

Thinning Systems for Western Oregon Douglas-fir Stands

W.H. Emmingham and D. Green

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Thinning is removing selected trees from a stand to allow others to continue growing. Ordinarily, a woodland manager uses a thinning system that encourages the remaining trees to grow in a manner consistent with the manager's objectives for those trees.

This publication will help you understand how to thin Douglas-fir. It also will help you choose the proper thinning system to achieve your objectives. You can apply the methods discussed here to all predominantly even-age and well-stocked Douglas-fir stands west of the Cascade crest in Oregon.

Thinning is the best way to maintain maximum diameter and board-foot volume growth in Douglas-fir stands. It can produce income at 5- to 10-year intervals instead of at 30- to 50-year intervals without thinning. It also can lengthen the time span in which a stand produces income.

Basic stand growth

A stand is a collection of living trees. It usually begins as hundreds of small seedlings per acre of land.

As these trees grow, they eventually occupy all the growing space, crowd out lower growing plants, and compete with each other just as carrots compete in a garden. Unless some of the trees die or are removed, others cannot continue to grow.

Certain trees dominate by slowly pulling ahead of their neighbors. They become stand *dominants* or *codominants* (see Figure 1, page 2) and later are harvested as *crop* trees.

Those that lose in this race for space, water, and light gradually fall behind, becoming *intermediate* and eventually *overtopped* or *suppressed* trees. They slowly die, fall to the forest floor, and rot.

Thinning removes trees before growth slows, thereby preventing mortality. It keeps crop trees growing rapidly.

It is easy to see the result of this process in the relative size of tree crowns (crown class) and stems within an undisturbed stand. Dominant trees have the largest diameters and crowns, whereas suppressed trees are smaller in diameter and shorter and have thin, short crowns.

William H. Emmingham, Extension silviculturist emeritus; and Daniel Green, former Extension forester, Clackamas County; both of Oregon State University.

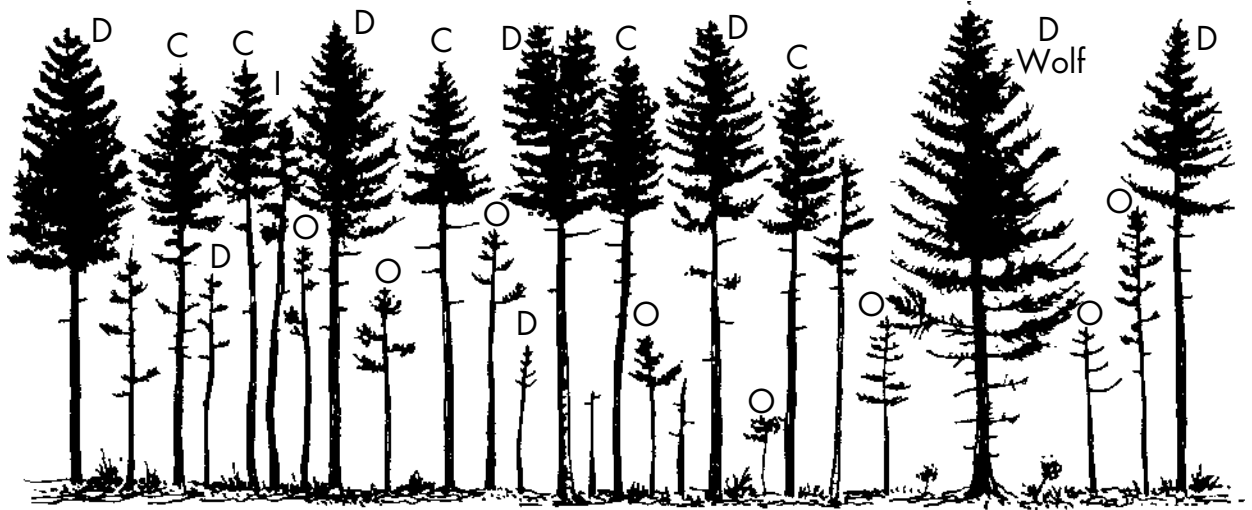


Figure 1.—A typical Douglas-fir stand, with dominant (D), codominant (C), intermediate (I), and overtopped (O) trees. A wolf tree (W)—one that occupies more space than it warrants—also is part of the stand. The relative amount of crown, height, and diameter of each tree determines its crown class.

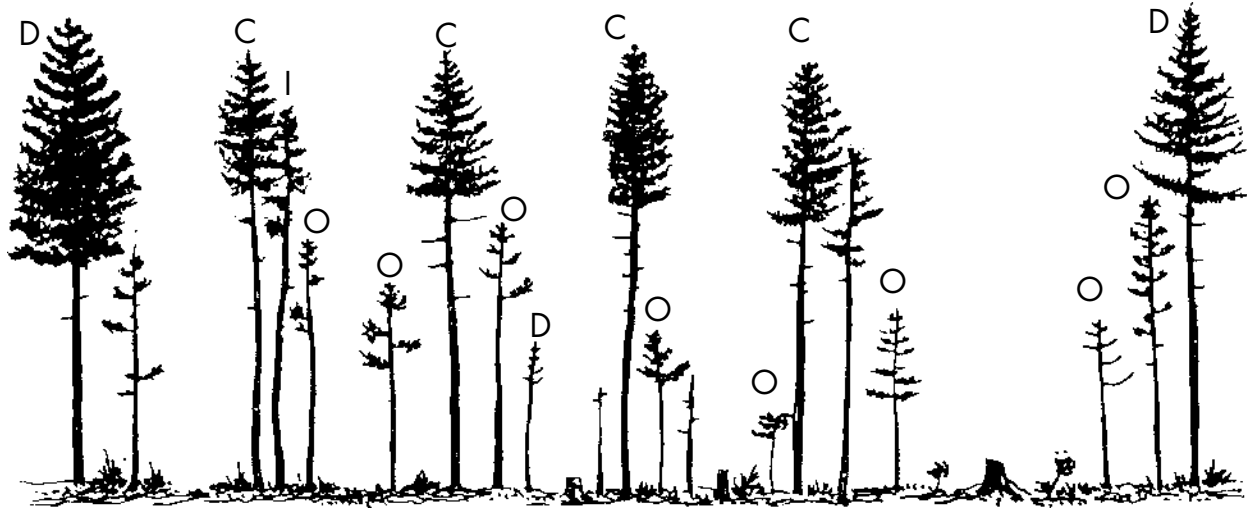


Figure 2.—The stand in Figure 1 will look like this after a high thinning removes various dominant trees, leaving codominants, dominants, intermediates, and overtopped trees to continue growing.

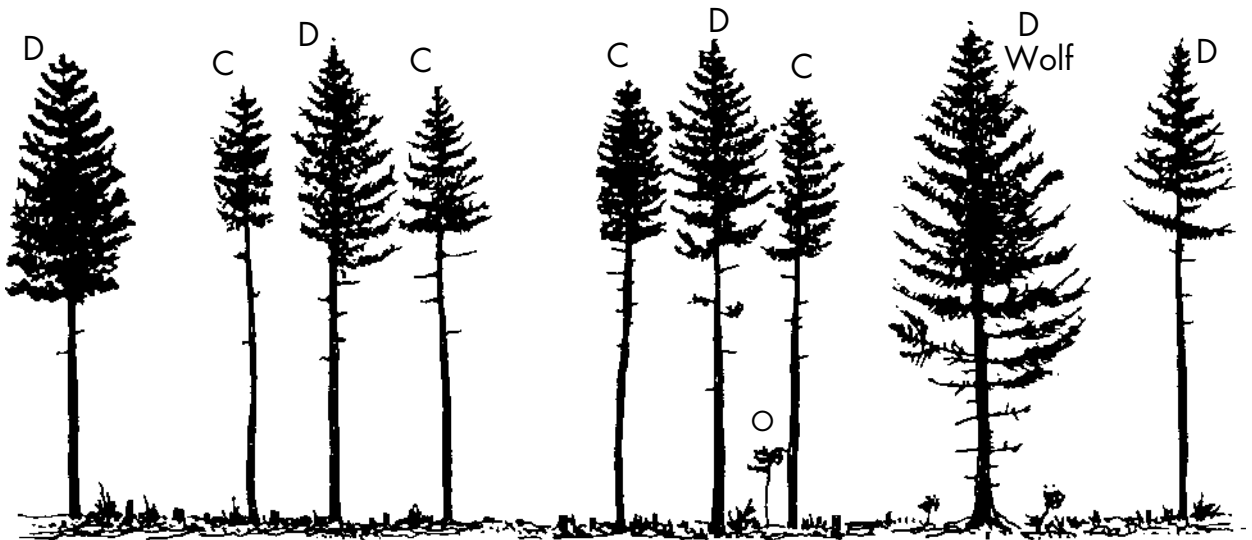


Figure 3.—The stand in Figure 1 will look like this after a low thinning removes all intermediate, most overtopped, and some codominant trees, leaving dominant trees to grow. Sometimes, a low thinning also removes wolf trees because they take up so much growing space.

In extreme cases of stand competition, growth in both diameter and height is restricted and trees stagnate, staying virtually the same size for years. A proper thinning system prevents stagnation. Fortunately, Douglas-fir does not tend to stagnate, especially on more productive sites.

Find further discussion of thinning basics in Extension publication PNW 184, *Thinning: An Important Timber Management Tool* (see page 8).

Thinning options

Timing

Precommercial thinning is thinning before trees are large enough to sell. Its objective is to give remaining young trees room to grow as quickly as possible to merchantable size. Precommercial thinning is necessary when young stands are overstocked or when some trees are poorly formed. (Young Douglas-fir stands are considered overstocked if they have more than 350 to 400 trees per acre.)

Although a precommercial thinning can be expensive, most foresters agree it is economically advantageous. Delaying precommercial thinning delays the accumulation of merchantable board-foot volume, increases mortality, and increases risk of stagnation.

The chief disadvantage of precommercial thinning is the expense. However, federal cost-share assistance might be available; see Extension publication EC 1119, *Incentive Programs for Woodland Management and Resource Conservation* (see page 8).

A rule of thumb is to precommercially thin stands to a 10- or 15-foot average spacing by age 15 or before trees are 20 feet tall. This allows trees enough room to reach commercial size before competition slows diameter growth.

Some woodland owners have inherited or bought unthinned stands that are more than 15 years old or greater than 20 feet tall but are not marketable. These owners must decide whether to wait for stands to reach commercial size slowly or to do a late

precommercial thinning. If such stands are severely overstocked and tending toward stagnation, owners should complete precommercial thinnings.

Some woodland owners have found markets for material that is too small for saw logs. This allows recovery of some precommercial thinning expense. Fenceposts, barn poles, and firewood are a few of the products.

Commercial thinning turns a profit immediately. A good commercial thinning system improves the stand's ability to grow, thereby producing further profit. It leaves healthy trees with live crowns extending more than 30 percent of the length of the trees' height. Also, proper thinning does not injure *leave* trees—those that remain after thinning. Collectively, leave trees compose the growing stock.

Thinning shock, sunscald, and windthrow are major reasons to avoid delaying thinnings.

Thinning shock When stands are allowed to compete excessively, the crown recedes to the uppermost portion of the tree. When thinned, these small-crowned trees are not capable of using the added light and space. In fact, they may experience thinning shock and stop growing for a few years after thinning.

Sunscald Tree trunks exposed suddenly to the sun after thinning might react with a condition called *sunscald* in which the hot sun on the south side of the tree kills the living and growing portion of the tree immediately under the bark. This results in defective logs and reduced growth and profit from future harvests.

Windthrow Windthrow and breakage might follow after heavy thinning in stands left too long unthinned. The slender trees that a late precommercial thinning leaves often are bent or broken by wind or snow.

Thus, promptly thinning Douglas-fir stands will prevent problems in addition to promoting rapid growth.

High and low thinning

Commercial thinning strategies include *high* (top or crown) thinning and *low* thinning. They differ by the crown class of trees removed. Each system has its own characteristics.

A *high thinning* removes dominant and codominant trees but *not* to the point that the growing capacity of the stand is seriously reduced (Figure 2). You must carefully choose the relatively few dominants to remove so you give other dominants, codominants, and even some intermediate trees a better chance to continue growing.

High grading is high thinning carried too far. It removes so many trees that future stand growth and tree form are downgraded. High grading eventually results in financial loss because it robs the growing stock to the extent that future growth is reduced excessively.

As compared with low thinning, high thinning has the advantage of increasing the volume per tree cut. Because large trees are cut, the average stand diameter decreases and leave trees have smaller live crown ratios.

Proper high thinning, however, leaves many stems per acre. Its chief advantages are that it:

- Allows early logging of marginally commercial stands
- Reduces logging costs by taking only a few large trees per acre
- Makes more options available for future thinnings

The major disadvantage of high thinning is that people tend to get greedy and take too many dominant and codominant trees. This leads to thinning shock and poor growth response in the remaining trees and turns an intended high thinning into an objectionable high-grade cut.

A *low thinning* removes the less competitive trees from a stand (Figure 3). It takes all overtopped and intermediate trees and some codominant trees. The remaining dominants and codominants, which had the best crown positions, continue growing. Since slow-growing trees are removed, the stand continues to grow at a rapid rate.

To remove the same amount of board-foot volume, you need to remove more trees in a low thinning than in a high thinning. Because you remove the less competitive trees, you must take more of them to maintain or increase growth of the remaining dominant and codominant trees.

A common problem in low thinning is not taking enough trees. Logging costs are

high because many small trees are removed. If the stand is large enough to be only marginally commercial, you may have to wait several years to get a profitable low thinning, but you could carry out a high thinning immediately.

The chief advantages of low thinning are:

- Little delay in growth response
- Little risk of windthrow or thinning shock (because the trees that remain are those that were exposed to nearly full sun before thinning)

If special products are your objective, you can combine high and low thinnings. For example, managing for poles and piling requires frequently thinning trees from either high or low crown classes. A common practice is to do a high thinning as the first commercial thinning following with a low thinning later in the life of the stand.

You have a great deal of flexibility in thinning strategy as long as it improves your stand.

Intensity and frequency

Thinnings vary in *intensity* or number of trees removed. A thinning that removes only a few trees is referred to as light; a heavy thinning removes more trees.

Frequency, or how often you thin, is another major difference in thinnings. You can thin several times or only once during the life of an individual stand. Increasing frequency may increase injury to remaining trees as well as increase soil compaction on the site. Thinning at 5-year intervals is considered high frequency; a 20-year interval is low frequency.

Frequency and intensity apply equally to high and low thinning systems. Consider them a unit. To maintain an acceptable level of growing stock, you must balance the two—if you increase intensity, reduce frequency.

In summary, thinning systems vary with respect to:

- Timing—precommercial or commercial?
- Strategy— which crown classes to remove?
- Intensity—how many trees to remove?

These factors influence a stand's response in terms of volume growth rate, type of product produced, extent of defect, species composition, and, ultimately, the dollars returned from harvested timber.

Stocking guides

The stocking guidelines in Table 1 are averages based on measurements taken in hundreds of Douglas-fir stands. Well-stocked stands have average spacing and trees per acre that range between the understocked and overstocked limits. Research has shown that this is the approximate size and distance at which the full potential of a site is captured on fast-growing crop trees without tree mortality.

Before you thin, compare the present condition of your stand to your target stand. Determine your target stand by looking at the overstocked column in Table 1. If you want your stand to grow to 16 inches in diameter, leave 160 trees per acre at about 17-foot spacing.

For example, a stand with a 14-inch average diameter is considered well stocked if it has 90 to 200 trees per acre. The average acceptable distance between trees is 15 to 22 feet. If the stand is near the limit of 200 trees per acre, you should thin it soon. If it is near the 90-trees-per-acre limit, it will be years before thinning is advisable or necessary.

When using the stocking guidelines, it is important to realize that thinning changes the average diameter of trees in a stand. A low thinning removes small trees, increasing the average stand diameter.

In contrast, high thinning reduces the average stand diameter because it removes large trees. This change in average diameter can affect the number of trees and spacing you use as a thinning target.

For example, consider a 14-inch stand with 200 trees per acre. A high thinning that reduces the average diameter by 2 inches should leave no fewer than 120 trees per

Table 1.—Trees per acre and spacing limits for even-age Douglas-fir stands*

Average stand diameter (inches)	Understocked stands have		Overstocked stands have	
	Fewer trees per acre than	Wider spacing than about (feet)	More trees per acre than	Narrower average spacing than about (feet)
8	300	12	500	9
10	200	15	390	11
12	120	19	280	13
14	90	22	200	15
16	75	24	160	17
18	60	27	125	19
20	48	30	100	21
22	42	32	90	22
24	35	35	75	24

* Trees per acre and spacing for well-stocked stands fall between the understocked and overstocked limits.

acre. On the other hand, a low thinning that increases average diameter by 2 inches could leave as few as 75 trees per acre.

You have considerable flexibility in the frequency and intensity of cuts. If cuts are frequent, restrict intensity. Infrequent cuts, however, can be more intense.

The time it takes to grow from under- to overstocking depends on the productivity of a site. On a less productive site, this might take 20 years; on a very productive site, perhaps only 5 years. Nevertheless, the relationship holds for all sites on which Douglas-fir can produce a fully stocked stand.

How do you put it all together?

Imagine that you have a 10-year-old stand on high ground with more than 1,200 stems per acre and an average diameter of 2 inches. If you do nothing, the stand will be overstocked long before the trees have 8-inch diameters. Growth will slow, and trees will die.

Unfortunately, markets for small material are extremely limited. Therefore, you decide to do a precommercial thinning.

From the stocking table, you see that leaving 280 trees per acre will allow trees

to reach 12 inches in diameter before the stand is overstocked. Therefore, you remove three of every four trees, resulting in a 12- or 13-foot spacing. This spacing will produce fast growth on individual trees, and the stand will become marketable as quickly as possible.

Because the trees are not crowded, they should grow at about three annual rings per inch of radius. In 10 to 12 years, the average stand diameter should be 12 inches. The stand will have grown to the point of overstocking, and it should be thinned at that time.

You decide to remove one-third of the trees, leaving about 200 trees at a spacing of about 15 feet. If trees have an average growth rate of five rings per inch, these trees will need another 8 years to reach an average diameter of 15 inches.

At that time, you remove 100 15-inch trees in a profitable commercial thinning. This leaves about 100 trees per acre. You allow these trees to grow until they reach a 20-inch average diameter, the point of being overstocked. At that time, you harvest the rest of the trees and plant a new stand.

In another example, imagine you have three stands, each averaging 12 inches in diameter. Stocking is 100, 200, and 400 trees per acre. What do you do?

First, it is important to thin the dense stand down to about 120 trees per acre (18-foot spacing); otherwise, trees will die soon.

The stand with 200 trees per acre is in good shape—for now—but you should thin it after it grows 3 inches in diameter.

The stand with only 100 trees per acre will have room to grow for years before the trees average 20 inches in diameter. Then you would most likely harvest all the trees and plant a new stand.

What is best for you?

Many factors determine which thinning system is best for you. Of critical importance is the condition of your stand and the steepness of your ground.

Your management objectives and financial situation have a strong influence on what you should and can do. For example, you'll need to consider whether you need a periodic income from your woodland property and whether you can afford out-of-pocket expenses.

Other factors include the time you have to devote to planning and thinning, your skill level for doing part or all of the work, and your aesthetic tastes (light thinnings are less noticeable than heavy thinnings).

Both high and low thinnings require skill, experience, and judgment. However, some foresters believe damage is more likely during high thinning. A novice thinner might do a low thinning to be more cautious.

A forest's appearance is important to most landowners. Both high and low thinnings can be done in a way that leaves the forest neat and attractive. However, each system produces a different result. High thinning creates greater diversity of tree size but relatively few large trees. Low thinning produces a more uniform forest because big trees are left to grow bigger.

Regardless of whether high or low, intense thinnings tend to create a more open, sunny, brushy forest than do less drastic thinnings. Infrequent thinnings allow the forest more time to return to an undisturbed state than do frequent entries. Either of these characteristics might influence you toward one thinning system instead of the other.

Fragile areas (e.g., streambanks and wetlands) and areas with access problems can influence your selection of a thinning system. You might use intense, infrequent thinnings to reduce the number of times you disturb a fragile site. In a similar case, you might decide infrequent logging entry is the best way to reduce the environmental impact of a temporary stream crossing.

Stands on very steep slopes (greater than 60 percent) require expensive cable logging. They are difficult to thin because logging can damage residual trees. The best

strategy might be a heavy precommercial thinning followed by final harvest. (A 16-foot spacing would produce 170 trees with 14- to 16-inch diameters for final harvest.)

On moderately steep ground (40 to 60 percent slopes), infrequent thinning allows you to take enough volume to make cable yarding profitable. If your ground is gentle (less than 25 percent slope), you can choose from an array of thinning systems.

In young, marginally commercial stands, an intense high thinning might be necessary to cut enough big logs to pay for the thinning operation. This could improve the stand if most of the trees cut are defective or of poor quality.

A high thin can turn into a high grade when it removes most of the trees capable of good growth. In older stands, you might use either a high or low thinning system or a combination of both.

The types of products you can market might affect your choice of thinning system. A high price for poles of a certain length may dictate taking those trees that qualify.

Damage to trees from insects, disease, and weather also can influence thinning. If wind and ice damage large trees, a high thinning would be logical.

The type of thinning system you choose also will influence the way you regenerate a stand of Douglas-fir. A heavy, high thinning often promotes natural seeding in western redcedar and western hemlock. You can encourage this by managing a forest with continued thinning and no final clearcut.

Low-intensity low thinnings at frequent intervals lead to a clearcut, and you will need to replace the stand with young and vigorous trees.

When you fully understand these implications, you can choose a thinning system that delivers the kinds of benefits you seek from your forestland at the times you need them.

Summary

The thinning concepts described here are not difficult, but they may be confusing as you read them for the first time and try to relate them to each other. Here is a review of the key concepts.

Crown class

- Dominants—Larger-than-average trees with crowns that extend above a stand's crown level.
- Codominants—Medium-size trees that form the general level of crown cover.
- Intermediate—Trees that are shorter than dominants and codominants; crowns are below or extend into the crown cover formed by the larger trees.
- Overtopped—Small trees with crowns below crown-cover level.

Types of thinning

- Precommercial thinning—Removing small trees in a young stand to reduce competition and to accelerate growth of remaining trees to the point that they have commercial value. Consider this first thinning an investment, because what you spend now will pay off later.
- Commercial thinning—A profitable operation that removes trees from a developing stand to give the remaining trees more growing space. It improves individual tree growth.
- High thinning—Removing large dominant and codominant trees, thereby releasing the remaining trees to grow more rapidly.
- Low thinning—Removing small, noncompetitive trees (overtopped, intermediate, and some codominants) so remaining trees can continue rapid growth.

Thinning factors

- Intensity—The number of trees you remove. It can be light (removing only a few trees) or heavy (removing a lot of trees).

- Frequency—How often you thin. It can be high (5-year intervals) or low (20-year intervals).

The present condition of your stand, your management objectives and constraints, and the amount of time and skill you can devote to managing your stand are important factors in determining the best thinning system for you. Thinning systems vary according to:

- Frequency of cutting
- Intensity of cutting
- Proportion of crown class removed (high or low thinning)

Many combinations of frequency and intensity will keep your stands well stocked. Do remember that intensity and frequency must balance each other—if intensity is high, keep frequency low.

High thinning tends to produce greater income in early logging entries than does low thinning. Low thinning tends to produce greater income in later logging entries and creates a forest with greater standing timber volume and, therefore, greater value.

Because of these differences, high thinnings appeal to landowners who need a larger cash flow in the present decade than in the decades to come. Low thinnings appeal to landowners who want to defer income into future decades.

For more information

PNW 184, *Thinning: An Important Timber Management Tool*. 8 pages.

EC 1119, *Incentive Programs for Woodland Management and Resource Conservation*. 4 pages.

The above publications are available from:

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