



Butt Rot Defect and Potential Hazard in Lodgepole Pine on Selected California Recreational Areas

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ABSTRACT: Within the area sampled, potentially hazardous lodgepole pine were common on recreational sites. The incidence of decayed and mechanically weak trees was correlated with fire damage. Two-thirds of fire-scarred trees were decayed; one-third were rated potentially hazardous. Fire scars occurred roughly in proportion to level of plot recreational use.

In California, lodgepole pine (*Pinus contorta* Dougl.) is usually considered to be a relatively decay-resistant and mechanically sound species. In the past few years, decay in this species has been the object of increasing attention and research--

especially in Canada, where the tree is of primary commercial importance. Until recently, however, no broad study of decay in lodgepole pine had been undertaken in California.

Two major factors have forced an evaluation of losses and hazards to be expected in stands of lodgepole pine and similar species: the growing use of high-altitude recreational areas, and the expanding commercial use of lodgepole pine. The need for such an appraisal is pointed up by the occasional accidents resulting from tree failure on recreational sites and by the high proportion of the lodgepole pine type (30 percent) reserved for recreational use. Consequently, an examination of this problem was undertaken as a joint study by the Forest Disease Research and Forest Recreation Research staffs of the Pacific Southwest Station.

This study of selected plots on the westside Sierra Nevada in California indicates a higher level of defect in lodgepole pine on certain recreational sites than was expected. Such situations may pose a considerable local hazard-control problem. The plots selected for this study are not necessarily representative of the entire area; therefore, no generalizations should be made solely on the basis of these findings.

THE RESOURCE

Lodgepole pine is one of the important tree species on commercial forest land in California. Of the 430,000 acres of productive forest land in lodgepole pine type, more than 80 percent are on public lands.^{1, 2}

¹U.S. Dep. Agr. Forest Serv. Timber trends in the United States. Forest Resource Rep. 17, 235 pp. 1965.

²U.S. Forest Service. Forest statistics for California. Calif. Forest & Range Exp. Sta. Forest Surv. Rel. 25, 63 pp. 1954.

This amount includes 129,000 acres of the type now withdrawn from commercial use, but does not include stands with less than 50 percent lodgepole. The productive reserved areas, which were increased considerably in 1963-64, are almost entirely in recreational use. Well over 90 percent of the lodgepole pine type in California is in old-growth sawtimber--a circumstance which adds to esthetic enjoyment of the species, but results in a larger proportion of defective trees within the type.

This species performs an important function as ground cover on low and medium quality sites, and on sites which would perhaps support no other tree species. As such, these trees help to maintain the snow pack, control runoff, stabilize the soils, and provide food and shelter for wildlife. Lodgepole pine also is valuable to local economies in which mills process it exclusively or along with other species. Its potential economic importance is suggested by the 3.2 billion board feet of live sawtimber volume on commercial forest land in the Sierra Nevada subregions. Finally, these trees are of great value in providing esthetically pleasing vegetation and shelter in prime recreational areas--especially in the higher altitude areas which are being exposed to rapidly increasing use by visitors.

STUDY AREA

Five plots were established on a National Forest on the westside Sierra Nevada as follows:

	<u>Altitude</u> (feet)	<u>Description</u>
Plot:		
1	7,400	Lower creek slopes and bottom. Destined for eventual recreational development. Being logged.
2	7,500	Near ridgetop. Being logged.
3	7,500	Ridgetop. Being logged.
4	9,500	Hunters' camp and picnic area just off ridge. Not an improved campground.
5	8,200	Long-established campground on creek.

Plots 1 and 3 were adjacent to a good packed-dirt road, while plot 2 was next to a poor but passable logging spur. These three plots were in a popular recreational area, but lacked any nearby improvements to encourage overnight stays. Recent recreational use was judged to consist primarily of occasional use by hunters, day-outing groups, and youth organizations.

Plot 5 was largely within a long-established improved campground along a creek. The availability of water at this old stream crossing was undoubtedly responsible for its first being used as a

campsite many years ago. Current use by campers during the summer season ranges from moderately light to full capacity.

Plot 4, a site near a ridgetop, was adjacent to a spur road leading to a popular viewpoint. It lay on the trail to a small lake which is visited by hikers and fishermen. The site lacks any facilities, and is a dry camp. But the fireplaces, artifacts, and trails indicate that the area has served as an established picnic spot and occasional campsite for many years.

PROCEDURE

The study was limited to selected high altitude stands of lodgepole pine in areas subject to heavy recreational use, to those sites planned for campground development, and to areas being cut or which will be cut within 10 years. The data depended primarily on samples and observations of the bole between ground level and 4-1/2 feet. Occasional supplementary observations were made of the upper bole.

Each plot encompassed 100 merchantable trees (over 10 inches diameter breast height) except for plot 2, where it was possible to obtain only 75. To increase the coverage of this area, plot 3 was enlarged to include 150 trees. Plot locations were chosen to provide a range in physiographic features and intensity of recreational use. On a plot, all of the merchantable trees were examined on contiguous strips until the required number of trees had been obtained. All examinations and evaluations were made by the same observer.

For each plot, general slope, exposure, soil type and depth, altitude, and intensity of recreational use were noted. Each tree was examined for the presence of any of 25 features which were considered as potential indicators of decay. Where appropriate, as in the case of wounds, an attempt was made to identify the probable cause of the feature. Wounds and scars were described as to location and size.

On two plots, each tree was sounded with a hand axe as a basis for evaluating the reliability of sounding as a means of detecting decay. After each judgment was made, the tree was sampled with the aid of an increment borer--both to determine whether rot was present and to obtain samples for culturing. Increment cores were taken primarily at 1.5 feet above ground level on the side away from obvious wounds or scars, with additional samples taken as needed. The radial depth inside bark to the first visual indication of decay in the cores was noted. Samples of some decayed cores were then transferred to malt-agar culture tubes. In increment core samples, the point at which rot was encountered was assumed to represent the periphery of a rot column concentric with the tree axis.

On plots where trees were being logged, the freshly cut stems were examined for the presence of rot; diameter measurements of the rot column were taken directly from the cut stump. Other features were tallied in the same manner as for the preceding plots except that axe-sounding was eliminated. Stump and breast height diameters were measured as well as the ages of a representative group of trees.

OBSERVATIONS

One-third of all trees examined had butt rot; one-half of these decayed trees were rated potentially hazardous because of the butt rot. Trees described as decayed are those trees with butt rot; a potentially hazardous tree is defined as a tree with 70 percent or greater loss in total wood diameter inside bark.³ The level of 70-percent loss in wood diameter is assumed to represent the point at which the decayed tree has suffered a significant loss in strength. A hazard exists only when a person or property is exposed to the possibility of failure of such a weakened tree. It should be noted that no studies have been made of failure as related to loss in wood diameter in standing lodgepole pine. Consequently, the term "potentially hazardous" refers to a mechanical condition rather than to a probability of failure.

DECAYED AND POTENTIALLY HAZARDOUS TREES

There was a wide range in the incidence of decayed and of potentially hazardous trees. On the plots examined, the number of potentially hazardous trees was greatest, through every diameter class, on those plots subjected to the highest use (fig. 1). On the most heavily used plot (plot 5), 39 percent of all stems over 10-inch d. b. h. were potentially hazardous. In the 38- to 47-inch diameter class, the proportion of trees rated potentially hazardous varied from 0 to as high as 69 percent--depending upon the plot.

Although the incidence of potentially hazardous trees was high on plot 4, the proportion of trees decayed was actually the lowest, by diameter class (fig. 2). From figure 2, it may be observed that plots 1, 2, and 3 showed an intermediate incidence of butt rot within comparable diameter classes, while plot 5 showed a consistently high proportion of trees with decay. Of all plot trees above 28-inch d. b. h., more than one-half were decayed.

The proportion of decayed trees rated potentially hazardous ranged from 71 percent for the two camp areas to an average of only 15 percent for the other plots (table 1). Thus, over four times the proportion of decayed trees were potentially hazardous on the plots which now receive relatively heavy recreational use. Statistically, all decayed trees of 35-inch d. b. h. or more were potentially hazardous (fig. 3). This diameter corresponds to an age of about 200+ years for plot trees.

ASSOCIATION OF DECAY AND POTENTIAL HAZARD WITH FIRE SCARS

Within the area sampled, fire scars were the most common abnormality associated with decayed and potentially hazardous trees. Of 131 trees with fire scars, two-thirds were decayed and one-half of these were potentially hazardous. A direct relationship was apparent between

³Wagener, Willis W. Judging hazard from native trees in California recreational areas--a guide for professional foresters. U.S. Forest Serv. Res. Paper PSW-P1. Pacific SW. Forest & Range Exp. Sta., Berkeley, Calif. 29 pp., illus. 1963.

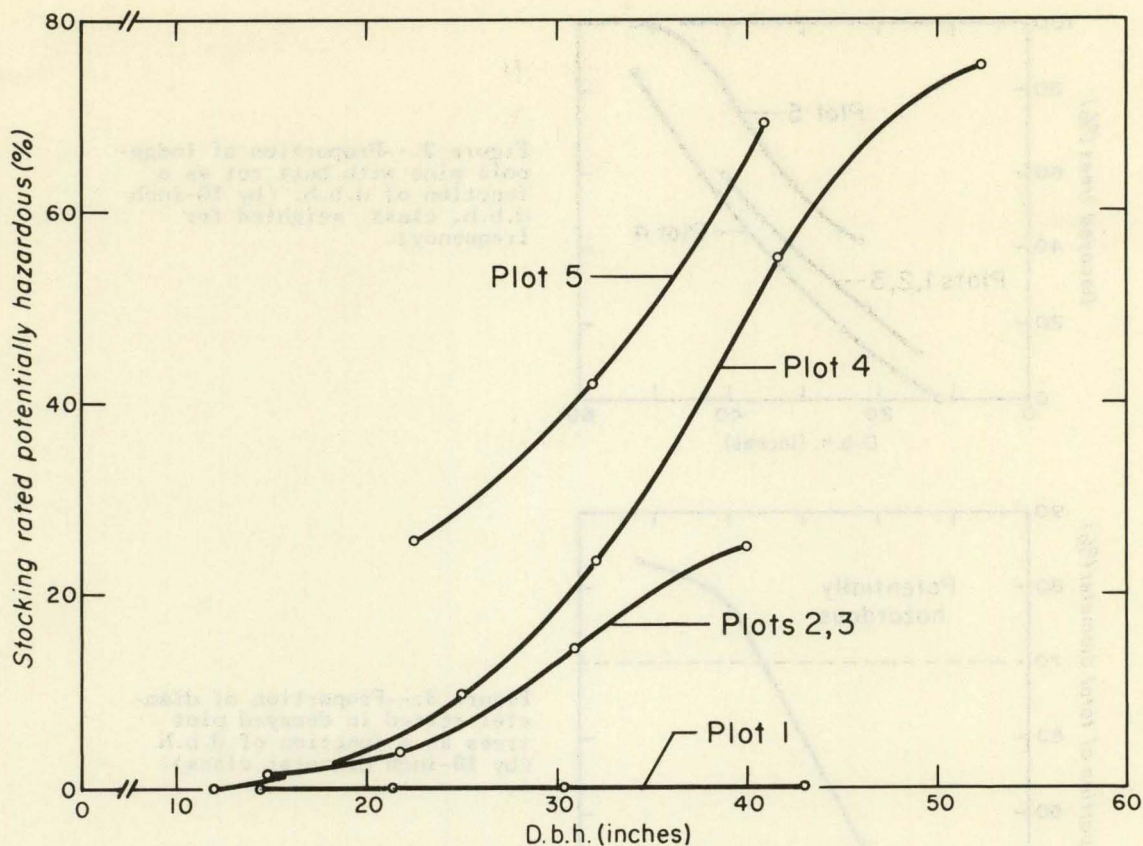


Figure 1.--Proportion of lodgepole pine rated potentially hazardous as a function of d.b.h. (by 10-inch d.b.h. class, weighted for frequency).

the proportion of trees which were potentially hazardous (or decayed) and the proportion of trees with fire scars (fig. 4). Both the proportion of defective trees and the proportion of trees with fire scars were low on those plots in less-developed areas. Injuries tended to be more serious on plots with much fire damage. Consequently, the number of decayed and potentially hazardous trees increased at a slightly faster rate than the number of fire-scarred trees.

Of the other factors which might affect the incidence of hazard or decay, only two showed any small degree of correlation: soil depth and burrows of a ground squirrel, probably the golden mantle Sierra chipmunk. There was only a slight trend toward an increasing number of decayed trees with decreasing depth of soil.

With respect to ground squirrel holes, 89 percent of those found at the base of trees were associated with decay in the tree, while more than two-thirds of the trees with ground squirrel holes were rated as potentially hazardous.

Although the presence of a squirrel hole suggests a high probability of decay in the associated tree, the absence of squirrel holes does not imply a sound tree. Ground squirrel holes occur infrequently in

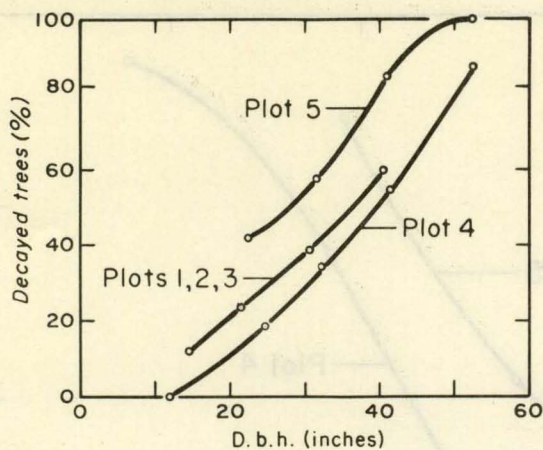


Figure 2.--Proportion of lodgepole pine with butt rot as a function of d.b.h. (by 10-inch d.b.h. class, weighted for frequency).

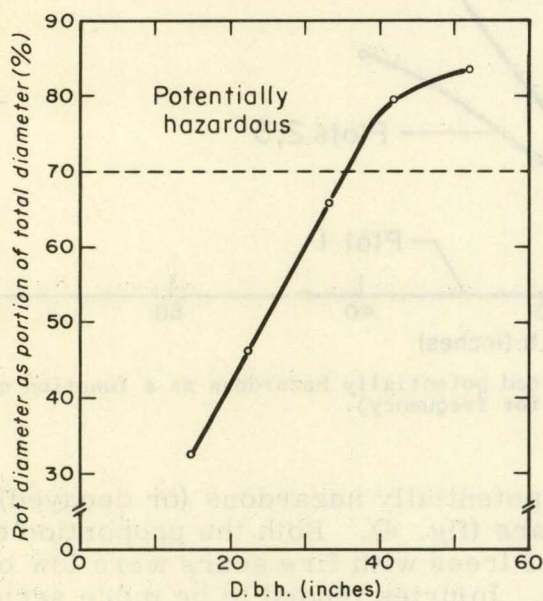


Figure 3.--Proportion of diameter rotted in decayed plot trees as a function of d.b.h. (by 10-inch diameter class).

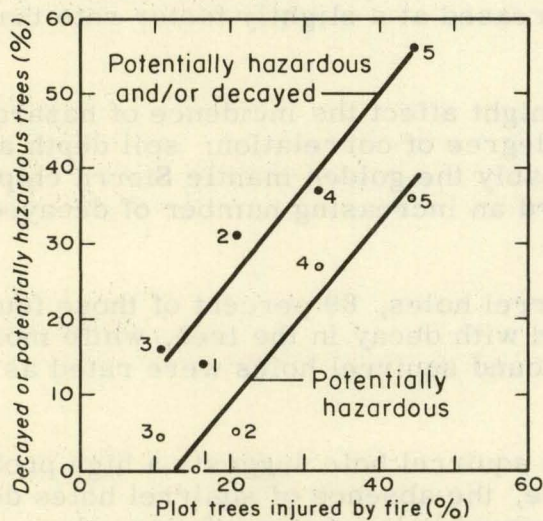


Figure 4.--Association of potentially hazardous trees and decayed trees with injuries caused by fire, by plot.

Table 1.--Decayed and potentially hazardous trees in lodgepole pine plots

Plot	Trees decayed	Trees rated potentially hazardous	Proportion of decayed trees rated potentially hazardous
	Percent		
1	14	0	0
2	16	4	25
3	31	5	17
4	37	27	73
5	56	39	70

this area--even beneath decayed trees. This situation suggests that ground squirrels prefer to dig beneath decayed trees, rather than that they are an agent in the infection process.

DISCUSSION

The data reported in this note were not necessarily representative of conditions on the westside Sierra Nevada. But it was apparent that decay is not uncommon in lodgepole pine. Furthermore, some recreational sites had an abnormally high proportion of trees rated potentially hazardous on the basis of butt rot alone. The proportion of trees rated potentially hazardous--and of trees with fire scars--was highest on the most used plots. In comparable diameter classes, the proportion of fire-scarred trees rated potentially hazardous was three to four times higher on the two higher-use plots.

Much of the fire damage on plots 4 and 5 stems from a period antedating Forest Service control. Considering the nature and history of the area, one may conjecture that users of the past--Indians and stockmen--were largely responsible for the high number of serious fire injuries on these two plots. Lightning scars accounted for only a small part of the damage. On the basis of these plots, inspection of lodgepole pine should be especially detailed on recreational areas having larger and older trees with evident fire scars--particularly on areas with a long history of uncontrolled use. In general, the proportions of potentially hazardous trees on the plots underscore the need for a more comprehensive and extended look at stands in recreational areas, where much of the timber is not only overmature but exempt from commercial cutting.

The Author

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