

Ponderosa Pine Tree Classes Redefined

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This article presents a redefinition of the tree classes proposed by the author in 1936 for determining the susceptibility of ponderosa pines to bark beetle attack. It is based on additional study of 3,700 trees and should assist in placing borderline trees in the class most nearly representing their rate of growth and mortality risk.

THE ponderosa pine tree classification developed by the writer (3) for determining susceptibility of ponderosa pines to bark beetle attack has been used in the Pacific Northwest for timber-marking purposes and for insect mortality and growth studies during the past 6 years. It has also been adapted by Hornibrook (2) to fit conditions found in the Black Hills of South Dakota and Wyoming and by Thomson (6) for application in the Southwest. In practical field use, the need has arisen for more exact definitions and a weighting of the more important factors, in order to obtain closer standardizing of interpretation and to iron out such ambiguities as existed in the original descriptions.

Following a recent study of 3,700 trees as to growth rates, crown characteristics, and susceptibility to bark beetle attack, new definitions have been prepared. Whereas no change has been made in the average criteria for any tree class, these new definitions should make possible an improvement in the classification of borderline trees so as to place them in the class most nearly representing their respective growth rate and mortality risk.

The two primary factors on which this tree classification is based are age and crown vigor. Each of these factors is subdivided into four parts, making a total of 16 tree classes. Although four age groups and four crown-vigor subdivisions can be recognized in any ponderosa pine stand, the tree characteristics which differentiate the age or vigor groups vary considerably in different parts of the pine region and on different sites, and hence cannot be described specifically except for a particular site and for

limited portions of the region. Thus the following descriptions apply primarily to average Site IV in central and southern Oregon and north-eastern California. Modifications similar to those proposed by Hornibrook and Thomson will be needed to fit conditions in other regions, but the general principles are the same anywhere.

AGE CLASSES

Trees are first divided into four age groups— young, immature, mature, and overmature. The purpose here is to recognize relative maturity or “physiological age” rather than any definite age limits as shown by the number of annual rings. Differences in site, moisture, elevation, and other environmental factors influence the age at which trees reach maturity in different parts of the ponderosa pine region. The tendency is for trees to reach maturity earlier on poor sites than on good sites.

The external characters most valuable as indicators of maturity are the color and character of the bark, total height of the tree, shape of the top, character of branches and branching, and diameter. These are listed as follows for the four groups recognized:

Age Class 1.—Young trees. Commonly referred to as “bull pines” or “black jacks”; thrifty trees making rapid height and diameter growth; age usually less than 80 years.

D.b.h.—Rarely over 20 inches.

Height.—In lower crown canopy: usually less than 60 per cent of total mature height.

Bark.—Dark, grayish brown to black; rough, and deeply furrowed without plates, but with narrow ridges between the fissures (sometimes coloring at extreme base).

Branches.—Upturned and in whorls for upper three-fourths of crown; small for diameter of bole.

Top.—Usually pointed, with distinct whorls.

Age Class 2.—Immature trees. Still making rapid height and diameter growth in thrifty trees; age approximately 80 to 180 years.

D.b.h.—Rarely over 30 inches.

Height.—Usually less than 90 per cent of total height at maturity. Trees still under the general crown canopy.

Bark.—Dark reddish brown, with narrow, smooth plates between the fissures on lower half of bole; dark, rough bark on upper half.

Branches.—Mostly upturned and in whorls for upper

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half of crown; horizontal near middle, horizontal or drooping below; small to medium size for diameter of bole.

Top.—Usually pointed, sometimes rounded, but with whorls indistinct.

Age Class 3.—Mature trees. Height growth practically complete; diameter growth slow; age approximately 180 to 300 years.

D.b.h.—Rarely over 40 inches.

Height.—Practically that of the general crown canopy, except intermediate, suppressed, or top-killed trees.

Bark.—Light reddish brown with moderately large plates between the fissures on lower three-fourths of bole; dark bark showing in upper quarter.

Branches.—Uprturned near top, middle crown horizontal, lower ones drooping; moderately large for size of bole.

Top.—Usually pyramidal or rounded, occasionally pointed; whorls indistinct except at extreme top.

Age Class 4.—Overmature trees. Making no further height growth; diameter growth very slow; age more than 300 years.

D.b.h.—Wide latitude in diameters, but usually large in dominant trees.

Height.—Full height of general crown canopy, except suppressed, spike-topped, or broken trees.

Bark.—Light yellow and uniform for entire bole, except in extreme top; plates usually very wide, long, and smooth; fissures often rather shallow.

Branches.—Large, heavy, and often gnarled or crooked; mostly drooping except in extreme top.

Top.—Usually flat; occasionally rounded or irregular.

The distinction between age classes 1 and 2 is based largely on color and roughness of bark, as well as character of branching. While both are sometimes called "bull pines" or "black jacks," only class 1 trees have the rough, black bark for practically the entire length of the bole, and upturned branches in distinct whorls, so characteristic of young, juvenile growth. Class 2 trees have this dark, rough bark in the upper half of the bole, but the bark on the lower half is turning red and developing narrow plates on the ridges, particularly on the south side.

The distinction between age classes 2 and 3 is mainly a matter of height, character of the bark, and branching in the upper part of the tree. Class 2 trees are understory trees, somewhat less than 90 per cent of the height of the general crown canopy, whereas class 3 trees have practically reached the height of the general crown canopy and only show dark bark and upturned branches in the upper quarter of the crown.

The distinction between age classes 3 and 4 is more difficult to recognize, since there is no sharp line of demarcation between a mature and an overmature tree. Light-colored bark for practically the entire bole, absence of dark bark on

the bole except at the extreme top, and large, heavy limbs, mostly horizontal or drooping, are the principal distinguishing features of overmaturity.

In the field, age classes of dominant and co-dominant trees are fairly distinctive. Suppressed and intermediate trees in the older age classes often cause more difficulty, since their diameters are small and they frequently simulate the characters of younger trees. Since ponderosa pine usually grows in even-aged groups, the age class of the surrounding trees will usually give a clue to the age of suppressed individuals in the group.

CROWN-VIGOR CLASSES

It is a well-recognized silvicultural principle that the growth rate of trees for a given site and age class is directly proportional to the size of crown or area of leaf surface (*I*). Therefore in this classification each age class is subdivided into four divisions based on size of crown and abundance of foliage. The following factors, in order of their importance, were found to be the best outward indicators of crown vigor and inherent growth capacity:

1. Size of crown—length, width, and circumference.
2. Density of crown.
3. Form of top—pointed, round, flat, or spiked.
4. Location of crown on the bole.
5. Position of tree—isolated, dominant, co-dominant, intermediate, or suppressed.

Apparently in uneven-aged stands, such as open-grown ponderosa pine, the size and density of a tree's crown usually reflects the tree's position as to dominance or light and the amount of root competition.

In defining the four crown-vigor classes, it is impossible to describe all the variations in crown shape which may be encountered. Crown size and density are the principal criteria, and typical trees of crown-class A, which might be considered as the ideal outline, may be used as a standard of comparison. In the following descriptions it should be understood that other shapes may still belong in the various crown-vigor classes, provided the total volume of crown comes within the established limits.

The four recognized crown-vigor classes are defined below:

A—Full vigor

Crown.—Full vigorous crowns with a length of 55

per cent or more of the total height, and of average width or wider; with density average or better, for its age class.

Foliage.—Needles of average length or longer, usually dense and thrifty.

Position.—Usually isolated or dominant, rarely codominant.

D.b.h.—Large for age.

B—Good to fair vigor

Crown.—Good to moderately vigorous crowns, with length from 30 to 55 per cent of total height, if of average width and density; or a longer crown if narrow or somewhat thin; but neither sparse nor ragged.

Foliage.—Needles of average length, usually dense and thrifty.

Position.—Usually codominant, but sometimes isolated or dominant; rarely intermediate.

D.b.h.—Average or above for age.

C—Fair to poor vigor

Crown.—Fair to poor crowns, with length from 10 to 30 per cent of total height if of average width and density, or long, sparse, and narrow; often flat on one or more sides.

Foliage.—Needles often short and thinly distributed, but of normal length and density when confined to top one-third of crown.

Position.—Usually intermediate, sometimes codominant or suppressed, but rarely isolated.

D.b.h.—Usually below average for age; sometimes large in decadent trees.

D—Very poor vigor

Crown.—Very short, less than 10 per cent of the total height; sometimes merely a tuft at top of tree, or somewhat longer when sparse and ragged; usually very narrow or limbs all on one side.

Foliage.—Needles often short, and foliage sparse or scattered, or only tufts at end of twigs; but of normal length and density if reduced in quantity.

Position.—Usually suppressed or intermediate, but

may occupy other positions if greatly reduced in vigor.

D.b.h.—Decidedly subnormal for age, but very old decadent trees may be of large diameter.

CURRENT TREE HEALTH

The present tree classification is primarily concerned with the relative maturity and inherent vigor or growth capacity of different classes of ponderosa pine. The factors, such as diameter, crown size, position, and general thrift, on which these classes are based, change but slowly over a period of years. In addition, there is the matter of current tree health which must be taken into consideration. For any tree, regardless of class, may become weakened or sick from such causes as deficiency of available moisture or food supply, root injuries, the debilitating effects of fire, insect attack, disease, or other pathological conditions. The symptoms of poor health may be evidenced by decadence or dying of the top, shortening and thinning or poor color of the foliage, or the presence of dying twigs on portions of the crown. These symptoms of current tree health form the basis of Salman and Bongberg's (5) system of rating risk, and it is recognized that they may change rather rapidly from year to year.

The tree class designation thus indicates maturity, growth capacity, and beetle susceptibility over a relatively long period of time. The additional appraisal of current tree health may be

TABLE 1.—GENERAL STAND STRUCTURE AND RELATIVE MORTALITY OF VIRGIN PONDEROSA PINE, BY TREE CLASSES, IN EASTERN OREGON, EASTERN WASHINGTON, AND NORTHEASTERN CALIFORNIA, FOR TREES 9.6 INCHES AND OVER

Tree class	D.b.h. ¹ <i>Inches</i>	Volume ¹ <i>Bd. ft.</i>	Occurrence by ²		Trees killed per year ³ <i>Per cent</i>	Mortality ratio (tree basis)
			Trees <i>Per cent</i>	Volume <i>Per cent</i>		
1A	13.6	116	7.7	1.2	0.1	0.1
B	12.7	85	7.3	0.8	0.3	0.3
C	11.5	54	2.4	0.2	0.7	0.8
D	10.9	40	0.3	0.9	1.1
2A	21.4	509	5.2	3.6	0.2	0.2
B	19.2	362	11.7	5.8	0.5	0.6
C	15.5	185	6.7	1.7	0.8	1.0
D	12.4	76	1.8	0.2	1.3	1.5
3A	31.0	1,560	6.3	13.5	0.3	0.3
B	26.3	992	18.7	25.4	0.8	1.0
C	21.0	524	13.0	9.3	1.6	1.9
D	14.8	186	4.4	1.1	2.2	2.6
4A	38.4	2,635	3.2	11.5	0.3	0.4
B	34.2	1,990	6.7	18.2	1.2	1.4
C	29.2	1,340	3.7	6.8	2.3	2.7
D	20.1	525	0.9	0.7	3.2	3.8
	21.3	670	100	100	0.85	1.0

¹From a 10-per cent cruise of 41,920 acres of sample plots in 1937.

²Based on 206,037 trees classified in 10-per cent cruises of 116,670 acres of sample plots in 1928-31, 1937, 1938, 1939.

³Based on 51,409 trees killed on 112,409 acres of sample plots during 1928-31, 1935-37, 1939-40.

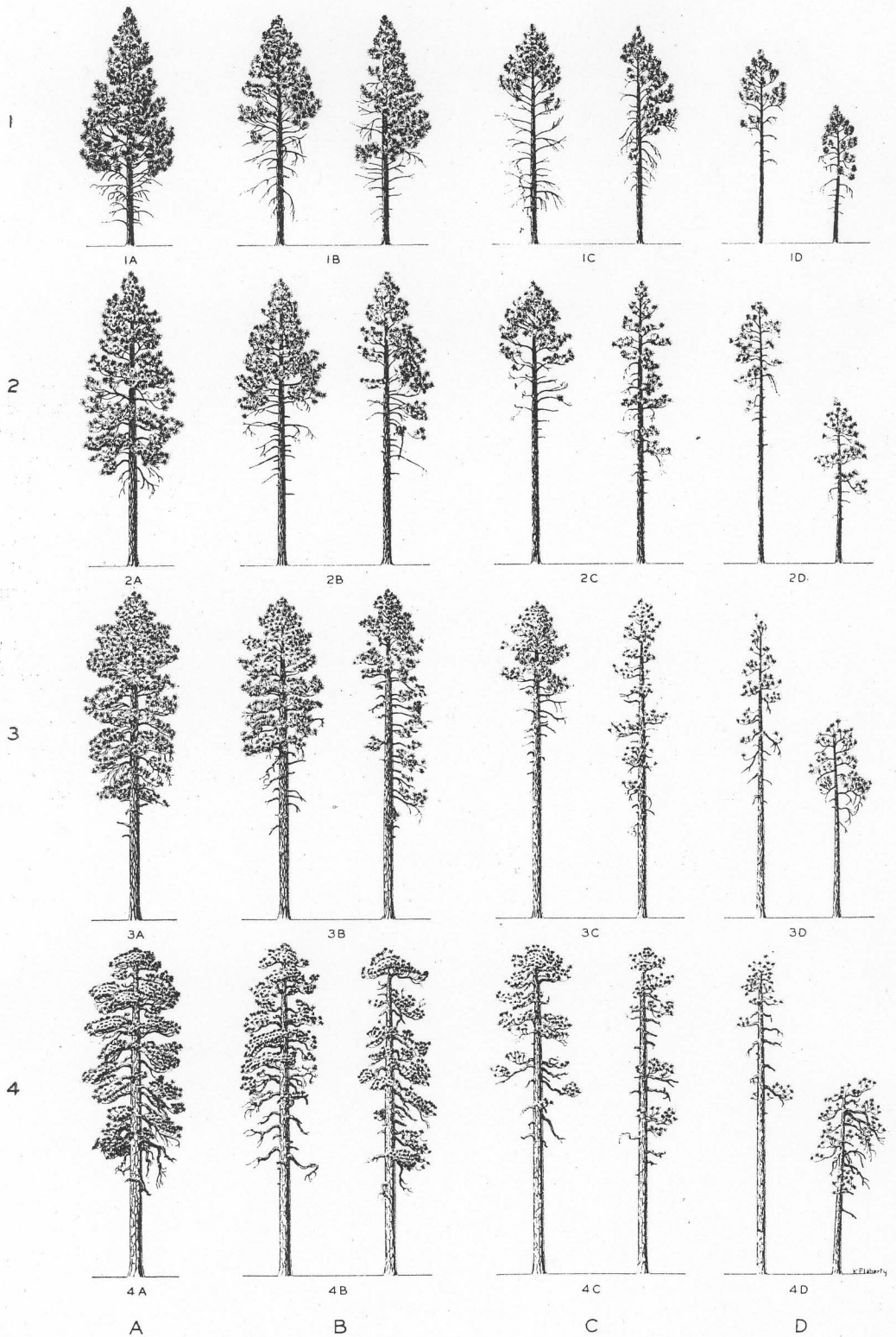


Fig. 1.—A ponderosa pine tree classification, based on age and vigor.

used to indicate for individual trees the risk of bark beetle attack over the next few years. Both appraisals are needed in marking ponderosa pine on a selective basis, if future loss from beetles is to be avoided (4).

RELATIVE MORTALITY BY TREE CLASSES

Records of annual mortality in virgin ponderosa pine stands have been accumulated on a large series of sample plots in eastern Oregon, Washington, and northeastern California over a period of years. These records of standing tree losses, primarily from bark beetle attack but also including all agencies other than fire and windfall, constitute a preliminary basis for setting up actuarial mortality rates for each tree class. The record includes mortality data from three independent samples as follows:

Period	Years	Infestation condition	Acres cruised	Beetle-killed trees
1928-1931	4	Epidemic	15,000	27,465
1935-1937	3	Endemic	41,920	13,387
1939-1940	2	Endemic	55,489	10,557
Total	9		112,409	51,409

The structure of the living stand was based on several 10 per cent cruises of these sample plots in which 206,037 green trees were classified to obtain the average distribution of trees by classes for typical mature ponderosa pine stands of this region.

The mortality ratio in Table 1 is on a tree basis. It was obtained by dividing the

average percentage of trees killed in a given class by the average loss for the stand as a whole. It thus gives a measure of relative susceptibility. For instance, loss in Class 3B averaged 0.8 per cent, which was the average for the stand, hence the mortality ratio is 0.8/0.8 or 1.00. Class 4D trees are killed 3.8 times as often as the average for all trees, while Class 1A trees are taken only 1/10 as often.

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