Beetle-Killed Lodgepole Pines Are Suitable for Powerpoles

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Abstract

Of 30.8 dead, standing, pole-size lodgepole pines per acre in southeastern Idaho, 38 percent yielded 35- to 40-foot-long poles that met ANSI standards for size and form. Decay prevented the utilization of 12 percent of the trees for poles. Basal decay, responsible for rejecting over 50 percent of the trees, usually could be eliminated by long-butting trees from 4 to 8 feet. Trees dead for 3 years or longer attained an EMC of about 30 percent at 1 foot, and 14 percent at 16 feet, and higher, above the ground.

THE MOUNTAIN PINE BEETLE (*Dendroctonus ponderosae* Hopk.) epidemic that started in the late 1950s, and spread throughout the lodgepole pine (*Pinus contorta* Dougl.) forests of western Wyoming and eastern Idaho, has decimated many sawtimber-size stands. Considerable growing stock still exists in regeneration and smaller pole-size trees, but numbers of live poletimber- and saw-log-size trees were greatly reduced. In some areas, only 29 percent of the trees above 12 inches diameter at breast height (DBH) survived (Parker 1973). This loss has caused a serious impact in areas managed primarily for timber production.

Green trees previously harvested for use as power poles are now scarce on the Targhee National Forest in southeastern Idaho, while the demand for poles has increased. The American National Standards Institute (ANSI) 1972 standard for wood poles does not require that poles be cut from living trees. Consequently, poles from insect-killed lodgepole pine are acceptable provided they are free of decay and otherwise meet specifications. The objective of the present study was to determine if there were significant numbers of beetle-killed lodgepole pine which were of a size and form to provide poles and, of these, what proportion would fail to meet the requirements of the ANSI standards because of decay.

Methods

Four areas on the Ashton Ranger District of the Targhee National Forest were chosen for study in May 1974. Tree mortality has been high over a period of years in the southern portion (Bitch Creek) and is continuing in the northern portion (Baker Draw). Forty-six study plots of variable size were established two chains into the forest at right angles to the road at 0.2-mile intervals along Baker Draw, Bitch Creek, Cave Falls, and Fish Creek roads. Trees for measurement were selected with a prism having a basal area factor of 10.

All trees on the plots, living or dead, were measured. The dead trees were classified by number of years since death as follows:

1 to 3 years:	foliage bright orange to straw colored to gray; some foliage lost,
3 to 5 years:	no foliage, most small twigs that had supported needle fascicles lost, and
5 + years:	no small twigs; bark peeling (Cole and Amman 1969).

Possible external indicators of decay and other defects were noted.

Dead pole-size trees were classified as being suitable, or not suitable, for poles on the basis of whether or not they would yield 35- or 40-foot-long poles. Trees suitable for poles were felled and measured to determine the class and length of pole they would yield according to the ANSI dimensions given in Table 1. The trees were longbutted as

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Table 1. — POLE LENGTHS AND CIRCUMFERENCES.

Pole length (ft.)	Groundline distance from butt (ft.)	Class 1	2	3	4	5	6
		Min. circumference at groundline (in.)					
35	6	41.5	38.5	36.0	33.5	31.0	28.5
40	6	44.0	41.0	38.0	35.5	33.0	30.5
		Min. circumference at top (in.)					
		27	25	23	21	19	17

Table 2. — NUMBER OF STANDING POLE-SIZE TREES PER ACRE, ASHTON RANGER DISTRICT, TARGHEE NATIONAL FOREST.

Area	No. of plots	Live trees	Dead Trees: Not suitable for poles	Suitable for poles	Total
Baker Draw	9	17.1	14.3	15.0	46.4
Fish Creek	12	18.4	13.4	16.2	48.0
Cave Falls	17	8.2	13.2	12.3	33.7
Bitch Creek	8	7.1	24.6	20.8	52.5

necessary to eliminate basal decay, and were then bucked into 8-foot lengths to facilitate inspection for the presence and extent of any defect. Trees considered suitable for poles on the basis of size and form but which, because of decay, failed to yield 35- or 40-foot poles, were considered cull. Conks, and samples of decayed and blue-stained wood, were collected in order to isolate and culture organisms for identification.

Moisture content (MC) of the outer sapwood and midheartwood of 25 randomly selected trees was measured at 1, 16 to 19, and 35 to 40 feet with a resistance-type moisture meter. Measurements were taken at a depth of about 3/4 inch in areas free of knots and decay on newly-exposed transverse faces.

Results

Of 217 pole-size trees on the 46 plots, average tree height varied from 73 to 80 feet and average tree age from 89 to 104 years. Seventy-six percent of the pole-size trees were dead. The number of dead trees of pole size and form varied between plots. There were 15 per acre in the Baker Draw plots in the northern portion of the district where the infestation was continuing and about 21 per acre in plots on the Bitch Creek area. The latter area had been infested longer (Table 2).

On the combined plots there was a weighted average of 12.4 live, and 30.8 dead, trees per acre. Of the dead trees, 15.5 failed to meet specification requirements because of trunk deformities, while 15.3 were considered suitable for poles on the basis of external appearances, of which 3.5 were culled due to decay. Thus, about 38 percent of the standing dead trees yielded poles that met the ANSI pole standards prior to processing.

Because the indicators used to judge time since death were found to be ambiguous, only two classifications of dead trees were used in the analysis — trees dead from 1 to 5 years and those dead longer than 5 years. Sixty percent of the pole-quality trees had been dead longer than 5 years, and of these, 70 percent were sound; that is, if decay was present, it was not extensive enough to prevent a pole from being cut from the trees. In contrast, 94 percent of the trees that had died within the past 5 years, and deemed suitable for poles, were sound.

Longbutting was necessary to eliminate basal defect in 76 percent of the trees dead less than 5 years and in 94 percent of the trees dead more than 5 years. The average longbutt cut was 3.3 and 5.9 feet, respectively. The need for longbutting to eliminate butt and sap rot was 2-1/2 times greater in both age classes than that for longbutting to eliminate other basal deformities such as cankers, wounds, involutions, and butt swell. In spite of these longbutt cuts, 35- and 40-foot poles were obtained from 77 percent of all trees whose boles met the form and size specifications for wood poles.

Butt rot was responsible for 50 percent of the cull in trees dead less than 5 years and for 63 percent in trees dead more than 5 years. Longbutting to eliminate butt rot in these trees resulted in so much shortening that 35-foot poles could not be obtained. The remaining cull was the result of heart or sap rot in the upper bole, a defect present in both living and dead trees.

Of the 27 percent of poles 35 feet in length, 14 percent were in classes 1-3, and 13 percent were in classes 4-6. Of the 73 percent of poles 40 feet in length, 29 percent were in classes 1-3, and 44 percent in classes 4-6.

We anticipated that conks, external indicators of decay, might be useful in estimating the amount and height of basal sap rot in the dead trees. Three fungi were found fruiting on the lower boles of trees: *Cryptoporus volvatus* (Pk.) Hubbard (=*Polyporus volvatus*), *Fomitopsis pinicola* (Swartz ex Fr.) Karst. (=*Fomes pinicola*), and *Hirschiporus abietinus* (Dicks. ex Fr.) Donk (=*Polyporus abietinus*). Conks were found on only 19 percent of the trees suitable for poles, and the sap rot caused by the primary organism resulted in average longbutt cuts of 4, 3, and 8 feet, respectively.

Other external defects were found on 37 percent of the trees. Although decay was frequently associated with such defects as basal wounds, flat faces, and involutions, the defects were not reliable indicators of decay. Longbutting to eliminate basal cankers averaged 6 feet, wounds 7 feet, involutions 8 feet, flat faces 18 feet, and butt swell 2 feet.

Although basal decays were responsible for 60 percent of the cull trees, the decays in general could be eliminated by longbutting 4 to 8 feet of the bole. The common sap rot fungi isolated were *C. volvatus, F. pinicola, H. abietinus, Coniophora arida* (Fr.) Karst., *Serpula himantioides* (Fr.) Karst. (=*Merulius himantioides*), and *Columnocystis abietina* (Pers. ex Fr.) Pouz. (=*Stereum abietinum*). Fungi commonly causing root and butt rot isolated in this study were *Inonotus tomentosus* (Fr.) Gilbertson (=*Polyporus tomentosus*), *Phaeolus schweinitzii* (Fr.) Pat. (=*Polyporus schweinitzii*), *Coniophora puteana* (Schum. ex Fr.) Karst., *Poria*

Table 3. — AVERAGE MC (% AND STANDARD ERROR) OF BEETLE-KILLED LODGEPOLE PINE SAPWOOD AND HEARTWOOD IN RELATION TO TIME SINCE TREE DEATH.

Height in tree (ft.)	Years since trees died: 1 to 3		3 to 5		5+	
	Sap-wood	Heart-wood	Sap-wood	Heart-wood	Sap-wood	Heart-wood
1	47±15	20±3	31±11	29±5	26±13	28±5
16-19	20± 3	26±8	15± 5	16±4	13± 2	15±3
35-40	24± [1]	27±[1]	12± 2	14±2	13± 3	15±5

[1]Only one measurement taken.

cocos (Schw.) Wolf, and *Flammula alnicola* (Fr.) Kummer. The trunk rot fungi included *Phellinus pini* (Thore ex Fr.) Pilat (=*Fomes pini*), *Haematostereum sanguinolentum* (Alb. & Sch. ex Fr.) Pouz. (=*Stereum sanguinolentum*), *C. puteana*, *Coniophorella olivacea* (Fr.) Karst. (=*Coniophora olivacea*), and *Amylostereum chailletii* (Pers. ex Fr.) Boid. (=*Stereum chailletii*).

The sapwood of beetle-killed lodgepole pine is usually extensively blue-stained within 1 or 2 years following beetle attack. Blue-stain increases the permeability of wood and is often associated with decay, but does not prevent the dead trees from being utilized as poles. Because of the increased permeability of wood, treating schedules would have to be modified. The most common staining fungus isolated was *Europhium clavigerium* R. C. Robinson and Davidson. Other staining fungi isolated were species of *Graphium* and *Leptographium*.

Many of the dead trees also had a coffee-colored stain, often mixed with the blue-stain. A species of *Cytospora* was consistently isolated from this coffee-colored stain. The stain is similar to those stains described by Rogers and Noskowiak (1976) in ponderosa pine (*Pinus ponderosa* Laws.) lumber, and by Fritz (1952) in red pine (*Pinus resinosa* Ait.). On the basis of mechanical tests, Fritz concluded that the stain had negligible effect on the mechanical properties of red pine wood.

The moisture content of the wood in the dead trees declined with time after death; differences were noted both between sapwood and heartwood, and with height (Table 3). In all cases, MC was highest at 1 foot above ground, and decreased rapidly with increasing height. Trees dead for more than 3 years appeared to have reached an MC equilibrium, and it is assumed that further drying would be insignificant.

Conclusions

The mountain pine beetle has caused extensive mortality of large lodgepole pines in southeastern Idaho and western Wyoming. Tree deaths continue, and recurrent outbreaks of a scattered nature are common in these areas. Potential losses of usable material are serious, particularly for specialized products such as power line poles. Beetles killed an average of 31 trees per acre in the four areas studied. As long as these dead trees remain standing, a large proportion of them can be utilized for poles and other wood products. Cull in trees suitable for poles, and dead less than 5 years, will be approximately 6 percent. Cull in trees dead more than 5 years can be expected to be as high as 30 percent. An average of about 12 trees of pole size and form per acre remain in the Ashton area. Utilization of these trees should help to ease the current pole shortage.

The mountain pine beetle epidemic has been on the decline for a number of years in all four study areas. Thus, few freshly killed trees can be anticipated in coming years. Actual tree mortality in the four areas that comprise this study was no doubt greater than the data indicate, because the Targhee infestation began in the late 1950s and many of these older dead trees have been windthrown. The rate of windthrow of dead trees in these stands should be studied to determine how long the dead trees will remain standing and salvageable.

The MC of upper portions of beetle-killed trees soon decreases to a level at which most wood-decaying fungi cannot grow. Snow and summer rains keep the soil and basal portions of these dead trees moist, however, so that butt and root rots continue to develop over a period of years, predisposing the trees to windthrow. Thus, these trees should be harvested soon after their death to guarantee their utilization. The development of a cull indicator system for estimating heartrot in lodgepole pine was unsuccessful and deemed impractical (Loman and Paul 1963).

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