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FINAL REPORT AND CRITIQUE OF THE 1988 LONGVIEW FIBRE/HOOD RIVER COUNTY WESTERN SPRUCE BUDWORM SPRAY PROJECT[1]

Introduction

Since 1980, a western spruce budworm (Choristoneura occidentalis Freeman) outbreak has grown to encompass most of the true fir and Douglas-fir host type in eastern Oregon. In 1983, budworm defoliation became visible on forest land along the eastern flank of Mt. Hood. By 1987, the spruce budworm outbreak had created significant concern among landowners in the Hood River area because of the increasing likelihood of top kill and tree mortality. The U. S. Forest Service decision to spray infested acreage on the Mt. Hood National Forest in 1988, provided the final impetus for adjacent private landowners to organize and conduct their own budworm suppression project.

Project Objectives

Objectives of the suppression project were 1) to preserve as much new foliage as possible and 2) to reduce budworm populations below one larvae/17.7 in (45 cm) branch tip. Reducing budworm populations below one larvae/branch tip should protect trees from severe damage for several years, possibly until the end of the outbreak.

Project Area

Spray blocks were located on forest land inside a sixteen miles square area centered on the Hood River Valley (Figure 1). Within project boundaries, the elevations of infested stands were from 1,200 - 4,000 feet. The size of spray blocks varied from 600 to 5,000 acres and the total map acreage of the spray blocks amounted to 40,684 acres. Factors affecting block configurations included host type, landowner participation, aspect, elevation, identifiable terrain features, and the presence of a budworm population.

Insecticides

Two insecticides were selected for use during the project. The majority of forest land was treated with Sevin 4-oil (carbaryl) mixed with diesel oil at a volume-to-volume ratio of 1:1 and

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[1] Prepared by D.L. Overhulser, Oregon Department of Forestry, from information supplied by Longview Fibre Co. and Hood River County.

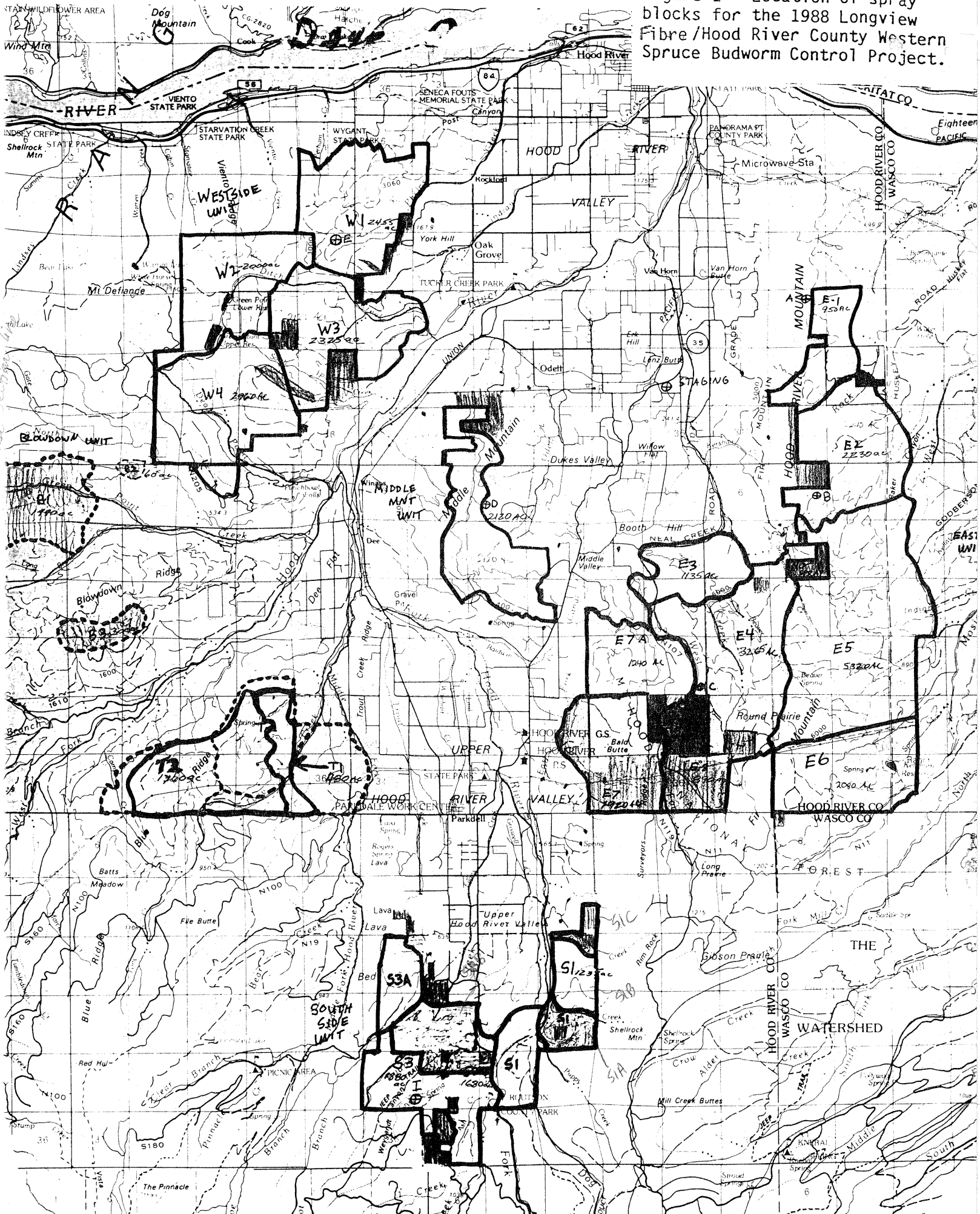

Figure 1 - Location of spray blocks for the 1988 Longview Fibre/Hood River County Western Spruce Budworm Control Project.

light shading = Bt; dark shading = not sprayed by Longview F.

applied at a rate of 1/2 gallon (64 oz.) per acre (1 lb a.i./acre). The carbaryl formulation has been a reliable budworm control agent for almost two decades. A major advantage from using carbaryl is a wider application window for effective budworm control. With carbaryl there is also the possibilities of returning excess chemical to the manufacturer if budworm populations are not high enough to justify treatment.

Stream buffers, sensitive areas, federal exchange acreage and some private lands were treated with an aqueous formulation of Bacillus thuringiensis (B.t.). The B.t. formulation chosen for the project was Thuricide 32LV mixed with water at a volume-to-volume ratio of 1:1 and applied at a rate of 3/4 gallon (96 oz.) per acre (12 Billion International Units per acre). Aqueous formulations of B.t. were extensively used during the 1987 budworm suppression projects in Oregon and Washington.

Application

A maximum of five small spray ships were employed during the course of the project. Most were Bell 47 G's and the largest was a Bell 206. Both the Sevin 4-oil and B.t. applications were made with Beecomist nozzles. Prior to the project, the effective swath width of a sprayship was determined on the basis of spray cards receiving at least 20 drops/cm^2 of insecticide deposit.

Variances to Oregon's Forest Practices Act were necessary in conjunction with the project. For Sevin 4-oil applications, the minimum humidity requirement was waived and the maximum permitted wind velocity for applications raised to 10 mph. To avoid leaving untreated reservoirs of spruce budworm, buffer areas around open water and Class 1 streams were treated with Thuricide 32LV.

Biological Sampling Procedures

Early Larval Density - In order to insure the presence of a sprayable budworm population (more than 4 larvae/17.7 inch branch sample), larval density sampling was conducted in each spray block. Two to eight plots were located in each block and plots consisted of three trees showing indications of previous budworm defoliation. Field procedures for this sampling are outlined in Appendix I (Instruction Sheet No. 1).

Budworm and Foliage Development - Sampling budworm development and the percent unfurled new growth is critical to the timing of a successful insecticide application. In most cases, plots used for development samples were the same as for early larval density. A description of the field procedures for taking samples is shown in Appendix I (Instruction Sheet No.3).

The criteria used for releasing a block for a carbaryl application was 50% of the larvae in the fourth instar and at least 90% of the buds unfurled. Blocks sprayed with B.t. were released when 95% of the buds were unfurled and less than 15% of the larvae were in the

second and third instars.

Post Treatment Sampling - Fourteen days after the insecticide applications, foliage samples were examined for the number of surviving budworm larvae/pupae and the percentage of undamaged new shoots. At least two post treatment sample plots were located in each spray block. Procedures for taking post treatment samples are described in Appendix I (Instruction Sheet No. 5). On each branch evaluated for surviving budworm larvae, 20 new shoots were examined for signs of budworm feeding. The number of undamaged shoots was reported as a percent of the sample.

Spray Assessment

To help monitor the quality of insecticide applications, 2-5 spray card plots were installed in all blocks. The average number of cards per plot was six. Oil sensitive (red dye) spray cards were utilized in carbaryl treated areas and white Kromekote cards used in B.t. areas.

Card lines were located along roadsides or in openings where good spray deposit was expected. Prior to spraying, cards were inserted into plastic holders attached to long wires which were pushed into the ground at 30 foot intervals.

After the application, cards were immediately examined for deposits using a microscope. The number of drops, within a one cm^2 template were counted and summarized on a daily basis.

Summary and Discussion

Organization and Costs - During June of 1988, Longview Fibre Company and Hood River County successfully organized to treat 40,684 acres of budworm infested forest at an approximate cost of $11.26/A. Partly because of the project's moderate acreage and the extent of landowner participation, its organization and costs differed significantly from agency managed spray operations. Some general facts about the project are summarized in Table 1.

Cooperators contributed most of the personnel to the project. With the exception of the entomologist and the spray contractor, all crews were forestry employees responsible for the day to day management of treated lands. Crew members performed multiple duties including aerial marking, foliage sampling, spray assessment and aerial weather data. Most personnel were familiar with the road system and ownership pattern which contributed to smooth operations and project safety. Ground crews used an existing forestry radio net for communications.

Other factors keeping costs low included a negotiated aerial spray contact and the very limited use of observer aircraft. Savings were also realized through the use of cooperator vehicles and equipment.

Despite the lack of observational aircraft, it was felt that adequate spray coverage was achieved on most blocks. Factors contributing to application success included experienced pilots and their use of recent aerial photos of spray blocks during operations. Aerial tree markers were used extensively for marking exterior and interior block boundaries. Ground observers had direct communication with helipad crews and provided valuable feedback on the progress of spray operations.

Pre-spray and Post-spray Budworm Populations - Early larval density sampling indicated more than four larvae/branch in all areas proposed for treatment (Tables 2 and 3). Most low elevation blocks treated with carbaryl were sprayed when average larval development was close to 50% fourth instar or greater. Treatment of blocks at elevations above 2600 feet were delayed because of the lack of bud flush. Larval development at higher elevations was essentially 100 % fourth instar or better before treatment. The progress of larval development and spray operations is shown in Table 4.

Post spray data from blocks treated with carbaryl are shown in Table 2. Out of 17 blocks primarily treated with carbaryl, only one had a post spray larval density greater than one larvae/branch tip. The percentage of undamaged new shoots on carbaryl treated trees averaged 55% (range 20-84%). The use carbaryl met the project's objectives of controlling spruce budworm and reducing damage to current growth.

Blocks treated with Thuricide 32LV for budworm control gave variable results (Table 3). Three out of four blocks did not meet the post spray objective of fewer than one larvae/branch. The percentage of undamaged new shoots on B.t. treated trees averaged 26% (range 0-41%).

Spray Assessment - One factor that may explain the excellent results with Sevin 4-oil was spray deposit. Based on a 407 card sample, the average deposit on Sevin 4-oil cards was 25 drops/cm^2. Based on 170 card samples from Thuricide 32LV treated areas, the average deposit was 14 drops/cm^2. Under operational conditions, drops/cm^2 from Sevin 4-oil applied at 64 oz./acre was almost 80% greater than the aqueous Thuricide 32LV applied at 96 oz./acre.

Project Critique - On July 12, 1988 a project critique was held at the Hood River Forestry Office. Cooperators were generally pleased with the projects accomplishments. A broad range of topics under the headings of planning, operations and forest practices were discussed (Appendix I). The item causing the most concern was the interpretation and enforcement of Oregon's new Forest Practices Rules regarding insecticide drift into riparian zones.

Table 1 General information on the Longview Fibre/Hood River County 1988 western budworm control project

Cooperators

- Longview Fibre
- Hood River County Forestry
- S.D.S. Lumber Company
- Oregon Department of Forestry
- Approximately 40 small landowners

Contractor

- Western Helicopter, Newberg, OR

Acreage

- 33,950 - Sevin 4-oil
  6,734 - Thurcide 32LV

Total 40,684

Project Personnel

Hood River County	9
Longview Fibre	4
Oregon Department of Forestry	1
Total	14

Costs*

Approximate Cost (including administration)
$11.26/AC

*Does not include time contributed by the ODF entomologist, or Forest Practices officers.

Table 2 Data from spray blocks primarily treated with Sevin 4-oil during the 1988 Longview Fibre/Hood River County western spruce budworm suppression project.

Block	Acres	Early larval Density[1] ($\bar{x}$/branch)	14 day Post Spray larval density[2] ($\bar{x}$/branch)	% Undamaged new shoots (%)
E 1	981	16.3	0.8	69
E 2	2225	14.1	0.7	74
E 3	1363	7.8	0.7	57
E 4	2780	5.7	0.1	55
E 5	5200	5.7	0.0	79
E 6	2131	5.3	0.1	84
E 7A	1364	37.0	0.3	35
MM	2120	10.6	0.7	63
W 1	2535	11.0	0.8	66
W 2	2573	57.7	0.2	20
W 3	2113	19.1	0.4	49
W 4	3140	23.2	0.4	55
T 1	670	12.3	1.9	60
T 2	1986	-	0.2	47
S1	1346	7.4	0.7	75
S3	1040	54.3	0.3	24
S3A	614	-	0.8	23

34,181

[1] Based on $\bar{x}$ of budworm larvae per 17.7 inch branch sample

[2] Post spray objective was to average less than 1 larvae/per 17.7 inch branch.

Table 3 Data from spray blocks primarily treated with Thuricide 32LV during the 1988 Longview Fibre/Hood River county western spruce budworm suppression project.

Block shoots	Acres	Early larval Density[3] ($\bar{x}$/branch)	14 day Post Spray larval density[4] ($\bar{x}$/branch)	Undamaged new shoots (%)
E 7	1833	37.0	3.2	28
E 8	814	8.0	5.1	41
S 2	1040	17.4	2.2	36
B	1675	-	0.3[5]	23
	5362		0.5	0

39,543

[3] Data based on $\bar{x}$ larvae/17.7 inch branch tip

[4] Post spray objective was to average less than 1 larvae/17.7 inch branch tip

[5] Very few samples were available from the B blocks because of limited access.

Table 4 - Timing of larval development and spray block treatment during the 1988 Longview Fibre/Hood River Company spruce budworm control project.

BIOLOGICAL FOR
BUDWORM DEVELOPMENT &

LEGEND	R	RELEASED	C	CANCEL
	S	SPRAYED	P	POST SPR

DATE	5/30	5/31	6/1	6/2	6/3	6/4	6/5	6/6	6/7	6/8	6/9	6/10	6/11	6/12	6/13	6/14	6/15	6/16	6/17	6/18	6/19	6/20
SPRAY BLOCKS																						
E 1	R 86%							S														P
E 2	R 49%							S														P
E 3	R 71%							S														P
E 4						28%				35%				R 81%								
E 5						31%				53%					R 47%							
E 6															46%							R 89%
E 7															11%							
E 7A			29%				37%			67%				R 92%								
E 8																						
MM		R 81%						S														P
W 1		R 61%						95%		S												
W 2			16%							27%												
W 3		37%						38%						R 87%	S							
W 4			14%							30%				81%								R 100%
S 1				21%										79%								R 100%
S 2			45%											89%								R 100%
S 3				37%										67%								R 91%
S 3A																S						
T 1										R 68%				94%	S							
T 2																68%						R 94%
B																						

A P P E N D I X I

INSTRUCTION SHEET NO. 1

Field Crew Instructions for Larval Density Sampling

1. At least two plots per spray block are needed.

2. Select 3 trees of the same species (Douglas-fir or true fir):
   - Trees must be open grown (exposed to full sun)
   - 20-30 feet tall
   - Must be 70 feet from any road
   - Must have new buds or flushes of new growth in the mid-crown for sampling
   - Should have some indication of past budworm defoliation

3. Mark plot location on the 7 1/2-minute map.

4. Clip one 17.7 inch branch sample (approximately the width of the pruner basket) from the mid-crown of each sample tree.

5. Each branch and any larvae that have fallen into the basket are placed in a paper bag. Don't trim branches. Long or "big" branches might have to be cut in half to get them into the bag. Be sure to allow enough room to fold bag and staple it shut.

6. Place a field data collection slip (copy of Biological From No. 1) in the bag with the sample.

7. Fold lip of bag and staple shut.

8. Write the unit name and plot number on the outside of the bag.

9. Staple the 3 bags together from each plot.

10. Place the bags in a large cardboard box in the rear of the truck.

11. Keep samples out of the direct sunlight to preserve larvae and foliage.

12. Place the box containing sample bags in a cooler if they are not immediately evaluated.

INSTRUCTION SHEET NO. 3

Field crew Instructions for Developmental Sampling (lower crown)

1. At least two development plots are established in each spray block.

2. Development plots should be distributed over the spray block to encompass different elevations and aspects.

3. Preferred plot locations are easily identifiable points, such as road junctions, since these plots will be re-sampled several times.

4. Plots consist of two similar tree species, either both Douglas-fir or true fir, depending on which species predominates on the site. Site characteristics include:
   - Open grown trees (exposed to full sun)
   - 20-30 feet tall
   - New buds or new growth are present in the lower crown
   - Trees must be 70 feet from the road
   - Should have some indication of past budworm defoliation

5. Flag branches and tree bole of sample trees with pink and green ribbon tied together; place white tags with plot identification on each tree.

6. Mark map with site location.

7. Clip enough apical branch tips (new foliage) from the lower crown with hand snippers to half-fill a size No. 1/6 paper sack (1 sack per tree).

8. Care must be taken to not disturb adjacent branches when taking samples.

9. Fill out a Field Data Collection Slip (Biological Form No. 1) and place on in each sample bag.

10. Fold the top of the paper bag twice and staple it closed.

11. Write the unit name and plot number on the outside of each bag.

12. Keep samples out of direct sunlight to preserve larvae and foliage. Throw a tarp over the open bed to shade samples if necessary.

13. Place the two bags in a cardboard box with other samples from the same spray block. Label the box with the unit name, block number, and date.

14. Don't get bags wet. If a bag gets wet and looks like it will open, slide it into another dry one.

15. Put boxes in a cooler if they are not immediately processed.

INSTRUCTION SHEET NO. 5

Field Crew Instructions for Post-Spray Sampling (mid-crown)

1. At least two plots are needed within a spray block.

2. Plots will be sampled 14 days after treatment.

3. Plots should be located at least 1/4 mile inside the spray block boundary.

4. Plots consist of three similar trees (either all true-fir or Douglas-fir) with the following characteristics:
   - Open grown trees (exposed to full sun)
   - 20-30 feet tall
   - New buds or growth are present in the mid-crown
   - Trees must be 70 feet from the road
   - Sample trees should not be under non-host overstory trees
   - Should have some indication of past budworm defoliation

5. Mark plot location on the map.

6. Clip two 17.7 inch (width of the pruner basket) branches per tree from the mid-crown with a pole pruner. Each branch should have at least 10 new shoots on it.

7. Care must be taken not to disturb the sample branch before it is cut (otherwise, larval will spin off the branch).

8. Put the two branches from each tree and all larvae, pupae, and pupal skins that are caught in the basket into a paper bag together with Biological From No. 1. Label the outside of the bag with unit name, block, plot, tree number, and date. Fold the bag top twice and staple closed. Large branches may have to be cut in half to fit in the bag.

9. Samples must be kept cool so that living larvae can be returned to the lab.

10. Put bags containing foliage in a cooler if they are not immediately processed.

A P P E N D I X II

Critique of Longview Fibre/Hood River
County Spray project
July 12, 1988

Planning

- Contractor felt that the unknown acreage figure for the project made it difficult to line up the appropriate amount of equipment.

- Identifying the project area in the fall rather than waiting until the spring would help all aspects of planning, especially coordination with small landowners.

- The project was greatly facilitated by a set of color aerial photos taken in the fall of 1987. Areas with visible defoliation in photos were used to set preliminary block boundaries. Pilots preferred photos for use in marking block boundaries and as an aide during spray operations. Photos were marked with erasable pens and could be reused for other forestry operations at the end of the spray project.

- Involvement of small landowners in the project was a worthwhile but time consuming endeavor. The ODF District contacted some 1076 landowners owning some 1838 tax lots concerning participation in the project. This represented a sizeable administrative burden for the District Office.

- Map development for small private land inclusions needs to start earlier and may require extra help.

- Small private landowners (5A - .1A) not wishing to participate in the project should be approached about spray drift waivers as early as possible.

- Contractor felt a planning meeting involving all personnel at the start of the project would have been beneficial. Such a meeting could have covered maps, sensitive areas and expectations of personnel involved in the project.

- Guidelines for selecting foliage sample plots should be provided well before the project so that foresters can identify potential sites for each block.

Operations

- Contractor felt that calibration and characterization of spray ships was worthwhile.

- Treatment of Private/Federal exchange acreage went smoothly. The spray contractor coordinated with counterparts on the USFS project concerning aircraft routes.

- Well maintained, reliable batch trucks and support vehicles helped relieve concerns about accidents and spills.

- Biological sampling (early larval densities) was cheaper than spraying extra acres. Larval sampling was important in fine tuning block boundaries.

- Project was greatly facilitated by personnel familiar with the area.

- Communications and coordination with the contractor were aided by assigning the same crews to a particular batch truck and helicopter.

- Because radios used different frequencies, communications between cooperators and the contractor were a chronic problem during spray operations. In the future the use of fire cache radios or rental of a commercial radio net might be the best approach to tie in all crews and the contractor.

- Contractor felt that block release forms would have helped in anticipating operational needs and preparedness.

- Contractor questioned whether the use of Sevin provided much advantage in spray timing because of the dependence of operations on bud flush above 2600 feet.

- Spray pilots preferred long straight runs. They also request a different color marking material for corners and interior boundaries. Some flags blew out of trees and created problems. Additional flagging (tree flags) 1/10 - 1/4 mile apart on boundaries would benefit pilots.

- The use of a single observation ship for five sprayships was successful. Observation ship concentrated on operations in sensitive areas.

- Ground observers contributed greatly to the success of spray operations. Observers provided important information on local weather differences that allowed operations to continue and also helped in spray assessment.

- A good road system in much of the area facilitated the movement of batch trucks and two wheel drive vehicles.

- Spray assessment provided valuable data near sensitive areas and an early indication that normal operations were successful.

- Handling pesticide drums was a lot of work. However, given the uncertainty of sprayable acreage, drums provided a convenient container if insecticide was returned to the manufacturer.

- Truck loads of insecticide drums get there on time, small lots of drums tend to sit on the loading docks.

- The use of drums aided in tracking gallonage in relation to acres treated. Batching at landings with drum was not feasible.

- The neutralizing agent for Sevin 4-oil, (caustic soda) should not be used unless a spill might move into water. Caustic soda is more dangerous to people and equipment than formulated Sevin 4-oil.

Forest Practices

- State spent about $12,000. on administering forest practices and contacting landowners regarding the Longview Fibre project.

- Three drift complaints occurred during the course of the Sevin applications although all rules concerning spray operations were observed.

- Contractor felt some drift was unavoidable with Sevin given the droplet size and height of application.

- The contractor or those in charge of the project may want to have their own program of water sampling.

- State should develop guidelines to aid FPO's in setting up and monitoring large spray projects.

- Ground observers may want to record weather every half hour to increase the confidence that conditions fall within forest practices guidelines.

- The standard of zero tolerance for insecticides within riparian zones needs to be clarified or revised.

- If the state is to do water sampling, a separate crew should be allocated to do only sampling. They should not be involved with monitoring the application.

- The state needs to decide if all domestic water supplies should be identified. The job of locating all sites and landowners is extremely time consuming. Not all domestic water supplies have filed for water rights.

- FPO found that meeting with project directors, contractor, and support personnel everyday after spraying, was valuable in identifying concerns relating to the Forest Practices Act.

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LEGEND																								
	R	RELEASED																C	CANCEL					
	S	SPRAYED																P	POST SPR					
DATE																								
SPRAY BLOCKS																								