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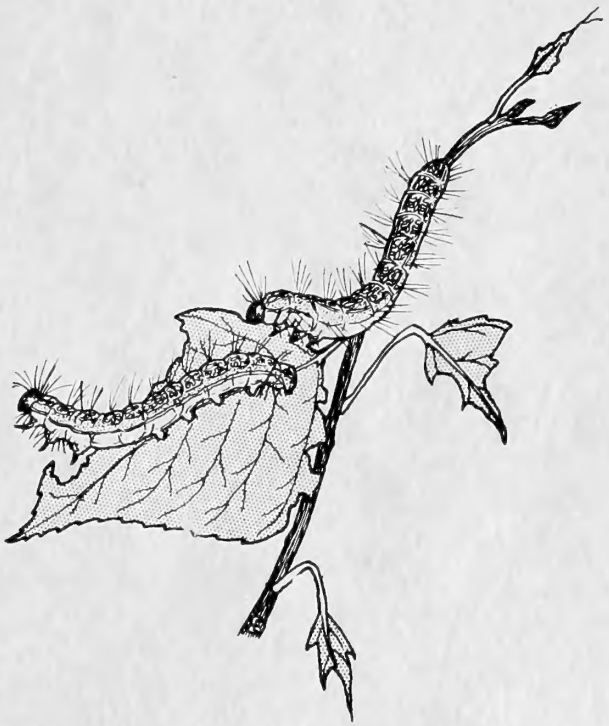
FOREST INSECT CONDITIONS IN THE CENTRAL ROCKY MOUNTAINS 1958

by

A. E. Landgraf



ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION
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FOREST SERVICE U. S. DEPARTMENT OF AGRICULTURE

FOREST INSECT CONDITIONS IN THE CENTRAL ROCKY MOUNTAINS

by

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The station maintains central headquarters at Fort Collins, Colorado, in cooperation with Colorado State University. The author is assigned to the station's Forest Insect and Disease Laboratory at Fort Collins.

SUMMARY

This report presents the status of forest insect infestations in Colorado, Wyoming, South Dakota, Nebraska, and Kansas as determined by the 1958 aerial and ground surveys.

Losses caused by forest insects have increased since 1957; infestations during 1958 totaled 851,570 acres as compared with 487,570 acres the year before. Current bark beetle losses exceed 20.6 million board-feet; in 1957 losses were nearly 17.2 million. The Engelmann spruce beetle has become epidemic in several sale areas. Black Hills beetle activity became greater and beetle populations nearly quadrupled. Damage by spruce budworm was more extensive than in 1957; three new areas of infestation were found. The Great Basin tent caterpillar is still epidemic in southern Colorado; several hundred acres of aspen are dead as the result of 9 years of defoliation.

The annual regionwide aerial survey required 205.5 hours of flying time. Both contour and gridiron patterns of coverage were used to cover 27 million acres of Federal, State, and private forest lands. The mountainous terrain in the central Rockies required about 70 percent of the survey to be made by contour flying. Methods for evaluating forest insect damage were described in the 1957 report.[1]

Twenty-one infestations were reported by cooperators; all were inspected. Seven infestations of epidemic proportions were appraised on the ground. Chemical control was advised for each one.

An operational survey crew from Region 2, U. S. Forest Service, surveyed 9 areas of infestation. This crew worked closely with personnel of the Rocky Mountain Forest and Range Experiment Station in training, programing, and completing operations.

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[1] Landgraf, A. E., and Ostmark, H. E. Forest insect conditions in the central Rocky Mountains, 1957. U. S. Forest Serv. Rocky Mountain Forest and Range Expt. Sta. Sta. Paper 34, 20 pp. May 1958.

Sixteen bark beetle control projects were carried out during the year. Station personnel provided technical assistance to the land managers on six of the major operations. A Great Basin tent caterpillar control project in southern Colorado was carried out cooperatively by the State of Colorado, Huerfano County, the towns of Walsenburg, LaVeta, and Cucharas Camps, and the U. S. Forest Service.

ENGELMANN SPRUCE BEETLE
(Dendroctonus engelmanni Hopk.)

The Engelmann spruce beetle is epidemic in several spruce stands in Colorado. All the infestations are within or adjacent to timber sales. Cull material and scattered blowdowns at the edges of leave strips provided the beetle with ideal host material. Snow protected the overwintering beetle broods from low temperatures and predation by woodpeckers, enabling large populations to survive and develop.

A 10-percent appraisal survey on 659 acres of spruce in leave strips adjacent to logged areas on Missionary Ridge, San Juan National Forest, revealed an estimated 7,970 Engelmann spruce trees infested in 1957-58. Large beetle populations were found in cull material attacked during 1957. Several thousand of the cull logs were treated with ethylene dibromide emulsion during 1958 (table 1). Leave strips with more than five infested trees per acre are being clear cut and logged; strips having fewer than 5 infested trees should be treated with insecticide in 1959.

Epidemic populations of spruce beetles were found in cull logs in timber sales on the Alder, Conejos, Creede, and Del Norte Districts of the Rio Grande National Forest. During 1958 several thousand cull logs were treated with ethylene dibromide. In addition, 812 trap trees were felled and will be salvaged or chemically treated after the 1959 beetle flight. Several thousand cull logs are scheduled for treatment in 1959.

Similar conditions exist in cull logs and standing trees on the Norwood District of the Grand Mesa-Uncompahgre National Forest. Inspections in timber sales in the Lone Cone area revealed epidemic spruce beetle populations in the cull. In Goat Creek, 300 trees infested in 1958 were found. These are being logged or chemically treated; 120 trees have already been treated. Chemical treatment has been recommended for several thousand cull logs in 1959.

Table 1. --Engelmann spruce beetle control accomplishments for 1958 and proposed projects for 1959

National forest	Accomplished 1958		Proposed 1959	
	Trees[1]	Cost	Trees[1]	Cost
	No.	Dollars	No.	Dollars
Grand Mesa-Uncompahgre	120	2,898	Culls	21,400
Gunnison	500 culls	100	Culls	650
Rio Grande	31,192 culls	25,600	Culls	36,972
Roosevelt	--	--	Culls	130
San Juan	4,670 culls	10,686	1,427	11,185
White River	23	120	--	--
Total	--	39,404	--	70,337

[1] The word "trees" has little meaning, since much of the control treating involves cull material (logs as well as trees).

Five hundred cull logs were treated with ethylene dibromide on the Black Mesa of the Gunnison National Forest. To complete this control program, additional cull logs in the logged areas will be treated during 1959.

The Illinois River infestation on the Routt National Forest was reappraised in August 1958. A 10-percent survey of 319 acres of spruce surrounding the old sale areas disclosed 230 trees infested in 1958; 800 trees were found during a similar survey in 1957. All the trees infested in 1957 were heavily worked by woodpeckers. The infestation is a study area for biological and chemical research. Consequently, no control is recommended.

Spruce beetle populations are at endemic levels in blowdown areas on the Minturn and Eagle Districts of the White River National Forest. Seventy-five bark samples, 1 foot square, were examined on 3 plots. Few egg galleries or live brood (table 2) were found.

Table 2. --Engelmann spruce beetle populations in windthrown Engelmann spruce, White River National Forest, 1958

Plot	Sample trees	Egg galleries	Live insects, all stages
	Number[1]	Average number per sq. ft.	
West Grouse Creek	25	0.04	0.80
Beaver Creek	25	0	0
East Lake Creek	25	.48	8.04

[1] Square-foot bark samples per tree.

Tornadic winds on September 13, 1957, blew down 19 patches of spruce varying in size from 10 to 200 acres. Because of peculiarities in the storm, the scattered blowdown was light.

BLACK HILLS BEETLE
(Dendroctonus ponderosae Hopk.)

Ponderosa pine mortality due to the Black Hills beetle is estimated at 4 million board-feet; area of infestation is 77, 290 acres (table 3).

An overall increase in Black Hills beetle populations occurred during 1958. Population sampling in Colorado and Wyoming show this increase to be about 4 to 1. During the annual aerial survey in 1958, twice as many single groups of "faders" were recorded as in 1957. This increase began before 1958. It was observed particularly in the ponderosa pine type east of the Continental Divide.

During 1958, seven national forests and four State and private land-managing agencies carried out successful control programs; 7, 337 ponderosa pines were treated with an emulsion of ethylene dibromide (table 4).

Table 3. --Summary of Black Hills beetle infestations by forests and other units (1958 aerial survey)

Forest[1]	Intensity of infestation				
	Light	Moderate	Heavy	Very heavy	Total
	Acres				
Arapaho	440	0	0	0	440
Black Forest	490	0	0	0	490
Denver Mountain Parks	130	0	0	10	140
Grand Mesa-Uncompahgre	5,910	2,690	50	0	8,650
Gunnison	100	0	0	0	100
Pike	2,640	590	0	0	3,230
Rio Grande	260	0	0	0	260
Roosevelt	8,270	560	0	0	8,830
San Isabel	11,110	0	0	0	11,110
San Juan	7,320	180	0	0	7,500
White River	0	10	0	0	10
Bighorn	510	720	0	0	1,230
Medicine Bow	200	0	0	0	200
Black Hills	32,910	1,010	1,180	0	35,100
Total	70,290	5,760	1,230	10	77,290

[1] Includes State and private lands adjacent to national forests.

In the Black Hills of South Dakota, the Black Hills beetle is at an epidemic level, especially on the Bear Mountain District of the Black Hills National Forest. During the 1958 control program, 4,085 trees were chemically treated. The operational survey crew subsequently found additional areas requiring treatment. Scheduled for control in 1959 are 7,010 trees, mostly on the Bear Mountain District.

A control project on the Bailey District, Pike National Forest, was carried out successfully; 1,283 infested ponderosa pines were treated. A small control project in 1959 probably will be needed to mop up the outbreak. Funds to treat 400 trees have been requested.

Table 4. --Black Hills beetle summary of control accomplishments for 1958 and proposed projects for 1959

National forest	Accomplished 1958		Proposed 1959	
	Trees	Cost	Trees	Cost
	No.	Dollars	No.	Dollars
Bighorn	107	709	--	--
Black Hills	4,085	17,320	7,010	36,600
Grand Mesa-Uncompahgre	157	3,403	--	--
Pike	1,283	6,178	400	2,040
Roosevelt	583	1,866	--	--
San Isabel	574	7,947	20	250
San Juan	63	474	250	1,500
Total	6,852	37,897	7,680	40,390
State and private	485	--	--	--

A maintenance control project on the Boulder District of the Roosevelt National Forest was continued. The crews treated 583 infested ponderosa pines around Gross Reservoir and along highways where esthetic values of the trees are high. To augment this control project the Colorado State Forest Service treated 30 infested trees in the Eldorado Springs area east of Gross Reservoir.

The San Isabel National Forest treated 574 infested trees during 1958. The trees were in scattered groups throughout the ponderosa pine type on the Spanish Peaks District. Funds to treat an estimated 20 trees in 1959 have been requested.

During mop-up control operations in Naturita Canyon on the Grand Mesa-Uncompahgre National Forest, 157 infested ponderosa pines were treated. The trees were felled and an oil solution of orthodichlorobenzene was applied to the bark. In 1957, a total of 1,121 infested trees had been felled and treated with "ortho." No need for control is anticipated for next year.

The Bighorn National Forest conducted a maintenance control program on the Buffalo and Goose Districts. Forest crews treated 107 infested pines. No control is planned for 1959.

A small project on the Animas District of the San Juan National Forest was carried out; 63 trees were treated by felling and applying ethylene dibromide. Funds to treat an additional 250 trees have been requested for the 1959 field season.

The Colorado State Forest Service treated 95 trees on Lookout Mountain west of Golden, Colorado. These trees were near home sites and at points of high public use.

During its annual maintenance control operations, the Mountain Parks Association treated 360 infested ponderosa pine near Evergreen, Colorado. These trees were around homes or along roads.

MOUNTAIN PINE BEETLE
(Dendroctonus monticolae Hopk.)

The mountain pine beetle continues to be epidemic in some areas on the Shoshone National Forest (table 5). The infestations cover 21,510 acres of lodgepole pine and limber pine. Losses are estimated at 4.6 million board-feet.

Table 5.--Summary of acres and intensity of mountain pine beetle infestations on the Shoshone National Forest (1958 aerial survey)

Forest[1]	Intensity of infestation				
	Light	Moderate	Heavy	Very heavy	Total
	Acres				
Shoshone	15,940	3,530	1,790	250	21,510

[1] Includes State, private, and other Federal lands within or adjacent to boundaries.

An appraisal survey on Wiggins Fork, Wind River District, reveals an estimated 9,700 infested trees on 3,850 acres of

lodgepole pine type. This is an increase of 2,200 trees over the 1957 findings. The infestation extends into the Stratified Wilderness Area. Control by combinations of salvage logging and chemical treatment has been recommended for 1959.

Another epidemic area on the Wind River District is on the West Fork of Long Creek. A 100-percent survey was made; 600 lodgepole pines infested in 1958 were found. The area is recommended for control in 1959.

Operational surveys were made in the drainages of the North and South Forks of the Shoshone River (Wapiti District). Mountain pine beetle populations were found to be at endemic levels in lodgepole and limber pine stands. During 1957, crews treated 4,417 trees with ethylene dibromide. Only mop-up control will be necessary in 1959.

Table 6. --Mountain pine beetle control accomplishments in 1958 and proposed estimates for the 1959 projects

National forest	Accomplished 1958		Proposed 1959	
	Trees	Cost	Trees	Cost
	No.	Dollars	No.	Dollars
Shoshone	4,532	22,904	[1] 11,000	[1] 57,000

[1] This includes the Wiggins Fork project for which approval has not yet been given.

DOUGLAS-FIR BEETLE
(Dendroctonus pseudotsugae Hopk.)

This bark beetle is one of the most destructive forest insects in the central Rocky Mountains. Infestations in Douglas-fir total 41,330 acres in Colorado and Wyoming (table 7). Annual losses are estimated at 4.8 million board-feet. Tree mortality increased on the San Juan, Grand Mesa-Uncompahgre, San Isabel, Pike, Roosevelt, and Gunnison national forests and the Sangre de Cristo Grant.

Table 7. --Summary of Douglas-fir beetle infestations by forests and other units (1958 aerial survey)

Forest	Intensity of infestation				
	Light	Moderate	Heavy	Very heavy	Total
	Acres				
Denver Mountain Parks	20	0	0	0	20
Grand Mesa-Uncompahgre	6,450	2,870	180	0	9,500
Gunnison	1,740	590	80	0	2,410
Pike	1,360	150	50	0	1,560
Rio Grande	3,230	1,100	0	0	4,330
Roosevelt	460	100	0	0	560
Sangre de Cristo Grant	640	2,070	0	0	2,710
San Isabel	3,870	1,640	0	0	5,510
San Juan	8,930	4,380	410	0	13,720
White River	0	200	150	0	350
Medicine Bow	50	0	50	0	100
Shoshone	340	160	60	0	560
Total	27,090	13,260	980	0	41,330

Douglas-fir beetle infestations total 13,720 acres on the San Juan National Forest. There are heavy infestations in the East Fork Drainage and the Blanco Basin areas of the Pagosa District. Infestations have become epidemic in Sand and Cold Creek drainages and on Devil Mountain of the Piedra District. On the Pine District, the drainages around Vallecito Reservoir are heavily infested.

On the Grand Mesa-Uncompahgre National Forest, Douglas-fir grows mostly in drainages and on inaccessible slopes. The Douglas-fir beetle has been active for a number of years, as is evident by the old kill. In general, infestations are of lighter intensity than in 1957 but more widespread. A moderate infestation in the San Miguel Canyon west of Placerville, Colorado, is still increasing.

Infestations on the Rio Grande National Forest are small. A decline in beetle activity has been due to a depletion of host trees within the infested areas.

Losses of Douglas-fir have been heavy in the Powder Horn area northwest of Lake City, Colorado. In many of the drainages all the mature and overmature Douglas-fir has been killed. Current infestations are in drainages of all forks of Powder Horn Creek.

A control project in 1957 in the Ute Pass area of the Pike National Forest was successfully carried out against the Douglas-fir beetle. Only small scattered groups of "faders" were found during the 1958 aerial survey.

The Colorado State Forest Service in cooperation with the Mountain Parks Association treated 41 infested Douglas-firs around summer home sites near Foxton, Colorado. Trees were treated with ethylene dibromide. This was the only Douglas-fir beetle control project in 1958.

WESTERN BALSAM BARK BEETLE

(Dryocoetes confusus Sw.)

and

FIR ENGRAVER

(Scolytus ventralis Lec.)

These two bark beetles are present throughout the range of subalpine fir in Colorado and Wyoming. Until the advent of the aerial-survey program in the central Rockies, it was generally believed that the beetles existed in an endemic state. This is not the case. Aerial surveys during 1958 revealed 98,300 acres of infested subalpine fir. Volume losses are estimated at 6.6 million board-feet. Because of the low commercial value and the inaccessibility of subalpine fir, these losses currently are considered of little importance.

Epidemic infestations occur on the Grand Mesa-Uncompahgre, Rio Grande, San Juan, White River, Medicine Bow, and Arapaho National Forests (table 8). The only infestations showing a decline are in the Flat Top area, White River National Forest. Nearly all the subalpine fir in this area has been killed by past epidemics.

Table 8. --Summary of fir engraver infestations by forests and other units (1958 aerial survey)

Forest	Intensity of infestation				
	Light	Moderate	Heavy	Very heavy	Total
			Acres		
Arapaho	2,020	1,580	1,130	770	5,500
Grand Mesa-Uncompahgre	15,200	7,500	330	0	23,030
Gunnison	3,130	2,300	20	0	5,450
Pike	770	640	0	0	1,410
Rio Grande	3,890	10,550	0	0	14,440
Rocky Mountain National Park	3,710	230	0	0	3,940
Roosevelt	2,000	150	0	0	2,150
Routt	2,430	300	50	0	2,780
San Isabel	1,430	740	0	0	2,170
San Juan	9,960	3,400	100	0	13,460
White River	5,780	4,840	950	80	11,650
Bighorn	2,070	460	0	0	2,530
Medicine Bow	3,360	3,510	1,440	0	8,310
Seminole Mountains	50	100	50	0	200
Shoshone	1,030	250	0	0	1,280
Total	56,830	36,550	4,070	850	98,300

SPRUCE BUDWORM
(Choristoneura fumiferana (Clem.))

Light to heavy spruce budworm defoliation occurs on 172,210 acres of Douglas-fir in Colorado (table 9). This is a marked increase over the 1957 damage. Incipient outbreaks were detected on the Pike and Rio Grande National Forests and the Sangre de Cristo Grant. Other infestations on the Rio Grande and San Juan National Forests increased in size and intensity.

Table 9. --Summary of spruce budworm infestations by forests and other units (1956, 1957, and 1958 aerial surveys)

Forest and year	Intensity of infestation				
	Light	Moderate	Heavy	Very heavy	Total
			Acres		
Pike					
1958	11,900	150	0	0	12,050
Rio Grande					
1956	16,180	15,160	2,870	0	34,210
1957	23,430	5,610	890	0	29,930
1958	26,660	28,470	1,640	100	56,870
San Juan					
1956	4,100	1,130	0	0	5,230
1957	59,570	0	0	0	59,570
1958	49,770	29,030	790	0	79,590
Sangre de Cristo Grant					
1958	7,630	0	0	0	7,630
Tierra Amarilla Grant					
1958	13,180	2,890	0	0	16,070

The spruce budworm outbreak on the Del Norte District, Rio Grande National Forest, has been watched closely since 1954. Results of the aerial survey of this outbreak are shown in table 10. Defoliation increased in 1958; top killing is now evident in the heavily defoliated areas.

Table 10. --A comparison of the 1956, 1957, and 1958 spruce budworm infestations on the Del Norte District, Rio Grande National Forest (aerial surveys)

Year	Intensity of infestation				
	Light	Moderate	Heavy	Very heavy	Total
			Acres		
1956	16,180	15,160	2,870	0	34,210
1957	23,430	5,610	890	0	29,930
1958	22,270	27,880	1,640	100	51,890

GREAT BASIN TENT CATERPILLAR
(Malacosoma fragile (Stretch.))

For the past 9 years this insect has been epidemic in aspen stands in southern Colorado with no signs of decline. In aspen stands on the Rio Grande and San Isabel National Forests, where there has been repeated heavy defoliation, tree mortality is very noticeable; recreational and watershed values are being affected. A natural virus disease of this insect is present within the infested areas; however, its full impact has not materialized.

During 1958 light to heavy defoliation occurred on 130,990 acres of quaking aspen (table 11). An additional 1,180 acres of aspen were classified as dead as a result of repeated defoliation. Scattered trees are also dying.

Table 11. --Summary of Great Basin tent caterpillar infestations (1958 aerial survey)

Area	Intensity of infestation				Dead aspen
	Light	Moderate	Heavy	Total	
			Acres		
Rio Grande National Forest[1]	6,320	6,140	32,440	44,900	590
San Isabel National Forest[1]	10,730	15,850	510	27,090	590
San Juan National Forest[1]	2,380	3,810	11,670	17,860	--
Sangre de Cristo Grant	6,710	17,820	1,840	26,370	--
Colorado Fuel and Iron lands	2,740	10,850	1,180	14,770	--
Total	28,880	54,470	47,640	130,990	1,180

[1] Includes adjacent State and private lands.

The annual survey of fall egg masses revealed a decline in caterpillar populations on the Purgatoire Creek, Whiskey Creek, and North Fork of Culebra Creek drainages. Egg mass counts

from trees in the remaining infested areas changed very little in comparison with last year's count, with the exception of the treated area (table 12). Continued moderate to heavy defoliation is forecast for much of the infested area in 1959.

Table 12. --Summary of egg masses of the Great Basin tent caterpillar 1955-58; relationship of 1957 egg masses per branch to 1958 defoliation,[1] and defoliation forecast for 1959 [2]

Area	New egg masses per main branch				Intensity of infestation	Defoliation forecast
	1955	1956	1957	1958	1958	1959
	Average number					
Cucharas Camps--sprayed with DDT (San Isabel Natl. Forest)	0.8	1.5	0.4	5.0	Heavy	Heavy
Cucharas Camps--sprayed with DDT (Private land)	.5	2.6	.2	.8	Light	Moderate
Cucharas Pass (San Isabel Natl. Forest)	--	5.0	.5	.9	Moderate	Moderate
Purgatoire Creek (San Isabel Natl. Forest)	3.2	2.1	1.2	.5	Moderate	Moderate
Whiskey Creek (Colo. Fuel & Iron lands)	3.4	.9	.5	.4	Moderate	Light
North Fork Culebra Creek (Sangre de Cristo Grant)	3.4	1.4	1.3	.4	Heavy	Light
Culebra Creek (Sangre de Cristo Grant)	--	--	.9	1.5	Heavy	Heavy
Bighorn Area (Rio Grande Natl. Forest)	3.9	3.3	.6	2.6	Moderate	Heavy
Cumbres Pass (Rio Grande Natl. Forest)	--	--	3.6	1.6	Heavy	Heavy
McIntyre Summer Home Group (Rio Grande Natl. Forest)	2.8	2.3	2.6	1.0	Moderate	Heavy
Upper Baldy Mountain (San Juan Natl. Forest)	--	--	--	1.1	Heavy	Heavy
Lower Baldy Mountain (San Juan Natl. Forest)	--	--	--	1.8	Heavy	Heavy

[1] Based on ocular estimate made during aerial appraisal survey.

[2] Based on average number of egg masses per branch in 1958: 0-0.4= light; 0.5-0.9 = moderate, 1.0 and over = heavy or complete defoliation.

The Cucharas Camps area near LaVeta, Colorado, was sprayed in mid-June of 1958. Approximately 1,800 acres of aspen were treated with DDT at the rate of 1 pound in 1 gallon of fuel oil per acre. Control was good but temporary. Moths flew in from adjacent unsprayed infestations, reinfesting the area. Heavy defoliation is forecast for 1959. Plans are already underway to spray the area in 1959 to protect the aspen foliage in this high-use recreational area.

LARGE ASPEN TORTRIX
(Archips conflictana (Wlkr.))

The large aspen tortrix, although widespread, caused less leaf damage than the tent caterpillar. Light to moderate infestations totaling 220,450 acres occurred throughout aspen stands on the Grand Mesa-Uncompahgre, Gunnison, and San Juan National Forests (table 13). Heavy defoliation was confined to small patches.

Table 13. --A comparison of 1956, 1957, and 1958 large aspen tortrix infestations by national forests (aerial surveys)

National Forest[1] and year	Intensity of infestation			
	Light	Moderate	Heavy	Total
	------ Acres -----			
Grand Mesa-Uncompahgre				
1956	19,860	100,860	1,950	122,670
1957	51,280	0	0	51,280
1958	86,860	8,320	80	95,260
Gunnison				
1956	44,130	21,100	0	65,230
1957	25,570	0	0	25,570
1958	113,020	1,770	0	114,790
San Juan				
1956	59,290	18,840	0	78,130
1957	3,250	980	290	4,520
1958	5,200	5,100	100	10,400

[1] Includes State and private lands adjacent to national forests.

Damage by this insect was reported for the first time during the 1956 aerial survey. Since then the infested areas have been delineated annually on the aerial survey work maps. The degree of damage varied tremendously from year to year. The cause of these wide fluctuations is not known.

PINE NEEDLE MINER
(Recuvaria sp.)

The infestations, all in ponderosa pine, total 86,470 acres; all are of light intensity. Two new infestations were found during the 1958 aerial survey, one in the vicinity of Durango on private and San Juan National Forest lands; the other, southwest of Colorado Springs. Examination of needles showed 10 to 20 percent of the 1957 needles had been mined.

The infestation near Rye, Colorado, now covers 16,430 acres of ponderosa pine. Examination of damaged needles shows 20 to 30 percent of the previous year's growth had been mined.

MISCELLANEOUS INSECTS

An unidentified sawfly (Neodiprion sp.) caused heavy defoliation of lodgepole pine on Deer and Goat Islands in Granby Reservoir. This incipient outbreak was reported by the U. S. National Park Service boat patrol. All of the 261 trees on these two islands were sprayed with DDT emulsion. Since the outbreak was not discovered until late, many of the sawflies had pupated before treatment could be applied; it may be necessary to respray the areas in 1959.

The fall webworm, Hyphantria cunea Drury, has damaged trees and shrubs in Cache la Poudre and Rist Canyons west of Fort Collins, Colorado, and in other drainages south to Colorado Springs. Recreational areas are being depleted of shade and esthetic values. The webs constructed by the caterpillars are unsightly; their feeding causes fading and premature falling of leaves.

DDT emulsion sprays applied to the crowns of infested trees and shrubs before the young larvae construct their protective webs provide satisfactory control.

AERIAL SURVEY SUMMARY TABLES

Table 14. --Summary of bark beetle infestations recorded during the 1956, 1957, and 1958 aerial surveys in Colorado, Wyoming, and South Dakota

Insect and year	Intensity of infestation				
	Light	Moderate	Heavy	Very heavy	Total
	Acres				
Fir engraver beetles					
1956	77,510	67,480	9,410	920	155,320
1957	25,240	32,470	6,160	180	64,050
1958	56,830	36,550	4,070	850	98,300
Black Hills beetle					
1956	32,150	12,200	3,530	330	48,210
1957	52,260	4,340	220	90	56,910
1958	70,290	5,760	1,230	10	77,290
Douglas-fir beetle					
1956	15,190	26,110	5,550	510	47,360
1957	9,180	18,730	4,570	380	32,860
1958	27,090	13,260	980	0	41,330
Mountain pine beetle					
1956	18,230	10,250	3,600	0	32,080
1957	5,860	6,660	260	0	12,780
1958	15,940	3,530	1,790	250	21,510
Engelmann spruce beetle					
1956	3,550	1,280	0	0	4,830
1957	1,090	1,010	100	0	2,200
1958	1,600	580	790	50	3,020
Total					
1956	146,630	117,320	22,090	1,760	287,800
1957	93,630	63,210	11,310	650	168,800
1958	171,750	59,680	8,860	1,160	241,450

Table 15. --Summary of defoliator infestations recorded during the 1956, 1957, and 1958 aerial surveys in Colorado, Wyoming, and South Dakota

Insect and year	Intensity of infestation				
	Light	Moderate	Heavy	Very heavy	Total
			Acres		
Spruce budworm					
1956	20,280	16,280	2,870	0	39,430
1957	83,000	5,610	890	0	89,500
1958	109,140	60,540	2,430	100	172,210
Great Basin tent caterpillar					
1956	12,080	42,600	42,600	0	97,280
1957	24,710	38,690	68,910	0	132,310
1958	28,880	54,470	47,640	0	130,990
Large aspen tortrix					
1956	123,280	140,800	1,950	0	266,030
1957	80,100	980	290	0	81,370
1958	205,080	15,190	180	0	220,450
Pine needle miner					
1956	0	0	0	0	0
1957	15,590	0	0	0	15,590
1958	86,470	0	0	0	86,470
Total					
1956	155,640	199,680	47,420	0	402,740
1957	203,400	45,280	70,090	0	318,770
1958	429,570	130,200	50,250	100	610,120

Table 16. --Comparison of losses due to forest insects as recorded during the 1957 and 1958 aerial surveys

Insect	Tree loss		Volume loss	
	1957	1958	1957	1958
	Number		M b.m.	
Engelmann spruce beetle	1,060	[1] 2,340	222.6	[1] 491.4
Black Hills beetle	13,621	20,040	2,724.2	4,008.0
Douglas-fir beetle	20,380	19,410	5,095.0	4,852.5
Mountain pine beetle	21,362	22,860	4,272.4	4,572.0
Fir engraver	34,870	47,440	4,881.8	6,641.6
Total	91,293	112,090	17,196.0	20,565.5

[1] Does not include the 1958 ground-appraisal estimate on Missionary Ridge, San Juan National Forest.