

Reduced Fire Frequency Changes Species Composition of a Ponderosa Pine Stand

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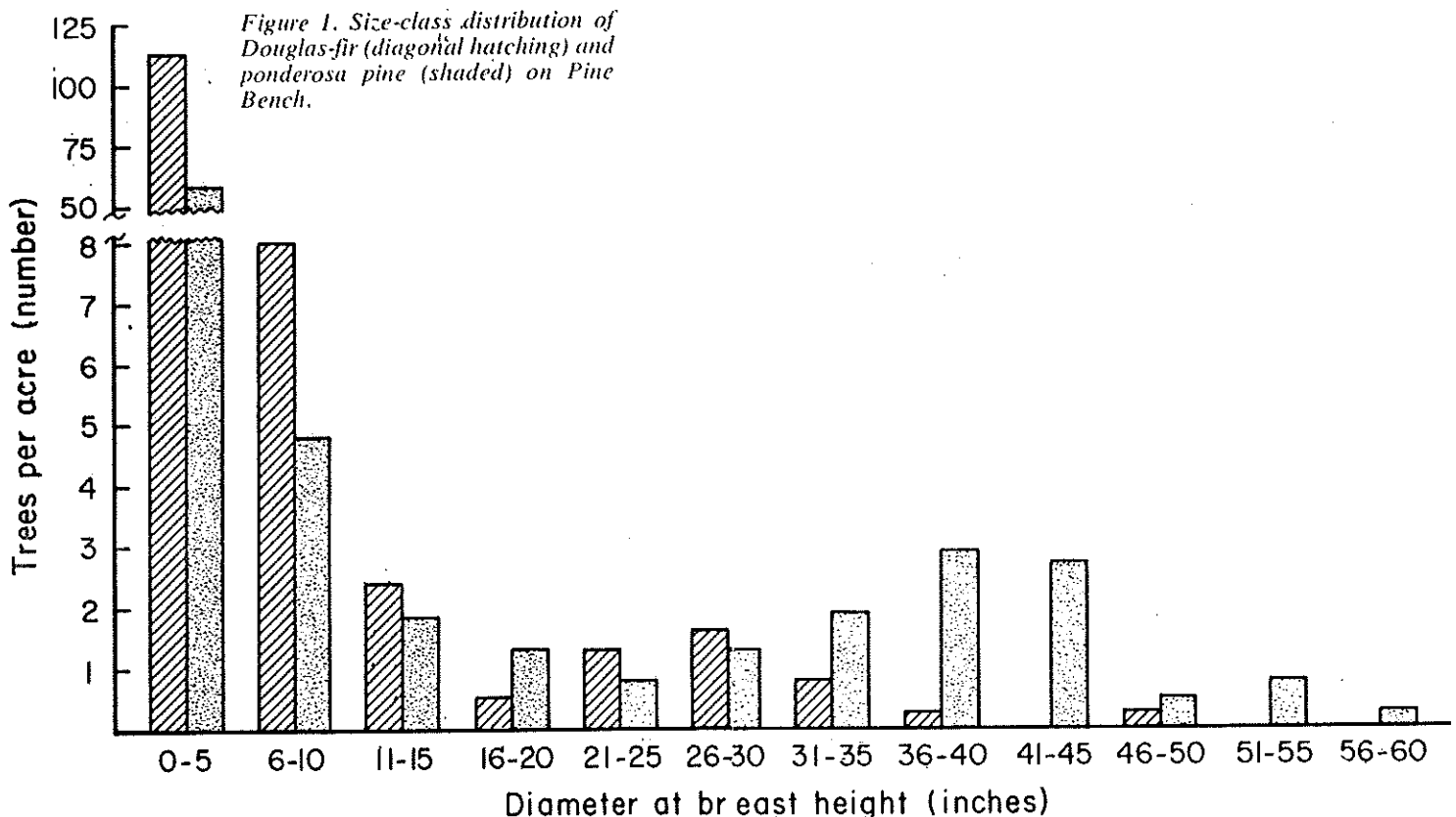
ABSTRACT—In the Umpqua National Forest, Oregon, a 35-acre ponderosa pine (*Pinus ponderosa* Laws.) stand situated in the midst of a Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) forest is being invaded by Douglas-fir seedlings as a result of reduced fire frequency within the last 50 years. In earlier times frequent ground fires kept Douglas-fir at a minimum.

Pine Bench, an area on the Umpqua National Forest, Oregon, is undergoing a drastic change in species composition. The understory, which according to an early settler, Jessie Wright (personal communication, 1975), was open and grassy until a half-century ago, now contains thickets of Douglas-fir that are shading out seedlings of the overstory ponderosa pines. A study was made to determine the cause and extent of this shift.

Study Area and Methods

Near Pine Bench, steep slopes that are predominantly forested with Douglas-fir drop into the North Umpqua River and its tributaries. Pine Bench sits 1,000 feet above the confluence of Boulder Creek and the North Umpqua River; rock cliffs provide a natural boundary for the pine stand and one side of the study area. The other boundary is formed by a sharp transition from ponderosa pine to Douglas-fir. The bench itself is anomalous to the area; it is flat and relatively free of underbrush.

Although a few incense-cedar (*Libocedrus decurrens* Torr.), white fir (*Abies concolor* [Gord. and Glend.] Lindl.), and sugar pine (*Pinus lambertiana* Dougl.) are present, Douglas-fir and ponderosa pine are by far the most numerous species.



Fifteen quarter-acre plots were located on a grid within the 35-acre study area. In each plot all ponderosa pines and Douglas-firs were counted and their diameters measured; those over 2.5 inches in d.b.h. were bored, except that trees more than 120 years old were generally too large to age with an 18-inch increment borer. Size-class and age-class distributions were compiled for both species. A linear regression correlating age and size of each species was used to determine the average age when breast height had been reached. For ponderosa pine the equation is:

$$\text{Age (years)} = 13 + 4.1 \times \text{d.b.h. (in inches)}$$

The correlation coefficient is 0.89, an indication that age and diameter are very closely related. For Douglas-fir the equation is:

$$\text{Age (years)} = 6.1 + 3.2 \times \text{d.b.h. (in inches)}$$

The correlation coefficient is 0.90. These equations give the average ages of ponderosa pine and Douglas-fir at breast height to be 13 and 6 years respectively. Adding these years to those obtained by boring gives the values used in the age-class distribution.

Results

The size-class distribution (fig. 1) shows that among the large trees there are far more ponderosa pines than Douglas-firs, while among the small trees there are far more Douglas-firs than ponderosa pines. The age-class distribution (fig. 2) shows that the change occurred rather suddenly.

While the age-class distribution excludes very young and very old trees, it can be accurately used in conjunction with the size-class distribution to show when the change occurred. The size-class distribution, which includes all trees sampled on the bench, shows that the invasion of Douglas-fir is continuing up to the present. The size-class distribution is also a reliable guide to the relative abundance of mature ponderosa pine as compared to Douglas-fir. The linear regressions show that Douglas-fir grows faster than ponderosa pine on Pine Bench; Douglas-fir appearing in the same size-class is actually younger. Therefore, the difference in the large number of old ponderosa pine

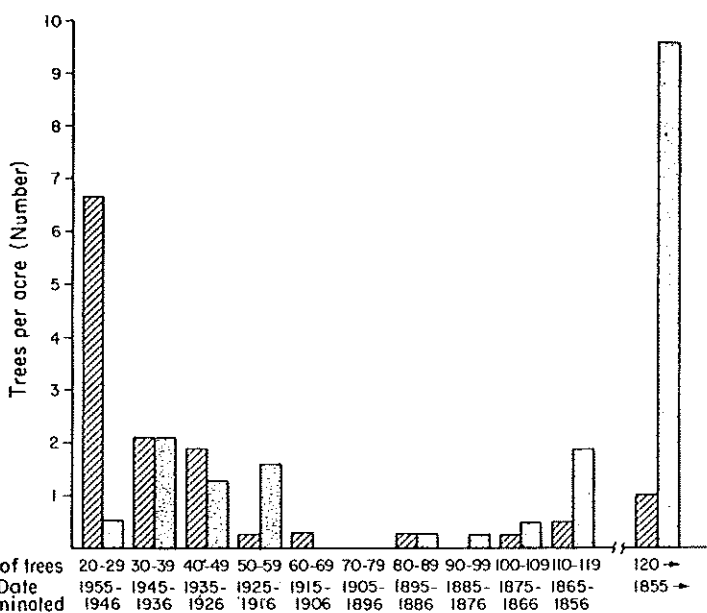


Figure 2. Age-class distribution of Douglas-fir (diagonal hatching) and ponderosa pine (shaded) on Pine Bench.

and the small number of old Douglas-fir is actually even greater than the size-class distribution indicates.

The shift in species composition began, then, when the middle-aged trees were seedlings. The number of Douglas-fir germinating and surviving was relatively small and stable until 1925, but thereafter increased steadily up to the present.

Discussion

The change seems too quick and drastic to be a result of natural succession. Grazing does not seem responsible, either. According to Jessie Wright (personal communication) cattle were driven through Pine Bench from 1917 to 1952 on their way between summer and winter grazing areas. The cattle were never on the bench long, however, and their impact was slight. Furthermore, Mrs. Wright told me that they grazed fir in preference to pine.

Reduced fire frequency seems the most likely cause of the invasion. Working on the Colville Indian Reservation in southeastern Oregon, Weaver (1964) found that invading species, as well as young pines, were kept out of the understory by frequent ground fires that burned the exfoliated bark scales, twigs, cones, and needles. But in openings where such fuel was scarce, small trees could establish themselves. As the young pines grew, they in turn would begin to drop fuel, thus keeping their own understory open.

Douglas-fir, being more shade-tolerant than ponderosa pine (Kozlowski and Ahlgren 1974), and growing faster, can grow up amongst the pine seedlings and shade them out. As ponderosa pines are more tolerant of heat than Douglas-fir (Bates 1924), frequent ground fires select against Douglas-fir where the two species are sympatric.

Two factors may have combined to reduce the frequency of fires on Pine Bench in this century. First is the absence of Indian or settler-caused fires, although as early as 1840 the number of Indians in the North Umpqua Valley was very small (Bakken 1970). An equally likely cause is the suppression of fires by the U.S. Forest Service.

By 1920, a Forest Service fire lookout was established on Illahee Rock, only four miles from Pine Bench, although it was not until the introduction of aerial fire-fighting techniques that control became highly effective. Douglas-firs living through the 1920s and 1930s would have almost been assured of survival once the more effective fire suppression of later decades began.

Prescribed burning has been proven valuable and workable in maintaining ponderosa pine stands (Weaver 1964, 1965) and should be considered for Pine Bench. ■

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