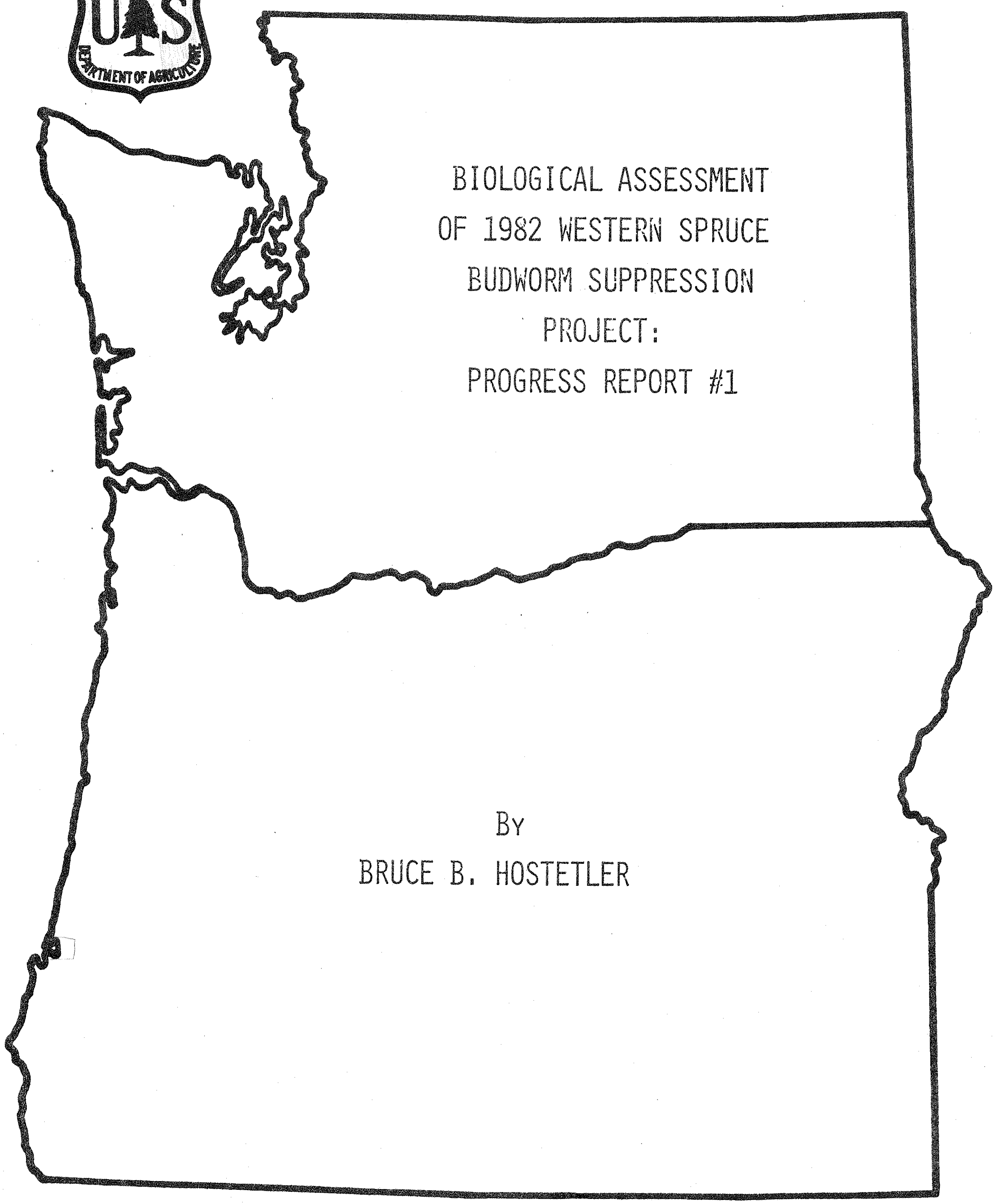
4142

H1

Forest Pest Management
Pacific Northwest Region



BIOLOGICAL ASSESSMENT
OF 1982 WESTERN SPRUCE
BUDWORM SUPPRESSION
PROJECT:
PROGRESS REPORT #1

By
BRUCE B. HOSTETLER

BIOLOGICAL ASSESSMENT OF 1982 WESTERN SPRUCE BUDWORM SUPPRESSION PROJECT: PROGRESS REPORT #1

Date?

by

Bruce B. Hostetler
USDA Forest Service
Forest Pest Management
Pacific Northwest Region
Portland, Oregon

INTRODUCTION

The first indication of the current western spruce budworm (*Choristoneura occidentalis* Freeman) outbreak in eastern Oregon was 2,300 acres of defoliation noted during the annual aerial detection survey in 1980 (McConnell et al 1980). In 1981, 310,000 acres of defoliation were mapped during the annual survey of eastern Oregon, a 130-fold increase over that detected in 1980. This prompted Forest Pest Management, National Forest and State personnel to conduct an environmental analysis of the situation. The Environmental Assessment (EA), which resulted from the analysis, proposed insecticide treatment of approximately 208,000 acres of budworm-infested mixed-conifer type and pine type on the Umatilla and Malheur National Forests and adjacent private lands (Anon. 1982). The principal host species involved were Douglas-fir, grand fir, and white fir. The EA proposed treatment with acephate (Orthene Forest Spray®) along areas adjacent to streams supporting spring Chinook salmon populations and treatment with carbaryl (Sevin 4-oil®) in the remainder of the areas. During June and July 1982, 169,354 acres were treated with carbaryl and 9,195 with acephate on four treatment units (Figs. 1-6).

The objective of this project was to have a residual western spruce budworm population of less than 7 larvae/100 buds in each Treatment Unit[1/] (TU) 14 days after insecticide treatment. This objective is expected to allow achievement of the long-term goal of this project: to reduce budworm populations so that they remain at nondamaging levels throughout the current outbreak period.

INSECTICIDE APPLICATION

Sevin 4-oil® was mixed with diesel oil at a volume-to-volume ratio of 1:1 and applied at a rate of 1/2 gallon/acre (1 pound active ingredient/acre). This mixture was applied with helicopters equipped with either Beecomist® or flat fan spray nozzles. The spray systems equipped with Beecomist® nozzles were calibrated to put out spray droplets with a volume median diameter (VMD) in the range of 150-200 μm. Flat fan nozzles were calibrated for a VMD in the range of 225-250 μm.

Orthene Forest Spray® was mixed in a proportion such that enough water was added to 2/3 lb insecticide to make 1 gallon of mixture. This mixture was applied at a rate of 1 gallon/acre (1/2 lb active ingredient/acre) using helicopters equipped with flat fan nozzles. The spray systems were calibrated to put out spray droplets with a VMD in the range of 300-350 μm.

1/ A Treatment Unit is the area actually treated in or adjacent to an entomological unit or units as defined in the 1982 EA (Anon. 1982). Some entomological unit boundaries as proposed in the EA were altered prior to treatment.

PROJECT AREA

This project was conducted on four TU's in eastern Oregon on or adjacent to portions of the Umatilla and Malheur National Forests. The two TU's on the Umatilla National Forest, Opal and Madison, ranged in elevation from 3500 to 5700 feet. The TU's on the Malheur National Forest, Middle Fork and Baldy, tended to be on steeper terrain than the Umatilla NF units and had an elevational range of 3800 to 7000 feet.

All TU's contained a mixture of mixed-conifer stands, pine stands and open meadows. Acreages treated by ownership on each TU were as follows:

Treatment Unit	Acres		
	Federal	Private	Total
Opal	25,664	5,034	30,698
Madison	46,617	7,891	54,508
Middle Fork	65,481	0	65,481
Baldy	26,701	1,161	27,862
Totals	164,463	14,086	178,549

The above acreages do not include nontarget areas which were avoided within each TU during the insecticide application.

Each TU was divided into spray blocks to facilitate timing and mechanics of insecticide application. Each spray block had a maximum elevational range of about 1000 ft and varied in size from 300 to 4200 acres.

SAMPLING DESIGN AND PROCEDURES

Larval Development

An attempt was made to sample a minimum of one larval development plot per spray block and, if possible, two or more. Plot locations were selected to represent differences in elevation and aspect within a particular block. If an elevation and/or aspect was not represented by a plot within a block, larval development information from the nearest plot at or near the same elevation and aspect was used.

A plot consisted of two open-grown Douglas-firs or true firs, the midcrowns of which could be reached with a 20-ft polepruner equipped with a catch-basket. Two midcrown (20-25 ft from ground level) 17.7-in apical branches were collected from opposite sides of each of two previously unsampled trees on each collection date. When possible, sample collections were made only once from any tree at a plot site. Samples were placed into paper bags and transported to the laboratory where they were held in a walk-in cooler at 40° F until they could be examined. All larvae from each branch were put into a petri dish along with isopropyl alcohol and examined for instar and species determination. When at least 50% of the western spruce budworm larvae from development plots representing a spray block were in the 4th instar or later and the new buds had unfurled, the block was released for treatment.

Larval Population Density

One or more larval population density plots were established for each 1500 acres of each TU, with at least one plot per spray block. The number of density plots and the proportion of plots to acres for each TU were:

Unit	No. of Plots	Plot:Acres
Opal	28	1:1100
Madison	51	1:1050
Middle Fork (carbaryl blocks)	47	1:1200
Middle Fork (acephate blocks)	30	1: 300
Baldy	34	1: 800

The proportion of plots to acres in the Orthene-treated spray blocks was considerably higher than those in the other areas due to the fact that a CANUSA[2/]-funded research project was being conducted in these areas. This project required more density plots than originally had been planned.

A plot consisted of three open-grown trees (Douglas-fir or true fir), the midcrowns of which could be reached with a 20-ft polepruner equipped with a catch-basket. Two 17.7-in midcrown, apical branches were collected from opposite sides of each plot tree during the prespray sampling period. Care was taken so that larvae from other branches were not knocked into the catch-basket and that all larvae from each sample branch, as well as the branch itself, were caught in the catch-basket. Each sample branch, as well as all larvae within the catch-basket, were put into a separate paper bag and labeled. Samples were transported to the laboratory and stored in a walk-in cooler at 40° F until they could be examined.

Post-spray samples were collected 14 days after treatment and consisted of four 17.7-in midcrown, apical branches (one from each quadrant) from each of the three previously sampled plot trees. When possible, branches were clipped from above those collected during prespray sampling to lessen the chance of larvae having been dislodged from the post-spray sample branches during the prespray collection period. All larvae and pupae from each sample branch, as well as those that had fallen into the catch-basket, were counted and recorded in the field.

For each pre-spray and post-spray sample, the number of buds (i.e., new shoots) was counted, and the length (L) from base to tip of foliage and width (W) at the widest part of the branch were measured. The foliage surface area (FSA) was calculated for each branch using the formula:

$$FSA = \frac{LxW}{2}$$

Larval density plots were also sampled in an untreated area called the Fall Mountain Unit (Figs. 2 and 7). This unit was originally designated to be treated with carbaryl but, because of expansion of acreages on other units and lack of funds, was not.

2/ Canada-United States Spruce Budworms Program

RESULTS

Larval Development

Larval development was earlier and more rapid on the lower elevation TU's (Table 1) than on those at generally higher elevations. All spray blocks were released for treatment within 6 and 7 day periods in Opal and Madison Units, respectively, as compared to 18 and 20 day periods in Baldy and Middle Fork Units, respectively.

Larval Population Density

Average pre-spray population densities in treated areas ranged from 21.7 larvae/100 buds in the Opal Unit to 47.6 in the acephate-treated blocks of the Middle Fork Unit (Table 2). Post-spray populations in units treated with carbaryl were 2.0-4.6 larvae/100 buds, with uncorrected population reductions of 84.1% (Madison) to 90.8% (Opal). The acephate-treated blocks showed a post-spray density of 9.1 larvae/100 buds with an uncorrected population reduction of 80.9%.

The untreated Fall Mountain Unit had an average "pre-spray" population density of 59.7 larvae/100 buds. This unit showed a population reduction of 33.8% 14 days after the "pre-spray" samples were collected with a "post-spray" population density of 39.5 larvae/100 buds.

Densities were also estimated as larvae per square meter of foliage surface area (Table 2), so that our data would be comparable to that of others who may be using this method of population density estimation. The population reduction percentages calculated using density estimates of larvae/foliage surface area are significantly higher than those using density estimates of larvae/100 buds.

DISCUSSION

Larval Development

Larval development was quite variable in the spray blocks in the southern treatment units with the release of blocks for treatment being spread over 18 and 20 days for Baldy and Middle Fork Units, respectively (Table 1). These time spans were expected to be longer than those of the northern units (6 days for Opal and 7 days for Madison) because of the greater elevational ranges of the southern units. However, they were not expected to be as long as they were. This was due in part to the abnormally cool and rainy weather experienced in the area during June and July.

Larval Population Density

Post-spray larval population densities for the three TU's (Opal, Madison, and Baldy) in which only carbaryl was used were below the density threshold of 7 larvae/100 buds (Table 2). Budworm populations in these areas are expected to remain at nondamaging levels throughout the current outbreak period.

Post-spray larval population densities also met the project objective in the 56,000 acres treated with carbaryl in the Middle Fork Unit (Table 2). However, the approximately 9,000 acres treated with acephate in the Middle Fork Unit did not meet our objective (Table 2). Thus, about 14% of the area treated in the Middle Fork Unit has a potential for occurrence of visible defoliation in 1983. The consequences of this for the Middle Fork Unit as a whole throughout the current outbreak period are unknown.

Because of the uncertainty involved in predicting future budworm population levels, treated areas will be monitored until budworm populations in surrounding untreated areas collapse. This monitoring will involve annual sampling within treated areas to estimate budworm population densities and/or host-tree defoliation intensities. This information will be augmented by that gained from the annual aerial forest insect detection survey.

Population reduction percentages in carbaryl-treated areas (Table 2) were within the range (77.6-97.2) observed in units or subunits of past projects in which carbaryl was used against western spruce budworm (Anon. 1976, Parker et al 1978, Mounts et al 1978, Livingston et al 1982). The population reduction percentage of 80.9 in the acephate-treated blocks (Table 2) was outside the range of percentages (84.2-99.7) reported in previous projects in which acephate was used (Anon. 1975, Flavell et al 1977, Stipe et al 1977, Livingston et al 1982).

The enhancement of the population reduction percentages when using densities of larvae per foliage surface area is difficult to explain. One possible explanation might be attributed to the severe feeding damage observed on some of the post-spray samples. On these branches, not only were all the new needles gone, but many of the new shoots were also completely gone. This made it difficult to determine the number of new shoots or buds and probably resulted in an underestimation of this number. This would result in an overestimation of the post-spray population densities using the larvae per 100 buds method which would, in turn, lower estimates of population reduction percentages. The effect of this severe feeding damage when using the larvae per foliage surface area method would probably be inconsequential.

Both carbaryl and acephate have been effective in the past in reducing western spruce budworm populations. However, the factors responsible for results on the lower end of the population reduction percentage range were not fully identified and/or evaluated. In future projects if these factors are to be identified and evaluated, more intensive monitoring of insecticide coverage, climatic conditions during and after treatment, spray system calibration and spray droplet characterization is recommended.

ACKNOWLEDGMENTS

Thanks are extended to D. Bridgwater, P. Joseph, and T. McConnell for supervising the entomological field and laboratory crews, and to the people on the field and laboratory crews for collecting the data.

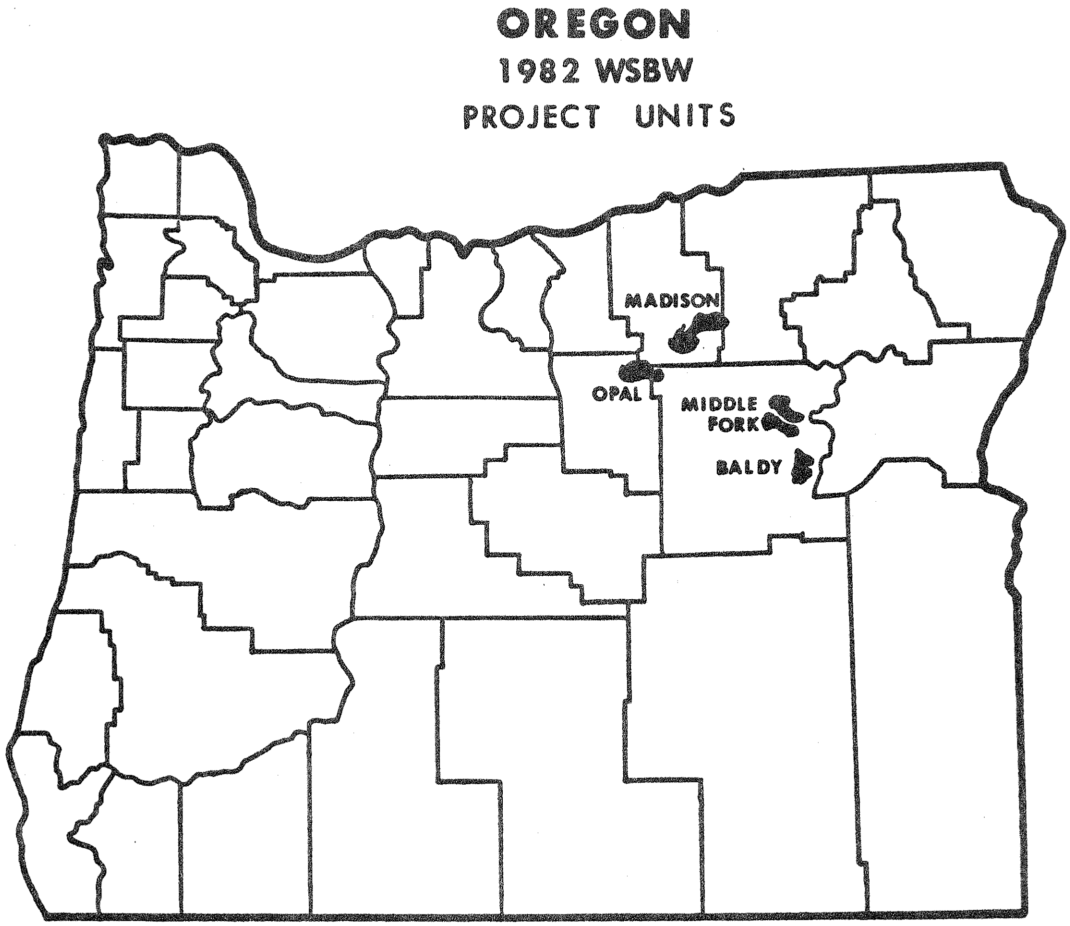


Figure 1. Index map showing location of the four 1982 western spruce budworm treatment units in eastern Oregon.

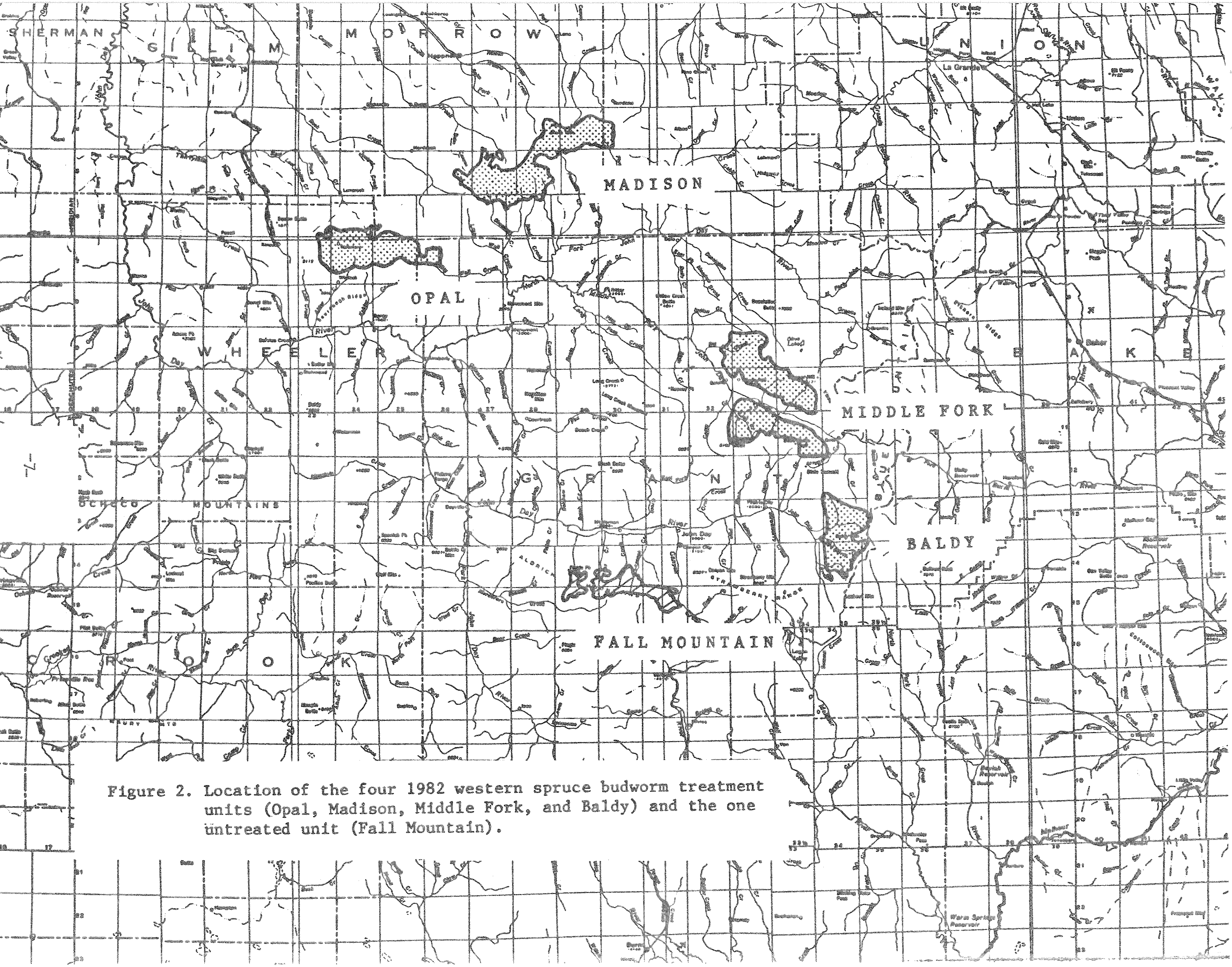
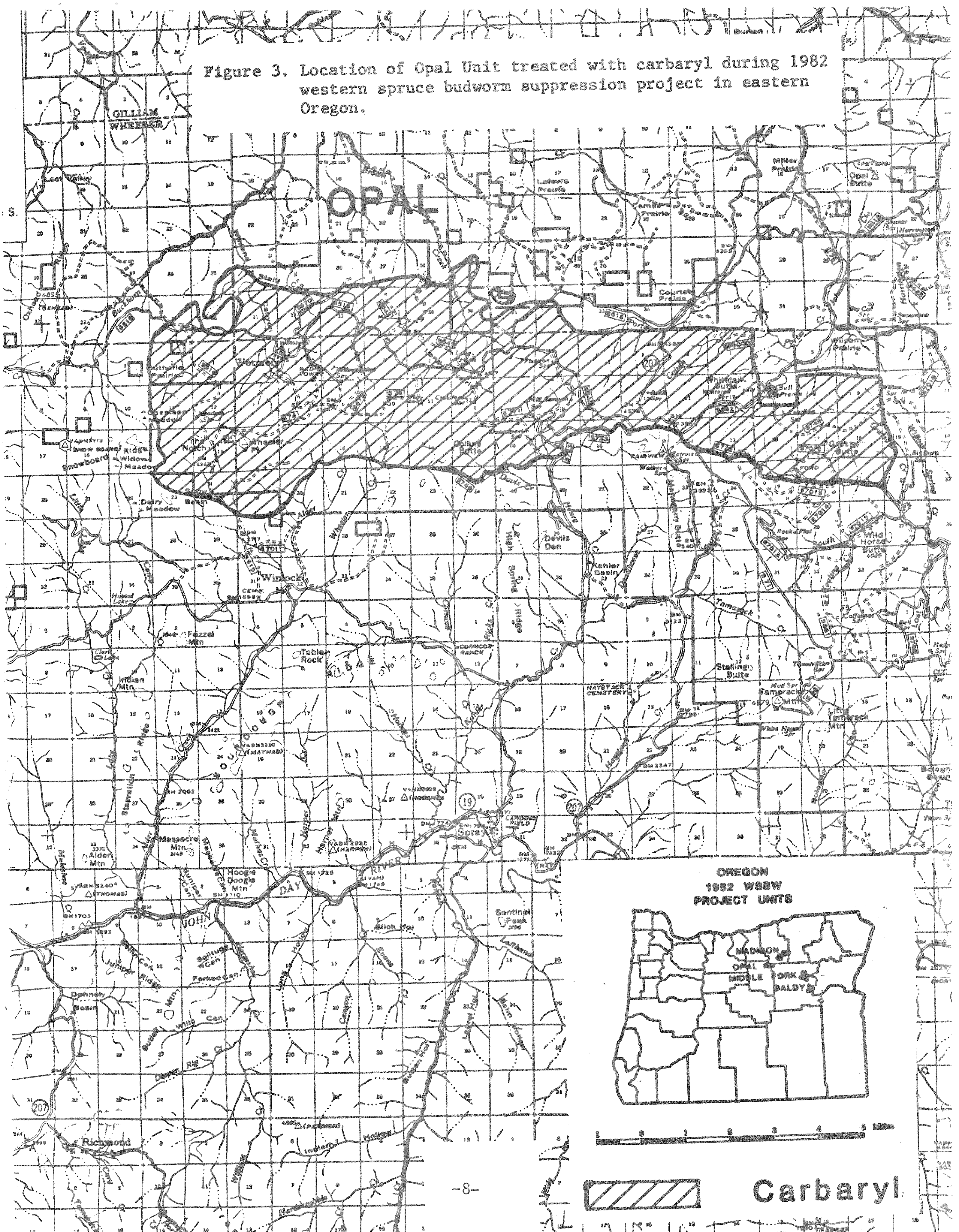


Figure 2. Location of the four 1982 western spruce budworm treatment units (Opal, Madison, Middle Fork, and Baldy) and the one untreated unit (Fall Mountain).

Figure 3. Location of Opal Unit treated with carbaryl during 1982 western spruce budworm suppression project in eastern Oregon.



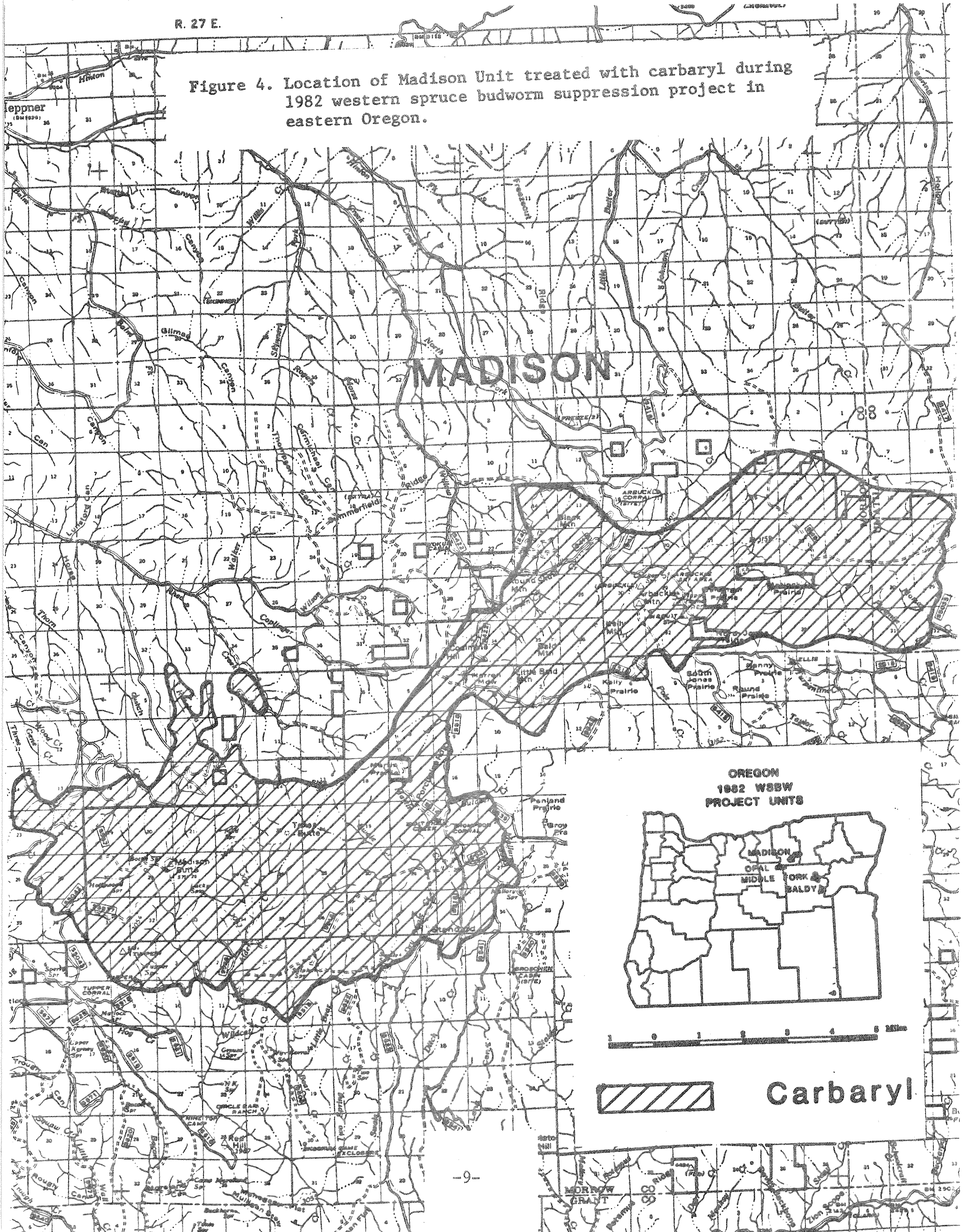


Figure 4. Location of Madison Unit treated with carbaryl during 1982 western spruce budworm suppression project in eastern Oregon.

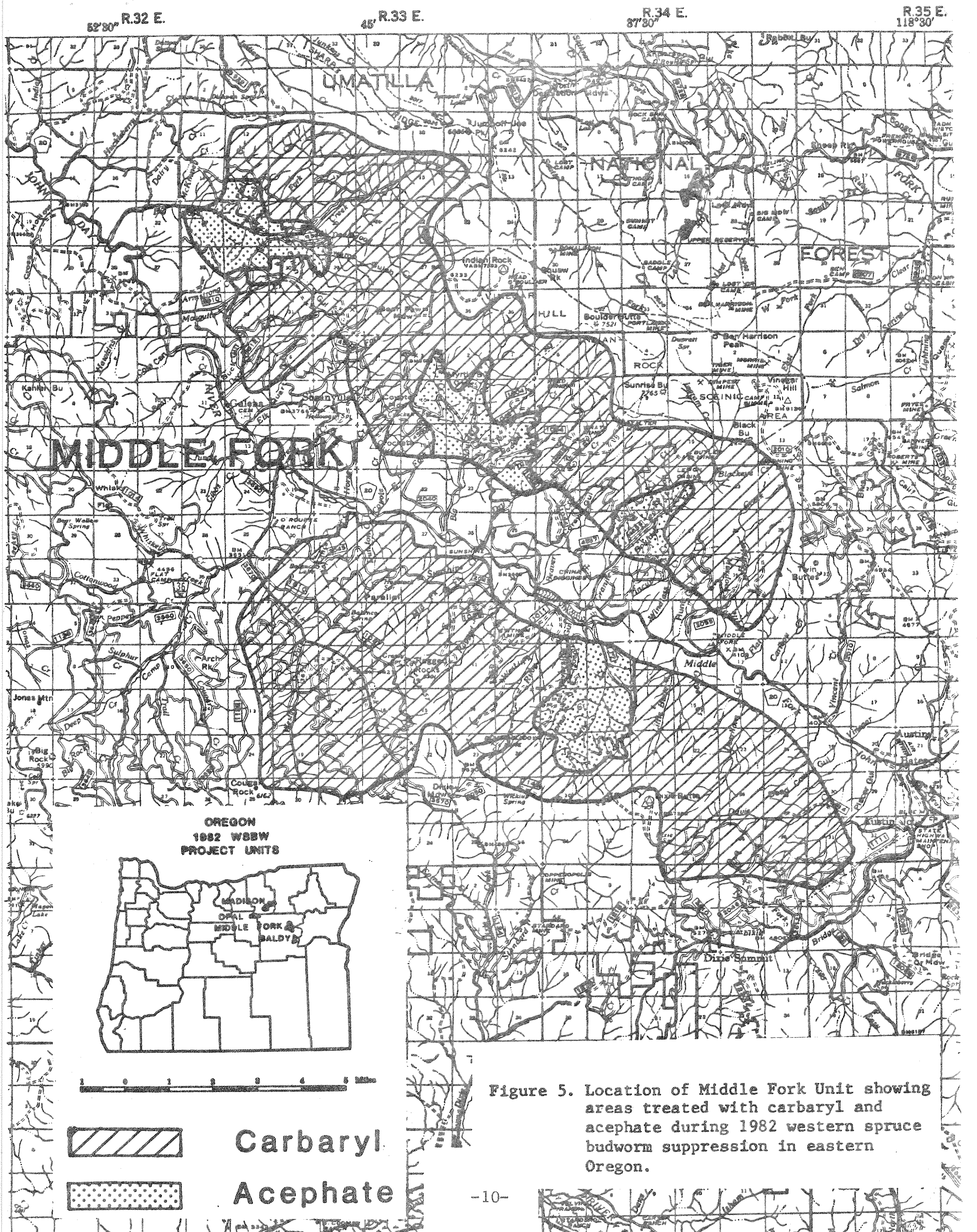


Figure 5. Location of Middle Fork Unit showing areas treated with carbaryl and acephate during 1982 western spruce budworm suppression in eastern Oregon.

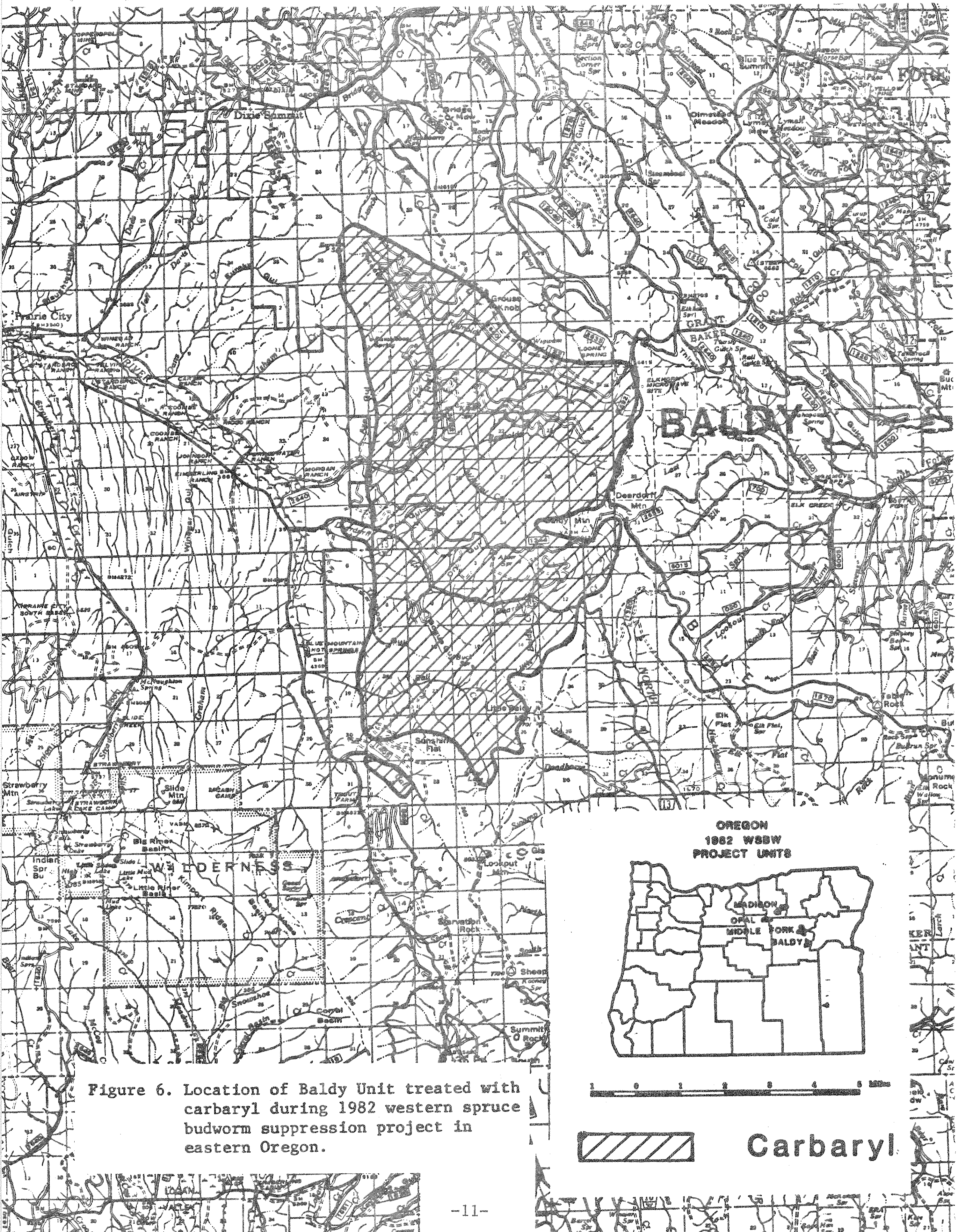


Figure 6. Location of Baldy Unit treated with carbaryl during 1982 western spruce budworm suppression project in eastern Oregon.

Figure 7. Location of untreated Fall Mountain Unit in which 1982 western spruce budworm larval populations were sampled in eastern Oregon.

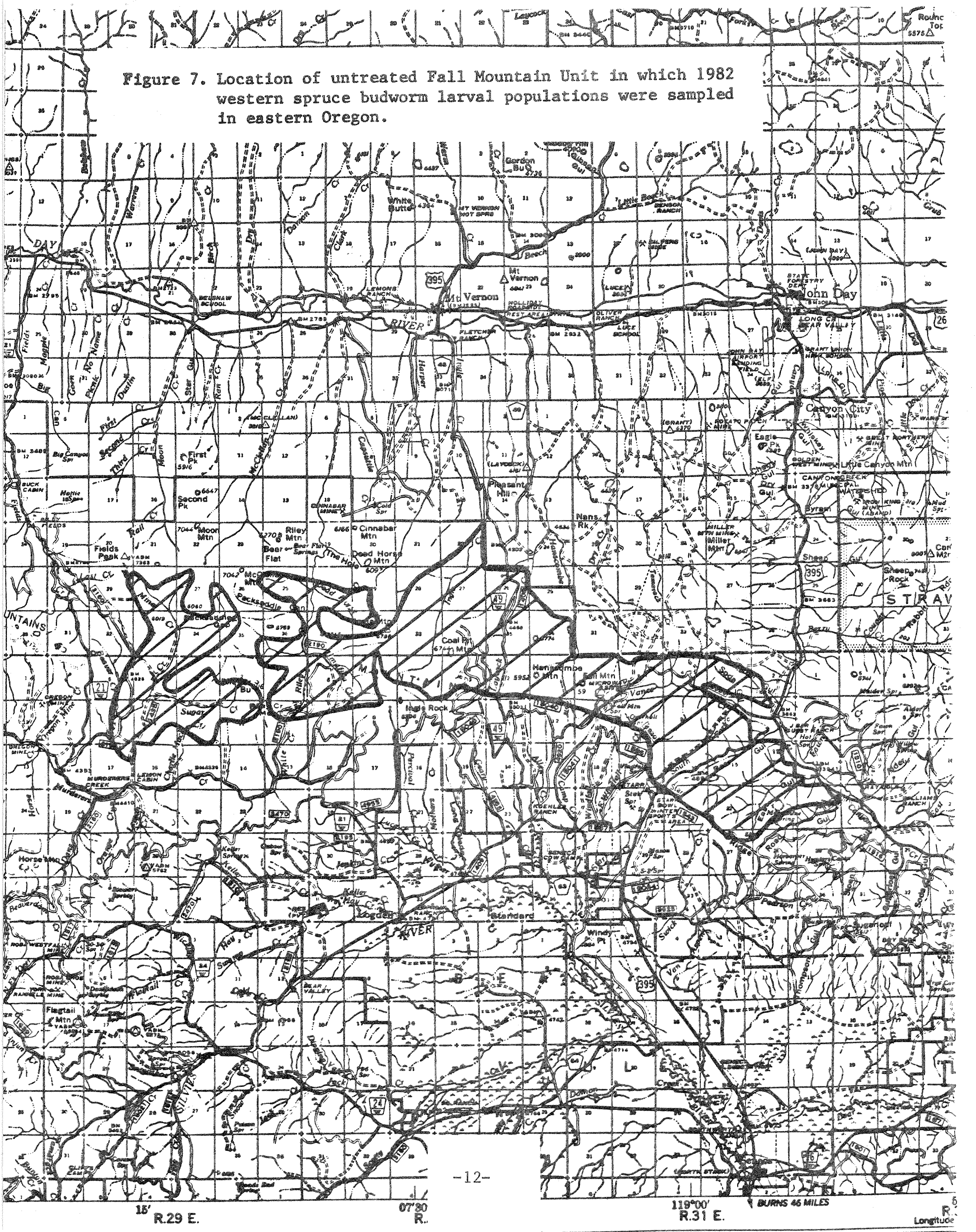


Table 1. Ranges of elevations and dates of first and last spray block releases in western spruce budworm treatment units in eastern Oregon, 1982.

Unit	Range of Elevations (Ft.)	Release of First Block	Release of Last Block
Opal	3600-3490	19 Jun	24 Jun
Madison	4100-5700	23 Jun	29 Jun
Middle Fork	3800-6620	22 Jun	11 Jul
Baldy	4400-7000	27 Jun	14 Jul

Table 2. Pre- and post-spray western spruce budworm larval densities and population reduction percentages for 1982 treatment units in eastern Oregon.

Unit	No. of Plots	LARVAL POPULATION DENSITIES 1/				Percent Population Reduction
		Pre-spray	S.E.	Post-spray	S.E.	
Opal	28	21.7 (102.3)	2.8 (12.8)	2.0 (7.4)	0.5 (2.3)	90.8 (92.8)
Madison	51	27.6 (142.1)	2.8 (18.0)	4.4 (13.3)	1.0 (3.1)	84.1 (90.6)
Middle Fork (Acephate plots)	30	47.6 (247.9)	4.8 (28.4)	9.1 (39.2)	1.4 (7.0)	80.9 (84.2)
Middle Fork (Carbaryl plots)	47	41.9 (214.1)	3.6 (22.1)	4.6 (18.6)	1.0 (4.0)	89.0 (91.3)
Baldy	34	38.5 (200.1)	4.2 (20.6)	3.8 (15.6)	0.7 (2.9)	90.1 (92.2)
Fall Mountain (untreated)	30	59.7 (348.7)	4.5 (26.3)	39.5 (195.0)	2.6 (14.7)	33.8 (44.1)

1/ The first numbers for each unit are based upon calculations using larvae/100 buds and those in parentheses using larvae/m^2.

REFERENCES

Anonymous.
1975. Interim report, 1975 field test with Orthene 75S against the western spruce budworm in north-central Washington. USDA Forest Service, Pacific Northwest Region. Unpublished Report.

Anonymous.
1976. Cooperative western spruce budworm control project. USDA Forest Service, Pacific Northwest Region, (Unnumbered Report). 18 p. + Appendix.

Anonymous.
1982. Western spruce budworm management in northeast Oregon. USDA For. Serv., Pacific Northwest Region, Environmental Assessment. 39 p. + Appendices.

Flavell, T. H., S. Tunnock, and H. E. Meyer.
1977. A pilot project evaluating trichlorfon and acephate for managing western spruce budworm, Helena National Forest, 1976. USDA Forest Service, Forest Insect and Disease Mgmt., Rep. No. 77-16, 49 p.

Livingston, R. L., J. W. Schwandt, J. Preston, W. Ciesla, B. Davidek, D. Beckman, L. Spickelmire, and R. Johnson.
1982. 1979 western spruce budworm control project, Cascade, Idaho. Idaho Dept. of Lands, Forest Insect and Disease Sec., Rep. No. 82-4. 64 p.

McConnell, T., P. Joseph, D. McComb, and D. Twardus.
1980. Western spruce budworm in eastern Oregon, 1980. USDA Forest Service, Forest Pest Mgmt., Pacific Northwest Region, (Unnumbered Report). 19 p.

Mounts, J., R. E. Dolph, D. McComb, and T. F. Gregg.
1978. 1977 western spruce budworm control project in north-central Washington. USDA Forest Service, Pacific Northwest Region, (Unnumbered Report). 33 p.

Parker, D. L., R. E. Acciavatti, and E. D. Lessard.
1978. Western spruce budworm suppression and evaluation project using carbaryl, 1977: Progress Report No. 1. USDA For. Service, Forest Insect and Disease Mgmt. Report R-3, 78-11. 136 p.

Stipe, L. E., J. A. E. Knopf, R. L. Livingston, R. W. Young, and G. P. Markin.
1977. A cooperative pilot project to evaluate Orthene Forest Spray for control of the western spruce budworm, *Choristoneura occidentalis* Freeman (Lepidoptera:Tortricidae), McCall, Idaho. USDA Forest Service, Intermountain Region. (Unnumbered Report). 34 p.+ Appendix.

Prepared By Bruce B. Hostetler Date 1 Feb 1983

Bruce B. Hostetler, Entomologist
Forest Pest Management

Reviewed by Roger Sandquist Date 1 II 83

Roger E. Sandquist, Supervisory Entomologist
Forest Pest Management

Approved by Paul E. Buffam Date 2/22/83

Paul E. Buffam, Director
Forest Pest Management