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SNOW INTERCEPTION, ACCUMULATION, AND MELT
IN LODGEPOLE PINE FORESTS
IN THE BLUE MOUNTAINS OF EASTERN OREGON

by

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Lodgepole pine (Pinus contorta) forests in the Blue Mountains of eastern Oregon occupy important water-producing lands. These forests generally occur at middle to high elevations on north slopes, where a substantial portion of the precipitation is snow. To learn more about the influence of lodgepole pine forests on accumulation of snow and rate of snowmelt, a series of measurements was made of the snow pack during the winter and spring of 1957 in an area typical of the lodgepole pine type.

The study was conducted in a 70-year-old stand, located about 16 miles west of La Grande, Oregon, in the Grande Ronde watershed. In the fall of 1956, 5 rectangular forested plots (4x6 chains) were established, and 20 snow-sampling locations were randomly selected and marked within each plot. In a large adjoining meadow, a snow course of 10 sampling locations was also established. At all locations snow depth and water-content were measured periodically with a Utah snow-sampling tube.

Two standard U.S. Forest Service precipitation gages were randomly located within each forested plot. These gages were moved to new randomized locations after each reading. In addition, a single gage was permanently located in a small natural opening adjacent to each plot.

Precipitation during the period of measurement was in the form of snow through mid-February; thereafter, both snow and rain fell. During the period of snow accumulation, measurements were made at bi-weekly intervals. During melt, intervals ranged from three to ten days.

STAND CHARACTERISTICS

The stand is representative of much of the lodgepole pine in the Blue Mountains. It seeded in following a fire in a former stand of mixed lodgepole pine, western larch (Larix occidentalis), Douglas-fir (Pseudotsuga menziesii var. glauca), grand fir (Abies grandis), and ponderosa pine (Pinus ponderosa). Large, old-growth relics of these species are scattered sparsely throughout the stand.

Lodgepole pine averages 700 trees over 1/2 inch d.b.h. per acre, with small patches varying from less than 600 to more than 800 trees per acre. Total basal area per acre of all trees averages about 140 square feet, with patches varying from 130 to 170 square feet. Lodgepole pine makes up 86 percent of the basal area; western larch, 13 percent; and grand fir and ponderosa pine together, 1 percent. Dominant trees of lodgepole pine average 63 feet high, with a 33 percent crown ratio.

Scattered reproduction of western larch, grand fir, and Douglas-fir occurs throughout. Grouse whortleberry (Vaccinium scoparium), pinegrass (Calamagrostis rubescens), and elk sedge (Carex geyeri) are the dominant species of the ground vegetation.

INTERCEPTION OF PRECIPITATION

Gages on the forested plots averaged 76 percent as much precipitation as that recorded in the small openings. Thus, 24 percent of the winter and early spring precipitation apparently was intercepted by the tree crowns. This may be compared with 32 percent interception loss in the Rocky Mountains of Colorado.^{1/} The Colorado study was made in a lodgepole pine stand containing 300 to 400 stems over 3.5 inches d.b.h. per acre, with the larger trees averaging 22 inches d.b.h. By contrast, the Blue Mountain stand contains 500 to 600 stems over 3.5 inches d.b.h. per acre, and the larger trees average only 11 inches in diameter.

1/ Wilm, H. G., and Dunford, E. G. Effect of timber cutting on water available for streamflow from a lodgepole pine forest. U.S. Dept. Agr. Tech. Bul. 968, 43 pp., illus. 1948.

Interception of precipitation was also reflected by snow pack characteristics under the trees as contrasted to those in the open meadow. During the period of study, snow depth on the forested plots averaged 62 percent of the depth in the meadow. Water content of the snow averaged only 55 percent of that in the meadow.

CHARACTERISTICS OF SNOWMELT

Rates of decrease in water content during the period of rapid melt after March 18 were fairly constant between areas (fig. 1). During this period, water content of the snow pack was reduced an average 0.30 inch per day in the open meadow and 0.12 inch per day under the lodgepole pine. Although rate of melt was more rapid in the open meadow, the snow cover lasted as long as that under the forest canopy because of the greater depth of accumulation in the open area.

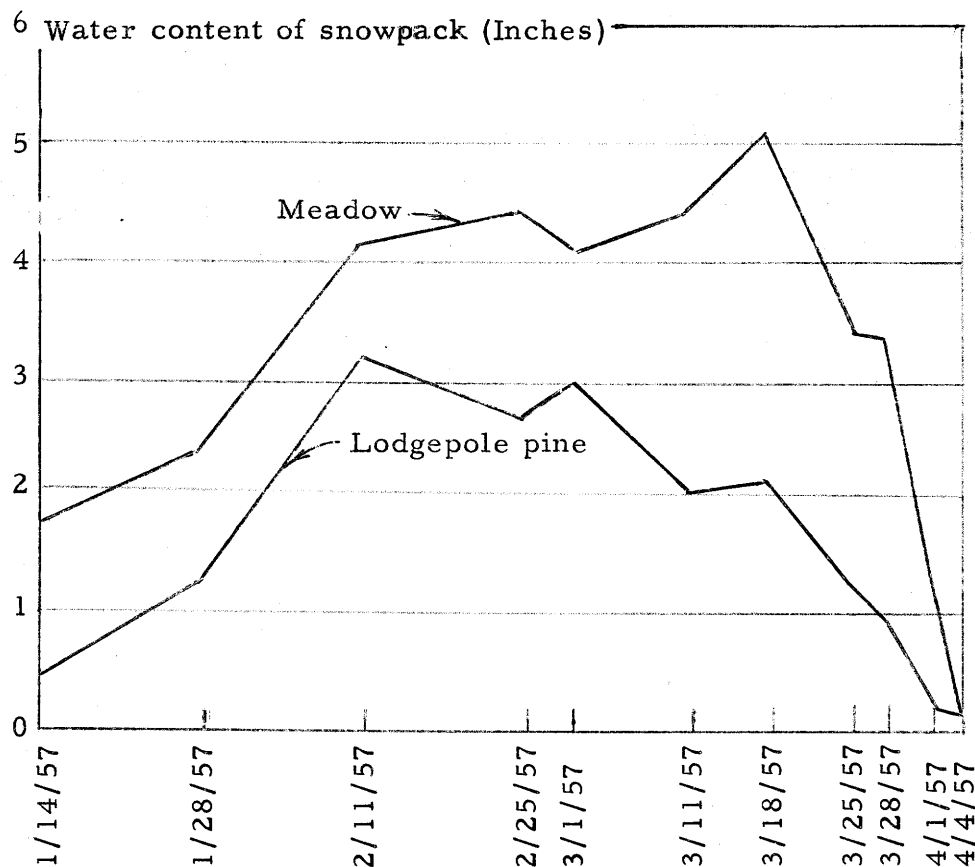


Figure 1. --Average water content of snow pack in a meadow and under 70-year-old lodgepole pine, winter and spring, 1957.

MANAGING STANDS FOR INCREASED SNOW ACCUMULATION

Although this study has been in progress for only one season and on a single area, it has provided some clues regarding snow pack management. Behavior of snow in the lodgepole pine stand during the winter suggests a type of stand treatment that would increase snow pack and perhaps prolong the runoff period.

In the lodgepole pine, largest volumes of snow accumulated in small natural openings, which are found intermittently throughout the stand. Snow remained longer on the ground in these small openings than in either the forest or the large open meadow. Openings as small as 20 feet in diameter received materially more snow than under the surrounding timber. Thickets of tree reproduction intercepted snowfall that penetrated the overstory lodgepole pine. This was particularly true of grand fir and Douglas-fir, which occasionally form understory thickets of saplings 10 to 20 feet high. The ground remained bare all winter under the densest of these thickets.

Accordingly, it appears that small clearcuts in lodgepole pine forests and thinning of dense reproduction would result in a heavier snow pack and might serve to retard melt and prolong runoff in the spring. Optimum size, shape, and orientation of such clearcuts will receive further study.