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R. W. COWLIN, DIRECTOR

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PONDEROSA PINE NEEDLE BLIGHT IN EASTERN OREGON DURING 1955 AND 1956

By

John Hunt and T. W. Childs

A survey of ponderosa pine needle blight during 1955 and 1956, principally in eastern Oregon (where the disease is much more abundant than in Washington), provided information on extent of damage and on association of infection with certain environmental factors. Observations were largely confined to localities where the disease was known to be more than ordinarily common, and further bias was caused by restriction of the survey to the immediate vicinity of roads. Results, however, were in fairly close agreement with estimates by local foresters and with information from other sources, and are considered indicative of the blight situation in localities where the disease is severe enough to be causing appreciable damage.

Methods

Estimates during most of 1955 were based on continuous strips that varied from less than a mile to several miles in length, depending on uniformity of both forest type and infection intensity. To increase accuracy of estimates and to permit analysis of effect of various environmental factors, the survey was subsequently based on temporary sample plots. These plots were usually about one acre in area and one-quarter to one mile apart, but varied somewhat in both area and distribution according to adequacy of representation of the different size classes of pine, continuity of ponderosa pine types, and intensity of sampling considered necessary.

On each plot, all of the overstory pines and enough of the understory to furnish an adequate basis were tallied by 4 size classes and 6 infection classes. Forest type, elevation, topography, aspect, density

of forest cover, and percentage of pine in the stand were also recorded. Infection intensity--that is, the average percentage of twigs bearing blighted foliage--was computed for each strip and plot, with equal weight given to overstory (P_3 and P_4) and understory (P_1 and P_2). Infection intensities were approximately equal on the two understory classes and also on the two overstory classes, but the latter two classes were usually only about half as severely infected as the former two. Accordingly, on the small minority of plots where either understory or overstory was inadequately represented, infection intensities were corrected by factors of 1.5 and 0.75, respectively.

Present Status of the Blight

Infection was, in general, no more severe in 1956 than in 1955, although minor local changes were observed. On 54 temporary plots examined in 1955 and again in 1956, the mean difference between the two years in average infection intensity was 0.00 $\pm$ 0.86. The standard deviation of the 54 differences was $\pm$ 6.31. These data are in agreement with those from larger permanent plots, where no significant change in infection intensities has been observed during the past 6 years.

On none of the forests surveyed did the average infection intensity exceed 8 percent (table 1). Tables 2 and 3, however, show that infection intensities were much higher on many of the plots and survey strips. For example, more than 20 percent of the twigs bore blighted foliage on each of 68 plots (9 percent) of the total of 711 plots (table 2), and on about 15 miles (8 percent) of the 186 miles strip-surveyed on the Heppner district (table 3).

Table 1.--Needle blight infection summarized by national forests (including intermingled and adjacent private lands), 1955-1956

National 1/ forest	Basis		Average infection intensity
	strips	plots	
	miles	number	percent
Deschutes	17.1	--	trace
Malheur	135.3	229	5
Ochoco	420.5	--	3
Umatilla	301.4	71	8
Wallowa-Whitman	20.5	411	7
Okanogan	62.0	--	7
Wenatchee	106.1	--	trace
Total	1,062.9	711	

1/ Including intermingled and adjacent private lands

Table 2.--Sample plots ranged by needle blight infection intensities, 1955-1956

Infection intensity class	Number of plots	Percent of total plots
None or trace	150	21
1-10	394	56
11-20	99	14
21-30	41	6
31-40	17	2
41+	10	1
Total	711	100

The distribution of the disease is shown in highly generalized form in figure 1. It must be emphasized that most stands, even within the zone of heaviest infection as shown on this map, are not being seriously damaged. In zones 1 and 2 the total effect of the disease has been negligible. In zone 3 a few merchantable trees have been killed, and weakening of trees is fairly common in occasional infection centers. In zone 4, killing of merchantable trees is fairly common in a few centers of exceptionally severe infection, and many trees have been weakened in several localities. Zones 3 and 4 contain some stands whose overstories have been only slightly affected by the disease but whose understories have been noticeably damaged.

In table 3, the Burns, Drewsey, and Snow Mountain districts are fairly representative of zone 1, Bear Sleds of zone 2, Big Summit and Heppner of zone 3, and Joseph-Imnaha-Snake-Chesnimnus and Bear Valley of zone 4. Some of the earliest and worst centers of the current outbreak occurred on the Big Summit district, but infection intensities here have been materially reduced by salvage logging of weakened trees where the disease was most common.

Table 3.--Ranges of needle blight infection intensities within selected localities, 1955-1956

District and forest	Strip or plot basis	Infection intensity class						Percent
		0	1-10	11-20	21-30	31-40	41+	
		Percent of strip or plot samples						
Burns, Drewsey & Snow Mtn. districts (Malheur & Ochoco N. F.)	155 miles	91	8	1				100
Bear Sleds district (Wallowa-Whitman N. F.)	75 plots	20	70	7	3			100
Big Summit district (Ochoco N. F.)	197 miles	30	54	12	4			100
Heppner district (Umatilla N. F.)	186 miles	32	45	15	8			100
Joseph-Imnaha-Snake-Chesnimnus districts (Wallowa-Whitman N. F.)	83 plots	4	45	29	14	7	1	100
Bear Valley district Deer Creek township T. 16 S., R. 28 E. (Malheur N. F.)	94 plots	14	45	18	10	7	6	100

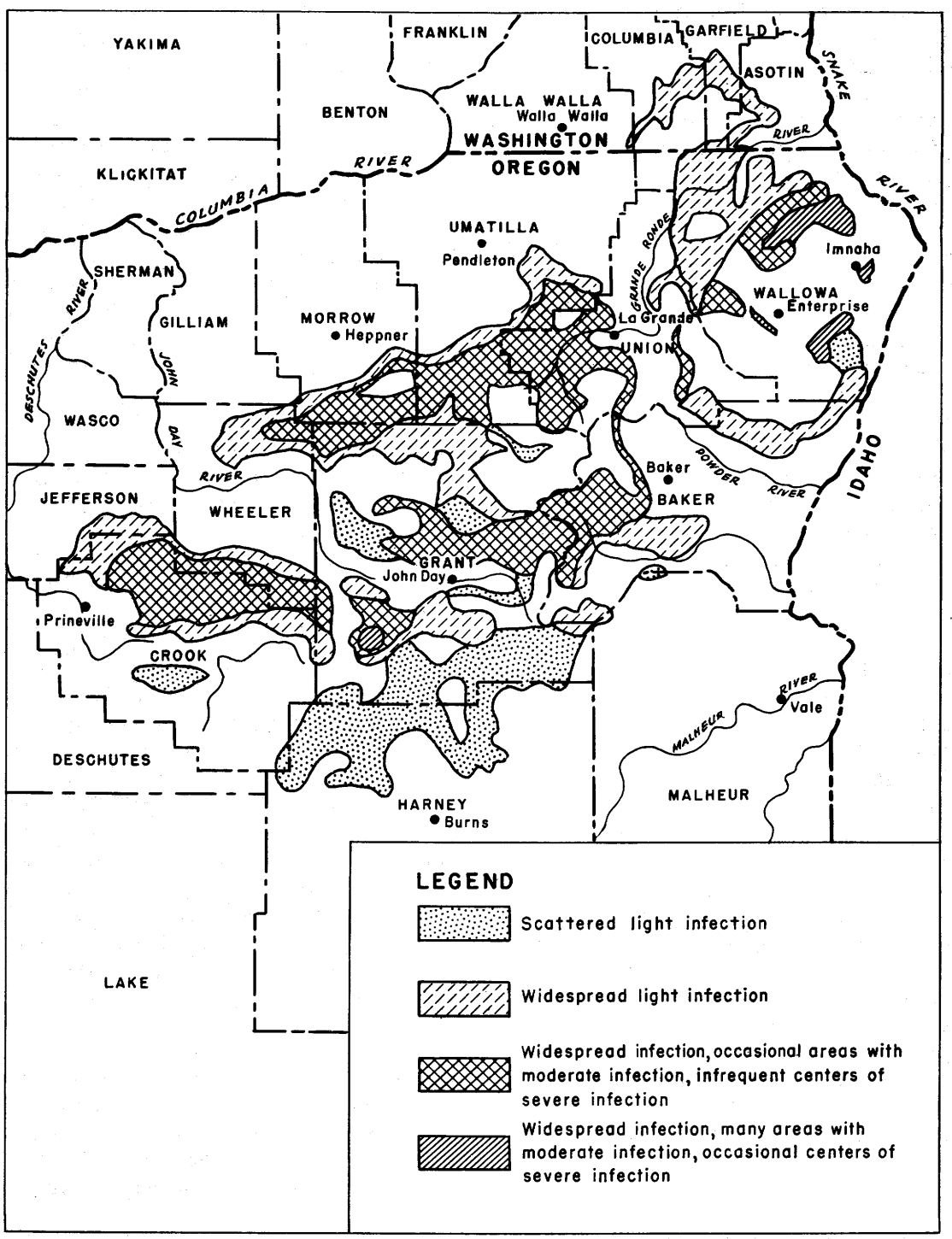

Figure 1.--Distribution of needle blight by infection zones, 1955-1956

Damage in Severely infected Stands

No sharp line can be drawn between negligible and weakening infection, or between weakening and killing, since the effect of the disease depends to some extent on the initial vigor of the host. However, studies [1/] on permanent plots together with general observations of the disease indicate that blight infection on individual overstory trees can be roughly classified according to its probable consequences as follows: less than two-fifths of the twigs affected--little or no injury to the host; two-fifths to four-fifths of the twigs affected--host vigor reduced and risk of subsequent killing by beetles or other enemies increased; more than four-fifths of the twigs affected--hosts likely to be killed quickly and directly by excessive defoliation. Even very severely infected trees may sometimes survive for many years: nevertheless, mature trees with more than half of their crowns blighted are in most instances appreciably damaged by the disease. Young trees appear more able than old ones to endure severe infection.

Infection intensities on plots or roadside survey strips are indirectly indicative of the frequency with which damaging concentrations of infection are present on individual trees. Table 4 shows that damaging infection was present on practically none of the overstory trees on plots with less than 20 percent infection intensity, on 4 percent of the overstory on plots in the 21-40 percent infection intensity class, and on 24 percent of the overstory where the plot infection intensity exceeded 41 percent.

These relationships are not defined precisely enough to justify their use in exact calculations; nevertheless, they provide a basis for rough estimates of total damage by the disease. From table 2 it appears that moderate to severe damage is occurring on slightly less than one-tenth of the area sampled by the plot method, and that within these relatively severely infected stands about 7 percent of the overstory is being injured (4 percent on 58 plots plus 24 percent on 10 plots). At Deer Creek, one of the most heavily infected drainages examined during the survey, damaging infection is present on about 9 percent of the overstory on one-quarter of the area (4 percent of the trees damaged on 17 percent of the plots plus 24 percent damaged on 6 percent of the plots). Survey tallies indicate that about nine-tenths of the damage consists of weakening only, and that direct and rapid killing by the blight is relatively infrequent.

Since the survey included a disproportionately large number of samples from localities where blight was abundant, it may reasonably be concluded that damaging infection is now present on considerably less than one-tenth of the acreage of ponderosa pine types in the Pacific Northwest, and that even in severely infected stands most of the merchantable

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[1/] Childs, T. W. Needle blight of ponderosa pine. Pacific Northwest Forest & Range Expt. Sta. Research Note 114. April 1955. 5 pp., illus.

trees have suffered little or no injury. Although needle blight becomes locally destructive at times, its importance from a region-wide standpoint appears to be only moderate.

Table 4.--Distribution of needle blight infection on individual overstory trees on plots of different infection intensity classes, 1955-1956

Plot infection intensity class	Plot basis	Overstory trees on plots	Individual overstory tree infection class[1/]				
			none	light	moderate	severe	all classes
Percent	Number	Number	Percent of overstory trees				
1-20	493	6487	67	30	3	+	100
21-40	58	700	22	55	19	4	100
41+	10	102	7	27	42	24	100
Total	561	7289	62	32	5	1	100

[1/] light = less than 1/5 of twigs with blighted foliage
moderate = 1/5 to 1/2 " " " " "
severe = more than 1/2 " " " " "

Environmental Factors Associated with the Disease

Since early in the current outbreak, foresters have observed that blight infection tends to be most severe at elevations intermediate in the ponderosa pine types. Figure 2 shows that average infection intensity on the sample plots was greatest at 5100 feet and decreased rapidly with either increase or decrease of elevation from this level. The roadside strip survey yielded a similar although less sharply defined correlation. Extent of variation in infection intensities within elevation classes is indicated in table 5. Free-hand curves also indicated that infection intensity (with or without adjustment for elevation) was greater on plots with overstories of intermediate density than on plots in either denser or sparser stands.

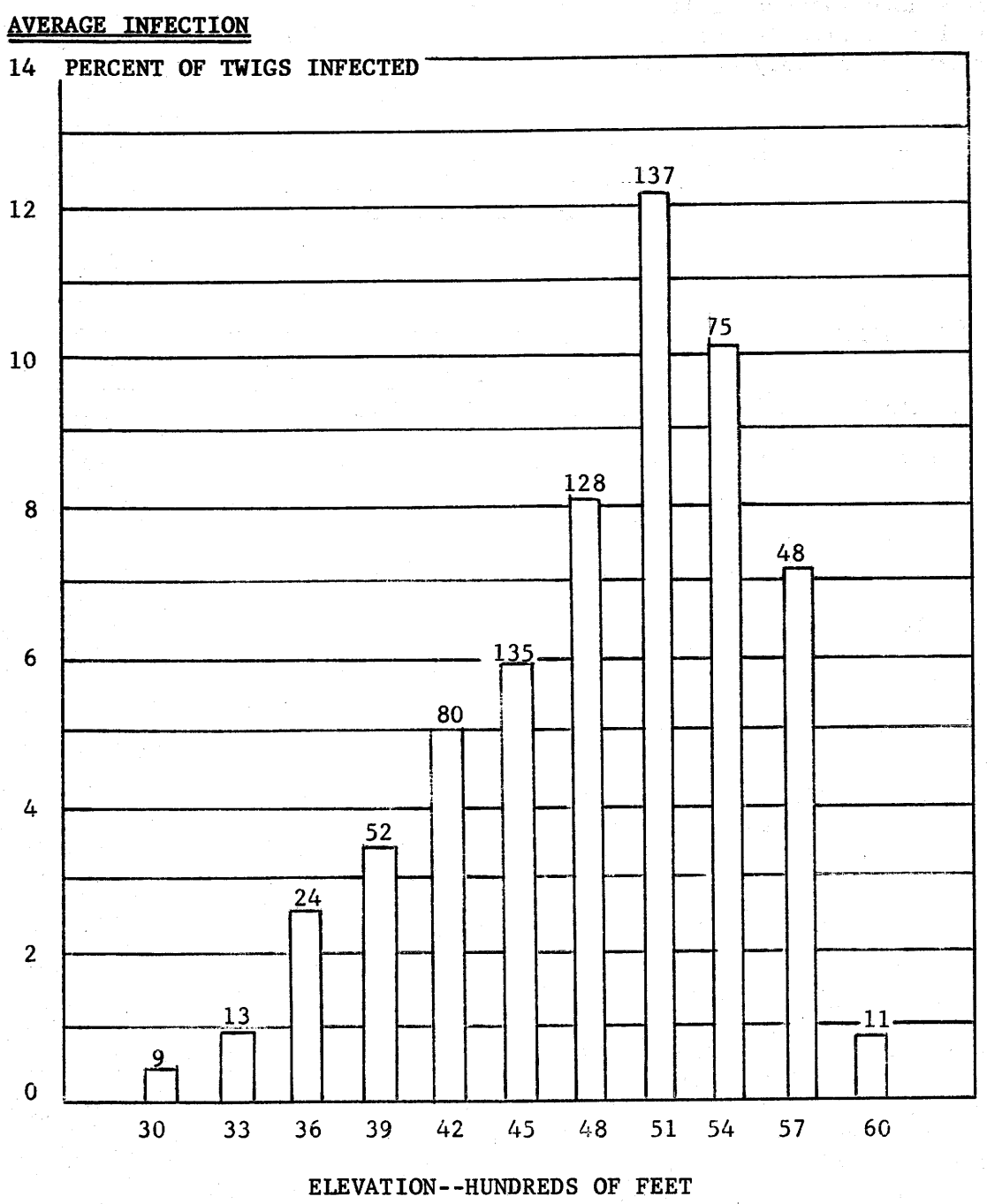

Figure No. 2.--Average infection intensity on sample plots at different elevations. (Numeral at the top of each bar is the number of sample plots used as basis.)

Table 5.--Average needle blight infection intensities on sample plots at different elevations, 1955-1956

Elevation	Plot basis	Infection intensity	
		Average	Standard error
Feet	Number	Percent	Percent
3000	9	0.4	±0.17
3300	13	1.0	± .51
3600	24	2.6	±1.04
3900	52	3.4	± .63
4200	80	5.0	±1.01
4500	135	5.8	± .59
4800	128	8.1	± .93
5100	137	12.2	±1.21
5400	75	10.2	±1.23
5700	48	7.2	±1.29
6000	11	.8	± .27

No statistically significant relationship was found between occurrence of the blight and topography, aspect, or stand composition. Average infection intensities, however, were higher in wide draws and on lower gentle slopes and level areas, especially at the edges of meadows, than they were on steep slopes, upper slopes, and ridges.

It is evident that present information is not adequate for a satisfactory understanding of the effect of environment on the disease.

Summary

A survey of 711 sample plots and 1,063 miles of roadside strip indicates that damaging infection is now present on less than one-tenth of the acreage of ponderosa pine forests in the Pacific Northwest, and that even in severely infected stands most of the merchantable trees are not seriously affected. Infection was most severe at elevations around 5,000 feet and in stands of moderate overstory density. On 54 sample plots examined during both years, average infection intensity was the same in 1956 as in 1955.