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WISCONSIN WOODLANDS

Harvesting and Forest Management

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Why should forests be managed? When the colonists came to this continent, didn't they discover some of the most magnificent forests that ever existed? And if those forests developed so well with so little human intervention, why can't our present forests be left to grow in the same manner?

Most forest landowners have at least one objective for owning their property. It may be to maximize timber production, create wildlife habitat, protect a watershed, or improve their land's aesthetic or recreational value. Achieving these goals usually requires that the owners manipulate the forest vegetation. If they waited for nature to take its course, the changes would most likely occur too slowly, with the outcome not necessarily being what the owners wanted.

To hasten and direct the process of change in the forest, landowners and foresters practice what is called **forest management.** Management practices that manipulate vegetation are pretty much limited to planting trees or cutting them down. When owners cut immature trees, the activity is called intermediate cutting or thinning; when they cut mature trees it is harvest cutting. The focus in this publication is on harvest cuts; intermediate cuts are explained in Extension Bulletin G3398, Wisconsin Woodlands Intermediate Cuttings in Forest Management.

Objectives of Harvest Cuts

The objectives of harvest cutting are to remove mature trees and to begin regenerating a new stand of trees.

Harvest cuts are important elements of sound forest management. By exposing mineral soil when logs are skidded (dragged) out of the woods, the cuts provide conditions favorable for regeneration and seedling development. Seeds of most species germinate and survive best if their roots have immediate contact with mineral soil. Landowners sometimes complete harvest cute on diseased or damaged trees, thus realizing some income from a stand that otherwise would be a total loss. (A stand is a community of trees distinguishable by age, species composition, or some other feature, large enough to be a manageable unit.)

Many landowners don't consider profit-making to be the most important reason for owning timberland. However, the income generated from selling forest products can help finance improvements they may want for other goals. For example, perhaps you would like to build a hunting cabin back in the woods. Not only might a timber sale help pay for building materials, but the increased sunlight reaching the forest floor may improve visibility and favor the growth of small forage plants that attract wildlife.

Harvest Systems

Because the number of trees removed and the way in which they are transported from a stand, determines what kind of new stand grows, the cutting method used might aptly be called a "harvest-regeneration system." However, for the sake of brevity, we will use a simpler term—harvest system.

Foresters do not arbitrarily choose a stand's harvest system. Instead, they base the choice on an understanding of the fundamental biological requirements of the species they went to regenerate, and stand characteristics such as soil type, water availability, topography, aspect and past activity.

Of the four systems—clearcutting, seed-tree, shelterwood and selection—only the selection system produces an uneven-aged stand. In an even-aged stand, less than 20 years separates the oldest and youngest trees. In uneven-aged stands, on the other hand, the oldest and youngest trees differ by more than 20 years. As a result, they usually contain a wide range of sizes from seedlings to mature trees.

Let's take a closer look at each harvest system, determine its characteristics, and see how it results in its unique stand structure.

Clearcutting System

In this harvest system, virtually all trees in a stand—large or small—are cut during one harvesting operation (Figure 1). Although sometimes called "unnatural," this criticism is unwarranted. Wildfires and high winds "clearcut" large tracts of timber each year, but the trees always grow back eventually. Either the burned trees' root systems resprout new stems, or else seeds from adjacent stands blow into the area and quickly germinate.

Because small woody plants proliferate rapidly after a clearcut, many wildlife species are attracted to this easily accessible food source. Populations of insects, mice, rabbits,

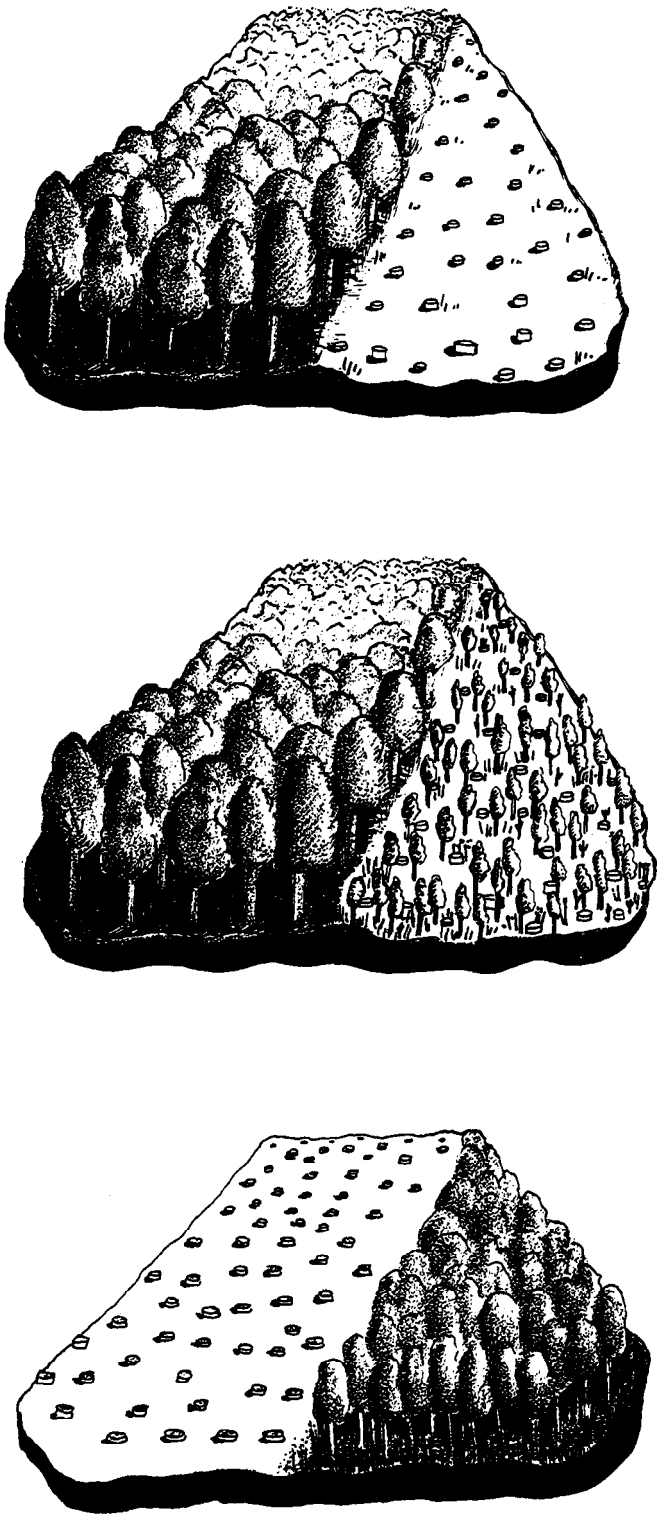


Figure 1. Clearcutting removes all trees from part of a mature stand. A new stand grows from root or stump sprouts, or from the seeds of surrounding trees. Later, after the new stand is well along, you can cut neighboring stands of mature trees. Clearcutting favors trees that don't tolerate shade.

grouse, deer, moose and their predators increase dramatically until trees once again dominate the clearing, shading out the food supply.

When regenerating species that require full sunlight—such as aspen, cottonwood, jack and red pine, paper birch, black cherry, and in some cases, red oak—you will most likely need to clearcut the mature stand. Clearcutting is also useful if the mature trees will not increase in value with additional growth, should not or cannot be used as a seed source or are not needed to protect the new trees. Aspen perhaps best illustrates this point. Most aspen stands live no longer than 40 to 60 years. Hence, they are clearcut to obtain the greatest volume of wood before they succumb to natural causes, and to provide the full sunlight required for successful regeneration.

After a clearcut, the next generation of trees may come from a variety of sources. Seed may blow into the opening from the adjacent forest, or seedlings and saplings present before the cut may take over after being released. Sprouts (also called suckers) may arise from the stumps and roots of the cut trees. Alternatively, you can either manually spread seed over the harvested area, or plant seedlings that were produced in a nursery. This latter method is quite popular because you can control the type and spacing of trees.

Compared to other harvest systems, clearcutting is easy to apply. You don't need to mark individual trees or worry about damaging residual trees. It is often possible to use large, efficient logging equipment when clearcutting an entire stand. Because there are no residual trees to be avoided, loggers sometimes find it advantageous to skid long logs or "tree-lengths" out of a stand.

Seed-Tree System

This system is similar to clearcutting except that certain trees, called seed trees, are left standing to furnish seed for natural restocking (Figure 2). After the new crop becomes established, the seed trees are usually removed. The seed-tree method is used primarily in the South and Northwest, but seldom in the lake States. Consequently, we won't discuss it in detail here.

The seed-tree method has one advantage over clearcutting in that there is no need to wait for a good seed year before executing the main harvest.

Shelterwood System

Here, you gradually remove the entire stand in a series of partial cuttings that extend over a short part of the rotation. (The rotation is the number of years between a stand's inception and its final harvest.) This method is essentially a clearcut because the parent trees are cut long before the new stand is mature.

The shelterwood system normally requires a minimum of two cuttings—the least desirable trees in the two lower (intermediate and overtopped) crown classes being cut first (Figure 3). The older stand, which protects the seedlings when they are most vulnerable, is cut when the new stand

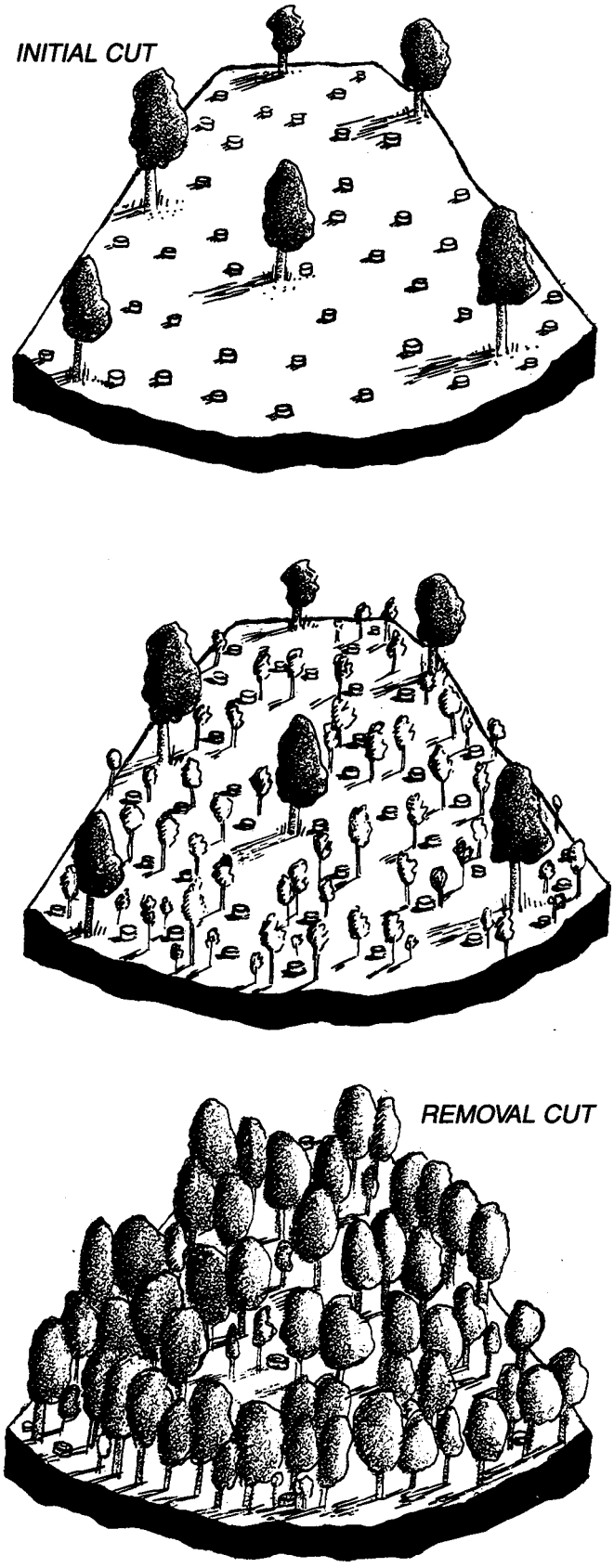


Figure 2. The seed-tree harvest system removes nearly all mature trees, but leaves enough seed trees to reseed the area. Later these seed-trees are logged.

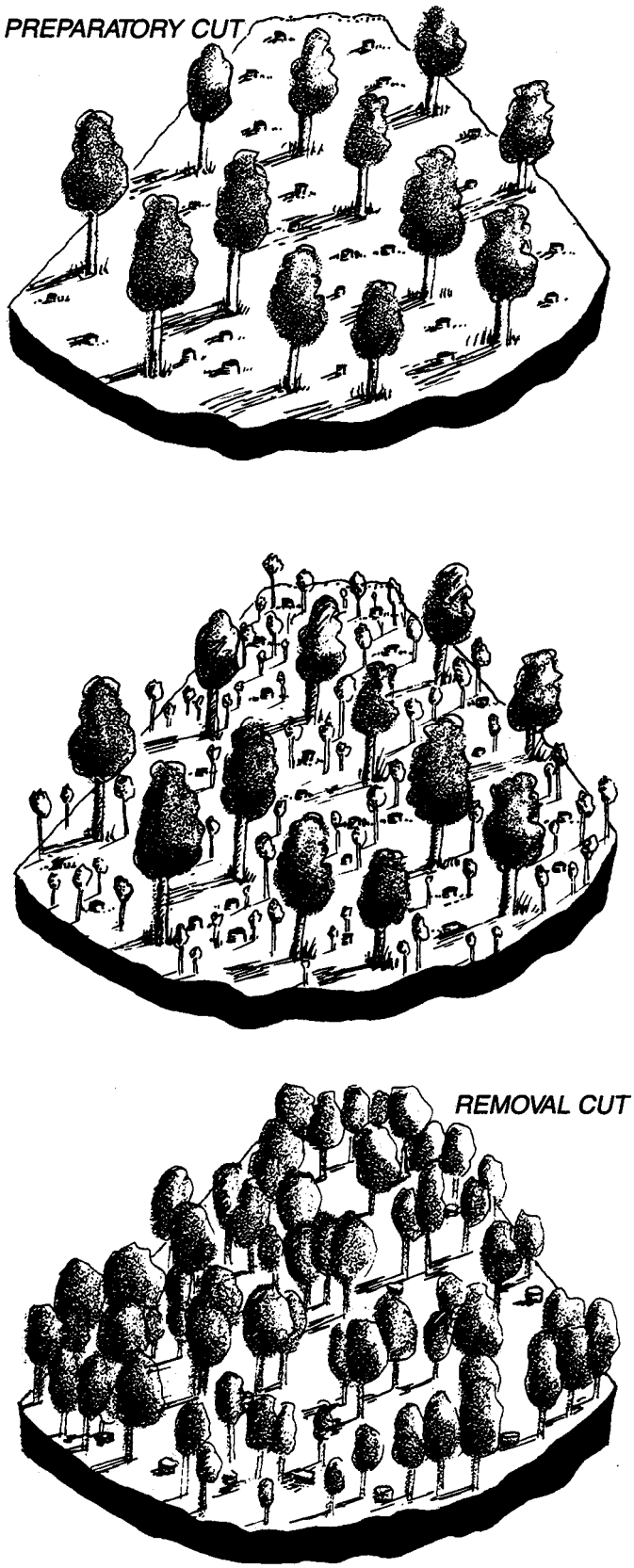


Figure 3. The shelterwood harvest system initially partly logs a mature stand, leaving some of the better trees to grow, cast seed and provide shelter for the new stand. The shelter trees are harvested after seedlings become established.

requires full sunlight and growing space. White oak, northern red oak, yellow birch, basswood and white pine are frequently regenerated by the shelterwood method.

The harvest operations are usually applied in the following order: **Preparatory cuts** are made to reduce the competition faced by prospective seed bearers. The cuts may expand the crop trees' crowns, improve their wind firmness and help decompose dead leaves and branches on the forest floor. Most of the trees cut at this stage come from the overtopped and intermediate crown classes in order to reduce root competition between established trees and seedlings. Openings in the canopy (the layer of leaves and branches formed by the trees' crowns) should be only as large as necessary to help the seed bearers develop.

One problem with the preparatory cut is that the harvested trees, because they are small, may be difficult to sell. Few mills may be interested in them. Also, the trees removed are often undesirable species from both a silvicultural and end-product viewpoint. As a result, you will be faced with several options: choose another harvest system to perpetuate your stand; cut and leave the small trees, understanding that you are making an investment with no immediate return; cut the trees and sell them as firewood; or, include some mature, merchantable trees to make the operation more attractive to a buyer. Before conducting the operation, be sure you are aware of its economic consequences.

The **seed cut,** if needed, may occur five to 10 years after the preparatory cut. It removes the least desirable trees remaining in the stand, and creates enough vacant growing space to allow seedlings to become established. In addition to cutting the remaining intermediate and suppressed trees, you may cut a few codominant trees.

If many seedlings begin growing soon after the preparatory cut, the seed cut will probably be unnecessary, and the stand will be ready for the **removal cut** within three to 10 years after the preparatory cut. If new trees are slow in appearing, you may be forced to wait for several years after the seed cut. The removal cut uncovers the new crop of seedlings by removing the rest of the mature overstory trees.

The shelterwood method has several advantages over clearcutting. First, because the canopy provides both a seed source and protection from soil erosion and other damage, natural reproduction under a shelterwood system is often more dependable and complete than with either the clearcut or seed-tree methods. Second, the rotation may be shortened because the second crop starts growing before you harvest the first. Last, since the new trees are typically 10 to 15 feet tall before the last mature trees are cut, the visual impact of the cutting operation may be less severe than in the other even-aged systems.

Because the shelterwood method means that loggers will drag large logs over the young reproduction, you may be concerned that this will damage the small seedlings. However, researchers have found that if you do knock over young trees of most northern hardwood species, those trees will resprout to produce trees that frequently grow more rapidly and develop better form than undamaged seedlings. Thus, normal logging operations may, in fact, improve the new regeneration.

The system may present foresters with problems when they attempt to regenerate moderately shade-intolerant species, such as red oak. Unless enough of the canopy is removed, the remainder will retard the growth of new trees and regeneration may fail altogether. One way to resolve this dilemma is to plant additional oak seedlings in the stand, and then reduce the surrounding competition as they grow.

Another cause for concern is the possible damage to the mature residual trees during the felling and skidding operations of the preparatory and seed cuts. As a result, loggers must exercise more care while administering shelterwood cuts than with a clearcut. Instead of skidding full-length trees, loggers should buck them to either log or pulpstick lengths before moving them to the landing. These lengths allow machines to make sharper turns, and lessens the risk of scraping bark off residual trees.

Selection System

The selection system creates and maintains uneven-aged stands by removing mature timber either as single, scattered trees, or in small groups (Figure 4). Regeneration and intermediate cuttings may extend throughout the entire rotation. The delicate seedlings of sugar maple, balsam fir and white ash are best nurtured under the selection system.

Uneven-aged stands are generally more resistant to insect and disease attacks because most pests prefer one age class of a tree species. However, if all the age classes are susceptible, an uneven-aged stand can also perpetuate the pest's existence.

Ideally, an uneven-aged stand should contain trees of every age class from one-year-old seedlings to mature timber, with each age class occupying an equal area. However, such a balance is very rare. Even virgin stands have irregular distributions in which some classes have too many or too few trees.

Theoretically, the oldest age (or largest diameter) class in a balanced, all-aged stand should be cut each year; by the time every age class has been harvested, the seedlings started on the area occupied by the age class that was first cut will have matured. In practice, however, stands are commonly harvested at approximately 10-year intervals to minimize harvest costs and residual stand damage. Also, because stands are unbalanced, foresters usually recommend cutting in those classes with too many trees, if it is economically feasible, to adjust the distribution closer to the recommended guidelines.

Because of the care loggers must take to avoid damaging the growing stock and adjacent crop trees, and the extensive area they must cover during the harvest to obtain sufficient product volumes, selection logging is typically more difficult and expensive than the other methods.

To minimize damage to the stand, it's desirable to harvest with smaller machines. Cut and delimb the trees with a

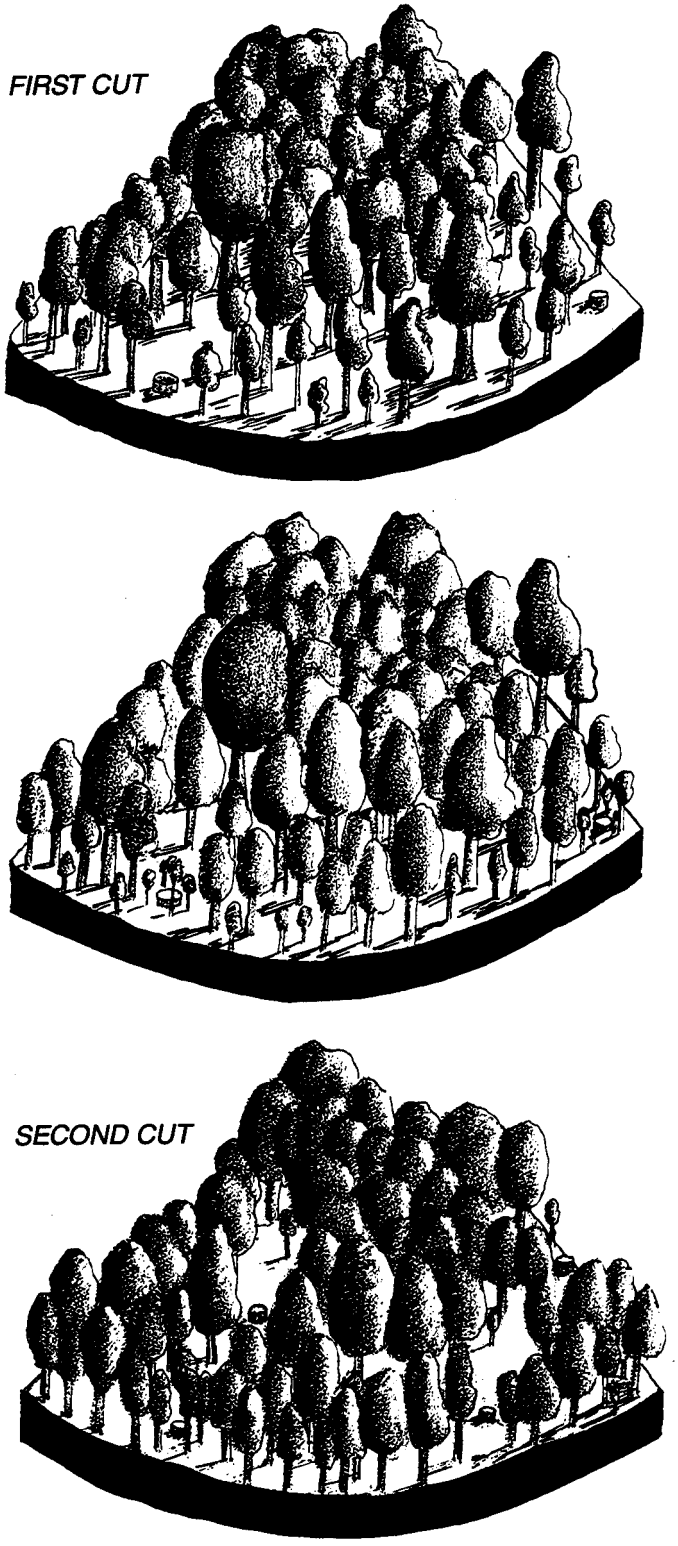


Figure 4. The single-tree selection system relies on frequent cuts and favors shade-tolerant species. During each cut, foresters remove undesirable trees, thin overly dense areas and harvest mature trees. This system produces stands with trees of many ages and has the least dramatic effects on the stand's appearance.

chainsaw and buck them to shorter lengths before skidding them to the landing. Skidding entire trees is usually not recommended.

There are modifications of the selection system, each with its own applications, and advantages or disadvantages. The most common modification is **single-tree selection.** With single-tree selection, each little even-aged component of the uneven-aged stand occupies the space created by removing one mature individual or a very small clump of less mature trees. Because reproduction develops on small, scattered openings, regenerating anything except shade-tolerant species may be difficult. The number of trees occupying the site gradually diminishes, either by thinning or natural mortality, until only one tree is left at the rotation's end for each one initially cut.

Woods Roads And Trails

A system of woods roads and trails maybe one of the most worthwhile investments you can make. To efficiently harvest logs, pulpwood or firewood, access for the proper equipment is essential, and increases the product's sale value. Roads also reduce the damage to uncut trees during harvesting.

Not only is logging more efficient, but roads also make other management and recreational activities easier and more enjoyable. Easy access for tree planting, fire control, wildlife management, snowmobiling, skiing and hiking, hunting and many other activities all make roads and trails invaluable.

Unless you have the time, money and equipment to build your own roads, a timber harvest may present the best opportunity for developing roads and trails on your property. Because you probably will use the trails for more than just logging operations, you should work closely with your logger to obtain a road network that is satisfactory for timber harvesting and other needs.

Regeneration

Try to view harvest and regeneration as one integrated process. Although we are treating them separately here, always consider how each affects the other.

Seeds or seedlings of many different species are usually present in the forest floor, ready to begin growing into any openings in the crown cover. But, if there are too few seedlings of the desired species to maintain dominance in the stand, you may need to plant more seedlings of that species. Consider the potential for natural regeneration or the possible need for planting before harvesting the original stand.

Your management objectives, economics and the biological requirements of the species desired should dictate which regeneration technique you choose.

Natural Regeneration

Vegetative reproduction is one method to restock some cut-over stands. Many species, the oaks, aspen and basswood in particular, sprout from either the roots of cut stumps (root suckers), or from dormant buds located on the root collar just below the ground (stump sprouts). Compared with seedlings, these sprouts usually grow faster because of their established root systems. Harvesting during late fall or winter, when the trees are dormant, usually causes more vigorous sprouting.

The quality of stump sprouts depends almost entirely on the height and age of the parent stump. The number and vigor of viable sprouts generally decrease with increased parent-tree age. In addition, sprouts that originate from the root collar or below the ground are the most vigorous and rot-resistant. Researchers usually recommend that you thin all clumps of hardwood stump sprouts, except aspen, to no more than two of the most dominant sprouts when they are 10 to 15 years old.

Aspen stands should be treated differently. According to the Manager's Handbook for Aspen in the North Central States, cut all trees 2 inches DBH or larger during harvest to allow as much sunlight as possible to reach the forest floor. Any remaining overstory vegetation may substantially reduce sucker growth. Full-tree or tree-length harvesting usually mixes the soil and uproots enough competing vegetation during felling and skidding that further site preparation is unnecessary.

After two years, when most of the suckering has occurred, the stand should contain a minimum of 4,000 to 5,000 stems per acre. You need not thin these aspen stands if you intend to produce pulpwood. However, if sawtimber is your goal, you may need one thinning to relieve competition around the crop trees.

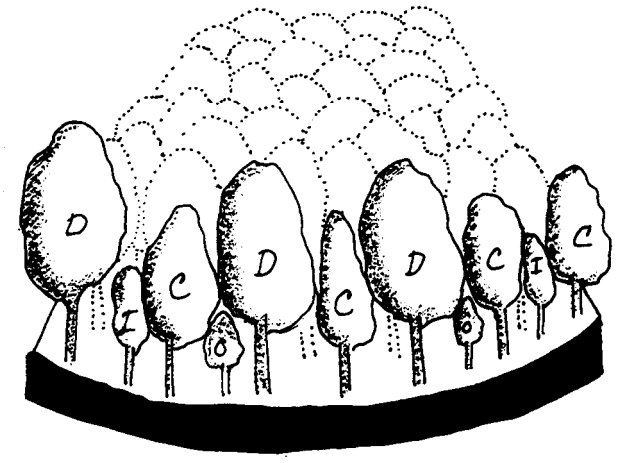
Natural seeding is another important regeneration method. Its success depends on the existence of vigorous seed-bearing trees and adequate seed dispersal, few seed predators, good germinating conditions and sufficient growing space.

Most researchers recommend that, for wind-disseminated seed, openings created during the harvest be downwind from, and no wider than five times the height of adjacent seed bearers, so that seed can cover the entire opening.

Seed that is not wind-disseminated, such as that of oak, hickory and walnut, is dispersed by gravity, water, birds, or squirrels and other rodents.

Artificial Regeneration

Although natural regeneration is used widely, there are instances in which landowners may need to step in and speed up or change the outcome. Artificial regeneration is popular because a forester or landowner can maximize product volume by closely controlling the stand's species composition, the number of trees per acre and spacing.



The illustration shows the relative positions of trees in the different crown classes in an even-aged stand that has not been thinned. The letters D, C, I and O stand for dominant, codominant, intermediate and overtopped crown classes.

Dominant. These are trees with crowns extending above the general level of the crown cover and receiving full light from above and partly from the side. Dominant trees are larger than the average trees in the stand, and have well-developed crowns that may be somewhat crowded from the sides.

Codominant. These are trees with crowns forming the general level of the crown cover and receiving full light from above but comparatively little from the sides. These trees usually have medium-sizsd crowns more or less crowded on the sides.

Intermediate. These trees are shorter than those in the two preceding classes but with crowns extending into the crown cover formed by codominant and dominant trees. Intermediate trees receive a little direct light from above but none from the sides. They usually have small crowns that are considerably crowded on the sides.

Overtopped (also called suppressed). These are trees with crowns entirely below the general level of the crown cover. Overtopped trees receive no direct light either from above or from the sides.

Artificial regeneration also has disadvantages; cost is the most prominent. Planting or direct seeding may be the most expensive activity you undertake during the life of your stand. The primary considerations when planting include matching the correct species to the site's characteristics, and deciding on the stock size, spacing and planting time. Obtain the advice of a consulting or service forester for this operation.

Site Preparation

For a new stand to grow quickly, you must sometimes modify a harvested site. This modification is called site preparation. Site preparation may include disposing of harvest residue, exposing mineral soil and controlling competing vegetation with prescribed burning, herbicides or mechanical treatment.

The objective of site preparation is to create growing spaces that are more favorable to the desired species than to any other. A light vegetation cover or well-scattered logging slash (debris) over bare mineral soil is good for seedling germination and establishment. Such conditions allow seeds to contact mineral soil while being shielded from direct sunlight, thereby reducing heat injury and direct evaporation losses from the soil.

Looging generally leaves considerable slash on a site. If the slash is too heavily concentrated, the piles may cast dense shade, preventing seedlings from becoming established. That is why the slash disposal method you use can determine the species composition of a stand if left to regenerate naturally. For example, burning the slash and site will favor shade-intolerant trees. However, if you leave the slash where it fell during logging, the more shade-tolerant species present before the operation will have the growing advantage.

Prescribed burning denotes the use of fire, under controlled situations, as a means of reducing slash volume, or killing competing or unwanted vegetation. Always take care to prevent the controlled burn from becoming a wildfire. Prescribed burning is not widely used in the Lake States because of the infrequency of suitable conditions.

One possible disadvantage of prescribed fire is that in some cases, herbaceous competition can actually increase during the first few yearn after burning.

Scarification is the process of mechanically mixing the forest floor with underlying mineral soil, usually by a specially outfitted bulldozer. Scarification has approximately the same effects as prescribed burning—reducing competing vegetation, redistributing slash, and exposing the mineral soil. However, scarification is usually more effective and expensive than fire. Use scarification where you can't use fire, such as during dry conditions, in proximity to buildings and among fire-sensitive species.

Herbicides are popular for site preparation and vegetation control. They are probably used more than either prescribed burning or scarification because they are less expensive and easier to apply. Many are selective in their activity—for example, killing hardwood brush but leaving conifers untouched. You can apply some herbicides in a variety of ways, including injection, aerial and hand spraying, and fogging. In most cases, only licensed individuals may apply them.

Conclusion

In this publication, we have introduced and described several harvest systems and other forest management practices. However, commercial logging operations can seldom be defined as one particular harvest system. Also, many stands will never lend themselves to a single management prescription. Consequently, view the narrowly defined systems we've described as an introduction to the more complex realities of forest management.

When outlining management goals, consider their economic and biological feasibility. A professional forester can evaluate your property, help decide if your goals are feasible and describe how you can reach them. This publication provides only general recommendations. To properly evaluate your stand's unique characteristics and to fill in the details, you will need the expertise of a service or consulting forester.

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