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PILOT PROJECT WORK PLAN FOR 1 AND 2 AERIAL APPLICATIONS OF FENITROTHION FOR CONTROL OF WESTERN SPRUCE BUDWORM 1975

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1/ Subject to incorporation of study design suggestion by FDJ. As per Dr. Buckman's request the study design was modified on 3/5/75 [illegible]

PILOT PROJECT WORK PLAN

for

1 AND 2 AERIAL APPLICATIONS OF FENITROTHION

for

CONTROL OF WESTERN SPRUCE BUDWORM

1975

March 20, 1975

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INTRODUCTION

The western spruce budworm, *Choristoneura occidentalis* Free., ~~is the most persistent and~~ one of the most, ~~if not the most,~~ serious defoliator of western conifer forests. Control of this moth through the aerial application of insecticides has been an accepted procedure since 1947. Most early control projects used DDT successfully until the registrations were cancelled because of environmental concerns. DDT was replaced with malathion and Zectran which, while never providing the high budworm mortality levels attained by DDT, did provide adequate control in some cases.

Erratic results obtained with malathion and the discontinuing of the production of Zectran has necessitated the search for one or more new control agents.

Each of the western regions of the Forest Service where outbreaks of the western spruce budworm are currently present will pilot test one or more insecticides during 1975. These tests will also be replicated in the eastern states. Pilot testing is the evaluating of promising insecticides against an insect outbreak under operational conditions, usually undertaken only after laboratory screening and successful field testing of selected candidate materials. This plan outlines the procedures to be used to pilot test fenitrothion against the western spruce budworm outbreak in north central Washington on Forest Service and private forest lands during the summer of 1975.

OBJECTIVES

The primary objectives of this pilot test are:

1. Determine under operational conditions, the efficacy of a single and double aerial application of fenitrothion to control an outbreak of the western spruce budworm. Efficacy will be determined by measuring budworm mortality and the degree of foliage protection.

2. Determine if two applications of fenitrothion will reduce budworm populations significantly better than a single application.

3. Determine if two applications of fenitrothion can preserve tree foliage in a budworm-infested forest significantly better than a single application.

4. Determine the effect of these treatments on western spruce budworm parasites.

5. Evaluate the effect of treatments on water quality and non-target organisms, i.e. fish, aquatic invertebrates, and birds.

TEST DESIGN

A completely randomized plot design will be used. Three suitable test areas will be selected in north central Washington. Three test plots ranging in size from 1000 to 3000 acres will be established in each of these areas for a total of nine plots. No plot will be within 1 mile of another plot to prevent possible insecticide contamination from drifting spray.

Treatments will be assigned to the plots by complete random selection using a random numbers table. Three of the plots will be treated once with an aerial application of 20 ounces of spray per acre, containing 3 ounces of fenitrothion in 17 ounces of fuel oil. Three plots will be aerially treated twice with each application consisting of 2 ounces of fenitrothion in 18 ounces of fuel oil applied at a rate of 20 ounces per acre. The second treatment will be applied 7 days after the first application. The three remaining plots will serve as unsprayed checks.

The variates to be measured are the number of post spray larvae per 100 buds/shoots and the percent of foliage damaged. The covariate is the prespray number of larvae per 100 buds/shoots. The means for the variates for the three plots will be adjusted through covariance analysis to a common prespray level of covariate.

Proposed Analysis for Covariance
In Completely Randomized Design

Source of Variation	df	df(covariance)
Total	8	
Treatments	2	
Error	6	5
Treatment & Error	8	7
Treatments Adjusted		2

The degrees of freedom for F-test among adjusted means is 5 & 2 d.f.

The results of the single and double applications will be compared to the following spruce budworm population standard for the Pacific Northwest.

Control	Post Spray Population (No. of larvae per 100 buds/shoots)
Excellent	2 or less
Good	5 or less
Marginal	10 or less
Poor	10 or more

Reducing the population less than 5 larvae/100 buds and/or shoots after spraying will be considered satisfactory for registration purposes if adequate foliage protection is achieved. (Carolin and Coulter - 1971) (Carolin and Coulter - 1972). Results of spruce budworm population studies in the Pacific Northwest indicate a surviving population of 7.5 larvae per 100 buds/shoots have resurged after treatment to epidemic levels within a few years. Consequently, another spray program is often required.

METHODS

Location

Suitable budworm test plots will be selected from areas currently infested on the Okanogan and Wenatchee National Forests and private lands in north central Washington. Results of budworm egg mass density surveys made in these areas during the fall of 1974 and the larval sample in February will determine the precise locations to be used. The over-winter larval survey in February will consist of removing two midcrown branches from five Douglas-fir or true fir at each potential test plot location.

Test plots having more than 8 larvae per 100 square inches of bark surface will be selected for this project but, accessibility, topography, and landownerships will be considered. The areas in which the plots will be established is one of the following five areas:

Okanogan National Forest - no private lands involved (See Figure 1)
- Lookout Ridge - Gold Creek Area, Twisp R.D.
- Early Winters Camp, Winthrop R.D.
- Goat Peak Area, Winthrop R.D.

Wenatchee National Forest and private lands (See Figure 2)
- North Fork Teanaway River, Ellensburg R.D.
- Nason Creek, Lake Wenatchee R.D.

Sampling Design

Several sampling procedures will be used during this pilot test to determine:

1. The stage of budworm larval development on each test plot so the insecticide may be applied at the proper time.

2. The budworm larval populations present on all test plots prior to the application of the test insecticide.

3. The degree of defoliation that had occurred to the current year's foliage prior to the application of the test insecticide.

4. The budworm population present on each plot at an interval after the plot has been sprayed.

5. The degree of defoliation that accumulates on the current year's foliage during the 1975 larval feeding period.

6. The budworm larval population present in 1976 at a time comparable to the prespray population counts made in 1975.

7. The degree of defoliation that accumulates on the current year's foliage during 1976.

Schedule of Applications and Surveys

The schedule of carrying out the spray applications and budworm populations and foliage surveys are as follows:

SCHEDULE OF SPRAY APPLICATION AND BUDWORM POPULATION AND FOLIAGE SURVEYS

PLOT NO.	TREAT-MENT	25% OF LARVAE 5-INSTAR	WITHIN NEXT 3 DAYS	75% OF LARVAE 5-INSTAR	WITHIN NEXT 3 DAYS	5-DAYS AFTER I SPRAY	7-DAYS AFTER I SPRAY	20-DAYS AFTER 25%-5	AUG. 1975	25% IN 5-INSTAR 1976	AUG. 1976
1.	One Spray	Popul. & Foliage Survey		Popul. Survey	Only Spray			Popul. Survey	Foliage Survey	Popul. Survey	Foliage Survey
2.	One Spray	"		"	"			"	"	"	"
3.	One Spray	"		"	"			"	"	"	"
4.	Two Sprays	"	1st Spray			Popul. Survey	2nd Spray	"	"	"	"
5.	Two Sprays	"	"			"	"	"	"	"	"
6.	Two Sprays	"	"			"	"	"	"	"	"
7.	Check	"						"	"	"	"
8.	Check	"						"	"	"	"
9.	Check	"						"	"	"	"

Timing of Insecticide Application

Proper timing of the application of the insecticide is vital for the pilot test to be successful. If the fenitrothion is applied too early, it will not contact the budworm larvae feeding within an unopened bud. As the buds open, new unsprayed foliage will be available for continued budworm feeding. If the application of the insecticide is delayed too long, the budworm may pupate and again not be available for contact by the spray.

A review of western spruce budworm outbreaks shows that most have occurred in mountainous terrain. Within any outbreak area there is a wide variation in elevation and exposure creating a significant spread in the rate of budworm larval development. Such conditions make it impossible to apply the fenitrothion to all larvae at the optimum time. Therefore, the spray will be applied when the majority of the budworm larvae on a plot are at the optimum stage for control.

In areas where two applications of fenitrothion are made, the purpose of the first application will be population reduction and preservation of the current year's foliage. The second application will be for maximum budworm population reduction. When only one spray application is made, the objective will be budworm population reduction.

In this pilot test, plots receiving one application will be sprayed 3 days after 75 percent of the larvae are in the 5th instar or later, providing that no more than 2 percent of the larvae have exceeded 10 days in the 6th instar. In this case, spraying will commence on the 10th day regardless of larval development.

Test plots receiving two applications will be sprayed first 3 days after 25 percent of the larvae have reached the 5th and 6th instar. The second application will be made 7 days later. This time period, rather than a larval developmental stage, will be used for the second application, because the first application might reduce the larval population to a point where development sampling is impractical.

Observations will be made on each plot to determine when the overwintering budworms break hibernation and move into the buds. Approximately 2 weeks later regular larval development sampling at 2-day intervals will start on 15 trees selected as being representative of each plot. On sampling days two 15-inch branches will be clipped from the midcrown of each tree. The two branches from a tree will be tagged and placed in a bag and taken to the field laboratory. In the laboratory, all the larvae will be collected from the branches and their instar determined by using Carolin's larval head capsule characteristics. The percentage of larvae having reached the 5th instar will be plotted daily on a graph and, when the target percentage for spraying is reached, the plot will be released for spraying 3 days later.

Budworm Population Sampling

Budworm populations will be sampled by using a tree cluster method. Twenty-five clusters of three trees each will be identified in each treatment plot. Both prespray and postspray population estimates will be taken from these trees.

Sample trees are defined as Douglas-fir or grand fir, 30 to 50 feet tall, open grown, and not shielded by larger trees.

Trees suitable for sampling budworm are not evenly distributed over the treatment plot; consequently, a truly random or systematic means of selecting sample trees is impractical under these conditions. Therefore, sample trees will be selected in such a way as to provide a representative sample over each plot to the extent that vegetational types within each area permit.

On each test plot a transit line will be run diagonally across the plot so it will intersect as many spray swaths as possible. At intervals of 100 yards along this line sampling clusters will be established. Each cluster will consist of the three closest trees, meeting the sample tree criteria, that are located within a 1-acre area.

The prespray population will be measured by collecting two branches approximately 15 inches long from as close to the midcrown level of the sample tree as can be reached. In the laboratory, the number of the current year's shoots or buds per branch will be counted as well as the number of budworm larvae per branch. The population estimate will be expressed as budworm larvae per 100 new shoots or buds.

The postspray population sample is identical to the prespray, except four branches will be collected per postspray sampling period instead of two. Extra postspray branches are collected because of the greater variability found with low populations. Budworm pupae may be found during the postspray population counts. They will be recorded separately, but included in the budworm population per 100 new shoots or buds.

The 1975 postspray budworm population counts will be made 10 days after the application of the insecticide to each plot has been completed. At the same time interval the budworm population on the matching check plot will be sampled.

During 1976 a postspray budworm population survey will be made approximately one year after the 1975 prespray population sample. This sampling period will be timed so that the budworm development stage is the same as when the 1975 prespray survey was made.

Budworm Foliage Sampling

Assessment of foliage damage caused by budworm feeding will be made on the same tree on which the budworm population sampling is done. The same branch used in the prespray population counts will be used, but the postspray

examination will not be made until all budworm larval feeding has been completed for the year. This will necessitate the clipping of four additional branches per tree some time after July 20, 1975, and again on a similar date in 1976.

As branches are collected in the field, they will be placed in individual paper bags, labeled, and delivered to the field laboratory for examination. Branches will be delivered to the laboratory the same day they are collected and stored under refrigeration at about 40°F. Care should be exercised to keep the branches cool in transit to the laboratory.

Each branch will be examined and the damage recorded individually. Only the apical 25 buds will be examined on each branch, a total of 100 buds or new shoots per tree postspray and 50 prespray. An optical examination will be made of the volume of feeding on each bud or new shoot, and this volume recorded as the percent defoliation to the nearest 10 percent.

Insecticide

Fenitrothion (O, O-Dimethyl O-(4-nitro-m-tolyl) phosphorothioate) is an organophosphate insecticide. Other names commonly used for this compound are Sumithion, Accothion, Folithion, MEP, Novathion, and Nuvanol. In its technical form, it is a yellow-brown liquid with a specific gravity of 1.3227; it is insoluble in eater, but is miscible with most organic solvents. It is primarily a contact insecticide and acaricide with a low ovicidal capability. The branch of fenitrothion to be used on this test will be Sumithion®. It is manufactured by Sumitomo Chemical Company, Ltd., of Osaka, Japan.

Formulation

The selected treatments consist of:

1. 3 ounces (0.1875 lbs. AI) of fenitrothion mixed with 17 ounces of fuel oil. This spray is to be applied once at a rate of 20 ounces per acre (0.156 gallon/acre).

2. 2 ounces (0.124 lbs. AI) of fenitrothion mixed with 18 ounces of fuel oil. This spray is to be applied twice 7 days apart; each application at a rate of 20 ounces per acre (0.156 gallon/acre).

Application of Insecticide

The test insecticide will be applied by either helicopter or fixed-wing aircraft depending on the awarding of a contract for spray application to a successful low bidder.

The spray aircraft will be calibrated to deliver the finished insecticide at a rate of 20 ounces per acre with a drop size of about 150 microns volume medium diameter (Vmd).[1/] Spraying will be carried out only in the early morning at elevations approximately 25 to 50 feet above treetop levels.

1/ Drop size, spray nozzle size, pump, pressure and air speed, to be established after the airport tests are completed by Pacific Northwest Forest and Range Experiment Station personnel at Corvallis, Oregon in April 1975.

Spraying will be terminated when wind speeds exceed 6 MPH and/or temperatures exceed 70°F. in the test area or, when in the contracting officer's judgment, conditions are not suitable for the successful application of the insecticide (wet foliage, rain, fog, etc.).

Transportation, formulation, and loading of the finished spray will be the responsibility of the application contractor.

A 20 ml. sample of the spray solution will be collected from the spray boom each day and labeled so as to identify the test plot to which it was applied. Samples will later be analyzed to determine insecticide concentration.

In order to avoid the accidental contamination of check plots or spray plots assigned a treatment different from the one they are spraying, loaded aircraft will not overfly other test plots.

Forest Service aerial observers will maintain surveillance of all spray aircraft while they are in the infestation area. They will insure that the spray is being applied to the proper test plot, that swath widths are correct, and that no material is misapplied or dumped except in case of emergency. They will also insure the avoidance of untreated plots. They will watch the spray patterns and, when spray begins to hang up or rise, will immediately notify the spray operations officer to shut off spraying. They will maintain aerial operations reports (Form 25) for each aircraft they are monitoring and at least once a day will check the calibration of the aircraft by clocking the application time for the prescribed load with a stopwatch.

Storage and Disposal of Insecticide

The Forest Service will purchase the insecticide and upon delivery, the bill of lading will be checked for the amount received. The material will be stored in a locked building at a Forest Service facility. All unused insecticide will be returned to the chemical company. The empty barrel will be rinsed three times with the carrier and then disposed of on an approved disposal site. The Forest Service will contact and cooperate with the Washington State Departments of Ecology and Agriculture and Region 10, EPA on insecticide handling.

Marking of Spray Plots

When possible, spray plot boundaries will be designated partly by visible topographic features. However, additional marking will be necessary to insure the entire plot and only the plot is sprayed. Failure to do so will result in unsatisfactory spray deposition as the spray craft will be calibrated and loaded to secure adequate coverage of the entire plot.

Using a helicopter, plot corners and all exterior boundaries will be marked by means of flagging dropped in treetops. In some cases, corners or critical areas may be marked with balloons.

Monitoring

A cooperative monitoring plan for effects on nontarget organisms for this pilot project is being developed with the State of Washington Departments of Ecology and Game, the U.S. Fish and Wildlife Service, and the Insecticide Evaluation Project, Pacific Southwest Forest and Range Experiment Station (See attachment).

For monitoring the effects of fenitrothion on the parasites of the western spruce budworm, a maximum of 30 larvae will be collected off each sample tree in a cluster (maximum of 90 larvae per cluster) during the prespray and postspray sampling periods. A total of 10 larvae, all from the same tree, will be placed in a petri dish and reared on an artificial diet to determine the number and diversity of parasites.

Spray Deposit

The spray solution will contain Rhodamine Extra Base red dye for analysis purposes. Two white Kromekote cards will be placed in plastic card holders on the ground in the nearest open area on opposite sides of each sample tree to assess spray deposit. Cards will be placed out on the plot in the morning of the test just before treatment and picked up within 2 to 4 hours after an area has been treated. The cards will be sent to Aerial Applications Project (PNW-2208), Corvallis, Oregon, where percent spray deposits and volume medium diameter (Vmd) of the spray droplets will be determined.

DATA ANALYSIS

Population Assessment

Budworm population assessment will be analyzed in the following manner:

1. Application effectiveness and control strategy will be evaluated by a comparison of postspray or residual larval densities among treated and untreated check plots. Analysis of covariance in a randomized complete-block experimental design will be used. Comparability will be maintained through an adjustment of postspray population means ($\bar{y}_i$) to minimize effect due to variation among prespray larval densities, the covariate ($\bar{x}_i$). Comparability among independent covariates will be provided by measuring prespray population densities at the same stage in larval development. (Note: Sampling at the same point in time with larval development assumed random can provide the same results. The use of larval development appears to be the most practical standard to use however).

Estimate of larvae densities will be computed for each sampling period and denoted as follows:

x_i = prespray larval density

y_i = first postspray larval density

y_n = n^{th} postspray larval density.

Measurements of budworm larval density will be made from population counts expressed as a number of larvae (pupae) per 100 shoots. Larval densities will be calculated for each branch sample. Mean larval densities for each in a multi-stage context 2/; i.e., larvae densities over branches, trees, and clusters as follows:

$$\bar{\bar{y}} = \frac{\sum_{i=1}^{n} \sum_{j=1}^{m} \sum_{l=1}^{k}}{nmk}$$

$\bar{\bar{y}}$ = per plot mean larval density computed over all sample stages

n = number of clusters (first-stage unit)

m = number of trees (second-stage unit)

k = number of branches (third-stage unit)

y_{ijl} = an observation (budworm larvae per 100 shoots) of the l^{th} third-stage unit within the j^{th} second-stage unit within the i^{th} first-stage unit.

Mean larval densities will be listed in the following format and analyzed in an analysis of covariance computer program.

Postspray larval densities adjusted ($\hat{\bar{\bar{y}}}_i$) and correspondence F test performed are presented in Tables 1 and 2.

Test significance will be considered at p = .90, highly significant at p = .95, and very highly significant at p = .99.

TABLE 1.--List of prespray and postspray larvel densities means for treatments and Blocks

Treatments					
A Single Application		B Double Application		C Untreated Check	
$\bar{\bar{x}}_i$	$\bar{\bar{y}}_n$	$\bar{\bar{x}}_i$	$\bar{\bar{y}}_n$	$\bar{\bar{x}}_i$	$\bar{\bar{y}}_n$

2/ Hazard, John W., L. E. Stewart.
1974. Planning and processing multi-stage samples with a computer program - MUST PNW-11, USDA Forest Service, Portland, Oregon.

The following is a list of covariance "F" test and special orthogonal comparisons among adjusted treatment means planned in this project as outlined in Table 2.

Sample Period	F test among treatment	F test among adjusted means with single Degree of Freedom
(Two-fifth) Postspray	y_1's	Check vs. single & double single vs. double

TABLE 2.--Proposed schedule of spray application and sample periods to be used in this test

	Spray Schedule and Sample Periods				
	1975			1976	
Application	(1) Prefeed & Prespray 1/	(2) Postspray	(3) Post-2/ feeding	(4) Early feeding	(5) Post-feeding
Double	$\bar{x}_1$	$\hat{y}_1$	$\hat{y}_2$	$\hat{y}_3$	$\hat{y}_4$
Single	$\bar{x}_1$	$\hat{y}_1$	$\hat{y}_2$	$\hat{y}_3$	$\hat{y}_4$
Check	$\bar{x}_1$	$\hat{y}_1$	$\hat{y}_2$	$\hat{y}_3$	$\hat{y}_4$

1/ Prespray sample will be used as the covariate (x_1). This data will be collected on all test plots when 25 percent of larvae are in the 4th instar.

2/ $\hat{y}_2$ and $\hat{y}_4$ - defoliation assessment measurements.

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2. As an interim step, effective measure of corrected percent control can be expressed using Abbott's modified formula which takes into account unequal sample sizes and natural population reduction.

$$\text{Percent Control} = 1 - \frac{TA \times CB}{TB \times CA}\ (100)$$

Where TA = postspray population treatment mean
TB = prespray population treatment mean
CB = prespray population control mean
CA = postspray population control mean

3. Spray Deposit

An analysis of the spray deposit data will be made to determine the relationship between spray coverage and budworm mortality. Standard linear regression analysis will be used to compute regression and correlation coefficients. Significances of regression slope will be tested by an analysis of variance.

Data analysis will be done for both individual trees and three tree clusters for each treatment plot. Spray deposit data in gallons per acre (independent variable x) and larval mortality (dependent variable y) will be transformed (by log probits or logit scales) to change the Sigmoid curve characteristics of the relationship between the dosage and mortality to a straight line. 3/

Foliage Assessment

Because of the feeding habit and biology of western spruce budworm, the amount of current year's foliage saved through spray application is quite limited. By the time the insect has developed and presents a suitable target for insecticide application, damage has already occurred. However, a portion of the current year's foliage can be saved if the spray application is conducted before the larvae reach late instars when the foliage is rapidly depleted.

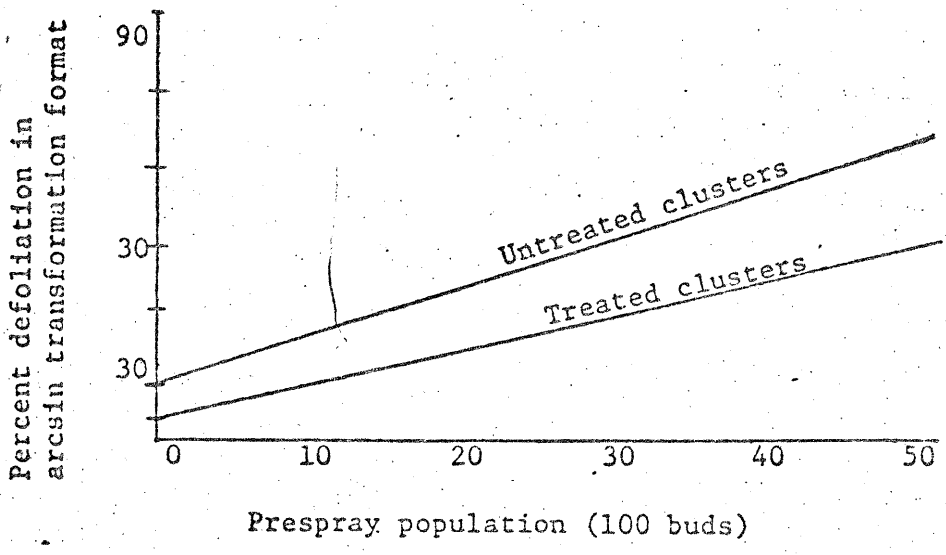
The foliage evaluation will be directed at measuring and comparing the amount of foliage destroyed by budworm feeding on sprayed and unsprayed plots the year following spray application, as well as the year the spray was applied. However, migration of egg laying budworm moths during the 1975 flight period onto the sprayed sample trees may prevent an accurate evaluation of all the foliage that might be saved on an operational control project where all the infested timber is sprayed. It is believed this problem will be minimized by using large (1,200 acres) test plots.

The amount of current year's foliage saved will be measured by removing four branches from each sample tree and estimating the amount of defoliation to the nearest 10 percent of apical 25 buds on each branch. The mean percent defoliation for the tree can then be calculated. The defoliation the following year will be evaluated in the same manner on the same sample trees.

To measure current year's foliage saved, covariance analysis will be used to test significant differences of slope and intercept between untreated and treated clusters where the independent variable is the prespray population and the dependent variable is the percent defoliation

3/ Maksymiuk, Bohdan.
1963. Spray deposit on oil-sensitive cards and spruce budworm mortality. J. Econ. Entomol. 56: 465-67.

in arcsin transformation format. If the treatment was successful, regression lines might appear as shown below.



To measure differences in foliage saved 1 year after spraying, an analysis of variance in completely randomized block design will be used to detect differences between treatments and checks if any occur. Another possibility is to use multiple covariance analysis to detect differences in defoliation.

COORDINATION

The fenitrothion pilot control project will be conducted in close cooperation with the Wenatchee and Okanogan National Forests, District personnel, Washington State Department of Natural Resources and private landowners in the area. Sampling plans and procedures have been developed through consultation with V. M. Carolin, Entomologist, and Floyd Johnson and John Hazard, Biometrics Section of the PNW Forest and Range Experiment Station. Proposed airport tests and methods of collecting spray deposit data and analyzing this data have been developed in cooperation with George Markin and John Neisess PNW, RWU 2208 at Corvallis, Oregon.

ORGANIZATION

Overall administration of the pilot test project has been delegated to Region 6, USFS, State and Private Forestry, Insect and Disease Control Group.

Jack Mounts has been assigned as overall Project Leader and Contracting Officer's Representative. David McComb will be the Project Entomologist and Leon Pettinger the Assistant Project Entomologist.

During the preliminary entomological phase of the pilot control project, approximately May 12 to June 1, four field biologists (one from R.O. and three from N.F.'s) will be assigned to the project for plot layout and tree cluster selection. An additional five biologists will be detailed to the project for the major sampling period June 1 through July 15.

A field laboratory will set up project headquarters in the Twisp-Winthrop area to handle the counting of budworm samples and measuring of defoliation from twig collections. This laboratory will be staffed by three or four foliage examiners hired locally during the sampling period. One additional person will be assigned to assist on the parasite evaluation study.

The spray contractor will be responsible for transporting, formulating, loading, and the proper application of the insecticide to the test blocks.

For the operational phase of the pilot control project there will be a need for an aerial observer, heliport manager, safety officer, clerk-receptionist, and an assistant project director.

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Carolin, V. M. and W. K. Coulter.
1972. Sampling Populations of Western Spruce Budworm and Predicting Defoliation on Douglas-fir in Eastern Oregon. U.S.D.A. Forest Service Res. Paper Pacific Northwest Forest & Range Exp. Sta. No. 149, 38 p.

TOTAL COSTS BY FISCAL YEAR

	FY 75	FY 76	FY 77
Insecticide			
(319 gals.)Fenitrothion @ $4.38 lb.	$ 12,536		
1919 gals. No. 2 fuel oil @ $.38	729		
Transportation storage & mixing	5,000		
Sub-Total Insecticide	$ 18,265		
Application			
Helicopter or fixed wing 10,800 acres @ $2.00	$ 21,600		
Observation helicopter - 70 hrs. @ $200/hr.	14,000		
Sub-Total Application	$ 35,600		
Personnel @ $420/wk. including overtime			
4 Forestry Aides for 10 weeks - 5/13	$ 10,080	$ 6,720	
5 Forestry Aides for 6 weeks - 6/1	8,400	4,200	
5 Foliage Examiners for 4 weeks - 6/1	8,400	4,200	
2 R.O. summer aides for 10 weeks - 6/1	3,360	5,040	
4 Forestry Aides for 3 weeks FY 76		5,040	
4 Forestry Aides for 2 weeks FY 77			$2,000
Overtime for regular personnel	4,320	1,440	320
1 Heliport Manager, 1 Aerial Observer, and 1 Safety Officer - 4 weeks	5,040		
1 Clerk-Receptionist - 4 weeks	1,680		
Sub-Total Personnel	$ 41,280	$26,640	$2,320
Vehicles			
6 - pickups for 36,000 miles @ $.16	$ 4,800	$ 720	$ 480
2 - carryalls for 10,000 miles @ $.16	1,600		
2 - 4 wheel drive P.U.'s for 10,000 miles @ $.30	3,000		
1 - 1 ton truck for 5,000 miles @ $.30	1,500		
1 personal auto for 5,000 miles @ $.09	450		
Sub-Total Vehicles	$ 11,350	$ 720	$ 480
Per Diem			
Forestry Aides	$ 8,450	$ 6,650	$1,200
Foliage Examiner	1,800		
R.O. Summer Aides	1,500	2,250	
Regular Personnel	3,525	700	350
Application Personnel	2,250		
Clerk-Receptionist	750		
Sub-Total Per Diem	$ 18,275	$ 9,600	$1,550

	FY 75	FY 76	FY 77
Equipment and Supplies			
Communication	$ 4,000		
Spray cards, card holders, bags, tools, etc.	1,000		
Other misc. equipment and supplies	3,200	$ 340	
Sub-Total Equipment and Supplies	$ 8,200	$ 340	
Public Relations			
I&E trips, photos, fact sheets, etc.	$ 2,000		
Utilities			
Telephone, lights, heat, etc.	$ 1,000		
Preparation of Report	$ 2,000		
Office Costs Above Normal	$ 2,300		
Environmental Monitoring[1/]	$ 20,000	$20,000	
Sub-Total	$160,270	$57,300	$4,350
Regional Office Overhead @ 10%	16,027	5,730	435
Total	$176,297	$63,030	$4,785

Grand Total FY 75-77 = $243,973

1/ Estimated monitoring costs

1975 MONITORING PLAN FOR THE WESTERN SPRUCE BUDWORM - FENITROTHION PILOT CONTROL PROJECT IN NORTHCENTRAL WASHINGTON

(Tentative Date March 20, 1975)

ENVIRONMENTAL MONITORING

A tentative plan for effects on nontarget organisms for this pilot project is being developed in cooperation with the State of Washington Departments of Ecology and Game, U.S. Fish and Wildlfe Service and the Insecticide Evaluation Project, PSW. The objectives of this program are:

1. To determine the biological effects, or their absence, on key parameters in the forest environment.

2. To qualify the accumulation and degradation of pesticide residue following application in key environmental parameters.

Monitoring Parameters

The proposed monitoring program is being designed for biological effects and residue monitoring. The biological monitoring will include effects on western spruce budworm parasites (number and diverstiy), aquatic insects (benthic and drifting), fish, and grouse. The residue monitoring program will include the collection and analysis of samples from water, fish, and birds.

Monitoring Coordination

The Forest Service will coordinate the monitoring program with several Federal and State agencies. Study plans will be developed by investigators under guidelines developed by the Western Spruce Budworm Steering Committee. Study plans will be approved by the Project Director and Monitoring Coordinator.

The U.S. Fish and Wildlife Service will do the pesticide residue analysis and biological effects on the grouse. All other residue analysis will be contracted to a single laboratory so standard methods for sample preparation, analysis, interpretation, and reporting of the data can be made. Residue analysis data will be provided to cooperators for further analysis and interpretation in the biological effects phase of the program. The residue analysis contract will be directly negotiated and funded by the Forest Service.

Data Analysis and Publication

The investigator will prepare a written report that shall include all significant data, analysis, conclusions, and/or recommendations. The written report or a summary will be included in the fund project report. In the event that the sample data provides worthwhile research information the investigator will have permission to publish the report with due credit to other participants involved.

FINANCIAL PLAN FOR MONITORING 1975 SPRUCE BUDWORM

PROJECT - REGION 6 1/

Item	Rate	Cost	
		FY 1975	FY 1976
Environmental Monitoring			
Residue Analysis	40 samples @ $60.00/sample	$ 2400.	$ 2400.
Biological Effects			
Parasites	1 person for 45 days plus equipment and supplies	1600.	900.
Aquatics (fish & insects)	2 men for 80 days plus equipment and supplies	7000.	7700.
Grouse	2 men for 80 days plus equipment and supplies	9000.	9000.
TOTAL		$20,000.	$20,000.

1/ Estimated approximate cost only

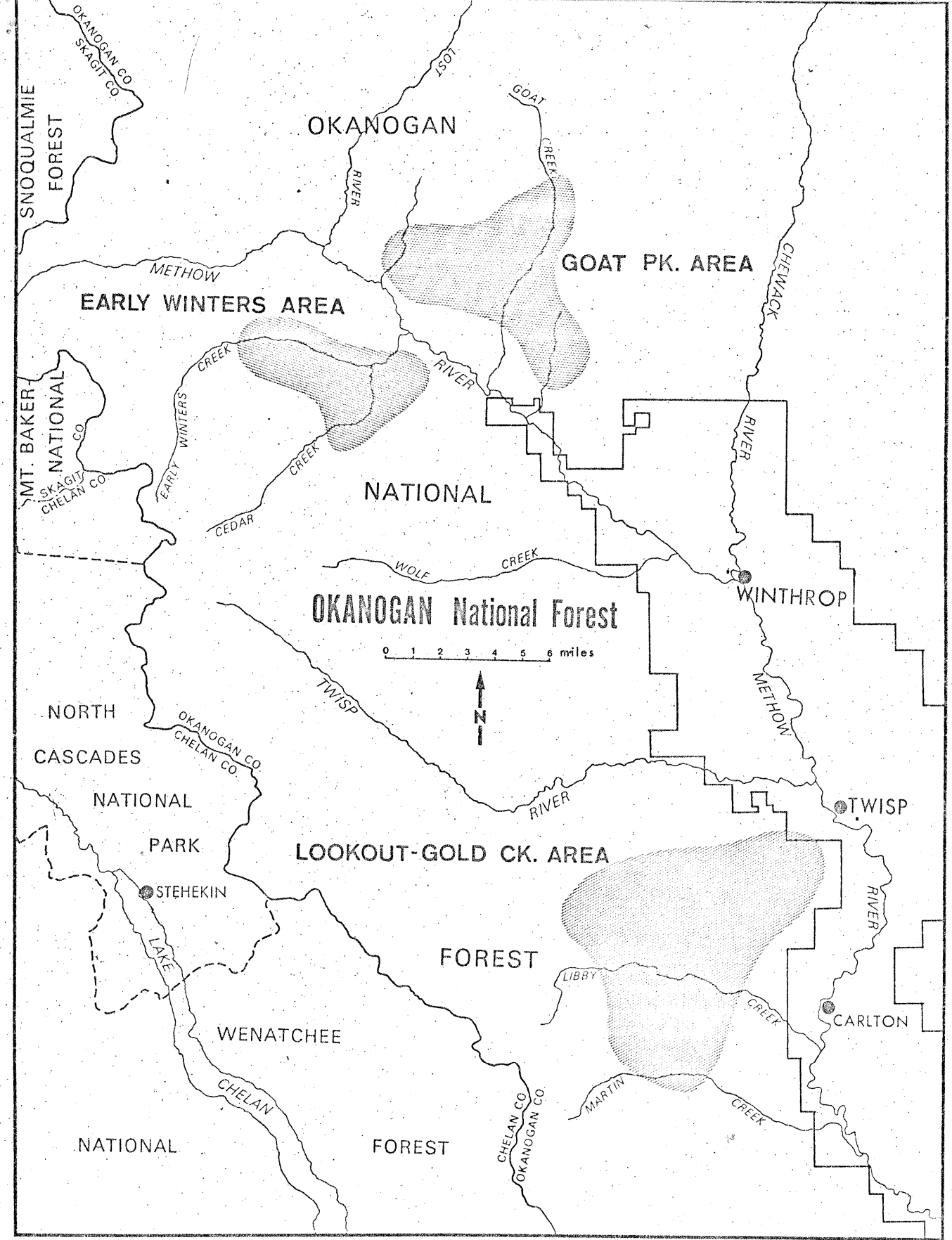

Fig. 1 Proposed Western Spruce Budworm Pilot Project Areas.

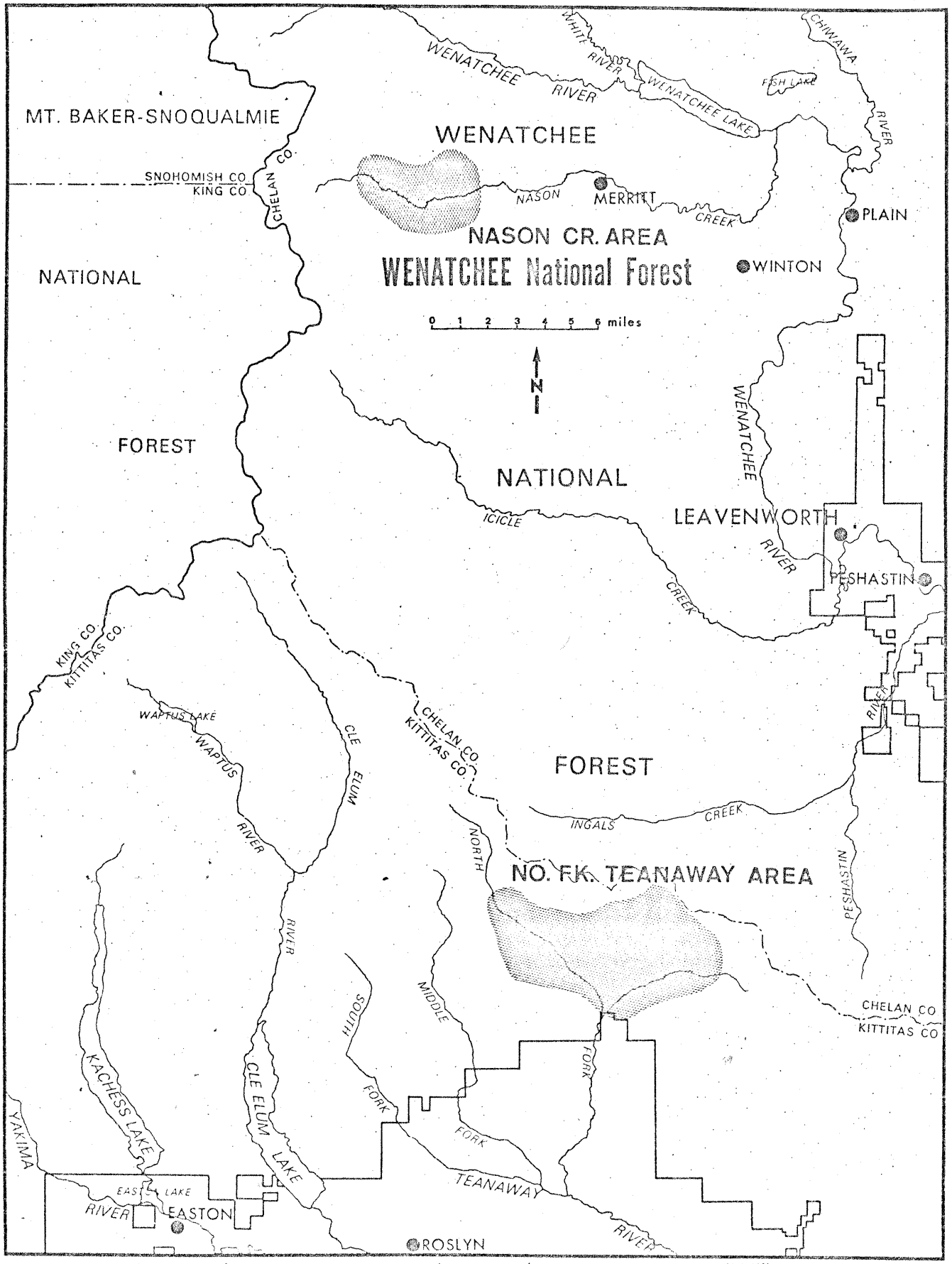

Fig. 2 Proposed Western Spruce Budworm Pilot Project Areas.