



# Forest Thinning

## A Landowner's Tool for Healthy Woods

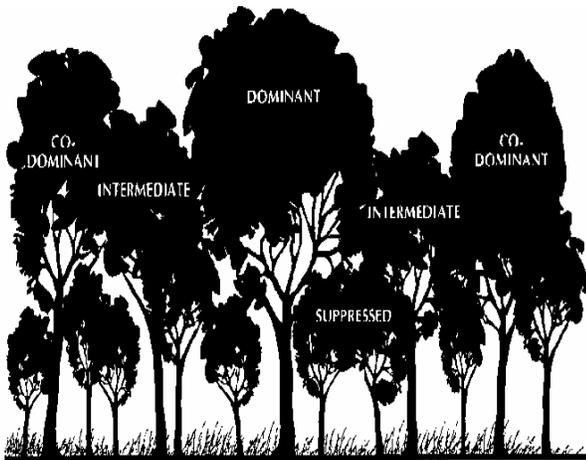
Trees and woodlands grow and change over time without any help from humans. However, their natural growth habits aren't always the best and quickest way for you to reach your goals as a woodland owner or manager. Forest thinning is a tool that woodland owners use to encourage trees to grow in a way that meets their goals.

Trees are in a constant and dynamic competition for light, water, and nutrients as a woodland develops. In most cases, light is the most critical factor and the trees that

grow the fastest into the canopy to capture the sunlight will dominate the others.

When you walk in the woods, there are trees of many diameters but you shouldn't think that just because a tree is larger than the rest, that it is also older. In fact, most forests are composed of trees of similar age (even-aged), and the larger trees won the competition for sunlight as the woodland developed. These larger trees have canopies that are dominant or co-dominant, while trees that have been less successful are intermediate or suppressed (Figure 1).

**Figure 1. Forest and Woodland Trees Have Different Levels of Dominance**



Robert Tjaden and Julia Klapproth, Maryland Cooperative Extension

As the woodland manager, you can thin the woodland by removing some of its trees. “Thinning” removes inferior trees to leave more resources for each of those remaining, allowing them to grow faster and bigger. The trees you choose to leave behind will have more sunlight and space. Their canopies will expand and produce more leaves, and therefore, more carbohydrates. This results in faster height and diameter growth. Thinning allows a tree that is struggling to compete to have the opportunity to become more dominant in the canopy. The trees to retain can be chosen for their potential for wildlife

**Figure 2. Comparison of Diameter Growth between a Dominant Tree in the Canopy and One That was Suppressed.**



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habitat, timber value, aesthetics, or whatever objective is *important to you*.

Although the total volume of growth per acre remains more or less the same after thinning,

**Value:** Traditionally refers to the potential for income through the sale of timber products, but may also refer to the quality of wildlife habitat, the level of aesthetic beauty, or any other goal towards which a forest landowner may work.

removing small and low-value trees results in bigger trees of greater value when the woodland matures. The woodland manager can focus on removing diseased or low-value trees that would interfere with the growth of high-value trees.

### Two Broad Categories of Thinning-- *Non-commercial* and *Commercial*

A woodland stand is a group of forest trees with similar species composition, age, and condition that is considered as a single unit for management purposes.

In young stands of small-diameter trees, landowners may choose to pay a contractor to implement a *non-commercial thinning* (also called pre-commercial thinning) to remove trees with limited commercial value for firewood or pulpwood. Removal of trees at this stage can reduce fuel that increases fire danger and promotes forest health and wildlife habitat. The primary reasons for non-commercial thinning are usually the long-term financial gain through improved timber quality and/or wildlife habitat.

Maryland Department of Natural Resources recommends against pre-commercial thinning during the April-August nesting season for forest interior-dwelling birds.

For example, white oak has a rotation length of 120 years or more. Rotation length is the time between stand establishment and the final

harvest. It can be shortened considerably by thinning early and regularly. A forester can help you decide if an investment in non-commercial thinning is likely to earn you more money when you sell the remaining trees for timber, or help you reach other objectives for wildlife, recreation, etc.

*Commercial thinning* provides an income opportunity between final harvests when you make a profit from the harvested trees. Possible products from thinning include utility poles, fence posts, firewood, pallets, lumber, fishing weir poles, and pulpwood. Research the market before thinning to know what products you will be able to sell in your area.

**Diameter at Breast Height (DBH)** is the diameter of a tree four and one half feet above the ground. The height may be adjusted to work around bulges or splits in the trunk.

A commercial thinning occurs later in the life of the stand and can remove trees of unacceptable form, species, or condition. Thinning allows more light to reach the forest floor, promoting the growth of understory vegetation and cover for wildlife habitat. Other possible benefits include increased carbon sequestration, more forage production, better aesthetic qualities, enhanced water quality, greater resistance to storm damage, increased

**Figure 3. Sections from a Tree in a Thinned Stand (left) and an Unthinned Stand (right). The black line indicates the time of the thinning when trees were 12 inches DBH. 25 years after thinning, diameter increased 3" in the uncut stand and 10" in the thinned stand, a tripling of the volume of wood produced.**



Jonathan Kays, University of Maryland Extension

fire control, and improved access to the stand for maintenance or recreation.

### Choices You Make in What, When, and How to Thin Depend on a Number of Factors

Your decision to thin will depend on site characteristics, your goals for the woodlot, species, age, and growth rate of the trees in question.

**So where do you begin?** First, determine the goals and objectives for your woodland. The choices you make today will affect your woodland for years to come, so you need to have a clear vision for your woodland. You also may need professional assistance from a forester.

Before taking any action, know your property boundaries and have them clearly marked. Walk the stand to better understand its assets

**Table 1. Internet Resources for Information on Identifying Trees**

Mapping and Planning	Tree ID
<a href="#">Forestry for the Bay</a>	<a href="#">Virginia Tech Tree Identification</a>
<a href="#">National Atlas</a>	Tree ID iPhone Apps
<a href="#">National Map</a>	<a href="#">Leafsnap</a>
<a href="#">Google Maps/Google Earth</a>	<a href="#">What Tree is That? Arbor Day Foundation</a>
<a href="#">Web Soil Survey</a>	<a href="#">What Tree Is It? Ohio Public Library Info. Network</a>

and the areas that require improvement. Check topographical, wetland and soil maps as well as aerial photographs. You can find this information at your local Natural Resources Conservation Service office or online (Table 1).

Determine what species and volume the site is able to support (see **Stocking and Basal Area** below). To identify the tree species in your stand, refer to a tree identification guide. There are many excellent tree guides available in paper or hardback as well as online (Table 1).

A professional forester can help you with this process. Note that there are several types of foresters: consulting, procurement, and service foresters. All foresters are required to be licensed to practice in Maryland, but the rules vary in other states.

- A *consulting* or *private* forester can help a landowner plan and manage their woodland, as well as assist with a thinning or timber sale.
- A *procurement* or *industrial* forester buys timber for a company, but may still be able to help you with forest management.
- A *service* or *county* forester works for the Maryland Forest Service, and can help a landowner plan and manage their woodland, but cannot assist with any commercial timber sales.

Some landowners choose to work directly with an independent logger or contractor who buys timber. These individuals may be knowledgeable, but they generally do not have the training and management experience of a licensed forester.

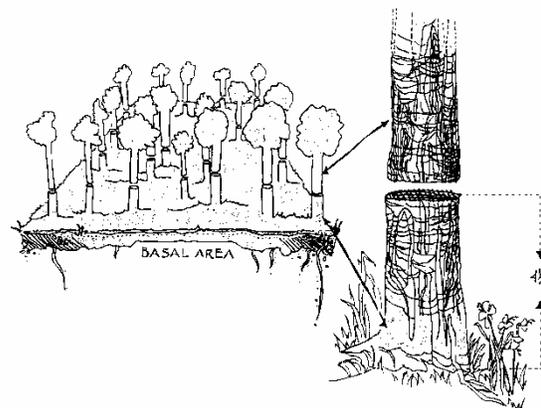
Even if you choose to do most of the planning on your own, you should always use a forester to conduct any timber sale, including thinning. Consult the University of Maryland Extension Bulletin, *Marketing Forest Products: Understanding the Sales Process*, (Extension

Bulletin 367) for more information on conducting a safe and profitable timber sale.

### Stocking and Basal Area Are Important Measures to Know and Understand

Stocking (or density) is a measure of the number of trees per acre compared with an optimal level for balanced health and growth. Basal area is the cross-sectional area of a tree usually defined in square feet (Figure 4). It is also used as the cross-sectional area of all the stems in a stand and expressed as per unit of land area. In both cases, the cross-section is measured at breast height (4 ½ feet above the ground). Basal area is commonly used to determine stocking (Figure 4).

Figure 4. Measure Basal Area 4 ½ Feet Above the Ground



Natural Resource, Agriculture, and Engineering Service

**But why not just count the number of stems in an area?** This technique does not take into account the size of the trees. A woodlot stocked with many small diameter trees may have the same basal area as one stocked with fewer large diameter trees (Figure 5).

Optimal stocking will vary depending upon a number of factors: stand age, average diameter, species, landowner objectives, and desired product. An adequately stocked stand

**Figure 5. A Thinned Stand Allows Light to Reach Trees and Forest Floor**



David Moorhead, University of Georgia, Bugwood.org

will have fast-growing trees of good form. For example, consider an even-aged hardwood stand. There may be well over 10,000 seedlings per acre in the first 5 years. This number decreases to about 1,000 as the stand matures to a point when the trees average 5-11 inches DBH (pole-sized). Most of the young trees naturally die as other trees out-compete them for sunlight. When trees average more than 11 inches DBH (saw-timber size), the number of trees declines to 500 trees per acre, and eventually to 150 trees per acre in very mature woodlands.

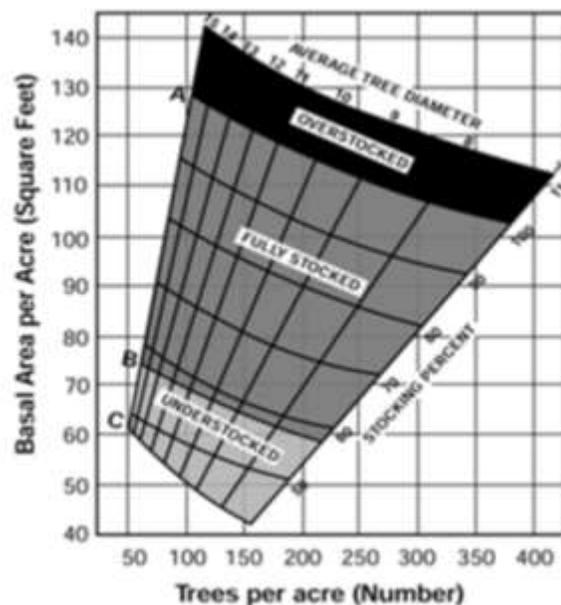
Plot sampling is used to measure tree density, size, and species in a forest stand. Tree density is measured using the stand's basal area or the trees per acre. The average tree diameter for the stand is used to estimate tree size. The stocking level is determined by the point where these three numbers intersect on the stocking chart (Figure 6). Because the three numbers are related to each other, you only need to determine two of them to find the correct point on the chart. You can find the remaining number on the chart using these first two.

If there are too many trees on the site, this point will fall within the black "overstocked" section. If there are too few trees, the site is understocked and will fall in the light gray

section. The chart indicates an adequately stocked stand as fully stocked or well-stocked when the point falls in the dark grey section.

Let's assume that a stand has 200 trees per acre and a basal area of 110 square feet per acre. Find 200 trees along the bottom of the chart (Trees per Acre) and a basal area of 110 along the left side of the chart (Basal Area per Acre). Find the point where they intersect—along the line for an average tree diameter of 10, close to the A-level curve. This site is nearly overstocked and would benefit from thinning.

**Figure 6. Stocking Chart is Guide for Determining if Upland Central Hardwoods Need Thinning**



U.S. Forest Service

How do you determine how much to thin? At the current basal area and trees per acre, the stand has an average tree diameter of 10. Following the 10 line down to where it intersects the B-level curve, shows a basal area of about 65 square feet per acre and 125 trees per acre. Thinning back to this stocking level would result in the best growth from the residual trees.

The stocking level may also be expressed as a percentage. Stocking charts have been developed for most major tree species and are available in many forestry texts, online, or by asking your forester.

### The Choice of When to Thin Can Have a Big Impact on Future Stand Growth

Depending upon your management goals and timber market conditions, you may choose not to thin. However, if you do wish to thin, you will need to decide the best point in the rotation to thin based on the tree species, age and condition of the stand.

For hardwood stands, thin when the growth in diameter of the dominant and co-dominant trees slows down. Some crowding is okay as this helps trees produce straight trunks free of branches, which can be processed into high-quality sawtimber. As the trees get bigger, crowding will eventually limit the amount of sunlight that each tree gets, reducing its growth. Thinning at this point will stimulate growth. Thin every 15 to 20 years after the initial thinning. If the stand is dominated by

low-growth, poor-quality trees, you may need to thin earlier. Your forester can guide you in this decision process.

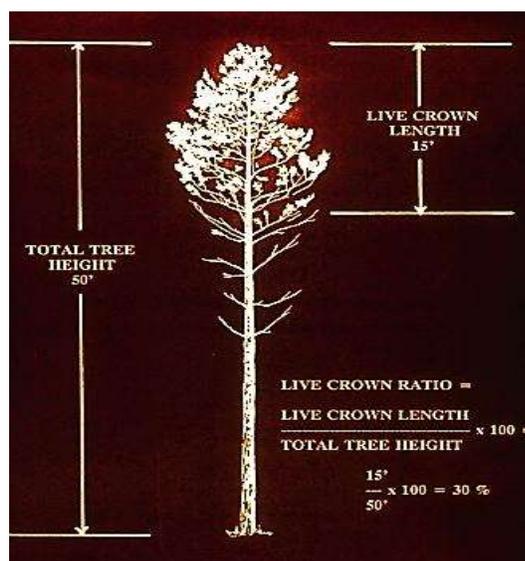
Conifers can usually be thinned when they are about 15 years old, when the average diameter is about 6 inches. As with hardwoods, competition from tight spacing when trees are young produces straight boles, few branches, and weeds out less healthy trees. Consider later thinnings when the branches of adjoining trees touch, when many trees in the stand are dying, or when the vertical length of the live crown is less than 30 to 40 percent of the total height of the tree (Figure 7).

### Thinning Techniques

There are five techniques used to thin stands.

- *High or crown thinnings* remove poor - quality dominant and co-dominant trees. The remaining dominant trees can then expand their crowns.
- *Low thinnings or thinnings from below* remove intermediate and suppressed trees from the stand.
- *Mechanical thinning (or row thinning)* removes trees within a fixed spacing interval or by strips with fixed distances between them, regardless of the form of each tree (Figure 8).

Figure 7. Crown Ratio Can Indicate When Stand Needs Thinning



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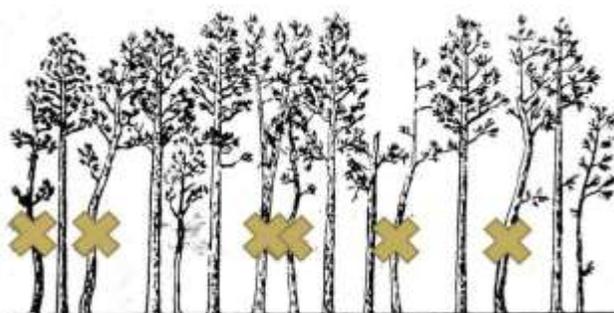
Figure 8. Mechanical/Row Thinning in Strips Removes Trees for Fixed Spacing between Rows



U.S. Forest Service, North Central Region

- *Selection thinning* is the removal of poorly formed dominants to favor trees in the lower canopy, and is primarily used when the dominant trees are low-value species or have stems of poor quality. (Figure 9).
- *Free thinning, or crop tree release* removes selected trees without regard for their crown position.

**Figure 9. Removal of Deformed and Diseased Encourages Growth of Remaining Trees**



Tjaden, R. and Julia Klapproth, Maryland Cooperative Extension

The best technique for a site will depend on several criteria, such as landowner objectives, cost, age of the stand, and the condition and species of the trees. Work with your forester to aid you in making proper management decisions. All thinning methods have their advantages and benefits, and disadvantages and risks.

One risk of thinning is that sunlight on the tree stem of remaining trees may stimulate epicormic branching (branches growing from the trunk of a tree) that degrades lumber value. Other risks include damage to remaining trees, windthrow, and snow and ice damage from increased exposure. High grading is an exploitive harvest that can cause long-term site degradation (see sidebar).

### High Grading: A Practice to Avoid

There are some cases when harvesting trees under the guise of thinning can do more harm than good for the health and quality of the future forest. *High grading* is one of these. This practice has resulted in the broad-scale decline in the quality of the northeastern hardwood forest, and is still sometimes used to get the most short-term income at the expense of long-term forest quality. High grading, also called *diameter limit cutting*, is when all trees larger than a certain diameter are harvested.

Unfortunately, this results in the removal of the larger, faster-growing species and individuals with superior genetic potential. After one or two diameter-limit cuts, the stand consists of low-quality, irregularly spaced trees, slow growth, and poor form; in other words, the runts of the litter.

Because the future forest now depends on these runts and their offspring, the outlook for the stand is diminished health, reduced capacity to produce quality sawtimber, and lower wildlife value. Trees should instead be selected based on their individual attributes. Landowners should avoid high grading, and be wary of loggers and foresters who promote it.

### Which Trees Should You Harvest?

One of the most important decisions you will make for your forest is selecting which trees to harvest now and which to harvest later. It is important to focus on the value of the future harvest, rather than what you can get from the stand at the present. Remember that thinning is often done when trees are at the height of productivity, and that cutting a healthy, well-formed tree may only deprive it of its potential.

In most cases, begin by choosing trees that meet or will meet the landowner's objectives when harvested at a later date. When

**Figure 10. Competing Trees Removed**



Brian Lockhart, USDA Forest Service, Bugwood.org

managing for timber and profit, select trees with the highest potential value and have dominant and co-dominant crowns that extend above the surrounding trees. They should have good vigor, be free of low branches, be disease free, and well-adapted to the site. Leave these

trees to grow and put on additional value (Figure 10).

Alternatively, when managing for wildlife, leave the trees that provide a good source of food, like hickories and oaks. In many cases, trees that are good for wildlife are also good timber trees. You also must ensure that the chosen trees will have adequate space to grow.

### Spacing between Trees after Thinning Determines How Much Room Remaining Trees Have to Grow

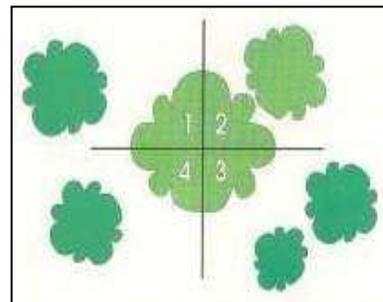
One common spacing guideline is the  $D + 6$  rule. Pick the ten "best" trees that you want to keep after thinning. Take the average diameter of these trees (add up the diameters and divide by 10), add 6 to that number, and then use that sum as a guide for the number of feet between each stem after thinning.

For example, if you measured 10 trees with DBHs of 8, 10, 10, 12, 12, 12, 12, 14, 14, and 16, add these and divide by the number of trees you sampled to get the average DBH:  $120/10 = 12$  average DBH. Add 6 to that number to get the number of feet between each stem after thinning:  $12 + 6 = 18$  feet between stems.

Another common spacing rule is the three-sides rule in which the trees are removed on at least three sides of the crop tree to allow crown development (Figure 11).

If you are planting trees to establish new woodland, it may seem wise to plant fewer trees rather than going through the trouble of thinning halfway through a rotation or allowing trees to naturally thin themselves. However, this is usually not the case. Planting too few trees will result in trees with large crowns and large side branches, which is good for a lawn but does not create a woodland environment or high-quality timber.

**Figure 11. Using the Three-Sides Rule, the Light Green Tree is Left and the Dark Green Trees are Removed**



Arlyn Perkey, Brenda Wilkins, and H. Clay Smith

Some degree of initial overstocking forces the trees to grow straight and tall. This results in a majority of branches near the top of the stem where they get the most sunlight from above.

Low-density planting encourages trees to grow out laterally to capture sunlight from all sides. This directs growth into branches instead of the stem, and creates value-degrading knots in future wood products.

Overstocking when planting also compensates for mortality due to drought, improper planting and deer or vole damage. Thinning is absolutely essential in stands of pine trees, since they tend not to naturally thin themselves, leading to overstocking, slow growth, and greater risk of insect infestation, disease and fire.

## Ask Loggers to Leave Woody Debris on the Forest Floor

Decomposition of the debris from thinned trees recycles nutrients, increases biodiversity, and reduces erosion. Woody debris also provides habitat for birds, amphibians, small mammals, and invertebrates; and creates microhabitats for fungi and moss species (Figure 12).

**Figure 12. Woody Debris Recycles Nutrients and Improves Animal Habitats**



Paul Bolstad, University of Minnesota, Bugwood.org

## Forest Improvements Don't Just Help the Owner

Thinning can improve the health, vigor and profitability of woodland while enhancing wildlife habitat and other woodland values, such as clean air and water, and wildlife habitat, which have the potential to benefit all Maryland citizens.

As with any management action, seek professional or educational assistance from a service forester, private forester or extension forester before making any big decisions to make sure that the details of your plan match the specifics of your land.

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