Theory and Practice of Commercial Thinning in Douglas-Fir

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Thinning is doubtless the major silvicultural practice that characterizes the change from extensive to intensive forestry. As a positive cultural practice, it goes beyond the basic protection and regeneration measures that keep forest lands productive. In fact, forestry cannot properly be called intensive until deliberate cultural practices such as thinning are undertaken.

Though premerchantable thinnings probably have more far-reaching economic effects, this discussion is limited to commercial thinnings—those that produce merchantable products having a value at least equal to the cost of their extraction.

About 5 million acres of young-growth Douglas-fir (Pseudotsuga menziesii [Mirb.] Franco) within the Douglas-fir region of Oregon and Washington could be termed "ripe for thinning." This estimate is based on reasonable specifications of stand age, terrain, site, accessibility, and markets. Commercial thinning of this acreage is believed capable of adding $3{1\over2}$ million cords, or $1{1\over4}$ billion board feet, to the annual cut of the region without impairment of existing productivity.

Theory of Thinning

Thinning, like all phases of silviculture, is an art and must be applied according to the judgment of the practitioner. It embodies two major objectives that will result in economic gain: (1) redistribution of total stand growth to fewer trees and (2) utilization of all merchantable material produced during a rotation.

In the Douglas-fir region several incidental benefits may follow automatically in a thinning that carries out these two main objectives: (1) reduced fire hazard, (2) reduced likelihood of disease and insect attack, and (3) retention of trees with desirable hereditary characteristics as a seed source for the succeeding stand.

Knowledge and understanding of the silvical factors that control development of trees and stands are necessary for the intelligent application of silviculture. For thinning, important factors include (1) tolerance, (2) variation among trees, (3) growth in height, diameter, and form, (4) wood and tree quality, (5) site preferences, and (6) wind-firmness.

Since Douglas-fir is intolerant of shade, stands are universally even-aged and usually well enough stocked to benefit from thinning at early ages. Diameter varies widely in thinnable stands, with the range roughly equal to the average diameter of the stand plus 2 or 3 inches. Height growth is rapid after the first 10-year period, an important characteristic in thinning since growth in height largely controls crown development. Crown development in turn governs tree response following release. Increased diameter growth, which is sought in thinning, depends upon maintenance of large, thrifty crowns, at least 40 to 50 percent of total height. Such crowns require ample growing space. Rapid diameter growth of selected trees can be sustained up to ages of 70 years on good sites. The smaller trees in a well-stocked
Thinnings will affect stand yields in two ways, which in turn will influence choice of rotation: (1) by increasing diameter growth of the average tree and (2) by delaying culmination of mean annual increment. An above-normal diameter growth rate can be attained only if thinnings are started early enough in the life of the stand to satisfactorily redistribute increment. The rotation under a thinning regime should ordinarily be long enough to produce a tree that is larger on the average than that produced in unmanaged stands. For stands on sites II and III, gross board-foot increment (assuming periodic salvage and utilization of most merchantable mortality) culminates about 30 years later than net increment.

Growing-stock levels in periodically thinned stands may be held much lower than those normally found in unmanaged stands, with little or no sacrifice of increment. This is true because (1) every well-stocked stand includes many trees that contribute very little to total increment, (2) individual tree diameter growth in well-stocked stands is far below the maximum possible, and (3) under a thinning regime many trees that will die before the next thinning can be removed from the growing stock.

Thinnings will increase total yields through salvage of normal mortality and production of larger trees. At a rotation age of 100 years, frequent commercial thinnings may increase board-foot yield from 20 to 30 percent over that in unmanaged stands. These modest estimates do not consider the possible effects of early premerchantable thinnings, which will promote even greater yields, according to the fragmentary evidence now available.

**Applicability of Thinning**

A commercial thinning should be carried out if it can be done at a profit and is silviculturally desirable. Some of the physical and economic factors influencing profit from thinning are:

1. **Crews.** Small, independent contract crews of 1 to 4 men, with a productivity exceeding 2 cords per man-day, operate more efficiently than large company crews.
2. **Access.** Good accessibility keeps road costs moderate.
3. **Markets.** Ready markets must exist for material produced and be within an economical hauling distance.

4. **Topography.** The effect of topography on skidding is most important. Horse skidding is difficult on slopes over 40 percent. Crawler tractors may handle slopes only slightly steeper. A modified highlead system has been used successfully on slopes up to 60 percent.

5. **Stand characteristics.** Size of trees to be cut and amount cut per acre must be sufficient for a profitable operation. In the Puget Sound area, minimum requirements are approximately 7 inches d.b.h. and 5 cords per acre, respectively.

Thinning methods should doubtless follow a flexible rather than a rigid sequence. A sequence of methods similar to the following is suggested: If the largest trees in a young stand (ranging from 20 years on site II to 40 years on site IV) are merchantable, a selection thinning (removal of largest stems) may be made. After the largest, roughest trees have been removed in two or three light selection thinnings, crown thinnings should be started to favor potential crop trees. Thinnings of this kind should normally be carried on until it is no longer possible to redistribute growth to trees in either the upper or lower crown classes. By this time, trees in the lower crown classes will be of merchantable size and low thinnings will be practicable. Normally, a series of low thinnings would then be made before final harvest.

Marking is the essence of thinning. Suggested marking rules would remove trees in the following order of priority: (1) merchantable trees that are dead, will not live until next thinning, or are slow growing; (2) rough, limbly dominants whose removal will release trees of better quality; (3) trees whose removal will improve spacing, provided remaining trees will respond to release; and (4) diseased, misshapen trees. In applying the guides, however, no reserve tree should be released on more than one side in any one thinning. Application of these guides will result in a thinning that follows no classical system.
Marking time may run from 0.05 to 0.10 man-hour per cord or 0.12 to 0.50 man-hour per M board feet. Severity of thinning is difficult to specify, but volume removed can be placed at roughly one-half of the cubic-foot increment between thinnings. This may range from 1-1/2 percent per year of growing stock in older stands to perhaps 4 percent in younger or more responsive stands.

Carrying Out the Thinning Operation

Financial success of a Douglas-fir thinning hinges largely on how well the harvesting operation is geared to small trees and light cuts per unit area. Perhaps in no other forest type in the United States is there a greater contrast between logging the virgin stand and thinning young growth.

Permanent roads are necessary for successful thinning, and they often may be a limiting financial factor. However, temporary make-shift construction will in most cases prove uneconomical, and it is best to build roads that will be usable for harvest of the final crop and for other management purposes. Road spacing will depend upon skidding equipment, topography, and nearness of public roads. A reasonable estimate is 1 mile to 140 acres. At this spacing, the right-of-way occupies approximately 3 percent of the forest area. Allowing a 20- by 20-foot spacing for final crop trees, however, compensates for over half of the road area loss.

Light, mobile, inexpensive equipment should be the rule in thinning young stands, since large, fixed equipment cannot produce enough volume to give reasonable unit costs. Many thinning jobs are overmechanized and overmanned. More research on thinning equipment is needed; meanwhile, horses, light rubber-tired tractors, or very small crawler tractors seem best.

The extraction process naturally divides into two parts: (1) felling, bucking, and skidding; and (2) loading and hauling. For large-scale commercial thinnings, foresters might consider dividing the work along these lines. The woods work could be contracted to small crews limited to roadside delivery. Company or larger contractors might take over at this point with a crew specifically equipped for loading and truck hauling.

Conclusions

Douglas-fir often grows in such dense stands that, without thinning, crowns become greatly shortened and growth inevitably suffers. In younger stands (less than 70 years), this condition may be remedied by thinning, which releases chosen trees and stimulates their growth.

Thinning produces small wood and lots of it. This fact is a controlling influence in determining thinning methods or combination of methods. Marking is influenced by minimum merchantable tree size and stand age. Extraction methods, crew organization, and equipment must also be built around this obvious limitation of tree size. Probably the greatest single hurdle in carrying out a profitable commercial thinning in the Douglas-fir region is the failure to recognize that thinning is an entirely different operation from logging mature timber.

In preaching the gospel of thinning, we must keep in mind that the objectives of thinning older stands (over 70 years) are limited to salvage of mortality and realization of income before final harvest. In these older stands, no growth stimulation or marked improvement in tree quality can be expected. To achieve growth and quality improvement, commercial thinnings should be started in the 30- to 50-year age class or even earlier.