowdown in Baxter State Park.

Eastern Region (H. Trial, Jr. - Regional Entomologist)

For the first time in the history of budworm control projects in Maine, a portion of Washington Co. was sprayed to control the spruce budworm. Some

Table 10. - Density of overwintering spruce budworm larvae and infestation levels per 100 sq. ft. of fir branch surface.

Overwintering Larvae/100 Sq. Ft.	Infestation Level	Expected Defoliation (%)
0	Nil	0
1 - 100	Low	1 - 30
101 - 300	Medium	31 - 65
301 - 650	High	66 - 90
651 +	Extreme	90 - 100

Table 11. - Density of overwintering spruce budworm larvae and infestation levels per single fir branch (from Kettela correspondence).

Infestation	Numbers	Expected Defoliation
Light	1 - 8	1 - 25%
Medium	9 - 21	30 - 65%
Heavy	22 - 32	70 - 100%
Severe	33 - 49	100% +
Very Severe	50 +	

75,500 acres along the St. Croix River from Vanceboro to Grand Falls and large portions of Waite and Indian Twps. were sprayed in 1974, and included areas with a hazard rating of 12 or more (Table 9).

Camp posting and personal contact were the major contact activities conducted. Oscar Ward and Roger Milligan of the Fire Control Division assisted regional entomology personnel. Hazard markers were installed along Dr. David Leonard's parasite release site along Flipper Creek, Indian Township and at two residences along U.S. Rt. 1 as per requested by the owners.

Development collections were started on May 22 and continued through June. The Flipper Creek Rd. (U-Road) west of U.S. Rt. 1 was chosen as being representative of the area because it was average in elevation and temperature. Additional checks on development were made throughout the spray area while pre-spray collections were being made.

Between May 30 and June 5 a total of 50 pre-spray collections were taken and populations determined in the field, except for 3 points. Twenty of the total number of collections were made outside the spray area.

Most of the area was sprayed on the evening of June 8 and the morning of June 9. A portion of block 1 was not completed until June 12. Helicopter acreage along the highway and flowage was sprayed by June 14.

Post-spray collections were taken between June 29 and July 3 and searched in the field. Larvae and pupae were saved for determination of percent parasitism. About 30% of the population was in the larval stage on June 29, but pupation was nearly complete by July 1. Most collections taken on June 29 were inside the spray area where very few larvae or pupae were found.

Western Region (Hubbard Trefts - Regional Entomologist)

Control efforts in 1974 in the Region did little or nothing to reduce tree damage in 4 out of the 5 areas treated. In the Coffeelos area, in that part which was sprayed both in 1973 and 1974, the trees have made a noticeable recovery. Foliage loss was almost complete on the other four areas (Beetle Mt., Umbazooksus, Longley Pond, and McCarty Field). The McCarty Field area apparently was not even sprayed in 1974. Surrounding areas suffered continuing heavy foliage loss with additional mortality showing up, especially in those areas missed during the 1973 operation. Extensive areas west of Chesuncook continued to be hard hit with some tree mortality expected there over the winter. New areas of defoliation in 1974 included the fir flats west of Farrar Mt. and north of First Roach Pond. Extensive areas of blowdown in western Baxter Park (within the budworm area) were expected to add further to the fire hazard already existing from budworm-killed trees in the area.

From the massive moth flights in July and the high number of egg masses found throughout the region, it appeared that more budworm damage would result in 1975 than we have seen for at least 50 years.

Spray recommendations were set forth for 700,000 to 800,000 acres in the Northern part of the Seboomook and Moosehead Districts (Caucomgomoc to Telos

south to Big Spencer Mountain area). Elsewhere in the Region (Cupsuptic, K.I., Dennistown, Jim Pond, Jackman, Richardson Lakes, Wilson Mills, Coburn Gore, etc.) budworm damage was expected to be severe in 1975 based on over-wintering larval surveys.

In 1974, Warren Bennett, Steve Day, Austin Sillanpaa, Steve Wheaton, and John Hinkley carried our share of the load during the spraying operations at Presque Isle. During the several ground and aerial surveys, Dave Wight, Ed Bowden, Bruce Downs (Eastern Region), George Johnson, Asa Markey, Myron Witherill, John Knight, Bruce Labbe, and Charlie Robinson of the Northern Region helped out in obtaining as intensive and as complete a budworm survey as has ever been undertaken in the Western Region. Mike Pelletier (Lilly Bay State Park), Larry Hunter (Allagash Waterway), Stan Carpenter (Great Northern Paper Company), and Scotty Skinner from Patten also assisted on the survey. Hub Trefts, Maynard Atwood, and Grayln Smith were kept very busy keeping these people going in the same direction and not tripping over one another. Continuing fall and winter surveys yielded more detailed information on what to expect in 1975. Approximately 350 egg mass samples were taken in those areas most seriously affected by budworm in 1974.

MEETINGS, RECOMMENDATIONS AND PREPARATIONS FOR THE 1975 SPRAY PROJECT

Following an early meeting of Maine Forest Service Entomology Division, U.S. Forest Service and industry personnel, a request was made to have a preliminary acreage figure for the 1975 project by September 10; this to be refined by mid-October for planning purposes. In conjunction with planning phases, the following meetings were held:

September 10 - Director Holt met with 3 - 4 of the major land managers in Orono in connection with getting 1975 spray funds and getting Dow Chemical Co. to produce Zectran for 1975. A preliminary acreage figure of 5.3 million heavily-to-severely-defoliated acres was presented, and a project of 3.5 million acres was recommended at this time.

September 19 - A joint Canadian - U.S. meeting was held at the Civic Center in Augusta to discuss cooperative budworm activities.

October 17 - The Entomology Staff Meeting was held at Bolton Hill to finalize spray recommendations.

October 23 - A Land Manager - Entomologist Meeting was held to inform land managers of the Entomology Division's recommendations to spray 3.5 million acres.

A real problem developed in late fall, 1974 when insecticides for the recommended acreage were found to be in short supply. By December 20, 1974 insecticide availability was as follows:

Insecticide Name	Gallon Quantity	Actual Insecticide Per Gal.	Gal. Cost	Acres Per Gallon	Total Acres
Zectran (Firm)	19,880	1 1/2 lbs.	$13.95	10	198,800
Sumithion (Firm)	12,000	8 lbs.	35.00	32	384,000
Sevin 4-Oil (Possible)	125,000	4 lbs.	7.00	4	500,000
				TOTAL	1,082,800

The big problem was finding facilities to convert elemental phosphorous to a sulfonated tri-chloride form as a basic ingredient of Sumithion. Then it had to go to Japan to prepare technical Sumithion with solvents, thence back to the U.S. for addition of emulsifiers, thence to Maine. To accomplish all this within the necessary time frame was an important factor in itself.

1974 SPRAY PROJECTS AND CONDITIONS IN THE ADJACENT CANADIAN PROVINCES

In 1974, Quebec sprayed about 6.5 million acres at a cost of approximately $1.28 per acre. Insecticides used in the operational project were Fenitrothion, Matacil, and Zectran.

New Brunswick's spray program covered approximately 3.9 million acres at a cost of approximately $0.68 per acre. Insecticides used in the operational project were Fenitrothion, Phosphamidon (Dimecron) and Trichlorfon (Dylox).

New Brunswick also tried Phosphamidon against adult moths in 1974 in a large scale test following small scale tests in 1973. The chemical was applied in two applications at 1 oz. in 6.4 oz. solution per acre. Application was by boom and nozzle (8006). A radar station at Renous, N.B. was used to record any moth migration into the adult spray area following spray application. Details on this test are available from Forest Protection Ltd., Fredericton, N.B.

The Newfoundland outbreak, initiated in 1971, intensified to an estimated 7.2 million acres in 1974. Some 2.1 million of these acres were moderately to severely defoliated. Results of the 1974 egg survey indicated an expected 4.5 million acres would be moderately to severely defoliated in 1975 barring a population collapse due to spring weather conditions.[1]

In New Brunswick, 8.3 million acres suffered moderate to severe defoliation in 1974 particularly in north, west, and north central portions of the province. In the Bay of Fundy and east coast areas, the situation had improved considerably. In the high country of central N.B. (2,000 feet altitude and up) trees appeared real green even though there were high egg counts in this area in 1973.[2]

[1] In: "Woody Points" Newfoundland For. Centre. Can. For. Ser. 6(3): 1974.
[2] Phone conversation R.W. Nash: For. Prot. Ltd. 7-24-74.

In Quebec, 80 million acres suffered moderate to severe defoliation. Smaller acreages were defoliated in Nova Scotia and P.E.I. Mortality of balsam fir resulting from the outbreak was observed over 3.9 million acres in Quebec Province. Some 90,000,000 acres were seriously infested in 1974 in Maine, Quebec and New Brunswick.[3]

Continued high population levels were forecast for 1975 in most infested areas and expansions anticipated in some areas.[4]

[3] Maine 1974 Fact Sheet.
[4] In: Annual Report 1974, Forest Insect and Disease Survey, Environment Canada, Forestry Service.

APPENDIX "A"

ZECTRAN - GENERAL INFORMATION - 1974

APPENDIX A

ZECTRAN - GENERAL INFORMATION - 1974

Introduction: These summary statements are based on technical reports on file with the Maine Bureau of Forestry and concern the insecticide used in the 1974 spruce budworm control project.

General: Zectran (C_{12} H_{18} N_2 O_2 (4 dimethylamino-3, 5, xylyl methylcarbamate)) is a carbamate insecticide and has been tested by the manufacturer (Dow Chemical Co.) since about 1960 and by various federal and state agencies since 1965. In many cases test animals were exposed to higher rates of Zectran than would normally be encountered outside the laboratory.

Registration: The Zectran formulation CF-24 is registered by the Pesticides Regulation Division of the Environmental Protection Agency of the U.S. Government for aerial application at the rate of 2.4 ounces of actual material in one quart of oil per acre against the budworm.

Mode of Action: Zectran is both a contact and stomach poison. Basically, Zectran adversely affects an organism by reducing the amount of cholinesterase available for normal functioning of its nervous system. The cholinesterase inhibition caused by Zectran is reversible and rapid recovery in animals exposed to sublethel doses can be expected. A single spraying at 2.4 ounces of Zectran per acre could not be expected to produce harmful effects on the nervous systems of higher animals.

Toxicity: Zectran is considered less hazardous than the organophosphorus insecticides (e.g. dibrom, malathion) and far less persistent than the chlorinated hydrocarbons (e.g. DDT, aldrin). It presents a low hazard from eye and skin contact and a moderate to high hazard from ingestion. However, when using normal precautions in handling insecticides, it does not pose a human health hazard. Zectran has a low cumulative effect and does not build up in an animal's body.

Persistence: Because of its low degree of persistence, Zectran's harmful side effects have been greatly reduced. Conclusive tests have shown that Zectran breaks down very rapidly in sunlight and loses 50% of its potency in 4 hours and is almost completely dissolved into harmless by-products in 4 days. Because of its low persistence, Zectran does not build up in food chains as occurs with some of the chlorinated hydrocarbons.

Selectivity: When compared with several other insecticides, Zectran was found to be far more selective against the spruce budworm and less active against non-target insects. In one test Zectran killed 91% of the spruce budworm and only 35% of other associated insects.

Effectiveness Against the Spruce Budworm: Extensive field tests indicate that budworms are reduced by 80 to 95% depending upon the particular test circumstances. A 10,000 acre test in Maine in 1971 indicated that 87.5% of the budworm were killed by Zectran when all factors were considered. Other insecticides have yielded a higher degree of control but are no longer acceptable for use.

Effect on Predators and Parasites: Tests conducted in 1965, 1966, 1968, and 1969 indicated that budworm parasitism by Apanteles fumiferanae and Glypta fumiferanae actually increased following treatment with Zectran. This survival or increase may be caused because parasitized budworm larvae are more lethargic and less likely to come in contact with the spray. When compared with the insecticide Naled, Zectran killed more spiders (non-specific predators) and aphid-mite predators. In times of epidemic populations, as now exist in northern Maine, parasites and predators simply are unable to cope with budworm populations.

Effect on Fish: Zectran is particularly safe to fish. Laboratory tests of Zectran against rainbow trout, bluegills and channel catfish by the U.S. Fish and Wildlife Service at Denver, Colorado, showed that Zectran is nearly 3,000 times less toxic to fish than DDT. In field tests (1965, 1966, and 1967) in Maine and Montana, no abnormal behavior was observed in live caged eastern brook trout when exposed to various dosages of Zectran. Since aquatic insects were only temporarily affected, there was no imigration or intrastream movement of trout because of loss of normal food supply. In the 1967 Maine Zectran tests no dead fish were noted in drift nets following spraying.

Effects on Birds: Because of their high metabolic rates, birds are very susceptible to some insecticides. Feeding tests have been conducted with coturnix quail, mallard ducks, chukar partridge, house sparrows and house finches where some mortality did occur when dosages of Zectran higher than those expected under normal field conditions were administered. No harmful effects on breeding success were noted in either blue or ruffed grouse in the field. Field tests in Idaho and Montana (1965-1967) indicated no measureable effect on population numbers, species composition, or nesting success of several species of thrushes, sparrows and western tanagers as a result of Zectran spraying. Since subtle changes were not noted by trained observers, it was assumed that aerial spraying had no effect on these birds. As part of these tests, fluorescent particles were added to the spray formulation which showed up in stomach analyses of insectivorous birds feeding on dead or dying budworm larvae in the spray area. Because of the spraying, budworm larvae became temporarily more available to the birds and small mammals studied. The seasonal decline in insect populations was not sufficient, however, to cause nest abandonment.

Effect on Mammals: Studies by the U.S. Fish and Wildlife Service indicate that daily doses of Zectran, producing symptoms of toxicity, could be tolerated by mule deer for months without permanent detrimental effects. Studies of small mammals (red squirrels, flying squirrels, golden-mantled ground squirrels, chipmunks, deer mice, and red-backed mice) indicated no harmful effects even when some species had consumed large numbers of Zectran-killed budworm larvae. Observations of these mammals, by trapping, marking, retrapping techniques were made on both sprayed and unsprayed areas.

Phytotoxicity: Zectran has been applied to over 600 plant species throughout the United States and no injury to foliage was detected.

Effect on Soil: Test applications of several formulations of Zectran and oil indicate that the proposed formulation CF-24 has no adverse effect on soil microflora.

Carcinogenicity: Feeding tests conducted by the Wisconsin Alumni Research group and the Dow Chemical Company indicate that cancerous effects were no different in animals either exposed or not exposed to varying amounts of Zectran in their diets. Based on these tests the Environmental Protection Agency concludes that Zectran does not pose an imminent threat of this nature at the proposed use level of 2.4 ounces of actual Zectran per acre.

Teratogenicity: No birth defects were noted in mice injected with Zectran at a higher rate than would be found in the field. It is, therefore, concluded that fetal abnormalities would not be expected in animals exposed to Zectran (e.g. 2.4 ounces/acre) in the proposed spray areas.

Summary: It is concluded that Zectran is one of the safer insecticides otherwise it would not have been accepted for federal registration. It is reasonably effective against the spruce budworm without adversely affecting fish and wildlife.

APPENDIX "B"

MONITORING DATA FROM EIGHT BLOCKS SPRAYED IN 1974 WITH ZECTRAN FOR CONTROL OF THE SPRUCE BUDWORM

APPENDIX B

MONITORING DATA FROM EIGHT BLOCKS SPRAYED IN 1974 WITH ZECTRAN FOR CONTROL OF THE SPRUCE BUDWORM

Dr. A. E. Brower

Working from Shin Pond, eight spray blocks (Nos. 35 to 42) were checked, from June 11 to 16 with additional limited observations outside the sprayed blocks. This was the fifth consecutive year of regular monitoring of spray areas. Unexpected weather conditions permitted spraying of a large part of this whole area June 10, the day of arrival.

This is an area of rolling hilly terrain covered with second growth forest. In the past it has been heavily cut, and now has a considerable admixture of hardwoods. Except in block 42 very little cutting in recent years was encountered, and so comparatively few man-made disturbances. The rock surface contained very few natural pools of shallow water. No severe defoliation was encountered; therefore, comparatively few budworm larvae were expected. The above combination of factors made the finding of spray affected spruce budworm larvae unlikely; therefore, the chief emphasis was placed on finding dead or affected vertebrate life, adult insects, or necrotic plant tissue. An unexpected factor was the relatively large number of adult moths knocked down by the spray. Fifty seven individuals of 21 species of forest moths were found. In block 38 a big tadpole was found dead, and in block 40 a large dragon fly nymph, with the spray the suspect; however, very numerous tadpoles of all sizes appeared normal. No other evidence of any effect on birds or other animal life was found, except insects. Lists of the species observed in these groups are attached. Black flies, mosquitoes, and toward the end, deer flies were annoying, presumably because of post-spray emergence. Midges, gnats, caddis-flies, and stone-flies were killed in usual numbers. A complete lack of dead parasitic Hymenoptera was unexpected. A flight of carpenter ants took place about the time of the spray. No bees were seen except seven about three-leaved dewberry one day. Rarely a bumble bee was seen at first, but they became fairly common about apple and lilac blossoms. No dead beetles were found; some live ones were identified toward the end. The delayed warm weather inhibited insect emergence.

A low number of warblers and insect feeding birds was noticeable, probably due to their having settled in areas of higher budworm populations. Birds of 66 species, 58 genera and 26 families were recorded. No dead or moribund birds were found.

Outside of microscopic life and fungi, an attempt was made to cover a wide range of plant life from lichens and mosses to the highest plants. Herbaceous plant growth was delayed and only the earlier species were identifiable. The list includes 69 families, 189 genera, and 255 species. No necrotic effects attributable to the spray were found. In various places on fir and spruce tip blight (probably by Rehmiellopsis) was observed. In block 39 a Crataegus bush was found with a considerable number of its leaves with most of their venation a striking bright red, possibly due to bacteria, in the vascular system.

A complete listing of the birds, upland animal life, amphibia, woody and herbaceous plant life monitored is on file at the Maine Forest Service, Entomology Laboratory, 50 Hospital Street, Augusta, Maine 04330. Only the moths and orders of insects killed by Zectran are included here.

Dead or Moribund Moths Found on Spray Blocks (35-42)
June 11-15, 1974 in Northern Penobscot Co.

McD. List Numbers		No. of Specimens Found
1675	Polia latex	1
4223 & 4223.1	Nyctobia limitaria & anguilineata	10
4225	Neodezia albovittata	2
4246	Lobophora nivigerata	1
4266±	Eupithecia miserulata, etc.	3
4485	Hydriomena renunciata	1
4509	Xanthorhoe lacustrata	7
4516	Xanthorhoe ferrugata	4
4558	Euphyia intermodiata	2
4605	Bapta semiclarata	1
4606	Bapta vestaliata	1
4608	Bapta glomeraria	1
4856 & 4857	Melanolophia canadaria & signataria	15
4875	Protoboarmia porcelaria	1
4882	Glena cognataria	1
5015	Campaea perlata	3
5023	Apaecasia detersata	1
5125	Caripeta divisata	1
8383	Machimia tentoriferella	1
21 species	Total specimens	57

Some moths were too decomposed to determine.

One larva of canker worm type was found and one spruce budworm larva.

Orders and Numbers of Insects Killed by
Zectran Spray - June 11-16, 1974

Hymenoptera		Diptera		Neuroptera	Plecoptera	Ephemerida
Carpenter ants	16	Crane flies	16	Hemerobius 3	10	255
		Tachinids	4			
		Midges, Gnats, etc.	769			
Totals	16		789	3	10	255

Total insects 1073

APPENDIX "C"

SPRUCE BUDWORM SURVEY - CHRISTMAS TREE AREAS

FALL-WINTER 1974-1975

APPENDIX C

SPRUCE BUDWORM SURVEY
CHRISTMAS TREE AREAS - FALL-WINTER 1974-75

Southern Region - McMullen & Pratt

Town	Location	Overwintering Larvae per 100 sq. ft. branch area	Infestation Level	Expected % Defoliation 1975
Friendship	On Forest Lake Rd. opposite pond.	144	Medium	31-65
Waldoboro	2 miles east of U.S. 1 on rd. by Duck Puddle pd. on Rte. 32.	343	High	66-90
Bristol	On road from Pemaquid neck to Rte. 32.	171	Medium	31-65
Wiscasset	At airport near town Christmas tree lot.	212	Medium	31-65
Southport	On east side Drive, half way point north and south on island.	92	Low	1-30
Southport	Same area only on spruce.	91	Low	1-30
Boothbay	.2 mile north of Boothbay playhouse on Rte. 27.	233	Medium	31-65
Benton	At fifteen mile stream on Unity Road	240	Medium	31-65
Albion	Near Albion-Benton town line on Bog Rd.	110	Medium	31-65
Knox	Knox Center on Rd. to Aborn Hill.	127	Medium	31-65
Jackson	.5 mile East of Jackson Corner on Rte. 7 towards Jackson.	52	Low	1-30
Troy	.5 mile north of Troy Corner.	90	Low	1-30
Burnham	Between Twitchell Corner and Dodge Corner.	202	Medium	31-65
Burnham	.5 mile south of Winniecook Station.	254	Medium	31-65
Winthrop	On rd. from Winthrop to Wayne, north end of Mt. Pisgah.	52	Low	1-30
Livermore Falls	On Moose Hill Rd.	486	High	66-90
Hartford	Rte. 140, 1/4 mile north of Sparrow Brk.	146	Medium	31-65
Sumner	On Rte. 219, south of Fields Hill.	126	Medium	31-65
West Paris	Rte. 219, 1 mile northeast of Trap Corner on Old Rd.	82	Low	1-30
Greenwood	Off Rte. 219, near Twitchell Brook at the Triangle in Rd.	75	Low	1-30
Greenwood	North of Overset Mt. along Twitchell Brook.	100	Low	1-30
Norway	South of Meadow Brook on Rd. going south from Rte. 118.	161	Medium	31-65
Waterford	Rte. 35 West of Rices Hill.	100	Low	1-30
Phippsburg	On Rte. 216, south of Small Point.	226	Medium	31-65
Windsor	On Rte. 17, .5 mile east of Windsor Corners.	499	High	66-90
Somerville	North of Jones Corner beyond Don Hewitt's farm on county rd.	303	High	66-90
Washington	On Rte. 17 near Davis Stream, just east	317	High	66-90
Searsmont	Off Rte. 173 on dirt rd. to east side of Quantabacook Lake.	190	Medium	31-65
Morrill	East of Row Hill.	277	Medium	31-65
Palermo	On road to Hostile Valley off Rte. 3	182	Medium	31-65

APPENDIX C

SPRUCE BUDWORM SURVEY
CHRISTMAS TREE AREAS - FALL-WINTER 1974-75

Eastern Region - Trial, Jr. & Devine

Town	Location	Overwintering Larvae per 100 sq. ft. branch area	Infestation Level	Expected % Defoliation 1975
Milford	7/10 mi. west of Greenfield-Milford town line on county rd.	620	High	66-90
Plt. 33	10.2 miles east of Crocker Turn, on CCC rd.	354	High	66-90
T 28 MD	3.1 miles south of Stud Rd. on CCC rd.	640	High	66-90
Springfield	2 miles north of Rte. 6 on rd. to Prentiss.	1198	Extreme	90-100
Mattawamkeag	1 mile north of town on Rte. 2.	2033	Extreme	90-100
Kingman	1 mile south of Kingman-Macwahoc town line on Rte. 170.	3267	Extreme	90-100
Webster	1/2 mile east of Mattagodus St., on Rte. 170	2469	Extreme	90-100
Drew	2 miles north of Drew-Prentiss town line on Rte. 170.	877	Extreme	90-100
Carroll	9/10 mile west of Washington County Line, on Rte. 6.	863	Extreme	90-100
Lincoln	About 1/2 mile in on Airport Rd.	2075	Extreme	90-100
T 31 MD	2/10 mile east of Main River on Rte. 9.	254	Medium	31-65
T 25 MD	2 miles in on T 25 Barren Rd. from Rte. 9.	234	Medium	31-65
Whitneyville	13.9 miles south of Rte. 9 on Rte. 192.	218	Medium	31-65
Jonesboro	2.2 miles west of Pleasant River, on Rte. 1.	712	Extreme	90-100
Penobscot	Paul Birdsalls Lot.	272	Medium	31-65
Blue Hill	Rodney Cookman Lot.	242	Medium	31-65
Sedgwick	Conrad Rupert Lot.	249	Medium	31-65
Baring	J. Bryson's Christmas Tree Lot.	994	Extreme	90-100
Franklin	H. Noyes Georges Pond Lot.	206	Medium	31-65
Franklin	Debeck's Lot on Rte. 200.	331	High	66-90
Franklin	H. Noyes Makerplace Lot.	384	High	66-90

Key

Overwintering Larvae per 100 sq. ft. branch area	Infestation Level	Expected % Defoliation
0	0	0
1-100	Low	1-30
101-300	Medium	31-65
301-650	High	66-90
651+	Extreme	90-100

APPENDIX "D"

SPRUCE BUDWORM OVERWINTERING LARVAL SURVEY REPORT

EASTERN REGION 1974-1975

APPENDIX D

SPRUCE BUDWORM
OVERWINTERING LARVAL SURVEY REPORT - EASTERN REGION
1974-1975

Due to the extensive budworm flights experienced in the summer of 1974 we feel it necessary to make a general survey of the overwintering budworm populations in the Eastern Region.

In addition to the general budworm evaluation we evaluated the 1975 budworm potential in a number of commercial Xmas tree lots and in the 1974 Washington County spray areas. A total of 53 overwintering samples were taken. Of these 31 were general samples, 8 were from Xmas tree lots, and 19 were from the 1974 Washington County spray area. All samples were considered in the general survey.

Most of the samples taken were searched by Dan Pratt and Jim McMullen in the Southern Region. Five samples were processed in the Northern Region.

Results - General Survey

Results of the general survey showed 35 points with extreme 1975 budworm populations. Of the remaining 23 points, 11 were high, 12 were moderate, and none were low. Results are summarized in Table 1. The mean larval count in the region was 1021 and 1495 in the extreme area.

With the exception of the 1974 spray area only 2 points had as high as moderate 1974 feeding with most of the remainder showing only a trace of 1974 feeding. Previous feeding in these areas was no greater than light with the great majority of points showing only a trace of past feeding. The lack of previous feeding strongly suggests that the great numbers of overwintering larvae are the result of 1974 moth flights and not from budworm populations native to the areas.

The areas hardest hit by the 1974 moth flights were the Northern two thirds of Penobscot County and the Northern half of Washington County (Figure I). Both these areas have uniform extreme overwintering populations and can expect 90 to 100% defoliation of 1975 fir growth. Hancock County and the remainder of Penobscot and Washington Counties showed a mixture of high and moderate infestation levels. Southern Washington County has some scattered extreme areas.

Results - Xmas Tree Lots

Results from Xmas tree lots are not encouraging (Table II). Of the 8 lots sampled 5 were moderate, 2 heavy and one extreme. Samples were taken from dominant or co-dominant fir in the area of the lots. The commercial trees themselves were not sampled but, many larvae from surrounding trees will spin down to the shorter stock. If budworm populations get to the Xmas trees,

even moderate damage would make the tree unmarketable. We do not know how many egg masses were deposited on the small trees this summer. We will sample Xmas tree size stock for population if time permits.

Results - Washington County Spray Area

The mean larval count from this area was 1813 per 100 sq. ft. This count is much higher than even the egg mass counts indicated. These larval counts are, however, comparable with counts taken in the extreme portion of the general survey area (1495 per 100 sq. ft.). It was thought that the excellent efficacy obtained in this area in 1974 would mean a reduction in the 1974 egg mass deposit. Because of the massive 1974 flight, this was not the case.

Overwintering larval counts from the Washington County spray area are given in Table III along with the egg mass counts taken at the same area in August of 1974. In terms of egg mass and larvae per 100 sq. ft. the two figures have very little correlation. This is probably due to the small number of samples taken.

OVERWINTERING BUDWORM POPULATIONS ON CHRISTMAS TREE SIZE STOCK

Our overwintering samples were taken on large trees surrounding Xmas tree lots, therefore, we have had no figures on the number of larvae on the Xmas trees themselves. To test this population we obtained 4 Xmas trees from a lot where the surrounding population was high. We cut the trees into 2 foot sections (starting from the top), measured the square foot area of the branches, and put the foliage through the soaking process. Results of this test are given in Table IV.

All trees showed moderate budworm population. Two trees taken near larger trees at the edge of the lot had higher populations than trees from the center of the lot. The top 4 feet of all trees produced the most larvae and in all cases there were probably enough larvae to cause considerable damage.

Budworm larvae on the Xmas trees at this time are from eggs deposited directly on them or fall dispersal of larvae from large surrounding trees. Another dispersal will occur when larvae become active this spring. This spring dispersal will deposit many more larvae on the Christmas trees in the lots.

Table I. - Eastern Region overwintering budworm population 1974-75.

Town	Larvae per 100 sq. ft.	Population Level	Expected Defoliation
Milford	620	H	61- 90%
Plt. 33	354	M	31- 60%
T 28 MD	640	H	61- 90%
Springfield	1198	E	91-100%
Mattawamkeag	2033	E	91-100%
Kingman	3267	E	91-100%
Webster	2649	E	91-100%
Drew	877	E	91-100%
Carrol	863	E	91-100%
Lincoln	2075	E	91-100%
Lincoln	887	E	91-100%
T 31 MD	254	M	31- 60%
T 25 MD	234	M	31- 60%
Whitneyville	218	M	31- 60%
Jonesboro	712	E	91-100%
Dixmont	161	M	31- 60%
Stetson	303	H	61- 90%
Garland	250	M	31- 60%
LaGrange	803	E	91-100%
Bradford	749	E	91-100%
Glenburn	132	M	31- 60%
Seboeis	1529	E	91-100%
Woodville	2683	E	91-100%
Long A	1932	E	91-100%
Hudson	882	E	91-100%
T 36 MD	221	M	31- 60%

Table II. - 1974-75 overwintering budworm samples from Xmas tree lots.

Town	Lot Owner	Larvae per 100 sq. ft.	Population Rating	Expected Defoliation
Penobscot	Birdsall	272	Moderate	31- 65%
Blue Hill	Cookman	242	Moderate	31- 65%
Sedgwick	Rupert	249	Moderate	31- 65%
Barring	Bryson	994	Extreme	90-100%
Franklin	Debeck	331	High	66- 90%
Franklin	Noyes	206	Moderate	31- 65%
Franklin	Noyes	384	High	66- 90%
Holden	Mills	190	Moderate	31- 65%

Table III. - Overwintering larval results for 1975 - Washington County spray area.

Town	Point #	Egg Mass Count per 100 sq. ft.	Egg Mass Level	Larval Count per 100 sq. ft.	Larval Level	Location With Regard to Spray Area
Lambert Lk.	E10	1547	E+	1488	E	In
Lambert Lk.	E11	769	E	739	E	In
T1R2	E14	763	E	1153	E	In
T1R2	E17	613	E	2587	E	Out
Lambert Lk.	E22	301	H	1064	E	Out
Lambert Lk.	E24	960	E	1954	E	In
T1R2	E27	587	E	1853	E	In
Waite	E28	354	H	3894	E	Out
Codyville	E31	133	M	832	E	Out
T1R1	E32	434	E	910	E	In
T1R1	E35	1079	E+	1090	E	In
T1R1	E38	870	E	1988	E	In
Talmadge	E42	273	H	2710	E	Out
Indian Twp.	E44	136	M	513	H	In
Indian Twp.	E45	405	E	1440	E	In
Indian Twp.	E47	800	E	1994	E	In
Codyville	E51	990	E	2338	E	Out
Danforth	E52	514	E	3053	E	Out
Topsfield	E53	456	E	2835	E	Out

Table IV. Overwintering spruce budworm larval population levels from the upper, mid, and lower crown of Xmas trees in the Eastern Region - winter of 1974-75.

	Sec. No.	Sq. Ft.	No. of Larvae	No. of Lar./sq. ft.	Larvae/ 100 sq. ft.	Ave/ 100 sq. ft.	Infestation Level	Expected Defoliation
T R E E 1*	Top	2.0	10	5	500	180	Moderate	31-65%
	Mid	17.0	4	.24	24			
	Bot	19.0	3	.16	16			
T 2*	Top	2.0	4	2	200	228	Moderate	31-65%
	Mid	4.5	19	4.2	420			
	Bot	26.0	17	.65	65			
T 3**	Top	2.25	6	2.7	270	116	Moderate	31-65%
	Mid	14.0	7	.50	50			
	Bot	15.0	4	.27	27			
T 4**	Top	2.0	6	3	300	159	Moderate	31-65%
	Mid	13.5	15	1.1	110			
	Bot	15.0	10	.67	67			

* Near Edge of Plantation
** Near Middle of Plantation

APPENDIX "E"

SUMMARY SHEET - OVERWINTERING LARVAL SURVEY

1974-1975 - NORTHERN REGION

APPENDIX E

SUMMARY SHEET - OVERWINTERING LARVAL SURVEY
1974-1975 - NORTHERN REGION

Grid Designation	Twp.	Larvae/100 Sq. Ft.	Hazard Rating
A19-7-12	T - 19R12	2667	14
B18-8-8	16R13	2859	5
B18-5-16	17R13	589	7
B18-4-23	16R13	867	4
B18-7-19	16R13	573	3
B18-4-23	16R13	494	3
B19-6-4	18R10	329	3
B19-5-19	Allagash	1422	14
B21-9-22	15R6	556	4
B21-6-25	16R6	1082	17
B21-6-23	16R6	341	6
B22-7-18	16R6	1702	9
B22-4-20	17R5	1085	14
B23-6-4	Van Buren	309	4
B23-9-17	Conner	2234	22
B23-9-2	Cyr	2439	22
C16-9-1	13R16	922	4
C17-6-3	14R14	1137	6
C17-2-16	14R15	2369	17
C18-7-10	13R13	1135	5
C18-2-8	15R13	643	4
C18-5-2	14R13	1308	5
C19-5-1	14R11	1636	15
C19-3-3	15R10	882	14
C20-9-14	13R8	374	4
C20-8-25	13R9	1355	6
C20-8-3	13R9	4434	6
C21-2-4	Winterville	614	3
C21-6-10	14R6	314	7
C22-6-11	14R5	910	8
C22-8-7	13R5	620	19
C22-5-24	14R5	488	17
C24-5-2	Limestone	1864	10
C24-5-18	Fort Fairfield	1045	9
D16-5-22	11R17	1556	5
D16-4-17	11R17	1382	5
D16-9-21	10R16	1101	5
D16-6-23	11R16	2278	5
D16-2-8 (9)	12R17	942	4
D16-1-17	12R17	523	4
D17-7-20	10R15	2486	5
D17-6-13	11R14	1736	19
D17-3-12	12R14	1205	8
D17-4-18	11R16	1747	10
D17-5-9	11R15	1198	18

Grid Designation	Twp.	Larvae/100 Sq. Ft.	Hazard Rating
D17-1-24	12R15	1288	18
D18-3-17 (22)	12R12	1305	14
D18-3-9	12R12	2790	18
D21-3-20	12R6	1385	8
E15-6-3	9R18	2214	5
E15-8-17	7R19	640	8
E16-6-1	9R16	3659	17
E16-1-21	9R18	1480	14
E17-4-2	9R16	876	9
E18-2-17	9R13	2831	14
E18-3-19	9R12	1195	18
E18-6-9	9R12	1733	18
E18-6-2	9R12	1162	18
E18-6-20	8R12	972	21
E18-2-21	9R13	2295	21
E18-7-10	7R13	2680	17
E18-6-21	8R12	1049	17
E18-9-4	8R12	1080	14
E21-2-23	9R7	863	9
E21-8-11	8R7	833	9
E20-6-23	8R8	1505	17
D20-3-13 (14)	12R8	1260	18

APPENDIX "F"

REPORT ON OVERFLIGHT OF PORTIONS OF PROJECTED 1975

SPRUCE BUDWORM SUPPRESSION AREA

DEC. 20, 1974 (STARK)

APPENDIX F

REPORT ON OVERFLIGHT OF PORTIONS OF PROJECTED 1975 SPRUCE BUDWORM SUPPRESSION AREA DEC. 20, 1974

D. A. STARK

On December 20, 1974, Stark, Struble, Trefts and Trial rented Folsom's of Greenville Bell Jet Ranger II helicopter at the rate of $175.00/hr. for 4.1 hrs. ($717.50). The purpose of the flight was to establish uniformity between Regional Entomologists as to what a "hot" budworm situation was by overflying representative areas in each area under the survey responsibility of the individual entomologist. This would enable the most equitable solution to the problem of choosing areas in greatest need of treatment, should the entire proposed 3,500,000 A suppression project have to be reduced in size.

Prior to going to Greenville, I phoned to determine snow conditions in the proposed flight area because of a 4" deposit in the Augusta area early in the morning of the flight. I was assured "only a dusting" had occurred, so proceeded to Greenville. On arrival, it was apparent the deposit was equal to that of the Augusta area.

The flight originated at Greenville, proceeded to west of Big Spencer Mt. (T2R13), north over Cranberry Pond and east of Lobster and Little Lobster Lake (T3R14 & 15), north along the east shore of the W. Branch of the Penobscot, west of Chesuncook L., north to Longley and Umbazooksus L., Eagle and Churchill L., Umsaskis L. (T11R13); east to Second Musquacook (T11R11), Carr Pond (T13R8), and there to Portage to refuel. From Portage we went south to just east and south of Chandler L. (T9R7), then followed the Mooseleuk Stream (T9R7), then followed the Mooseleuk Stream (T9R8) to Mooseleuk L. (T10R9). We then back tracked south on Mooseleuk Stream east to Oxbow and Cranberry Pond just across Rt. 11 (T9R5); thence south along St. Croix Stream past St. Croix Siding, St. Croix L. to Smyrna Mills; thence west along the northern 1/4 of Dyer Brook-Hersey, between Roberts and Hay Bk. Mt. (T6R6), northwest to Snowshoe L. and west to the south shore of Scraggley L., west to Beetle Mt., (T7R10), south between Webster and Telos L., southeast around the east and south side of Strickland Mt. (T4R10); west to the south side of Soubunge Mt. (T4R11), west to Chesuncook Lake and return to Greenville. We set down once north of Lobster Lake along the W. Branch of the Penobscot and also the outlet of Second Musquacook (T11R11) to observe defoliation from the ground.

The advantage of the flight was ease of communication with one another due to the low noise level in the cockpit. Headphones were also available and were used part of the time. In addition, we were able to set down and make ground observations in normally inaccessible places.

The disadvantage of the flight was the high per hour cost. The objectives of the flight could have been met with the Forestry Cessna or Beaver; however, we would not have been able to communicate as freely or set down as

we did on occasion.

The joint flight confirmed our individual ideas of most severely damaged areas and unified thoughts as to areas in greatest need of spraying between regions. Some impressions I got while flying over the infested areas were as follows:

1. Need for a more intensive fall damage survey. The defoliation survey is fine as is and outlines the area wherein the egg mass survey should be conducted, however, this only shows current defoliation. If we are going to be asked to modify our recommendations (stratify) for areas to be included within a spray project, we need more detailed data on the damage as it appears after red needles have weathered off.

2. There are extensive areas of spruce/fir type heavy to spruce. In these areas the fir cannot withstand another year of defoliation but the spruce possibly can stand 1 or 2 more years. We possibly should eliminate such areas from the 1975 spray project and concentrate our efforts on those areas that are heavy to spruce/fir; with a predominance of fir in them. The fir is in need of immediate protection; the spruce can wait a year or two.

3. It was also quite apparent that full-crowned fir trees could probably withstand another year of heavy feeding, but the fir with small crown ratios would suffer extensive mortality if not included in the spray project. The fact that we had a recent snowfall allowed this observation. Heavy budworm feeding did not allow snow accumulation compared to lower crown portions.

4. In line with comment number 1, more Federal monies should be made available for pre- and post- project tree condition studies. More detailed data initially costs more money than we are used to having spent in past years; however, if we cut down acreage to the bare necessity, we will save money in the end.

5. It is obvious that new systems have to be devised to establish priority areas within the total recommended spray area. This means (a) greater input from concerned landowners and (b) greater use of aerial or ERTS photography. Also, more attention has to be given stand composition, especially in relation to ratio of spruce/fir in softwood stands. Certain areas in the state can be eliminated from current and future spray projects and such areas should be established on a 1:250,000 base map. Such areas would be (1) mixed stands with less than a given basal area or volume per acre of red and white spruce and fir (2) extensive black spruce stands, (3) hardwood areas and (4) areas that have spruce-fir but are "fragile areas" (above a given elevation), are not scheduled to be cut in the near future, or

for some other reason e.g. rocky and hard on machinery, inacessible, etc.

Some of the more severely damaged areas observed were Long Lake-Umsaskis (T11R13), Second Musquacook (T11R11), Mooseleuk River (T9R8), Dyer Brook-Hersey along the Mattawamkeag River, Howe Brook, Snowshoe-Scraggley Lake (T7R7-T7R8), West Branch of the Penobscot River, Longley Pond-Umbazooksus, Chesuncook Village (Gero Island) (T5R13), South of Little Millinocket Lake and Beaver Pond (T7R9), east and south of Strickland Mountain (T5 and T4R10) and north of Mud Pond (T4R12).

Respectfully submitted,

D. A. Stark

NOTE: This report is strictly my own impression and unbiased by Regional Entomologist's reports which are also being submitted independently for later consolidation following discussion.

APPENDIX "G"

SPRUCE BUDWORM REVALUATION-COMMENTS & RECOMMENDATIONS

FROM JET RANGER FLIGHT, DECEMBER 20, 1974 (TRIAL)

APPENDIX G

SPRUCE BUDWORM REVALUATION
COMMENTS & RECOMMENDATIONS FROM
JET RANGER FLIGHT, DECEMBER 20, 1974

1. We did not fly the entire area. The entire area must be flown before the best 600,000 or 1,000,000 can be chosen.

2. Of the areas we covered, several stand out as having the most softwood per acre and the worst budworm damage.

    a. Along the west branch of the Penobscot from Lobster Lake to Chesuncook. The river valley itself was very heavy to fir.
    b. The East shore of Chesuncook Lake and Gero Island.
    c. Longley Pd. and north of Umbazooksus Lake.
    d. West shores of Chamberland and Eagle Lakes.
    e. West of St. Croix Stream; between the stream and Rt. 11.
    f. Dyer Brook Township.
    g. Millinocket Lake area and southwest to Telos.
    h. The McCarty field - Strickland Mt. section of Baxter Park.

3. We should consult the land owners regarding areas of high fir content or high spruce content. Several areas we examined had poor looking fir but the spruce looked good. I think we could let the high spruce areas go another year. High fir content should provide much weight toward a spray recommendation.

4. The areas we checked in Hub's region were much more consistant as far as heavy damage and high softwood content. I think we may get the most for our money in that area. Parts of my area are damaged just as heavily but the sprayable units are not nearly as large. We didn't see Dave's worst areas.

5. The part of the Musquacook area sprayed in 1974 looked very good.

6. Parts of the Telos area and northern Baxter Park may be beyond saving.

My recommendation is that we do considerable more flying and mapping in the entire spray area. After we have seen it all, we should map 500,000 acre blocks of the land we think have the most danger from the budworm and rate them by priority. I think the Regional Entomologist and Stark should establish these blocks together. When I refer to a block, I do not mean the land has to be in one unit. When we are told what the final spray acreage will be, we can choose the appropriate number of spray unit.

Finally, I think any future flights should be made in one of our own aircraft due to the cost of the jet ranger.

H. Trial, Jr.

APPENDIX "H"

JOINT HELICOPTER FLIGHT (STRUBLE)

APPENDIX H

STATE OF MAINE
INTER-DEPARTMENTAL MEMORANDUM

Date: 12/23/74

To: Doug Stark Dept. Conservation - Forestry

From: David Struble, Regional Entomologist Dept. Northern Region

Subject: Joint Helicopter Flight - Folsom's Jet Ranger

Thoughts -

Trip was valuable in that it enabled regional entomologists to compare representative areas of budworm damage in the different areas of responsibility. I question the added value over a trip in the amphib. beaver considering the total cost.

I feel very strongly that this trip should not be interpreted as a damage survey. Certainly there was ample chance to evaluate damage in certain areas but some areas were looked at more closely than others and not all the areas suggested for spraying were examined.

Of the positive aspects of the flight:

1. Damage seems to be, for the most part, associated with balsam fir. This indicates to me that, if we must cut back acreage, priorities of areas could be determined by the percentage of fir in the stand. This information should be available from the various landowners' cruise data.

   Another criterion might be the total volume of fir in the stand. It seems to me that even if there is 95% fir in the stand composition, there must be a minimum volume per acre that can be economically sprayed.

2. The 1974 Musquacook spray block looked fairly good. The total infestation around Musquacook looked better than I remembered, but I don't think we took a representative look at the area. Before we talk of removal of any areas I think they should be examined much more closely.

3. Aerial photography of the dead tops and trees appeared very plausible while we were flying.

   The fresh snow did not stick to the dead, bare tops but did remain on the foliated part of the trees. Photographic analysis of damage should be facilitated by such a situation. There would be a problem with sun angle, but the advantage of snow on the trees may offset this liability.

APPENDIX "I"

LETTER TO DIRECTOR HOLT REGARDING WINTER OVERFLIGHT OF

BUDWORM-DAMAGED AREAS (TREFTS)

APPENDIX I

BUREAU OF FORESTRY
WESTERN REGION
GREENVILLE, MAINE 04441

December 23, 1974

Mr. Fred Holt, Director of Forestry
State Office Building
Augusta, Maine 04330

Dear Fred:

I thought I would put down a few thoughts for you regarding our helicopter tour of some of the budworm areas last Friday with Henry Trial Jr., Dave Struble, Doug Stark, the pilot, and myself.

The purpose of the flight (e.g. 4.1 hours flying time) was:

1. To compare budworm damage in several different areas.
2. To see what areas most deserved spraying within the 3.5 million acres (e.g. to see which areas would be sprayed if only 600,000 or 1,000,000 acre supply of insecticides were available).

We found in answer to the first objective that we were in general agreement on our hazard ratings, etc.

The second objective evoked considerable discussion. As we viewed several specific areas from the air and then from the ground, we asked ourselves how much of the area would die if it were not sprayed in 1975. (Incidentally our flight took us from Greenville over Ragged Lake, Lobster Lake, Ragmuff Road, down to West Branch to Chesuncook, west of Black Pond, up the west shore of Chamberlain Eagle, Churchill and Umsaskis, thence east to Second Musquacook, Portage, Forks of the Machias, Mooseleuk Drainage, Oxbow, St. Croix Stream and Lake, Dyer Brook, Mt. Chase, Whitehorse Lake, Scraggly Lake, south of Millinocket Lake to Third Lake Matagamon, Webster Lake, Thistle Pond, Strickland Mtn. area, Nesowadnehunk Lake, Harrington Lake, Mud Pond, Chesuncook Lake, Caribou Lake, and Greenville. Most of these areas are included in part of the 3.5 million acres).

In some areas we would estimate a total loss of fir if not sprayed in 1975, but in most areas we did not feel that more than 10% of the total fir component would be lost. In other areas of a high spruce content, even a total loss of the fir might not be significant. I feel with additional flights of all areas that we could eliminate large acreages knowing that only 600,000 or 1,000,000 acres could be sprayed. Of the areas that we viewed together by far the roughest areas were down the West Branch to Chesuncook, between Black Pond and Longley Pond, some small spots along the Allagash between Chase Carry and Umsaskis Forestry Headquarters, the Mooseleuk Drainage, Dyer Brook, between Millinocket Lake and Third Lake Matagamon, the Strickland Mtn. area,

and Mud Pond just east of Chesuncook.

1. I feel quite strongly that we (the Maine Forest Service Entomology Group) should make the first choices as to which areas could be eliminated because I feel we are completely unbiased and certainly most knowledgeable of the budworm.

2. The next criteria would be the percentage of spruce and fir in a stand which would also be unbiased. (e.g. eliminate all areas of high spruce content regardless of landowner intentions).

3. The next criteria would be access roads, management plans, type of stand landowners desire, etc. which would be biased and different for each landowner or manager.

The above three points might serve as a suggested approach as to how best to fit 600,000 or 1,000,000 acres into 3.5 million.

There were several other points of discussion but they do not bear directly on the current situation.

These thoughts are primarily my own so you may have some differences expressed by Doug, Dave, or Henry. Although a little too long, it is hoped that some of the thoughts expressed here may prove useful in approaching the budworm problem.

Respectfully,

Hub Trefts
Regional Entomologist

jp

cc: Williams
Nash
Stark
Trial, Jr.
Struble