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EARLY EFFECT OF TWO SUCCESSIVE THINNINGS IN WESTERN HEMLOCK

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The Hemlock Experimental Forest near Grays Harbor in western Washington was established in 1949 in cooperation with the St. Regis Paper Company. A major effort in this cooperative research program is a study of commercial thinning 1/ in a stand of nearly pure, well stocked, even-aged western hemlock that originated in 1903, after logging.

Thinning treatments under investigation in a compartment-scale study include:

1. Crown thinning at 3-year intervals.
2. Crown thinning at 6-year intervals.
3. Low thinning at 3-year intervals.
4. Low thinning at 6-year intervals.
5. No thinning.

1/ Staebler, G. R. Design for a test of commercial thinning on the Hemlock Experimental Forest. Mss. on file at Portland, 2-17-57.

Compartments vary in size from 15 to 25 acres. The first thinnings were made in 1952 and the volume removed in each thinning roughly equals 85 percent of the gross cubic-foot increment for the 3- or 6-year period. Detailed cost records are providing a measure of financial practicability of the several methods of thinning. Silvicultural data on growth and yield are obtained from 16 to 25 permanent 1/10-acre sample plots mechanically spaced in each compartment.

By 1956, the low and high thinning compartments in the 3-year cycle had been thinned twice and a growth record for the same period was available for the unthinned compartment. This interim report is based on the records from these three compartments and covers only a small part of the total experiment.

Original Stand and the First Thinning

The stand when thinned in 1952 was 49 years old, and is nearly pure western hemlock with small amounts (less than 10 percent by cubic volume) of Sitka spruce and Douglas-fir. Site index is 157 feet based on the revised site index curves. 2/ The stand is well stocked except for widely scattered small openings or poorly stocked areas. Though predominantly even-aged, scattered trees from the original stand are present. These include both trees that must have been part of the main canopy and those that were in the suppressed understory. Many of these older trees are poor quality and infected with mistletoe. Some were cut in thinning where their removal favored remaining trees.

Before thinning, stands in the three compartments averaged 9,100 cubic feet per acre. 3/ However, the check stand, with 10,900 cubic feet, contained nearly one-third more volume than the stands to be thinned, which averaged 8,200 cubic feet (fig. 1). Scribner volume 4/ averaged 41.2 M board-feet per acre, with nearly 50

2/ Barnes, G. H. Site classifications for even-aged stands of western hemlock. Pacific Northwest Forest and Range Experiment Station Res. Note 50. 1949.

3/ Cubic volume includes volume of trees larger than 5.5 inches d.b.h., measured to a 4-inch top.

4/ Scribner volume includes volume of trees larger than 11.5 inches d.b.h., measured to an 8-inch top.

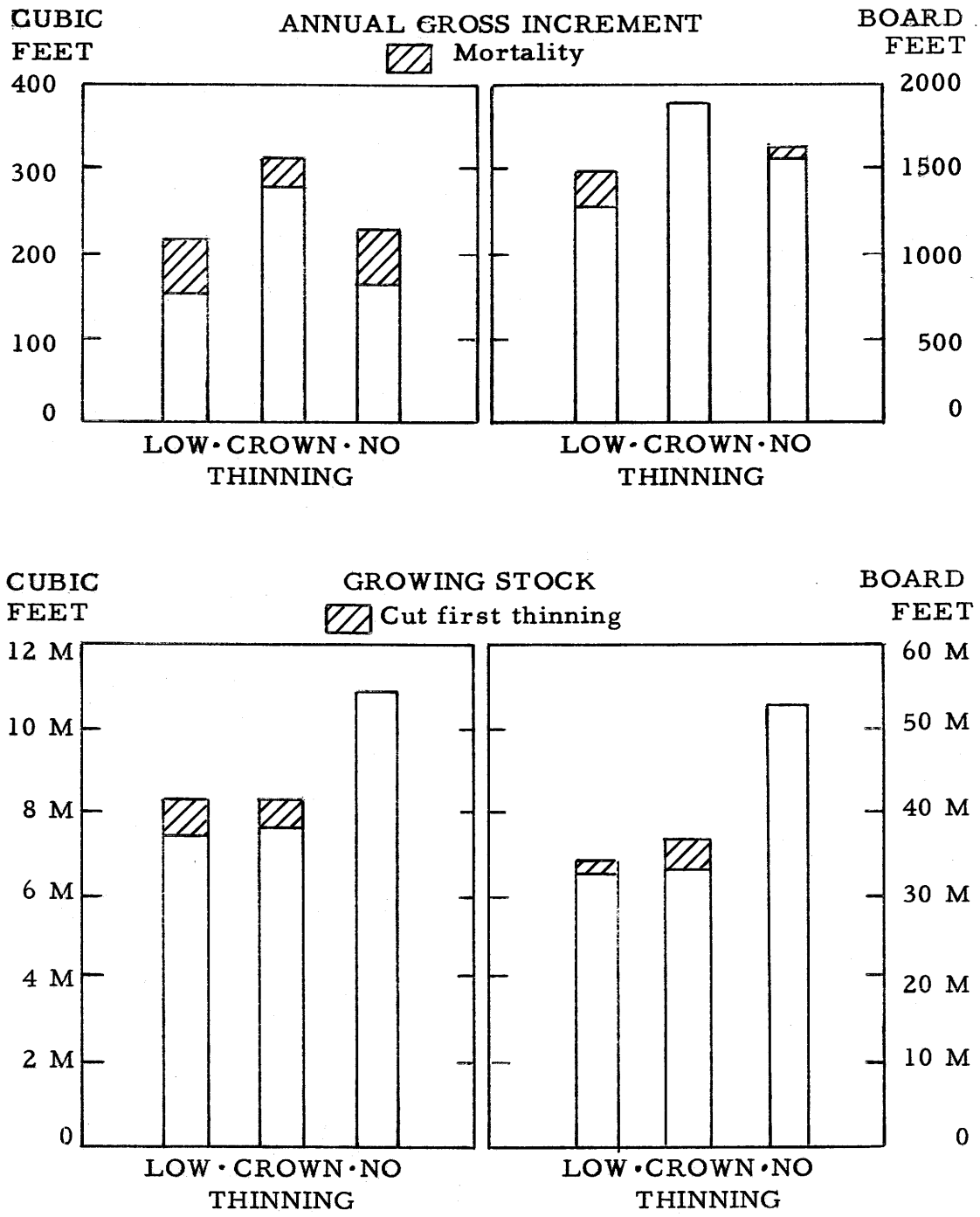

Figure 1. --Annual gross and net increment following thinning and growing stock before and after thinning (per acre basis).

percent greater volume in the check compartment (52.8 M) than in the thinned (35.5 M). The much greater initial volume of growing stock in the check compartment at least partially invalidates simple growth comparisons for thinned and unthinned stands.

Thinnings were purposely very light. Objective was removal of 85 percent of 3-years' increment at each thinning. Low thinning removed 631 cubic feet per acre or 7.6 percent of the volume (fig. 1). The approximately 30 trees cut per acre averaged 11.1 inches d.b.h. Saw-timber-sized trees removed contained only 1,474 board-feet, 4.4 percent of the total.

Crown thinning removed 495 cubic feet or 6.1 percent. Since most of this volume was in larger trees (averaging 16.9 inches), their board-foot volume was 2,768 board-feet, representing 7.6 percent of the total. Only 8.4 trees per acre were cut.

Increment Following Thinning

Gross annual increment[5/] per acre following thinning was:

Crown thinning	312 cu. ft.	1,913 bd.-ft.
Low thinning	216 cu. ft.	1,484 bd.-ft.
No thinning	222 cu. ft.	1,638 bd.-ft.

Ingrowth was a negligible part of cubic foot growth, but accounted for approximately 22, 25 and 20 percent of the board-foot growth on the crown, low, and no thinning compartments, respectively.

Mortality occurring during the period between measurements offset 10 percent of cubic foot increment following crown thinning, 30 percent after low thinning, and 27 percent in the unthinned stand. Corresponding percentages for board feet were 0, 9, and 1, indicating that most mortality occurred in trees less than saw-timber size. The biggest single cause of mortality was breakage of tall, slender trees following a heavy, wet snow that fell during the latter half of

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5/ Period between measurements was 3-1/2 growing seasons for low thinning, three growing seasons for crown thinning, and five growing seasons for the check compartment.

January 1954. 6/ Mortality from this cause was slightly heavier in the compartment thinned from below than in the unthinned compartment. It was least in the crown thinning. Apparently low thinning was not successful in forestalling mortality. However, since most of the mortality was caused by one isolated storm, this first experience may not be typical.

The variations in periodic annual increments noted above and shown in figure 1 probably should not be interpreted as being caused only by the thinning treatments. Structure of the three stands is so different that any real effects of the thinning treatment are probably masked by other variables, at least for the short growth period studied.

However, it is important to note that gross increment in thinned compartments almost equalled or exceeded increment in the unthinned check, even though thinned areas had far less growing stock before the initial thinning. As a result, ratio of gross growth to growing stock (growth percent) is much more favorable in the thinned compartments, as shown below:

	Cubic-foot	Board-foot
Low thinning	2.9	4.5
Crown thinning	4.1	5.7
No thinning	2.0	3.1

These differences in growth percents are believed valid despite initial differences between stands. If the lower initial growing stock in the thinned stands had resulted from prior thinnings rather than from natural causes, periodic gross growth and growth percent might have been very similar to those obtained in this study.

Disposition of Increment at Second Thinning

What becomes of wood grown between thinnings? Analysis of the disposition of this increment is important in a study of repeated thinnings and is shown in figure 2. Here gross increment that

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6/ Weather Bureau, U. S. Dept. of Commerce. Climatological Data Washington 1954, 58(1).

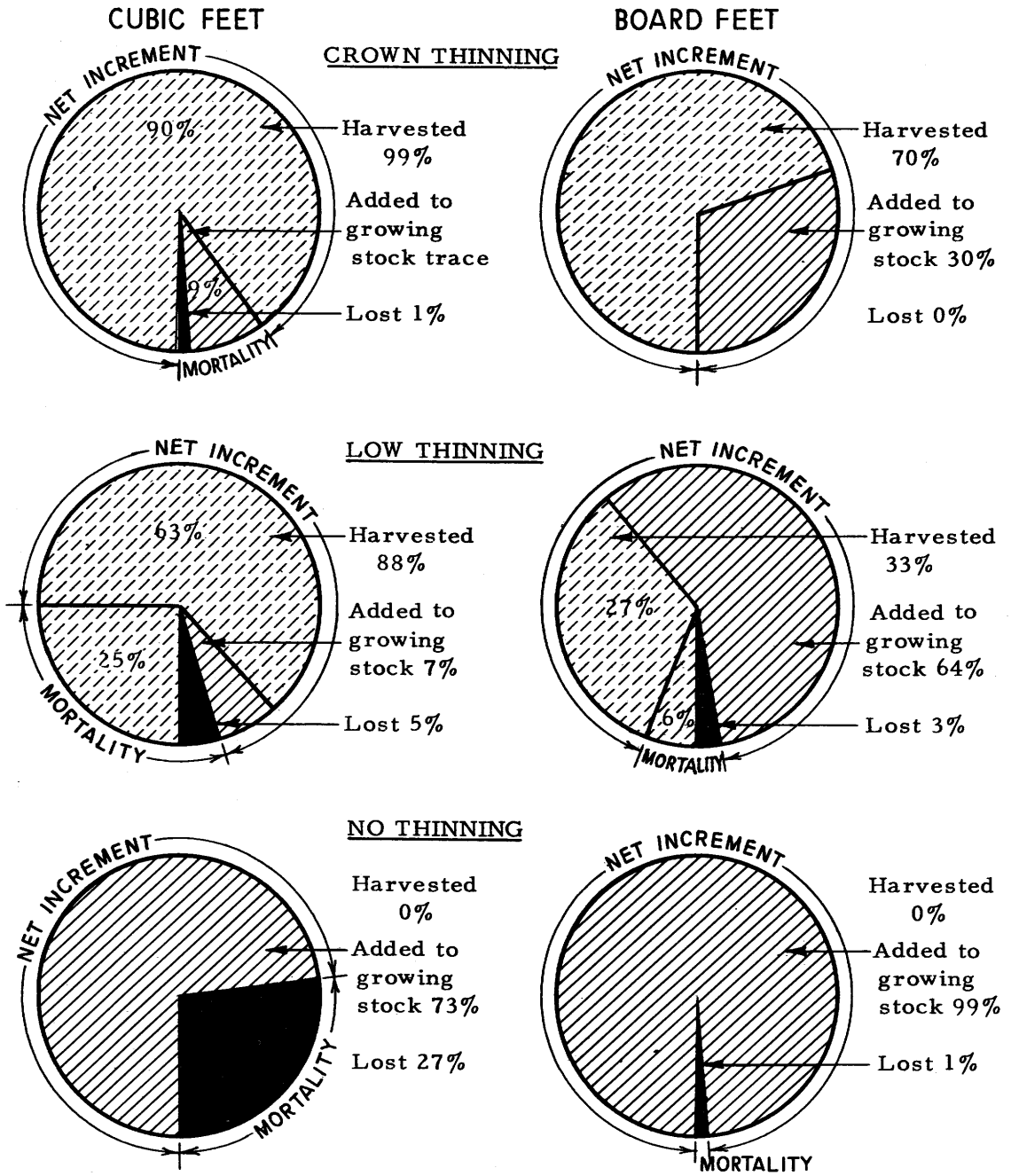

Figure 2.--Percentage disposition of gross increment (net increment and mortality) at second thinning.

occurred between thinnings, separated into net increment and mortality, is divided into four categories: unsalvaged mortality, salvaged mortality, net increment harvested, and net increment added to growing stock.

Figure 2 brings out one of the foremost advantages of frequent thinning. Whatever the reason, the first thinning was not too successful in reducing subsequent mortality. However, 82 percent of the cubic foot mortality that did occur was salvaged in the second low thinning and 87 percent in the second crown thinning. Thus, in low thinning, 95 percent of gross increment occurring between thinnings was either cut in the second thinning or added to growing stock; in crown thinning, 99 percent. In contrast, in the check compartment, 73 percent of gross increment was added to growing stock and 27 percent was lost since mortality was unused.

Realized increment--the volume harvested in thinning plus the volume added to growing stock--measures the contribution to total yield during the growth period. By this measure the low thinning compartment grew 205 cubic feet, the crown thinning compartment 308 cubic feet, and the unthinned stand 163 cubic feet (equal to the net increment).

For the unthinned stand, growth percent calculated from realized cubic foot increment is only three-quarters of that computed for gross increment (reduction from 2.0 to 1.5 percent). But in the thinned compartments growth percents calculated from gross and realized increment are only slightly different, further demonstrating the advantage of thinning.

Realized increment in terms of board-feet is almost identical to gross increment since so few saw-timber-size trees died. However, as the stand grows older and larger, the advantages of thinning may be expected to show up in this measure, also.

Summary

Measured increment and other stand data are presented for three compartments in a commercial thinning experiment on the Hemlock Experimental Forest. Two thinnings, 3 years apart, have been made; low thinning in one compartment, crown thinning in another. A third compartment was left unthinned as a check. Gross increment was approximately equal in unthinned and thinned-from-below compartments, and considerably higher in the crown-thinned

compartment. Differences are not believed to be entirely due to the thinning treatments applied.

Realized increment, which is the sum of mortality salvaged in the second thinning and increment retained in the growing stock, shows a pronounced advantage for thinning. After low thinning, realized increment was 205 cubic feet (95 percent of gross increment); crown thinning, 308 cubic feet (99 percent of gross increment); and unthinned, 163 cubic feet (73 percent of gross increment).