AN INTRODUCTION TO SOCIOLOGICAL AND ECOLOGICAL ASPECTS OF YOUNG-GROWTH MANAGEMENT

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THE FORESTS OF YOUNG DOUGLAS-FIR AND WESTERN HEMLOCK are great economic and social natural resources. They produce fiber for the manufacture of lumber, plywood, and pulp and a large variety of other products such as poles and piling, Christmas trees, fern fronds, and crude drugs. Forest land also produces water, wildlife, recreation facilities, and esthetics. These products will be of greater importance with time. Man, in increasing numbers, is turning to the forest to renew himself and to find freedom from the pressing problems of modern life. The management of young-growth forests, then, is concerned with all the products and uses of the forest.

THE FOREST IS A COMPLICATED ecosystem, and although trees are a large part of this system, they are not the only part ecologically. For instance, minor vegetation, animals, birds, insects, fungi, and microorganisms are all parts of this forest complex. Each affects and is affected by the total. The soil, the material from which the soil is formed, the climatic conditions that formed the soil, and the present climatic conditions and topography all influence the kind of forest that will develop.

Each forest area has different problems of management. Every forester will approach these problems differently. All, however, will have some problems that are alike or similar. As a manager of forest land, the forester must be concerned with ecological and social aspects of the forest. I think this is essential. Several discussions here are concerned with these aspects. They are not intended to be a comprehensive coverage, however.

Intensive management of the forest will change the environment of the forest, but in most instances these changes will not create a serious imbalance. Research is only beginning, and much more work must be done.

Nutrient Cycle Under Management

Forests are dynamic ecosystems through which nutrients move in large quantities (5). The cycle is not closed, and nutrients are added and subtracted by both natural and artificial processes. Silvicultural practices modify this cycle. For instance, the utilization of wood increases the drain on the nutrient capital. Also, more litter occurs in a natural stand than in a stand thinned lightly. And more occurs in a stand thinned lightly than in a stand thinned heavily (1,7). The long-term effects of intensive management on nutrient cycling and capital are not known, and this information is urgently needed. The quantity and quality of litter, the changes because of management practices, the amount of nutrients removed and returned to the soil by harvesting, and the effect of understory that adds and removes nutrients from the soil must be given intensive study, if foresters are to understand the total effect of management on the forest over a long time.

Some species in the forest are important in the nutrient cycle. "The soil-improving properties of alder are generally well known" (2). Franklin *et al.* (2) reported that organic matter, total nitrogen, and acidity were significantly greater in A horizons under stands of alder or mixed alder and Douglas-fir than under pure coniferous stands. Tarrant (10) reports that "the degree of nitrogen fixation in nodules of alder considerably exceeds that in legume nodules" and that "alder is perhaps most effective as a nitrogen-fixing plant when soil nitrogen is low."

The litter of bigleaf maple is known to contain high quantities of calcium and potassium (9). Ecologically, then, species other than Douglas-fir or western hemlock are valuable additions to the forest.

Changes in Understory

An important change that can occur from management is in the density and composition of the understory. The understory affects the water regime, the nutrient cycle, and the temperature of the duff and soil. It can also prevent or retard regeneration after the final harvest.

The problems with understory in forests depend upon the ecological condition of the area and the intensity of the management program. For instance, the composition and density of vegetation are different on the coastal slopes than on the valley slopes of the Coast Range or on the west slopes of the Cascade Range. They are different in a stand thinned heavily from one thinned lightly. For instance, on our research forest at Wilark in Columbia County, a 60-year-old Douglas-fir stand was reduced to 80 trees per acre in 1956. Now a dense stand of alder has established itself under the Douglas-fir. Unthinned and lightly thinned stands adjacent to this stand are not so affected.

A 108-year-old stand of Douglas-fir, on site IV in the Wind River experimental forest was thinned lightly in 1951 by removing 9 percent of volume. Another was thinned moderately by removing 27 percent of volume. The understory changes that occurred to both by 1958 were not significant (4). Generally, however, the heavier the thinning, the denser the understory.

Seed Production

The effect of thinning on seed production in Douglas-fir and western hemlock is of great importance in natural regeneration. That most seed is produced on dominant and codominant trees is well known (3). Trees growing in the open or trees in a stand with little or no competition also produce more seed than trees in a well-stocked stand.

Shaw reported that increased seed production from a heavily thinned 40-year-old Douglas-fir stand on the Voight Creek experimental forest was twice the average for the entire area sampled. This increase did not occur on either medium or lightly thinned areas (8). Seven years later, Ruekema found that seed production increased more in areas thinned at all intensities than in the unthinned areas at Voight Creek (6).

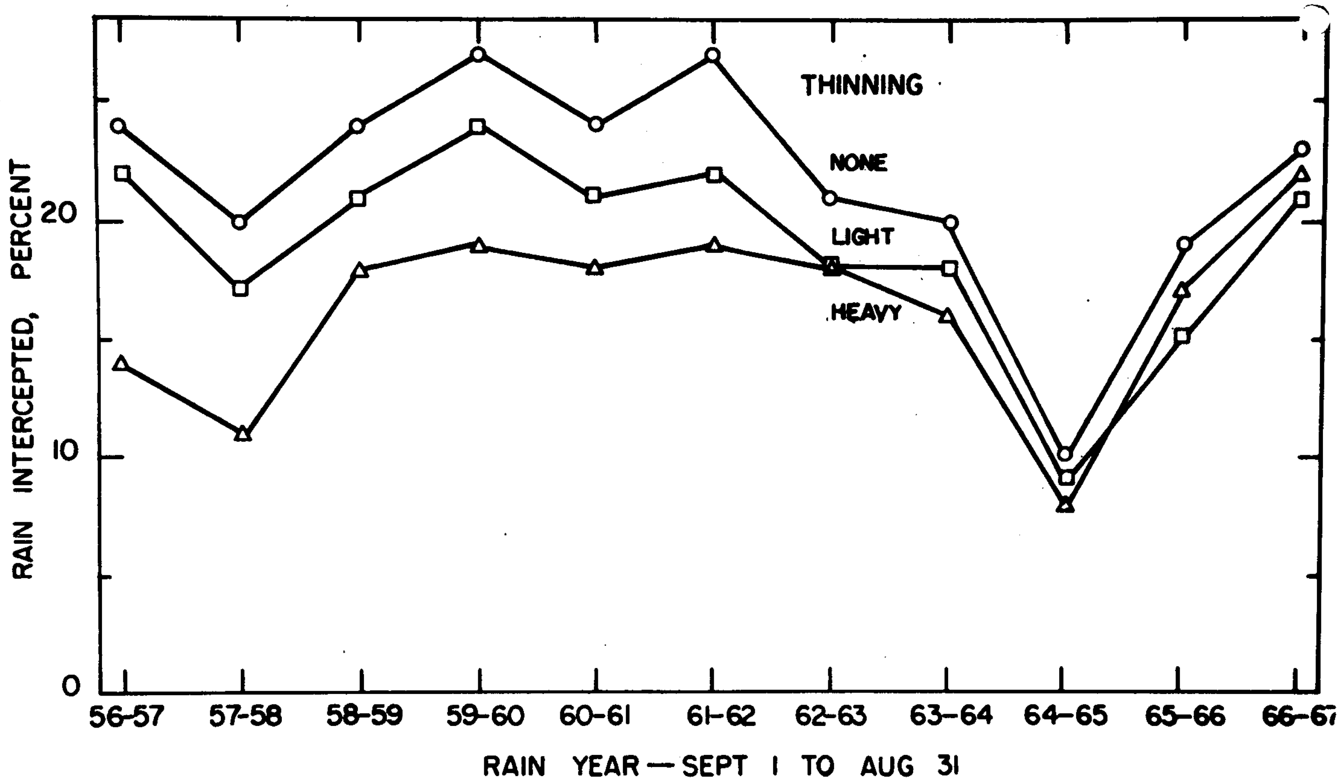

Figure 1. Percentages of rain intercepted by the crown canopy for three intensities of management. The differences immediately after thinning in 1965 were slight by 6 years after thinning.

Similar increases because of thinning have occurred at Black Rock. Studies there will indicate how long these increases will endure.

Rainfall Patterns

The amount of rain that reaches the ground is related to density of crown cover. The interception of rain by crowns will depend, of course, upon the intensity and length of the rain period. Crowns will intercept a greater percentage of light rains than of heavy rains and a greater percentage of short rains than of long rains. During the winter, when rains are more intense and of long duration, the amount of rain to reach the forest floor is about the same in all crown densities. Also, winter rain saturates the soil regardless of plant cover. This is not so for light rains in the spring and fall.

The percentage of rain intercepted by the crown canopy for three intensities of management is shown in Figure 1. Immediately after thinning in 1956, rain interception by crowns was quite different for the three stands. About 6 years after thinning the difference was negligible, and during the last 4 years shown on the graph, the interception was about the same, which indicated that the crown canopies of all three areas were much alike in density. Why light and heavy thinning reached equilibrium at the same time is not explained. Perhaps the crowns in the heavy thinning expanded faster than those in the light thinning because each tree was released to a greater degree.

Air and Duff Temperatures

At Black Rock, the difference in air temperature measured by a thermograph in plots of various stand densities from thinning was slight. The data, however, were taken from small plots within the forest. Air movements within the forest tended to equalize the air temperature of small areas of different stand structures. On larger areas of 160 acres or more, thinned heavily, the results would likely be different from those obtained at Black Rock on small areas.

The temperature within the duff layer of a forest area, however, is lower than that in an open area. Figure 2 compares

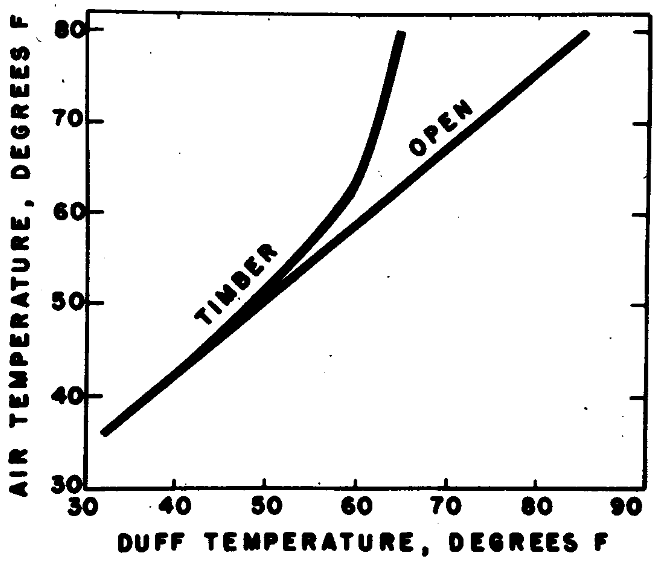

Figure 2. Relations between air temperatures and duff temperatures in the open and in a dense stand of young Douglas-fir.

the duff temperature under tree cover and in the open to air temperatures from 35 to 80 degrees F. The data were collected adjacent to and within a dense young Douglas-fir stand at the Jack Stump Farm near Monmouth, Oregon. The relation between air and duff temperatures in the open was linear. In general, with air temperatures below 50 degrees F in the open, the duff temperatues were slightly lower. With air temperatures above 50 degrees in the open, the duff temperatures were slightly higher. Under the timber, the duff temperatures remained lower than air temperatures in the higher readings because of shading from direct sunlight. The lower air temperatures occurred during cloudy weather, and duff temperatures under these conditions are the same in the timber as in the open.

Drying of Fuel

Figure 3 represents the drying of fuel sticks under five forest conditions; a dense unthinned stand, a stand lightly thinned, a stand heavily thinned, a bracken fern patch, and an open area. The fuel stick readings expressed in percentage of moisture content approximate the moisture content of dead wood about the same size on the forest floor. Notice on the top graph of Figure 3 that after a period of clear, dry weather, the fuel stick readings tend to cluster together. The readings in the open and in the fern patch are only slightly lower than those in the timber areas.

After 5 days of summer rain followed by only 1 clear day, the fuel sticks in the open and the fern patch dried out rapidly and became low in moisture content. The fuel sticks in the unthinned area and the area lightly thinned, however, retained the moisture gained from the rain, and the readings remained high. The fuel sticks in the area of heavy thinning did lose moisture, but not nearly as much as in the open or fern areas. These data seem to indicate that the drying of forest fuels in areas of light thinning are not nearly as critical as in areas of heavy thinning.

These examples, then, show that changes do occur. The magnitude or the long-reaching effects of these changes are not demonstrated. We can only speculate about their importance. The problems of forest management, however, would seem to be greater than the simple problems of what kinds of equipment to use for thinning, or how many and what kinds of trees should form the residual stand in thinning.

Many questions will arise. How will management influence the ecological balance? Will understory become a problem—especially in stands thinned heavily? Will spraying vegetation with herbicides after the harvest create problems? Will thinning change the nutrient cycle? Will the removal of wood over a time seriously reduce the nutrients of the forest? Will commercial fertilizer help maintain or increase the nutrients? What impact will fertilization have on the ecology of the forest? Are species other than the main crop of economic or ecological value? What are these values? Is compaction of the soil a serious problem in intensive management of the forest?

Can we develop through genetics the "supertree"? Will intensive management by increasing vegetation also increase wildlife populations? Is this beneficial? Can we manage the forest for both optimum fiber and wildlife production? What pathological and insect problems will increase with managment? What problems will decrease? Can management practices maintain or improve esthetic qualities? Can they maintain or improve the quality and quantity of the water? What are the recreation potentials of managed stands? These problems deserve your deep attention.

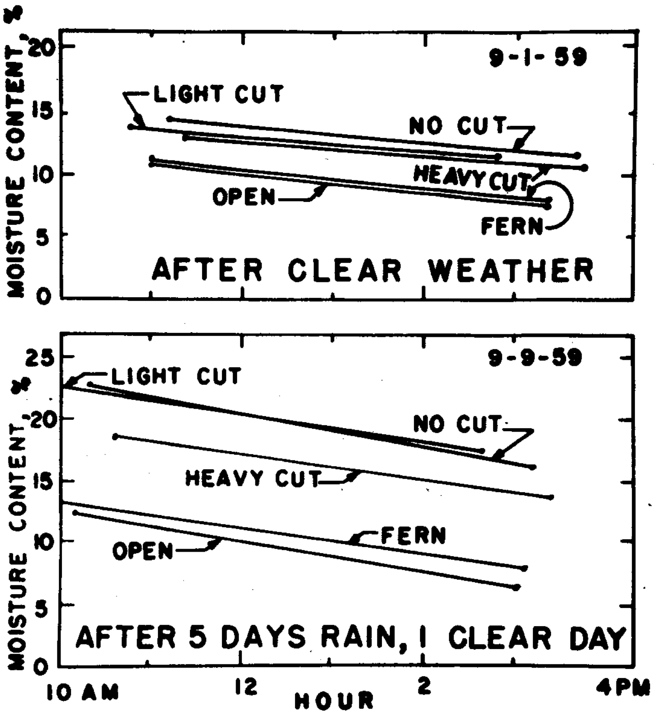

Figure 3. Drying of fuel sticks under five forest conditions.

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