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The Heart Rots of Redwood

By James W. Kimmey, forest pathologist,
California Forest and Range Experiment Station[1]

Two types of heart rot are responsible for 10 billion board-feet of cull in the heartwood of redwood (*Sequoia sempervirens* (D. Don) Endl.). This cull exceeds 20 percent of the 49 billion board-feet, gross volume, of redwood timber growing in a narrow strip along the north coast of California. It represents essentially all of the heart rot and 92 percent of the total cull in standing redwood. The rot also contributes to additional loss through excessive breakage when the defective trees are felled.

Types and Causes of Rots

The most common type is the brown cubical rot caused by the fungus *Poria sequoiae* Bonar (figs. 1 and 2). The second is a white ring rot caused by *P. albipellucida* Baxter (figs. 3 and 4); it is especially prevalent in the northern part of the redwood region. Other decay fungi, among which are *Poria versipora* (Pers.) Rom., *Trametes carbonaria* (Berk. and Curt.) Overh., and *Fomes annosus* (Fries) Cooke, enter through fire scars and cause limited decay in the immediate vicinity of such wounds.

Description of Decays

Poria sequoiae heart rot, in the earliest visible stage, appears as a dull dark brown stain in the central heartwood. Thinly distributed pockets, ranging from very small to several inches across (fig. 1) and up to 8 or more inches long and irregularly lens-shaped, are later formed in this discolored area. The wood in these pockets is reduced to brown charcoallike "dry rot," which upon exposure and drying shrinks and cracks to form rough cubes (fig. 2, *A*). The rot pockets are at first widely scattered in the center of the heartwood. In later stages they become so numerous or individually so large that the outer heartwood is affected as well, and eventually these pockets form an almost solid mass of rot, the units of which are separated only by an occasional partition of firm wood.

[1] Maintained at Berkeley, Calif., in cooperation with the University of California.

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FIGURE 1.—Brown cubical rot of redwood caused by *Poria sequoiae*: End of an old-growth log showing a cross section of rot pockets.

Poria albipellucida in living redwood trees is also first visible as a dark brown discoloration in the firm heartwood. Later the wood softens and turns lighter brown. In the advanced stage the wood is typically soft and cinnamon brown and separates along the annual rings as the early wood disintegrates (fig. 3). The wood surfaces between these layers contain numerous minute, elongate pits. At times, but only

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FIGURE 2.—Brown cubical rot of redwood: *A*, Longitudinal detail of rot pockets in a split log; *B*, fruiting of the fungus on the end of a decayed log.

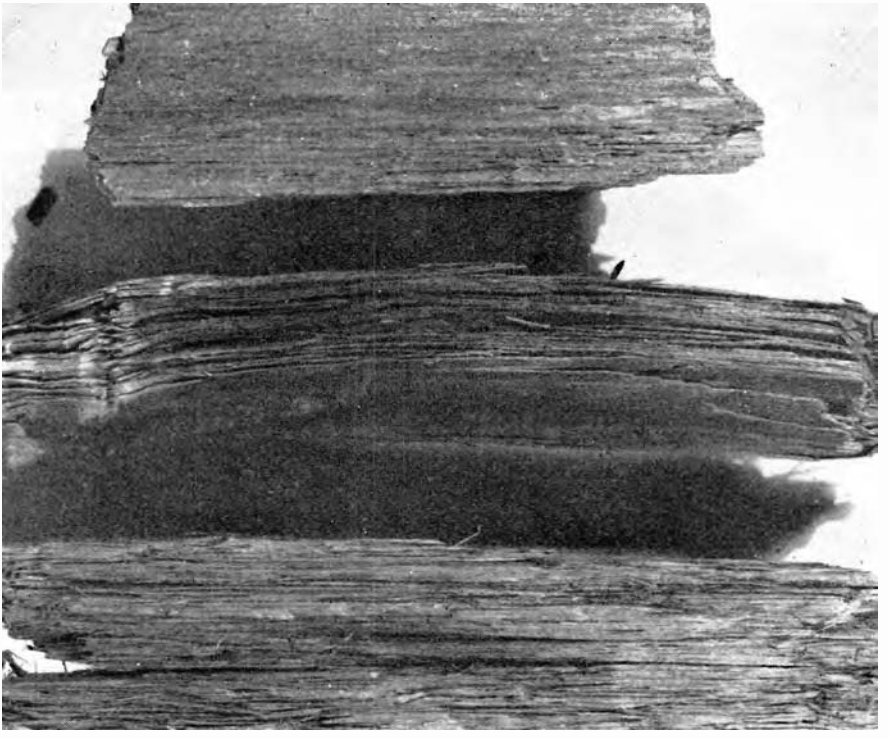

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FIGURE 3.—Detail of white ring rot caused by *Poria albipellucida* showing laminations.

where the decay is near a rift crack, the surfaces of the layers are coated with a black exudate. In the final stage the decayed wood is orange brown, and the pitted surfaces of the late wood become hairy with fine wood fibers or the entire decayed mass may lose its layered character and become fibrous (fig. 4).

Incipient decay caused by either fungus is firm and looks like normal heartwood except for the discoloration. Affected wood is usually dark brown but at times almost black. Such wood, locally called "black heart," is culled or degraded in lumber manufacture and is of value only for restricted uses where strength and discoloration are not factors and where the wood will not be in contact with the ground. Decay in the incipient stage accounts for about one-third of all the cull in the heartwood.

Entrances for Fungi

Fire scars are the main entrances for both fungi. Also, the fungi often enter through broken tops and other wounds exposing heartwood in the bole. Broken branches are

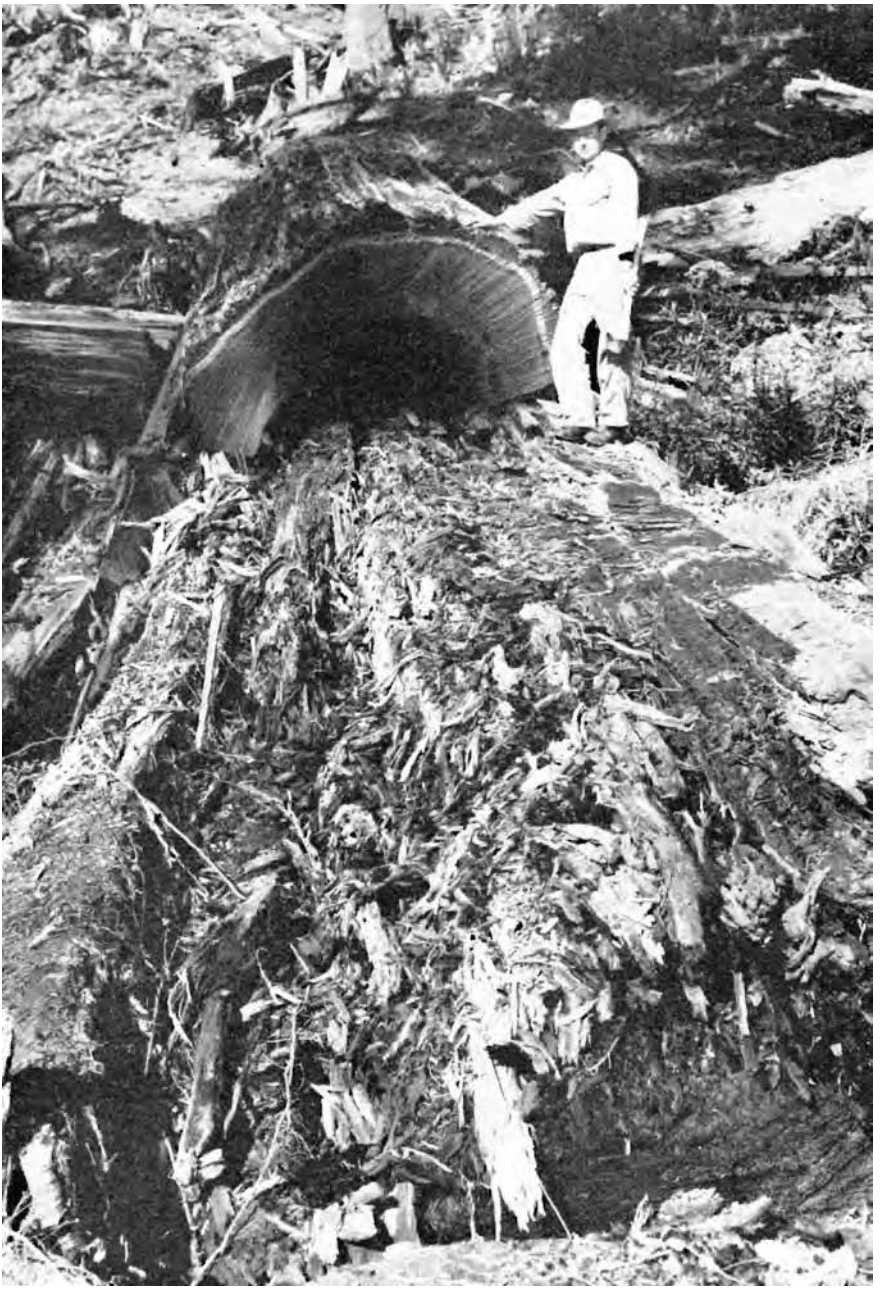

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FIGURE 4.—White ring rot of redwood caused by *Poria albipellucida*: Longitudinal view of badly decayed log, showing stringy nature of the rot.

not entry points for the heart rot organisms.

Occurrence of Decay

Heart rot in young-growth redwood trees amounts to about 3.5 percent of the gross cubic-foot volume. It varies from about 0.2 percent in trees 11 to 20 inches d. b. h.[2] to nearly 6 percent for trees 31 inches d. b. h. and over.

In old-growth redwood stands the cull percentage increases with increased latitude. From south to north in the four counties making up the main commercial range of redwood, the cull as a percent of gross cubic-foot volume averaged: Sonoma County, 19 percent; Mendocino, 20; Humboldt, 24; and Del Norte, 34. Tree growth is faster in the northern part of the redwood range than in the southern; therefore trees of equal diameter have a higher percentage of cull in the south because they are older.

[2] Diameter at breast height (4.5 feet) outside the bark.

Poria sequoiae causes much more rot than *P. albipellucida* in old-growth redwood—72 percent of the total against 28 percent caused by *P. albipellucida* in sample trees from all four counties (table 1). *P. albipellucida*, however, infected an increasing share of the sample trees from south to north and caused more than half the rot in Del Norte, the northernmost county.

Indications of Decay

External indicators of decay can be seen on many old-growth redwood trees containing heart rot. Fire scars and other bole wounds that extend into the heartwood, broken tops, and large sucker-type branches are all reliable indicators of a significant amount of heart rot in living trees.

Control

Heart rots in young redwood stands may be largely prevented by protecting them from fire. Fire-scarred or broken-topped trees should be harvested as soon as pos-

TABLE 1.—*Sample trees infected and total rot volume caused by* PORIA SEQUOIAE *and* P. ALBIPELLUCIDA *in old-growth redwood, by counties*

County	Poria sequoiae		P. albipellucida		Trees infected with both fungi
	Total rot	Trees infected	Total rot	Trees infected	
	Per-cent	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*
Sonoma	99	81	1	7	2
Mendocino	97	85	3	7	5
Humboldt	76	81	24	15	12
Del Norte	45	63	55	73	48
All counties	72	80	28	18	12

sible to avoid heavy losses from decay.

Heart rot is not transferred from stumps to stump sprouts, so young trees of sprout origin are not endangered.

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