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PLAN FOR THE TECHNICAL DIRECTION OF THE 1963 WESTERN HEMLOCK LOOPER CONTROL PROJECT IN SOUTHWEST WASHINGTON

by

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THE HEMLOCK LOOPER
Lambdina fiscellaria lugubrosa Hulst

Figure 1

Figure 4

Figure 5

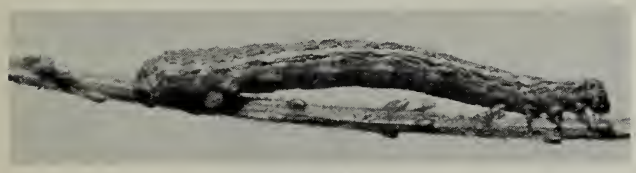

Figure 2

Figure 3

Figure 6

Figure 1 - Western hemlock damage
Figure 2 - Caterpillar in extended position
Figure 3 - Caterpillar in looping position
Figure 4 - Adult male
Figure 5 - Eggs
Figure 6 - Pupa

CONTENTS

INTRODUCTION

To control a serious outbreak of the western hemlock looper in southwest Washington, insecticide will be applied by aerial methods to 70,000 acres of coniferous forest land in the summer of 1963. The Northwest Forest Pest Action Council, after assessing potential timber loss and possible hazards to other resources, recommend control. The project will be a cooperative venture with private industry, the Washington State Department of Natural Resources, and the U. S. Forest Service. This plan presents the duties and responsibilities of project technical personnel. These personnel will be under the direction of the U. S. Forest Service.

BACKGROUND

The western hemlock looper, Lambdina fiscellaria lugubrosa Hulst, is a serious defoliator of coniferous forests in the coastal region of Oregon, Washington, and British Columbia. Six major epidemics and several minor ones have occurred in this area during the past 75 years, leaving behind vast amounts of dead timber. An outbreak from 1929 to 1932 in Pacific and Grays Harbor Counties in Washington destroyed about 200,000,000 board feet of hemlock timber. In 1944, about 40,000,000 board feet of timber were killed outright and substantially more weakened from partial defoliation as a result of a looper epidemic in Clatsop County, Oregon. 1/ Prior to 1962, the most recent infestation in southwest Washington was in 1952-53, when light defoliation was detected on 2,000 acres. This outbreak subsided from natural causes and widespread tree mortality did not occur.

Several outbreaks of the western hemlock looper have been held in check by aerial application of insecticides. Lead and calcium arsenate dusts were applied in early years to attempt control. In 1945, DDT was used for the first time at a rate of 1-pound in 2 gallons of fuel oil per acre and provided effective control while lowering costs. 2/ In 1962, DDT was applied at the rate of 1/2-pound per 1-1/2 gallons of insecticide per acre on 32,500 acres in northwest Oregon. Although over-all mortality averaged 88 percent, some defoliation and subsequent tree mortality occurred following spraying. 3/ Results of the 1962 control project indicate that 1/2-pound of DDT per acre does not provide sufficient control to prevent tree mortality.

1/ Keen, F. P. Insect enemies of western forests. U. S. Dept. Agr. Misc. Pub. 273, 280 pp., illus. 1938 (rev. 1952)

2/ Biennial report of the State Forester to the Governor - July 1, 1944 to June 30, 1946. Oregon State Board of Forestry, Salem, Oregon.

3/ Buffam, P. E. Summarization report of the technical aspects of the 1962 western hemlock looper control project at Astoria, Oregon. U. S. Forest Serv., Pacific Northwest Region, 19 pp. March 1963.

CONTROL NEEDS

The 1962 cooperative forest insect aerial survey detected over 5,500 acres of epidemic hemlock looper infestation in southwest Washington. A cooperative ground survey showed that a potential hazard due to the western hemlock looper is present on approximately 70,000 acres of forested land in Pacific and Wahkiakum Counties. 4/ Therefore, the Northwest Forest Pest Action Council recommended spraying in 1963 to prevent widespread tree mortality.

The 1963 project in Pacific and Wahkiakum Counties is designed to protect valuable hemlock stands from serious losses until natural control factors can again hold looper populations in check while protecting other resources as much as possible.

PROJECT ADMINISTRATION

The project will be administered by the Washington State Department of Natural Resources. Technical assistance will be provided by the U. S. Forest Service. G. R. Little, head of the Department of Natural Resources' forestry inventory program at Olympia, will be project director. C. R. Fink, forester in the Insect and Disease Control Branch of the Division of Timber Management, U. S. Forest Service, will furnish liaison. P. E. Buffam, entomologist for the Forest Service, will be technical director and project biologist.

RESPONSIBILITIES OF THE TECHNICAL STAFF

The Forest Service will arrange for testing of the insecticides used and their ingredients and for all biological phases of the project.

INSECTICIDE TESTING

Two insecticides will be used on the 1963 project. The carbonate sevin will be applied to looper-infested land containing streams that empty into Willapa Bay and the chlorinated hydrocarbon DDT to lands with streams emptying into the Columbia River. Willapa Bay supports an extensive oyster industry. The Federal Pest Control Review Board felt that DDT might cause damage to the oysters or the oysters might store the DDT and then pass on this insecticide when the oysters were consumed by humans. Sevin was selected to replace DDT in the Willapa Bay area because it is relatively non-toxic to oysters and has a short residual life compared with that of DDT. The efficiency of sevin in controlling hemlock looper outbreaks is unknown. Sevin will be applied

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4/ Buffam, P. E. Results of the 1963 western hemlock looper egg survey in southwest Washington. U. S. Forest Serv., Pacific Northwest Region, 21 pp. May 1963.

at the rate of 2 pounds (1.6 pounds of active ingredient) in enough water to equal 2 gallons per acre, and DDT will be applied at the rate of 3/4 pounds active ingredient, 0.9375 of one quart of an auxiliary solvent, and #2 fuel oil to make 1-1/2 gallons per acre.

The Forest Service will arrange to have chemists from the Division of Insecticide Investigations, U. S. Agricultural Research Service, Yakima, Washington, perform the following:

1. Test ingredients to be used in formulating the insecticides.

2. Test samples of each formulated batch to insure compliance with contract specifications.

3. Inspect the plants of the successful bidders if requested by the Department of Natural Resources.

Personnel from the Department of Natural Resources will collect 1-pint samples from each batch of formulated insecticide and mail them to the Agricultural Research Service laboratory at Yakima for analysis. The Agricultural Research Service will notify the Project Director of the results of the analysis, and the Project Director will notify the insecticide contractor's chief chemist. If the insecticide meets contract specifications, the batch will be released for transportation to the project area. If the batch does not meet specifications, more active ingredient will be added and another sample taken and analyzed before the batch is released.

BIOLOGICAL AND OPERATIONAL PHASES

The Insect and Disease Control Branch, Division of Timber Management, U. S. Forest Service, will be responsible for all biological phases of the project. The main responsibilities are:

1. Provide adequate survey data upon which control decisions can be based.

2. Participate in control planning, which includes selecting spray boundaries and contract specifications.

3. Provide guidelines and procedures to insure biological soundness of control operations.

4. Train and supervise technical personnel who will act as assistant biologists and insect checkers.

5. Inspect the operational procedures for entomological soundness.

6. Assess spray distribution.

7. Assess effectiveness of each insecticide in controlling the western hemlock looper.

8. Collect and record biological information that could be useful on future western hemlock looper control projects.

9. Prepare reports on the biological phases of the project as needed.

DUTIES OF TECHNICAL PERSONNEL

The project director will be responsible for over-all conduct of the spray program, and the technical director will be responsible for the technical or entomological phase of the project (figure 1). The technical director, two assistant biologists, and eight insect checkers will conduct the biological phases of the spray program. The technical director and assistant biologists will be Forest Service personnel. Insect checkers will be hired specifically for this project by the Department of Natural Resources. Salaries and other expenses of these men will be financed from project funds. The Forest Service will furnish one man for liaison. The following is a breakdown of technical positions and assigned duties:

TECHNICAL DIRECTOR AND PROJECT BIOLOGIST

The project technical director and biologist will be directly responsible to Benton Howard, Chief, Insect and Disease Control Branch, Division of Timber Management, U. S. Forest Service, for the field direction of the biological phase of the project.

The project technical director will begin work in the project area about the first of June. His duties will be:

1. Train and supervise the assistant biologists and insect checkers and be responsible for their work.

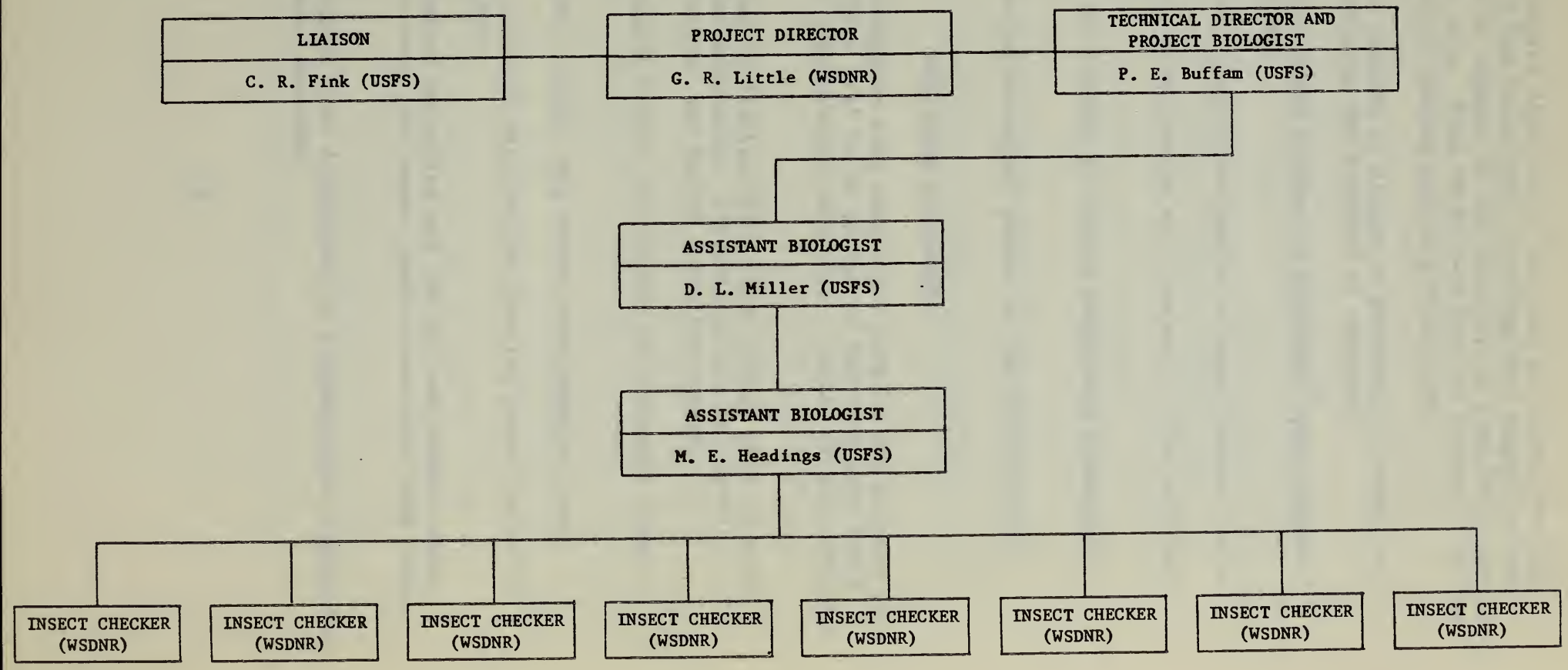
2. Become thoroughly familiar with each control unit -- maps, mosaic, roads, boundaries, elevations, and spray blocks.

3. Select sampling points for twice-weekly larval collections by the assistant biologists and insect checkers.

4. Compile and interpret developmental data collected by the assistant biologists and insect checkers and assessed by the assistant biologists.

5. Keep accurate records of larval development.

Figure 1.--Technical organization chart for the 1963 western hemlock looper control project



6. Advise the project director of the rate of larval development and help him decide when spraying will begin, so that aircraft can be ordered to the airstrip in time for inspection, instructions, etc. Form R6-5240-35 will be submitted to the project director stating spraying priorities.

7. Keep accurate records of blocks or portions of blocks released for spraying and progress of spraying.

8. Plan and direct field studies to determine spray-induced larval mortality.

9. Plan and direct field distribution of spray deposit cards.

10. Estimate spray distribution with the aid of the assistant biologists.

11. Plan and direct studies to obtain additional biological information.

12. Report on the entomological phases of the 1963 control project.

ASSISTANT BIOLOGISTS

The assistant biologists will report for work in the project area on June 10. D. L. Miller will be in charge of the technical staff during the absence of the technical director. Duties of the assistant biologists will be:

1. Become thoroughly familiar with each control unit -- maps, mosaic, roads, boundaries, elevations, blocks, larval collection points, and larval mortality points.

2. Make twice-weekly larval collections to determine looper development.

3. Separate larval instars and record developmental data.

4. Assist the technical director in choosing larval mortality sampling points.

5. Sample for larval mortality and lay out and collect spray deposit cards when the insect checkers are busy with other duties.

6. Count and collect dead Arthropods on 2-square-foot collection trays following spraying.

7. Assist the technical director in estimating spray deposit on oil-sensitive spray deposit cards.

8. Confirm all communications -- radio messages, telephone conversations, verbal reports, etc. -- in writing.

INSECT CHECKERS

Insect checkers will report for work at the Department of Natural Resources office in Naselle on June 12. The duties of the insect checkers will be:

1. Become familiar with the control units in which they will be working.

2. Make twice-weekly larval collections to determine looper development when the assistant biologists are busy with other duties.

3. Make pre- and post-spray larval counts on mortality plots.

4. Distribute spray deposit cards before spraying and collect them after spraying.

5. Observe the performance of spray planes whenever possible.

6. Do other work as assigned by the technical director or assistant biologists.

BIOLOGICAL PHASE OF THE PROJECT

Technical personnel will determine: (1) development of the western hemlock loopers in each unit, (2) spray distribution, (3) looper mortality caused by the insecticide, and (4) other Arthropods killed by the spray. The results of observations and studies to determine each of these points will be reported after the project is completed.

LARVAL COLLECTIONS

Larval development will be determined by larval collections from understory and overstory foliage in hemlock stands within the spray area. Egg hatch should occur between May 1 and June 30. Following this, looper larvae will be collected and the stage of development determined. Start of spraying operations in each spray block will depend upon looper development.

Procedures for making larval collections will be:

1. The technical director will select at least one collection point within each control unit. The points will be selected in areas containing moderate to heavy looper populations. Samples may be collected at random to supply more developmental data when desired. Plot location records will be kept by the technical director or assistant biologist.

2. About the first of June, larval collections will be made at least twice-weekly until all of the areas have been sprayed. At each collection point, 50 larvae will be collected from understory plants and 50 larvae from standing intermediate or suppressed hemlocks. Branches of red alder (Alnus rubra), red huckleberry (Vaccinium parvifolium), tall blue huckleberry (V. ovalifolium), salmonberry (Rubus spectabilis), vine maple (Acer circinatum) and western hemlock seedlings (Tsuga heterophylla) will be sampled to obtain larvae from understory foliage. To sample understory foliage, a 3 X 3 foot beating sheet will be held under individual branches and each branch will be tapped with a stick causing larvae to drop onto the sheet. Larvae from the overstory foliage should be collected from branches of intermediate and suppressed western hemlock using an aluminum pole pruner with an attached basket. Larvae should be placed by collecting location (understory or overstory foliage) in alcohol-filled vials and transported to the office at Naselle for instar separation.

3. Each larvae from the two different lots will be separated by stage of development either the day of collection or the day following. Head capsule widths will be used to determine the different instars of development (Appendix). The number of larvae in each instar will be recorded on Form R6-5240-32.

Spray blocks will be released for spraying when most of the larvae from the understory and overstory foliage collections are in the second instar and some in the third instar of development and when no recently hatched first instars are observed. Looper development in the overstory hemlock may be a little advanced over that in the understory. Collections of larvae from both habitats should determine this. Form R6-5240-35 will be filled out by the technical director and submitted to the project director when blocks are released for spraying. Spraying priorities will be listed on this form. Initiation of spraying should occur between June 15 and July 15.

MORTALITY COUNTS

If possible, the technical director and assistant biologists will select at least one plot in each of the spray blocks to sample

for insecticide-caused looper mortality. Some blocks may not be accessible or contain a moderate to heavy looper population. In this case, no mortality plots will be sampled in these blocks, but more than one plot will be established in other more accessible and more populated blocks. Each mortality plot will be sampled one or two days before spraying and ten days after spraying.

Prodecures for sampling larval martality as a result of aerial spraying will be:

A. Before spraying

1. Sample affected mortality plot 1 or 2 days prior to spraying.

2. To sample, clip five 18-inch twigs from each of five designated plot trees using an aluminum pole pruner with attached basket.

3. Examine each twig for looper larvae.

4. Count the number of living larvae and record on Form R6-5240-34.

5. Turn each form in to the technical director or one of the assistant biologists.

B. After spraying

1. Ten days after a mortality plot has been sprayed, pick up the Form R6-5240-34 for the plot and sample the plot the same way it was sampled before spraying.

2. Turn each form in to the technical director, so he can compute larval mortality.

The following formula will be used to compute looper mortality resulting from spraying:

$$\% \text{ mortality} = \frac{\text{pre-spray count} - \text{post-spray count}}{\text{pre-spray count}} \times 100$$

SPRAY ASSESSMENT

Amount and distribution of spray reaching the ground in the project area and at the side of critical streams, bays, and pastures will be assessed by the technical staff. Oil-sensitive spray deposit cards placed in areas sprayed with DDT in fuel oil will pick up

droplet patterns from which spray density can be estimated. Spray distribution in areas with sevin in water will be obtained using black paper. Sevin will appear as white or creamy spots on the black paper. Actual amounts of spray reaching the ground will be measured in some areas by placing filter papers at the side of oil-sensitive spray cards or black paper and having the filter papers analyzed for insecticide quantities.

Spray deposit cards will be placed in an area the day before spraying. At least ten cards will be distributed on each mortality plot along a straight line running through the center of the plot at a right angle to the flight line of the spray planes. Cards distributed in dense hemlock stands will be placed in moderate to large canopy openings to gain a true spray assessment. In small openings, spray is shielded from cards by surrounding trees. Cards will be either mounted in wire holders similar to those used on the 1962 looper project at Astoria, or nailed to stump tops. 5/ Moisture from fog or rain rolls off cards mounted in wire holders easily, and the cards dry out quickly because they are suspended in air. Also, wire holders keep the cards above ground vegetation and hold the cards firmly, thus preventing card curling. When cards are placed on stump tops, all four corners of the card will be nailed down to prevent curling. Each card will be assigned a number. The person distributing the cards will record the card location and identification number on a sketch map.

Cards will be gathered either the same day the area is sprayed or early the next morning. Cards will be given to the technical director or assistant biologists who will estimate spray coverage and deposit on the oil-sensitive cards by comparing the cards with a set of standards. 6/ The black cards will be examined for presence of sevin droplets. Results of the estimations will be listed on Form R6-5240-43 and sent to the project director. In cases of inadequate coverage, the technical director will check larval mortality due to spraying in the area in question and notify the project director if a respray is necessary. All spray deposit cards will be saved for future reference.

COLLECTION TRAY SAMPLING

Several 2-square-foot collection trays will be installed beneath a few mortality plot trees in the spray area before spraying to

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5/ Ibid.

6/ Davis, J. M. Standards for estimating airplane spray deposits on oil-sensitive cards. Forest Serv., U. S. Dept. Agr., Wash., D. C. 1954.

provide supplemental information. The number of dead looper larvae and other Arthropods found on these trays will be counted daily or once every two days for a period of from one to ten days after the area is sprayed. Periodic counts will be made thereafter until dead organisims no longer appear on the trays. Specimens of the Arthropods other than western hemlock loopers will be collected and preserved for later identification.

REPORTING OF RESULTS

The technical director will prepare a final report summarizing the entomological phases of the project soon after the project is completed.

APPENDIX

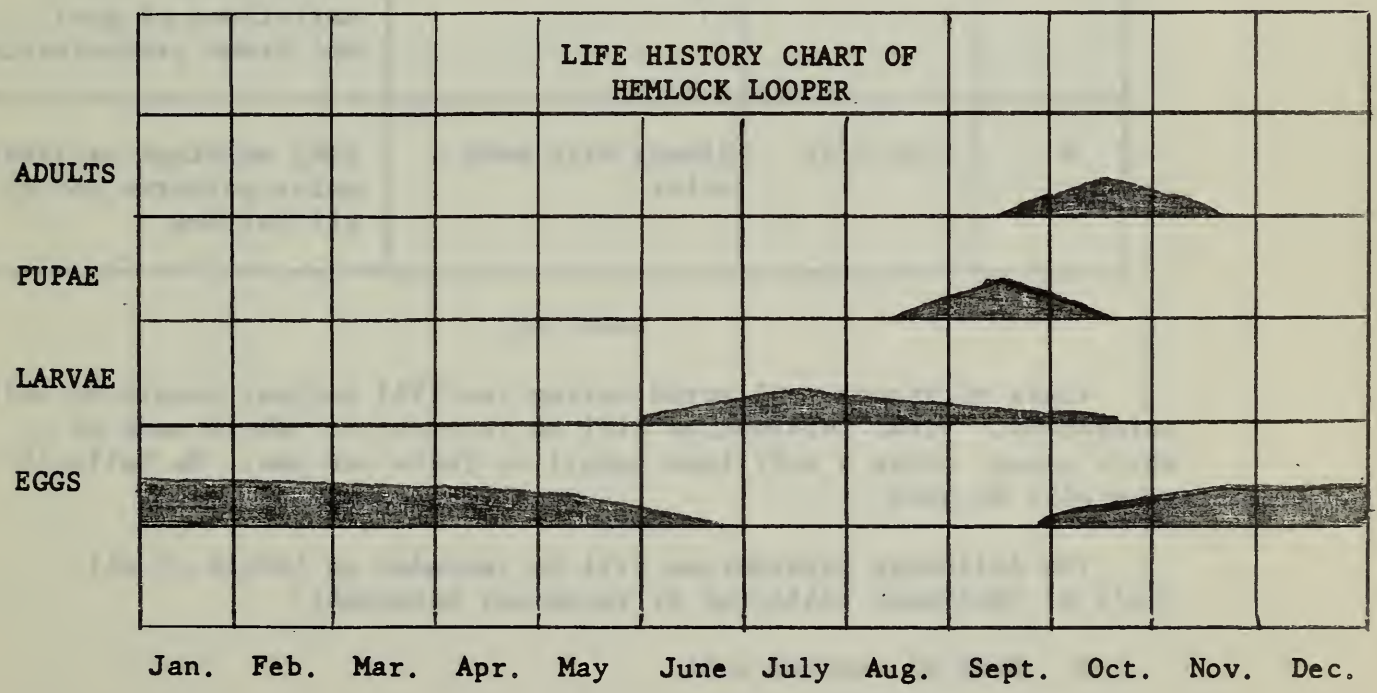
NOTES FOR TECHNICAL PERSONNEL

This section is designed as a working guide for the technical staff during the control project. The biology of the western hemlock looper is summarized, and a guide for labeling specimen collections and the spray unit coding system are included.

Western Hemlock Looper Biology

The western hemlock looper overwinters in the egg stage on moss and in bark crevices in overstory western hemlocks and understory plants. The larvae hatch from the eggs in May and June. These newly hatched larvae, which are about 1/4-inch long, feed on new foliage of western hemlock and other plants. As the larvae mature, they feed on both old and new foliage and in the last instar may clip twigs. Although the larvae begin feeding in May and June, the more noticeable feeding does not occur until the middle of July and continues until the loopers pupate in August and September. Pupation occurs for the most part in cracks and crevices in the bark of standing hamlock. The moths appear in late September and October, mate, and lay eggs on the moss and in bark crevices.

The following chart summarizes Beal's looper life history studies in southwestern Washington. 7/



7/ Beal, J. A. Unpublished progress report - further studies on the hemlock looper in southwestern Washington, U. S. Dept. Agr., Bu. Entomology, Forest Insect Investigations, Portland, Oregon, 42 pp. 1933

The larval characteristics included in the following table was extracted from Beal's 1933 report and will be used as a guide in determining the different larval developmental stages.

Instar	Head Capsule Width (MM)	Color	
		Head	Body
I	.36-.47	Dark brown to black	Alternating dark and light gray bands.
II	.58-.76	Dark	Alternating bands indistinct. Spots begin to appear on dorsal side.
III	.89-1.18	Mottled brown and gray	Bands appear only as dark spots showing mainly on the sides of the larvae.
IV	1.29-1.76	Blends with body color	Body markings less uniform with wide variations of gray and brown predominating
V	1.91-2.56	Blends with body color	Body markings variable; color patterns not at all uniform

Labeling

Vials of insects collected during the 1963 project should be well referenced. Vital information will be recorded on labels made of white paper, using a soft lead pencil or India ink pen. No ballpoint pens will be used.

The following information will be included on labels of all vials of specimens collected by technical personnel:

1. Name of control unit
2. Collection point number
3. Collection data
4. Collector's initials

Coding

The following coding system will be used on insect specimen labels and field and office forms on the 1963 looper control project.

Control unit:	Nemah	- N
	Willapa	- W
	Long Island	- LI
	Bear Ridge	- BR
	Naselle	- N
	Jim Crow Cr.	- JCC
Type of sample:	Collection Point	- CP
	Mortality Plot	- MP
	Random Sample	- RS

Numbering will run consecutively for each type of sample as follows:

NCP-1 - Nemah control unit collection point #1.
BRMP-1 - Bear River control unit mortality plot #1.
JCCRS-1 - Jim Crow Creek control unit random sample #1.

EQUIPMENT FOR TECHNICAL PERSONNEL

Laboratory	Biologist	Assistant biologist	Insect checkers	Total
Alcohol, ethyl (95%)	1 gal.			1 gal.
Binocular microscope	1			1
Brush, camel's hair	2			2
Corks:				
#2	1 gross			1 gross
#10	1 gross			1 gross
Dissecting needles	6	3		12
Extension cords	2			2
File boxes, 3"x5"	2			2
Forceps	2	2		6
Graduate (250 Ml.)	1			1
Insect pins (No. 3)	1 pkg.			1 pkg.
Magnifier, Ring	1			1
Microscope grid	1			1
Microscope lamp	1			1
Petri dish	1	1		3
Pipettes (eyedroppers)	2			2
Spray deposit index	2			2
Tape, masking (1" width)	1 roll			1 roll
Vials:				
25x95 mm.	1 gross			1 gross
12x75 mm.	1 gross	1 gross		2 gross
Vial racks:				
25x95 mm.	2	1		3
12x75 mm.	2			2
Wash bottles:				
1 liter	1			1
500 Ml.	1			1
Wash glasses (Syracuse)	2			2
Field				
Altimeter	1			1
Axes	1	1		2
Balloons, Helium-filled	36			36
Binoculars	1			1
Canteen (1 gal.)	1	1		3
Climbing spurs and belt	1 set			1 set
Collecting cloth	1	1	1/crew	7
Compass, pocket	1	1	1/crew	7
Dissecting needles			1/crew	4
First aid kits	1	1		3
Forceps			1/crew	4
Hand lenses	1	1	1/crew	7

EQUIPMENT FOR TECHNICAL PERSONNEL ... (Continued)

Field (Continued)	Biologist	Assistant biologist	Insect checkers	Total
Hard hats	1	1		3
Machetes	1	1	1/crew	7
Muslin	10 yards			10 yards
Paper, filter	1,200			1,200
Paper, black	1,000			1,000
Paper, white	400			400
Pruners, hand	1	1	1/crew	7
Pruners, pole	2		1/crew	6
Spray deposit cards (oil-sensitive)	500			500
Spray paint (pressurized)	12 cans	6 cans	3 cans/ crew	36 cans
Stamp, serial numbering	2			2
Tape (plastic flag)	2 rolls	1 roll	1 roll/ crew	8 rolls
Tatum holder (8" x 10")	1	1	1/crew	7
Thermometers	1	1	1/crew	7
Trays collection	50			50
Tree tags	150			150
Vehicle (Pickup)		1		1
Vehicle (Sedan)	1			1
Wind meters	2	1		4
Supplies				
Control plan	1	1		3
Control unit map	1	1	1/crew	7
Diary forms	75	50		175
Form R6-5240-32				30
Form R6-5240-34				50
Form R6-5240-35				15
Form R6-5240-43				50
Franked envelopes	25			25
Notebook, 3" x 5"	2	2		10
Notebook, 5" x 8"	1	1		3
Office box	1			1
Paper clips	1 box			1 box
Pen, ballpoint	2	2		10
Pencils	3	3	2	27
Purchase order book	1			1
Tablets	2	2	1	14
Tape, Scotch	1 roll	1 roll		3 rolls
Technical direction plan	1	1	1	11
Time report forms	10			10
USGS quadrangle sheets	2 sets			2 sets

WESTERN HEMLOCK LOOPER LARVAL DEVELOPMENT RECORD

CONTROL UNIT_____ SPRAY BLOCK NUMBER_____

SEC._____ T._____N. R._____W. COLLECTION POINT NUMBER_____

BLOCK RELEASED_____ SPRAYING BEGUN_____

Collection date	Larval instars from understory foliage												Larval instars from overstory foliage											
	I		II		III		IV		V		Total		I		II		III		IV		V		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%

R6-5240-32
(Rev. 6/63)

WESTERN HEMLOCK LOOPER MORTALITY RECORD

SPRAY BLOCK ____________ DATE BLOCK RELEASED ______ DATE(S) BLOCK SPRAYED __________

PILOT ______________________________

DATE PLOT COLLECTED BEFORE SPRAYING __________ DATE PLOT COLLECTED AFTER SPRAYING ______

Collection point number	Tree number	Number larvae per 18-inch twig before spraying					Total	Number larvae per 18-inch twig after spraying					Total
		Branch						Branch					
		1	2	3	4	5		1	2	3	4	5	
	1												
	2												
	3												
	4												
	5												
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Form R6-5240-34
(Rev. 6/63)

HEMLOCK LOOPER CONTROL PROJECT

Notification of Release of Spray Blocks

Date: _____

To: _____, Project Director

From: _____, Biologist

The following described spray blocks will be ready for spraying on _____ (day), _____ (date) in the priority listed below:

Priority	Block No.	Total Acres	Remarks
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Total acreage released by this notice: _____ acres

Unless otherwise stated, the lower elevations of each block should be sprayed first if the period of spraying each block exceeds one day.

Approved: _____
Biologist

If this is a verification of a release by earlier communication, such release was given by me on _____ (date) by _____ communication.

1 copy each to: Project Director
U.S. Forest Service (Div. Timber Mgmt.)
Project Biologist

Form R6-5240-35 (5/62)

DAILY ESTIMATE OF SPRAY COVERAGE

Spraying date _____

Spray unit number	Spray block number	Location of spray cards			Number of cards	Spray coverage	
		Sec._____	T._____N.	R._____W.		Satis-factory	Unsatis-factory

Form R6-5240-43
(6/63)