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SEEDLING DISTRIBUTION ON A SPRUCE-HEMLOCK CLEARCUT

By

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EDITOR'S
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A better job of regeneration on cutover areas can be done if foresters know what areas are difficult to regenerate and what sort of practices are best for the difficult areas. A study recently completed at Cascade Head Experimental Forest has supplied that sort of information for a typical spruce-hemlock clearcut. Nearly a fifth of the area was still unstocked 6 years after logging, but this condition need not happen again. Most problem areas can be readily identified, and special treatments applied soon enough can insure better seedling establishment.

The Study

The study was in a 100-year-old stand on the Cascade Head Experimental Forest that is typical of the spruce-hemlock type along the coast of Oregon and Washington. Clearcutting removed a net volume of 87,000 board feet per acre, Scribner decimal C. Sixty percent of this volume was western hemlock, 30 percent Sitka spruce, and 10 percent Douglas-fir.

The 21-acre, rectangular study area was athwart a main ridge which divided it into nearly equal north- and south-facing components (fig. 1). Falling and bucking were started in the fall of 1947, and

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1/ Willamette Research Center, Corvallis, Oregon. Maintained in cooperation with the School of Forestry, Oregon State College.

Figure 1.--South slope of study area 6 years after logging.

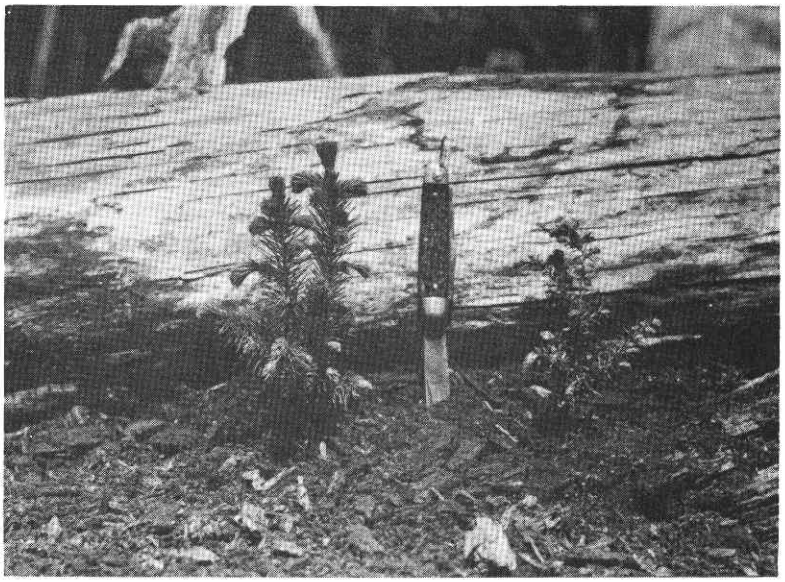

Figure 2.--Well established seedlings, spruce (left) and hemlock (right). These trees are 3 years old and 6 to 7 inches high.

logging was completed in the spring of 1948. Slash on the western half was burned in the fall of 1948, destroying most of the seedlings which had germinated from the 1947 seed. The eastern half was left unburned.

Forty circular 1/250-acre plots, each with a radius of 7.4 feet, were established in a systematic pattern in 1951: 20 on the north and 20 on the south aspect. Each plot was divided into 4-milacre quadrants, making a total of 80 milacre plots on each aspect.

Plots were first examined in November 1952, at the end of the fifth growing season after logging, and again in March 1954, one growing season and 2 winters later. All seedlings 1 year old or older were tallied and classified as established or not established. An established tree was defined as being (a) at least 2 years old, (b) showing an increasing rate of growth, and (c) having at least one side free of competition (fig. 2). Very few trees less than 6 inches tall qualified under this rule. Many taller trees that were overtopped by brush did not qualify. Advance reproduction was not included in the analysis.

Seedbed conditions were classified for each plot as follows:

1. Rotten wood--all stages of decomposing wood, from crumbly $\frac{1}{2}$-inch cubes to pulverized brown or reddish remains of windfalls and stumps.

2. Mineral soil--both exposed mineral soil and that covered with a light layer of organic material.

3. Slash--soil surface completely covered with a layer of limbs and logging debris.

4. Heavy vegetation--plot dominated by brush and herbaceous vegetation.

5. Swampy--areas of high water table usually dominated by sedges.

Seed fall counts were started on the study area in 1949 and continued through 1952. Since this record did not include the first 2 years after timber was cut, seed fall cannot be correlated directly with natural regeneration for that period; but the record does provide a basis for estimating annual seed fall and seed distribution. Seed traps near the center of the study area indicated an average seed fall of 421,975 sound seeds per acre per year for the 4-year period. 2/ This amount included

2/ Ruth, Robert H., and Berntsen, Carl M. A 4-year record of Sitka spruce and western hemlock seed fall. Pacific Northwest Forest and Range Experiment Station, Research Paper No. 12, 13 pp. March 1955.

Table 1.--Natural regeneration, 21-acre clear-cut area, Cascade Head Experimental Forest

Item	November 1952	March 1954
TOTAL TREES PER ACRE	12,887	15,714
ESTABLISHED TREES PER ACRE		
Total	2,062	4,406
By aspect		
North	2,962	6,137
South	1,162	2,662
By species		
Spruce	956	2,331
Hemlock	969	1,950
Douglas-fir	137	125
By treatment		
Burned	1,750	4,887
Unburned	2,375	3,925
PERCENT STOCKING		
Total	62	81
By aspect		
North	76	90
South	49	72
By species		
Spruce	46	53
Hemlock	47	44
Douglas-fir	7	3
By treatment		
Burned	54	76
Unburned	71	86

more than a pound of hemlock, and nearly three-fourths pound of spruce seed per acre annually. Douglas-fir seed fall was negligible. Fifty-six percent of the seed fell on the south aspect and 44 percent on the north aspect. The unburned east half of the study area received more seed than the west half that was broadcast burned, probably because much seed was released from cones by drying east winds.

Results

In November 1952, 5 years after logging, there were 12,887 seedlings per acre on the study area. Of these, 16 percent, or 2,062 were classified as established (table 1). In March 1954, one growing season later, there were 15,714 seedlings per acre on the area; 4,406, or 28 percent were well established. These figures indicate that seed supply was plentiful despite losses due to rodents, birds, and germination failure.

Nevertheless, the area was not fully stocked because of gaps in seedling distribution. Based on the stocked milacre plot system of measurement, which considers seedling distribution, stocking was 62 percent in November 1952, and 81 percent in March 1954.

The number of established trees and the stocking varied greatly with aspect. Both the 1952 and 1954 examinations revealed more than twice as many established seedlings on the north aspect. The 1954 examination showed 90 percent of the milacre plots on the north aspect were stocked with one or more established trees, compared with 72 percent on the south aspect.

Spruce showed a greater capacity to become established than hemlock. Although hemlock comprised about 73 percent of total annual spruce-hemlock seed fall, only 44 percent of the seedlings established in 1954 were hemlock and 53 percent were spruce (table 1). The ratio was about the same for both aspects.

More established seedlings were found on the unburned than on the burned area in 1952, but the situation was strikingly reversed in 1954 (table 1). This change occurred even though 50 percent more seed reached the unburned area, and the change is interpreted to mean that burning favored seedling establishment by reducing debris and retarding competing vegetation. The conclusion that slash burning favored seedling establishment agrees with results obtained by Morris 3/ in

3/ Morris, William G. Record of regeneration stocking in 1953 on burned and unburned slash study plots. Manuscript report. Pacific Northwest Forest and Range Experiment Station. 1954.

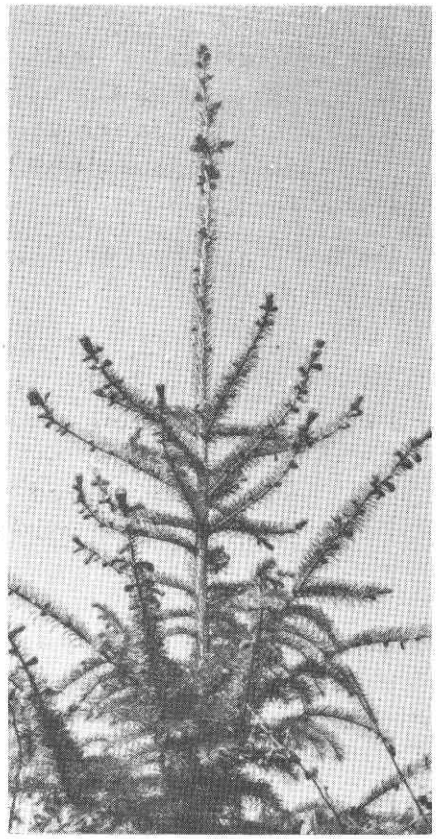

Figure 3.--This 63-inch spruce thrived in full sunlight after it received partial "dead shade" during the first 2 or 3 years after germination.

studies in this area and others along the Oregon coast. Results were slow to show up, however, owing in part to the destruction of the 1947 seed on the burned area.

Although the burned area supported the greater number of established seedlings, the unburned area had the higher percent of stocking: 76 percent on the burned compared to 86 percent on the unburned. It was not determined what factors, if any, besides the greater volume of seed on the unburned area contributed to the better distribution.

Rotten wood provided the best conditions for seedling establishment, followed in descending order by mineral soil, slash, heavy vegetation, and swamp. Forty-two percent of the total plot area was classified as rotten wood and was 97 percent stocked. Twenty-six percent was classified as mineral soil and was 83 percent stocked. Slash and heavy vegetative cover each dominated 15 percent of total plot area and were 67 and 62 percent stocked, respectively. The 2 percent of plot area classified as swampy was unstocked.

Rotten wood was an especially good seedbed because tree seedlings started on it readily, but competing vegetation apparently did not. Frequent summer fogs and rain provided the moisture to sustain the good growth on rotten wood. Mineral soil is a very favorable seedbed for other vegetation as well as for tree seedlings. Competitors were usually strong on mineral soil, sometimes crowding out tree seedlings that seemed well along toward establishment.

Accumulations of slash, on the other hand, seemed to retard both trees and other vegetation. Dense slash prevented much seed from reaching a seedbed and shaded out many seedlings which did germinate.

However, slash burning seemed to reduce the shade to a point where it was an aid to seedling establishment. After becoming established, seedlings thrived in full sunlight (fig. 3).

Only swampy areas, a very small part of the total study area, were more poorly stocked than areas dominated by heavy vegetation. All kinds of dense vegetation appeared detrimental, but brush patches which were present in the original stand and survived the logging and slash fire were especially bad (fig. 4). These patches completely dominated the site, and seedlings were seldom found under them. Much of the failure of seedling establishment on the south slope was attributed to drying out of the seedbed and to heat injury to seedlings on the steeper portions. Natural regeneration on this area should have been supplemented by planting.

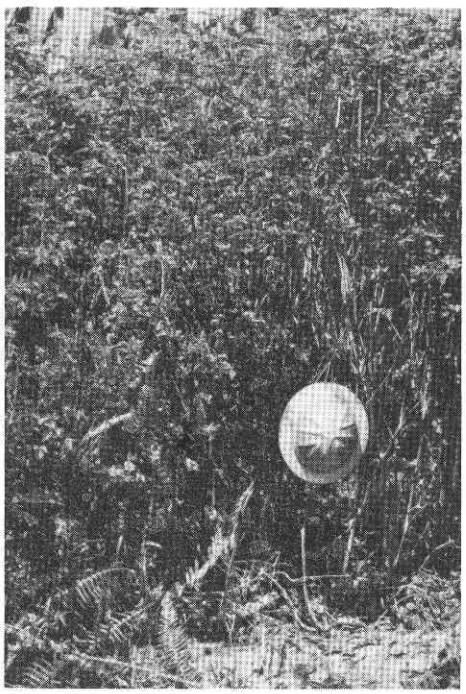

Figure 4.--This 6-foot-tall patch of salmonberry brush (Rubus spectabilis) started under the original stand. Trees failed to survive under this dense cover.

Special treatment of swampy areas was probably not warranted because of their small area. Treatments probably were warranted, however, in areas of heavy vegetation and slash. Broadcast burning would have improved conditions for seedling establishment on the unburned area by reducing slash accumulations and retarding development of the competing vegetation. Chemical brush control might have been used alone or in combination with the burning. Burning would not be appropriate, however, on areas well stocked with advance reproduction. Planting also might have been helpful in cleared brush areas by giving trees a head start on new brush.

Eighty-one percent of this clearcut was stocked with established trees 6 years after logging. Stocking on the remaining 19 percent could have been obtained by early recognition of problem areas and special treatments to facilitate seedling establishment.