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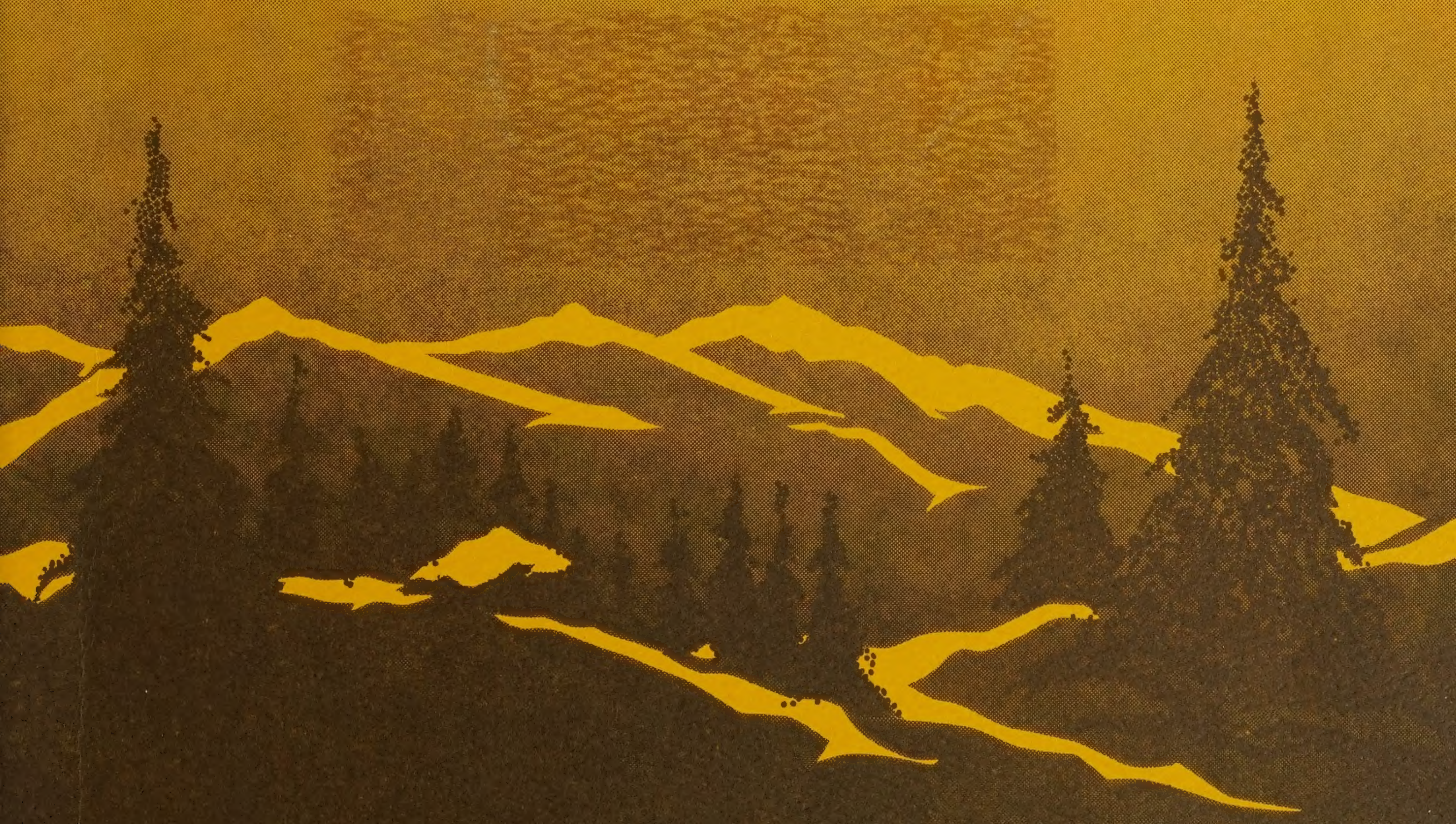
FOREST PEST MANAGEMENT

BIOLOGICAL EVALUATION

R2-86-3

Douglas-fir Tussock Moth,
Orgyia pseudotsugata (McDunnough)
Pike National Forest

1986



United States Department of Agriculture
Forest Service
Forest Pest Management
Denver, Colorado

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TECHNICAL INFORMATION

Insect: Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDunnough)

Hosts: Douglas-fir
true firs
other conifers

Life History: The Douglas-fir tussock moth completes one generation each year.

Stage	Time	Location on Host
Eggs	Overwinter	Laid on the female pupal cocoon in a mass consisting of up to 300 eggs. Found on small branches of host tree.
Small larva	May-June	Hatch just after new foliage has appeared. Feed on new needles.
Large larva	June-July	Feeding on older needles.
Pupa	July-August	Found in a coooon which is usually attached to the foliage and small branches of the host tree. May also be found on objects such as rocks and buildings adjacent to host trees.
Adult moths	August-Sept.	Found on host trees. Female moth has only rudimentary wings and cannot fly. She usually is found in the vicinity of her pupal cocoon.

Evidence of Infestation:

1. Conifers with thin, redish crowns.

2. Damage first appears in the tops of the trees and progresses downward.

3. Seriously damaged trees turn brown as bare twigs are exposed.

4. Continued severe defoilation causes top mortality then total tree mortality.

INTRODUCTION

Historically, the Douglas-fir tussock moth has not been a significant pest in the forests of the Rocky Mountain Region. Virtually all reports of damage by this insect have come from suburban landowners in the Denver, Colorado Springs and Cheyenne areas. Only two outbreaks of tussock moth have been reported in the forested areas in Region Two.

The first outbreak was detected in 1937 on Cheyenne Mountain near Colorado Springs (Higgins, 1938). As a result of this outbreak, all of the Douglas-fir and white fir were killed on 150 to 200 acres. The second outbreak was reported in 1947 in Evergreen, Colorado (Beal, 1948). The extent of the outbreak is not known. However, the area was treated experimentally with DDT.

Detection surveys using pheromone-baited sticky traps were conducted in 1975 and 1976 in the forested areas of the Colorado Front Range (Cahill, 1976). In 1977, the survey was expanded into Wyoming (Eggelston, 1977). Although tussock moths were captured at many of the trapping sites, no areas of tussock moth damage were discovered.

In 1982, several individual ornamental spruce at Evergreen, Conifer and Shaffer's Crossing were defoliated by the tussock moth. These isolated occurrences were adjacent to hundreds of acres of natural stands of Douglas-fir that were not affected by this insect.

During the last three years, however, several small stands of natural Douglas-fir have been severely defoliated by the tussock moth along the Platte River drainage on the Pike National Forest.

The objectives of this evaluation are:

1) To establish permanent monitoring plots for Douglas-fir tussock moth - 50 in 1986 and 150 in 1987 and beyond.

2) To assess population dynamics over a range of elevations and plant associations.

3) To assess the competitive interactions between Douglas-fir tussock moth and western spruce budworm.

4) To monitor changes in predator-parasite populations for both insects in relation to elevation and plant association.

METHODS

Fifty plots were established on the Pike National Forest (Figure 1). On each plot, slope, aspect, elevation, plant association, slope position (Table 1) and basal area (10 baf) by species (Table 2) were measured. Radiation index - the ratio of the total annual potential insolation to the maximum potential insolation at the site - was interpolated from tables (Frank and Lee 1966). Radiation index is a composite of slope, aspect and latitude and, provides a relative measure of solar climate between sites based solely on topography.

Douglas-fir tussock moth pheromone-baited sticky traps were placed on each plot. Five traps were placed at each plot using procedures described by Daterman et al. (1979). Traps were deployed the second week in August and retrieved the last week in October.

RESULTS

Though not significantly different 1/ ($P \leq .05$), more Douglas-fir tussock moth were trapped in 1986 (0.95 ± 0.51) than in 1985 (0.52 ± 0.37). Average catch per plot in 1985 ranged from 0 to $5.\bar{6}$; and, in 1986 ranged from 0 to 8.8. An average of 25 adults per plot is needed to produce visible defoliation in the following year.

In 1986, the average number of tussock moths trapped per plot decreased with increased elevation. This relationship is expressed in the following regression equation:

$$y = 127.51 - 14.11 \ln x \quad ; \; r^2 = .61$$

where: x = plot elevation
y = average number of tussock moth trapped

When the plots are stratified by cover-type and aspect the relationship between elevation and number of tussock moths caught improves, particulary for the south facing Ponderosa pine cover type (Table 3). Twice as many tussock moth were trapped in the ponderosa pine (PIPO) cover-type than the Douglas-fir (PSME) cover-type.

The lodgepole pine (Pico) and blue spruce (Pipu) cover-types were poorly represented.

An additional 100 plots will be established in 1987. These plots will be used to evaluate the hypothesis that Douglas-fir tussock moth population levels are a function of slope, aspect and latitude (radiation index), elevation, position on the slope, plant association and stand density. In addition pheromone trapping will be considered for western spruce budworm. The same hypothesis will be evaluated for budworm and tussock moth. The hypothesis will be evaluated over time as both insects increase from current endemic levels.

Larval populations, as well as predator and prey populations, will be sampled when pheromone trapping indicates a significant change in population levels has occurred.

From this work we expect to provide a stand hazard rating system for both the Douglas-fir tussock moth and the western spruce budworm. In addition we expect to determine, statistically, the relationship between number of adults trapped, larval densities and consequent host tree defoliation.

1/ t - Statistic for two means - Statistical Theory and Methodology in Science and Engineering, K. A. Brownlee, John Wiley and Sons, 1965

Table 1 -- Site Data by Plot, Pike National Forest

Plot #	Slope %	Aspect degree	Radiation Index	Elevation ft	Plant Association
1	28	40	.4088	7360	Pipu/Alte
2	33	358	.3553	7960	Pipo/Aruv
3	42	20	.3347	8160	Psme/Juco
4	10	240	.4950	8580	Pico/Aruv
5	30	275	.4783	8200	Pipo/Aruv
6	0	0	.4826	7920	Psme/Aruv-Juco
7	0	0	.4826	8300	Psme/Cemo
8	33	326	.3520	6600	Pipo/Caro
9	40	275	.4751	8000	Psme/Jaam
10	18	40	.4357	7640	Psme/Aruv-Juco
11	10	30	.4491	7660	Pipo/Aruv
12	28	308	.4088	7680	Psme/Aruv-Juco
13	45	340	.3247	6220	Psme/Cemo
14	35	350	.3475	7680	Psme/Aruv-Juco
15	65	230	.5654	6580	Pipo/Ansc-Agsm
16	48	310	.3583	6320	Pipo/Aruv
17	50	300	.4123	6520	Pipo/Aruv
18	35	330	.3591	6920	Psme/Aruv-Juco
19	33	10	.3553	7200	Psme/Juco
20	15	225	.5153	8520	Pipo/Aruv
21	15	300	.4612	7880	Psme/Aruv-Juco
22	0	0	.4826	8060	Psme/Aruv-Juco
23	23	332	.3878	7640	Psme/Aruv-Juco
24	50	50	.3535	8240	Psme/Aruv-Juco
25	15	15	.4312	8440	Psme/Aruv-Juco
26	23	230	.5297	8800	Psme/Aruv-Juco
27	16	180	.5311	8840	Pico/Aruv
28	36	230	.5474	8720	Psme/Aruv-Juco
29	25	340	.3951	7940	Psme/Aruv-Juco
30	30	70	.4397	9100	Pico/Vase
31	34	215	.5451	8080	Psme/Cemo
32	17	40	.4383	7940	Psme/Aruv-Juco
33	15	360	.4267	8760	Psme/Aruv-Juco
34	28	260	.4788	6600	Pipo/Cemo
35	10	295	.4688	8480	Pipo/Aruv
36	17	8	.4189	7720	Psme/Aruv-Juco
37	10	92	.4821	8180	Pipo/Aruv
38	15	120	.5002	8580	Pipo/Aruv
39	0	0	.4826	9180	Psme/Aruv-Juco
40	15	60	.4612	7600	Psme/Caro
41	0	0	.4826	8200	Pipo/Aruv
42	17	145	.5192	7080	Pipo/Aruv
43	28	286	.4426	7640	Psme/Caro
44	30	40	.3775	8240	Psme/Aruv-Juco
45	30	65	.4397	8580	Pipo/Aruv

Plot #	Slope %	Aspect degree	Radiation Index	Elevation ft	Plant Association
46	20	20	.4133	8480	Psme/Aruv-Juco
47	18	6	.4150	9100	Pipo/Aruv
48	20	20	.4133	8960	Pipo/Aruv
49	18	345	.4150	6920	Psme/Aruv-Juco
50	7	360	.4563	7960	Psme/Aruv-Juco

Table 2 - Basal Area and Trees Per Acre by Species for each Plot, Pike & San Isabel National Forest

Plot	Jusc		Pipo		Pico		Psme		Potr		Pipu	
#	BA	T/A	BA	T/A	BA	T/A	BA	T/A	BA	T/A	BA	T/A
1			40	40.3			30	469.4			50	292.8
2			100	508.4			40	112.9	10	50.9		
3							110	443.4	30	432.9		
4					30	31.3	10	8.1				
5			70	91.3			40	46.6				
6							70	45.4				
7							30	148.1				
8			50	176.7			30	103.4				
9			20	39.4			90	203.2				
10							20	30.2				
11			70	141.9			40	226.1				
12	10	37.4	30	63.9			100	236.9				
13							70	94.0				
14			10	10.8			60	167.3				
15			10	3.5			30	94.7				
16			50	77.7								
17			90	211.9			30	44.7				
18			50	115.4			50	105.0				
19			70	234.8			80	180.7				
20			30	85.6								
21			30	89.9			60	123.2				
22			10	73.3			30	20.2				
23			20	50.1			130	594.6	10	28.6		
24			20	66.0			40	73.9				
25			30	30.7			40	61.7	20	146.6		
26			10	5.7			30	130.4				
27			20[1]	31.0	50	76.3	10	6.3				
			10	203.7								
28			50	120.7			60	368.7				
29							80	194.5	10	37.4	20	48.2
30					110	292.4	10	10.8	10	73.3	10	12.7
31			30	30.4			50	41.9				
32							80	188.6				
33			10	15.1			50	118.1				
34			100	218.4			30	72.3				
35			40	307.1			20	9.9				
36	10	28.6					40	134.2				
37			60	95.7			30	263.7				
38			100	119.7			60	83.0				
39			20	51.2			80	187.2				
40							120	307.7				
41			50	270.1	10	15.1	10	7.2				
42			60	72.0			20	187.9				
43			10	12.7			30	29.2				
44					30	149.5	30	52.4	30	269.7		

Plot #	Jusc BA	Jusc T/A	Pipo BA	Pipo T/A	Pico BA	Pico T/A	Psme BA	Psme T/A	Potr BA	Potr T/A	Pipu BA	Pipu T/A
45			60	115.6			30	35.6				
46			30	21.0			80	109.8			20	27.7
47			60	614.3			40	115.5			20	46.9
48			80	124.8			20	52.5	10	203.7		
49			10	37.4			20	29.1				
50							50	79.2				

Jusc - Juniperus scopulorum Sarg. - Rocky Mountain Juniper
Pipo - Pinus ponderosa Laws. - Ponderosa pine
Pico - Pinus contorta Dougl. - Lodgepole pine
Psme - Pseudotsuga menziessii Franco - Douglas-fir
Potr - Populus tremuloides Michx. - Quaking Aspen
Pipu - Picea pungens Engelm. - Colorado Blue Spruce

1/ Limb Pine Pifl

Table 3 - Relationship between elevation and number of Douglas-fir tussock moth trapped by cover-type and aspect

Cover Type	Aspect	Ave. No. of Tussock moth trapped	No. of Plots	r^2	Regression Equation
		$\bar{y} \pm s\bar{y}$			
Pipo	South	1.43 ± .69	6	0.87	y = 113.96 - 12.60ln x
	North	1.56 ± .87	11	0.63	y = 159.17 - 17.58ln x
		1.52 ± .60			
Psme	South	Ø	3		
	North	0.82 ± .27	26	0.64	y = 126.93 - 14.06ln x
		0.73 ± .25			
Pico	South	Ø	2		
	North	Ø	1		
Pipu	South	Ø	Ø		
	North	0.6	1		

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